DRAFT (DO NOT CITE)

DRAFT SCIENCE ACTION AGENDA REVIEW BY THE DELTA ISB

January 11, 2022

Below is the draft review outline of the Delta Independent Science Board's (Delta ISB's) review of the 2022-2026 Science Action Agenda (SAA). If you need assistance interpreting the content of the document, please email disb@deltacouncil.ca.gov.

1 SCOPE OF THE REVIEW

Primary questions addressed

Science Issues

1. How well do the six management needs capture pressing gaps to be addressed by science activities in the next four to five years? (Question from the Delta Science Program)
2. Do the selected management questions provide useful links between the management needs and science actions? (Question from the Delta Science Program)
3. Do the management questions support innovation? Resilience thinking? Managing uncertainty?
4. Are the management needs presented at the appropriate level of detail (e.g., sufficient to lead to action)?
5. Are some urgent science needs missing? (Consider Science Needs Assessment (SNA) and recent Delta ISB reviews)

Process & documentation

6. Was the process of identifying needs adequate? Was it responsive to last SAA review?
7. Does the draft [adequately] explain how progress made on the 2017-2021 SAA informed the 2022-2026 SAA development process? (Question from the Delta Science Program)
8. Do the appendices provide the appropriate supporting material? (Question from the Delta Science Program)

2 STRENGTHS OF THE REVIEW

2.1 SCIENCE ACTION AGENDA

- The team is to be commended for producing a clearly written and succinct document that integrates a large quantity of diverse inputs. The overall 2022-2026 SAA effort shows rigor, timeliness, dedication, and thoroughness.
- The science needs that were identified will all fill important knowledge gaps.
- Overall, the management themes are representative and provide high-level documentation supporting their place in the SAA. Management questions are generally well posed and timely.
- The mix of general and specific priorities, with associated management questions, provides for diverse uses of the document and enables multiple related research priorities to be succinctly summarized.

2.2 PROCESS AND DOCUMENTATION

- The co-production process was ambitious and engaged many stakeholders with diverse backgrounds and interests. The process was open and transparent and showed a strong commitment to meaningful engagement with diverse stakeholders. The process promoted the inclusion of the concerns of the broad community working on Delta challenges and provided ample opportunity for public input.
- The approach is well organized and the document provides clear information about the processes used to identify the priority management needs. The summary in the “Co-Production by the Numbers” box is helpfully specific about the amount and sources of input.
- One of the highlights is the forthcoming availability of a cyber tool – Delta Science Tracker – to help science-based planning. We appreciate the inclusion of this vision, which is responsive to SAA, Action 1A of the 2017-21 SAA.
- Multiple process elements were responsive to prior Delta ISB recommendations.
- The appendices are thorough. In particular, the process for developing and applying screening criteria for the management questions and science actions is clearly articulated.

3 MAJOR CONCERNS

3.1 SCIENCE ACTION AGENDA

- Goals and applications of the management needs and science action priorities are unclear, which makes it difficult to assess whether the prioritization is consistent with urgent needs.
    - We recommend articulating the goals that drove the selection of the management needs, possibly by succinctly bringing some of the material that is now in the preface to the report body.
    - We recommend better explaining the purpose of the SAA in the context of other reports and efforts that make up the Delta Science Strategy, as shown in the diagram on page 10. While this content is eventually covered in the report, it would be helpful to have a succinct paragraph in the introduction to orient readers. If not all the research topics raised by stakeholders fit within the existing reports' context, it would be helpful to discuss why and any implications.
- The priority of the management needs was unclear. Are they all equal or are some paramount?
- The temporal scope and purpose of the science action priorities do not appear to be fully consistent with the results. The introduction and charge suggest that the SAA's purpose is to prioritize science actions for the next 4 years, implying that the prioritized actions are intended to be achievable over this time period. However, much of the identified needs encompasses research that will only provide management-relevant results after many years of continued effort.
    - We recommend articulating more directly that the priorities identified in the SAA may include both short-term and longer-term management needs and science actions. Additionally, the document could clarify that the 4-year time frame is the period around which the DSP evaluates and reassesses these priorities and, while progress is expected on these priorities during the 4-year period, the priorities may not be completed or fully achieved.

    - We recommend establishing clear goals to be addressed in the short term (3-5 years) and linking short-term goals to longer term (decadal) management needs and science actions.
    - The relationship between available funding and needs should be explained, since the research needs well exceed the available budget.
- Some urgent science needs appear to be missing or did not receive sufficient emphasis. Given the role of the SAA in the science enterprise, we recommend that a larger component of the SAA be used to set specific science actions that require immediate attention. We note that these needs might have been identified if an adaptive management framework for tracking science needs were used (see Suggestions for Future).
    - We recommend increasing the emphasis on water supply, which is a vital element of Delta management and ought to permeate all management and science needs, not only in Needs 1, 2, and later in 6. Some recommendations from the water supply reliability review (covering hydrologic/hydraulics) could be brought into 'existing gaps.'
    - Drought and other potential Delta crises deserve mention. They are barely mentioned, despite evidence of accelerating change that could push systems over tipping points, marked by dramatic changes in system functioning. Although these issues are not readily resolved in a short-term research agenda, neither should they be ignored.
    - Science synthesis and analysis is a major science gap. Making sense of the details we already have, discussing findings, and sharing knowledge are critical to creating and applying new knowledge. The mention of the collaboratory appears intended to address this need but interim or highly focused efforts may be needed until such an organization is developed and to eventually complement that effort.
    - Integrative modeling may need more emphasis: For example, estuarine programs with similar goals, such as the Louisiana Coastal Assessment (see their coastal masterplan 2023), uses integrative modeling as a key pillar of analysis, where complex interactions of key ecosystem elements can be gleaned (within uncertainty margins). The SAA rightfully takes pride in infusing more science into planning, but without a mix of science and technology, the impacts could be limited,

especially in 4-6-year time scale. The technology time scale is usually relatively short and shortens the time from science results to application. In management need 2, model interoperability and integration are mentioned, but they are buried in monitoring.

    - Managing under uncertainty deserves more emphasis. Investing in analysis to develop data and tools to help manage unavoidable uncertainties is complementary to new research. Risk analyses, strategic contingency planning, and adaptive management are common successful approaches to managing with uncertainties.
- The word modeling is used to encompass all types of data analysis, forecasting, and prediction. It would be helpful to be more precise and to differentiate uses, particularly between analysis and prediction.
- Although social science is integrated across many biophysical research needs and given a distinct category, many social science questions could be improved to better represent how social science researchers approach problems and to enable innovation. Some examples illustrate this point:
    - Good example (Need 6, page 31): “How and why are different human communities in the Delta currently adapting or not adapting to climate change, and what are the barriers communities face to adaptation?” This question is useful because it seeks to identify problems and innovative solutions.
    - Less good example (Need 5): “What degree of control keeps invasive/non-native populations at a level that allows for desired and cost-effective management outcomes (e.g., boating access, fish habitat, food production)?” This question is narrow and prescriptive rather than promoting innovation to understand and possibly alter cost-effectiveness, as might be reflected in the question: “What types and levels of invasive species management produce the highest cost-effectiveness (e.g., in terms of goals for boating access, fish habitat and food production), with the least ancillary harms?”
    - Could be improved (Need 4): “Measure and evaluate the effects of using co-production or community science approaches (in management and planning processes) on communities' perceptions of governance and decision-making processes.” Perceptions are good to

evaluate but why not also consider the contribution of co-production to improvements in program implementation or in generating innovative ideas? Meaningful co-production has benefits to communities and institutions.

- Missed opportunity for social science integration – such as the impacts of HABs on different communities (Need 5C).

3.2 PROCESS AND DOCUMENTATION

- It would be helpful if continuing recommendations were distinguished from new recommendations to highlight novel elements from the last SAA, as well as to show what priorities from the previous SAA remain.
- Although the report describes connections to the previous SAA, the process by which the SAA Progress Summary (as described in Appendix B) informed the prioritization of actions in the new SAA remains vague. We recommend adding clarification to address the question, How did the *level* of progress across different actions from the previous effort inform the need for new actions or ongoing actions?

4 MINOR CONCERNS

4.1 SCIENCE AGENDA

- Reasons for the low survey response rate should be investigated. Also, it is not clear how representative the respondents were. Not all agency representatives attended some of the SAA meetings. Including information about the nature of responders (management experience, management advisory experience, science cognizance) would help explain the overall 'Delta-representativeness' of management questions.
- Assessing impacts on disadvantaged communities (DACs) is a valid research need. However, isn't there also a lack of understanding of management impacts across all communities, including small to large businesses? A more systematic or holistic approach to impact assessment may be desirable.
- Some questions may need to be refined to generate the information most useful for management or to clarify the management application. (The use of

an adaptive management framework in the future could prevent these issues.)

- Example (Need 5): “Quantify spatial and temporal "hotspots" of chemical contaminants and evaluate ecosystem effects through monitoring, modeling, and laboratory studies.” This question could be improved by mentioning the need for upstream source tracking and in-situ burial rates to better understand the system dynamics that could influence management priorities.
- Example (Need 3): “How do management actions (e.g., source control practices or managed flows) and habitat types influence nutrients, carbon, contaminants, and sediment fluxes in the Delta?” This management questions appears to be a science question because it promotes basic science without stating an application or goal.

4.2 PROCESS

- The Delta Science Tracker appears to be a good idea. Details, especially those providing measurements of success (or not), would be appreciated. For example, a side bar introducing its capabilities will be a welcome addition.
- The Executive Summary gives the impression that ecological and social sciences are being conducted separately and could better reflect the integration that is evident in the body of the recommendations.

5 SUGGESTIONS FOR FUTURE APPROACHES

5.1 SCIENCE ACTION AGENDA

- Scientific research can effectively support management when it is embedded in an adaptive management (AM) framework. The Delta ISB recommends future versions of the SAA seek to 1) systematically identify research that supports AM components; 2) apply that framework to track how science output are used in AM; and 3) make recommendations for future research that respond to shortfalls or emerging needs, as identified in AM. This approach could avoid concerns about whether the recommendations are most representative of the urgent needs based on a thorough examination across agencies, scientists and stakeholders.

- Quantitative indicators (e.g., SMART or KPI metrics) should be used to motivate and improve tracking of progress towards the subset of management needs and science actions that can be enhanced through such methods. However, complementary and needed research that is less amenable to quantitative tracking may not benefit from such metrics if they limit innovation or if the feasible (measurable) metrics are only weakly aligned with the primary research goals. As one example, social science groundwork, which is needed to design effective behavioral interventions, may not be well-served by such metrics.
- Engaging more social scientists in the future, including as reviewers on draft final products, would likely improve the framing of social science questions and, hopefully, integration of social science across diverse management needs.
- The separate climate change section appears repetitive. It could be better in future rounds to recognize that climate change effects need to be integrated across all research questions. Also, the CA science enterprise can leverage existing institutions to generate some of the basic climate change projections needed and thereby narrow their focus to CA-specific questions that would not otherwise be addressed.
- It could be clearer as to how you do or could use external partnerships (e.g., NCAR could do climate predictions, NOAA RISA)? Are you trying to do too much that is strictly internal to CA agencies?

5.2 PROCESS

- The draft was generally clear in explaining how progress was made on the current SAA and how this informed development of the new SAA. The measurement of progress, however, was subjective, and a statement of performance benchmarks for the 2022-2026 science actions would add more rigor for future evaluation. The discussion of various projects that used the SAA as a guide was helpful but most of those projects were funded by or with the science program that used the SAA as a criterion for funding. Therefore, this result seems to be a bit of a confounded experiment. Assessment of progress could be improved by evaluating which actions are completed at the end of 4 years and by identifying other meaningful metrics of progress.

- We recommend that the process of reducing the number of management needs and science actions from the initial large list be re-evaluated to identify the level of specificity that is most useful for spurring action. The process of lumping a number of related 'actions' into more general categories makes them largely undoable in 4 years.
- The document could be structured to make the science suggestions more actionable. A 1-2 page description and action plan for each science action would describe a) who is responsible, b) who else is involved, c) who is funding, d) what scientific approach(es) are to be taken, e) what has been done so far, and f) what kinds of products and time lines are expected. This kind of appendix material could essentially become a contract for accomplishment.
- The co-production process needs to be constructed in a way that is less sensitive to the participation rates. The process was clearly challenged by Covid-19 restrictions that limited the time for both informational presentations and group discussions. As a result, small group discussions could have been more effective at identifying key concerns and characterizing the degree of consensus on concerns.
    - An alternative structure to conducting prioritization, such as a Delphi technique, might be preferable for prioritizing concerns in the future through a facilitated process and systematic combination of surveys and discussions that 1) organize research priorities by goals, 2) promote deep thinking by individuals, and 3) enable group refinement of ideas. (See Appendix for more detail).
- The co-production process emphasizes a highly "inductive" approach to developing management needs and science action priorities. However, the process could also be balanced with some additional "deductive" guidance from the Delta Science Plan and State of Bay-Delta Science, alongside the Progress Summary from the previous SAA. The contributions of these documents to establishing goals and criteria for guiding the prioritization process could be made more explicit in the future. This will also help connect to adaptive management goals as noted above.
- We recommend the SAA developers conduct a "post mortem" of this SAA. This first effort to assess progress on the prior SAA is impressive. Future

efforts could seek to systematically identify and address weaknesses and potential improvements in terms of process and scientific results.

6 APPENDIX A. CLARIFICATIONS, MINOR ISSUES AND QUESTIONS

- What impact, if any, does the new White House (federal) focus on indigenous people have on the Delta activities? It seems that the environmental justice principles (page 26, which are never articulated in the SAA), values of Delta communities, and traditional ecological knowledge incorporation into the Delta science enterprise might benefit from this federal focus by supporting management activities and policy decision-making in the Delta.
- The collaboratory is an interesting proposal but requires some thoughtful deliberation and negotiation before launching. Its description in Table 1 is only part of the science and governance concept that was discussed at the SNA. Is it wise to use the word collaboratory in Table 1, given the premature status of the idea? We also recommend that the highlight on page 19 be deleted.
- Additional details on a potential modified Delphi process that includes direct, facilitated negotiation are (from Wolfe et al. 2017):
    - Have a facilitator work with independently with the resource managers, scientists, and key stakeholders in the Delta.
    - Have that group create a tangible, though interim and "living," product (e.g., a preliminary integration framework or conceptual model of the entire Delta systems that can be used in an adaptive management approach to identify priority science actions).
    - Elicit input first from resource managers and key stakeholders on the framework (or its necessary dimensions and components) and then from the scientists. Have the scientists propose indicators that, collectively, provide comprehensive and useful metrics that serve as a basis for improved environmental management.
    - Direct, facilitated negotiation: Have a meeting (or meetings) that includes both groups to finalize framework.
- Representative photos and captions providing context are needed: Each of the photographs located side by side of the management needs can include a quick reference to enhance its relevance. For example, how Regional San's

upgrades represent integration of large (plant)-scale experiments, data collection, and evaluations. It is unclear that low water level in Shasta Lake water on a given day is a representation of climate change impacts; a better plot on climate problems would be an eye-catching graph showing suitably averaged water level variation over several decades.

- In the tables that show the existing gaps relative to each of the science actions (starting on page 20), there are several references to building on "progress made" from the past SAA. To some degree, this leaves the reader with the impression that many current science actions are focused on areas where progress has already been made, rather than areas where there has been limited progress.

7 REFERENCES

Wolfe AK, VH Dale, T Arthur and L Baskaran. 2017. Ensuring that ecological science contributes to natural resource management using a Delphi-derived approach**.** Chapter 6 in (MJ Paolisso, Ed.) *Participatory Modeling in environmental decision-making: Methods, tools, and applications.* Springer: New York, pages 103-124. https://link.springer.com/chapter/10.1007/978-3-319-25053-3_6