

# Comments on the draft Grand Challenges

State of the Estuary – May 28-29, 2024

Interactive poster presentation (anonymous)

Comment (post it notes)	Response
Tribes need to be involved at the forefront. Need to be partners not afterthought. Need to be integrated at the early stage	Agreed, this supports GC#4
What is this group's opinion about the Delta tunnel project? Why is this not highlighted?	This is not covered under the Delta Science Plan.
GC #2 leads to GC#1. Very similar challenges	Thank you for this comment.
Not all opinions/viewpoints are knowledge. Knowledge is not equal (e.g., fishermen have incentives, farmers have incentives)	GC#4 is more clearly defined to include coproduction and TK.
Traditional knowledge -> use indigenous knowledge instead	Thank you for this comment, we follow the recommendation of CNRA to use "traditional knowledge" to keep the focus on California Native American knowledge rather than using the broader term "indigenous knowledge".
Lumping communities and decisionmakers in GC#3 isn't accurate. Decisionmakers have all the access they need.	Thank you for this comment, strategies and tools to address communication to communities and decision makers will be more clearly defined in the Delta Science Plan.
Translational science: translate the outcomes of science so it can be actionable; translate science into the office so science can be applied rapidly.	Agreed, thank you for this comment.

## Delta Independent Science Board Public Meeting – June 21, 2024

### Oral presentation

<b>Commenter</b>	<b>Comment</b>	<b>Response</b>
<b>Bob Naiman</b>	Grand Challenge 4 is not as compelling as 1-3; not at same level right now but might be in next 5-10 years. GCs1-3 are well defended Sees this as hurdle to overcome, but that's it	This point is well taken, and unfortunately there is much less Delta-specific literature to support GC#4 as there is for GCs#1-3. We believe this adds to the urgency of including a GC like #4.
<b>Lisa Wainger</b>	Tribal groups also look at things at a systemwide scale which we should be shifting toward and away from our more narrow projects.	Agreed, this is a nice dovetail between GC#1 and GC#4
	As a decision scientist- there are suggestions on how to be more nimble, but there are lots of impediments to being nimble. What management frameworks can we create to allow for rapid response. Need to identify management challenges and options.	Thank you for this comment, this is something that should be more fully expanded on in the Delta Science Plan.
	GC#4 is important- maybe articulated better; there's a need to better understand the management questions underlying the challenges and strategies; what's missing is dynamic approaches; decisions as a dynamic process; consider the metro maps from DMDU There is not as much in this document on dynamic approaches . What are we building now to get to another decision point down the road. We need to shift to rethinking decisions to check in at key points in our management timelines	This is a really great point, and more adaptive management language has been added to the essay.
<b>Jayantha Obeysekera</b>	Looking at Grand challenges- will need a dynamic adaptive policy path. These things are connected	More information on adaptive governance and adaptive management has been included in the essay.

<b>Inge Werner</b>	appreciate the coordination pieces. The suggestion of focused service centers and communicating with decision makers are really effective in complex systems	Thank you for this comment.
<b>Virginia Dale</b>	Adaptive management can be expanded on more in Grand Challenge 1;	Agreed, AM has been expanded.
	Grand Challenge 2: emerging ecosystems and novel ecosystems need mention; there is a need to deal with the ecosystem as-is and not just slow down the changes that are happening	Thank you for this comment, we believe tools and strategies to address this will be covered under GC#2.
	For topical service centers we need to be aware that information routing into these does not create more siloing	Thank you for this comment.
	GC4: this is important; go to where indigenous people are making decisions; when they meet you go to them not just always asking them to come to you	Thank you for this comment.
<b>Bob Naiman</b>	no suggestions for expansion because first 3 grand challenges are so broad they seem to cover everything	Thank you for this comment.
<b>Jayantha Obeysekera</b>	what about levee failures or seismic disaster? Where we don't have plans for (Lisa mentioned this is similar to her comment on identifying management challenges)	Adaptive management and governance language has been added that can be used to cover unforeseen planning challenges.
<b>Tom Holzer</b>	collaboratory should be mentioned throughout more; this may be central management tool for Delta going forward	Agreed, we have included the collaboratory as an example of improving centralization of information and working across agencies with different mandates.
<b>Lisa Wainger</b>	need to learn from test cases and incorporate lessons learned moving forward	Adaptive management and governance language has been added to address this.

## Public Response Period – May 28 – July 12, 2024

### Comment letters

Author	Comment	Response
Sam Luoma	1.0 Set the agenda more explicitly.	
	<p>One place the presentation is weaker is in presenting an agenda for the next decade. Whether you mean this “essay” as just an essay or as the science plan for the next decade is not directly stated in the introduction. Some great quotes from your introduction suggest a plan is to come:</p> <p>“...can advance shared goals and accelerate scientific understanding and decision-making.”</p> <p>“...build out actionable steps to address the Grand Challenges”.</p> <p>“...Feasible to address given current capabilities and assuming a significant infusion of resources...”</p>	<p>Correct, the intent of this document is to present the Grand Challenges before they are integrated into the greater Science Plan. We have made this more clear in this document.</p>
	<p>But the text that accompanies each challenge does not seem to directly deliver on these promises. When I first perused the text with each challenge it came across mostly as a defense of the choices of challenges. But then when I read more closely I realized that you have the material for much if not all of a compelling agenda. I just doesn't quite read that way. I think just some small changes in tone could make it a little more clear that this document frames an answer to the question of “what can we do about addressing these massive challenges”.</p>	<p>Agreed, we plan to expand on that in the Science Plan itself. This document was written and put out for public comment at this stage to allow the community to provide feedback. We have made this more clear in the document.</p>
	<p>Another way to bring out the agenda aspect would be for each challenge to be accompanied by a table or a text box that puts the suggestions in the text into bullets. For example, I created such a text box/outline for challenges #1 and #2 inserted at the bottom of this message. These could be more succinct but I just used words from your text with the exception of a couple items I added (highlighted; see text box at bottom).</p>	<p>Thank you for this recommendation, I believe that this will be a great structure to build from for the Science Plan.</p>

Author	Comment	Response
	<p>Example of Text Box:</p> <p>Grand challenge #1:</p> <ol style="list-style-type: none"> <li>1.. Support horizon scanning efforts to systematically search for <ol style="list-style-type: none"> <li>i. potential threats and opportunities,</li> <li>ii. emerging or potential challenges not yet present within the system</li> <li>iii. future novel conditions that could affect or require management.</li> </ol> </li> <li>2. Expand knowledge of the Delta ecosystem in areas that could support: <ol style="list-style-type: none"> <li>i. expanded strategies for protecting or restoring key species and ecosystems,</li> <li>ii. managing for improved ecosystem function,</li> <li>iii. potential policies if species go extinct and current ecosystem protections thereby disappear.</li> </ol> </li> <li>3. Develop and employ models that project how different management strategies will interact with future environmental conditions and assess tradeoffs. Use scenario-based approaches or stress-testing, model system performance and tradeoffs over the widest range of potential climate changes.</li> <li>4. . Expand the capacity for social science focused on anticipating future policy decisions as well as how human values and changing economic conditions influence human use of the Delta and its resources.</li> </ol> <p>Grand Challenge #2</p> <ol style="list-style-type: none"> <li>1. Accelerate the pace of Delta science to allow for quicker decision-making: <ol style="list-style-type: none"> <li>i. Improve monitoring (small scale?) of adaptive experiments that can address emerging change, while maintaining a capacity to document long-term trends.</li> <li>ii. Anticipate near-future conditions with enhanced tools, including</li> </ol> </li> </ol>	

Author	Comment	Response
	<p>modernized forecasts of water supply, water quality, and ecosystem conditions relevant to management.</p> <ul style="list-style-type: none"> <li>iii. Build trust in Bay-Delta management by transparently identifying/investigating scientific uncertainties associated with specific regulations and addressing critical gaps in general knowledge of the Bay-Delta ecosystem.</li> <li>iv. expand capacity and mechanisms to perform and disseminate syntheses;</li> <li>v. identify, investigate and resolve barriers to the use, transparency, communication, and linking of models and data</li> </ul> <p>2. Slow the pace of environmental change:</p> <ul style="list-style-type: none"> <li>i. Supporting local actions that improve regional resilience to climate change;</li> <li>ii. Test management interventions specifically designed to generate more time for adaptation using models and adaptive management experiments.</li> </ul> <p>3. Address the inefficiencies in the polycentric organizational structure:</p> <ul style="list-style-type: none"> <li>i. Improve interagency coordination and collaboration.</li> <li>ii. Increase research coordination (i.e., monitoring, knowledge transfer) at the watershed and estuary scale.</li> <li>iii. Develop rapid-response funding processes for targeted studies;</li> <li>iv. Improve timeliness in executing and reporting on those studies;</li> <li>v. Sustain peer review but investigate mechanisms to accelerate publication of results (e.g. publication of pre-prints).</li> <li>vi. Reduce redundancies in committees, reviews, and other capacity-draining activities;</li> <li>vii. Support multi-interest venues where new findings can be discussed and information needs identified;</li> </ul>	

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	<p>2.1 A major factor slowing our response to change is lack of trust amongst competing interests. You address that in #3 to some extent. Collaborative forums, transparency about uncertainties in regulations, explicitly working on narrowing uncertainties, communicating widely about ongoing improvements in ecosystem knowledge are some mechanisms that seem to have worked (below the surface anyway) in the past. It might be worth being more explicit, and tying this together with some of organization adjustments in earlier text. I suggest using science to provide forums that improve trust to your themes.</p>	<p>Additional information has been included to address reducing conflicting opinions in collaborative spaces</p>
	<p>2.2 Each researcher will look at your science agenda to see where they fit. My view is that broader goals about where to grow understanding will expand your bought-in audience, and allow more flexibility in the next decade, moreso than the narrow focus sometimes advocated for plans. Your text is pretty good in that regard, but I did suggest a couple broad “ecosystem knowledge” phrases with that in mind.</p>	<p>Thank you for this comment and your recommendations. Specifics on where groups fit into this work will be more detailed in the Science Plan</p>
	<p>2.3 The science plan can say where you will support science. But it is a little more awkward to suggest organizational adjustments in a science plan. Bringing those out is much needed to meet the challenges. But it might be worth adding some text recognizing your lack of authority in this regard. Or suggest some studies or some way you can identify specific problems or review/test alternatives. How do we contribute to improving the situation? What can the DSC/DSP do to speed organizational adjustments. You might note I labelled this “Addressing inefficiencies in the polycentric organization”...just a suggestion ☺.</p>	<p>Thank you for this comment. We agree that additional thought must be given to identifying how to address organizational adjustments. We will keep that in mind during the Science Plan development.</p>

Author	Comment	Response
	2.4 Speeding up delivery of science creates a tension between quality and quantity. We all know that shortcuts hardly ever work when designing and carrying out challenging studies and lack of meaningful review of science can be exploited in nefarious ways. The science plan need not solve this, but you might consider recognizing it. To this effect I suggest adding “sustain peer review” to discussions of delivering scientific results.	The quantity vs quality tension is wrapped up in the uncertainty for decision-makers, which is expanded on in the final paragraph of this Grand Challenge. Agree that sustaining peer review in its current capacity is a method for moving findings forward, and this is expanded to include the DSP's peer review process as an example.
	2.5 Artificial intelligence is undergoing explosive growth. It is hard to comprehend where it will be in a decade. It could offer some real benefits in areas like synthesis but, as we all know, the risks from disinformation, misinformation and artificial “hallucinations” are just as immense. You might consider including recognition of the need to better understand how to apply this new tool.	Great point, included mention of ML and AI.
	3.1 The text supporting Challenge 3 is an interesting review but is longer than for the other challenges. Perhaps a little less detail would tighten it up.	Thank you for this comment.
	3.2 Challenges 3 and 4 are difficult to craft an agenda from. Perhaps be more explicit in both with ideas about what can be done to address the challenges.	Additional information has been included.
Steve Lindley (NOAA)	My main comment/suggestion is to think about whether the resist-adapt-direct (RAD) framework for managing rapid environmental change that is getting some traction in the recent literature might have something to offer the first two challenges.	Thank you for this comment, we will review this framework as a tool to include in the final Science Plan.



Author	Comment	Response
SLDMWA	<p>The four grand challenges identify relevant concerns. However, in order for the grand challenges to be addressed or resolved, there must be an Interagency Ecological Program capable of delivering reliable knowledge to resource managers and policy makers. In addition, there must be a science agenda that can be enhanced in order to generate the information necessary to meet the Delta co-equal goals managing future environmental and ecosystem changes. The Water Authority suggests improving or developing a science forum to ensure the scientific capacity to review, recommend, and implement actions is available to address the grand challenges. In contemplation, the Water Authority suggests the following four challenges be addressed to enable the feasibility to address the Delta Science Program's grand challenges</p>	<p>This suggestion fits nicely with the concept of service centers as suggested in Grand Challenge 3. We agree that such a "science forum" or service center, as we call them, would benefit the Delta science community.</p>
	<p>Challenge 1- Adopting an ecosystem conservation focus in resource management</p> <p>The increasing number of protected fish species inhabiting the Bay-Delta under the management through the California Endangered Species Act and the federal Endangered Species Act indicates the collapse of the estuarine ecosystem. While that is widely recognized by scientists and resource managers alike, the conservation effort in the Delta focuses on single species management rather than an ecosystem-based management approach. The Delta Science Program should encourage the regulatory agencies and policy makers to develop a comprehensive conservation approach that is responsive to organisms on all trophic levels, and supports identification and prioritization of reducing the environmental factors that are limiting species recovery efforts.</p>	<p>We agree with these points, and believe this to be reflected in Grand Challenge #1. Thank you for this information which we will use to scope the final Delta Science Plan.</p>

Author	Comment	Response
	<p>Challenge 2 -- Management actions should be implemented on a much broader spatial scale</p> <p>Management actions and restoration efforts must be expanded to geographic (spatial) scales consistent with the ecosystem challenges, including addressing multi-stressor impacts like the effects of invasive species, habitat degradation, food-web disruption, and other environmental stressors. Recovery of the Bay-Delta ecosystem requires a broad focus on all trophic levels and species to address a wide range of environmental stressors in a complex array of diverse landscape attributes that determine the quality and availability of suitable habitat to support fish species and community health and condition. The commitment to Bay-Delta ecosystem recovery will require coordination and support by local, state, and federal levels.</p>	<p>We agree with these points, and believe this to be reflected in Grand Challenge #1. Thank you for this information which we will use to scope the final Delta Science Plan.</p>
	<p>Challenge 3-- Adaptive resource management should be used as the primary method for increasing scientific knowledge</p> <p>The resource agencies should adopt an adaptive management framework for actions with achievable objectives, a scientific foundation, and ecological models. To address the environmental challenges in the Delta, adaptive management should be enhanced by evaluating monitoring results, assessing the performance of management actions, facilitating real-time decision making, and adjusting to the changing environmental needs. The necessary adaptive management program emerges from structured decision-making, identifying and acting on the management priorities, and subsequent monitoring and evaluating the performance of the actions.</p>	<p>Thank you for this comment, these details are now better reflected in the Grand Challenges.</p>

Author	Comment	Response
	<p>Challenge 4 -- Broadly focused, interdisciplinary science advice for decision-makers</p> <p>The current scientific approach to Bay-Delta science is divided between resource agencies, regulated agencies, academic researchers, and other interested parties. While the science community has improved the coordination over the past few years, there is still opportunity to better integrate the information and results in a timely manner. Often, the study results are not available for including in management analyses and decisions. The program would benefit from the following:</p> <ul style="list-style-type: none"> <li>- Expansion in participation by senior-level interdisciplinary scientists in Bay-Delta investigations, structured decision-making at the ecosystem scale, and providing the programmatic scientific leadership.</li> <li>- Development of fishery monitoring programs to improve understanding of the status, dynamics, and factors limiting the recovery of species and aquatic communities</li> <li>- Implementation of special studies and targeted monitoring to investigate the performance and contribution of resource management and regulatory actions to the health and condition of the estuarine ecosystem and recovery of protected species</li> <li>- Attention to improved data collection, management, and analyses, interdisciplinary modeling, synthesis of scientific information, identification of important areas of uncertainty, and reporting of management-relevant scientific results</li> <li>- Coordination of resource managers and policy decision-makers regarding the interpretation and appropriate application of scientific information</li> </ul>	<p>Thank you for this comment, these details should be better reflected in the Grand Challenges and will be integrated.</p>

Author	Comment	Response
SSJDC	<p>The Delta Conservancy is very supportive of the approach put forward by the document, which seeks to update the Delta Science Plan through a forward-looking, visionary lens. Though broad, the Delta conservancy agrees that the four grand challenges put forward by the document cover a large portion of the issues that may be addressed by Delta science.</p>	<p>Thank you for your support</p>
	<p>In particular, Grand Challenge #3 "Flows of scientific information remain decentralized and poorly connected to communities and decision makers" seems particularly important, as it informs and is informed by the other three challenges presented. The large list of organizing groups presented on page 14 makes it clear that reckoning with the polycentric nature of Delta governance has been a challenge since before the passing of the Delta Reform Act. Meeting this grand challenge will require study by social science researchers, and, perhaps more importantly, dedicated effort by all parties to facilitate timely, targeted exchanges of scientific information. An updated Delta Science Plan that puts forward measurable, specific proposals for how to achieve these aims would be extremely valuable.</p>	<p>We agree that social science research is important for improving science in the Delta. We will consider these comments for the Delta Science Plan.</p>
John Callaway	<p>This is a valuable step forward for the Delta Science Plan. I very much appreciate using "Grand Challenges" to highlight and unite the science challenges for the Delta. It will be a very useful approach to focus on critical science issues in the coming years. I also feel like the four challenges are valuable and very much on target with the current needs for coordinated and collaborative science in the Delta.</p>	<p>Thank you for your support.</p>
	<p>I appreciate that you laid out the method that you used to go from the large number of potential issues to the four challenges, but a little more detail here would be informative. In particular, it would be useful to see what the preliminary list of 17 challenges was before you consolidated them into 4. Similarly, it would be useful to highlight</p>	<p>The method for defining the final three Grand Challenges is now expanded in Appendix A.</p>

Author	Comment	Response
	<p>in appendix A which of the items in this broad list were carried over into the short list of 17.</p>	
	<p>Just before the methods section, it is indicated that the document is meant to assemble the various challenges from previous documents and “to build out actionable steps to address the Grand Challenges.” As presented, it seems like the focus of the document is primarily on identifying the challenges, rather than the actionable steps. Lots of ideas are packed into the summary of each grand challenge (as I would expect), and some of these are likely future steps. However, it was not entirely clear to me if the ideas that are presented are meant to be the specific “actionable steps” for a particular challenge, or if these are potential examples and the specific recommended actions will be presented in the final document. It would be very useful to include a summary table for the final document that illustrates the key issues and the actionable steps for each challenge, especially since the actionable steps are what will give guidance to the community of what can and should be done going forward.</p>	<p>The essay was published without many actionable steps, as we believe that is information that belongs in the Delta Science Plan. The purpose of publishing the Grand Challenges at this juncture is to hear from the community on the Grand Challenges themselves as well as on the concept of using the Grand Challenges as the structure for the Delta Science Plan.</p> <p>Such a summary table, as you describe, is information that we can include in the Delta Science Plan. Thank you for this comment.</p>

Author	Comment	Response
	<p>Challenge #1: Scientist and managers must anticipate a world in which environmental conditions and regulations may be fundamentally different</p> <p>- As much as future differences in environmental conditions are important, I would recommend emphasizing the complexity, heterogeneity, and unpredictable variability in future conditions for this challenge. These issues are in the text for this section, but could use more emphasis and connection to the challenge as presented. To me, these are the key issues/characteristics that will create very difficult management going forward, more so than the fact that the system will be different. In addition, highlighting complexity, heterogeneity, and unpredictable variability would allow for the climate focused issues that are currently in Challenge #1 to be moved into Challenge #2, so that the focus there is on both the change in conditions, and the rapid pace of environmental change.</p>	<p>Agreed, there was some bleeding between Grand Challenge #1 and #2 and this has been streamlined. Greater attention was given to the complexity of the multistressor future that must be managed.</p>
	<p>- These key issues also lead to the strong reliance on adaptive management to address uncertainty and to the value of new approaches like modeling and forecasting to evaluate trade-offs and different potential futures. A further issue that could use some more detail is the need to incorporate social issues into decision making more effectively, as this adds more complexity to decision making. This is included some here, and in Challenges #3 and 4, but it could be called out more in this challenge.</p>	<p>Additional detail on AM has been included. More direct calls for social science research has been included</p>

Author	Comment	Response
	<p>Challenge #2: Environmental change is outpacing the traditional pace of science</p> <p>This challenge is very much on target to me – as above some of the issues here dovetail well with those in Challenge #1. My comments for this are on details: in the last paragraph, you indicate that high uncertainty will remain the norm. As in the rest of the section, I would highlight that it’s not just that high uncertainty will remain, but that it will be much greater in the future with rapid environmental change. In addition, in this section where you discuss “slowing the pace of environmental change” it seems like this is really about resilience and slowing the effects climate change – not slowing drivers of environmental change. Clarifying this would be valuable. When I first read it, I was confused and thought that it was going to be about climate change mitigation and adaptation, when it really appears to be about adaptation. Last, I very much appreciate the incorporation of decision making under deep uncertainty here. Insights from this review and these approaches should be very valuable.</p>	<p>Thank you for this comment. We have clarified that uncertainty will remain and increase, and we have clarified that this section speaks to slowing the pace of environmental change.</p>
	<p>Challenge #3: Flows of scientific information remain decentralized and poorly connected to communities and decision makers</p> <p>As with the general comment above, it was not clear if the topically focused “service centers” are a specific recommendation/actionable step or a potential example. There are multiple issues presented within this challenge, and the service centers seem like just one approach that would address improved access to information and communication. More information on additional approaches for engaging communities, and in particular marginalized communities, would be useful in the final document.</p>	<p>We appreciate this feedback and do anticipate offering more tools and strategies to address this Grand Challenge in the Delta Science Plan.</p>

Author	Comment	Response
	<p>Challenge #4: Other ways of knowing, including Traditional Knowledge, remain siloed from decision making</p> <p>Challenges #3 and #4 seem even more closely linked than #1 and #2. It might be useful to clarify the connections and differences between these two challenges. In both cases, it seems like the target is to engage communities more effectively in decision making, with this one more directly focusing on TK and how information is collected, while #3 is more on information flow and governance issues. Some more clarity here (and in the ensuing “actionable steps”) would be very useful. Engaging the Tribes is definitely a high priority that is deserving of specific focus. It also would be useful to identify how other marginalized communities can be better engaged for this challenge.</p>	<p>Both GCs 1 and 2 and GCs 3 and 4 have been more clearly defined and delineated.</p>
	<p>other details:</p> <p>It might be useful to provide the 2001 NRC Grand Challenges in a box (or at least the most relevant examples) for context and background on the overall approach of grand challenges.</p>	<p>The NRC's eight grand challenges are now included as Supplementary Information 1</p>
	<p>It also might be useful to emphasize where coordination is important and necessary throughout the different challenges, since this is “a strong rallying cry for coordinating Delta science.”</p>	<p>Thank you for this comment.</p>



Public Response Period – May 28 – July 12, 2024

Anonymous survey responses

	Responder #1 (State government)	Responder #2 (NGOs)	Responder #3 (State government)	Responder #4 (State government)
<b>Question 1.1. How well does this Grand Challenge reflect the challenges you experience as a member of the Delta science community? (on a scale from 1-5)</b>	4		5	5
<b>Question 1.2. What strategies, actions, or tools have you identified that would be useful for addressing this Grand Challenge?</b>			Broader surveys of more available habitats would be an improvement over more details of more restricted habitats, e.g. include more extensive remote sensing surveys and less hyper-focused individual species or project-based surveys.	
<b>Response to comments</b>			Thank you for this comment	

	Responder #1 (State government)	Responder #2 (NGOs)	Responder #3 (State government)	Responder #4 (State government)
<b>Question 1.3. Is there anything else you would like to share regarding this Grand Challenge?</b>	<p>NDFS is not an example of functional flow management and subsequent research since Frantzich et al. has indicated that it did not stimulate phytoplankton productivity as they identified. Please see Davis et al. 2022. Challenges #1 and #2 are connected, so it may help to combine them into one larger topic. In a way, #2 lays foundation for #1. One difficulty with this challenge is that future climate change forecasts can negatively impact management objectives or benefits, which can lead to a disincentive to consider those future forecasts. Resource managers will need to make difficult decisions with trade-offs for their objectives under climate change, and difficult conversations will be necessary to achieve this. Davis et al. 2022. North Delta Food Subsidy Synthesis: Evaluating Flow Pulses from 2011-2019. Department of Water Resources, Division of Integrated Science and Engineering. Draft. 249 pp.</p>	<p>This grand challenge is so broad that it doesn't really provide guidance to scientists toward salient research questions or approaches. Instead, it states the reality in which we, as scientists, are already well aware that we operate - both in the Delta and elsewhere - in which we know there are limitations to our ability to use the past and present to predict future effects. This reality is useful high-level framing, but I think there's an opportunity to identify more specific and actionable grand challenges that could help steer Delta science toward the questions and answers most important to the Delta management community and the coequal goals. An example might be "Improve our ability to model the effects of future climate and regulatory changes on multiple desired ecosystem functions." This type of specific challenge would be more akin to the grand challenges from the NRC report that inspired this essay's approach.</p>		

	Responder #1 (State government)	Responder #2 (NGOs)	Responder #3 (State government)	Responder #4 (State government)
<b>Response to comments</b>	Thank you for this comment, we have delineated the differences between GC#1 and GC#2.	<p>Thank you for this comment. The essay was published without many actionable steps, as we believe that is information that belongs in the Delta Science Plan. The purpose of publishing the Grand Challenges at this juncture is to hear from the community on the Grand Challenges themselves as well as on the concept of using the Grand Challenges as the structure for the Delta Science Plan.</p> <p>We appreciate this feedback and do anticipate offering more tools and strategies to address this Grand Challenge in the Delta Science Plan.</p>		
<b>Question 2.1. How well does this Grand Challenge reflect the challenges you experience as a member of the Delta science community? (on a scale from 1-5)</b>	3		5	3

	Responder #1 (State government)	Responder #2 (NGOs)	Responder #3 (State government)	Responder #4 (State government)
<b>Question 2.2. What strategies or tools have you identified that would be useful for addressing this Grand Challenge?</b>		I see this grand challenge, as phrased, as really a governance or funding challenge than a science challenge. Accordingly the strategies or tools to address it are also rooted as much in governance and management as they are in science. The strategies you lay out in the essay get at this well, e.g., streamlining the funding processes and adaptive management. I would add the importance of designing (and funding) longer-term research efforts that are designed to track change over time and are nimble enough to adapt and redirect as conditions change.	More flexible regulatory approach is needed. While scientific process approach takes time, regulatory process takes 2x as long and can be outdated before regulations even have an effect.	
<b>Response to comments</b>		Thank you, we agree and have added more information on adaptive governance to this section.	Agreed, we have included adaptive governance in this Grand Challenge.	

	Responder #1 (State government)	Responder #2 (NGOs)	Responder #3 (State government)	Responder #4 (State government)
<b>Question 2.3. Is there anything else you would like to share regarding this Grand Challenge?</b>	CSAMP may be a difficult venue for fast-tracking scientific results. Since CSAMP is a collaborative group with a wide range of viewpoints, scientific results are carefully negotiated in a time-consuming process before release. The Interagency Ecological Program and the Delta Science Program have been much more successful in producing quick, objective scientific results (e.g., Operation Baseline).	Similar to my comments about grand challenge #1, I think this challenge could go farther to identify more discrete and defined science tasks, and also to separate the science challenges from the governance challenges. As an example, a more actionable governance challenge might be, "develop new rapid-response funding processes that enable targeted science to be conducted and made available to decision makers at the pace needed to keep up with environmental change." More actionable science challenges might be, "identify management interventions that can slow the pace of rapid change and generate more time for adaptation," or "improve our near-term and long-range forecasts of water supply, water quality, and ecosystem conditions relevant to management."		

	Responder #1 (State government)	Responder #2 (NGOs)	Responder #3 (State government)	Responder #4 (State government)
<b>Response to comments</b>	Thank you for this comment.	Thank you for this comment, as clarified in response to your comment on GC#1, we did not intend to capture all tools and strategies in this document but will consider these comments for the structure of the Delta Science Plan.		
<b>Question 3.1. How well does this Grand Challenge reflect the challenges you experience as a member of the Delta science community? (on a scale of 1-5)</b>	3		4	2
<b>Question 3.2. What strategies or tools have you identified that would be useful for addressing this Grand Challenge?</b>			Co-production projects are becoming more common, and have promise, but take more resources than a traditional approach of top-down command and control	
<b>Response to comments</b>			Thank you for this comment.	

	Responder #1 (State government)	Responder #2 (NGOs)	Responder #3 (State government)	Responder #4 (State government)
<p><b>Question 3.3. Is there anything else you would like to share regarding this Grand Challenge?</b></p>	<p>The statement that correlative value of habitat creation verses flow increments for ecologically significant fish species factored significantly into the 2021 negotiations on the Voluntary Agreements is not accurate. There is not a defined mechanism to trade habitat for flow as part of the VAs and the habitat included in the VAs will be restored with or without the VAs. Justification for habitat benefits is not settled science and neither is the premise that flow can be substituted for habitat. This is especially unknown for the VAs given the unknowns in the habitat commitments. There was no analysis of the relative value of habitat verses flow that factored into the VA negotiations or subsequent analysis. Furthermore, the VAs are not the best example for this section since the referenced problem was more related to inclusivity and outreach rather than connections between scientists and managers. This example</p>	<p>I recognize the importance of bridging science and decision making. After all, this is the fundamental purpose of the Delta Science Program. In keeping with my comments above, however, I think this essay would benefit from more clearly distinguishing between science and governance/management challenges, and also from stating the challenges as tasks more akin to those in the NRC report. This challenge, for example, might be rephrased as, "improve science information flows and coordination between scientists and decision makers."</p>		

	Responder #1 (State government)	Responder #2 (NGOs)	Responder #3 (State government)	Responder #4 (State government)
	may be more related to challenge #4.			



	Responder #1 (State government)	Responder #2 (NGOs)	Responder #3 (State government)	Responder #4 (State government)
<b>Response to comments</b>	Thank you for this comment, we agree and have removed the VAs as an example.	This is a great point, and we will pursue categorizing tasks as "science" or "governance" within each Grand Challenge for the Delta Science Plan		
<b>Question 4.1. How well does this Grand Challenge reflect the challenges you experience as a member of the Delta science community? (on a scale from 1-5)</b>	4		4	4
<b>Question 4.2. What strategies or tools have you identified that would be useful for addressing this Grand Challenge?</b>		I would add the importance of developing trust through long-term relationships and research partnerships oriented around community-defined objectives.		
<b>Response to comments</b>		Thank you for this comment.		
<b>Question 4.3. Is there anything else you would like to share regarding this Grand Challenge?</b>		Echoing my comments above, I think this grand challenge is as much or more a policy challenge as it is a science challenge. I also think it would be more useful to the community if reframed as a task, e.g., "transform the decision-making process to act on information from historically marginalized communities and	There is much opportunity here, but to be fully behind TK implementation means challenging existing power and financial structures -- we need to be honest with people about whether this is realistic or not.	

	Responder #1 (State government)	Responder #2 (NGOs)	Responder #3 (State government)	Responder #4 (State government)
		other ways of knowing, including Traditional Knowledge."		
<b>Response to comments</b>		Thank you for this comment, we will parse these out into tasks in the Delta Science Plan.	Thank you for this comment.	

	Responder #1 (State government)	Responder #2 (NGOs)	Responder #3 (State government)	Responder #4 (State government)
<p><b>Is there anything else you would like to share with the Delta Science Program that pertains to the development of the 2025 Delta Science Plan?</b></p>		<p>I appreciate all the work that went into this essay, which I think effectively frames the context in which the Delta community should determine which science questions to pursue, how work should be funded, and how findings should be integrated into management and policy. I'm a little perplexed about the framing, though. The introduction compares this essay's grand challenges to those from the NRC report, described as "major scientific tasks." Similarly, the conclusion states that the grand challenges "offer a set of goals for the Delta science community to work toward together. The 4 grand challenges, though, are neither tasks nor goals, and all but #1 speak more directly to the management community than the science community. I noticed that the report is titled "grand challenges TO Delta science," whereas the text uses the phrase "grand challenges FOR Delta science" throughout. The 4 grand challenges seem to</p>	<p>Good overall strategy for Science Plan organization. I support this as a structure for creating the next Plan.</p>	

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		<p>me to be challenges TO science (present-day realities that make it hard to effectively define, fund, and use the science projects in the Delta that address the most salient management questions), as opposed to challenges FOR science (research tasks or science objectives that would best meet the needs of the Delta community). All of this leaves me thinking the essay could more clearly state what these grand challenges are intended to be, who they are intended to speak to, and how the Delta science community should use these contextual statements to define tasks and goals. I also noticed that much of the reviewed literature is reports or articles authored by DSC, the ISB, or affiliated scientists. This makes the literature review more of a synthesis of past DSC priorities/initiatives than a review of Delta science. While I don't think this is misrepresented per se in the description of lit review methods, I do think it could be called out a bit more clearly in</p>		

	Responder #1 (State government)	Responder #2 (NGOs)	Responder #3 (State government)	Responder #4 (State government)
		<p>the Introduction and Identifying Grand Challenges sections. I hope this feedback is useful!</p>		

	Responder #1 (State government)	Responder #2 (NGOs)	Responder #3 (State government)	Responder #4 (State government)
<b>Response to comments</b>		<p>Thank you for this comment. As stated in previous responses to your comments, this essay was intended to provide the Delta science community an opportunity to provide feedback at an early stage on the use of the Grand Challenges to frame the Delta Science Plan. Further detailed work creating actionable steps to address the Grand Challenges will be crafted over the course of the development of the Delta Science Plan, during which we will continue to work with the Delta science community.</p> <p>Thank you for your comment regarding the content of the literature review, given the parameters of our review to focus on "visionary" literature, we did have weight toward ISB materials. However, the ISB is independent from the Delta Science Program and has their own mandates and mission. If you feel that any literature was missed or should be included we are open to receiving additional</p>	Thank you for this comment.	

	Responder #1 (State government)	Responder #2 (NGOs)	Responder #3 (State government)	Responder #4 (State government)
		documents for the construction of the Grand Challenges.		

