

Delta Science Funding and Governance Initiative

Implementation Report



DELTA STEWARDSHIP COUNCIL
A California State Agency

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Executive Summary and Request to DPIIC

The white paper, *Funding Science to Meet Tomorrow's Challenges* (Appendix 3), highlighted critical needs for effective science, including more consistent and reliable funding for science, and a better understanding of what we're funding, why we're funding it, and what level of funding is needed to adequately support science to inform robust decision-making in the Delta. At its April, 2019 meeting, the Delta Plan Interagency Implementation Committee (DPIIC) endorsed the white paper, including the problem statement and recommendations. DPIIC directed the Delta Science Funding and Governance Initiative (Initiative) to expand its workgroup and return with actions to implement those recommendations.

This report reflects the Initiative's intensive effort to broaden its participation base and deliver these specific, time-sensitive actions to implement the white paper's recommendations.

This document also reflects the Initiative's responses to the Delta Independent Science Board's (Delta ISB) letter to DPIIC in February 2019 (Appendix 4), highlighting the need for forward-looking science. As the Delta ISB pointed out in its letter, the Delta science enterprise¹ needs to strengthen its foundation in order to be able to respond to a rapidly changing environment: "Moving forward will require scientific leadership and vision, identification of major scientific priorities, and organizational and funding structures to greatly enhance interagency science integration." In other words, the Delta ISB says it's time to look at our problems differently.

To take a phrase from the Governor's Water Resilience Portfolio Executive Order (N-10-19), these implementation actions are "necessary and possible." The Executive Order's emphasis on the need for a "broad portfolio of collaborative strategies" and the need for increased interagency coordination is not just necessary and possible for a resilient water future but also for a resilient science enterprise; we can't have the former without the latter. Science is foundational to improving resilience and guiding adaptation.

The Delta Stewardship Council (Council) and Delta Science Program are committed to working with DPIIC agencies to strengthen alignment of research priorities and funding among state agencies in support of a shared body of scientific knowledge. The DPIIC can serve as the collaborative venue to implement actions recommended here, including identifying both current and longer-term management questions to address water resilience and science investments, as well as how these questions may evolve with climate change and other future changes.

Three actions were identified as highest priority because they are essential to further the development of a comprehensive, integrated, and forward-looking science enterprise, including

¹ Science Enterprise: The broad collection of science programs and activities that exist to serve managers and stakeholders in a regional system. This includes agency science programs, academics, NGOs, and the private sector.

providing long-term, sustainable funding. These three actions will help to develop a well-informed foundation from which to build and strengthen the rest of the enterprise.

The Initiative requests that DPIIC endorse the following immediate actions and commit to participating in their implementation:

- *Implement common accounting and reporting protocols and coordinate a critical review of science funding in the Delta;*
- *Support and participate in an update of the Science Action Agenda, of which the first step would be to collaboratively identify and prioritize current management questions² for addressing water resilience and science investments; and*
- *Conduct a workshop to assess the science needs in the Delta under a rapidly changing environment.*

Background and Report Organization

At the 2017 State of the Estuary Conference, a panel of leaders in Delta science and policy discussed the outcomes and lessons from the 2016 Science Enterprise Workshop. The main topic of discussion was how to adequately fund science in the Delta to support robust decision-making. In response, the Initiative was launched to build on current efforts that promote coordinated science such as the Delta Science Plan. The role of this collaborative Initiative was to improve the tracking, support, and funding of Delta-related science and ensure the development of action-oriented recommendations for implementation by decision-makers.

Following DPIIC's endorsement of the white paper, the Initiative divided into four advisory sub-groups (see Appendix 2 for the membership of each sub-group) to address implementation. Each sub-group was given a specific recommendation (including those found in the Delta ISB's letter to DPIIC) and asked to identify priority actions to implement each of the recommendations. The four sub-groups convened multiple times, and their full reports are included in Appendix 1.

Actions and Timeline

All of the actions identified by the four sub-groups are important and necessary. There are, however, a few actions that have been recognized as essential to building long-term, sustainable funding and to further developing a comprehensive and integrated science enterprise. We are calling these Tier 1 actions. Tier 1 actions also include a general timeline for completion and greater detail than the other actions, given the immediate focus of the work ahead. Tier 2 actions are priority actions that have already begun and in some instances have been on-going for some time with substantial progress to date. Finally, Tier 3 actions are important and need to be addressed, but given the high-priority work

² Management Question (from the Delta Science Plan): High-level questions posed by natural resource managers (e.g., how does this variable effect the ecosystem? As opposed to when is the best time to treat for certain vectors?).

that needs to occur first, should wait for implementation. For all actions, please refer to the individual sub-group reports (Appendix 1) for greater context.

Tier 1 Actions – Priority Actions Requiring Immediate Focus

These actions rose to the top due to the role they play to improve understanding of where we are in terms of funding, reducing redundancy, identifying gaps, and providing a degree of accountability. These actions are essential to building a base of shared understanding from which we can then implement the other actions identified in this paper.

- Immediately: Increase our understanding of science funding via:
 - Implementing common accounting and reporting protocols. Develop an annual Delta Crosscut Budget of science expenditures and obligations by the DPIIC agencies and other organizations that fund science (such as local public water agencies and non-governmental organizations) that is credible and allows for an accurate assessment of science funding in the Delta to address management or decision-making needs. Sub-group 1 has reviewed existing efforts to quantify financial investments in the Delta, developed a template (see appendix A to sub-group 1's report), and begun working with DPIIC member agencies to complete this action. Upon completion of year 1, sub-group 1 will re-convene to fine tune the template and identify best practices to assist agencies in completing the Delta Crosscut Budget annually. *The Council with assistance from the U.S. Bureau of Reclamation and sub-group 1 will take the lead in gathering this data annually, but the DPIIC agencies will be asked to assign staff to fulfilling this request.* (Rec. 1.1)
 - Coordinating a critical review of science funding in the Delta. To implement this action, there need to be clear goals and deliverables on what a critical science funding review should achieve. *Upon implementation of year one of the Delta Crosscut Budget, Sub-group 1 will reconvene to develop a scope of work for this critical review.* (Rec. 1.3)
- 2020-2021: Support and participate in an update of the Science Action Agenda (SAA). The 2017-2021 SAA identified the gaps in Delta science and supporting actions that would glue the disparate pieces of this complex enterprise together to advance the vision of *One Delta, One Science*. For the 2022-2026 update, there will be broader stakeholder engagement and an increased emphasis on connecting science with key policy and management questions. A first step in the development of the updated SAA will be to identify current management questions, with substantial agency and stakeholder participation. This action should also be developed in close coordination with the ongoing Voluntary Agreement process for the Bay-Delta and will incorporate the Delta Agency Science Workgroup. *The Delta Science Program will take the lead in this action, but full DPIIC and stakeholder participation is necessary to ensure success and buy-in via the convening of the Delta Agency Science Workgroup and other outreach and participation methods.* (Rec. 2.1)

- Spring 2020: Support and participate in a 2.5 day workshop to identify a) key science needs to provide long-term management insights in the context of rapidly changing environments and b) recommendations for organizing a forward-looking science enterprise that will be equipped to address such complex and changing problems. Following the workshop, the conference organizing committee will develop a report outlining recommendations on needed science priorities, infrastructure, and governance based on the workshop. *The conference organizing committee, coordinated by the Council, has been formed; DPIIC agencies will be asked to partner in workshop implementation, sponsorship, and funding.* (Rec. 4.1)

Tier 2 Actions – Priority actions already underway

- Fill and create permanent analysis and synthesis positions at federal, state, regional, and local agencies to make efficient use of current research and data and to develop a framework for future use. (Rec. 3.3)
- Develop the Delta Science Tracker as a tool for tracking science funding. (Rec. 1.2)
- Develop best practices for Policy-Science Forums to improve the effectiveness of communications and the interchange of information. (Rec. 2.1)
- Prioritize transparency and best practices for applying decision-support tools. (Rec. 2.2)
- Develop protocols and consider actions to implement recommendations based on the reviews of the effectiveness of monitoring following the completion of two current Delta ISB reviews. (Rec. 2.3)
- Use the topic-specific science implementation plans noted in the Delta Science Plan to identify currently available sources and uses of funds as well as the significant funding gaps in order to quantify the incremental need for consistent, long-term funding. (Rec. 3.1)
- Endorse (and apply through budgeting and grant making) protocols and best practices for collecting, formatting and entering data to be accessed and used immediately, consistent with the Open and Transparent Water Data Management Act (AB 1755). (Rec. 3.3)
- Promote improved communication among managers, regulators, operators, and scientists, including pre-publication communication of results to aid in timely decision making and establish mutual understanding for actionable reports. (Rec. 3.4)
- Outline funding sources dedicated to scientific study in similar systems to support the need for equitable federal funding, potential philanthropic solicitation, and matching opportunities. (Rec. 3.2)

Tier 3 Actions – Important and necessary, but should wait until Tier 1 and Tier 2 actions are more established

- Establish equitable principles for incremental science enterprise funding that are agreed upon among agencies and stakeholders. (Rec. 3.2)

- Identify additional potential sources of consistent, long-term science funding that can reach beyond mitigation science and include data analysis, synthesis, communication of findings, and adequate response to the impacts of climate change and future threats in a rapidly changing Delta. (Rec. 3.2)

Next Steps

With DPIIC's endorsement, the DPIIC agencies, under the leadership of the Council, will be able to engage more fully in the successful implementation of these actions. The planning required to implement all of the immediate actions is already underway, and we anticipate reporting progress on these action regularly to DPIIC.

As this work progresses, we anticipate that this work will support other aspects of the greater Delta science enterprise. Namely, how this kind of effort can better integrate restoration and science and better fund restoration over the long-term.

There is also a need to look beyond the Delta, downstream to the Bay as well as upstream to the upper watershed. Keeping our eyes and our minds open to how we can better incorporate the entire watershed will help all of our work and make for a more resilient water future.

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APPENDIX 1: SUB-GROUP REPORTS

EFFICIENCY: SUB-GROUP 1 REPORT

Executive Summary

There currently is not a reliable or consistent source of information on how much is annually expended on synthesis, monitoring, and research in the legal Sacramento-San Joaquin Delta and Suisun Marsh (the Delta) across various agencies, nor a comprehensive repository of all these science activities that occur in the system. This makes it difficult to evaluate whether funds are being used effectively and whether additional funding is needed for these activities. To address this issue, DPIIC endorsed the implementation of the recommendations from the white paper (*Funding Science to Meet Tomorrow's Challenges*) to standardize accounting and reporting protocols across agencies, to support a web-based system to track science activities, and to coordinate an independent review on science funding.

To address these recommendations, sub-group 1 of the Initiative developed the Delta Science Funding Crosscut Budget (Delta Crosscut Budget) template (see Appendix A to this report), which will be applied and refined over time to provide an annual report of science activities similar to the Platte River Recovery Implementation Program. The template provides a consistent format to track obligations and expenditures from July 1 to June 30 for monitoring, research, and synthesis in the Delta. The template will track funding across the State and Federal agencies of the DPIIC, along with other organizations that fund science, including local/regional agencies (e.g., public water agencies, city, county, etc.), non-governmental organizations, universities, industry, and private contractors. Individual agencies that provide funding on these science activities would report information through the Delta Crosscut Budget template every November, and a compiled annual Delta Crosscut Budget would be available by the ensuing December with a statement on the level of accuracy of what is being reported.

In the first few years, a representative from DPIIC, with assistance from United States Bureau of Reclamation (Reclamation), would need to manually compile the information generated from individual agencies. However, the Delta Science Tracker, a web-based tool, that is being developed by the Council to track information on current science activities could be used to catalog funding information from the template and automatically generate the annual Crosscut Budget and report.

Together, the Delta Crosscut Budget and the Delta Science Tracker will provide the mechanism to assess funding on monitoring, research, and synthesis. At this time, the Council has the resources to develop and maintain the Delta Science Tracker, and the Crosscut Budget template has already been developed through the voluntary collaboration of sub-group 1. Support from all the DPIIC agencies is necessary to ensure that adequate staff resources are provided to complete the Crosscut Budget, and subsequently, the Delta Science Tracker.

Prior to the DPIIC meeting in November 2019, sub-group 1 will seek feedback from staff of the DPIIC agencies and other interested stakeholders on the feasibility of providing information to complete the Crosscut Budget. The Crosscut Budget, along with the completion of other near-term deliverables from the Initiative, will help inform the scope and goals for an independent review on how current monitoring, research, and synthesis efforts are addressing management needs, and how science is funded in the Delta.

Subgroup Charge

Sub-group 1 was charged with identifying actions for the implementation of recommendations from the white paper related to a need for shared, rigorous mechanisms to critically assess science and monitoring efforts:

- 1.1: Establish common accounting and reporting protocols
- 1.2: Support the web-based tracking system, known as the Delta Science Tracker, identified in the Delta Science Plan
- 1.3: Coordinate a critical review of science funding in the Delta

Problem Statement

The need to accurately quantify science-related expenditures across agencies or to develop a web-based tracking system to catalog funding information are not new ideas or recommendations. Over the years, there have been many attempts to quantify science-related expenditures and projects in the Bay-Delta. In 2004, the CALFED Bay-Delta Authorization Act (Public Law 108-361) authorized Federal agencies to participate in the California Bay-Delta Authority that oversaw the CALFED Bay-Delta Program, as non-voting members. Pursuant to Public Law 108-361, the Office of Management and Budget (OMB) within the Executive Office of the President of the United States must prepare an annual crosscut budget of all State and Federal expenditures and obligations in the Bay-Delta (Section 106) and submit an annual report every February on the implementation of the different components of CALFED Bay-Delta Program, which includes water quality, ecosystem restoration, levee system integrity, and water supply reliability (Section 105).

Although the CALFED Bay-Delta Program is no longer in effect for the State, Public Law 108-361 is still part of Federal law. OMB continues to prepare an annual crosscut budget of all Federal activities (see OMB 2019 for the Fiscal Year 2020 Crosscut Budget), but the State no longer provides its financial information as a part of this effort. Even so, rough estimates have been compiled in recent years on State and Federal expenditures using the California Bay-Delta Crosscut and the State budget; the information is even used to compare funding levels in other regions (Tennefoss 2018; Council and USGS 2016). Nevertheless, there are concerns about the accuracy of these figures that have been cited in various reports.

For example, the United States Government Accountability Office (GAO) in reviewing the coordination and implementation of restoration efforts in the Bay-Delta assessed the reliability of the information provided in the California Bay-Delta Crosscut Budget and found that the information was not reliable for tracking expenditures, capturing the extent of all projects, aggregating funding levels across programs, or comparing funding levels of various agencies (GAO 2018). It was only reliable for reporting the magnitude of funding for individual agencies. This is due to the lack of written guidelines, which have not been updated since 2011, and has resulted in inconsistent reporting among the different agencies. Not having reliable information makes it difficult for congressional and other decision-makers to assess the appropriate level of funding for the Bay-Delta.

While drafting the white paper, the authors attempted to quantify the amount of funding that goes to monitoring and research in the Delta across various agencies. Many agencies provided the information, but confidence in the accuracy of the sum of the responses was low, in part because 1) not all agencies responded; 2) there were different interpretations of what the categories of funding meant (e.g., compliance, decision-support, or emerging); 3) some funds appeared to have been double-counted (e.g., both the funding and implementing agency included the same funds), and 4) there was uncertainty over whether agencies were reporting obligations or expenditures. Due to these concerns, the information collected was not presented in the white paper.

Recommended Actions

Action 1.1. Establish Common Accounting and Reporting Protocols

The ultimate goal of implementing Action 1.1 is to have an annual crosscut budget of science expenditures and obligations from the DPIIC agencies and other organizations that fund science, such as local agencies (e.g., public water agencies) and non-governmental organizations, that is credible and allows for an accurate assessment on science funding in the Delta to address management or decision-making needs (Action 1.3).

To move forward with standardized protocols and an interagency crosscut budget template on science expenditures, subgroup 1 began reviewing existing efforts to quantify financial investments in the Delta to brainstorm ideas for a template and to understand challenges associated with these efforts. This included the California Bay-Delta Crosscut Budget described above, and the Department of Water Resources (DWR) and Reclamation's Biological Opinion Coordination Team (BOCT) Cost Share Agreement (2018) that established standardized accounting and reporting protocols to track costs and identify funding to implement the requirements in the biological opinions for the long-term operations of the State Water Project (SWP) and Central Valley Project (CVP). In addition to reviewing efforts within the Delta, the subgroup also reviewed crosscut budgets from other programs from across the United States, which included the Chesapeake Bay Restoration Program, the South Florida Ecosystem Restoration Program, and the Platte River Recovery Implementation Program. Based on a review of existing crosscut budgets and brainstorming sessions on what level of financial detail is needed, sub-group 1 drafted the Delta Crosscut Budget template that would track the

obligations and expenditures of individual projects according to the five categories of science activities developed in the white paper with refinements for clarity.

- Core monitoring: Monitoring that provides information on a seasonal and daily basis to inform specific decisions, such as operations for water supply and fish species actions. Core monitoring is conducted almost entirely to fulfill requirements for regulatory compliance.
- Status and trends monitoring: Monitoring that contributes to long-term datasets used to compare environmental conditions (e.g., species populations, water quality) over time. Information improves system understanding and can be applicable to a variety of management decisions rather than a specific action. Status and trends monitoring is primarily required for regulatory compliance, although it may also be associated with non-regulatory efforts.
- Synthesis: The combining of diverse information from multiple sources into one concept, model, finding, or report. Synthesis can take many forms from (1) analyzing and integrating data across multiple datasets (2) to summarizing findings across a range of sources to help support decision-making needs.
- Targeted foundational research: Science efforts that provide the knowledge and context to inform long-term management and policymaking, while also identifying and understanding emerging issues, so that natural resource managers can be better prepared for future challenges. This is not typically supported by funds allocated for science efforts linked to regulatory requirements.
- Targeted immediate research: Science efforts that answer current management questions by providing evidence to support or refute hypotheses. This is not typically supported by funds allocated for science efforts linked to regulatory requirements.

When deciding on the categories for the template, there was discussion among sub-group 1 participants on whether to reduce the categories to just monitoring, research and synthesis, or expand the five categories further. At this stage, the template tracks all five categories, as these definitions were endorsed by DPIIC. The Interagency Ecological Program (IEP) also uses similar definitions for tracking projects and funding in its annual work plan (see IEP 2018). The categories could be reduced in the future, however, if the information provided from all five categories is not well utilized or if there are difficulties with categorizing projects using these definitions. Since it is easier to combine categories than to split them apart after the financial information has been collected, the template begins with all five categories initially.

To determine the financial integrity of the financial information submitted, there was agreement that the Code of Federal Regulations (CFR) 200 (Uniform Administrative Requirements, Cost Principles, and Audit Requirements for Federal Awards) would be the base of reporting. The budget template would allow for the tracking of individual projects by type of monitoring and research (see above), funding source (e.g., General Fund, Proposition 1, etc.) and the percent reimbursable by water users of the CVP/SWP, which were key areas of interest of sub-group 1. In addition to compiling budgetary information, the goal is to also compile project descriptions (which can just be taken directly from the scope of work for a contract or study plan) to produce a report similar to the Platte River Recovery Implementation Program.

The template would be filled out by the agency that appropriated the funding to implement the work and not the implementing agency; this will avoid “double counting” of the same funds. Even so, the funding and implementing agencies may not clearly differentiate these roles, so coordination will be needed between the agencies to assure the credibility of the aggregated data. In the initial application, only science projects in the Delta would be covered in the Crosscut Budget. If a project includes the Delta as well as other parts of the Delta watershed, then the full expenditures and obligations for the science project can be reported. For example, the IEP’s Environmental Monitoring Program (EMP), which monitors water quality, phytoplankton, zooplankton and benthic organisms in the upper San Francisco Estuary (DWR 2012), covers the Delta and other areas outside of the Delta (e.g., San Pablo Bay). DWR and Reclamation who provide funding to the EMP would report all of the expenditures rather than attempt to estimate and isolate the portion devoted to the Delta.

As the Crosscut Budget is focused on just the Delta, and on monitoring, research, and synthesis, it is not intended to satisfy the requirements of the California Bay-Delta Crosscut Budget under Public Law 108-361, which covers the full Bay-Delta watershed. However, it will help supplement the California Bay-Delta Crosscut Budget and re-engage the State with providing financial information, as recommended by GAO (2018). In the future, there is interest to eventually expand the geographic scope of the Crosscut Budget throughout the watershed (“from timbers to tides”) to capture science projects supporting adaptive management of the Voluntary Agreements.

Furthermore, there is interest to expand the Delta Crosscut Budget to track the funding of restoration projects in the future. The definitions from the white paper would only capture the synthesis, monitoring, and research that goes into a restoration project (e.g., pre/post restoration monitoring or research to inform the design of a restoration project). It would not capture the funding to construct a project, prepare environmental documentation, or perform maintenance on a project. This could, however, be expanded in the future through the Delta Science Tracker.

Although a template has been drafted, it needs to be refined through dialogue with the major agencies that fund Delta science and those agencies will have to provide the information requested in the template. There is the possibility that the agencies do not have the staff resources to gather and format the information, or their accounting systems cannot produce the template information. Given these possible hurdles, Reclamation will share the draft template before the DPIIC meeting in November 2019 with staff of the DPIIC agencies and other organizations to solicit their thoughts on the feasibility of providing the information now or in the future, to provide implementation support, and to refine the draft template.

In the end, the goal is to submit an annual report which includes the Delta Crosscut Budget to DPIIC that covers the State fiscal year (July 1 to June 30) by December 2019 (and every December thereafter). Given current workloads, this will not be an effortless task for agencies on different fiscal year cycles or due to reporting constraints. However, it would provide a greater level of accuracy in reporting. If this is not possible, then the entity may report to its own fiscal year (e.g., the Federal fiscal year is from October 1 to September 30), or use the best available fiscal information, which would be documented in the annual report.

The Crosscut Budget will include a description of the level of accuracy or reliability in the figures. The first Crosscut Budget and annual report is meant as a work in progress that may not have all of the funding captured, but would increase in both agency coverage and accuracy in subsequent years. The first annual report is meant to illustrate what is possible now and what can be achieved in the future. For 2019, a few agencies have already indicated that they will not be able to provide the level of financial detail requested by November, but will strive to in the future.

Action 1.2. Support the Web-Based Tracking System (Delta Science Tracker)

The budget template that has been prepared will be used to inform the type of financial information that the Delta Science Tracker will catalog and help inform the Council's Request for Offer (RFO), which will be released at the end of 2019, for a vendor to assist with the development of the web-based tool. The Delta Science Tracker is meant to go beyond just synthesis, monitoring and research; it may also capture information on restoration efforts. In addition to cataloging information on funding, the Delta Science Tracker can also store other project-related information, such as the entity conducting the activity, the purpose of the activity, and potentially link projects to the management or science questions identified or endorsed by DPIIC, such as the Science Action Agenda (Council 2017) or those identified through the Initiative.

The Delta Science Tracker should be operational within a few years. Eventually, the individual agencies can provide information to the Delta Science Tracker, which can automate the annual Delta Crosscut Budget and report. This will reduce the workload for manually compiling information from individual agencies. There have been many attempts to develop different project-tracking systems in the Delta with differing levels of success. Like with the development of the Delta Crosscut Budget template, the Council should ensure the vendor selected considers "lessons learned" from past efforts and determines how the Delta Science Tracker fits in with existing web-based tools that track project information. Some current examples to consider include the Central Valley Monitoring Directory (now defunct), DeltaView (and its predecessor the CALFED Project Performance Information System), EcoAtlas, Bay-Delta Live, and the Delta Monitoring Enterprise Review Inventory Tool (in development; Delta ISB 2017).

Many of these web-based tools share common challenges, such as difficulties with ensuring the information is complete or up to date because it requires voluntary actions of partnering agencies (e.g., DeltaView and EcoAtlas), and not having a sustainable source of funding to maintain the tool in the long run (e.g., Central Valley Monitoring Directory). As the Council prepares the RFO, it should determine how the Delta Science Tracker will integrate with existing project-tracking tools and overcome the challenges that other project-tracking tools have faced. The Council will be forming a multi-agency advisory team in the fall of 2019 to help inform the scope and implementation of the Delta Science Tracker. The Council should work with the advisory team and discuss having a mechanism in place, such as incentives, a Memorandum of Understanding (MOU), a contract, or a regulatory requirement, to ensure the information is kept-up-to-date in the Delta Science Tracker.

In addition, the Council released a user-needs assessment in June 2019, which will help guide the development of the tool. The Council likely has the funding and staff resources to develop and maintain the Delta Science Tracker, but would need the partnership and support from the DPIIC agencies and stakeholders to ensure the project information is up to date. Additional funding sources beyond the Council may be needed to maintain the Delta Science Tracker if there is interest to expand the geographic coverage to the full Bay-Delta watershed, which is outside the jurisdiction of the Council.

Action 1.3. Coordinate a Critical Review of Science Funding in the Delta

The annual Delta Crosscut Budget and report (Action 1.1), along with the Delta Science Tracker (Action 1.2), will provide the data necessary to conduct a comprehensive assessment of science funding and the efficiency on the use of those funds. It would document the science activities in the Delta, which could help with the implementation of the Initiative's recommendations to better link science and management, and establish the base funding when seeking additional funding for science that goes beyond CVP/SWP funding. However, it may not resolve whether current synthesis, monitoring, and research efforts are serving decision-making needs, or how to improve inefficiencies with funding science (e.g., there are huge disparities with what is expended and obligated; See Appendix B of this sub-group report). An independent review on how current science projects are addressing management needs, and how science is funded in the Delta could provide useful insight to improve the Delta science enterprise.

To implement Action 1.3, there needs to be clear goals on what a critical science funding review should achieve. In order to pursue this review, it would require key deliverables from the Initiative, such as which management questions to use to evaluate projects, and the science that needs to occur to answer these management questions. Upon implementation of year one of the Delta Crosscut Budget, sub-group 1 will meet to begin developing a scope of work for this effort and will be coordinated as much as possible with the updated SAA and the science needs assessment workshop.

In addition, the review on science funding should build upon the review of the Delta ISB on whether monitoring is serving the needs of management agencies, whether there are areas for improved coordination, and whether there are any gaps or overlaps in monitoring (Delta ISB 2017). This review began in 2017 and is expected to wrap up in 2020. As the Delta ISB's review is focused on monitoring, a DPIIC facilitated review could focus on how well research and synthesis efforts are meeting management needs. In addition, the Delta ISB's review will not assess how science is funded to address management needs, which is of key interest to DPIIC. Examples of potential review questions on how science is funded and the documentation needed for the review can be found in Appendix A to this sub-group report.

Timeline and Resource Assessment

A timeline for completing major deliverables are in the tables below. There have been sufficient staff resources to develop the draft template for the Crosscut Budget based on the voluntary collaboration of sub-group 1. In addition, the Council has the resources to hire a vendor to assist with the development of the Delta Science Tracker. However, DPIIC's member agencies must provide the staff resources to provide the information that is needed to fill out information from the Crosscut Budget and provide project-related information for the Delta Science Tracker on a continuing basis. DPIIC's example can also help encourage non-DPIIC agencies to provide its information.

The cost of a science funding review will depend on the scope of the review. Based on past science reviews of the Delta Science Program, an independent review could be as low as \$36,000, which would involve individual comment letters from three panelists and no public facing meeting (~\$12,000 per panelist for 60 hours of work), to over \$1 million, such as the Delta ISB's review of the monitoring enterprise (Delta ISB 2017). Typically, science reviews cost about \$35,000 per panelist and would include a public facing meeting. If the review consists of six panelists, it would cost over \$200,000.

Action 1.1 Deliverables

Deliverable	Tasks	Responsible Party	Estimated Date of Completion
1. Delta Crosscut Budget Template and Protocols	<ul style="list-style-type: none"> • Draft a budget template and protocols for filling out the template on what is expended and obligated for synthesis monitoring, and research. • Identify the DPIIC representative who will compile information from the agencies. 	Sub-group 1	<p>Completed, July 2019</p> <p>The Council with assistance from Reclamation will serve as the representative.</p>
2. Point of Contacts List and Refined Budget Template	<ul style="list-style-type: none"> • Identify point of contacts from the DPIIC agencies (State and Federal) and other organizations that can provide the information requested in the template (see Deliverable #1). • Seek feedback on draft template and modify template, as needed. • Determine if agencies can provide information on the prior year's expenditures (July to June) by November. 	Reclamation	August 2019
3. Completed Template from Individual Agencies	<ul style="list-style-type: none"> • Individual point of contacts from the different agencies provide financial information using the Crosscut Budget template and protocols. 	All DPIIC Agencies and Stakeholders	November 2019 (and every November thereafter)

Deliverable	Tasks	Responsible Party	Estimated Date of Completion
4. Annual Crosscut Budget and Report	<ul style="list-style-type: none"> • Compile information from Deliverable #3. • Perform quality assurance and control to ensure no double counting of funds. • Submit report to DPIIC. 	DPIIC Representative	December 2019 (and every December thereafter)
5. Revised Annual Crosscut Budget Template and Protocols	<ul style="list-style-type: none"> • Based on “lessons learned” from the 2019 Crosscut Budget and report, revise template and protocols. • Send revised template out to the agencies and request financial information on what has been expended from July 1, 2019 to June 30, 2020. With this notification, individual agencies provide the financial information to complete Deliverable #3. 	DPIIC Representative	June 2020 (and every June thereafter)

Action 1.2 Deliverables

Deliverable	Tasks	Responsible Party	Estimated Date of Completion
6. Form Advisory Team	<ul style="list-style-type: none"> • Form an advisory team from the agencies and stakeholders of DPIIC that can assist with the development and implementation of the Delta Science Tracker. 	Council	Fall 2019
7. RFO	<ul style="list-style-type: none"> • Release a RFO to select a vendor to develop the Science Tracker. • Prior to releasing the RFO, should consider the budget template and how the Science Tracker fits in with other project-tracking tools. <ul style="list-style-type: none"> ○ Should also have a mechanism in place to ensure the information in the Science Tracker will be kept up-to-date and consider the long-term operations and maintenance of the tool. 	Council	End of 2019
8. Award Contract	<ul style="list-style-type: none"> • Upon reviewing the offers, select and contract with a vendor to develop the Science Tracker. 	Council	Summer of 2020
9. Delta Science Tracker	<ul style="list-style-type: none"> • Within two years, a functional Science Tracker should be in place that would help with producing the annual crosscut budget and report (Deliverable #4). 	Council	2021+

Action 1.3 Deliverables

Deliverable	Tasks	Responsible Party	Estimated Date of Completion
10. Science Funding Review Scope of Work	<ul style="list-style-type: none">• Upon implementation of the first year of the Delta Crosscut Budget, sub-group 1 will reconvene to develop a scope of work.• Scope of work should describe goals for the review, questions to the panelists, entity facilitating the review, what agencies will participate, timeline, and funding for the review.<ul style="list-style-type: none">○ Appendix A could be used to help inform the scope of work.	Sub-group 1	Fall of 2020

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Appendix A: Delta Crosscut Budget Template

Below are the reporting instructions for filling out the draft Delta Crosscut Budget template, which is an Excel table. For the actual template, please e-mail Amanda.Bohl@deltacouncil.ca.gov.

1. Reporting period is from July 1, 2018 to June 30, 2019 (FY 19).
2. Contract refers to all types of financial instruments (e.g., Grants, Interagency Agreement, and Service Contracts).
3. Person Year (PY): labor costs by individual in support of the program, not associated with a contract
4. Report projects that take place in the legal Delta and Suisun Marsh (the Delta).
5. The base of reporting is the Code of Federal Regulations (CFR) 200 (Uniform Administrative Requirements, Cost Principles, and Audit requirements for Federal Awards)

Column Header	Explanation	Example
A: Project ID	Unique identifier that ties several different contracts across all agencies with the same end date.	DOP – Directed Outflow Project
B: Project Title	Contract title	
C: Primary Purpose - Delta Science Funding and Governance Initiative	Primary purpose of the Contract – Select from the Drop Down	Select: Core Monitoring OR Status and Trend Monitoring OR Synthesis OR Targeted Foundational Research OR Targeted Immediate Research
D: Secondary Primary Purpose - Delta Science Funding and Governance Initiative	Secondary Primary Purpose– Select from the Drop Down. Enter information into a different row, if you can breakout the funding by secondary purpose.	Leave blank if this does not apply.
E: Sub-Purpose - Delta Science Funding and Governance Initiative	Sub-Purpose – Select from the Drop Down. Enter information into a different row, if you can breakout the funding by sub-row.	Leave blank if this does not apply.
F: Secondary Sub-Purpose - Delta Science Funding and Governance Initiative	Secondary Sub-Purpose – Select from the Drop Down. Enter information into a different row, if you can breakout the funding by sub-row.	Leave blank if this does not apply.
G: Funding Agency	Your agency acronym	BOR
H: Contract Number or Labor	List the Contract or the Labor Charge code	R19AC00001 for Contract. RX.18527909.0000000 for Labor
I: Vendor	List the name of the contract recipient	Commerce Department

Column Header	Explanation	Example
J: Project Status	Select the Project Status from drop down.	New OR Complete OR On-going
K: Funding Source	Select from the Drop Down the source of funding. Use separate rows when there are multiple or split funding sources.	<ul style="list-style-type: none"> • CBDF= CalFED Bay Delta Fund • Prop 1 • General Fund • ELPL=Environmental License Plate Fund
L: Program Authority	List the Program Authority that is used to fund the Project.	Endangered Species Act
M: Type of Obligation	Select from the Drop Down the Type of Obligation.	<p>Federal obligation types: Miscellaneous Obligation OR Interagency Agreement OR Cooperative Agreement OR Grant OR Labor OR TSC Agreement</p> <p>State obligation types (Taken from the State Contracting Manual): Architectural and Engineering OR Consulting Services OR Grant OR Interagency Agreement OR Joint Power Agreement OR Labor OR Revenue Agreements (Reimbursable Agreements) OR Subvention/Local Assistance OR UC-CSU-UEI-GOV</p>
N: Total FY 19 Obligation	Amount of funds obligated in the reporting period.	Dollar amount
O: Total FY 19 Expenditure	Amount of funds paid in the reporting period.	Dollar amount
P: Reimbursability	List the percentage that is reimbursable per the Program Authority. This field is mainly used to document the percent that DWR and Reclamation reimburses to the water users of the SWP and CVP.	37.5 percent shall be reimbursed as main project features, 37.5 percent shall be considered a non-reimbursable Federal expenditure, and 25 percent shall be paid by the State of California.

Appendix B: Possible Questions for an Independent Panel Review

The table below describes potential questions to the panelists for a review on how science is funded to serve management needs, which could be used to inform the scope of work.

Problem Statement	Questions to Panelists	Documentation Needed
<p>For some organizations, there are huge disparities with what is obligated and what is expended. Oftentimes, funds that are not expended goes back to the originator of the funds (e.g., the State General Fund) and not used for science. However, in some cases, the unused funds can be used for a different science project.</p>	<ul style="list-style-type: none"> • How can we reduce the scale of disparity between obligations and expenditures? • What is the typical scale of disparity between obligations and expenditures in other systems? 	<ul style="list-style-type: none"> • The disparity between what is obligated and what is expended for past Delta projects. • What happened to funds that were not expended from a contract (e.g., went back to State General Fund, used for another project).
<p>Although there are exceptions, the most common practice is to fund a project to the lowest bidder.</p> <p>There are examples of projects that have been delayed by over two years in hopes of getting the “most qualified” rather than the lowest bidder.</p>	<ul style="list-style-type: none"> • Does always going for lowest cost result in the best value to meet decision-making needs? • Are there major differences in products produced by the lowest bidder versus other mechanisms (e.g., non-competitive bid)? 	<ul style="list-style-type: none"> • Documentation on contracting procedures among different agencies. • How many projects were funded through the lowest bidder and how many were funded through an exception/alternative mechanism? • Any “lessons learned” from going with the lowest bidder and through other mechanisms; contracting procedures.
<p>Oftentimes, scientists are not using state-of-the art equipment due to the procurement process, which favors low cost. This makes it difficult for scientists to conduct research and monitoring to address decision-making needs. However, there are exceptions like with projects (e.g., sole sourcing).</p> <p>Even so, there are concerns that through sole sourcing, you may lose out on better services and products.</p>	<ul style="list-style-type: none"> • What are the best practices for procurement to ensure scientists have adequate equipment for monitoring and research? 	<ul style="list-style-type: none"> • Documentation on the procurement process among different agencies. • Any “lessons learned” where experiments or monitoring failed due to equipment issues. • Documentation of what percentage of science gear is “sole sourced.”

Problem Statement	Questions to Panelists	Documentation Needed
<p>There are challenges with determining the appropriate overhead costs, indirect rates and staff not directly working on the project. Some contracts have lower overhead costs, indirect rates, etc. compared to others, which allows more of the funds to go towards the “science.”</p>	<ul style="list-style-type: none"> • What is the typical overhead costs, indirect rates, etc. in other systems? • What are the best practices for setting these rates? • What are the tradeoffs associated with high overhead costs? • How can we reduce operating costs or better manage these costs, so more of the funds can go towards science? 	<ul style="list-style-type: none"> • How are overhead costs, indirect rates, and staff not directly working on the project determined across DPIIC agencies and stakeholders? • How are these terms defined among the different agencies? • What is the typical rate (or range of rates)?
<p>Based on the findings of the Delta ISB, the level of integration and coordination of science in the Delta is not where it needs to be to address rapid environmental change. The Delta ISB recommends exploring alternative organizational structures that may facilitate efficiencies in science funding.</p>	<ul style="list-style-type: none"> • Would the alternative organization structures (e.g., JPA) that have been proposed work for the Delta? • Are there other opportunities for improving efficiencies that does not involve a new organizational structure (e.g., Platte River – Nebraska Community Foundation, which does all the contracting for the Platte River)? 	<ul style="list-style-type: none"> • The product produced by Subgroup #4 who are addressing the Delta ISB recommendations, which may include a proposed alternative structure.

INTERCHANGE: SUB-GROUP 2 REPORT

Executive Summary

This report outlines actions for implementing recommendations from the white paper, *Funding Science to Meet Tomorrow's Challenges* endorsed by DPIIC in April 2019. Sub-group 2 urges that the following actions be taken to address Recommendations 2.1, 2.2, and 2.3 from the white paper:

- Support and participate in an update of the Science Action Agenda (SAA)
- Develop a framework for linking science actions to management needs and monitoring
- Develop best practices for Policy-Science Forums to improve the effectiveness of communications and the interchange of information
- Prioritize transparency and best practices for utilization of decision-support tools
- Develop protocols and coordinate independent, regular reviews to evaluate the effectiveness of monitoring following the completion of two current Delta Independent Science Board (Delta ISB) reviews

Sub-Group Charge

Sub-group 2 was asked to address the issue of ineffective and/or limited interchange between scientists, policy-makers, managers, and the public for informing science funding and management in the Delta. The sub-group was specifically charged with considering how to implement the following recommendations:

- 2.1: Establish effective interchange between decision-makers, stakeholders, and scientists
- 2.2: Promote decision-support tools
- 2.3: Develop protocols to evaluate monitoring programs and the value of information generated

Problem Statement

Multiple collaborative venues exist in the Delta science enterprise, but coordination and communication between these venues, and with stakeholders is often ineffective and/or limited. This results in inconsistent understanding of science and management needs, expectations, and outcomes. Without clearly articulated management and science needs and consensus around those needs, it is difficult to establish science funding priorities. Furthermore, we are missing opportunities for better understanding and learning by not engaging with stakeholders more effectively. Without effective interchange of information, there continues to be wide variations in knowledge about important Delta factors, inhibiting our ability to collectively work toward solutions.

Decision-support tools, such as life-cycle models, conceptual models, analytical models, and other process models (e.g., structured decision making), are effective for explaining complex relationships between stressors, actions, and responses. They can also be important communication tools. Despite the recognized value of these tools, they have not been consistently integrated into our common practices.

There are many applications of monitoring including addressing uncertainties, supporting adaptive management, informing status and trends analyses for the purposes of improving management, and ensuring compliance with regulatory requirements. Many monitoring programs have been in place for decades in the Delta, but there is a lack of understanding of how current monitoring programs inform management needs and decision-making beyond what is described in the regulatory requirements. It is important that the specific applications of these programs are understood by all stakeholders and that the funding of these monitoring efforts is justified. Evaluation of these programs is called for in the Delta Science Plan (Action 3.3).

Recommended Actions

Recommendation 2.1: Establish Effective Interchange Between Decision-Makers, Stakeholders, And Scientists.

Developing a comprehensive and agreed-upon list of management needs to serve as an overarching 'guide' is an essential first step to creating synergies and collaborations within the complex Delta science enterprise.

Action 1 – Support and participate in an update of the SAA.

The 2017-2021 SAA identified the gaps in Delta science, gluing disparate pieces of this complex enterprise together to advance the vision of *One Delta, One Science*. For the 2022-2027 update, there will be broader stakeholder engagement and an increased emphasis on connecting science and policy. This action should also be developed in close coordination with the ongoing Voluntary Agreement process for the Bay-Delta and will utilize the Delta Agency Science Workgroup. The Delta Science Program will take the lead in this action, but full DPIIC and stakeholder participation is necessary to ensure success and buy-in.

Action 2 - Develop a framework for linking science actions to management needs and monitoring.

The goal is to ensure that our science activities are responsive to management questions and needs. The concept builds on recommendations in the white paper, discussions by the sub-group, and the Delta Science Plan, for improving policy-science interactions. For example, the framework should articulate the linkages between management questions, regulatory mandates, and the associated scope and scale of science actions. The sub-group charges DPIIC's Delta Agency Science Workgroup to collaborate with the Collaborative Adaptive Management Team (CAMT) and the Interagency Ecological Program (IEP) to develop this framework.

Action 3 – Implement Action 2.1 in the Delta Science Plan by developing best practices for Policy-Science Forums.

Policy-Science Forums allow for decision-makers, scientists, and stakeholders to engage, learn, and discuss key issues. In these forums, coalescing around a unified priority or question helps to maintain

coordination and communication during the development of management decisions, research projects, or modeling and synthesis efforts.

Best management practices will be developed for the exchange between scientists and managers and input on science products, with the goal of improving the effectiveness of communications. For example, best practices may include engaging communications experts to assist with organizing and facilitating policy-science communication. They may also include establishing guidelines for presentations. The Collaborative Science and Adaptive Management Program/CAMT and IEP should develop these best practice in collaboration with the Delta Science Program.

Additional actions for improving interchange and understanding between decision-makers, scientists, and stakeholders identified by the sub-group focus on communications. These include:

- Using tools, such as data dashboards and visualizations, to improve communications of results and annual conditions
- Promoting Policy-Science forums and other efforts that seek to directly link science and management (e.g., Science Action Agenda), including all stakeholders at the table
- Providing opportunities for in-person exchange
- Seeking early and broad input on goals and directions of programs/projects, as well as the appropriate source of funds
- Continuing the use of independent synthesis teams. Synthesis is critical to addressing complex questions and can be effective for linking science to management, using the best available science, and resolving conflicts

Recommendation 2.2.: Promote Decision-Support Tools.

Implementation actions identified by the sub-group to promote the use and effectiveness of decision-support tools, include:

Action 4 - Prioritize transparency and best practices for utilization of decision-support tools.

Continue to improve and promote the use and understanding of decision-support tools, starting with efforts that are currently underway (e.g., Integrated Modeling Steering Committee, Winter-run life cycle model). Actions 3.8 and 3.9 of the Delta Science Plan call for the development and implementation of a strategy to grow a more collaborative and interdisciplinary modeling community. Best practices should be utilized in developing these tools. We highlight the successful Winter-run Life Cycle Model (Box 1) effort and provide the “dos and don’ts of decision support tools”:

- Do be transparent, including clearly stating assumptions, strengths, and weaknesses
- Do collaborate with all key agencies, NGOs, and other stakeholders early and often
- Do utilize peer review to identify and resolve conflict and use the best available science
- Do identify priority model needs and science needed to inform models
- Don’t limit opportunities for feedback and modifications

- Don't apply tool(s) without vetting first with stakeholders

Box 1. Winter-run Life Cycle Model

We explore the elements that made the Winter-run Life Cycle Model, developed by NOAA's Southwest Fisheries Science Center, a successful decision-support tool.

- All stakeholders were given opportunities to review and discuss the model, and stakeholders invested time to engage
- The model was created to answer specific management questions
- Adequate funding was provided to support model development, review, and modifications
- Modifications to the model occurred after review and input from the Center for Independent Experts
- Hosted multiple stakeholder-attended workshops

For more information, please visit <https://swfsc.noaa.gov/ChinookLCM/>.

Recommendation 2.3: Develop Protocols To Evaluate Monitoring Programs And The Value Of Information Generated.

Monitoring in the Delta science enterprise is one of several critical components for effectively connecting science activities with management needs and assessing/understanding the performance of various management actions.

There are currently three significant monitoring evaluations underway relevant to the Delta science enterprise:

- Delta ISB Monitoring Enterprise Review (MER)
- Delta ISB IEP Review of the IEP's Ability to Provide Science Supporting Management of the Delta
- IEP review of ongoing monitoring and studies

Specific implementation actions to develop protocols for evaluating monitoring programs should await the completion of these reviews. The sub-group did discuss the value of periodic reviews and identified the following general implementation action

Action 5 - Develop protocols and coordinate independent, regular reviews to evaluate the effectiveness of monitoring (e.g., establish workgroups to evaluate monitoring efforts), following the completion of the Delta ISB reviews.

Waiting for the completion of the Delta ISB MER and IEP Review, implementing the recommendations from those reviews, then discussing additional needs is recommended. After completion of these reviews, it will be important to ensure that there are protocols for evaluating monitoring, consistent with any recommendations provided by these reviews.

The sub-group suggests that DPIIC convene a discussion following the completion of the reviews. The discussion should focus on determining if additional steps and/or reviews are necessary and moving those efforts forward. All stakeholders, including public water agency and NGO representatives, should be included in the conversation.

Timeline

The highest priority recommendation of sub-group two is action 1: support and participate in an update of the Science Action Agenda.

Promoting the use and best practices of decision-support tools will be an ongoing effort following this report, as are the development of Policy-Science Forum best practices.

The IEP Review and Delta ISB MER are expected to be completed in late 2019 and late 2020, respectively. The DPIIC will discuss the outcomes of these efforts and determine if additional work is needed. If protocols for assessing monitoring efforts or an additional review are required, this will not begin until fall 2020.

FUNDING: SUB-GROUP 3 REPORT

Executive Summary

It is critical to pursue efficiencies in the use and deployment of current funding for the Delta science enterprise. As a step towards improving efficient use of current funding, Sub-group 1 has proposed a crosscut budget that should bring much needed clarity to the source and allocation of current funding. However, funding at its current level will not support the science necessary to address emerging challenges. Increasing the usefulness of current monitoring efforts also requires more scientific resources for analysis and synthesis of existing data, and for increasing data accessibility. To address unmet needs, Sub-group 3 recommends multi-faceted and bold steps to secure additional sources of reliable funding. Among the multiple actions outlined in this report, we recommend immediate focus on three actions:

- Fill, establish and fund multiple permanent/dedicated analysis and synthesis positions in each of the agencies/entities responsible for carrying out the Delta science enterprise
- Appoint an agency/stakeholder task force to propose equitable principles for consistently funding the expanded science enterprise capable of responding to both current management questions and the foreseeable challenges of climate change
- Create a science communication task force to train scientists in how to communicate to non-scientists, and to encourage proactive approaches to communication between scientists and decision makers

While highlighting the above actions, Sub-group 3 proposes a suite of complimentary actions to implement the recommendations in the white paper, *Funding Science to Meet Tomorrow's Challenges* which was endorsed by DPIIC at its April 2019 meeting:

- Use the topic-specific implementation plans as outlined in the Delta Science Plan (June 2019) to identify currently available sources and uses of funds as well as the significant funding gaps in order to quantify the incremental need for consistent, long-term funding;
- Outline funding sources dedicated to scientific study in similar systems to support the need for equitable federal funding, potential philanthropic solicitation, and matching opportunities;
- Establish equitable principles for incremental science enterprise funding that are agreed upon among agencies and stakeholders;
- Identify additional potential sources of consistent, long-term science funding that can reach beyond mitigation science and include data analysis, synthesis, and communication of findings, and adequate response to the impacts of climate change and future threats in a rapidly changing Delta;
- Create, fund, and fill permanent analysis and synthesis positions at federal, state, regional, and local agencies to make efficient use of current research and data to match management needs, and to develop a framework for future use;

- Endorse (and apply through budgeting and grant making) protocols and best practices for collecting, formatting and entering data to be accessed and used immediately, consistent with the Open and Transparent Water Data Management Act (AB 1755); and^{3,4}
- Promote improved communication practices and increased opportunities among managers, regulators, operators, and scientists, including pre-publication communication of results to aid in timely decision making and establish mutual understanding for actionable reports.

Sub-Group Charge

The white paper listed the following findings regarding the need for consistent funding across the Delta Science enterprise:

- 3.1 Inconsistent and fragmented research efforts
- 3.2 Limited staff assigned to turn data into information
- 3.3 Information not sufficiently accessible or digestible by decision-makers and stakeholders

From those findings, the white paper made these recommendations:

- 3.1 Develop topic-specific Delta science implementation plans
- 3.2 Secure additional sources of reliable funding to achieve Delta science needs
- 3.3 Support open science by implementing current road maps for collaborative and open data access, analysis, and synthesis
- 3.4 Support more user-friendly and timely information sharing

Problem Statement

Overall expenditures on scientific research in the Delta are notably less than other similar large-scale ecological efforts.⁵ Public funding for non-regulatory science activities in the Delta from both State and federal sources falls short in comparison to ecological systems with similar economic outputs and current tracking of these funding sources falls short.^{3,6,7} Lessons can be learned from the Coastal Wetlands Planning, Protection and Restoration Act;⁸ though it is a federal initiative, the majority of the funding (70 percent) goes to the Louisiana coastal resiliency program.⁹ Framing the Delta as a critical national asset under severe threat may assist in bringing adequate federal funding to support both science and informed management actions. Although the deterioration of the Delta is cumulative and incremental rather than dramatic and catastrophic as in Louisiana, the national-value-at-risk support for sustainable science funding is similar.

³ Wheeler Water Institute, UC Berkeley School of Law, 2018, *Data for Water Decision Making*.

⁴ California Data Collaborative, UC Davis, 2019, *Proceedings of the Fourth Annual Water Data Summit*.

⁵ Science Enterprise Workshop Advance Briefing Paper, Nov. 2016. <http://deltacouncil.ca.gov/docs/science-enterprise-workshop-advance-briefing-paper-nov-2016-2>.

⁶ San Francisco Bay Delta Watershed: Wide Range of Restoration Efforts Need Updated Federal Reporting and Coordination Roles (GAO-18-473).

⁷ Tennefoss, A. 2018. Shared science for the Sacramento-San Joaquin Delta. UC Davis, Practicum Report.

⁸ <https://lacoast.gov/new/Default.aspx>.

⁹ Coastal Wetlands Planning, Protection & Restoration Act Public Law 101-646, Title III, Section 306.

In comparison, the majority of the funding for current Delta science comes through DWR and Reclamation as operators of the SWP and the CVP (together, the Projects).¹⁰ However, expenditures are generally limited to core monitoring, status and trends monitoring, and some targeted research (foundational and immediate). While some non-Project funds have been made available for targeted research, these funds have been primarily sourced from voter-approved State bonds (e.g. Prop 1), which are inherently inconsistent and for the short-term. It is notable that in 2018, the Department of Fish and Wildlife, Reclamation and the Delta Science Program initiated a large-scale joint solicitation for research proposals aligned with the Delta Science Plan and the Science Action Agenda.¹¹ Nonetheless, the joint funding totaled only about \$17 million, spread across 26 research projects, all of limited scope and duration.

The demands on the Delta science community go beyond mitigation and compliance core-monitoring, and beyond the episodic availability of bond funds. Data needed to identify environmental patterns, develop and test causation hypotheses, inform potential management actions, and monitor responses often require long-term scientific commitment and funding. There is a significant but unquantified need for consistent research related to the impacts of climate change on the Delta and its watershed, in addition to science that informs current management actions and fulfills regulatory requirements (see also the report of Sub-group 4). Therefore, it is imperative to develop and dedicate a sustainable source of funding for Delta science that is broader than the Projects' contractors. Without a broader, more consistent base for funding a targeted Delta science enterprise, the Delta ecosystem will be at risk, water supply reliability for the California will be undermined, and eventually, a functioning estuary will be lost.

Recommended Actions

Recommendation 3.1: Develop topic-specific Delta science implementation plans.

The Delta science community, organized around the concept of *One Delta, One Science*, has made significant progress in strengthening the science enterprise. Led by DPIIC, the Delta Science Program, the California Data Collaborative and the Collaborative Science and Adaptive Management Program (CSAMP), and with oversight from the Delta ISB, the Delta science community is better organized, more diversely represented, and more geared toward collaboration than at any time in the past. Leveraging these existing institutional forums, consistent, sustainable and predictable sources of funding should be arrayed against competitively developed and efficiently managed research efforts.

Actions:

- Identify topic-specific implementation plans that focus research on one area and comprehensively describe research needs (examples include the Delta Smelt Science Plan and the Delta Research Nutrient Plan)
- Develop additional topic-specific implementation plans based on the Delta Science Plan

¹⁰ Funded largely by water users through rates charged by CVP and SWP contractors.

¹¹ <http://deltacouncil.ca.gov/science-program/delta-science-proposal-solicitation-0>.

- Encourage agencies and stakeholders to collaborate in drafting, refining and periodically updating research topics deemed critical to Delta management challenges, and incorporate management questions into competitive science grant solicitation and agency budgeting processes to generate proposals and projects in response
- Integrate the use of topic-specific implementation plans into the next update of the Delta Science Plan and Science Action Agenda
- Identify funding needs based on both topic-specific implementation plans and over-the-horizon challenges

Recommendation 3.2: Secure additional sources of reliable funding to adequately support unmet Delta science needs

A funding plan must describe how funding would be used to responsibly inform management actions that are expected to improve conditions and uses in the Delta; but the plan must also describe where the funding could come from, and to what equitable purposes it could be put. This starts with recognizing the concern of the Projects’ contractors that the demand for incremental science funding goes beyond their collective obligation to mitigate the Projects’ direct impacts on the Delta and their current science funding obligations. A viable funding plan must also address other concerns, such as preferential funding of ESA specific plans at the expense of integrated ecosystem research and the lack of adequate analysis and synthesis of data and findings.

Multiple approaches to secure additional funding have been identified, each with its costs and benefits, some of which may be challenging from a policy or water rights perspective. Thus, we recommend a path for establishing funding principles before proposing specific funding sources and mechanisms. These principles may include:

- Connection to Delta outcomes
- Equity of burden
- Sustainability
- Rigorous accounting and tracking
- Maintenance of effort
- Matching provisions

The guiding principles can then help to objectively rank a menu of potential funding sources. Broadening the funding base will be necessary to induce collaborative budgeting across agencies and non-governmental stakeholders, and to extend scientific research outside the current confines of mitigation and compliance. It will be important to identify steady and consistent sources of funding that will best serve the entire science community in the long-term and not just the three- to five-year duration of a single research project. Moreover, consistent funding allocated to effectively implement the Delta Science Plan and the SAA will improve the connection between science and management actions to address the co-equal goals.

The menu of funding sources within the integrated portfolio could include:

- Federal funding: Federal support for Delta science is low in comparison with what has been awarded in the past (e.g. CalFed) and may be best allocated to funding specific science positions for analysis and synthesis to build the funding of those critical positions into baselines in the on-going budget process;
- State general fund: Build consistent budget support for personnel (synthesis, publication and coordinating positions); consider an equitable “fair share” formula whereby a portion of Delta science enterprise that is beyond Project mitigation is funded according to the broad general public’s interest in a healthy, sustainable, functioning Delta ecosystem, independent of water supply; track science expenditures through consistent use of the crosscut budget tool proposed by sub-group 1;
- Bonds: Although these funds are episodic and short-term, they can be used for specified projects that fill identified knowledge gaps, point the way for follow-up research projects, and/or resolve scientific conflict that would otherwise impede management actions;
- Joint Powers Authority or non-profit mutual funding entity: mechanism for accepting private contributions; create additional incentives to reduce combat science;
- Taxes and fees: Examples include a watershed extraction tax and caps, tax form check-off, Delta benefit surcharge on non-water services, settlements, fines, license plate fund, etc; and
- Philanthropy: could be in the form of establishing an endowment, providing challenge grants, etc.

Actions:

- Establish an agency/stakeholder task force to propose equitable principles for consistently funding the expanded science enterprise; this group will also be responsible for implementing these actions;
- Engage policy makers, regulators, water managers, environmental advocates, and other stakeholders in the evaluation of funding alternatives;
- Evaluate the menu of potential funding sources against those principles and propose a sustainable funding portfolio to meet the identified need for incremental and consistent support for the science enterprise; and
- Present an integrated proposal for incremental science funding for review and implementation by DPIIC.

Recommendation 3.3: Support open science by implementing current road maps for collaborative and open data access, analysis, and synthesis

There are several groups, including the IEP’s Data Utilization Working Group (DUWG), the California Water Quality Monitoring Council, the California Data Collaborative, and the State Water Resources Control Board – Office of Information Management and Analysis, for which consistently supporting *One Delta, One Science* and open data is a priority. DPIIC and its member agencies can support these efforts through active participation in existing forums for collaborative Delta science, and by consistently implementing their collaborative initiatives. However, much of the foundational work for furthering these objectives has been done without adequate funding or as an unfunded “added

responsibility” for those dedicated to related projects. Incremental funding will add to this foundational work, but consistent attention to collaboration, efficiency, innovation, and integration of science is required prior to the demand for incremental Delta science funding. Performing analyses and syntheses will require continued support from current “siloed” budgeting and funding mechanisms in order to model responsible and imaginative use of existing resources, and to establish what gaps in knowledge and understanding should be filled by future research.

Existing data and project reports also require infrastructure in the form of accessible repositories or web portals so that researchers do not needlessly repeat work. Several portals already exist (e.g. Water Data Library, Bay-Delta Live, etc.), but with many options that are not necessarily interconnected, things can be missed. Better use of existing data from prior research and integrated search tools should also direct new research based on understanding of established patterns. Through synthesis, the usability of research will increase, thereby increasing efficiency in science investment. Therefore, DPIIC and its member agencies should leverage existing forums and protocols via requirements embedded in future grants, consistent with the 2016 Open and Transparent Water Data Act (AB 1755). Over time, science budgeted by State and federal agencies, local/regional governments and non-governmental entities and science funded through grants would meet higher standards of data quality and usefulness so that data may be used for multiple projects. Data must also be in “actionable” formats so that correlations between data sets become more useful in supporting management actions and policy development.¹²

Actions:

- Fill, create, and fund permanent analysis and synthesis positions at agencies and interagency coordination groups. Implementing this action would help address the Delta ISB’s recommendations on the need for additional resources for synthesis from its review of the IEP and on “fish and flows” research in the Delta^{13,14}
- Promote protocols, data standards and best practice for data management already being developed by DWR and the State Water Resources Control Board
- Define direction for synthesis efforts to adhere to match management needs
- Support implementation of the Delta Science Tracker (see also report of Sub-group 1)
- Revise grant funding contracts and agency practices to require compliance with The Open and Transparent Water Data Act (AB 1755)

Recommendation 3.4: Support more user-friendly and timely information sharing

It can be challenging for science to inform management actions in a timely fashion when it takes years to go through the peer review process for vetting and validating scientific findings. However, with proper quality assurance and quality control measures, and adherence to emerging data standards, some data can be made available to inform real-time and short-term decisions and

¹² Cantor et al, *Data for Water Decision Making: Informing the Implementation of California’s Open and Transparent Water Data Act through Research and Engagement*, 2018, Center for Law, Energy & the Environment, UC Berkeley School of Law, available at: <https://doi.org/10.15779/J28H01> or law.berkeley.edu/datafordecisions.

¹³ <https://cawaterlibrary.net/document/flows-and-fishes-in-the-sacramento-san-joaquin-delta/>

¹⁴ <https://deltacouncil.ca.gov/pdf/isb/meeting-materials/2019-08-12-ISB-IEP-Review.pdf>

actions. This is particularly the case in areas where monitoring guides adaptive management. Data standards outlined in Recommendation 3.3 will increase the usability of these data so that the data can be accessed by scientists and interpreted by regulators in ways that can more immediately inform decisions.

A more accessible version of data allows for the possibility of more interactions among scientists, regulators, and the public so that all parties have consistent and credible information available. User-friendly data can be more easily transformed into infographics, posters, and presentations and other visualization formats that can be understood by a wide variety of audiences. With scientists having access to more information, those who attend bi-yearly conferences such as the State of the Estuary Conference (odd years), the Bay-Delta Science Conference (even years) and the annual meeting of the California Water and Environment Modeling Forum will be able to draw more accurate conclusions in real-time to inform management decisions.

Scientists should additionally be able to communicate to non-scientists to get timely messages across in a way that is not isolating from the general public. Scientists need to learn how to present their data in a way that a policy-maker can understand it. Too much detail or too many PowerPoint slides diminishes from the main message and distances scientists from the people with which they are trying to communicate. To accomplish these tasks, scientists will need to go through proper science communication training and use what they learn to increase the impact and usefulness of science in the Delta. Sources already exist for decision-makers to increase the communication,¹⁵ but communication has to go both ways.

Actions:

- Adapt guidelines and best practices developed by the California Council on Science and Technology and the American Association for the Advancement of Science to disseminate technical information to decision-makers, stakeholders, and the public. The guidelines include strategies to increase communication of preliminary scientific information (e.g. workshop presentations, meeting briefs, etc.); and
- Develop or incorporate a science communication professional development training that can be easily accessed by all scientists so that all scientists will have the tools to communicate.

TIMELINE

Sub-group 3 recommends that agencies begin to fill or create permanent and dedicated analysis and synthesis positions. Discussions should continue on developing equitable principles for consistently funding science, as well as the formation of a science communication task force. These latter two actions, and others identified in this report, however, should be secondary to the actions identified in the full implementation report.

¹⁵ Data for Water Decision Making: Informing the Implementation of California's Open and Transparent Water Data Act through Research and Engagement. <https://doi.org/10.15779/J28H01>

SCIENCE NEEDS: SUB-GROUP 4 REPORT

Executive Summary

In response to their charge (see below), Sub-group 4 will:

1. Organize a 2.5 day workshop to identify a) key science needs to provide long-term management insights in the context of rapidly changing environments; and b) recommendations for organizing the science enterprise to better address such complex and changing problems; and
2. Develop a report outlining recommendations on needed science infrastructure and governance based on the science needs assessment workshop.

Sub-Group Charge

Develop an implementation plan for the following recommendations from the Delta ISB in their letter to DPIIC.

- 4.1 Development of a broad and fundamental interagency and multidisciplinary science needs assessment via a workshop, followed by a draft assessment for policy refinement;
- 4.2 Create a white paper summarizing different organizational approaches for science to better develop and inform further discussions.

Problem Statement

In their letter to the DPIIC, the Delta ISB emphasized the rapidly changing environment and the need for more strategic and forward-looking management and science to respond to these changes. Current Delta interagency science efforts are not organized in a way that efficiently “support[s] the kinds of science-driven policies and solutions needed to address the Delta’s diverse, interacting, and rapidly changing management challenges which routinely span the mandates of multiple agencies.” There is a need for more forward-looking science to guide policy decisions, and for more integrated multi-agency organization to implement approaches to connecting science to management and policy in the Delta.

To address this need, the Delta ISB recommended a science needs assessment workshop to guide a forward-looking science strategy to support management decisions in the Delta, and a report summarizing approaches to improve science governance to better prepare for rapid change. Moving forward will require scientific leadership and vision, identification of major scientific priorities, and organizational and funding structures to greatly expand interagency science integration. The Delta Science Plan identifies some existing mechanisms to foster interagency collaboration and communication to be expanded upon.

Recommended Actions

Action 1. Conduct a 2.5-day science needs assessment workshop

Sub-group #4 proposes a 2.5-day Science Needs Assessment Workshop and additional efforts (e.g. pre-workshop briefing paper) that identify forward-looking science and provide recommendations to improve science governance (see Appendix A to this sub-group report for a more detailed description of the workshop). The overall goals of the workshop are to:

- Identify key science needs to support long-term management in the context of rapidly changing environments
- Explore how to organize the science enterprise to better address such complex and changing problems

The science needs identified at the workshop will be based around a set of management issues focused on climate change and other major changes

Participants in the first two days of the workshop will include those conducting, prioritizing, coordinating, and funding science in the Delta, representing agencies including those on DPIIC and broader Delta stakeholders. A half-day session on the third day will involve higher-level management/directors to communicate the outcomes of the prior two days and receive feedback. The workshop will be held in early spring of 2020, allowing sufficient time for planning, scheduling, and logistics.

Prior to the workshop, members of sub-group 4 and additional collaborators will prepare a briefing paper which will be disseminated to attendees to frame thoughts on discussion topics during the workshop (see Appendix B of this sub-group report). The authors of the briefing paper are:

- Jay Lund (Delta ISB)
- Amanda Bohl (Council)
- Steve Brandt (Delta ISB)
- John Callaway (Council-DSP)
- Mike Chotkowski (USGS)
- Louise Conrad (Council-DSP)
- Lynda Smith (Metropolitan Water District)

Action 2: Author a report outlining recommendations on needed science infrastructure and governance based on the science needs assessment workshop

Following the workshop, a report outlining recommendations from the discussions will be developed and presented to DPIIC. The document also will include discussions on organizational structures that promote more nimble and adaptive governance in response to rapid environmental change, which responds to the Delta ISB's second recommendation. Moreover, the discussion on organizational structures may help facilitate another set of recommendations made by the Delta ISB to the IEP on the need to review and consider alternative organizational structures within IEP to better enhance

collaboration and commitment with the IEP member agencies and stakeholders (Delta ISB 2019). In the future, coordination may be needed with IEP to assess whether this effort may assist with the implementation of the Delta ISB's recommendations on IEP's ability to produce science to support the management of the Delta.

Timeline

February 10	Advance Briefing Paper finalized
April 27-29	Workshop
May	Present initial findings to DPIIC

Appendix A (sub-group 4 report): Science Needs Assessment Workshop Outline

Purpose

Strengthen the Delta Science Enterprise to support strategic and forward-looking management and stakeholder needs in the face of a rapidly changing environment.

Workshop Objectives

- Identify key science that needs to happen to provide answers to long-term management questions
- Discuss how to organize science and the science enterprise for complex and changing problems

Advance Briefing Paper

An advance briefing paper will be developed and distributed to all participants before the workshop. This briefing paper will provide a background on the science foundations for managing the Delta's changing challenges and will discuss recommendations from previous workshops and reports, the science and management questions facing the Delta, the scientific foundations for adaptive management, the science organization, governance and funding needed to support science needs and ideas for engaging policy and decision-makers.

Background and Rationale

Fundamental environmental conditions in the Delta are changing rapidly, and we face a future that will likely be very different from the present. Climate change, a growing population, new invasive species, increasing demand for water diversion, shifts in land use, and declines in native species will fundamentally challenge our ability to sustain natural values in the Delta environment and deliver adequate water for California's farms and cities. Decisions made now will have consequences and perhaps constrain our options in the future in ways we cannot currently envision. We must, therefore, ensure that our science strategy elevates the theme of *change*, as a lot of change lies ahead.

The Science Action Agenda represents a major step forward and has identified key current management issues and short-term science needs. The underlying Delta Science Plan has set forth a host of mechanisms to foster interagency collaboration and communication. We propose to build on these efforts and develop a bold, forward-looking, longer-term science strategy that recognizes the ever rapidly changing Delta environment and looks farther into the future.

The stakes are high. Delta management requires the use of best available science. The cornerstone of Delta management is *adaptive management*, which works on the premise that one can learn by studying the effects of management policies and then changing those policies if new information indicates that other policies will better achieve desired outcomes. It depends on the ability to forecast outcomes. But management policies do not affect the environment in a vacuum. Underlying conditions in the Delta are, and have been, rapidly changing in the face of pressure from multiple drivers, including climate change. Clearly, management informed by careful forecasts of future environmental conditions has a better chance of success. We must ask ourselves: is our science on

the right track to predict future conditions sufficiently well that current and future management can succeed in a changed and rapidly-changing Delta? If we are concerned that our science isn't doing all it can, where can we improve? What are the emerging issues?

Focus On Climate Change

Climate change is perhaps the biggest single driver of environmental conditions in the future Delta. Climate has far reaching impact on all major Delta management issues/goals. It was singled out in both the Delta Plan and the latest State of the Bay-Delta Science as a fundamental 'stressor' that affects most of the other major drivers in the ecosystem. Climate-related changes will increase temperatures, lengthen summers, increase sea levels and hydrologic extremes, shift seasonal stream flows and change habitats that will open the door for new nonnative species and close it for some natives. As stated in the State of the Bay-Delta Science "The Delta's climate is characterized by high variability, and climate change is expected to accentuate this variability, resulting in both more extreme flood risks and greater drought risks. Thus, the Delta of the future will be very different than the Delta we know today" (Dettinger et al. 2016).

Next Steps

Moving forward will require scientific leadership and vision, identification of major scientific priorities, and organizational and funding structures to greatly expand interagency science integration. This workshop will be the first step in developing a comprehensive scientific needs assessment based on fundamental system-wide scientific and management challenges facing the Delta relative to short-term (seasonal to interannual) and long-term (decadal or longer) changes in climate.

The primary audience for this workshop are those conducting, prioritizing, coordinating and funding science in the Delta as represented by DPIIC. Broader Delta stakeholders are also an intended audience so that they can begin to assess their strategic needs and expectations. Once scientific needs and components are identified, we can examine scientific structures, organizations and collaborations mechanisms, some outlined in the Delta Science Plan, Science Action Agenda and other documents, and funding initiatives to see if they are capable to address these priorities and recommendations.

The Science Needs Assessment Workshop – 2-days

Logistics and Timing

This will be a two-day workshop modelled tailored to the specific management needs, scientific knowledge, conditions, and stakeholders in the Delta. An additional half day will be scheduled with policy managers and key agency leads to discuss workshop recommendations and next steps. The workshop will be held in spring of 2020, with a targeted participation of about 80 scientists from the Delta as well as other systems, Delta managers and Delta stakeholders.

Goals

The overarching purpose of the workshop is to develop a science strategy that addresses the effects of environmental change, especially climate change, on Delta's co-equal goals as driven by management and stakeholder needs. The workshop will focus on a strategic science needs assessment directed toward identifying and prioritizing major research needs and future plans toward understanding changing climatic impacts on key physical, chemical, and biological processes identified in the Delta Plan in the context of potential changes in other major drivers. What are the fundamental scientific questions and how to we enhance our scientific enterprise to be able to address these questions?

Scope of the Scientific Questions

The workshop will examine climate-related science needs at short term (seasonal to interannual) and longer-term (decadal and beyond) time scales. The focus is large ecosystem level spatial scale. For example, we would not address specific restoration projects but the basic elements/goals/limitations of Delta restoration which, of course, would have trickle down applications to individual projects.

Specific Workshop Objectives

The workshop will focus on Key Scientific Theme areas from the Delta Plan and the management questions related to each of these themes:

- Water Supply Reliability, including water storage capacity, infrastructure capacity and needs
- Nonnative species including new introductions, spread and ecosystem impacts
- Water quality including nutrients, contaminants, human health
- Delta flows e.g. inundation, runoff timing, including extreme events such as drought and flooding
- Restoration
- Fish and wildlife habitat and productivity in including water temperatures, growing seasons, thermal tolerances, plant communities, abundance by species, size, condition, distribution, habitat, and food web structure and function
- Ecosystem sustainability
- Delta as Place, including environmental justice and tribal considerations

The workshop will bring Bay-Delta scientists, managers and stakeholders together to:

1. Examine the current state of knowledge of the physical, chemical, and biological impact of climate change on the Bay-Delta. Such a knowledge base includes current scientific understanding, products, services, expertise, monitoring and observing systems, datasets, and forecast models.
2. Explore the magnitude of environmental changes that may occur in the future, based on present knowledge. What is expected, and what is possible? What indicators of change should we be studying? Are there potential emergent issues we should be looking for in the Bay-Delta (e.g. ecological regime shifts) that are informed by climate science and the experience of environmental change in other estuaries?

3. Develop a dialogue with Delta stakeholders to identify their key needs related to the impact of climate change on Delta resources.
4. Document key challenges that climate change impacts pose in continuing effective management, restoration and protection of the integrity of the Delta Ecosystem and related resources of particular concern to stakeholders.
5. Identify and apply presently available scientific expertise, products, services, monitoring and observing systems and forecast models that best support needs of stakeholders in confronting impacts of climate change in protecting, managing, or restoring Delta resources.
6. Identify new scientific research efforts and resulting products that will enhance stakeholder capabilities to better anticipate impacts of climate change on Delta resources and develop more effective, pre-emptive strategies to meet new challenges in managing, protecting, or restoring such resources.
7. Compile and disseminate a report summarizing workshop proceedings and recommendations.

Workshop Agenda – 2 days

Plenary Sessions

Plenary Session 1 - State of Our Scientific Knowledge: Individual Speakers and Panels: The current state of scientific knowledge of present and expected future impact of climate change in the context of other long-term underlying drivers (such as population growth and changes in land use) that may affect the Bay-Delta. Informed speculation about potential emergent issues that we should consider studying more closely.

Panel sessions organized around the bulleted key scientific theme areas identified above

Plenary Session 2 - The Changing Future: Individual Speakers and Panels: What can we forecast about climate change impacts in the Delta at seasonal, interannual and decadal scales? What is the level of uncertainty? What is really missing?

Panel sessions organized around the bulleted key scientific theme areas identified above

Plenary Session 3 - Management and Stakeholder needs: Individual Speakers and Panels: Focus is on stakeholder needs and issues and concerns in confronting anticipated impacts of climate change on the Delta ecosystem and meeting new challenges in managing, protecting or restoring resources.

Panel sessions organized around specific stakeholder and manager groups including:

- Management of invasive species (e.g. invasive 'weeds');
- Recreation;
- Land use managers;
- Commercial and municipal water users; and
- Regional, state, tribal and local policymakers and managers

Plenary Session 4 - *Climate Change: From Science to Solutions*: Individuals and Panels Discussion: practical approaches to improving our ability to forecast the future, explore potential emergent effects, and frame rigorous, reliable scientific products that are useful to managers and stakeholders.

Breakout Sessions

Breakout Sessions that addressed science and stakeholder issues divided among the Key Scientific Theme areas defined above.

First Breakout – What Do We Need and What is Missing?

Information and Research Needs – based on science themes identified above

1. What do you see as major strategic research products (such as a forecast tools, technology, methods, and models)? Or information gaps in each of the Key Scientific Themes?
2. What scale (geographic and spatial) is needed to address this need?
3. What do you see as immediate first steps in this theme area (within the next 5 years) towards achieving the strategic goals identified?
4. What do you see as longer-term needs (within the next 5-7 years) for Delta climate change research?
5. What scientific products, services, expertise is needed?

Consider:

1. Forecasts, Models, Prediction, Outlooks, Scenarios, Predictive / Decision-Making Tools, Uncertainty, Risk and Risk Assessment
2. Research to increase understanding and/or to expand knowledge base

Second Breakout – What information will stakeholders need?

1. Who are your stakeholders and how do you engage them in this issue?
2. What specific forecasts would be of value?
3. What is the best way for to communicate new information, tools and technologies related to this issue?
4. How do we maintain communications, collaboration, scientist-stakeholder engagement

Third Breakout – What is needed to Get Us There?

1. What are the essential ingredients of a Science Governance/Funding Structure to achieve these goals?
2. What collaborations, integration and coordination are needed to achieve useful development and application of products and services?
3. Who should take the lead?
4. Are there implications for data, data sets, databases, monitoring and observing systems
5. Why is it of value to society?

Policy/management discussion of Recommendations – ½ day

Policy managers and key agency leads will meet to discuss the workshop recommendation and next steps that can be taken to benefit the Delta.

Workshops Products and Follow-up

- Preparation of White Paper with specific recommendations
- Presentation to DPIIC with specific recommendations
- Communication products for wide distribution
- Consideration of recommendations in development of Next Science Action Agenda
- Development of implementation/funding/science governance structure necessary to achieve recommendations

Pre-Workshop Activities

- Gathering of essential background material and reading for participants including
 - Delta Science Plan
 - Science Action Agenda
 - Science Enterprise Report
 - IEP Science strategy
 - DISB review Delta Monitoring/adaptive management
 - Key scientific literature
 - 2016 Status of Bay Delta Science
- Invited speakers on dealing with Rapid Environmental Change and Horizon Scanning (being done by Delta Independent Science Board)
- Production of background briefing paper to introduce the topic, flush out key questions/gaps abased on an analyses of previous reports/workshops and explore how the issue is being addressed in other major aquatic ecosystems.

Appendix B (Sub-Group 4 Report): Draft Briefing Paper Outline

Below is a draft outline of the pre-workshop briefing paper

1. Executive Summary
2. Introduction
 - a. Context of change and complexity
 - b. Goals of report
 - c. Structure of report
3. Approaches to Organizing a Science Needs Assessment
 - a. "Grand Challenges"
 - i. Management questions
 - ii. Science questions
 - b. Immediate and long-term management questions
 - c. Scientific foundations for adaptive management

- d. Continue what we have done before
 - e. Hybrids
 - f. Other?
4. Today's Dispersed Science (table)
5. Major Science Problems
- a. Separations of expertise from problem responsibilities
 - b. Unreliable and fragmented funding
 - c. Dispersion and dissipation of efforts
 - d. Transparency
 - e. Synthesis
 - f. Lack of integrated foresight
 - g. Communications
 - h. Availability of information, data, documentation, journals, etc.
 - i. Others?
6. An Initial Draft Assessment of Science Needs
- a. Foundations for Adaptive Management
 - b. Some Grand Challenges
7. Improving science organization and governance to support science needs
- a. Some ways to organize science for complex and changing problems
 - b. Thoughts on organizing Delta science
8. Science funding to support science needs
- a. How much?
 - b. Reliability
 - c. Effective administration of funds
9. Workshop objectives
- a. Improve and expand science needs assessment for 5-50 year timeframe
 - b. Better focus science needs assessment on immediate and strategic decision needs
 - c. Develop ideas for engaging policy and decision makers
 - d. Others?
10. Conclusions and Next Steps
- a. Draft needs assessment based on findings from workshop
 - b. Draft a white paper summarizing different organizational approaches for preparing science for major changes (recommendation 2)

References

APPENDIX 2: SUB-GROUP FOCUS AND MEMBERSHIP

Sub-Group 1: Efficiency

Issue 1: Need for shared, rigorous mechanisms to critically assess science and monitoring efforts	
<i>Finding: Challenges estimating science-based expenditures</i>	Chair: Mario Manzo, Reclamation Lead writer: Edmund Yu, Council-DSP
Recommendations: <ul style="list-style-type: none"> • Establish common accounting and reporting protocols • Support the web-based tracking system identified in the Delta Science Plan • Coordinate a critical review of science funding in the Delta 	Participants: Cindy Messer, DWR You Chen Chao , DWR Frances Brewster, SCWD Steve Culberson, IEP Mike Hendrick, Reclamation Sheila Greene, Westlands Todd Manley, Northern California Water Agency Darcy Austin, SWC Stephanie Fong, IEP George Isaacs, Council – DSP Karen Gehrts, DWR John Ridilla, Reclamation Lynda Smith, Metropolitan

Sub-Group 2: Interchange

Issue 2: Limited interchange among policy makers, scientists, and the public to inform science funding priorities and management questions	
<i>Findings:</i> <ul style="list-style-type: none"> • <i>Limited communication to inform resource allocations</i> • <i>Unclear alignment of management needs and science linkages to support structured decision making</i> • <i>Limited guidance for compliance monitoring programs</i> 	Chair: Bruce DiGennaro, CSAMP/CAMT Lead writer: Rachael Klopfenstein, Council-DSP
Recommendations: <ul style="list-style-type: none"> • Establish effective interchange between decision-makers, stakeholders, and scientists • Promote decision-support tools 	Participants: Carl Wilcox, CDFW Jennifer Pierre, SWC Stephanie Fong, IEP Thomas Jabusch, Conservancy Jeffrey Payne, Friant Sam Safi, RegionalSan

<ul style="list-style-type: none"> Develop protocols to evaluate monitoring programs and the value of information generated 	<p>Jose Gutierrez, Westlands Mike Roberts, Resources Maria Rea, NOAA Terrie Mitchell, RegionalSan Cindy Messer, DWR Erik Loboschevsky, DWR Shelley Ostrowski, Westlands</p>
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Sub-Group 3: Funding

Issue 3: Need for consistent funding across the Delta science enterprise

<p><i>Findings:</i></p> <ul style="list-style-type: none"> <i>Inconsistent and fragmented research efforts</i> <i>Limited staff assigned to turn data into information</i> <i>Information not sufficiently accessible or digestible by decision-makers and stakeholders</i> 	<p>Chair: Michael George, Water Board Lead writer: Kate Melanson, Council-DSP</p>
<p><i>Recommendations:</i></p> <ul style="list-style-type: none"> Develop topic-specific Delta science implementation plans Secure additional sources of reliable funding to achieve Delta science needs Support open science by implementing current road maps for collaborative and open data access, analysis, and synthesis Support more user-friendly and timely information sharing 	<p>Participants:</p> <p>Jay Ziegler, TNC Cathy Marcinkevage, NOAA Dave Mooney, Reclamation Kevin Masuhara, CDFA Jeffrey McLain, USFWS Rebecca Akroyd, SLDMWA Mike Wade, California Farm Water Coalition Maurice Hall, EDF Louise Conrad, Council Kris Jones, DWR Ryan Stanbra, Council Lynda Smith, Met Kate Spear, NOAA</p>

Sub-Group 4: Science Needs

Issue: Our current science efforts are falling behind and are unable to prepare policy-makers for rapidly changing conditions in the 5-50-year time frame.

<p><i>Findings:</i></p> <ul style="list-style-type: none"> <i>The Delta is changing fast due to changing climate (higher temperatures, seasonal shifts,</i> 	<p>Chair: Jay Lund, Delta ISB Lead writer: Yumiko Henneberry, Council-DSP</p>
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<p><i>more variable hydrology, higher sea levels)</i></p> <ul style="list-style-type: none"> • <i>Rapid changes are also occurring in the composition of the Delta's ecosystem and water supply infrastructure</i> • <i>Voluntary agreements also will need integrated science support that we are not currently prepared for</i> 	<p>*</p>
<p>Recommendations:</p> <p>2.3 Development of a broad and fundamental interagency and multidisciplinary science and R&D needs assessment via a 2-day workshop, followed by a draft assessment for policy refinement</p> <p>3.3 Creation of a white paper summarizing different organizational approaches for preparing science for major changes would inform further discussions</p>	<p>Participants:</p> <p>Steve Brandt, Delta ISB Mike Chotkowski, USGS Amrith Gunsekara, CDFA Kristin Peer, CalEPA Larry Goldzband, BCDC Ted Sommer, DWR Leo Winternitz, GEI Consultants Steve Rothert, American Rivers Louise Conrad, DSC-DSP Mark Lubell, UC Davis Campbell Ingram, Conservancy Erik Loboschevsky, DWR Linda Smith, Met</p>

Appendix 3: Funding Science to Meet Tomorrow’s Challenges (original white paper)

Executive Summary

Why this document?

At the 2017 State of the Estuary Conference in Oakland, a panel composed of leaders in Delta science and policy discussed the outcomes and lessons learned from the 2016 Science Enterprise Workshop.¹⁶ The main topic of discussion was how to adequately fund science in the Delta to support robust decision-making. In response, the Delta Science Funding Initiative Workgroup (Workgroup) was launched to build on current efforts that promote coordinated science such as the Delta Science Plan, which established the vision of *One Delta, One Science*. The role of this collaborative Workgroup (see page 10 of the following paper for a list of participants) was to improve the tracking, support, and funding of Delta related science and ensure the development of action-oriented recommendations for implementation by decision-makers. This collaborative document represents support from the diverse membership of the Workgroup

What’s next?

The Delta Plan Interagency Implementation Committee (DPIIC), whose members come together biannually to further the implementation of the State’s Delta Plan, will consider endorsing this white paper at its spring 2019 meeting. Assuming endorsement, a workgroup will be created to develop a plan and schedule for implementation of these recommendations to be reviewed and adopted by DPIIC at its fall 2019 meeting, with implementation starting January 2020.

What’s the nexus between this initiative and current calls for accelerated improvements to Delta science governance?

Running concurrently with this effort is a request from the Delta Independent Science Board (Delta ISB) to explore how to “accelerate efforts to address the rapidly growing and interlinked challenges for science-based policy and management decisions in the Delta...”and to “initiate and lead a bolder, forward-looking, and better integrated science and management program that provides policy-makers and managers with better scientific information and management options for the Delta.” Delta Stewardship Council staff is working with the Delta ISB and the DPIIC agencies to address this request and the recommendations included in the request.

¹⁶ http://www.sfestuary.org/wp-content/uploads/2017/10/SOE17Oral21_FutureCal.pdf and <http://deltacouncil.ca.gov/events/implementation-committee-event/science-enterprise-workshop>

Issues, Findings, and Recommendations

Issue 1: Need for shared, rigorous mechanisms to critically assess science and monitoring efforts

Findings

1. Challenges estimating science-based expenditures

Recommendations

- 1.1 Establish common accounting and reporting protocols
- 1.2 Support the web-based tracking system identified in the Delta Science Plan
- 1.3 Coordinate a critical review of science funding in the Delta

Issue 2: Limited interchange among policy makers, scientists, and the public to inform science funding priorities and management questions

Findings

- 2.1 Limited communication to inform resource allocations
- 2.2 Unclear alignment of management needs and science linkages to support structured decision making
- 2.3 Limited guidance for compliance monitoring programs

Recommendations

- 2.1 Establish effective interchange between decision-makers, stakeholders, and scientists
- 2.2 Promote decision-support tools
- 2.3 Develop protocols to evaluate monitoring programs and the value of information generated

Issue 3: Need for consistent funding across the Delta science enterprise

Findings

- 3.1 Inconsistent and fragmented research efforts
- 3.2 Limited staff assigned to turn data into information
- 3.3 Information not sufficiently accessible or digestible by decision-makers and stakeholders

Recommendations

- 3.1 Develop topic-specific Delta science implementation plans
- 3.2 Secure additional sources of reliable funding to achieve Delta science needs
- 3.3 Support open science by implementing current road maps for collaborative and open data access, analysis, and synthesis
- 3.4 Support more user-friendly and timely information sharing

Funding Science to Meet Tomorrow's Challenges

A white paper for the Delta Plan Interagency Implementation Committee, prepared by the Delta Science Funding Initiative Workgroup

Goal

An ongoing, consistent, relevant and reliably funded science enterprise providing useable information directly linked to critical management questions of a diverse set of stakeholders, federal and state agency managers, and scientists.

Problem Statement

The Sacramento-San Joaquin Delta (Delta) is a complex system and a critical linchpin of California's ecosystems, water supply, and economy. The region's ecosystem however, is in a highly altered and rapidly declining state. Climate change effects such as sea-level rise, prolonged drought, and increased flood risk are accelerating this change and complicating the management challenges. These factors have increased threats to reliable water deliveries for an expanding population, habitat for native species, and sustainability for Delta residents and communities. There is an acute sense of urgency to address these issues given the large-scale consequences of inaction.

Scientific information is a critical component of objective, effective, and defensible decision-making. Consequently, many environmental policies and regulations including the 2009 Delta Reform Act, federal and state endangered species acts, and state water quality control plans call for best available science to support management decisions. In the Delta, investments in science support a wide-range of required and non-regulatory activities and programs that have been well respected and widely recognized including the Interagency Ecological Program (IEP), Surface Water Ambient Monitoring Program, and Delta Regional Monitoring Program (Delta RMP). A wide variety of science activities are conducted including core monitoring, status and trends monitoring, targeted immediate and foundational research, modeling, and synthesis (see Key Terms). These activities range from those that directly support current management needs and those that provide key information on emerging issues that will have a bearing on decision-making in the long-term.

Despite the wealth of scientific information, the Delta's dynamic ecosystem is a moving target for natural resource management and environmental policy challenges of the region continue to resist a clear resolution. There is broad agreement "that society needs to do a better job of using scientific knowledge to guide conservation and resource management policies".¹⁷ Three overarching issues contribute to this science-policy disconnect in the Delta:

1. Need for shared, rigorous mechanisms to critically assess science and monitoring efforts
2. Limited interchange among policy makers, scientists, and the public to inform science funding priorities and management questions
3. Need for consistent funding across the Delta science enterprise

¹⁷ Cloern, J and Hanak, E. 2013. It's time for bold new approaches to link Delta science and policymaking. San Francisco Estuary and Watershed Science. (11):3.

These three issues are not unique to the Delta and have been explored and debated in numerous venues including the 2016 Science Enterprise Workshop and panel discussions at Delta science conferences. The findings and recommendations in this document also expand upon the framework provided by the Delta Science Plan and support chapter 8 of the Delta Plan.

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This document is a call for the agencies that sit on the Delta Plan Interagency Implementation Committee (DPIIC) and those in the wider Delta science community to act collectively upon these three issues. The findings and recommendations included here are not meant to be a panacea but are intended to spark dialogue and initiate efforts to strengthen the Delta science enterprise so that we can better manage such a dynamic and multi-faceted system. Although the focus of this document is on addressing immediate issues for funding Delta science, science governance and management activities must be considered in coordination with upper watershed and Bay efforts.

¹⁸ Chapter 8: Funding Principles to Support the Coequal Goals.

Key Terms

Core monitoring: Monitoring that provides information on a seasonal and daily basis to inform specific decisions on operations for water supply and fish species status. Core monitoring is conducted almost entirely to fulfill requirements for regulatory compliance.

Data: Recorded symbols (e.g. words, numbers, and images) and sensory readings that capture a set of facts about an event. Examples include measures of precipitation, flow, and population abundance. (<http://www.tlainc.com/articl134.htm>)

Information: A message with relevant meaning used to make decisions or solve a problem (e.g. synthesis report, model output). Information can come from processed data but can also come from other forms of communication (e.g. instructions). (<http://www.tlainc.com/articl134.htm>)

Open science: The practice of making scientific data and information publically available and accessible.

Status and trends monitoring: Monitoring that contributes to long-term datasets used to compare environmental conditions (e.g. species populations, water quality) over time. Information improves system understanding and can be applicable to a variety of management decisions rather than a specific action. Status and trends monitoring is primarily required for regulatory compliance, although it may also be associated with non-regulatory efforts.

Science enterprise: The broad collection of science programs and activities that exist to serve managers and stakeholders in a regional system. This includes agency science programs, academics, NGOs, and the private sector.

Synthesis: The combining of diverse information from multiple sources into one concept, model, finding, or report.

Targeted foundational research: Science efforts that provides the knowledge and context to inform long-term management and policymaking, while also identifying and understanding emerging issues so that natural resource managers can be better prepared for future challenges. This is not typically supported by funds allocated for science efforts linked to regulatory requirements.

Targeted immediate research: Science efforts that answer current management questions by providing evidence to support or refute hypotheses. This is not typically supported by funds allocated for science efforts linked to regulatory requirements.

The following is a description of the issues, the findings that led to the identification of these issues, and recommendations regarding how to address these issues. Please note that all of the findings and recommendations are interconnected and could be addressed in multiple issue areas.

Issues and Recommendations

Issue One - Need for Shared, Rigorous Mechanisms to Critically Assess Science and Monitoring Efforts

Currently, science funding is dispersed across various agencies that use different accounting protocols with different fiscal years. This impedes efforts to consolidate and evaluate funding across the system. For example, there is no common set of funding categories (e.g. core monitoring, status and trends, targeted research), itemization protocols (e.g. staff salaries, instrument purchase and maintenance) or strategies to evaluate State and federal agency expenditures.

Findings

Challenges estimating science-based expenditures

The disparity in accounting methods along with obstacles to accessing budgetary values makes estimating spending across organizations difficult. Consequently, there is concern that no clear linkages exist between expenditures and science actions to inform critical management questions. These factors hinder more efficient resource allocation and the development of clear justifications when prioritizing or proposing funding increases.

Recommendations

Establish common accounting and reporting protocols

Develop a common accounting template based on ongoing efforts.¹⁹ Such an effort would allow for transparent and accurate characterization of science funding sources (e.g. general funds, funds reimbursed through water rates). Strategies should address how to standardize accounting and reporting across federal, State, and local agency budgets. This effort should support actions in recommendation 2.4 and include annual reporting of Delta science investments allowing for 1) effective tracking of science funding and 2) awareness of how different levels of funding impact scientific understanding and policy decisions. Both the Chesapeake Bay Restoration Program and the South Florida Ecosystem Restoration Program provide examples of existing cross-cut budgets.

Support the web-based tracking system identified in the Delta Science Plan

The science tracker identified in Delta Science Plan²⁰ can provide a mechanism to efficiently, accurately, and transparently assess financial investments and science activities in the Delta. The tracking tool could use the budget template described above and will catalog information.

Coordinate a critical review of science funding in the Delta

In order to adaptively manage the Delta science enterprise, an outside review of science funding should be conducted to highlight opportunities to increase efficiency, reduce redundancies, and clarify

¹⁹ In December 2018, the U.S. Bureau of Reclamation (Reclamation) and the Department of Water Resources (DWR) signed a Memorandum of Agreement (BOCT Agreement) to specifically identify funding and track costs for the joint and individual requirements for DWR and Reclamation that are set-forth by the 2008 U.S. Fish Wildlife Service 2008 Biological Opinion (BiOp) and the 2009 National Marine Fisheries Service 2009 BiOp. These agencies also agreed to use standardized accounting methods and to report this financial data by December 31 of each year. The BOCT agreement provides a standardized accounting method and reporting protocol that could be used for this effort.

²⁰ 2019 Delta Science Plan action 5.3.

accounting. Given the number of State, federal, and other funders, and the complexity of the Delta science enterprise, an independent review could provide valuable insight into the enterprise's efforts.

Issue Two - Limited Interchange among Policy Makers, Scientists, and the Public to Inform Science Funding Priorities and Management Questions

In the past decade, several venues have emerged including the Collaborative Science and Adaptive Management Program/Collaborative Adaptive Management Team (CSAMP/CAMT), Delta RMP, DPIIC, and the Delta nutrient research plan work groups, where decision-makers, scientists, and stakeholders can collaboratively identify management priorities and discuss research and monitoring efforts to address these needs. These more recent science management venues add to longer-standing collaborative groups such as the IEP. Shared science priorities are exhibited in collaborative documents such as the Science Action Agenda (SAA), the IEP Science Strategy, and Delta RMP and IEP work plans. However, there are few opportunities for discussion across these coordinated efforts. This results in a lack of consistent understanding among decision-makers, scientists, and stakeholders of management priorities and how coordinated science efforts link to and support them.

Findings

Limited communication to inform resource allocations

Leaders of public agencies and stakeholder organizations often express frustration that they are presented with multiple requests for funds to support scientific activities but do not have enough information to prioritize them. This can result in redundant efforts or missed opportunities due to the lack of information to justify expenditures.

Unclear alignment of management needs and science linkages to support structured decision making.²¹

Existing efforts lead by CSAMP/CAMT and the Delta Stewardship Council are applying structured decision making approaches; however, there are still limited opportunities for interchange among scientists, decision-makers, and stakeholders where research results and their implications for management are conveyed and management decisions and priorities are articulated to guide science actions. These exchanges are critical elements of structured decision making. The lack of communication can result in different expectations about the extent to which research outcomes can inform management decisions, creating tensions among interest groups.

Limited guidance for compliance monitoring programs

Most monitoring programs in the Delta have been established to inform regulatory processes. Many of these programs have been in place for decades and collect large amounts of data to inform the ecological health of the Bay-Delta Estuary. However, there are no established processes to evaluate the information generated from these efforts and whether they satisfy current informational needs. There is also limited stakeholder engagement for scientific tracking at the program-level. These issues, combined with challenges for the timely dissemination of information, have contributed to a lack of trust and understanding of the value of these monitoring programs.

²¹Structured decision-making is a widely recognized approach for objectively addressing natural resource management issues involving diverse stakeholder groups and competing objectives.

Recommendations

Establish effective interchange between decision-makers, stakeholders, and scientists

Utilize existing groups such as the DPIIC, CSAMP/CAMT, and IEP, to increase solution-oriented dialogue among decision-makers, stakeholders, and scientists. Discussions should include sharing information and identifying opportunities to coordinate across venues. Key to effective interactions is the use of information that is digestible by a wide audience (e.g. data visualization). Use concepts and tools identified in the Delta Science Plan such as the policy-science forum approach²² and SAA to identify shared and conflicting priorities. Increasing opportunities for two-way dialogue between scientists and decision-makers and stakeholders will help develop trust, strengthen linkages between management needs and current research, identify knowledge gaps, increase appreciation for the time it takes to address uncertainty and the effects of management actions on a complex ecosystem, and reduce redundancies.

Promote decision-support tools

Support integrated modeling and structured decision making including the Integrated Modeling Steering Committee efforts in developing a strategy to better integrate physical, biological, and conceptual models of the Delta to support decision-making. Examples of existing efforts to integrate mechanistic and conceptual models include the salmon life cycle model,²³ and current efforts surrounding model integration for Delta smelt and reoperation of the Suisun Marsh salinity control gates.²⁴

Develop protocols to evaluate monitoring programs and the value of information generated

Establish a workgroup composed of State and federal agencies and stakeholders involved in monitoring activities to evaluate current monitoring efforts. Workgroup members should be individuals with authority to provide regulatory direction, have in-depth understanding of the monitoring programs, and knowledge of financial expenditures. These include senior scientists, contract managers, and executive leaders. The upcoming Delta Independent Science Board's reviews of both the Delta monitoring enterprise and IEP governance structure will provide recommendations for improving current monitoring efforts. Program assessments should include identification of management needs, how monitoring activities align with current management needs, how they can be more effective, and opportunities to leverage investments to better support ongoing management decisions. Information exchange should occur on an annual basis at dedicated venues (e.g. annual workshop, an IEP stakeholder project work team meeting).

Issue Three - Need for Consistent Funding Across the Delta Science Enterprise

Although science-based expenditures in the Delta over the past 10 years total nearly \$1 billion, the Workgroup found that overall expenditures in the Delta are notably less than other similar large-scale ecological efforts.²⁵ Public funding for non-regulatory science activities in the Delta from both State

²² See 2019 Delta Science Plan Chapter 2. Policy-Science Forums offer deliberate and direct dialogue among scientists, decision-makers, and stakeholders. The objectives of Policy-Science Forums are to identify scientific uncertainties, clearly define priority management questions, and facilitate exchange among different programs and entities.

²³ <https://www.nwfsc.noaa.gov/research/divisions/cb/mathbio/lifecycle.cfm>

²⁴ <https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Environmental-Services/Interagency-Adaptive-Management-Program/Suisun-Marsh-Salinity-Control-Gates-Action-Pilot-Study.pdf?la=en&hash=18090ADA6265D529CA1981E3A05B3FD024893984>

²⁵ Teneffoss, Aston. 2018. Shared Science for the Sacramento-San Joaquin Delta. Practicum Report.

and federal sources fall short in comparison to ecological systems with similar economic outputs.²⁶ In addition, the majority of the funding for science comes from DWR and the US Bureau of Reclamation,²⁷ but statutory authorities limit expenditures to core monitoring, status and trends monitoring, and some targeted research. While some funds for targeted research have been made available, these funds have been primarily in the form of voter-approved State bonds (e.g. Prop 1), which are sporadic. Large-scale joint solicitations supporting a broad call for research proposals have only occurred once –the 2018 joint Proposal Solicitation Notice²⁸ (PSN) between the Delta Science Program and Department of Fish and Wildlife, with support from the US Bureau of Reclamation.

Findings

Inconsistent and fragmented research efforts

Current targeted research funding typically supports limited-term contracts or grants, resulting in research efforts that only last a few years at a time. Most of this research focuses on one species or stressor, with little coordination across efforts or research focused on larger ecosystem interactions. This, and the lack of dedicated resources for synthesizing available information, prevents a comprehensive understanding of the ecosystem. While support for some long-term research exists, data for many current stressors (e.g. harmful algal blooms, invasive plants) lack long-term data. The current monitoring approach in addressing these stressors is opportunistic, leaving gaps in data and knowledge. There are additional opportunities to coordinate research with existing long-term monitoring efforts.

Limited staff assigned to turn data into information

Monitoring and research programs are limited in both staff and technological capacity to continuously process and analyze the vast amount of data collected, resulting in lack of valuable information for decision making. Current synthesis efforts, such as the IEP synthesis teams and Delta Nutrient Research Plan science workgroups, continue to be *ad hoc* in nature, while the number of positions dedicated to synthesis are inadequate for the scale or frequency of synthesis needed to provide useable and actionable information.²⁹ It should also be noted that some agencies have experienced difficulty in filling positions; filling positions should be prioritized over creating new positions.

Information not sufficiently accessible or digestible by decision-makers and stakeholders

Many scientific articles and synthesis reports are too detailed and lengthy to be useful to decision-makers and the public. Information dissemination can be delayed by the publication process for scientific peer-review, and once published, many journal articles are not freely accessible nor easy to find. Passage of Assembly Bill 1755, or the Open and Transparent Water Data Act, will facilitate data accessibility across multiple platforms; however, reluctance to share data, combined with barriers to process data and release information in a timely manner, continues to leave potentially invaluable discoveries hidden in routinely collected data.

²⁶ San Francisco Bay Delta Watershed: Wide Range of Restoration Efforts Need Updated Federal Reporting and Coordination Roles (GAO-18-473)

²⁷ Funded largely in part through public water agencies.

²⁸ <http://deltacouncil.ca.gov/science-program/delta-science-proposal-solicitation-0>

²⁹ Discussed in *The Future of the IEP: Adapting to New and Emerging Needs – Addressing Key Areas. Discussion Document for IEP Directors Meeting, October 19, 2010*

Recommendations

Develop topic-specific Delta science implementation plans.³⁰

Utilize existing organizations such as CSAMP, IEP, and the Regional Monitoring Programs (RMPs) to develop coordinated study plans. These plans should clearly articulate management issues that will benefit from the science, the expected value of new scientific information, the practical approach to obtain it, and existing funding sources and science funding needs. The 2017-2021 SAA and IEP science strategy can be used as a starting point to identify priority management topics and associated science actions. The draft Delta Smelt Science Plan (CSAMP/CAMT) and Central Valley Regional Board's Nutrient Research Plan provide recent examples of topic-specific plans.

Secure additional sources of reliable funding to achieve Delta science needs

Utilize existing collaborative groups such as CSAMP/CAMT and IEP to address science funding and establish new forums if needed. Participants must include individuals with financial decision-making authority, in-depth understanding of accounting, lead scientists from federal and State agencies, and stakeholders who participate in and/or support science activities in the Delta. Frequent interchange among stakeholders, scientists, and managers and coordination among the different groups will be critical (see recommendations 2.1 and 2.2). Outcomes of these discussions should address how to coordinate and set funding priorities, identify resources (including support for new positions), and avenues to reallocate or leverage current funding (e.g. modernizing technology, eliminating redundancies). The topic-specific science implementation plans described above, the IEP Science Strategy, and the SAA can be used to guide funding priorities.

Support open science by implementing current road maps for collaborative and open data access, analysis, and synthesis

Support current efforts including the IEP Data Utilization Workgroup and California Water Quality Monitoring Council Data Management Workgroup, which provide support for data standardization, sharing, and conduct data needs assessments. Build on existing open science data repositories and sharing opportunities.³¹ Require research supported by public funds to submit results to a shared data repository.³² Building on existing IEP efforts,³³ create "synthesis steering teams" that have the authority to identify priority topics to marshal resources (staff and funding) and to make science accessible to decision-makers. Collaborate with external synthesis centers like the National Center for Ecological Analysis and Synthesis³⁴ that curate datasets for large-scale synthesis efforts.

³⁰ See Delta Science Plan Chapter 5 for more information.

³¹ An example is the Environmental Data Initiative <https://environmentaldatainitiative.org/>

³² [USGS](#) and [NOAA](#) have open data portals and science practice requirements that could serve as models.

³³ For example, the [IEP Synthesis Framework](#)

³⁴ <https://www.nceas.ucsb.edu/>

Support more user-friendly and timely information sharing

Establish a team of experts in science communication to develop guidelines to disseminate technical information to decision-makers, stakeholders, and the public. Communication tools include data visualization, summary papers, and web portals (e.g. Bay Delta Live, EcoAtlas). Guidelines should include strategies to increase communication of preliminary scientific information (e.g. workshop presentations, meeting briefs). Public data repositories and a Delta science tracker (see recommendation 1.2) can also improve transparency and accessibility.

Conclusions and Next Steps

The future of the Estuary, its residents, and California's critical water resources depend on clear answers to questions that can only be addressed by strategic and adequately funded scientific research. Until we critically assess research and monitoring needs and consistently and robustly support science, finding these answers will continue to be challenging.

The recommendations provided here outline a path towards achieving this goal within the Delta but additional challenges remain. Although the white paper does not directly address governance issues, governance and funding issues are deeply intertwined. Ensuring a well-funded science enterprise that provides information linked to critical management questions will require effective science governance, including strong leadership and collective efforts to develop an "effective structure for creative scientific and technical integration".³⁵ In addition, we acknowledge that the Delta is integrally connected to the San Francisco Bay and upstream watersheds. Attempts to link research and monitoring programs across these regions will require substantial support but will result in improved management responses to climate change and other growing challenges. Efforts that further address these two issues include implementation of the Delta Science Plan and actions to address recommendations from the Delta Independent Science Board (see footnote 21).

Collaborative Efforts in Other Systems

Below are examples of collaborative science and management efforts both in California and in other areas in the United States. Although every program has its strengths and weaknesses, each region has taken on innovative approaches to leveraging resources for science activities and governance structures to ensure transparency, inclusion from a wide range of stakeholders, and coordinated efforts.

Southern California Coastal Water Research Project

Originally a joint powers authority supported by Southern California's wastewater agencies, the Southern California Coastal Water Research Project (SCCWRP) has grown to include 14 member agencies spanning wastewater, storm water, and water quality regulatory entities in California. A Commission composed of the 14 member agencies oversee the research portfolio at SCCWRP to maintain relevancy of this science to management needs. They hold public meetings and work

³⁵ <http://deltacouncil.ca.gov/sites/default/files/2019/02/2018-2-14-FINAL-ISB-DPIIC-Letter-20190211.pdf>

together to develop a comprehensive, independent research plan that includes “long-term research and broadly supported priorities for SCCWRP’s future research directions”.

The Great Lakes Observing System

Part of the 11 regional associations of the Integrated Ocean Observing System, the Great Lakes Observing System (GLOS) is an example of a data collection, management, and sharing effort involving international, federal, regional, academic, and private sector participants. The GLOS has lead the “integration of interoperable, easy to access data, products, and related services” among bi-national partners to provide stakeholders and decision-makers with real-time, management relevant information about the Great Lakes. In 2016, the GLOS collaboratively developed a strategy with recommendations for actions and investments over the next five years to further develop and expand the data collection network and build upon existing private-public partnerships.

The Chesapeake Bay Program

The Chesapeake Bay Program is recognized as a clearly organized restoration program with strong partnerships among federal, state, and local governments as well as non-profit organizations and academic institutions. The Program includes several programs and teams including a Modeling Workgroup focusing on integrated modeling supported by the wider science community, a Communications Workgroup to support outreach and communication among the different Program partners, and a Budget and Finance Workgroup.

Missouri River Recovery Program

The program implements management actions that are necessary to comply with the Endangered Species Act by avoiding a finding of jeopardy to three federally listed species on the Missouri River. Planning follows implementation directions in a comprehensive Science and Adaptive Management Plan and employs a standing Independent Scientific Advisory Panel to assure the best available science is used to develop alternatives and evaluate the effects of those alternatives on environmental resources and the human uses of the river. Funding mostly through federal appropriations to the Army Corps of Engineers is allocated to staff support and governance, management actions implemented in an adaptive framework, and a research, modeling, and monitoring program explicitly directed to inform and guide management decisions by evaluating management-relevant hypotheses and confronting key ecological uncertainties.

List of Acronyms

CAMT:	Collaborative Adaptive Management Team
IEP:	Interagency Ecological Program
CSAMP:	Collaborative Science and Adaptive Management Program
RMP:	Regional Monitoring Program
DASW:	Delta Agency Science Workgroup
SAA:	Science Action Agenda
DPIIC:	Delta Plan Interagency Implementation Committee

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Acknowledgments

We would also like to recognize the work that was conducted prior to the development of this document that provided important foundational information: Kate Anderson (Delta Stewardship Council) for her work in preparing material for the Science Enterprise Workshop and Aston Tennefoss (UC Davis) for his Master's Practicum Project with the Office of the Delta Watermaster.



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February 11, 2019

Delta Plan Interagency Implementation Committee
Attention: Susan Tatayon, Chair
980 Ninth Street
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Sent via e-mail to Susan.Tatayon@deltacouncil.ca.gov

Subject: Urgency and Opportunities for Improving Interagency Science and Technical Integration for the Sacramento-San Joaquin Delta

Dear Delta Plan Interagency Implementation Committee Members,

In reviewing the first five-year update to the *Delta Science Plan* and the Delta Stewardship Council's draft *Delta Science Funding Resiliency Strategy*, it became clear to us that the State's overall portfolio of science and technical activities for the Delta is substantial and useful. Yet the scientific enterprise must become better organized and accelerate efforts to address the rapidly growing and interlinked challenges for science-based policy and management decisions for the Delta, including science to support adaptive management and negotiated environmental agreements under trying circumstances.

Environmental conditions are changing at an increasing rate and demand comprehensive scientific advances that take advantage of rapidly evolving technology to meet policy goals and support management strategies for the Delta's future. Climate change, new invasive species, the end of groundwater overdraft, less water from the Colorado River, increasing demand for water exports, and declines in native species fundamentally challenge ecological sustainability in the Sacramento-San Joaquin Delta and water management throughout California. Most scientists acknowledge this. However, without a fundamental shift to more forward-looking science and accompanying policy discussions, it is likely that we will fundamentally mismanage the Delta. When things are moving fast, looking farther ahead is necessary to reduce mishaps.

The State of California's Delta Plan Interagency Implementation Committee, working with local governments and other non-governmental and university expertise, needs to initiate and lead a bolder, forward-looking, and better integrated science and management program that provides policy-makers and managers with better scientific information and management options for the Delta.

Interagency science efforts for the Delta have certainly improved in recent years, but remain insufficient to support the kinds of science-driven policies and solutions needed to address the Delta's diverse, interacting, and rapidly changing management challenges, which routinely span the mandates of multiple agencies. Moreover, climate change will bring higher sea levels, temperatures,

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and evapotranspiration, together with shifts in land use, alterations in inflows, and introductions of new species that will fundamentally change the composition of Delta ecosystems and pose unforeseen challenges for managing water supply and water quality.

Moving forward will require scientific leadership and vision, identification of major scientific priorities, and organizational and funding structures to greatly enhance interagency science integration. This can be accomplished in various ways. The major state, federal, and local agencies and users involved in science for the Delta, along with major non-agency Delta and estuary specialists, should develop a comprehensive scientific needs assessment based on fundamental system-wide scientific and management challenges facing the Delta.³⁶ This could be accomplished with the commission of a task force of leading scientists from inside and outside the Delta system to identify 1) future Delta conditions and fundamental driving forces, and 2) science needs to forecast/predict how the Delta might change under these conditions. Stakeholder engagement also must be an important component of this effort. The Delta Independent Science Board can help to organize and implement the framework for the scientific needs assessment.

In parallel with a scientific needs assessment, specific planning for substantially more aggressive multi-agency organization is necessary to provide leadership and an effective structure for creative scientific and technical integration. Potential organizational structures for promoting scientific and technical integration should include establishing a Joint Powers Authority (e.g., the Southern California Coastal Water Research Project and the San Francisco Estuary Institute/Aquatic Science Center) and/or a system of problem-focused joint science centers that involve experts from a variety of agencies, universities, and NGOs.

Without an urgent and fundamentally more effective approach to organizing science and technical information for the Delta, we can expect a deterioration of the ability of science to support decision-making and solutions for the Delta's problems. This is counter to what is frequently advocated by policy-makers.

History may view this and coming decades as the time when critical decisions about the Delta ecosystem and water management throughout the state should have been made. The time for action is now. We look forward to working with you to address this major issue.

Sincerely,



Stephen Brandt, Ph.D.
Chair, Delta Independent Science
Board brandt.disb@gmail.com

³⁶ Climate change might be valuable as an initial unifying theme for integrating the State's technical and scientific work on the Delta because it is affecting all Delta problems and will create new problems.