Delta Stewardship Council

A CALIFORNIA STATE AGENCY

Delta Science Plan

2026

Strengthening Science in the Sacramento-San Joaquin Delta

Contents

“Science is our single best tool to see into the future, shining a light and guiding us forward together”

DELTA LEAD SCIENTIST DR. LISAMARIE WINDHAM-MYERS

Highlight: Through a combination of bubbles, flashing LED lights, and low-frequency sound, this bioacoustic fish fence helps young, sensitive fish species stay in the Sacramento River to complete their migration out to the ocean instead of entering the interior Delta.

Letter from the Delta lead scientist

As we release the 2026 Delta Science Plan, we find ourselves in interesting times. Little did we know how "grand" our challenges would become when the work began in 2021 to scope this forward-looking science plan. We are seeing skepticism about the foundational value of science, even though it remains our strongest tool for adapting to challenges that we understand as well as challenges that we don't. Science is a fundamentally human endeavor of curiosity and creativity, but growing the science enterprise, along with growing scientists themselves, has become increasingly difficult. Even as we work to strengthen its relevance and representation, science remains a powerful way to understand the world, and we must continue to advocate and communicate its importance as we move forward.

Science is powerful because it is inherently hopeful, inherently optimistic. Science is a progression of lights that guides us into an increasingly uncertain future, illuminating paths and voids. We succeed in growing science when we light a fire through education and communication, and when we support keepers of the flame. We succeed in protecting science when we value this lighthouse we have built, and we succeed in accelerating science when we identify a north star to collectively point to, so we can go farther and faster together.

That is our goal here in the updated Delta Science Plan – to provide a collective platform for this creative and effective science enterprise to use in launching discoveries within an ever-growing solution space. Those discoveries are key to addressing the ever-growing resource and representational challenges of the Sacramento-San Joaquin Delta. From my vantage point as the Delta lead scientist, I see an extensive network of leaders throughout this passionate community, all suggesting practical and aspirational actions that are collectively represented in this collaborative science plan. Together, we are building a relevant and resilient science enterprise for a changing world that can adapt and grow to be more effective through interweaving disciplines and ways of knowing. And I can see it because I am standing on our community's shoulders, your shoulders, the true shoulders of giants. I am eternally grateful for this view, as even more light can be seen on the horizon.

The Delta Science Plan provides the vision, principles, and approaches for coordinating, conducting, and communicating science in the Delta. Each Action plays a part in helping us to address our grand challenges, but some especially relevant Actions that I want to highlight are:

- **ACTION 1.6** | **BUILDING STRONGER SCIENCE AND MANAGEMENT GOAL ALIGNMENT »** Everyone loves a cool science story, but we as a community need to also share the love for science that directly informs management and "moves the needle" on decisions to mediate risks to reliable water supplies, ecosystem

sustainability, and cultural preservation. Aligning research questions, timeframes, and settings with actual agency and economic pivot points will make research efforts imminently more useful and impactful.

- **ACTION 2.3** | **SUPPORT SCENARIO-BASED MODELS THAT ALLOW US TO TEST MANAGEMENT INTERVENTIONS THAT CONSIDER RADICALLY DIFFERENT FUTURE CONDITIONS »** Delta actions, and inactions, often intersect in unpredictable ways. Not exploring future scenarios, even when they are unlikely or when they are expected to lead to undesired outcomes, leaves us poised for unpleasant surprises. From conceptual to numerical to advanced statistical approaches, we have many powerful modeling tools to explore decision optimization, and we should not be afraid to use them.
- **ACTION 3.3** | **INCREASE RESEARCH COORDINATION AT THE WATERSHED AND ESTUARY SCALE THROUGH SYSTEMS THINKING »** Systems thinking, through its search for integration of landscape and societal components, allows us to fully embrace the tools and opportunities that we have to respond to the resource management that we need. Coastal, upland, and societal drivers dance together in the Delta, leading and lagging in different ways, in different places, and increasingly through extreme events. We accelerate a deeper and more nimble understanding of our interwoven system when we collaborate across the land-ocean-human aquatic continuum, as well as across the continuum of modeling approaches.
- **ACTION 4.4** | **BUILD TRUST THROUGH INTENTIONAL AND RECIPROCAL WORKING RELATIONSHIPS »** Our shared knowledge – whether gained through institutional, ancestral, or lived experience – is our primary toolbox, and true sharing takes trust. We can build that trust by intentionally seeking the missing or quiet voices in our community who hit the high notes and the harmonics that can diversify our perception of the problems we face and the solutions we seek. It is a richness we have available to us if we are only brave enough to recognize it.

While our steps may be small, all these intentional actions are essential in order to address our grand challenges. And in some ways, we are light-years ahead of other regions in addressing similar challenges, due in large-part to the value that this science community places on partnership and transparency as fundamental to innovation and insight. The potential and the practice of science are rarely advanced alone, and I sincerely hope we never choose singular paths again. For all our challenges, Delta science today reflects a commitment to community discovery and governance that radiates far beyond the three corners of the Delta – Freeport, Vernalis, and Suisun – informing solutions to statewide goals as well as inspiring collective management actions around the world. May we keep that hard-won perspective and send strength where and when it is needed, to meet our resource challenges of tomorrow.

Lisamarie Windham-Myers

Delta Lead Scientist
Dr. Lisamarie Windham-Myers

Highlight: 2024 Bay-Delta Science Conference in Sacramento, CA. **Credit:** Lynn Takata.

Acknowledgements

This document would not be possible without the energy and enthusiasm provided by the Delta science community. Special thanks to the many participants of the February 2025 Delta Science Plan Workshop for their time and thoughtful insights, to the individuals and agencies who provided input during the public comment period, and to the Delta Stewardship Council's staff for their contributions throughout the process. Review and comments from the Delta Independent Science Board also further improved the contents of the document, and their dedication and time to providing valuable input is much appreciated.

Unless otherwise noted, all photographs are courtesy of the California Department of Water Resources.

Suggested citation

Delta Stewardship Council, Delta Science Program. 2026. 2026 Delta Science Plan: Strengthening Science in the Sacramento-San Joaquin Delta.

Executive summary

The Delta Science Plan, produced by the Delta Stewardship Council's (Council) Delta Science Program, provides the vision, principles, and approaches for conducting, coordinating, and communicating science in the Sacramento-San Joaquin Delta and Suisun Marsh (collectively referred to herein as Delta; California Water Code § 85058), the San Francisco Bay-Delta (Bay-Delta) system, and the broader San Francisco Estuary (estuary). The 2026 Delta Science Plan advances 24 Actions (see Table 1) that collectively strive to tackle four "grand challenges" in Delta science (see Figure 1). The four grand challenges describe major impediments facing the Delta and are designed to push the Delta science community to be more forward-looking and collaborative in our efforts. Like past iterations, this Delta Science Plan, called for in the Council's Delta Plan, aims to strengthen the doing of science across the Delta. Ultimately, Delta science is strengthened by aligning it to better inform the management and advancement of the State's coequal goals for the Delta of providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem, in a manner that protects and enhances the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place (California Water Code § 85054).

The Delta benefits from a strong foundation of high-quality science led by researchers across academic, local, state, federal, tribal, and non-governmental organizations (NGOs). Yet as the pace of environmental change surpasses the traditional pace of science, we must ensure that Delta science remains open, trustworthy, coordinated, and anticipatory. **The 2026 Delta Science Plan calls on the Delta science community to think big and invest in collaborations and relationships that turn shared knowledge into collective action.** We are all accountable for making progress towards a more resilient Delta ecosystem and reliable statewide water supply.

Grand challenge 1

Scientists and managers must anticipate a world in which environmental conditions and regulations may be fundamentally different from those faced today

2026 Delta Science Plan

Grand challenge 2

Environmental change is outpacing the traditional pace of science

Grand challenge 3

Flows of scientific information remain decentralized and poorly connected to communities and decision-makers

Grand challenge 4

Other ways of knowing, especially Traditional Knowledge, remain siloed from decision making

Figure 1 | The four grand challenges facing the Delta are not independent but rather overlapping and interconnected issues that require collaborative and interdisciplinary action.

Each of the 2026 Delta Science Plan's 24 Actions is presented within the context of one of four grand challenges and one of seven cross-cutting themes: Monitoring; Modeling & experimentation; Data accessibility; Collaboration & communication; Synthesis & review; Funding; and Governance & relationships. This framework is intended to emphasize persistent system-wide issues, while making it easier for users seeking specific themes (e.g., Monitoring) to navigate. However, many of the Actions are cross-cutting and intertwined across grand challenges and themes. For example, Actions within the Monitoring theme are intrinsically tied to Funding to support monitoring efforts, Data accessibility practices for using the monitoring data, Modeling & experimentation to interpret the data, Collaboration & communication to share the data, and so on. We encourage readers to use the grand challenge and theme organization more as a guiding framework than strict designations. Each Action also features an associated example (referred to as "Action Example") to showcase existing or planned initiatives that are making progress in addressing the Action, while still encouraging new connections and inspiration for future work.

The 2026 Delta Science Plan continues to advance priorities such as adaptive management, science communication, scientific peer review, and research funding, while also expanding on 1) governance; 2) social science; and 3) Traditional Knowledge and other ways of knowing. These three areas of emphasis have not historically received as much investment, but they are equally important for tackling the four grand challenges identified by the Delta science community.

In addition to the 24 Actions outlined in Table 1, the 2026 Delta Science Plan also includes eight Resources. Six of these Resources (formerly Appendices) have been updated from the 2019 iteration to better reflect our current practices and progress. These Resources provide practical and useful information for the Delta science community and are responsive to the Actions within the Delta Science Plan. In addition to the six that were updated, there are two new additions:

1. **Resource A: Data governance, portals, and online resources**
2. **Resource B: Making science whole: Embedding social science in natural science workflows**

The 2026 Delta Science Plan was developed through a transparent, open, and inclusive process with the broader Delta science community to reflect the collective action that will be necessary for successful implementation (see **Appendix 2: Process to update the 2026 Delta Science Plan** for more details). Our vision for success is a Delta where management decisions are adaptive, science-based, and socially informed – anticipating and responding to environmental change at estuary, ecosystem, and regional scales. We encourage members of the Delta science community to leverage the Delta Science Plan by seeking alignment with existing science planning efforts and utilizing the Actions and tools outlined in this document to guide and strengthen their own efforts towards this vision. Addressing the grand challenges detailed within this plan cannot be accomplished overnight or by one organization alone; success will depend on strong, sustained partnerships that bridge organizational boundaries.

Table 1 | Summary of Actions within each grand challenge and their corresponding theme.

GRAND CHALLENGE	ACTION		THEME
 **GRAND CHALLENGE 1:** Scientists and managers must anticipate a world in which environmental conditions and regulations may be fundamentally different from those faced today.	1.1	Support the ongoing shift from single species to holistic monitoring and management of ecosystems	Monitoring
	1.2	Support horizon scanning to detect and understand emerging signals	Modeling & experimentation
	1.3	Strengthen links between models and data for more streamlined and informed decision-making	Modeling & experimentation
	1.4	Focus on regional resilience to climate change	Modeling & experimentation
	1.5	Improve connectivity between executive, management, and staff/scientist levels	Collaboration & communication
	1.6	Build stronger science and management goal alignment	Synthesis & review
 **GRAND CHALLENGE 2:** Environmental change is outpacing the traditional pace of science.	2.1	Expand support for adaptive management and monitoring to inform decision-making in a changing Delta	Monitoring
	2.2	Invest in enhanced tools and expertise in cutting-edge technology to anticipate near-future conditions	Monitoring
	2.3	Support scenario-based models that allow us to test management interventions that consider radically different future conditions	Modeling & experimentation
	2.4	Support actions to cut green tape and streamline decision-making practices	Collaboration & communication
	2.5	Utilize mechanisms of sharing information more efficiently and effectively	Synthesis & review
	2.6	Implement more responsive and targeted funding structures	Funding

GRAND CHALLENGE	ACTION		THEME
 **GRAND CHALLENGE 3:** Flows of scientific information remain decentralized and poorly connected to communities and decision-makers.	3.1	Support free and open data	Data accessibility
	3.2	Support collaborative venues for efficient flow of information	Collaboration & communication
	3.3	Increase research coordination at the watershed and estuary scale through systems thinking	Collaboration & communication
	3.4	Improve social science literacy	Collaboration & communication
	3.5	Incorporate social science data and disciplines in management decision frameworks	Collaboration & communication
	3.6	Proactively identify opportunities to leverage independent scientific peer review processes to enhance the rigor, transparency, and credibility of science underpinning management and policy decisions	Synthesis & review
	3.7	Increase funding opportunities and capacity for social science research and collaborations	Funding
 **GRAND CHALLENGE 4:** Other ways of knowing, especially Traditional Knowledge, remain siloed from decision-making.	4.1	Respect tribal data ownership and confidentiality	Data accessibility
	4.2	Support more co-produced and community-engaged science	Collaboration & communication
	4.3	Explore ways to expand funding that supports and engages community and tribal expertise	Funding
	4.4	Build trust through intentional and reciprocal working relationships	Governance & relationships
	4.5	Embrace more ways of knowing	Governance & relationships


MOON
CAFE

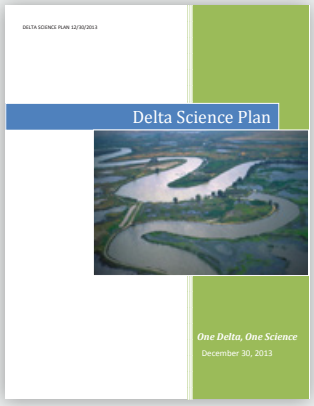
The Delta Science Plan: What it is and why we need it

There are few places in the world with the ecological, economic, cultural, and political significance of the Delta (see Box 1). The region supports a diverse array of complex ecosystems, is home to many threatened and endangered species, is California's first National Heritage Area, and is a place of residence and importance to human communities and tribes, both currently and historically (Luoma et al., 2015). The Delta also provides water for approximately 27 million people and supports California's substantial agricultural economy (Delta Conservancy, 2025). However, over the last century and a half, the Delta has undergone significant transformations due to large-scale changes including draining and poldering of land, impacts from hydraulic mining, upstream and in-Delta water diversions, the introduction of non-native species, subsidence, climate change impacts, and other factors. These changes have reduced the scale, function, and resilience of the Delta ecosystem and made it vulnerable to numerous threats, including floods and long-term droughts (Hartman et al., 2025). There is a shared sense of urgency to take action to protect and manage the Delta's resources. Science is essential to this effort, providing the evidence base needed to understand the Delta's complex dynamics, anticipate future threats, and guide management decisions that balance competing needs. To help organize science activities in the Delta, the Delta Science Plan provides the framework for conducting, coordinating, and communicating science to support this vital region.

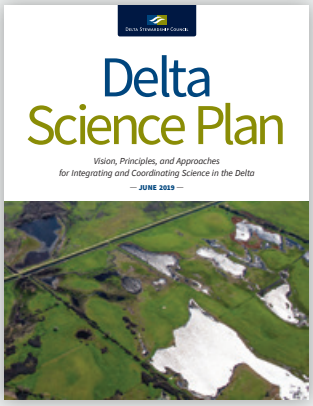
What is the Delta Science Plan?

In 2009, the Sacramento-San Joaquin Delta Reform Act of 2009 (Delta Reform Act) established California's coequal goals for managing the Delta (see Box 2) and created the Council to adopt and implement the Delta Plan, a comprehensive, long-term management plan for the Delta (California Water Code §§ 85084, 85059, and 585302(g)). One of the recommendations in the Delta Plan is the development of the Delta Science Plan by the Delta Science Program (Delta Plan G R1. Development of a Delta Science Plan) that provides a framework for coordinating, conducting, and communicating science in the Delta.

Past Delta Science Plans



2013
Delta Science Plan



2019
Delta Science Plan

BOX 1

THE SACRAMENTO-SAN JOAQUIN DELTA

Background

The Delta provides the water supply for two-thirds of California's population and provides critical habitat and migratory pathways for a diverse set of species – many of which are threatened or endangered. The Delta is also an area of significance for tribes throughout the watershed that have stewarded these lands for time immemorial. A highly engineered mosaic of land uses, the Delta is home to roughly 600,000 residents and sustains a $32 billion agricultural industry in California. The Delta and its ecosystem are also at constant risk of catastrophic damage from climate change, sea-level rise, droughts, floods, earthquakes, invasive species, subsidence (Delta ISB, 2025), and other stressors (NASEM, 2025). In this rapidly changing and intricately connected system, resource management in the Delta has been termed a "devilishly wicked problem" (Luoma et al., 2015).

Geographic significance

The Delta is situated at the confluence of California's Sacramento and San Joaquin rivers (see Figure 2). The region is central to the continuum of ecosystems and management issues connecting freshwater flows within and outside of the Delta (NASEM, 2025).

Given the complexity of the issues and the scope represented in the Delta Reform Act, the Delta Science Plan focuses primarily on the legal Delta and Suisun Marsh. However, it is important to note that tribes throughout the California region viewed and still view the entire watershed that runs from Mount Shasta to the Tulare Basin as one interconnected, culturally sacred system that cannot be demarcated into sections (heard in tribal pre-consultations prior to release of the public draft of the Tribal and Environmental Justice in the Sacramento-San Joaquin Delta paper; Delta Stewardship Council, 2025). The ecological health of the Delta and the reliability of California's water supply are deeply intertwined, underscoring the need for a holistic management approach that considers the full continuum of upstream and downstream processes.

Today's Delta

Challenges in the Delta have many dimensions (e.g., physical, social-economic, and ecological), sometimes conflicting solutions, and substantial uncertainties (Delta ISB, 2026). In a rapidly changing social-ecological landscape, addressing these challenges successfully requires a high level of communication and coordination among scientists, engineers, communities, and decision-makers.

BOX 2

THE SACRAMENTO-SAN JOAQUIN DELTA REFORM ACT OF 2009 (DELTA REFORM ACT) AND THE COEQUAL GOALS

The Delta Reform Act (California Water Code § 85000 et seq.) created in state government the Delta Stewardship Council as an independent agency of the state to "develop, adopt, and commence implementation of the Delta Plan… that furthers the coequal goals." (California Water Code §§ 85200(a) and 85300(a)). "'Coequal goals' means the two goals of

1. providing a more reliable water supply for California and
2. protecting, restoring, and enhancing the Delta ecosystem.

The coequal goals shall be achieved in a manner that protects and enhances the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place," (Cal. Wat. Code § 85054).

Developed through extensive engagement with the Delta science community, the Delta Science Plan represents a shared commitment to improving how science is done and used in the region. We encourage members of the Delta science community to use the Actions and Resources provided in this document to guide and strengthen efforts for a more connected, collaborative, and resilient Delta. The Delta Science Plan is also the first element of the three-part Delta Science Strategy (see One Delta, One Science and the Delta Science Strategy). We invite agencies and organizations working in the Delta to leverage the Delta Science Plan, seek alignment with existing science planning efforts, and collaborate and coordinate resources to implement the Delta Science Plan's Actions and Resources.

Since its first release in 2013, the Delta Science Plan has been updated twice (in 2019 and now in 2026) to reflect emerging concepts, evolving management needs, and new opportunities for action (see **Appendix 1: Implementation Successes: Status of 2019 Science Plan and Relevant Outcomes** for a brief review of progress made on the 2019 Delta Science Plan Actions). While the Delta Science Plan helps inform priorities within the Delta Science Program, the broader intent is to catalyze science activities across the Delta and better coordinate an open Delta science community.

Here, we define the Delta science community as any entity actively participating in science and management actions in the Delta, including federal, state, and local agency scientists, tribes, NGOs, academic researchers, and interested members of the public. **Resource F: Science governance and the collaborative Delta science-scape** provides an updated network analysis of the main collaborative science venues in the Delta and shows almost 200 organizations that participate in at least one of the 12 core venues identified in the analysis. This intended broad audience is reflected in the extensive engagement that has been central to this update process (see **Appendix 2: Process to update the 2026 Delta Science Plan** for details).

Figure 2 | The Delta watershed and areas receiving Delta water.
Adapted from The Delta Plan Figure ES-1.

Why do we need a Delta Science Plan?

A coordinated, science-based approach is essential for managing the Delta and Suisun Marsh to achieve the vision of One Delta, One Science (described in the following section) and to further the coequal goals in a manner that enhances and protects the Delta as an evolving place. The Delta already benefits from a strong foundation of high-quality science conducted by researchers across academic, local, state, tribal, and federal institutions. One of our grandest challenges now is ensuring that this science remains open, trustworthy, and anticipatory – designed to meet the pace and scale of environmental change that is already outpacing the traditional pace of science. The Delta Science Plan offers principles and approaches for advancing not only coordination and communication, but also the integrity, transparency, and adaptability of science – ensuring that the collective knowledge of the Delta science community can guide decisions in an era of rapid change.

The challenge of effective science coordination remains paramount, particularly for complex issues with wide-ranging impacts that cross agency jurisdictions and geographic boundaries, such as the grand challenges (see Figure 1). In the Delta, insufficient flows of information between scientists and decision-makers have contributed to a disconnect that creates barriers to adaptive governance and erodes public trust in decision-making. Each iteration of the Delta Science Plan provides an opportunity for the community to work together to identify tools and strategies that are relevant to current science and management needs. The resulting updated Delta Science Plan serves as a catalyst for collective action, helping to advance towards a more unified and scientifically informed community. See Box 3 for examples of how to use the Delta Science Plan.

BOX 3

THE DELTA SCIENCE PLAN IN ACTION

The Delta Science Plan provides a shared framework for doing science across the whole Delta science community. All who visit the Delta Science Plan are invited to help implement the Actions, learn from the Action Examples, and utilize the Resources. Some specific ways the Delta Science Plan can be used by example audiences are included below.

University biologist: Use **Resource A: Data governance, portals, and online resources** to learn about how to apply open data principles that support discoverable and accessible data and explore a list of resources and Delta-specific data portals to supplement ongoing research.

Agency decision-maker: Refer to grand challenge 4 Actions and Action Examples for entry points and examples for incorporating multiple ways of knowing into decision-making. Action Examples can also help inspire initiatives, identify partners, and build collaborations.

Science funding program staff: Consult Actions 2.6, 3.7, and 4.3 to learn more about pathways to more responsive and targeted funding and explore ways to expand support for projects that engage the social sciences as well as community and tribal expertise. Use **Resource D: Research funding** to understand the Delta Science Program's model for aligning research funding with management needs.

One Delta, One Science and the Delta Science Strategy

The vision of One Delta, One Science refers to an open Delta science community that works together to build a common body of scientific knowledge. Achieving this vision requires a sustained culture of cooperation and stewardship among decision-makers, scientists, managers, interested parties, and the public.

Three guiding documents were developed to form the Delta Science Strategy and to help further the vision of One Delta, One Science at the Council. The Delta Science Plan, the State of Bay-Delta Science (SBDS), and the Science Action Agenda (SAA) each play a different role in promoting the use and understanding of collaborative science in the Delta (see Figure 3). These three distinct, yet interconnected, products are developed by the Delta Science Program with the Delta science community but are not representative of the complete breadth of work, core operations, and strategic thinking of the Council (see Box 4). Updates to each component of the Delta Science Strategy offer an opportunity to refine the approach to furthering One Delta, One Science.

All three guiding documents in the Delta Science Strategy are openly developed and updated based on input from the Delta science community, including the Delta Independent Science Board (Delta ISB), and information gathered from peer-reviewed literature, existing science plans, and synthesis reports. However, these documents alone cannot achieve the vision of One Delta, One Science – the Delta science community must enthusiastically embrace and implement the concepts laid out to ensure science is used effectively to support natural resource management decisions.

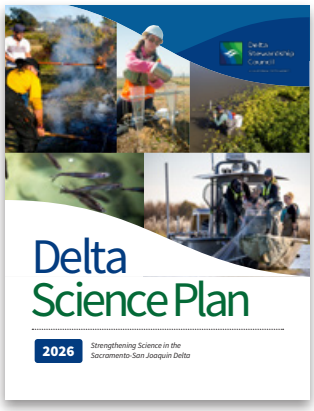
BOX 4

SAN FRANCISCO ESTUARY AND WATERSHED SCIENCE (SFEWS)

In addition to the three guiding documents discussed below, a key success in bringing the vision of One Delta, One Science to fruition and supporting an open and coordinated body of scientific knowledge is the journal SFEWS. Called for and led by past Delta Lead Scientist Dr. Samuel Luoma, this open-access and peer-reviewed journal was launched in 2003 to improve collaboration and access to research about water and watershed issues in Northern California. Today, the SFEWS journal continues to publish high-impact science and research that tackles the complex social-ecological issues of the Delta in an accessible way.

"The idea that came out of the committee was to create a peer-reviewed publication that was authoritative and objective, and that everyone interested in California water could read, and could write for, at no cost."

DR. SAMUEL LUOMA



THE DELTA SCIENCE PLAN

The Delta Science Plan[1] is the overarching "how to" document that identifies the tools, organizational structures, mechanisms, and actions needed to support a more collaborative and integrated Delta science community. This shared framework is developed through an iterative and collaborative process with the Delta science community and represents a shared commitment to improving how science is done and used in the region.

THE STATE OF BAY-DELTA SCIENCE

The SBDS[2] is an ongoing effort to synthesize and communicate scientific knowledge about the Bay-Delta system. It provides science and policy audiences with the current state of the science to support informed decision-making and resource management. The effort aims to distill key advances in our understanding and highlight remaining knowledge gaps for science and policy audiences through the publication of peer-reviewed articles, accessible summaries, and information sheets, as well as other avenues such as speaker series. The SBDS also provides context for the Delta Science Plan and guides updates to the SAA. The 2025 edition[3] features seven articles exploring extreme climate and weather events and their impacts on the Bay-Delta and its watershed.

THE SCIENCE ACTION AGENDA

The SAA[4] identifies "what" specific science actions help achieve the objectives of the Delta Science Plan and proactively address key management questions. The science actions are focused on filling gaps and promoting collaborative efforts. The SAA serves as the common agenda from which agencies and programs can develop more detailed, shorter-term work plans (e.g., the Interagency Ecological Program Annual Work Plan). Further, the priorities in the SAA guide funding decisions of the Delta Science Program and partner organizations. See Box 5 for more information on how the SAA works together with the Delta Science Plan to advance One Delta, One Science.

1. https://deltascienceplan.deltacouncil.ca.gov/
2. https://sbds.deltacouncil.ca.gov/
3. https://sbds.deltacouncil.ca.gov/sites/default/files/2025-04-01-sbds-information-sheet.pdf
4. https://scienceactionagenda.deltacouncil.ca.gov/

BOX 5

ACTIONS TO ADVANCE ONE DELTA, ONE SCIENCE

While the Delta Science Plan represents the planning component of the Delta Science Strategy, the SAA serves as the focusing component (see Figure 3). The SAA prioritizes specific investigable science actions to address management needs and questions, while the Delta Science Plan provides a broader framework for planning how science can be conducted to address these gaps. These two documents both contain "actions" that work together to achieve a common goal. For example, the 2026 **Delta Science Plan Action 3.5** directly supports the work necessary to address the 2022-2026 **SAA Action 6D.**

> **2026 Delta Science Plan Action 3.5:** Use social science data and disciplines to inform management decisions.

> **2022-2026 SAA Science Action 6D:** Identify how human communities connected to the Delta watershed are adapting to climate change, what opportunities and tradeoffs exist for climate adaptation approaches (i.e., agricultural practices, carbon sequestration, nature-based solutions/green infrastructure), and how behaviors vary with adaptive capacity.

This is just one example of a connection between two actions, and there are many other links to be made. We encourage the Delta science community to consult the SAA for further exploration of priority knowledge gaps and a finer focus on specific management needs, and the SBDS for the state of knowledge on a topic.

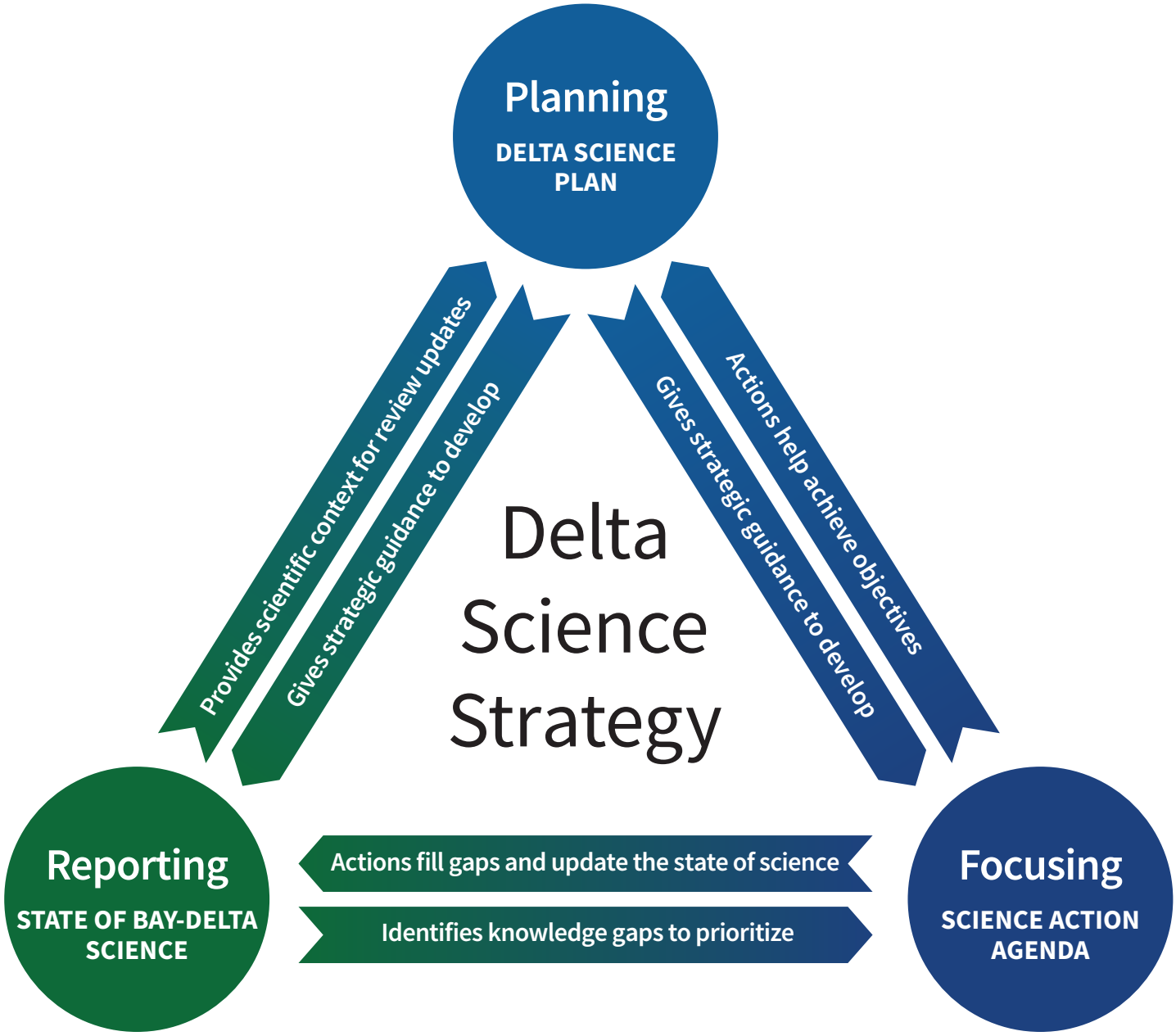


Figure 3 | The Delta Science Strategy.
The three guidance documents that make up the Delta Science Strategy and the relationships among the three elements. These documents are formed openly and transparently based on input from the Delta science community, drawing from a variety of existing documents.

Progress since 2019: What has been achieved so far?

The **2019 Delta Science Plan**[5] included a total of 26 Actions that were organized around six objectives and four thematic chapters. Many of the previous Actions built upon actions in the first Delta Science Plan (2013). There has been substantial progress towards achieving many of these objectives, and some highlights from the last five years are provided below. For more details, see **Appendix 1: Implementation successes: Status of the 2019 Delta Science Plan and relevant outcomes,** which briefly summarizes the status of each of the 26 Actions from the 2019 Delta Science Plan.

Highlights from the 2019 Delta Science Plan's four chapters

1. **Shared Mechanisms to Inform Policy and Management:** Calling for the creation and expansion of tools to support effective coordination and collaboration in the Delta science community, most progress in this chapter was achieved through the creation of new online tracking tools (e.g., Delta Science Tracker), workshops, and early career training.
2. **Modernize, Integrate, and Build the Delta Science Infrastructure:** Many of the Actions within this chapter aimed at building science infrastructure saw progress and yielded completed products, especially those related to social science, monitoring evaluation, and open data resources.
3. **Support Effective Decision-Making Through Science-Based Adaptive Management and Decision Support Tools:** The Actions in this chapter yielded progress related to decision-making by enhancing support for adaptive management and collaborative venues for sharing and discussing resources and lessons learned.
4. **Collectively Support Implementation of The Delta Science Plan:** Many of the efforts from this chapter still have a lot of room for growth, providing opportunities from which the 2026 Delta Science Plan was built.

5. https://deltacouncil.ca.gov/pdf/2019-delta-science-plan.pdf

How is this update different?

Structure

The Actions in the 2019 Delta Science Plan were assigned a lead organization or agency ("Primary Responsibility") to steer implementation, and other "Action Participants" to support. In contrast, the 2026 update contains 24 Actions that are organized around the four grand challenges to Delta science and seven cross-cutting themes: Monitoring; Modeling & experimentation; Data accessibility; Collaboration & communication; Synthesis & review; Funding; and Governance & relationships. This updated framework is intended to emphasize persistent system-wide issues that cannot be addressed by a single entity. The grand challenges and themes are meant to make the document easier to navigate for users seeking specific themes (e.g., Monitoring), but many of the Actions are cross-cutting and intertwined across these organizational silos. We encourage readers to use the grand challenge and theme organization more as a guiding framework than strict designations.

Some Actions may also have this connections symbol referencing an Action from a different grand challenge. These connected Actions are complementary and should be considered simultaneously. They do not necessarily represent an exhaustive list of connected Actions.

Each of the Actions also has an associated example of ongoing efforts coined "Action Example". The Action Example sections are meant to serve as illustrative examples of each Action, highlighting current momentum and/or areas for further investment, motivation, or collaboration. They are by no means a comprehensive review of ongoing or planned activities in the Delta.

Additionally, the 2026 Delta Science Plan includes both Appendices and Resources. While Appendices describe work to develop the current plan and the implementation progress from the previous plan, the Resources provide practical and useful information for the Delta science community and are responsive to the Actions included within this plan. The intention is that these Resources will become stand-alone living documents that will be accessible online, separate from the Delta Science Plan.

Areas of emphasis

The 2026 Delta Science Plan continues to advance priorities such as adaptive management, science communication, scientific peer review, and research funding, but delves deeper into several additional topic areas. Governance, social science, and Traditional Knowledge and other ways of knowing are considered priority tools for tackling the four grand challenges by the Delta science community. These three areas of emphasis have not historically received as much investment, but during the

public outreach process and the February 2025 Delta Science Plan Workshop, all three were raised as equally important for tackling the four grand challenges.

GOVERNANCE

This update addresses governance more directly. Flows of information and collaboration between entities in the Delta (such as agencies and collaborative groups) are highly networked, constituting a classic system of polycentric governance (Eberhard et al., 2017), discussed further within grand challenge 3. The decentralization of Delta science is a persistent challenge, but it has seen vast progress in recent decades, with a shift toward increasing centrality but also increasing complexity. Grand challenge 3: Flows of scientific information remain decentralized and poorly connected to communities and decision-makers, highlights the Delta's polycentric governance system and proposes actions to strengthen communication and coordination across boundaries. Governance in the Delta is further discussed in **Resource F: Science governance and the collaborative Delta science-scape.**

SOCIAL SCIENCES

A major shift in this update is a stronger focus on the social sciences. Humans are a central part of the Delta system, and effective planning must consider how the region impacts the health and well-being of the people who live, work, recreate, and rely on the estuary as well as how their behavior influences the outcomes and success of different management actions. The 2019 Delta Science Plan included a call to establish a Social Science Task Force, and this 2026 iteration builds on that foundation, emphasizing the importance of social science to addressing the Delta's challenges. The 2026 Delta Science Plan includes three social science-oriented Actions (3.4, 3.5, and 3.7) as well as the new **Resource B: Making science whole: Embedding social science in natural science workflows,** which outlines the breadth of social sciences, dispels common myths that limit their application, and offers practical entry points for natural scientists and managers seeking to integrate the social sciences into environmental research and decision-making.

TRADITIONAL KNOWLEDGE AND OTHER WAYS OF KNOWING

Perhaps the most significant change is through the addition of grand challenge 4: Other ways of knowing, especially Traditional Knowledge, remain siloed from decision-making. As used in this document, Traditional Knowledge "…is a body of observations, oral and written knowledge, innovations, practices, and beliefs that promote sustainability and the responsible stewardship of cultural and natural resources through relationships between humans and their landscapes" (Daniel et al., 2022). Traditional Knowledge and other ways of knowing offer valuable insights into the understanding of complex social-ecological systems, but many still struggle to understand how and when to meaningfully interweave them with their work. This under-inclusion has led to a general loss of valuable insights into biodiversity, restoration, and sustainable futures (Simpson, 2001), but presents an opportunity to make improvements to be more inclusive moving forward.

Highlight: Members of the Scotts Valley Band of Pomo Indians and Navajo Nation demonstrate the traditional art of tule boat making. Tule reeds are found in wetlands across California and hold cultural and practical importance for many Native American Tribes.

Grand challenges framework and Action development

In considering how best to update the Delta Science Plan, the Delta Science Program proposed a slightly different approach compared to past Delta Science Plans. Rather than documenting what the community already does well, the focus of this updated plan is on specific grand challenges that, when addressed through coordination and collaboration, can better advance shared goals and accelerate scientific understanding and decision-making. With this more targeted approach, this Delta Science Plan will build on past Delta Science Plans but be more forward-looking and serve as a rallying cry for better coordinated science to advance the coequal goals.

The grand challenges framework

The four grand challenges describe major impediments facing the Delta. By design, the grand challenges are rooted in multidisciplinary literature and encompass the needs of many organizations. **The resilience of the Delta's social-ecological system depends on all vested parties working together to create strategies to address these challenges and prioritize tools and actions that can advance progress.** The grand challenges push us to be more forward-looking and collaborative in our mission.

BOX 6

THE FOUR GRAND CHALLENGES TO DELTA SCIENCE

Grand challenge 1: Scientists and managers must anticipate a world in which environmental conditions and regulations may be fundamentally different from those faced today.

Grand challenge 2: Environmental change is outpacing the traditional pace of science.

Grand challenge 3: Flows of scientific information remain decentralized and poorly connected to communities and decision-makers.

Grand challenge 4: Other ways of knowing, especially Traditional Knowledge, remain siloed from decision-making.

These four grand challenges were selected following the National Research Council (2001) guidance that a grand challenge must be: 1) Compelling for intellectual and practical reasons and offer the potential for major breakthroughs in science or science governance (i.e., potential for impact); and 2) Feasible to address given current capabilities and assuming a significant infusion of resources.

To identify and synthesize grand challenges, a diversity of visionary documents were reviewed that are widely referenced by scientists and managers as perspectives that are relevant to the science of the Delta, its watershed, and the broader San Francisco Estuary. A total of 32 visionary documents, published between 2007 and 2022, were reviewed, and 125 candidate grand challenges were identified. These were further refined into the final four grand challenges (see Box 6 for the criteria used). Please see the **Grand Challenges Essay**[6] for more information regarding the process to identify and synthesize the grand challenges and **Appendix 2: Process to update the 2026 Delta Science Plan** for more details about the Grand Challenges Essay public outreach process.

Action development

The 24 Actions included in this 2026 Delta Science Plan to address the four grand challenges were developed through an iterative process that began with the Grand Challenges Essay and outreach efforts with the Delta ISB, public input period, 2024 State of the Estuary Conference, 2024 Bay Delta Science Conference, and February 2025 Delta Science Plan Workshop. The February 2025 Delta Science Plan Workshop, which hosted 99 participants over two days, collected feedback on strategies to address the grand challenges, resulting in a total of 533 individual comments. These comments were merged with 46 actionable items from the Grand Challenges Essay and distilled into 24 final Actions, which are included in this plan based on topic, specificity, and framing. More details on this process are included in **Appendix 2: Process to update the 2026 Delta Science Plan**.

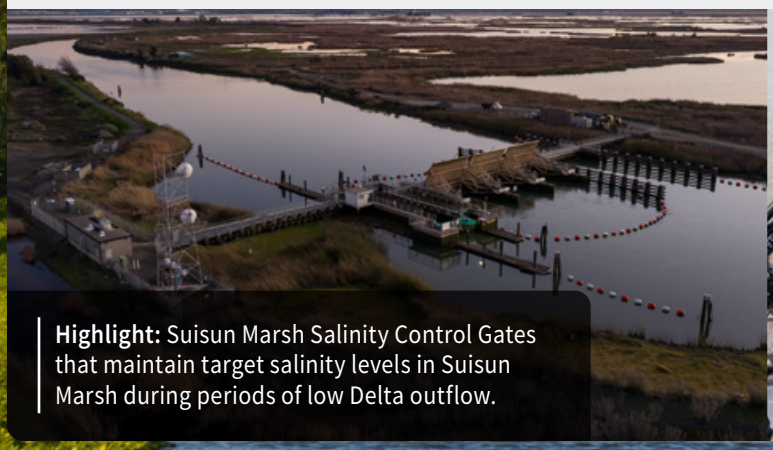
The following four chapters focus on each of the grand challenges. Each chapter provides background on the grand challenge and outlines Actions identified by the Delta science community to address it. To illustrate how these Actions are already moving forward, each Action includes an associated Action Example that showcases ongoing or planned efforts, giving a sense of current momentum in each area. This framework was chosen to showcase existing initiatives while encouraging new connections and inspiration for future work.

6. https://deltascienceplan.deltacouncil.ca.gov/sites/default/files/2024-11-20-grand-challenges-in-delta-science-essay.pdf

Grand challenge 1

Scientists and managers must anticipate a world in which environmental conditions and regulations may be fundamentally different from those faced today.

The Delta is a highly interconnected social-ecological system experiencing rapid change across physical (e.g., levee conditions, water exports, subsidence), ecological (e.g., shifting species distributions, climate change), and social (e.g., economic, political, environmental justice) dimensions. Together, these dynamics are transforming the Delta in complex and unpredictable ways. Without comprehensive social-ecological monitoring and a holistic management approach, we may overlook key signals of environmental tipping points, invasions, population declines, levee breaches, or social vulnerabilities. We find ourselves in a situation where we are anticipating a future that cannot be predicted based on past experiences alone. This will require scientists and managers to work closely together to anticipate and prepare for a world in which environmental conditions and regulations may be fundamentally different from those faced today. The following chapter identifies Actions to address grand challenge 1.



Highlight: Suisun Marsh Salinity Control Gates that maintain target salinity levels in Suisun Marsh during periods of low Delta outflow.

Highlight: Sampling to support water quality analysis and phytoplankton, zooplankton, and benthic community studies.

Monitoring

ACTION 1.1 | SUPPORT THE ONGOING SHIFT FROM SINGLE SPECIES TO HOLISTIC MONITORING AND MANAGEMENT OF ECOSYSTEMS

Current ecological monitoring and resource management in the Delta is primarily driven by regulations and permits focused on individual listed species, such as Delta smelt and winter-run Chinook salmon. While this remains important, focusing primarily on single species leaves critical gaps in our understanding of complex, interconnected dynamics of the broader ecosystem and limits our ability to anticipate system-level responses. There has been a recent push towards managing for ecosystem, food-web, or functional goals, which allows us to better account for the cumulative effects of regulatory and management actions. Shifting to a more holistic framework does not replace single-species monitoring and management but rather situates those efforts within a broader framework of ecosystem health that considers the drivers of change, not just their results. This paradigm shift requires coordination across local, state, and federal levels at the watershed/estuary scale to integrate diverse monitoring data into models that can help us to understand, anticipate, and manage system-level dynamics. See Box 7 for a more in-depth discussion of monitoring in the Delta.

See also Action 3.3: Increase research coordination at the watershed and estuary scale through systems thinking

Action Example 1.1 | Delta Plan Ecosystem Amendment

In 2022, the Council adopted an **amendment to the Delta Plan Chapter Four**[7] (Protect, Restore, and Enhance the Delta Ecosystem). This amendment focuses on restoring ecosystem function and implementing strategies to provide a comprehensive approach to ecosystem protection, restoration, and enhancement in the Delta. Ecosystem function, in this context, represents the full range of physical and biochemical processes that sustain an ecosystem over time and space (Naeem & Wright, 2003). By focusing on restoring ecosystem functions, through actions such as establishing large, interconnected habitats, managers can support not only individual species such as salmon, but the broader suite of native Delta species and the resilience of the ecosystem as a whole.

Modeling & experimentation

ACTION 1.2 | SUPPORT HORIZON SCANNING TO DETECT AND UNDERSTAND EMERGING SIGNALS

Horizon scanning is a systematic search for potential threats and opportunities to identify future challenges we have not yet experienced. Unlike routine monitoring that tracks ongoing change, horizon scanning is forward-looking and seeks to look out further and detect emerging trends before they fully manifest. In an era of accelerating change where historical patterns don't always reliably predict future conditions, this is essential for proactively addressing future risks. Horizon scanning can help identify actions needed to avoid approaching tipping points in rapidly evolving situations such as the spread of invasive species and development of harmful algal blooms (HABs) (Sutherland & Woodruff, 2009). Effective horizon scanning relies on the integration of long-term monitoring data and scenario-based modeling and decision support tools that can help managers test responses before thresholds are crossed. These tools are particularly important in consideration of compound risks such as drought, salinity intrusion, and sea level rise.

7. https://deltacouncil.ca.gov/blogs/updated-vision-and-guidance-for-restoration

Action Example 1.2 | ARkStorm 2.0

ARkStorm 2.0[8] is a climate-informed extreme scenario generated from climate model projections, based on a series of intense atmospheric storms that hit the western U.S. coastline over approximately one month. By modeling potential future storm sequences before they occur, ARkStorm 2.0 applies horizon scanning principles to assess risk, anticipate flooding vulnerabilities, and inform proactive resilience planning by testing how systems would respond to extreme winter storms under a changing climate. ARkStorm 2.0 can also help identify critical uncertainties and data gaps – highlighting where current models, monitoring systems, or planning frameworks are insufficient to predict system responses under extreme conditions. Addressing these uncertainties can strengthen our horizon scanning framework.

ACTION 1.3 | STRENGTHEN LINKS BETWEEN MODELS AND DATA FOR MORE STREAMLINED AND INFORMED DECISION-MAKING

Strengthening the links between models and data is essential for timely and adaptive management. While both are often technically strong, they are frequently institutionally siloed, limiting usability. Investing in transparent, open modeling environments and "collaboratories" can better integrate real-time and long-term data with models capable of scenario analysis, uncertainty exploration, and user-centered visualization. For example, continuous water-quality monitoring and remote-sensing data can be used to inform models that predict the likelihood of HABs. Improving interoperability and accessibility of both models and datasets across agencies will further support coordinated decision-making. Additionally, stronger links between models and data can also help us pinpoint key uncertainties in models that new data could inform, improving predictive capacity.

See also Action 2.3: Support scenario-based models that allow us to test management interventions that consider radically different future conditions

Action Example 1.3 | The Delta Modeling Collaboratory

In 2025, the Delta Science Program launched three modeling projects as part of a scoping effort for a Delta Modeling Collaboratory[9], an envisioned collaborative environment where researchers, managers, and others from diverse disciplines and communities come together to develop, integrate, and use models and data for simulating and understanding complex systems. Individually, these three pilot projects are exploring modeling approaches for predicting cyanobacterial HABs, evaluating salinity intrusion, and improving our understanding of tidal wetland food webs in the Delta. Through its efficiencies of shared resources (data and code libraries, visualizations, etc.), the Delta Modeling Collaboratory is envisioned to accelerate discovery that serves the broad needs of the Delta science and management community and beyond. As of 2026, the project teams and Delta Science Program staff are developing a white paper to summarize outcomes and prioritize resource needs to support future phases and sustained support for the Delta Modeling Collaboratory.

8. https://www.dri.edu/project/arkstormsierrafront-2-0/
9. https://deltacouncil.ca.gov/delta-science-program/collaborative-modeling

ACTION 1.4 | FOCUS ON REGIONAL RESILIENCE TO CLIMATE CHANGE

In addition to local issues, the Delta's social-ecological system is heavily influenced by actions that occur outside of the Delta, such as upstream water management practices and downstream land use and water demand. These external complexities and increasing climate volatility make regional climate adaptation planning efforts more important than ever. Scenario-based, watershed-to-estuary analyses can help reveal cross-regional trade-offs and support more coherent adaptation strategies. For example, **Flood-MAR**[10] (Flood-Managed Aquifer Recharge) is a voluntary resource management strategy that uses flood water resulting from, or in anticipation of, rainfall or snowmelt for managed aquifer recharge on agricultural lands and working landscapes. This regional approach results in local benefits by reducing flood risk and improving groundwater sustainability. Additional holistic and systemic approaches to climate adaptation are essential to achieving Delta resilience goals.

Action Example 1.4 | The Delta Adapts Adaptation Plan and Delta Climate Adaptation Team

Since 2018, the Council has led a two-part climate initiative called "Delta Adapts," consisting of a Vulnerability Assessment and Adaptation Plan. The **Delta Adapts Adaptation Plan**[11] takes a comprehensive, regional approach to climate resiliency that cuts across regional boundaries and addresses how Delta communities, infrastructure, and ecosystems can adapt to climate change. The Council will rely on Delta Plan Interagency Implementation Committee (DPIIC) leadership to guide the implementation of the Adaptation Plan. As of early 2026, the Council is standing up a Delta Climate Adaptation Team (DCAT) composed of adaptation practitioners across the Delta to collaborate on shared challenges and opportunities for climate adaptation. The DCAT is expected to extend adaptation decision-making beyond government by engaging with those historically excluded from public process, including tribes and environmental justice communities.

BOX 7

MONITORING MATTERS

Monitoring is essential for understanding change in the Delta – tracking ecosystem status and trends, establishing baselines, evaluating management actions, and identifying emerging risks. It is also central to adaptive management, providing the information needed to assess outcomes, reassess actions, and respond to changing conditions.

Across the Bay–Delta, networks of real-time continuous monitoring stations collect water quality and quantity data (e.g., water levels, flow, salinity, turbidity) as well as meteorological variables (e.g., air temperature, precipitation, evapotranspiration) that managers use daily to balance the needs of communities, agriculture, and ecosystems. These decisions have important public health implications, including drinking water quality, agricultural irrigation, habitat conditions, and recreation for the Delta's thousands of residents and visitors. Water quality and quantity monitoring can also help anticipate, prepare for, and mitigate events before they occur, such as forecasting HABs, floods, or water supply disruptions.

Additional types of monitoring efforts in the Delta include fish counts (i.e., Chinook salmon, steelhead, Delta smelt), phytoplankton and zooplankton assessments to better understand food web dynamics, habitat surveys to evaluate the quality and availability of habitats for different salmonid life stages, detecting and tracking invasive species, and more. For more examples and information see the **National Academies Review of the Long-Term Operations of the Central Valley Project and the**

10. https://floodmar.org/

11. https://www.deltacouncil.ca.gov/delta-plan/climate-change

BOX 7 | *Continued*

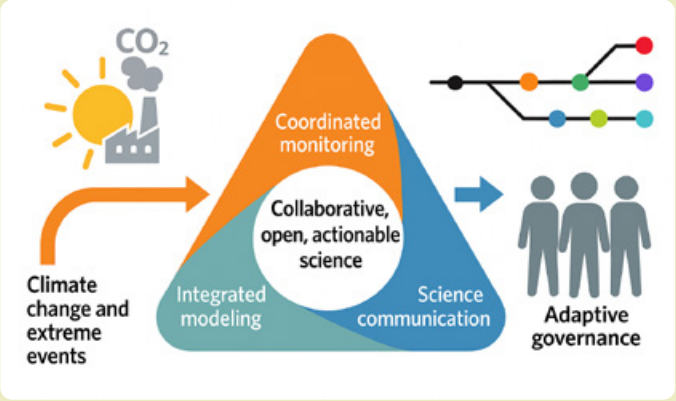
State Water Project[12]. Beyond monitoring ecological and hydrological conditions, efforts such as the **Delta Residents Survey**[13] (see Action Example 3.5 for more information) have expanded monitoring to include social well-being, establishing baselines that can track how management decisions affect Delta communities over time. There is also growing awareness in the Delta that Indigenous-led monitoring can provide rigorous, place-based ground-truthing that can complement predominant scientific methodologies while centering culturally important indicators such as fisheries and wildlife to generate new insights (Colombano et al., 2025). Integrating these different types of monitoring data with predictive and scenario-based models can translate these diverse indicators into real-time decision-relevant insights and support more adaptive management.

Monitoring in the Delta is carried out by a large and diverse enterprise of State (e.g., Department of Water Resources, California Department of Fish and Wildlife) and Federal (e.g., U.S. Bureau of Reclamation and U.S. Geological Survey) agencies and local partners. The 2022 **Review of the Monitoring Enterprise in the Sacramento-San Joaquin Delta**[14] by the Delta ISB reported 132 organizations that implement, fund, or support monitoring across the Delta. Collaborative venues such as the **Interagency Ecological Program**[15], the **California Water Quality Monitoring Council**[16], and the **Delta Regional Monitoring Program**[17] help align efforts, but continued coordination is needed (Delta ISB, 2022). The effectiveness of monitoring depends on coordination across organizations, open data management and sharing practices, and ensuring that information is accessible and usable for decision-making.

Disrupted, inconsistent, or poorly coordinated monitoring can lead to missed warning signs, delayed interventions, and heightened public health and safety risks, such as contaminated fish from mercury or HAB toxins, levee breaches, and unchecked spread of invasive species. Missing these signals can have cascading impacts on the Delta's social-ecological systems and erode public trust.

Monitoring is one of the seven themes in the 2026 Delta Science Plan, with three Actions focused specifically on supporting holistic ecosystem monitoring (Action 1.1), expanding adaptive monitoring (Action 2.1), and investing in advanced tools and expertise to anticipate near-future conditions (Action 2.2). The importance of monitoring is also woven throughout the rest of the Delta Science Plan and Delta Science Strategy. For example, monitoring underpins progress on scenario-based modeling to test management interventions (2026 Delta Science Plan, Action 2.3) and is central to the 2022-2026 SAA's Management Need 2: Enhance monitoring and model interoperability, integration, and forecasting.

Sustaining a robust, coordinated monitoring enterprise that shares data freely and openly is essential to informed decision-making and the long-term resilience of the Delta.



Adapted from Colombano et al. (2025), this conceptual model describes how coordinated monitoring, integrated modeling, and science communication work together to support adaptive governance.

12. https://www.nationalacademies.org/projects/DELS-WSTB-22-01
13. https://www.openicpsr.org/openicpsr/project/195447/version/V2/view;jsessionid=2E19DBE12440F0DBD4FCF4AF3FC7E657
14. https://deltacouncil.ca.gov/pdf/isb/products/2022-03-22-isb-monitoring-enterprise-review.pdf
15. https://iep.ca.gov/
16. https://mywaterquality.ca.gov/
17. https://deltarmp.org/

Collaboration & communication

ACTION 1.5 | IMPROVE CONNECTIVITY BETWEEN EXECUTIVE, MANAGEMENT, AND STAFF/SCIENTIST LEVELS

When scientists, managers, and executives aren't well connected, their different perspectives can create blind spots. Scientists may not fully understand management's constraints and tradeoffs, while executives and managers may not always appreciate how science is best performed, its limitations, what success looks like, or how to interpret scientific products at a technical level. Additionally, each of these groups has different constituencies to which they are required to be responsive. These disconnects can lead to inefficient use of resources, duplication of effort, or science that doesn't directly serve decision-making needs. Improving connectivity across these groups fosters a shared understanding of needs and priorities, strengthens trust, and enables resources to be utilized more effectively. To get there, we need repeated opportunities for interaction, continued investment in fellowships, internships, and mentorship programs (see Box 8), training in science-to-policy communication, a shared lexicon, and inclusive forums (i.e., "collaboratories", see Action 1.3) where scientists, practitioners, and policymakers can work together to understand each other better. Removing communication barriers and creating trust-based networks helps align knowledge with power, ensuring that technical expertise and decision-making authority are more effectively integrated (Rittelmeyer et al., 2025).

Action Example 1.5 | Delta Plan Interagency Implementation Committee (DPIIC)

DPIIC[18] strives to facilitate Delta Plan implementation through coordination, collaboration, and supporting shared national, statewide, and local goals for the Delta (California Water Code § 85204). DPIIC functions to build trust, improve connections across diverse agencies and perspectives, and improve science-policy communication. It is also a forum to highlight key projects of shared interest across agencies, such as restoration, flood safety, and recreation. An example of DPIIC improving connectivity between executive, management, and staff/scientist levels is the establishment of the Restoration Subcommittee in 2022. This Subcommittee brings together scientists and managers to identify and implement strategies that reduce barriers to landscape-scale restoration and enhance estuary-wide restoration coordination.

18. https://deltacouncil.ca.gov/dpiic/

BOX 8

BUILDING THE NEXT GENERATION OF DELTA SCIENCE LEADERS

Investing in fellowships, internships, and mentorship programs is essential for strengthening the Delta science community and training the next generation of science leaders. Programs at progressive educational stages – from middle school through postdoctoral training – help build expertise, expand professional networks, and improve connectivity between science, policy, and communities. Programs such as the **Estuary Youth Council**[19], hosted by the San Francisco Estuary Partnership, empower and support youth from marginalized communities to become influential leaders in the planning, management, and decision-making of the San Francisco Estuary. At the undergraduate level, the Delta Stewardship Council and other California agencies host **Executive Fellows**[20] and **CivicSpark Fellows**[21] to gain hands-on experience. Graduate student fellowships such as the **Delta Stewardship Council's Delta Science Fellowship**[22], which pairs graduate students with community mentors, and post-graduate opportunities like the **California Council on Science & Technology (CCST) Science & Technology Policy Fellowship**[23] and the **California Sea Grant State Fellows Program**[24] help bring early career scientists into policy and decision-making spaces. The Delta science community has an important role in helping to create and sustain opportunities such as these to foster a well-trained and representative workforce. These opportunities can also help improve connectivity across science and management decisions or staff and executive levels over time through exposure and learning.

Synthesis & review

ACTION 1.6 | BUILD STRONGER SCIENCE AND MANAGEMENT GOAL ALIGNMENT

The goals of Delta scientists and managers do not always align, as decision-making must balance many competing priorities regarding issues such as agricultural production and water quality, as well as their organizational missions and funding constraints. Strengthening this alignment requires collaborative processes to co-produce shared goals, including jointly identifying research questions, metrics, and timelines. These collaborations must value the needs and insights of managers, scientists, and other involved parties to make progress. Such co-production can increase relevance, accountability, and uptake of science in management decisions. In addition, decision support frameworks can help improve goal alignment by identifying high-priority uncertainties that, if addressed, could lead to different management choices (Schwartz et al., 2018). This approach can help direct scientific efforts and limited research funding toward projects that address the most pressing challenges.

Action Example 1.6 | Science Action Agenda

The **SAA**[25] is a four- to five-year focused science agenda for the Delta that prioritizes and aligns science actions to inform management decisions, identifies major knowledge gaps, and promotes collaborative science. As part of a broader Delta Science Strategy (see Figure 3), the SAA establishes a foundation for funding critical science investigations (e.g., helping guide the Delta Research Awards and Delta Science Fellowships) and tracking the impact of science activities. The SAA is created by and for the Delta science community and led by the Council.

19. https://www.sfestuary.org/estuary-youth-council/
20. https://www.csus.edu/center/center-california-studies/capital-fellows/#executive-fellowship-program
21. https://civicsparkfellowship.org/fellow-faq/
22. https://deltacouncil.ca.gov/delta-science-program/research-funding-and-fellowships
23. https://ccst.us/ccst-science-fellows-program/
24. https://caseagrant.ucsd.edu/students/fellowships
25. https://scienceactionagenda.deltacouncil.ca.gov/

Grand challenge 2

Environmental change is outpacing the traditional pace of science.

Environmental conditions in the Delta are rapidly changing due to climate change and human activities. Furthermore, the Delta also experiences abrupt, high-impact events such as levee failures, heatwaves, species invasions, water management actions, and new infrastructure projects that can alter a system almost immediately, though it may take years to understand and manage their full impacts. As conditions become increasingly unpredictable, traditional scientific approaches to understanding and responding are being challenged. This grand challenge reflects the need to carry out science more efficiently and nimbly to assess risks while reducing uncertainty in forecasting responses to interventions. As knowledge expands, scientific uncertainty also grows, but planning frameworks, such as decision-making under deep uncertainty and improved communication protocols between scientists and managers, can help address this uncertainty. Voluntary and collaborative groups may also be well-suited to address this need by bringing together diverse interests to focus on cross-perspective information needs for water and ecosystem management. The following chapter identifies Actions to address grand challenge 2.

Highlight: The Lower Elkhorn Basin Levee Setback Project 'set back' 7 miles of levees by approximately 1,500 feet to expand the capacity of the Yolo and Sacramento Bypasses, reducing flood risk and improving ecosystem function.

Highlight: Researchers gather data from eddy covariance flux towers on Twitchell Island after a pilot-scale burn to track carbon sequestration and water use.

Monitoring

ACTION 2.1 | EXPAND SUPPORT FOR ADAPTIVE MANAGEMENT AND MONITORING TO INFORM DECISION-MAKING IN A CHANGING DELTA

Adaptive management is a science-based approach for making management decisions under uncertain conditions rather than delaying action until more information is available (see Figure 4). Fundamental to adaptive management is its cyclical nature: management actions are modeled, implemented, and monitored so that lessons learned from each effort can inform the planning and implementation of future actions. As climate change continues to reshape environmental conditions in increasingly unpredictable ways, adaptive monitoring (i.e., modifying monitoring to address emerging issues) will be essential for tracking and detecting changes. Expanding adaptive monitoring and management requires dedicated, sustainable, and long-term funding; flexible regulatory frameworks to facilitate changes; improved communication, collaboration, and data sharing across projects; and inclusive governance structures that incorporate diverse values and perspectives.

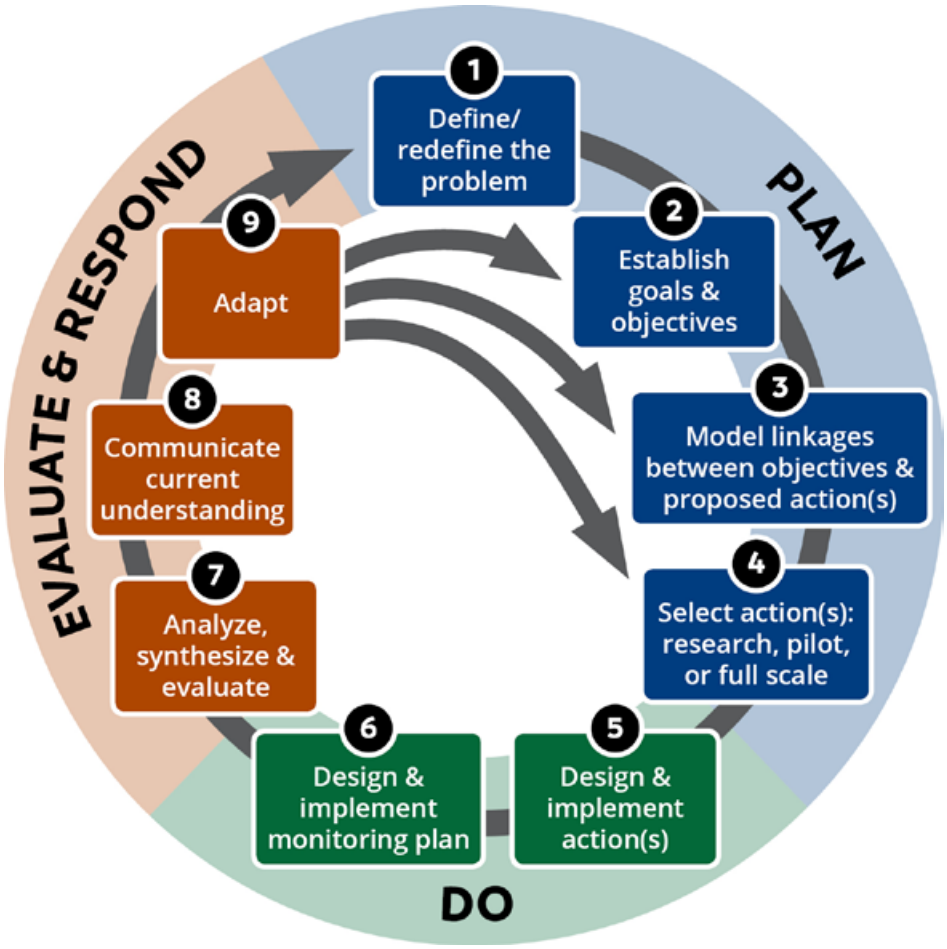


Figure 4 | The nine-step framework for adaptive management, as depicted in the Delta Plan. Boxes represent steps in the process, and the circular arrow represents the general sequence of steps. The additional arrows indicate possible next steps to address the problem or revise the selected action based on what has been learned.

Action Example 2.1 | California State Water Resources Control Board's Bay-Delta Monitoring and Evaluation Program (BDMEP)

The monitoring and evaluation program (BDMEP)[26] proposed in the latest Bay-Delta Water Quality Control Plan identifies biological, ecological, and water quality monitoring activities needed to assess compliance with the Plan's requirements and inform adaptive management and potential future updates of the Bay-Delta Plan. These monitoring activities build from existing monitoring efforts and establish baselines, identify outflow needed for ecological benefits, identify and evaluate changes in abundance and distribution of lower food web and fish populations, and develop a better understanding of ecological interactions to inform management actions. The proposed initial BDMEP will then be expanded to a more comprehensive program to cover monitoring activities needed for the entire Bay-Delta watershed.

ACTION 2.2 | INVEST IN ENHANCED TOOLS AND EXPERTISE IN CUTTING-EDGE TECHNOLOGY TO ANTICIPATE NEAR-FUTURE CONDITIONS

Cutting-edge tools and technologies – such as remote sensing, environmental DNA (eDNA), artificial intelligence (AI), and advanced forecasting methods – are already offering critical time and resource efficiency gains and improving our ability to predict or track water supply, water quality, salinity, and ecosystem responses that enable more timely and informed management decisions. These new tools can work alongside long-standing methods in an adaptive management framework to add insight, enhance monitoring capabilities, and bolster understanding. To effectively implement and integrate these tools, agencies must also invest in workforce development by hiring and training staff in data science and emerging techniques, and by supporting early-career scientists in building expertise with new technologies. These investments help ensure that new information is communicated in interpretable formats and can be readily used by non-technical decision-makers. See Box 9 for a discussion of AI tools in the Delta.

Action Examples 2.2 | Forecast Informed Reservoir Operations (FIRO) and AquaWatch

FIRO[27] is a reservoir operations strategy that provides better information for decisions on retaining or releasing water. Weather and streamflow forecasting have undergone significant improvements over the past 50 years, thanks to investments in research, modeling, monitoring, and advanced technology. As forecast skill has improved, reservoir operations have leveraged these enhanced forecasts by integrating flexibility into operational policies to maximize reservoir storage, meet flood control objectives, and mitigate flood risks as the volatility of extreme storms (e.g., atmospheric rivers) increases (Gershunov et al., 2025).

AquaWatch[28] is an integrated water quality monitoring and forecasting system developed by Australia's national science agency, CSIRO (Commonwealth Scientific and Industrial Research Organisation). The system combines data from on-site water sensors with satellite observations, applying advanced data analytics and AI to deliver near-real-time updates and short-term forecasts of water conditions. Researchers in California have partnered with CSIRO to pilot AquaWatch and assess its utility for regional monitoring in the Delta. The integrated forecasting capability provided by AquaWatch enables managers to anticipate water quality changes several days in advance, supporting more proactive and informed decisions for agriculture, ecosystem protection, and water supply reliability.

26. https://www.waterboards.ca.gov/bay_delta/bay_delta_plan/docs/rev-draft-sacdelta-bdplan-updates-appendix-a.pdf
27. https://cw3e.ucsd.edu/firo/
28. https://www.csiro.au/en/about/challenges-missions/aquawatch

BOX 9

ARTIFICIAL INTELLIGENCE IN DELTA SCIENCE

Many people have encountered artificial intelligence through generative AI tools such as ChatGPT (OpenAI) or Gemini (Google), just to name a few. However, generative AI is only one branch of a much broader set of technologies, such as machine learning and deep learning. AI is increasingly being used in the Delta – from **analyzing fish passage footage at monitoring stations at a fish ladder on the lower Mokelumne River**[29], to improving hydrologic forecasts (see Action Example 2.2: **AquaWatch**[30]), and predicting salinity changes on hourly scales (Qi et al., 2022).

Applications of AI can expose gaps in scientific understanding as well as increase efficiency, such as by processing large and complex datasets in near real time to reveal patterns that may otherwise go undetected. At the same time, AI raises important ethical concerns related to data privacy, intellectual property, and transparency (Blau et al., 2024); as well as environmental costs, including significant electricity consumption and related emissions, expanded energy infrastructure, and freshwater demands for cooling the data centers needed to operate AI systems (Xiao et al., 2025).

While there are no AI-specific actions within the 2026 Delta Science Plan, many of the actions will likely be implemented using AI-enabled tools. As AI capabilities and applications continue to expand rapidly, continued exploration and learning are necessary so that we can develop policies and best practices that provide appropriate guardrails while remaining adaptable to change. We are at a pivotal moment and must proactively establish clear best practices for transparency, data governance, and equity to ensure the responsible use of AI in science and management.

Modeling & experimentation

ACTION 2.3 | SUPPORT SCENARIO-BASED MODELS THAT ALLOW US TO TEST MANAGEMENT INTERVENTIONS THAT CONSIDER RADICALLY DIFFERENT FUTURE CONDITIONS

Uncertainty surrounding future environmental, social, and economic conditions strongly influences how decisions are made and how well those decisions hold up over time. Deep uncertainty refers to unpredictable events or system variability that cannot be reliably described using existing data, models, or scientific understanding. When probabilities of uncertain events cannot be estimated, they may be omitted from research and planning. Tools for decision-making under deep uncertainty (DMDU) assist agencies in planning more effectively for the future by helping to avoid costs associated with being underprepared for an event (Stanton & Roelich, 2021). While DMDU approaches cannot eliminate the risk of harm entirely, they strengthen preparedness and improve recovery rates by equipping decision-makers to respond more effectively when challenges arise. A central DMDU approach is scenario-based modeling, which uses scenarios to explore a wide range of possible outcomes to evaluate when a management strategy may fail or become maladaptive and to include risks that may be underestimated or omitted, often due to common cognitive biases (e.g., normalcy bias, optimism bias). When used alongside existing models and data, these approaches can strengthen preparedness and inform more resilient management decisions (Schirrmeister et al., 2020).

See also Action 1.3: Strengthen links between models and data for more streamlined and informed decision-making

29. https://calsport.org/how-artificial-intelligence-will-help-count-fish/

30. https://www.csiro.au/en/about/challenges-missions/aquawatch

Action Example 2.3 | Delta ISB's review "Understanding Decision-Making Under Deep Uncertainty" (DMDU)

The Delta ISB reviewed scientific tools and concepts that can increase the capacity to anticipate and adapt to growing uncertainty of future conditions in the Bay-Delta system. This review[31] examines the techniques and recommendations, including structured scenario development methods, that can be applied to the Delta to better characterize and prepare for uncertainty, thereby improving decision-making processes. One key takeaway was that not all decisions will benefit from the use of DMDU tools, but the effort can be worthwhile for decisions that are complex, difficult to reverse, and costly, so that certain management decisions don't commit us to suboptimal outcomes.

Collaboration & communication

ACTION 2.4 | SUPPORT ACTIONS TO CUT GREEN TAPE AND STREAMLINE DECISION-MAKING PRACTICES

Cutting the Green Tape[32] is a statewide California initiative to accelerate the pace and scale of habitat restoration by streamlining and improving government processes. Efforts to "cut green tape" aim to improve interagency coordination, clarify permitting pathways, and simplify funding processes – while still paired with transparent, defensible, and rigorous scientific frameworks. Supporting these actions can help deliver timely, science-based projects for restoration, stewardship, and improved resilience by reducing delays and fostering more effective collaboration among agencies and partners.

Action Example 2.4 | California Environmental Quality Act (CEQA) Statutory Exemption for Restoration Projects (SERP)

This exemption[33] provides a statutory exemption from CEQA for fish and wildlife habitat restoration projects that meet specific requirements. As of August 2025, three projects within the Delta have utilized SERP exemptions: Knightsen Wetland Restoration Project, Webb Tract Wetland Restoration Project, and Staten Island Wetland Restoration and Carbon Farming for Habitat, Climate and Communities Project. On average, feedback suggests that these projects are saving approximately eight months of planning time and over $127,000 statewide, with Delta projects each saving around 12 months and $25K-450K (CDFW, 2025).

Synthesis & review

ACTION 2.5 | UTILIZE MECHANISMS OF SHARING INFORMATION MORE EFFICIENTLY AND EFFECTIVELY

To support timely decision-making, scientific findings must be communicated efficiently, clearly, and in accessible formats. While sustaining rigorous scientific peer review remains critical to maintaining the credibility of science, the traditional pace of science – including lengthy journal and agency publication timelines – can delay the integration of new information into action. By investigating mechanisms for sharing information more efficiently and effectively, such as pre-print repositories,

31. https://www.deltacouncil.ca.gov/pdf/isb/products/2024-10-02-isb-dmdu-seminar-synthesis.pdf
32. https://resources.ca.gov/Initiatives/Cutting-Green-Tape
33. https://wildlife.ca.gov/Conservation/Cutting-Green-Tape/SERP

summary briefs, or early-release formats, we could accelerate the availability of key findings and increase understanding around rapidly evolving situations such as species invasions or population declines.

See also Action 3.1: Support free and open data

Action Example 2.5 | The Delta Science Tracker

The **Delta Science Tracker**[34] is a tool designed to enhance the coordination and collaboration on science activities, providing valuable insights for scientists, decision-makers, and managers in the Delta. The Delta Science Tracker allows users to explore and visualize recent research and monitoring efforts through the lenses of science activities, organizations, and people. It also enables users to access project outputs before they undergo official peer review and publication pipelines. It is intended to promote communication, create opportunities for collaboration, and enhance transparency for research funding opportunities and decisions. See **Resource C: Science communication** for a more in-depth discussion of ongoing communication efforts in the Delta.

Funding

ACTION 2.6 | IMPLEMENT MORE RESPONSIVE AND TARGETED FUNDING STRUCTURES

Delta research faces a pivotal moment: shrinking state and federal contributions are forcing hard choices, and we must explore ways to adapt. The limited funding available for research and synthesis (**Delta Crosscut Budget Report FY 2023-24**[35]) must become more responsive and targeted to keep pace with rapid environmental and management change.

At the same time, the Delta science community and its funding partners must be responsive to fill gaps when previously reliable sources of funding disappear. This Action requires mechanisms such as rapid-response funding programs that enable timely research on emerging or urgent issues, while maintaining a rigorous selection process, to ensure that credible findings are available to decision-makers on more actionable timelines. Without this, we are likely to miss opportunities to study the effects of environmental management decisions or natural events. For example, when the False River **Emergency Drought Barrier**[36] was installed to limit salinity intrusion into the Delta during drought, an opportunity emerged to study the effects of salinity management actions on Delta ecosystems. Capturing the effects of unpredictable events offers critical science-based insights into future management decisions. Demonstrating the value of responsive and targeted funding by sharing success stories will also be critical for ensuring continued investment in these mechanisms.

Action Example 2.6 | The Council's Directed Actions

Funding research is key to the Delta Science Program's mission of providing the best possible unbiased scientific information to inform water and environmental decision-making in the Delta (California Water Code § 85280(b)(4)). **Directed Actions**[37] are critical science investigations that the Council, through its Delta Science Program, awards through a non-competitive process when timing is urgent, funds are available, and when allowed by applicable law. Recent Directed Actions have advanced our understanding of salinity intrusion during extended drought conditions, "Early Detection and Rapid Response" for new invasive species, and the effects of wildfire retardants on juvenile fish. See **Resource D: Research funding** for more information on the Council's funding processes.

34. https://sciencetracker.deltacouncil.ca.gov/
35. https://deltacouncil.ca.gov/pdf/dpiic/meeting-materials/2025-12-09-fy-2023-2024-delta-crosscut-budget-report.pdf
36. https://escholarship.org/uc/item/0b3731ph
37. https://deltacouncil.ca.gov/delta-science-program/directed-actions

Grand challenge 3

Flows of scientific information remain decentralized and poorly connected to communities and decision-makers.

Collaboration and flows of information between "actors," such as agencies, NGOs, tribes, academia, and collaborative groups in the Delta are highly networked, constituting a classic system of polycentric governance, whereby no one agency or decision-maker holds ultimate authority for making collective decisions (Eberhard et al., 2017). The insufficient direct and bidirectional flow of information between scientists and decision-makers, and other issues related to polycentric governance systems, such as fragmented accountability and coordination failures, have resulted in a disconnect that imposes barriers to adaptive governance (Cloern and Hanak, 2013; Norgaard, 2017; Pozzi et al., 2025; Rittelmeyer et al., 2025) and is detrimental to public trust in decision-making (Norgaard et al., 2009). Addressing this grand challenge requires more than improving communication; it calls for a more cohesive and shared vision of governance that invests in interdisciplinary research to build stronger institutional linkages, and a shared commitment to bold, system-wide approaches to managing the Delta. The following chapter identifies Actions to address grand challenge 3.

Highlight: Tour of gravel augmentation efforts in the Stanislaus River to restore habitat for juvenile and adult salmonids. **Credit:** Henry DeBey.

Highlight: A groundwater monitoring well along the California Aqueduct will collect data to document changes in ground water levels and aid in the understanding of land subsidence and its impacts to aqueduct infrastructure.

Data accessibility

ACTION 3.1 | SUPPORT FREE AND OPEN DATA

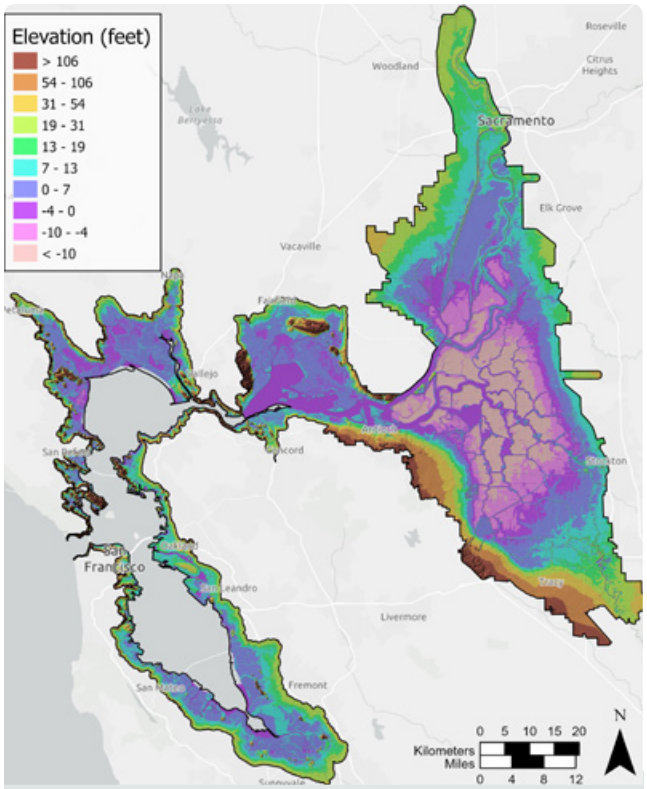
Inconsistent data accessibility is a significant impediment to the consideration and inclusion of varied data sources in decision-making. To address this, repositories must support both data producers and users by ensuring data is Findable, Accessible, Interoperable, and Reusable (FAIR). Free and open data repositories that are usable by people with a variety of technical backgrounds can help build trust, foster collaboration, and support diverse uses and users. The Delta science community can support open data in many ways, including requiring data management plans and open data practices for funded research, promoting open-source platforms and decision support tools, and providing the funding required to maintain these open-source tools and datasets. One way that the Council is advancing this Action is through a partnership with the National Center for Ecological Analysis and Synthesis (NCEAS) to lead **collaborative synthesis working groups**[38] that receive training in synthetic data science and statistical techniques to analyze questions important to Bay-Delta management. See **Resource A: Data governance, portals, and online resources** for additional information on open data.

See also Action 2.5: Utilize mechanisms of sharing information more efficiently and effectively

Action Example 3.1 | California Water Data Consortium

Established to advance the Open and Transparent Water Data Act (AB 1755, Dodd), the **California Water Data Consortium**[39] (Consortium) is an independent nonprofit that convenes state agencies, local water managers, researchers, and community partners around open data solutions. The Consortium leads initiatives including the **Groundwater Accounting Platform**[40], which supports sustainable groundwater management through transparent, interoperable data; the **Telemetered Water Monitoring Project**[41], advancing real-time data collection for water rights administration; and a **LiDAR Working Group**[42], helping to coordinate remote sensing acquisition across agencies. Through its **Data for Lunch series**[43] and roundtable events, the Consortium builds communities of practice committed to data-driven water and ecological management.

38. https://deltacouncil.ca.gov/delta-science-program/science-synthesis-working-group
39. https://cawaterdata.org/
40. https://groundwateraccounting.org/
41. https://cawaterdata.org/projects/telemetered-data-project/
42. https://cawaterdata.org/projects/lidar/
43. https://cawaterdata.org/data-for-lunch-series/



In 2025, the Delta Stewardship Council **partnered**[44] with the Wetlands Regional Monitoring Program, the California Department of Water Resources, and the San Francisco Estuary Institute to survey over 1.25 million acres and create a seamless elevation map of the San Francisco Estuary using Light Detection and Ranging – or "LiDAR". This highly detailed, three-dimensional model can reveal how water moves, where flood risks exist, how landscapes are changing over time, and give us a more holistic understanding of the region, not just the Delta. The Council has already started putting preliminary data to work creating maps such as this one to inform our climate and flood management initiatives and more. See **Mapping California's Bay-Delta Like Never Before**[45] for more information.

Collaboration & communication

ACTION 3.2 | SUPPORT COLLABORATIVE VENUES FOR EFFICIENT FLOW OF INFORMATION

Collaborative venues that bring together members of the Delta science community are essential for two-way learning, transparent dialogue, and trust-building. These spaces support more effective information flow, coordination, and governance. The Delta already hosts many collaborative venues; however, continued evaluation is needed to understand which venues are most effective, where gaps remain in disciplinary or community representation, and how well efforts are coordinated across the broader science enterprise. This landscape is always evolving, but continuously strengthening existing effective venues and establishing new representation or engagement opportunities is critical to ensure coordination across the broader science enterprise. Strengthening inclusive, cross-agency and cross-disciplinary venues allows new findings and approaches to be discussed, emerging needs to be identified, and decision-making processes to become more transparent and responsive. See **Resource F: Science governance and the collaborative Delta science-scape** for an updated network analysis of the leading collaborative science venues in the Delta.

Action Example 3.2 | Interagency Adaptive Management Integration Team (IAMIT)

Convened by the Delta Science Program, **the IAMIT**[46] is a collaborative venue that discusses and coordinates strategies for implementing adaptive management for conservation efforts in the Delta and related areas. The IAMIT serves as a technical team composed of scientific and technical staff from local, state, and federal agencies, as well as key interested groups. The team cuts across individual agency missions and provides high-level input and guidance on current and future adaptive management. By meeting quarterly, the IAMIT gives

44. https://sciencetracker.deltacouncil.ca.gov/activities/elevate-bay-delta
45. https://deltacouncil.ca.gov/pdf/council-meeting/meeting-materials/2026-03-26-item-7-attachment-2-mapping-california-bay-delta-like-never-before-information-sheet.pdf
46. https://deltacouncil.ca.gov/delta-science-program/interagency-adaptive-management-coordination

members and invited guests opportunities to build relationships, learn from each other, and share lessons on how to enhance adaptive management in the Delta.

ACTION 3.3 | INCREASE RESEARCH COORDINATION AT THE WATERSHED AND ESTUARY SCALE THROUGH SYSTEMS THINKING

Increasing research coordination at the watershed or estuary scale requires a systems-thinking approach that considers the social, ecological, and economic contexts of complex and interconnected Delta issues. Achieving this holistic perspective is contingent upon interdisciplinary teams that intentionally link research across disciplines, geographies, and institutions. However, the Delta's complex, polycentric governance system can create barriers to research coordination. Organizational structures that promote research and information coordination at the watershed and estuary scale can support the ability of science to inform decision-making and solutions for the Delta's challenges (Delta ISB, 2019).

See also Action 1.1: Support the ongoing shift from single species to holistic monitoring and management of ecosystems

Action Example 3.3 | Wetlands Regional Monitoring Program (WRMP)

The WRMP[47] aims to increase research coordination at the watershed and estuary scale by addressing the challenges posed by differences in monitoring protocols and data management practices that limit our ability to understand restoration success and large-scale changes affecting wetlands. To do this, the WRMP is developing a protocol and portal to store and share comparable data. This effort embodies a systems thinking approach by enabling analyses that compare the success of different restoration techniques, identify factors that inhibit success, and inform restoration design and adaptive management recommendations based on realized outcomes. For example, by using regional forecasting of sediment demand, coupled with individual local marsh elevation monitoring, the WRMP can use systems thinking for a more complete picture of the system.

BOX 10

WHAT IS SOCIAL SCIENCE?

The social sciences, including economics, political science, public administration, psychology, and more, vary in their methods, data types, and analyses, but ultimately all aim to understand people. Specific social science approaches should be tailored to the context and research question at hand, just as natural science methods are selected to best address particular environmental questions. These fields range from environmental economics – asking questions like: "How much are people willing to pay for clean water?" or "What incentives are needed to improve conservation behaviors?" – to environmental governance – asking questions like: "What formal and informal rules affect conservation outcomes?" By understanding how people interact with their environments, the social sciences help answer questions about how human and natural systems influence the outcomes of environmental policy and natural resource management. See **Resource B: Making science whole: Embedding social science in natural science workflows** for more information about the breadth of social sciences and how they can be leveraged in natural science workflows.

ACTION 3.4 | IMPROVE SOCIAL SCIENCE LITERACY

One of the primary impediments to the effective use of social sciences (see Box 10) in the Delta is a failure to fully understand, value, and leverage these different disciplines to tackle natural resource management issues. Humans are a central part of the Delta system. Creating a truly resilient Delta

47. https://www.wrmp.org/

that supports a reliable statewide water supply and healthy ecosystems – as well as thriving communities – requires an understanding of 1) the people who live, work, and recreate in and around the estuary; 2) how the region impacts their health and well-being; and 3) how their behavior influences environmental issues. Improving social science literacy across management levels – not only among scientists or agency staff members, but at the executive levels and with research funding entities – is fundamental to ensuring that social science is used and valued.

Action Example 3.4 | Bay-Delta Social Science Community of Practice

This community of practice[48] aims to facilitate social science research and interdisciplinary investigation, provide opportunities for the social sciences to inform management and policy, and advance our understanding of the estuary as a complex social-ecological system. To achieve these goals, it brings together social science scholars, practitioners, and interested parties who are committed to advancing research on the human dimensions of resource management in the San Francisco Bay and Delta that is both relevant and applicable. The community is not just a resource for other social scientists; it works to improve social science literacy at the highest levels of management and maintains a database of social scientists in the Delta, along with their expertise, to facilitate connection and collaboration with the broader Delta science community.

ACTION 3.5 | INCORPORATE SOCIAL SCIENCE DATA AND DISCIPLINES IN MANAGEMENT DECISION FRAMEWORKS

Working in concert with the natural sciences, social science datasets and tools can help answer questions related to how human and natural systems interact to influence natural resource policy and management outcomes and to foster trust with communities. The social sciences encompass a broad range of disciplines that can be integral components of effective management decisions. For example, by using the social sciences to understand behavioral drivers, managers can design effective frameworks for things like changes in water use during a drought or proper cleaning methods for boats infested with invasive species. Scientists, policymakers, and managers should leverage existing datasets with social metrics to design management approaches that earn trust, reflect shared values, and advance equity. One practical way to ensure that social dimensions are fully integrated into management decisions is to use structured decision support frameworks that explicitly incorporate social science data alongside ecological and technical information. These frameworks make social-ecological tradeoffs transparent and elevate social considerations.

Action Example 3.5 | Delta Residents Survey (DRS)

The 2023 DRS[49] was a household survey conducted in the Delta and adjacent areas to gain a better understanding of residents' livelihoods, well-being, priorities, and concerns for the region. By capturing shared values and diverse experiences, the DRS provides insights for developing more effective and equitable resource management approaches. Understanding and tracking changes in the human dimensions of the estuary, such as residents' opinions on regional priorities and concerns, stewardship behaviors, and experiences, is crucial for effective estuary management (Rudnick et al., 2023). The DRS is intended to be a recurring survey that can monitor the well-being of an evolving Delta. For more information about the DRS, see Case Study 1 in **Resource B: Making science whole: Embedding social science in natural science workflows.**

48. https://deltacouncil.ca.gov/bay-delta-social-science-community-of-practice
49. https://www.openicpsr.org/openicpsr/project/195447/version/V2/view;jsessionid=2E19DBE12440F0DBD4FCF4AF3FC7E657

Highlight: The State Water Project (SWP) and federal Central Valley Project (CVP) deliver water to millions of people and acres of farmland south of the Delta.

Synthesis & review

ACTION 3.6 | PROACTIVELY IDENTIFY OPPORTUNITIES TO LEVERAGE INDEPENDENT SCIENTIFIC PEER REVIEW PROCESSES TO ENHANCE THE RIGOR, TRANSPARENCY, AND CREDIBILITY OF SCIENCE UNDERPINNING MANAGEMENT AND POLICY DECISIONS

Through independent scientific peer review, qualified experts are called upon to objectively evaluate processes, programs, plans, or products, which in turn help to ensure the provision of the best available science. **Resource G: Delta Science Program services for independent scientific review and scientific advice** provides information about the process the Delta Science Program uses to promote high-quality independent scientific review and advice, including public input options. When updating regulatory documents, plans, or products, agencies can consider incorporating peer review by an external entity (e.g., **Council's Delta Science Program**[50], **Delta ISB**[51], and **California Council on Science and Technology**[52]) and public input into the process at critical junctures. Doing so builds trust and enhances adaptive management, which is particularly useful in the face of growing disinformation and distrust in science.

Action Example 3.6 | Scientific peer review services

The Delta Science Program has been experiencing an increased demand for its independent **scientific peer review**[53] services. This stems from several factors, including peer reviews stipulated in state and federal permits for operations of the State Water Project and the Central Valley Project (e.g., incidental take permit and biological opinion). These state and federal permit documents are critical tools in governing and mitigating the impacts of water operations on threatened and endangered species in the Bay-Delta. Further, the process (see **Resource G**) is highly transparent and has been applied and refined to over 37 peer reviews since 2010.

50. https://deltacouncil.ca.gov/delta-science-program/scientific-peer-review
51. https://deltacouncil.ca.gov/delta-isb/products
52. https://ccst.us/study-process/peer-review/
53. https://deltacouncil.ca.gov/delta-science-program/scientific-peer-review

Funding

ACTION 3.7 | INCREASE FUNDING OPPORTUNITIES AND CAPACITY FOR SOCIAL SCIENCE RESEARCH AND COLLABORATIONS

Despite its importance, funding for social science has increased at a slower rate than funding for the natural sciences nationwide (Table 5.6 in National Science Board, 2018). We encourage members of the Delta science community to explore ways to increase opportunities for collaborative social science projects that include social scientists from a wide variety of disciplines. To promote relevant social science research in the Delta, funding systems should integrate the social sciences into all stages of research – from early planning to the communication of findings. This includes involving social scientists in the development of funding solicitations, identifying priorities, and ensuring their representation on proposal review panels. Integrating different social science techniques and practitioners into the research process can help create more meaningful collaborations and flows of information between different entities in the highly networked Delta governance system. This investment also requires increasing social science capacity and expertise by creating more social scientist positions and training courses within agencies and academia.

See also Action 4.2: Support more co-produced and community-engaged science

Action Example 3.7 | Delta Research Awards

To increase funding opportunities for social science in the Delta, the Delta Science Program has included language and criteria in its **Delta Research Awards**[54] funding solicitations to encourage proposals that explicitly integrate social science and social-ecological systems. Council staff have been evaluating and refining these funding opportunities over time in collaboration with social scientists to improve every step of the review process, positioning social science proposals to be evaluated equitably rather than unintentionally undervalued against natural science projects.

Highlight: Thiamine deficiency, a vitamin B1 shortage that can cause strange swimming behavior, including spinning, and low survival in young Chinook salmon is being studied by a group of researchers including students through the Fish and Rivers Youth Scientists (FRYS) Network. Thousands of high-school age students have helped progress this research through daily observation and discussions. Delta Science Fellow, Becca VanArnam, has been evaluating the educational impact of the FRYS Network asking: What happens when young people living in the Delta region don't just learn about science, but actively 'do' science? **Credit:** Peggy Harte.

54. https://deltacouncil.ca.gov/delta-science-program/research-awards

Grand challenge 4

Other ways of knowing, especially Traditional Knowledge, remain siloed from decision-making.

Science that incorporates diverse knowledge improves the effectiveness of research and decision-making in the long term. For the purposes of the Delta Science Plan, Traditional Knowledge "…is a body of observations, oral and written knowledge, innovations, practices, and beliefs that promote sustainability and the responsible stewardship of cultural and natural resources through relationships between humans and their landscapes. [It] cannot be separated from the people inextricably connected to that knowledge" (Daniel et al., 2022). Traditional Knowledge stemming from tribes and tribal communities, which may also be referred to as Traditional Ecological Knowledge or Indigenous Knowledge, as well as other ways of knowing such as local ecological knowledge or experiential knowledge, are often siloed, despite offering important contributions to the understanding of complex social-ecological systems (Delta Stewardship Council, 2025). The Delta Plan acknowledges Traditional Knowledge as a source of valuable insight in its discussion of criteria constituting "best available science" (Delta Plan Appendix 1A). Despite this, research and management systems rarely incorporate Traditional Knowledge, partly due to the inflexibility established by years of academic training and social-political systems that limit opportunities for integrating other ways of knowing (Huntington, 2000; Shinbrot et al., 2025). This chapter identifies Actions to address grand challenge 4.

Data accessibility

ACTION 4.1 | RESPECT TRIBAL DATA OWNERSHIP AND CONFIDENTIALITY

For data collected by tribes, or in collaboration with tribal partners, data management protocols that protect and respect tribal data and community ownership of that data are critical to maintaining trust (Delta Stewardship Council, 2025). Due to historical misuse and exploitation of tribal data and Traditional Knowledge, sharing sensitive tribal information is a concern for tribal partners (CNRA, 2025). Sensitive data, such as the location of cultural resources, the number of cultural resources, the location of sacred sites, and the location of buried ancestors, are all types of information that may be exploited if made available to the public (CNRA, 2025). This protection can sometimes conflict with FAIR (Findable, Accessible, Interoperable, and Reusable) open data requirements (see **Resource A: Data governance, portals, and online resources** for more information on open data) and other laws applicable to transparent governance. One way to navigate these conflicts is to apply the CARE Principles for Indigenous Data Governance, which encompass **C**ollective Benefit, **A**uthority to Control, **R**esponsibility, and **E**thics (CARE) (Carroll et al., 2020). Tribal data management protocols should be explicitly written into agreements for projects and funding solicitations that involve Traditional Knowledge or tribal nations, to the extent that applicable law allows.

Action Example 4.1 | Tribal Grant Administration Guidance document

The California Natural Resources Agency (CNRA) has developed a **Tribal Grant Administration Guidance document**[55] that outlines best practices for maintaining data confidentiality and data sovereignty. One best practice recommends working closely with grantees to design reporting solutions for sensitive data. "For example, species monitoring data helps scientists understand species populations and behaviors to set protective policy and even regulatory protections, but if this is a significant, cultural species that is also vulnerable to poaching, grantees may report the approximate quantity (such as in a range) or location (such as approximate location within county) of the species but omit specifics (precise numbers, details on the observed species, exact coordinates, etc.)" (CNRA, 2025).

Collaboration & communication

ACTION 4.2 | SUPPORT MORE CO-PRODUCED AND COMMUNITY-ENGAGED SCIENCE

Community-engaged science is a collaborative approach in which local communities actively participate in all stages of the scientific process – from identifying research priorities and co-designing studies to interpreting results and informing policy (Israel et al., 2017). When done well, this process fosters transparency and accountability, building trust between scientists and the community. Collaborating with social scientists to employ social science methods, such as participatory mapping and interviews, can help ensure that engagement is both inclusive and effective.

When co-producing knowledge with community or tribal partners, creating spaces – physical, digital, and procedural – is essential for integrating other ways of knowing into decision-making and dismantling the structures that have historically kept it siloed. Building these relationships with community or tribal partners requires repeated, respectful interactions that demonstrate long-term commitment and knowledge capacity limitations. Additionally, when co-producing knowledge with tribes and Traditional Knowledge holders, it is paramount that the Traditional Knowledge be applied by the designated individuals of the tribe from which that knowledge originated, or with permission by, and in partnership with, that tribe (Delta Stewardship Council, 2025). Transparency

55. https://resources.ca.gov/Initiatives/Tribalaffairs/TribalGrantAdminGuide

is key throughout this process to ensure that all data and findings are being presented in a holistic way. Please refer to the **California Natural Resources Agency Tribal Consultation Policy**[56] for more information on policies, procedures, and best practices for consultation, engagement, and communication with California Native American tribes.

See also Action 3.7: Increase funding opportunities and capacity for social science research and collaborations

Action Example 4.2: Science for Communities (SFC)

The Council's SFC initiative[57] facilitates and fosters partnerships among Delta communities, tribes, local public agencies, and subject matter experts to collaborate on projects in the Delta region. The initiative promotes the sharing of knowledge, tools, and data to support relationship building, collaboration in addressing social-environmental issues, and access to funding for further research and training. See **Resource H: Guidance for science workshops** for more information about the Council's process for hosting workshops to facilitate co-production, such as SFC.

Funding

ACTION 4.3 | EXPLORE WAYS TO EXPAND FUNDING THAT SUPPORTS AND ENGAGES COMMUNITY AND TRIBAL EXPERTISE

Limited resources, limited funding, and the perception of public engagement or tribal consultation as a "box-checking" exercise rather than a process that influences decision-making all hinder community and tribal participation in scientific decision-making processes. Additionally, traditional funding structures are often confusing and opaque, with outside parties unclear on how to engage (Delta Stewardship Council, 2025). Exploring ways to expand funding that fairly compensates community and tribal partners for their expertise and time, and aims to reduce bureaucratic burdens, is important for interweaving other ways of knowing into decision-making processes. It is also important to acknowledge that co-produced knowledge may require longer timelines and, therefore, higher costs; funding mechanisms must allow flexibility for these to occur. This Action builds on the **Tribal and Environmental Justice (TEJ) Issue Paper**[58] Goal 4: *Explore ways to address funding inequities in communities that have historically received the least investment* (Delta Stewardship Council, 2025).

Action Example 4.3 | Eco-Cultural Renewal of Delta Tule Landscapes

The Delta Science Program funded eight projects totaling $5.9 million from the 2025 **Delta Research Awards**[59] solicitation. Several of the projects focused on collaborations with tribal groups, such as the **Eco-Cultural Renewal of Delta Tule Landscapes**[60]. This project is a partnership between the San Francisco Estuary Institute, Shingle Springs Band of Miwok Indians, and Colfax Todds Valley Consolidated Tribe. By bringing together different perspectives and knowledge to document and integrate Traditional Ecological Knowledge of tule wetlands, the project aims to integrate Traditional Knowledge into Delta management and restoration.

56. https://resources.ca.gov/-/media/CNRA-Website/Files/Initiatives/Tribal-Affairs/CNRA-Tribal-Consultation-Policy-09252025.pdf
57. https://deltacouncil.ca.gov/science-for-communities
58. https://deltacouncil.ca.gov/pdf/2025-04-24-tribal-and-environmental-justice-in-the-sacramento-san-joaquin-delta-issue-paper.pdf
59. https://deltacouncil.ca.gov/delta-science-program/research-awards
60. https://sciencetracker.deltacouncil.ca.gov/activities/eco-cultural-renewal-delta-tule-landscapes

Governance & relationships

ACTION 4.4 | BUILD TRUST THROUGH INTENTIONAL AND RECIPROCAL WORKING RELATIONSHIPS

In the Delta's polycentric governance system, with many competing interests, building trust through intentional and reciprocal working relationships is essential to improving coordination and decision-making. By seeking local perspectives with an open mind from the start, both science and management can become more transparent and responsive. Early, meaningful, and frequent engagement and consultation can strengthen relationships between scientists, managers, tribes, and communities, reducing decision-making inefficiencies and fostering a sense of shared ownership of solutions. Building relationships with communities and tribes requires recognizing capacity limitations, avoiding participation fatigue, clearly communicating the purpose of engagement or consultation, and prioritizing follow-through and accountability. If possible, agency staff should go to tribes and communities to meet people in their spaces, on their terms, and experience their events and ways of life. Reaching people effectively requires significant time and effort (Delta Stewardship Council, 2025). We encourage members of the Delta science community to analyze their role in helping provide opportunities for collaboration and trust building with community or tribal partners, ranging from high school mentorship programs to formal tribal consultation on policy initiatives. See Action Example 4.2: Science for Communities for another example of a relationship building platform in the Delta.

Action Example 4.4 | Interweaving Roundtable Series

The goal of the Council's Interweaving Roundtable Series is to cultivate and/or strengthen relationships between tribal and non-tribal partners in the San Francisco Estuary through collaboration and dialogue. By creating a space to share experiences and exchange perspectives, the series can help identify approaches for interweaving Traditional Ecological Knowledge and Western science to explore the management of the estuary. The first events took place in summer 2026.

ACTION 4.5 | EMBRACE MORE WAYS OF KNOWING

Incorporating more ways of knowing into science-based decision-making requires a fundamental rethinking of specific academic and social-political norms. Some examples include questioning biases that commodify knowledge, shifting the values of traditional scientific culture (i.e., "publish or perish") to include community involvement, allowing storytelling and other knowledge systems to reveal values and perspectives, and including partners in the early stages of a project to help guide the development. Building on the **TEJ Issue Paper**[61] Strategy 3b (1): *Embrace More Ways of Knowing,* this Action highlights the need for scientists to embrace new partnerships and approaches to science (Delta Stewardship Council, 2025). Eliminating systemic barriers, understanding the cultural and place-based context, and engaging early and continuously with an open mind are essential steps in making this shift.

Action Example 4.5 | Ecocultural Working Group for Webb Tract restoration

The Metropolitan Water District of Southern California, owner of four islands in the Delta, including Webb Tract, reached out to Plains Miwok cultural practitioners for help in stewarding the islands from an Indigenous perspective. This connection eventually evolved into the **Ecocultural Working Group**[62], which includes basket weavers, healers, and other Indigenous culture bearers and practitioners. This group served as the official voice for tribal partners throughout the Webb Tract wetland restoration design process.

61. https://deltacouncil.ca.gov/pdf/2025-04-24-tribal-and-environmental-justice-in-the-sacramento-san-joaquin-delta-issue-paper.pdf
62. https://mavensnotebook.com/2025/06/19/notebook-feature-partnering-with-tribes-to-restore-a-delta-wetland-benefits-go-both-ways/

Looking forward

The grand challenges are four major impediments to science-based decision-making in the Delta, but they are not independent issues. Many of the Actions detailed here address multiple challenges simultaneously, reflecting their interconnected nature. These Actions are not a comprehensive roadmap to 'fixing' these problems, but instead, represent the most fruitful opportunities for us as a Delta science community to work together to address shared challenges in a rapidly changing and dynamic landscape. By promoting scientific priorities developed through an open, transparent, and inclusive process with the Delta science community, we aim to catalyze collective action across the community.

Our vision for success is a Delta where management decisions are adaptive, science-based, and socially informed – anticipating and responding to environmental change at estuary, ecosystem, and regional scales. We envision a well-connected governance system in which science and management priorities are clearly communicated, effectively implemented, and supported by sustained and responsive funding. Success also means fostering an open, forward-looking science enterprise that proactively addresses environmental and community needs, ensuring a resilient, equitable, and sustainable Delta.

To move from vision to action, the Council is committed to taking a leadership role in implementing the Delta Science Plan. Although many Actions represent long-term investments that require sustained commitment to translate science into real-world outcomes, we are committed to sharing progress as it occurs. Progress for each Action will be assessed and reported annually; the format may evolve but could consist of an annual meeting, a website publication, or a presentation. We aim to find the most effective format for tracking and sharing progress. We will leverage the other components of the Delta Science Strategy (SAA and SBDS) along with the **Delta Science Tracker**[63] to comprehensively evaluate both short- and long-term performance. This includes tracking

63. https://sciencetracker.deltacouncil.ca.gov/

the evolution of Action Examples. New examples may arise, as more ways each Action can be implemented are identified.

By implementing the 2026 Delta Science Plan and providing regular tracking updates and opportunities for engagement, we aim to hold ourselves – and the broader Delta science community – accountable, while ensuring that our collective efforts remain coordinated and aligned in the face of rapid change. We encourage members of the Delta science community to use the Actions and tools in this document to guide and strengthen efforts for a more connected, collaborative, and resilient Delta. In addition to the Actions and Action Examples, the Resources provide a starting point for a variety of activities, from planning workshops or developing social science collaborations, to understanding processes for peer review and consistently identifying conflicts of interest. Addressing the grand challenges cannot be accomplished overnight or by one organization alone; success depends on strong, sustained partnerships that bridge organizational boundaries.

Highlight: Indigenous cultural burn.
Credit: Alysha Beck, UC Davis.

Glossary

The definitions in this glossary are provided for convenience to clarify terms as used in the context of the Delta Science Plan.

Adaptive management — A framework and flexible decision-making process for ongoing knowledge acquisition, monitoring, and evaluation leading to continuous improvement in management planning and implementation of a project to achieve specified objectives (California Water Code § 85052); California Code of Regulations., Title 23., § 5001, subsection (a)).

Adaptive governance — Flexible and learning-based collaborations and decision-making processes involving both state and nonstate actors, often at multiple levels, with the aim to adaptively negotiate and coordinate management of social–ecological systems and ecosystem services across landscapes and seascapes (Schultz et al., 2015).

Best available science — The best scientific information and data for informing management and policy decisions consistent with the guidelines and criteria found in Appendix 1A. (California Code of Regulations., Title 23., § 5001, subsection (g)). Delta Plan Appendix 1A defines the six criteria for best available science, initially developed by the National Research Council — relevance, inclusiveness, objectivity, transparency & openness, timeliness, and peer review (Delta Stewardship Council, 2015).

Biological opinion — A document stating the opinion of the US Fish and Wildlife Service or the National Marine Fisheries Service as to whether or not federal action is likely to jeopardize the continued existence of a threatened or endangered species or result in the destruction or adverse modification of critical habitat (Delta Plan, 2013, page 303).

Climate change — Any significant change in measures of climate (such as temperature, precipitation, or wind) lasting for an extended period (decades or longer). It may result from 1) natural factors, including changes in the sun's intensity or changes in the Earth's orbit around the sun; 2) natural processes within the climate system (such as changes in ocean circulation); or 3) human activities that change the composition of the atmosphere (for example, through burning fossil fuels) and land surfaces (for example, deforestation, reforestation, urbanization, and desertification) (Delta Plan, 2013, page 304).

Collaboration — Involves sharing information and resources with the parties pursuing a common interest or objective that they jointly define (see **The Science Enterprise Workshop, 2016[64]**).

Collaboratory — A networked organizational forum that includes social processes, collaboration techniques, formal and informal communication, and agreement on norms, principles, values, and rules (Cogburn, 2003).

Coequal goals — The two goals of providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem. The coequal goals shall be achieved in a manner that protects and enhances the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place (California Water Code § 85054).

Cooperation — Involves sharing information and sometimes resources while each party pursues its own goals (see **The Science Enterprise Workshop, 2016[65]**).

64. https://mavensnotebook.com/wp-content/uploads/2017/03/SEW_Complete-Proceedings-Day-1-2.pdf

65. https://mavensnotebook.com/wp-content/uploads/2017/03/SEW_Complete-Proceedings-Day-1-2.pdf

Coordination — Involves sharing information and resources with parties pursuing a common interest or objective. The interest or objective, however, is defined independently by each party (see **The Science Enterprise Workshop, 2016**[66]).

Scientific credibility — The degree to which scientific claims, research, methodologies, or institutions are believable and trustworthy (see **The Science Enterprise Workshop, 2016**[67]).

Data — For the purpose of the Delta Science Plan, data are measurements or observations that are collected as a source of information. Examples include measures of precipitation, water flow, and population abundance.

Data accessibility — The ease with which individuals or systems can locate, retrieve, and utilize data. It also encompasses the ability to understand the data, its format, and its relevance to a specific need or task. See Wilkinson et al. (2016) for more information on Findable, Accessible, Interoperable, and Reusable (FAIR) Guiding Principles for scientific data management and stewardship.

Delta — The Sacramento-San Joaquin Delta as defined in Section 12220 and the Suisun Marsh, as defined in Section 29101 of the Public Resources Code (California Water Code § 85058).

Decision-maker — An individual or entity that has the authority to make decisions and allocate resources (Hall, 2010).

Delta Plan — The comprehensive, long-term management plan for the Delta to further the achievement of the coequal goals, as adopted by the Delta Stewardship Council in accordance with the Sacramento-San Joaquin Delta Reform Act of 2009 (California Water Code § 85059; California Code of Regulations., Title 23., § 5001, subsection (r); **Delta Stewardship Council, 2025**[68]).

Delta science community — For the purpose of the Delta Science Plan, the Delta science community comprises a group of scientists, including federal, state, and local agencies; academics; consultants; NGOs; Traditional Knowledge holders; and the interested public who actively participate in scientific and management activities in the Delta.

Delta Science Program — The Delta Stewardship Council's Delta Science Program was established to provide scientific information and syntheses for the state of scientific knowledge on issues critical for managing the Bay-Delta system. The mission of the Delta Science Program shall be to provide the best possible unbiased scientific information to inform water and environmental decision-making in the Delta (California Water Code § 85280(b)(4)).

Ecosystem — A biotic community and its physical environment, considered as an integrated unit (Delta Plan, 2013, page 308).

Ecosystem restoration — The application of ecological principles to restore a degraded or fragmented ecosystem and return it to a condition in which its biological and structural components achieve a close approximation of its natural potential, taking into consideration the physical changes that have occurred in the past and the future impact of climate change and sea-level rise (California Water Code § 85066; Delta Plan, 2013, page 308).

Estuary — A place where fresh and saltwater mix, such as a bay, or where a river enters an ocean (Delta Plan, 2013, page 309).

Forum — A place where multiple organizations and/or participants collectively develop and exchange ideas and undertake various science activities ranging from data collection, analysis, interpretation, and science communication (Rittelmeyer et al., 2024).

66. https://mavensnotebook.com/wp-content/uploads/2017/03/SEW_Complete-Proceedings-Day-1-2.pdf
67. https://mavensnotebook.com/wp-content/uploads/2017/03/SEW_Complete-Proceedings-Day-1-2.pdf
68. https://viewperformance.deltacouncil.ca.gov/the-delta-plan

Framework — There is no single, universal definition for "framework," and it varies across disciplines. However, for the Delta Science Plan, a framework is a set of standards and principles from which to build a more detailed plan, program, or strategy.

Habitat restoration — The manipulation of the physical, chemical, or biological characteristics of a site to return the majority of natural functions to the lost or degraded native habitat (Delta Plan, 2013, page 311).

Horizon scanning — A process to identify emerging trends, issues, and opportunities of importance to managers and scientists so they are better prepared to take advantage of or to react to in a well-thought-out and timely manner (Sutherland & Woodroof, 2009).

Human dimensions of natural resources — How humans value, use, and depend on the natural environment and how they affect and are affected by natural resource management decisions (see **University of Minnesota, 2025**[69]).

Incidental take permit — A permit issued by federal fisheries agencies that authorizes take of listed species incidental to otherwise lawful projects (Delta Plan, 2013, page 311).

Independent scientific review — Assessment of a scientific or management product or program by scientists with appropriate expertise and no personal or institutional stake in the outcome of the review (Meffe et al., 1998). See **Resource G: Delta Science Program services for independent scientific review and scientific advice** or the web page, **Delta Science Program Independent Scientific Reviews and Advice — Frequently Asked Questions**[70], for more information about how the Delta Stewardship Council utilizes independent scientific review.

Information — A product with relevant meaning used to make decisions, solve problems, or realize an opportunity. Information can come from processed data but can also come from other forms of communication (e.g., instructions) (Liew, 2007).

Interested party — For the purposes of the Delta Science Plan, we are using the term 'interested party' to refer to any entity or individual that can influence, or will be affected by, an issue, set of findings, or action.

Invasive species — An alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health (**Executive Order 13112**[71] - Invasive Species (Section 1. Definitions)).

Local agency — Any public agency other than a state or federal agency, board, or commission. A local agency may include, but is not limited to, cities, counties, districts, public water agencies, and boards, commissions, or organizational subdivisions of a local agency (California Code of Regulations. Tit. 14, § 15368).

Manager — For the Delta Science Plan, a manager is generally a "science manager" or "natural resource manager," who is an upper-level staff member within an agency division responsible for overseeing day-to-day functions (e.g., operations), strategic planning, and coordination and communication within the organization. Science managers may possess expertise in a technical field and participate in data analysis, monitoring design efforts, and authoring scientific publications.

Management question — For the Delta Science Plan, management questions primarily refer to high-level questions posed by natural resource managers.

69. https://www.dnr.state.mn.us/wildlife/research/hd/index.html
70. https://deltacouncil.ca.gov/delta-science-program/independent-scientific-reviews-and-advice-faq
71. https://www.invasivespeciesinfo.gov/executive-order-13112

Mechanism — For the Delta Science Plan, a 'mechanism' is a way of getting something done. This includes both institutional (e.g., organized entities) and procedural (e.g., bylaws and memorandum of understanding) mechanisms.

Mathematical model (model) — A representation of a biological process, system, or relationship by means of a mathematical equation or set of equations, which can be used to explain complex processes and predict possible future trends, such as future river temperatures or flows (see **Oxford Reference, 2025**[72]).

Monitoring — In an environmental context, monitoring refers to ongoing sampling, analysis, measurement, and survey activities used by scientists and managers to assess the status and trends of natural resources and environmental conditions (see **US EPA, 2025**[73]).

Open data — Data that are freely available to the public and are accompanied by sufficient documentation for their appropriate reuse (Baerwald et al., 2020).

Open science — A broader movement that aims to make all aspects of scientific research — including data, methods, software, publications, and peer review — transparent and accessible. Open science can help democratize research, leading to more inclusive, responsive, and impactful science. It relies on open data to enable collaborative knowledge-building and reproducibility (Baerwald et al., 2020).

Policymaker — Someone who is responsible for or involved in establishing policy (see **Merriam-Webster, 2025**[74]). This can refer to individuals who develop policies for their agencies and departments, as well as those who participate at the legislative level and develop state-wide and nationwide regulations.

Public — For the Delta Science Plan, 'public' generally refers to something open to everyone (i.e., not restricted to agency staff), such as a public comment period; or more usually referring to a group of people as the public that may not necessarily fall into the category of "scientist", "decision-maker," or "interested party".

Science — Information gathered in a rational, systematic, testable, and reproducible manner (see **The Science Enterprise Workshop, 2016**[75]).

Science activities — For the Delta Science Plan, science activities encompass a broad range of efforts, including compliance monitoring, modeling, exercises to identify science issues that may be of management concern in the near future, research focused on supporting decision-making, as well as more basic research that can inform future management issues.

Science co-production — Participation of managers or interested parties in the design, execution, and interpretation of scientific studies (see **The Science Enterprise Workshop, 2016**[76]).

Science enterprise — The collection of science programs and activities that exist to serve managers and interested parties in a regional system (see **The Science Enterprise Workshop, 2016**[77]).

Science governance — A form of collaborative governance that involves collectively prioritizing research questions, setting goals for science efforts, determining best practices for how science is conducted, and the results of these efforts (Lebel et al., 2005; Raik & Decker, 2007).

Synthesis — For the Delta Science Plan, synthesis refers to the scientific process of integrating information from multiple sources into one concept, model, finding, or report.

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72. https://www.oxfordreference.com/display/10.1093/oi/authority.20110803100139955
73. https://www.epa.gov/measurements-modeling/monitoring-programs
74. https://www.merriam-webster.com/dictionary/policymaker
75. https://mavensnotebook.com/wp-content/uploads/2017/03/SEW_Complete-Proceedings-Day-1-2.pdf
76. https://mavensnotebook.com/wp-content/uploads/2017/03/SEW_Complete-Proceedings-Day-1-2.pdf
77. https://mavensnotebook.com/wp-content/uploads/2017/03/SEW_Complete-Proceedings-Day-1-2.pdf

Tool — For the Delta Science Plan, a tool is an item used to perform a job or task (e.g., integrated models, interoperable datasets, collaborative workshops, real-time monitoring systems, structured decision-making frameworks).

Tribal consultation — The use of this term in the Delta Science Plan is meant to convey a meaningful engagement as expressed in the California Natural Resource Agency (CNRA) Tribal Consultation Policy that defines tribal consultation under Government Code Section 65352.4 as — "the meaningful and timely process of seeking, discussing, and considering carefully the views of others, in a manner that is cognizant of all parties' cultural values and, where feasible, seeking agreement. Consultation between government agencies and Native American tribes shall be conducted in a way that is mutually respectful of each party's sovereignty. Consultation shall also recognize the tribes' potential needs for confidentiality with respect to places that have traditional tribal cultural significance." This definition notes that California Native American tribes may also have their own unique definitions of tribal consultation. (see **CNRA Tribal Consultation Policy**[78], **Appendix 1 — Definitions**[79]).

Watershed — The land area that drains water to a particular stream, river, or lake. It is a land feature that can be identified by tracing a line along the highest elevations between two areas on a map, often a ridge (see **Maven's Notebook, 2025**[80]).

78. https://resources.ca.gov/-/media/CNRA-Website/Files/Initiatives/Tribal-Affairs/CNRA-Tribal-Consultation-Policy-09252025.pdf
79. https://resources.ca.gov/-/media/CNRA-Website/Files/Initiatives/Tribal-Affairs/CNRA-TCP-Appendix-1-Definitions.pdf
80. https://mavensnotebook.com/glossary/watershed/

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Appendices

APPENDIX 1

Implementation successes: Status of 2019 Delta Science Plan and relevant outcomes

Background

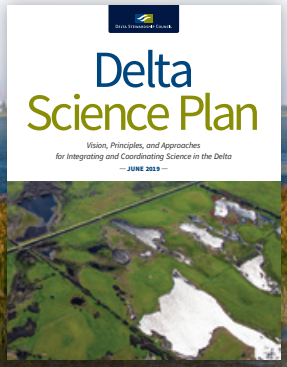
With over a decade of progress since the initial Delta Science Plan in 2013, this Appendix provides an overview of the major outcomes from the 2019 Delta Science Plan. Many 2013 Delta Science Plan Actions were incorporated into the 2019 Delta Science Plan to continue ongoing work. Successes related to these Actions are explored in this Appendix 1. The Delta Science Program tracked progress on the 2019 Delta Science Plan throughout the interim years of 2019-2025, and examples of implementation are listed in each section below.

2019 DELTA SCIENCE PLAN

The 2019 Delta Science Plan Actions overlapped with those of the 2013 Delta Science Plan but also included many novel initiatives. Examples of this progress are included below, and legacy Actions are denoted in the title of the examples. The 2019 Delta Science Plan is organized into four chapters. The following four tables detail Actions within each corresponding chapter, their status, and provide example related outcomes. Many examples are crosscutting and address multiple Actions; this is not meant to be a comprehensive summary of all progress. The 'Action Status' column represents the overall progress achieved for each Action.

Chapter 2. Shared mechanisms to inform policy and management

This chapter aimed to motivate the development and expansion of tools to support effective coordination and collaboration among Delta decision-makers, scientists, and interested parties. While progress is ongoing for many Actions, noticeable progress has been achieved through the creation of new online tracking tools (e.g., Delta Science Tracker), public workshops, and new training sessions (see Table Appx. 1-1).



2019
Delta Science Plan

Table Appx. 1-1 | Progress on Chapter 2 Actions.

ACTION		STATUS	EXAMPLE RELATED OUTCOMES
2.1 (also 2013 Delta Science Plan Action 2.1)	Develop guidelines and best practices for policy-science forums	Ongoing	• The Collaborative Science and Adaptive Management Program (CSAMP) provided research question connections for the 2018 and 2021 Delta Science Program Research Awards and Science Action Agenda (SAA) • 2020 CAMT Salmonid Subcommittee researcher and manager discussions
2.2 (also 2013 Delta Science Plan Action 2.2)	Update and continue to implement the Science Action Agenda	Ongoing	• Developed 2022-2026 SAA to address management needs
2.3 (also 2013 Delta Science Plan Action 2.6)	Regularly update and publish the State of Bay-Delta Science (SBDS)	Completed and ongoing	• 2022 (primary producers) and 2025 (extreme events) editions of the **State of Bay-Delta Science (SBDS)**[81]
2.4	Develop, compile, and share methods for science communication to leverage existing efforts	Ongoing	• **Delta Science Tracker**[82]
2.5	Support and enhance communication efforts and tools	Ongoing	• Convened the 2021 (virtual) and 2024 Bay-Delta Science Conferences
2.6	Support opportunities for training that enhance the science communication skills of Delta scientists	Ongoing	• Early Career Leadership Workshops for Delta Science Fellows, CCST Science and Technology Policy Fellows, and California Sea Grant State Fellows
2.7	Ensure consistent application of scientific peer review and independent science advisors	Completed and ongoing	• **Delta Science Program peer reviews**[83] • **National Academy of Sciences review of the Long-Term Operations of the Central Valley Project and the State Water Project**[84] • **Delta ISB completed reviews**[85]

81. https://sbds.deltacouncil.ca.gov/
82. https://sciencetracker.deltacouncil.ca.gov/
83. https://deltacouncil.ca.gov/delta-science-program/scientific-peer-review
84. https://www.nationalacademies.org/projects/DELS-WSTB-22-01
85. https://deltacouncil.ca.gov/delta-isb/products

Chapter 3. Modernize, integrate, and build the Delta science infrastructure

This chapter focused on building the necessary science infrastructure to tackle current and expected challenges. Many Actions saw progress and yielded completed products, such as expanding social science, evaluating monitoring programs, and creating resources, processes, and tools to promote open data (see Table Appx. 1-2).

Highlight: A harmful algal bloom turns the water green in the San Luis Reservoir which serves the State Water Project and the federal Central Valley Project.

Table Appx. 1-2 | Progress on Chapter 3 Actions.

ACTION		STATUS	EXAMPLE RELATED OUTCOMES
3.1 (also 2013 Delta Science Plan Action 4.3.1)	Host a summit to identify useful emerging data science and technology	Ongoing	• California Water Boards Water Data Science Symposium and California Water Data Challenge[86]
3.2	Establish a social science task force and a strategy to engage and integrate social science research in the Delta	Complete	• Social Science Task Force Report completed (2020) by the Delta Social Science Task Force[87]
3.3	Routinely evaluate monitoring programs in the Delta to identify gaps, redundancies, and management relevance	Complete and ongoing	• IEP Pilot Review of Long-Term Monitoring Elements 2020[88] • Delta ISB completed Monitoring Enterprise Review (2022)[89]
3.4 (also 2013 Delta Science Plan Action 4.2.2)	Develop a working group to facilitate monitoring program coordination and integration	Ongoing	• Delta ISB review of the CHABs Monitoring Strategy (2024)[90]
3.5 (also 2013 Delta Science Plan Action 4.1)	Establish sustainable funding for forward-looking science	Ongoing	• Release of the annual crosscut budget[91] • Continued to fund forward-looking science through the 2021 & 2025 Delta Research Awards and 2020, 2022, & 2025 Delta Science Fellowships

86. https://www.waterboards.ca.gov/resources/data_databases/wq_science_symposium.html
87. https://deltacouncil.ca.gov/social-science-task-force
88. https://www.usgs.gov/publications/interagency-ecological-program-long-term-monitoring-element-review-pilot-approach-and
89. https://deltacouncil.ca.gov/pdf/isb/products/2022-03-22-isb-monitoring-enterprise-review.pdf
90. https://deltacouncil.ca.gov/pdf/isb/products/2024-03-28-isb-comments-chab-monitoring-strategy.pdf
91. https://deltacouncil.ca.gov/dpiic/initiatives

ACTION		STATUS	EXAMPLE RELATED OUTCOMES
3.6 (also 2013 Delta Science Plan Action 4.3.2)	Develop a shared framework that broadly addresses the data lifecycle to support the goals of AB 1755 and beyond	Completed	• **An Open Data Framework for the San Francisco Estuary – Baerwald et al., 2020**[92] • State Water Board's Office of Information Management and Analysis': **Strategic Data Management Action Plan**[93] • IEP's Data Utilization Work Group • **CA Water Data Consortium Steering Committee**[94]
3.7	Promote accessibility to peer-reviewed scientific literature, data, and tools	Ongoing	• Delta Science Program established a partnership and training series with the National Center for Ecological Analysis and Synthesis (NCEAS) to build capacity for open data and open science research techniques (**Delta Synthesis Working Groups with NCEAS**[95]) • Delta Science Tracker • Recipients of Delta Science Program funding are strongly encouraged to use reproducible workflows, follow FAIR (Findable, Accessible, Interoperable, Reusable) data principles, publish model code, and publish journal articles using open-access services like the **San Francisco Estuary and Watershed Science journal**[96] • USGS Data portal for high frequency data in the Delta, including flow and water quality
3.8 (also 2013 Delta Science Plan Action 4.4.1)	Develop and implement a strategy to grow the collaborative modeling community	Ongoing	• **The Delta Collaboratory: Advancing an Integrated Modeling Collaboratory for the Delta**[97]
3.9 (also 2013 Delta Science Plan 4.4.3)	Support high-priority model development across agencies and programs	Initiated and ongoing	• **Water Temperature Modeling Platform peer review (2023)**[98] • Salinity Management Workshop Series (2022-2024) CalSim3 model development project to improve model performance for sea level rise and new restoration scenarios • 2025 Delta Science Program Collaboratory profiling initiative

92. https://escholarship.org/uc/item/02q969kt
93. https://www.waterboards.ca.gov/resources/data_databases/strategic_data_management_action_plan.html
94. https://cawaterdata.org/our-team/the-consortiums-steering-committee/
95. https://deltacouncil.ca.gov/delta-science-program/science-synthesis-working-group
96. https://escholarship.org/uc/jmie_sfews
97. https://deltacouncil.ca.gov/delta-science-program/collaborative-modeling
98. https://deltacouncil.ca.gov/delta-science-program/water-temperature-model-development-independent-advisory-panel

ACTION		STATUS	EXAMPLE RELATED OUTCOMES
3.10	Establish a shared set of best practices and protocols for focused synthesis	Ongoing	• Training materials and products from the **Delta Synthesis Working Groups with NCEAS**[99]
3.11 (also 2013 Delta Science Plan Action 4.5.1)	Provide and support opportunities for synthetic thinking across the Delta science and management communities	Ongoing	• **Tidal Wetland Science Symposium (2023) publication**[100] • IEP Synthesis Project Work Team • **Sacramento River Spring-Run Chinook Salmon Workshop (2020)**[101] • **Delta Synthesis Working Groups with NCEAS**[102] • Annual Delta Science Program and UC Davis Coastal and Marine Sciences Institute symposia

99. https://deltacouncil.ca.gov/delta-science-program/science-synthesis-working-group
100. https://escholarship.org/uc/item/1pt6w706
101. https://deltacouncil.ca.gov/pdf/science-program/2020-09-08-10-sacramento-river-drainage-spring-run-chinook-workshop-summary.pdf
102. https://deltacouncil.ca.gov/delta-science-program/science-synthesis-working-group

Highlight: Measuring juvenile spring-run Chinook salmon to determine growth rates.

Chapter 4. Support effective decision-making through science-based adaptive management and decision support tools

This chapter was dedicated to promoting Actions that improve informed decision-making and adaptive management in the Delta. Actions saw significant progress, particularly for enhancing support for adaptive management and utilizing public venues for sharing adaptive management resources and lessons learned (see Table Appx. 1-3).

Highlight: 2025 Adaptive Management Forum presenters and panelists shared lessons from across all stages of the adaptive management cycle to showcase successes, gaps, and future needs. **Credit:** Carlie Guadagnolo.

Table Appx. 1-3 | Progress on Chapter 4 Actions.

ACTION		STATUS	EXAMPLE RELATED OUTCOMES
4.1 (also 2013 Delta Science Plan Action 3.2)	Implement adaptive management and structured decision-making approaches more fully and consistently	Complete and ongoing	• Finalized **Element and Monitoring Plans with Examples**[103] • CSAMP Structured Decision-Making (SDM) report to discuss how and when SDM may be used as a model to support planning and adaptive management for ecosystem restoration projects • **Interagency Adaptive Management Integration Team (IAMIT) and Suisun Adaptive Management Advisory Team (AMAT)**[104] promote adaptive management coordination
4.2 (also 2013 Delta Science Plan Action 3.1)	Provide adaptive management liaisons	Complete	• Delta Science Program staff serving as adaptive management liaisons and participating in early consultations for 31 restoration and water management projects, including the Lookout Slough Tidal Wetland Restoration Project • Delta Science Program staff participate in a variety of interagency groups to support adaptive management planning (e.g., IAMIT and AMAT)
4.3 (also 2013 Delta Science Plan Action 3.4)	Convene regular adaptive management forums	Complete and ongoing	• 2021, 2023, & 2025 **Adaptive Management Forums**[105]

103. https://deltacouncil.ca.gov/pdf/science-program/2021-01-28-elements-of-amps.pdf

104. https://deltacouncil.ca.gov/delta-science-program/interagency-adaptive-management-coordination

105. https://deltacouncil.ca.gov/delta-science-program/adaptive-management

Chapter 5. Collectively support the implementation of the Delta Science Plan

This chapter aimed to further support the Delta science community in achieving the vision of One Delta, One Science: an open Delta science community that collaborates to build a shared understanding of science and has the capacity to adapt. Most progress is initiated (e.g., enhancing research funding) or ongoing (e.g., development of science plans), providing an opportunity to improve the coordination, tracking, and implementation of the 2026 Delta Science Plan (see Table Appx. 1-4).

Table Appx. 1-4 | Progress on Chapter 5 Actions.

ACTION		STATUS	EXAMPLE RELATED OUTCOMES
5.1	Establish shared mechanisms and processes to enhance science funding	Initiated	• Delta Crosscut Budget • Funding partnerships for solicitations (e.g., Delta Science Program, CA Department of Fish and Wildlife, Proposition 1, U.S. Bureau of Reclamation, and State Water Contractors)
5.2	Develop, coordinate, and implement topic-specific Delta science implementation plans	Ongoing	• **Draft Pyrethroid Research Plan**[106] • **Delta CHABs Monitoring Strategy (2024)**[107] • **Healthy Rivers and Landscapes Science Plan (2024)**[108]
5.3 (also 2013 Delta Science Plan Action 2.3)	Develop a web-based tracking system of science activities in the Delta	Completed and ongoing	• **Delta Science Tracker (2023)**[109]
5.4 (also 2013 Delta Science Plan Action 5.4)	Maintain and grow the scientific expertise workforce needed to support the Delta Science Plan implementation	Ongoing	• **Delta-specific Frontiers for Young Minds publication (2022)**[110] • Delta Science Fellows, CCST Science and Technology Policy Fellows, and California Sea Grant State Policy Fellows • **Delta Synthesis Working Groups with NCEAS**[111]
5.5 (also 2013 Delta Science Plan Action 2.8)	Develop and report performance measures for the Delta Science Plan	Initiated	• 2026 Delta Science Plan Appendix 1

106. https://www.waterboards.ca.gov/rwqcb5/water_issues/tmdl/central_valley_projects/pyrethroid_control_program/
107. https://deltacouncil.ca.gov/pdf/science-program/2024-10-21-final-delta-chabs-monitoring-strategy.pdf
108. https://resources.ca.gov/-/media/CNRA-Website/Files/Initiatives/Voluntary-Watershed-Agreements/Draft_VA_Science_Plan.pdf
109. https://sciencetracker.deltacouncil.ca.gov/
110. https://kids.frontiersin.org/articles/10.3389/frym.2022.615776
111. https://deltacouncil.ca.gov/delta-science-program/science-synthesis-working-group

APPENDIX 2

Process to update the 2026 Delta Science Plan

Background

The 2026 update of the Delta Science Plan was conducted to reflect the current science and management landscape in the Delta. To ensure the content is relevant to the regional needs of the Delta and to promote broad acceptance of the Delta Science Plan as a useful and valuable framework, the update process involved early and continuous engagement from the Delta science community. Although the Delta Science Program has taken the role of leading the update and review effort, improvements to the Delta Science Plan rely on the Delta science community to shape the content, along with additional input and guidance from the Delta ISB and individuals with expertise in coordinating other complex systems. The approach to updating the Delta Science Plan was similar to that taken in previous iterations; however, the 2026 Delta Science Plan employs a new framework built around the four grand challenges to Delta science. The grand challenges are explained in the **Grand Challenges Essay**[112], which provides the rationale, process, and starting ground for actionable items to address the selected grand challenges. This new framework helped respond to the Delta ISB's comments on the draft 2019 Delta Science Plan, calling for the Delta Science Plan to be bolder, more strategic and flexible to address the rapidly growing and interlinked challenges for science-based policy and management decisions for the Delta (Delta ISB, 2019). See Figure Appx. 2-1 for a generalized timeline for the development of the 2026 Delta Science Plan.

112. https://deltascienceplan.deltacouncil.ca.gov/sites/default/files/2024-11-20-grand-challenges-in-delta-science-essay.pdf

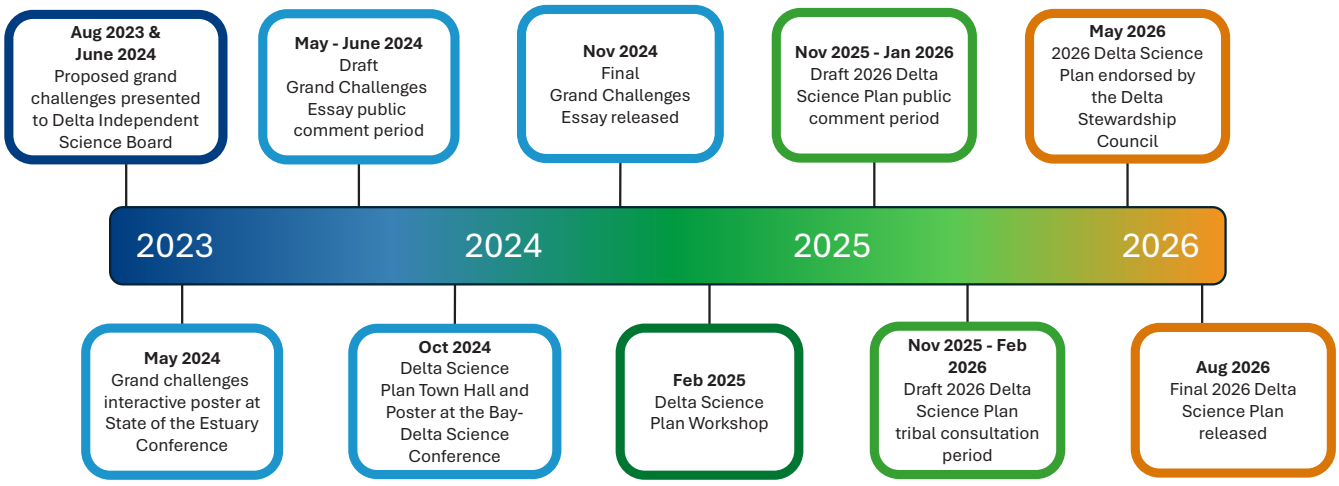


Figure Appx. 2-1 | Timeline describing key milestones in the development of the 2026 Delta Science Plan

Grand challenges framework development and outreach

The development of the 2026 Delta Science Plan began in 2021 with an effort to identify the grand challenges, as initially envisioned and led by former Delta Lead Scientist Dr. Laurel Larsen and former Deputy Executive Officer for Science Dr. Louise Conrad. See Figure Appx. 2-2 for an overview of the grand challenges development process.

To gather input from the greater Delta science community, the Grand Challenges Essay was broadly shared via several engagement opportunities, including:

- Delta ISB meetings in 2023 and 2024 (14 comments)
- 45-day public comment period from May-July 2024 (43 comments)
- 2024 State of the San Francisco Estuary Conference with an interactive poster (7 comments)
- 2024 Bay-Delta Science Conference Jeopardy Town Hall and Poster

The Grand Challenges Essay was considered, finalized, and released in November 2024. This essay contains additional details about the development process for the four grand challenges and is available here[113].

113. https://deltascienceplan.deltacouncil.ca.gov/sites/default/files/2024-11-20-grand-challenges-in-delta-science-essay.pdf

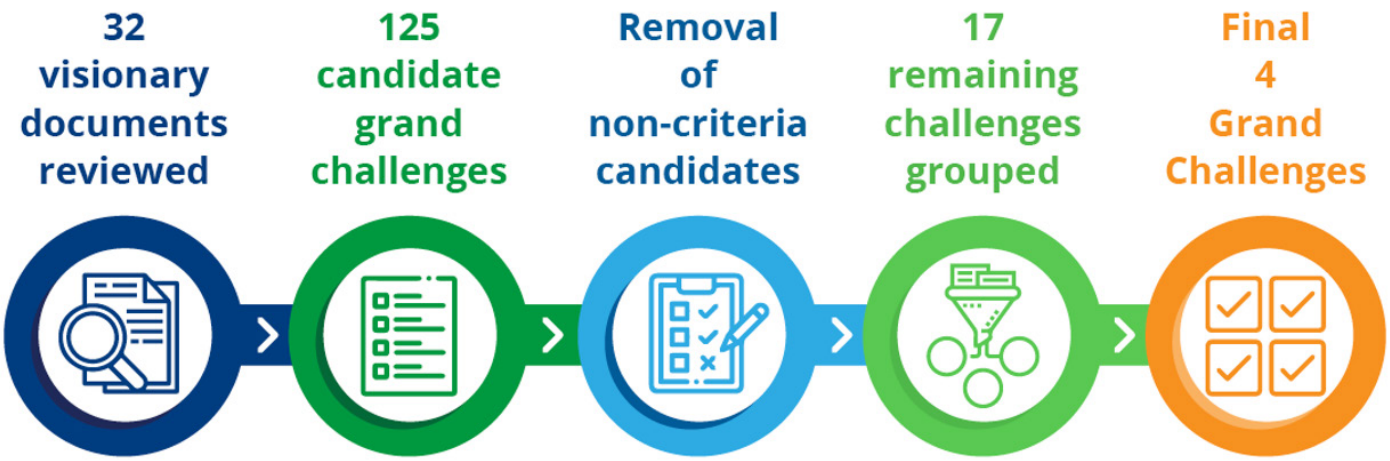


Figure Appx. 2-2 | Grand challenges development process, starting with a review of 32 visionary documents on the Bay-Delta system. This resulted in 125 candidate grand challenges being pulled from a literature review, which were then reviewed against the grand challenges criteria and finally compiled into the final four grand challenges.

February 2025 Delta Science Plan Workshop

The Delta Science Plan Workshop took place on February 20-21, 2025, with a hybrid option on Day 1 and all virtual sessions on Day 2. Both days were recorded and are available here: Day 1[114], Day 2[115]. See Table Appx. 2-1 for a breakdown of the 99 total participants' affiliations over the two-day workshop.

To begin the workshop, a real-time poll was used to gain a better understanding of how participants utilize the Delta Science Plan. Forty-nine attendees responded to at least one question. When asked to rank their preference for the new structure organized around the grand challenges, most participants supported the shift, ranking it highest, followed by "no preference," and with preference for the 2019 chapter and objective format ranked lowest. Participants also shared a wide range of perspectives on which 2019 Actions were most frequently used and/or beneficial to their work, and which Actions they would have liked to see more success from.

Participants were also asked about their familiarity with the 2019 Plan's Appendices. The most commonly noted were:

- Science Governance and the Collaborative Delta Science-scape
- Policy and Procedures for Independent Scientific Review
- Policy and Procedures for Independent Science Workshops

When asked which Appendices should be prioritized for updates, Policy and Procedures for Independent Scientific Review and Policy and Procedures for Research Funding received the most support. Finally, we asked whether there were additional "informative" or "policy and procedure" documents that should be developed. Science communication and data governance were both mentioned in the responses. See the section below, Appendix and Resource update process, for more information on how the Appendices were updated.

Table Appx. 2-1 | Breakdown of the affiliations of the 99 total participants who attended the February 2025 Delta Science Plan Workshop.

AFFILIATION	NUMBER OF PARTICIPANTS
Delta Stewardship Council	35 (24 were facilitators or notetakers for the event)
Other State Agencies	25
Local Agencies	8
NGOs	7
Academic	6
Federal	5
Tribal	1
Other	3

Over the course of the two-day workshop, presenters were selected to speak to each of the four grand challenges and breakout groups were used to collect feedback on strategies to address them. We used the collaborative software program Mural to create both online and printed interactive environments (virtual whiteboards). Each breakout group focused on one grand challenge and had one designated notetaker, one facilitator, and at least three additional participants. After a brief introduction, participants were asked to individually brainstorm tools and strategies that the Delta community can use or improve to address the grand challenge and add them to their Mural. Participants were then encouraged to discuss ideas within the breakout group, cluster ideas based on similarity, and place them on a priority matrix according to how much effort the tool or strategy would take and what impact it could have. Across the four grand

114. https://www.youtube.com/watch?v=z8elYmMC9m4&t=11923s

115. https://www.youtube.com/watch?v=WntiNemmWEI

challenges, the workshop convened 12 breakout groups, which resulted in a total of 533 individual comments. See Table Appx. 2-2 for a breakdown of number of breakout groups/Murals and comments by grand challenge.

Action selection and development

The February 2025 Delta Science Plan Workshop generated 533 individual comments. These comments were condensed into 24 final Actions to address the grand challenges, as detailed in the Table Appx. 2-3. Final Actions were reviewed, and Action Examples were solicited internally.

Table Appx. 2-2 | February 2025 Delta Science Plan Workshop breakout group details.

	BREAKOUT GROUPS/ MURALS	COMMENTS
Grand challenge 1	3	158
Grand challenge 2	2	88
Grand challenge 3	5	178
Grand challenge 4	2	109
Totals	**12**	**533**

Table Appx. 2-3 | February 2025 Delta Science Plan Workshop breakout group details.

IDEA COUNT	DELTA SCIENCE PROGRAM METHOD	OUTCOME
533 comments	The 533 individual comments from the February 2025 Science Plan Workshop were grouped by similarity and merged if they were determined to convey the same information	533 individual comments were merged/combined into 134 priority topics
134 priority topics	The 46 actions from the Grand Challenges Essay were added to the 134 priority topics synthesized from the February 2025 Science Plan Workshop	180 resulting priority topics
180 priority topics	The 180 priority topics synthesized from the February 2025 Science Plan Workshop and Grand Challenges Essay were merged based on: 1. Topic: Individual comments that shared a common topic, goal, or concern were grouped together	90 resulting draft Actions
90 draft Actions	The 90 draft Actions were further merged based on: 2. Specificity: Draft Actions that offered specific tools, strategies, or examples were grouped 3. Framing: Draft Actions that supported complementary forward-looking and feasible Actions were grouped	24 resulting final Actions were then organized within seven themes that were consistent across each of the grand challenges: Monitoring, Modeling & Experimentation, Data Accessibility, Collaboration & Communication, Synthesis & Review, Funding, and Governance & Relationships

Appendix and Resource update process

Feedback from the February 2025 workshop highlighted that the Appendices are a valuable resource for the community and that continuing to provide guidance through this format is important. To highlight their usefulness to the community, we have renamed Appendices that are not directly tied to the development or tracking of the Delta Science Plan as Resources. These Resources provide practical and useful information for the Delta science community and are responsive to the Actions within the Delta Science Plan. The intention is that these Resources will become stand-alone living documents that will be accessible online, outside of the Delta Science Plan. The 2026 Delta Science Plan now only contains two true Appendices:

- **Appendix 1:** Implementation successes: Status of 2019 science plan and relevant outcomes
- **Appendix 2:** Process to update the 2026 Delta Science Plan

Three Appendices from the 2019 Science Plan were not updated in the 2026 iteration: Process for updating the Science Action Agenda, because this process is captured in the current SAA and on the Delta Stewardship Council's **SAA web page**[116]; The State of Bay-Delta Science (SBDS), because this information is captured on the Delta Stewardship Council's **SBDS web page**[117]; and Delta ISB Review, because this process is captured in the **Delta ISB's operating guidelines**[118].

Two new Resources were added to the 2026 iteration:

- **Resource A: Data governance, portals, and online resources**
- **Resource B: Making science whole: Embedding social science in natural science workflows**

These new additions reflect emerging needs identified through the February 2025 Delta Science Plan Workshop and broader engagement efforts, as well as recommendations from the 2019 Delta Science Plan.

The following 2019 Delta Science Plan Appendices have been transitioned to be "Resources" and were updated to better reflect our current practices and progress.

- **Resource C: Science communication**
- **Resource D: Research funding**
- **Resource E: Conflict of interest considerations for reviewers, advisors, and applicants**
- **Resource F: Science governance and the collaborative Delta science-scape**
- **The former 2019 Delta Science Plan Appendices:** Policy and procedures for independent scientific review; and Policy and procedures for independent science advisors, were combined into a single **Resource G: Delta Science Program services for independent scientific review and scientific advice,** to reduce redundancy
- **Resource H: Guidance for science workshops**

Outreach and review

The draft 2026 Delta Science Plan was posted for public review and comment for 72 days, circulated for tribal consultation for 90 days, and provided directly to the Delta ISB for review on November 19, 2025. The impending release of the draft was also presented at the State of the Estuary Conference in October 2025 and directly to the Delta ISB in early November 2025. To encourage more public comment, an anonymous, optional survey was circulated that allowed respondents to comment on each individual Action in the draft. When the draft was released for review, the Council conducted

116. https://scienceactionagenda.deltacouncil.ca.gov/
117. https://sbds.deltacouncil.ca.gov/
118. https://deltacouncil.ca.gov/pdf/isb/meeting-materials/2022-07-14-isb-operating-guidelines.pdf

outreach to raise awareness and gather feedback during the 90-day tribal consultation period to California Native American Tribes included in the Council's internal California Native American Tribal contact log, the Native American Heritage Commission contact list, and the Bay-Delta Monthly Tribal Newsletter contact list. The announcement was also shared via the Council's listserv, website, social media, newsletters, and via targeted emails to representatives of each Action Example and collaborative venue discussed in **Resource F**.

In total, four comment letters, 22 emails, 15 survey responses, and **a publicly available review by the Delta ISB**[119] were received. Combined, this included >200 individual comments that were each considered in the revision process. Overall, feedback was supportive of the updated grand challenges framework and the Actions and Resources included within the draft, while highlighting several areas for improvement. Feedback requested more detailed and explicit connections between the Actions themselves and the Action Examples, a more nuanced discussion of the social sciences, a more explicit discussion of the use of decision-making frameworks, and more details on future tracking of the Delta Science Plan.

While there were no substantial changes to the Actions themselves, there is now significantly more detail describing how each Action and Action Example supports science in the Delta. In addition, six new call-out boxes were added to provide additional context on topics such as the Delta's monitoring enterprise, emerging uses of artificial intelligence in Delta science, and efforts to build the next generation of Delta science leaders. These revisions substantially strengthened the 2026 Delta Science Plan, and we are grateful to all who provided feedback during the review process.

The upcoming release of the final 2026 Delta Science Plan was also presented at the 2026 Interagency Ecological Program Workshop.

Delta Stewardship Council endorsement

The Delta Stewardship Council endorsed the 2026 Delta Science Plan at the May 28, 2026 meeting, which included public comment.

References

Delta Independent Science Board. (2019). Urgency & Opportunities for Improving Delta Interagency Science & Technical Integration. Sacramento, California. https://deltacouncil.ca.gov/pdf/isb/products/2019-02-11-isb-letter-to-dpiic.pdf

119. https://deltacouncil.ca.gov/pdf/isb/products/2026-03-05-isb-final-delta-science-plan-review.pdf

Highlight: GPS surveying around Bethany Reservoir to aid in elevation mapping efforts to detect signs of subsidence, erosion, or damage that may not be visually detectable.

RESOURCE A

Data governance, portals, and online resources

Introduction

This Resource provides a basic overview of open data principles and practices that may be useful for anyone working directly or indirectly with scientific data in the Delta. The purpose of the Resource is to: 1) provide one possible interpretation of open data and describe a practical approach to the data lifecycle; 2) provide background on the history and evolution of open data in the Sacramento-San Joaquin Delta and Suisun Marsh (collectively referred to herein as Delta; California Water Code § 85058), the San Francisco Bay-Delta (Bay-Delta) system, and the broader San Francisco Estuary; and 3) highlight key guiding documents and online resources that are relevant to the Delta science community.

Research and monitoring generate large amounts of data in the Delta, which are used to deliver management-relevant science to decision-makers (Baerwald et al., 2020). But these data are not always collected or formatted in standardized ways that allow them to be combined with other similar data, or they may be difficult to access or understand (Hale et al., 2015). To increase the efficiency of data use and re-use, the Delta science and management community has moved toward an "open data" framework to facilitate collaboration, ensure transparency, and increase the capacity for data synthesis, all of which can help generate new insights on the system and its management (Baerwald et al., 2020).

What is open data?

The **California Open Data Portal**[1] is a statewide open data portal operated by the Government Operations Agency. According to the California Open Data Portal, open data refers to information that can be freely used, shared, and built upon by anyone, anywhere, for any purpose. Open data must be publicly available in a discoverable data portal without cost or restrictions, stored in a machine-readable and open format such as CSV or JSON, and accompanied by sufficient metadata. Open datasets must also be published and updated promptly to ensure they are usable and relevant. Open data practices align closely with the FAIR principles of data management, which state that data should be Findable, Accessible, Interoperable, and Reusable (Wilkinson et al., 2016).

Ensuring that data is easily discoverable, stored in standard formats, and adequately documented makes it easier for different institutions to collaborate and helps to ensure that research is reproducible and verifiable. It also enables the integration and synthesis of data from multiple sources and across various disciplines to generate new knowledge. Making data accessible to and usable by the public also increases transparency and can help promote innovation and scientific advances. Overall, increased access to more comprehensive, interoperable datasets promotes better and more efficient science-informed decision-making.

Open data is closely related to open science, a broader movement that aims to make all aspects of scientific research – including data, methods, software, publications, and peer review – transparent and accessible. Open science can help make research more accessible and lead to more inclusive, responsive, trusted, and impactful science. It relies on open data to enable collaborative knowledge-building and reproducibility.

The data lifecycle

The data lifecycle is a framework for understanding and describing the various stages through which data passes during its journey from collection to application, encompassing storage, analysis, and other related processes (Delta Stewardship Council, 2019). There are many ways to represent the data lifecycle, but it is important to examine the data lifecycle through the lens of open data. The 2019 Delta Science Plan included a diagram of a data lifecycle (Figure A-1) that is driven by a management need or scientific hypothesis, which helps characterize how the required data can adhere to the principles of open data and open science throughout its journey. The Delta Stewardship Council (Council) and numerous other institutions working within the Delta contribute to various stages of this lifecycle.

As described in the 2019 Delta Science Plan (page 35), the eight stages in the data lifecycle naturally follow one another, but the process is not always linear. The eight stages are:

1. **Plan:** identify the type of data needed and how it will be collected, managed, and made accessible.
2. **Collect:** gather observations and apply checks and inspections to ensure the quality of the data.
3. **Store:** submit data and sufficient metadata to an appropriate long-term archive.
4. **Provide access:** make data accessible to external users for informative purposes, including decision-making and learning.
5. **Analyze:** combine data from disparate sources to form one homogeneous dataset and analyze together.
6. **Transfer knowledge:** communicate results using interactive maps, graphs, dashboards, and so on.
7. **Make decisions:** base management decisions on knowledge gained through data.
8. **Assess data:** ensure that data collection continues to provide relevant information.

1. https://data.ca.gov/

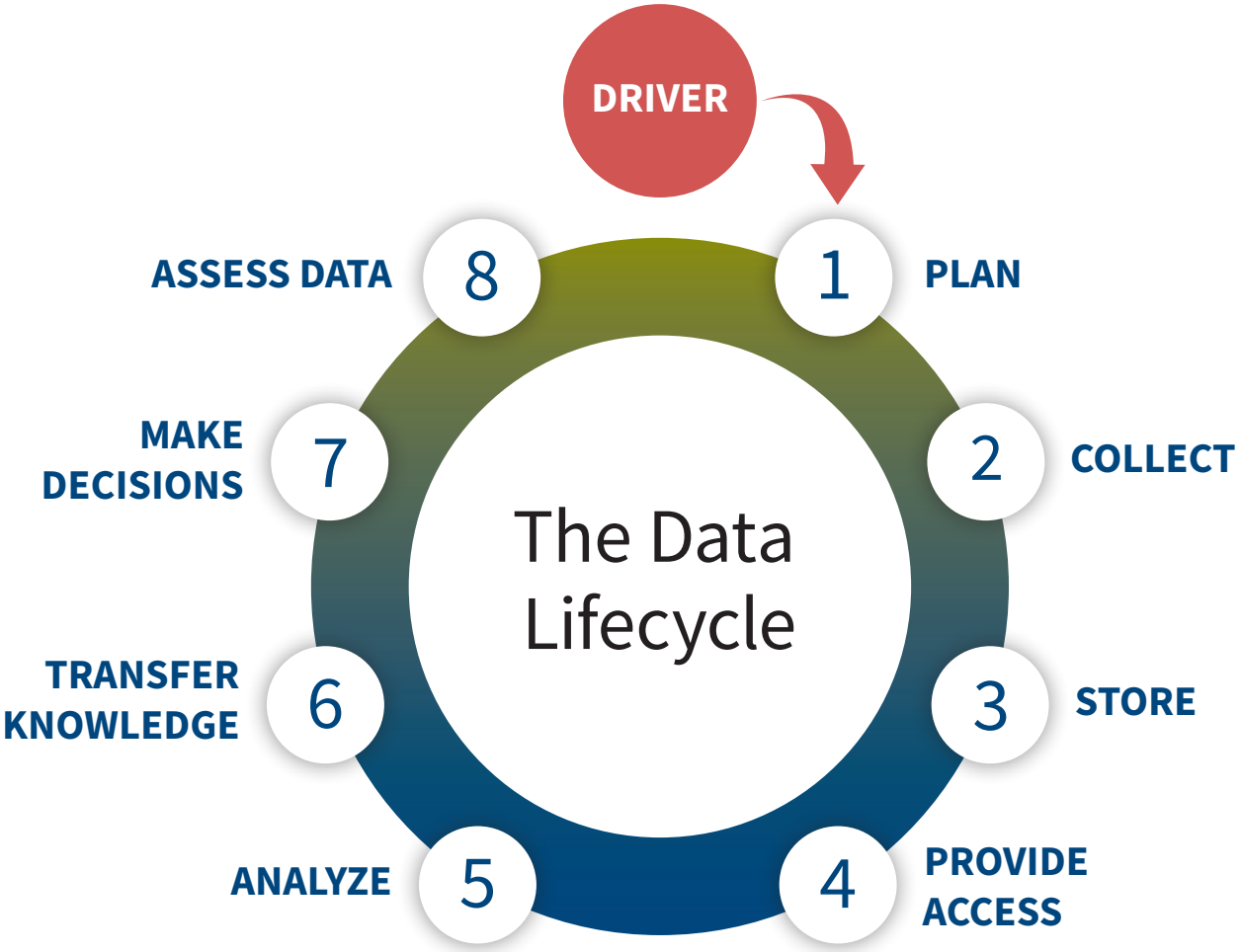


Figure A-1 | Major steps involved the data lifecycle. A management action or a hypothesis drives the data lifecycle. While the eight steps present a natural progression, the process is not always linear, and feedback loops can be important. "The eight steps consist of (1) Plan; (2) Collect; (3) Store; (4) Provide access; (5) Analyze; (6) Knowledge transfer; (7) Make decisions; and (8) Assess data.

Open data and the Delta Stewardship Council: A brief history

In 2014, the Council's Delta Science Program helped to coordinate the Environmental Data Summit, a seminal summit on data sharing and management in the Delta, which was driven by priorities identified in the 2013 Delta Science Plan. This summit led to the publication of the white paper, "Enhancing the Vision for Managing California's Environmental Information" (Hale et al., 2015). Following this effort and others, the California Legislature passed the Open and Transparent Water Data Act (Assembly Bill 1755, Dodd) in 2016. The bill requires the Department of Water Resources, in consultation with the California Water Quality Monitoring Council, the State Water Resources Control Board, and the California Department of Fish and Wildlife, to "create, operate, and maintain a statewide integrated water data platform; and to develop protocols for data sharing, documentation, quality control, public access, and promotion of open source platforms and decision support tools related to water data" (Cantor et al., 2018).

Highlight: Water quality sampling on the Sacramento River.

See Table A-1 for a highlighted selection of key guiding documents and online resources that provide information on open data best practices, protocols, and other relevant resources for the Delta science community.

Table A-1 | Key guiding documents or online resources with information on open data best practices, protocols, or other resources.

TYPE	DESCRIPTION	REFERENCE
Article	Open data framework for the Delta	Baerwald et al. (2020)
Report	California's open and transparent water data act	Cantor et al. (2018)
Report	Environmental Data Summit 2014	Hale et al. (2015)
Article	Findable, accessible, interoperable, reusable (FAIR)	Wilkinson et al. (2016)
Article	Collective benefit, authority to control, responsibility, ethics (CARE)	Carroll et al. (2021)
Article	Tribal data sovereignty in the Delta	Shinbrot et al. (2025)

TYPE	DESCRIPTION	REFERENCE
Website	Interagency Ecological Program (IEP) Data Utilization Working Group	https://iep.ca.gov/Data/Data-Utilization-Working-Group
Website	The Delta Science Program's Delta Synthesis Working Groups with the National Center for Ecological Analysis and Synthesis	https://deltacouncil.ca.gov/delta-science-program/science-synthesis-working-group
Website	Delta Science Tracker	https://sciencetracker.deltacouncil.ca.gov/
Repository	California Open Data Portal	https://data.ca.gov/
Repository	Environmental Data Initiative (EDI)	https://portal.edirepository.org/nis/home.jsp
Repository	ScienceBase Catalog	https://www.sciencebase.gov/catalog/
Repository	Inter-university Consortium for Political and Social Research (OpenICPSR)	https://www.openicpsr.org/openicpsr/
Website	National Science Foundation's (NSF) Preparing Your Data Management and Sharing Plan	https://www.nsf.gov/funding/data-management-plan
Website	AB 1755: Open and Transparent Water Data Platform for California	https://water.ca.gov/ab1755

Suggested citation

Delta Stewardship Council, Delta Science Program. 2026. 2026 Delta Science Plan: Resource A: Data governance, portals, and online resources.

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RESOURCE B

Making science whole: Embedding social science in natural science workflows

Introduction

Changes in the Sacramento-San Joaquin Delta and Suisun Marsh (collectively referred to herein as Delta; California Water Code § 85058), the San Francisco Bay-Delta (Bay-Delta) system, the broader San Francisco Estuary, and many other complex social-ecological systems are outpacing traditional approaches to science and management, underlining the need for researchers and natural resource managers to prioritize and respond with limited resources (Lee et al., 2024). The social sciences help navigate and ameliorate these management challenges by understanding emerging behavior changes throughout the social-ecological system (Biedenweg et al., 2020) (Box B-1). For example, the Delta Stewardship Council's (Council) 2023 Delta Residents Survey (DRS) revealed key concerns among Delta residents regarding where they obtain information, whom they trust, and their top priorities (Rudnick et al., 2023; see also Case Study 1). Insights like these can inform which projects should be funded to maximize impact, and how communities engage in conservation, restoration,

BOX B-1

THE DIVERSITY OF THE SOCIAL SCIENCES

The social sciences are the systematic study of classic disciplines (e.g., anthropology, sociology, economics, political science, psychology) and applied disciplines (e.g., education, communications) (Niemiec et al., 2021). Together they work to "understand, describe, theorize, deconstruct, imagine, or plan" social phenomena (Bennett et al., 2017). These fields range from environmental economics – asking questions like: How much are people willing to pay for clean water? What incentives are needed to improve conservation behaviors? – to environmental governance – asking questions like: What formal and informal rules affect conservation outcomes? The social sciences can be used to understand how to communicate climate change in a way that resonates, how community values influence restoration priorities, or how institutions collaborate (or not) for co-management. Different social science fields and methodologies use a wide range of assumptions, theories, and epistemologies, so they are not interchangeable or equally useful for all questions. Understanding the right tool for the right problem is key.

and research – ultimately making science and science investments more comprehensive, relevant, actionable, and successful.

Despite this demonstrated value, social science remains underutilized in Delta conservation, restoration, and water management (Bennett et al., 2017; Biedenweg et al., 2020; Fox et al., 2006). The purpose of this resource is to demystify common myths about social science and provide natural scientists with practical entry points for collaborating with social scientists and utilizing social science data. Examples in this document highlight success stories in the social sciences, as well as possible ways for academic researchers, agency scientists, and managers to directly engage in or support social science integration efforts in the Delta.

Myth 1: Social science is a soft science

Social science is often dismissed as "soft," implying it is less objective, less empirical, or less scientific than fields like biology, chemistry, or physics. This myth persists in part because social science deals with human behavior, values, and institutions – domains that are dynamic, variable, and hard to design a control group or test alternative scenarios. However, this complexity is countered by rigorous methods. Social scientists require many of the same elements as researchers in the natural sciences: they develop hypotheses, conduct experiments, construct and operate theoretical frameworks, collect empirical data, and use systematic methods or modeling to test and refine the hypotheses. For example, a conservation social scientist might hypothesize that decentralized water governance leads to more adaptive policy outcomes. A null hypothesis would posit that there is no relationship. They could test this using comparative case studies, regression models, or even experimental designs. Interested yet? Such studies have already been conducted by Andersson and Ostrom (2008). Similarly, a sociologist studying public trust in science might design a randomized survey experiment to test whether different message framings influence attitudes toward environmental policy (Ophir & Jamieson, 2021) or marine conservation behaviors (Kolandai-Matchett & Armoudian, 2020) – methods directly analogous to experiments in the natural sciences. For more background and examples, see the Delta Social Science Task Force report (Biedenweg et al., 2020).

Myth 2: Social science is just public participation

Social science is often misunderstood as merely facilitating public engagement or communication. In environmental management and policy, this leads to the misconception that social scientists are only valid after technical work is complete, to "translate" science for the public, or to help check

Photo: Researchers share insights from landowner interviews at the Suisun Marsh Spring Landowner Workshop, highlighting strong support for collective action to manage Phragmites, an invasive plant that has increased in cover by over 230% between 2003 and 2018. See Case Study 2 for more information. **Credit:** Zhao Ma.

an engagement box. While participatory methods, such as interviews, focus groups, or co-design, are valuable components of some social science approaches, they represent only a fraction of the field's full scope. For example, political science and institutional analysis help illuminate why specific governance arrangements succeed or fail in managing shared resources (Ostrom, 1990). Behavioral economics uses data and experimental designs to identify how cognitive biases and heuristics influence decision-making under deep uncertainty (Independent Science Board, 2024; Shogren et al., 2010; Tversky & Kahneman, 1974). Sociology and human geography provide critical insights into how power, culture, and identity shape environmental conflict, collaboration, and knowledge production (Escobar, 2008; Forsyth, 2003). These contributions go well beyond outreach – they are foundational to gaining insights or testing ideas as part of feasible, equitable, and effective research. Evidence-based insights from social science promote socially viable solutions to natural resource concerns, but social scientists need to be involved early enough to shape the solutions under consideration, rather than being brought in late in the process.

Easy entry points to social science

What are the easy entry points for natural scientists and managers interested in the social sciences?

1. COLLABORATE WITH SOCIAL SCIENTISTS EARLY IN THE RESEARCH PROCESS

Ignoring social science until the natural science research is ready to be implemented often results in solutions that are sound in theory but socially unviable. One of the benefits of involving social scientists early on is the ability to help predict how people may adapt or change their behavior in ways unexpected by natural resource managers. For example, a Kansas cost-share program that subsidized water-saving irrigation technologies – intended to reduce groundwater extraction – instead found that participating farmers expanded irrigated acreage, offsetting the expected water saving (Pfeiffer & Lin, 2014). So, social scientists can be valuable members of teams devising regulations or incentives to enhance their effectiveness at meeting resource goals.

When conducting surveys, interviews, workshops, or other work involving research on and with people, the best way to ensure that the data is collected ethically is to work with a social scientist. Social scientists can help determine whether Institutional Review Board (IRB) requirements for human subjects research are necessary, design ethically sound studies, including identifying the most relevant questions to ask and determining the optimal order, and enhance data quality. The consequence of conducting research without IRB approval can be severe: suspension of research, loss of funding, publication retraction, legal liability if participants are harmed, and damage to your credibility and professional reputation. See Box B-2 on where to find social scientists.

BOX B-2

WHERE DO I FIND A SOCIAL SCIENTIST?

There are many types of social scientists, and understanding the relevant disciplines for the question at hand will help with finding the right person for the right problem. Many social scientists are based at universities and research institutions, and relevant expertise can often be found in departments such as economics or sociology. Reviewing published research on related topics can also help identify appropriate collaborators. Alternatively, you can obtain customized research through consultants like Gallup, which designs surveys and conducts focus groups. In the Delta, you can explore the **Delta Stewardship Council's Social Science Integration Web page**[1] and the list of **Bay-Delta Social Science Community of Practice members**[2] interested in Delta human dimensions topics. If you're still searching for more information, reach out to the Delta Stewardship Council's Social Science Integration Team at **socialscience@deltacouncil.ca.gov**.

2. INTEGRATE SOCIAL DATA INTO MODELS AND ANALYSES

Social-ecological system models encompass social, ecological, and spatial scales – serving as an appropriate framework for natural and social scientists to bring together diverse interests and actors (Steger et al., 2020). Natural scientists are often already familiar with the range of data from which they can draw to understand landscape or population change; however, they usually lack an understanding of the social drivers (Zimmerer & Bassett, 2003). For example, models that forecast regional climate change may not incorporate local-level human drivers, such as land use change, even though these may present the highest vulnerability to the system (Altaweel et al., 2009). Box B-3 illustrates a few examples of social science datasets that natural science researchers can start to explore. Below, Case Studies 2 and 3 include a discussion of integrating social and biophysical data.

3. BECOME FAMILIAR WITH SOCIAL SCIENCE METHODOLOGIES

Familiarity with interviews, surveys, case studies, or discourse analyses enhances interdisciplinary collaboration and reduces the risk of misinterpretation. Even a basic understanding improves the framing of joint research. Researchers, both from academia and agencies, can start by signing up for and reading applied interdisciplinary journals that might relate to your field (e.g., Global Environmental Change, Ecology & Society, Environmental Science & Policy) to see how social science complements ecological questions. There are many resources available that can be found by searching within a management topic area. Most robust approaches tend to come from teams that include social scientists, where case studies written entirely by biophysical or natural scientists can be unreliable examples of applying evidence-based social research.

1. https://deltacouncil.ca.gov/social-science
2. https://deltacouncil.ca.gov/bay-delta-social-science-community-of-practice

BOX B-3

SOCIAL SCIENCE DATASETS

There are several open-access datasets with social metrics that serve as useful starting points for natural scientists. National and global resources include NASA's Socioeconomic Data and Applications Center, which offers gridded data on population, poverty, and urbanization; the U.S. Census Bureau and American Communities Survey provide decadal demographic assessments; the World Values Survey captures global public attitudes toward science, governance, and the environment; the Zillow Home Value Index provides information on markets and home values; and InVEST is a suite of software models for mapping and economic valuing of ecosystem services created by the Natural Capital Project.

4. CO-DESIGN RESEARCH WITH NON-SCIENTISTS

Co-design – i.e., collaboratively developing questions, methods, and goals with those affected by environmental decisions – can improve the relevance and impact of scientific work. Social science practitioners, including trained facilitators, may have excellent skills co-designing workshops to help navigate power dynamics, ensure inclusive representation, and build trust with communities. Social science researchers, on the other hand, might help to design research to learn about the effectiveness of a co-produced approach or to document outcomes. However, social scientists may play both roles in designing group processes. Navigating and documenting these types of dynamics are especially important in regions like the Delta, where diverse groups hold competing values and histories with land and water management (Delta Stewardship Council, 2025). Research co-designed with local actors is more likely to reflect real-world needs, avoid blind spots, and generate actionable findings (Beier et al., 2017; Norström et al., 2020; see also Case Study 3). For natural scientists, partnering with social scientists in this way not only enhances the use of findings but can also more directly benefit tribes and communities while helping to meet agency mandates for equity, transparency, and collaboration.

5. ADDRESS FUNDING AND CAPACITY CONCERNS

Two of the most fundamental barriers to incorporating social science on a large scale are a lack of funding and a lack of capacity. Designing research solicitations that incorporate social sciences and participatory approaches is one effective way to integrate social sciences. For example, in 2021, the Council began accepting proposals for integrated social-ecological systems research and funded two proposals in this category (see Case Study 2). By 2025, the Delta Research Awards required interested researchers to describe whether and how they were engaging with tribes or local communities – using the Council's **social vulnerability index**[3] (SoVi) – and whether and how they were employing participatory research methods. Applications with a substantial social science component earned up to 7% more points during the scoring process. The Council also assisted in identifying tribal or community partners and facilitated partnerships through a survey sent to researchers, community-based organizations (CBOs), tribes, and tribal-serving organizations to gauge research interests and needs.

To further catalyze social science integration and research, in 2020, the Council started funding a Social Science Extension Specialist (SSES) through California Sea Grant. The first SSES, Dr. Jessica Rudnick, was instrumental in launching and implementing the DRS (Case Study 1), the Bay-Delta Social Science Community of Practice, and setting the groundwork for the Tribal and Environmental Justice Issue Paper (Delta Stewardship Council, 2025).

3. https://deltascience.shinyapps.io/Delta_vulnerability_map/

Case studies

Social sciences have helped inform a wide range of questions in the Delta, including research on invasive species management, restoration, governance, interweaving Traditional Knowledge and Western Science, and many more. Below is a selection of three case studies that serve to show the role that social science can play in science and management.

CASE STUDY 1: DELTA RESIDENTS SURVEY

The 2023 **California Delta Residents Survey (DRS)**[4] was an effort to gain a deeper understanding of the people who live in the Delta. Historically, most Delta research and monitoring have focused on ecological and hydrological conditions, with less attention paid to how residents experience, influence, and are affected by environmental changes and policy decisions. The DRS sought to address that imbalance by reaching over 2,300 residents across rural and urban communities in the Delta and Delta-adjacent areas. Surveys were sent to 82,000 households, yielding a response rate of 2.9%, roughly double the typical rate for similar large-scale community surveys, indicating strong community engagement. The survey had four core goals: 1) Characterize residents' sense of place; 2) Assess the well-being of a diverse and evolving population residing in the region; 3) Understand residents' experiences and perceptions of environmental and climate change across the estuary; 4) Evaluate residents' civic engagement and perceptions of governance in the region.

Survey results highlighted that the Delta is not a homogeneous community – residents differ in what they value, what concerns them, and how they relate to the region. For example, rural residents emphasized quietness and scenic beauty, while urban residents valued recreation. Concerns about climate change were widespread but took different forms across communities. Notably, the survey also revealed disparities in well-being and access to resources, pointing to environmental justice challenges that require targeted policy responses. By capturing shared values and diverse experiences, the DRS provides insights for more effective and equitable communication, outreach, and planning. Agencies working on climate adaptation, for instance, can use these insights to tailor messages that resonate with specific communities. Furthermore, survey results showed that a majority of Delta residents trust scientific experts, local residents, and community advisory groups more than policy makers at local, state, or federal levels to make decisions in the best interest of the Delta. This underscores the importance of government agencies collaborating with local community groups, community leaders, and scientists when engaging with residents. This effort marks a significant advancement in understanding the social landscape of the Delta and is intended to be a recurring survey that can track the well-being of an evolving population.

CASE STUDY 2: COLLECTIVE ACTION FOR PHRAGMITES CONTROL

Invasive species management in the Delta presents both ecological and social challenges, particularly in mixed-ownership landscapes such as Suisun Marsh. An interdisciplinary team led by John Takekawa from Suisun Resource Conservation District (SRCD) and researchers from six academic institutions sought to **integrate social science into efforts to manage the rapid spread of *Phragmites australis* (Phragmites)**[5]. This invasive plant has increased in cover by over 230% between 2003 and 2018. Its spread across Suisun Marsh threatens the function of wetlands by impeding navigation, increasing fire risk, and reducing critical habitats for wildlife. It requires coordinated efforts across property boundaries (i.e., collective action) to achieve shared goals.

4. https://www.openicpsr.org/openicpsr/project/195447/version/V2/view;jsessionid=2E19DBE12440F0DBD4FCF4AF3FC7E657

5. https://sciencetracker.deltacouncil.ca.gov/node/52581

To address this issue, the research team conducted remote sensing to map the plant's spread, field and greenhouse experiments to study the revegetation response following Phragmites removal, and a retrospective analysis of herbicide treatments. Importantly, they also recognized that the success of invasive species management in Suisun Marsh hinges on landowners participating together in invasive species removal. To better understand these social dynamics, the team employed a combination of social science methods, including semi-structured interviews, a landowner survey, and a spatial prioritization model that identified high-value zones for Phragmites control. These approaches helped identify key factors that facilitate or hinder collective action for managing invasive plants, providing a comprehensive understanding of the extent of the Phragmites invasion.

Interviews with interested parties, including duck club members, NGOs, and government representatives, revealed widespread distrust of state and federal agencies and frustration with perceived inaction on public lands. In contrast, SRCD was consistently viewed as trustworthy due to its local presence, shared values, and strong relationships with landowners. Their spatial prioritization model for Phragmites control balanced ecological urgency with the likelihood of landowner engagement, yielding useful insights on how to build trust and improve communication. A key takeaway from this case study is that invasive species control in Suisun Marsh is more effective when it addresses the social dimensions of land management. The mixed-ownership mosaic, common in the Delta, necessitates collective action, which is facilitated when conservation efforts are grounded in trust, shared values, and meaningful collaboration.

CASE STUDY 3: PARTICIPATORY MAPPING FOR FRANKS TRACT FUTURES

Frank's Tract is a nearly 3,000-acre flooded island in the central Delta, situated at the intersection of significant ecological, social, and economic

Highlight: An aerial view of Franks Tract.

challenges. The tract is well-used for recreational activities such as boating, hunting, and fishing; however, it is also a significant contributor to salinity intrusion into the central Delta, which, during drought years, threatens the reliability of the water supply. In 2017–2018, the California Department of Fish and Wildlife completed an initial feasibility study proposing restoration to manage salinity intrusion and support Delta smelt habitat. However, the plan met significant resistance from the local community due to concerns about reduced navigability and recreation opportunities. Researchers launched the Franks Tract Futures project to co-design a suite of multi-benefit futures that ensured the local community's needs were represented (CDFW, 2020).

A key part of the project was a participatory mapping exercise – one of many social science tools – that allowed participants to map out common boating routes, pinpoint culturally important resources, and identify areas of the design that they liked or disliked. These results directly informed the design process and were made publicly accessible through an interactive map.

Despite these efforts to involve the community in the planning process, Franks Tract Futures has faced major and continuing challenges to the planning process in the Delta – a lack of trust in government-led processes, limited funding, and frustration/participation fatigue from repeated engagements that fail to deliver tangible results (Maven's Notebook, 2024). As of Spring 2026, Franks Tract Futures is in a third round of planning. For any updates, please visit: https://franks-tract-futures-ucdavis.hub.arcgis.com/.

Conclusions

This resource outlines the breadth of social sciences, dispels common myths that limit their application, and demonstrates how social science methods – from surveys and interviews to institutional analysis and participatory mapping – enhance both the rigor and relevance of conservation and water management efforts. By connecting natural and social sciences, building partnerships early, and addressing barriers such as funding and capacity, researchers and agencies can better navigate complex social-ecological challenges, foster trust with communities, and ultimately produce more equitable, actionable, and durable outcomes for the Delta.

Suggested citation

Delta Stewardship Council, Delta Science Program. 2026. 2026 Delta Science Plan: Resource B: Making science whole: Embedding social science in natural science workflows.

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RESOURCE C

Science communication

Introduction

Science communication is vital to addressing each of the grand challenges[1] to science in the Sacramento-San Joaquin Delta and Suisun Marsh (collectively referred to herein as Delta; California Water Code § 85058), the San Francisco Bay-Delta (Bay-Delta) system, and the broader San Francisco Estuary. In a world where future environmental conditions and regulations may look very different and traditional science struggles to keep pace with constant change, we need ways to share information as efficiently and effectively as possible among Delta scientists and decision-makers. At the same time, we must ensure that science communication is an inclusive exchange of ideas – connecting Delta communities to the science in their regions and connecting traditional ways of knowing to decision-making. By fostering dialogue, building trust, and creating spaces for meaningful engagement and knowledge co-production, science communication can strengthen connections between science, communities, and decision-making.

Science communication is a broad, complex, and evolving field that can have multiple meanings for different individuals. At its core, however, it is the process of ensuring that scientific knowledge is not merely produced but is also understood, trusted, and acted upon (Kappel & Holmen, 2019). As such, science communication, as used in the

1. https://deltascienceplan.deltacouncil.ca.gov/sites/default/files/2024-11-20-grand-challenges-in-delta-science-essay.pdf

context of the Delta Science Plan, means more than simply publishing academic articles in journals or presenting at conferences. It requires thinking deeply and strategically about the reasons for communicating and how best to engage audiences in ways that support effective decision-making. The Delta Stewardship Council's (Council) Delta Science Program recognizes this need and increasingly encourages research proposals to include a strategic communication and engagement plan. This helps to ensure that science communication is not merely an afterthought.

The purpose of this resource is to: 1) highlight general principles of effective science communication; 2) provide a few examples of Delta-specific audiences and communication methods; and 3) share helpful information for interested readers to learn more. While the resource cannot be comprehensive in every way, we hope it will help advance the conversation about effective science communication in the Delta.

Effective science communication principles

In the words of Bawah (2019), effective strategic communication can be boiled down to "getting the right message, through the right media, to the right audience at the right time." Knowing who your audience is, how scientific research can inform their needs, and your reasons for communicating will generally determine the nature of the message you want to convey and the best method to use for delivery. Furthermore, it is important to recognize that science communication is an ongoing process of two-way communication, and not something that happens only at the end of a project when you package up and deliver your results.

The three core science communication components – audience, message, and delivery – overlap and interact with each other and cannot be fully understood in isolation or without context. However, some general principles are worth bearing in mind.

AUDIENCE

First, and perhaps most important, identifying and understanding your audience is key. Different audiences have different values, experiences, knowledge, and interests. They also differ in how they prefer to receive information, whom they trust to deliver it, and the kinds of information they are more likely to accept or reject. Listening to, and building trust with, your audience is vital. When identifying potential audiences, consider who is affected by the topic, who is interested in it, and who can take action. Targeting small, tightly connected groups of people can be more effective than broadcasting to large networks of weak ties (Toomey, 2023). Here in the Delta, there are many ways to group audiences. In this resource, we use the following broad groups: scientists, decision-makers, tribes, and local communities. We will discuss these in more detail in the next section, Science Communication in the Delta.

MESSAGES

It is also vital to know precisely what you want to communicate and why. Your message content might be, for example, the factual results of a study, management recommendations based on interpretation of those results, or a solicitation for input. Your reasons for communicating can be similarly varied and may include informing, influencing, or engaging your audience. A good message is clear, concise, relevant, and aligned with the needs and characteristics of your audience. It should avoid unnecessary jargon and not assume too much (or too little) prior knowledge.

DELIVERY

Ultimately, your approach or method for delivering communications should align well with both the message and the audience. Academic papers and conference presentations are important for scientists; however, decision-makers concerned with policy development may prefer one-page briefs, while members of the public may find less formal media like podcasts or videos more engaging.

Approaches that incorporate storytelling, interactivity, and provide actionable information are often more persuasive or compelling than presenting facts alone (Kolandai-Matchett & Armoudian, 2020; Toomey, 2023). Interactive approaches, such as ArcGIS StoryMaps or data visualization dashboards, can help communicate complex information in ways that are more accessible to diverse audiences. Participatory approaches, such as community workshops, can be an effective way to engage with and learn from other interested parties. These approaches reflect a broader shift toward viewing effective science communication as an ongoing, two-way exchange of information, rather than a one-way transmission of facts (Druckman et al., 2025).

Science communication in the Delta

Science communication in the Delta is a complex issue. There are myriad producers and consumers of scientific information with multifaceted interests and priorities, belonging to different groups with varying levels of overlap and alignment. It is impossible to keep track of everything that is happening, and the system itself is changing in response to intensifying environmental and social pressures. This Delta-specific complexity overlays the structural challenges of a 21st-century media ecology that is characterized as "post-truth," hyper-partisan, fractious, and contemptuous of scientific expertise (Druckman et al., 2025). As such, we must work to improve science communication in the Delta. This section will highlight some science communication audiences and delivery methods that are important in the Delta.

DELTA AUDIENCES

As mentioned earlier, science communication audiences in the Delta can be broadly divided into scientists, decision-makers, tribes, and local communities. We acknowledge that this categorization is arbitrary and reductive, and that these groups are nebulous and overlapping in nature. However, such groups can be helpful as a structured starting point for considering Delta audiences.

Scientists

Researchers conducting studies or monitoring activities to address Delta-relevant questions. This audience includes members from many disciplines affiliated with a wide range of institutions, including academia, non-profits, consulting firms, other non-governmental organizations, tribes, and local, state, and federal agencies.

Decision-makers

Professionals who develop and/or implement Delta management and policy may require differing levels of scientific detail or context, including:

- Program staff who rely on science to execute everyday operational decisions in the Delta (often referred to as "environmental managers").
- Lawmakers, policy-level staff, and governing boards concerned with advancing state policy, governance, agency mission, and/or shaping strategic direction.
- Those interested in applied science and what it means for Delta policy and management.

Local communities

People or groups with some level of personal relationship to the Delta. Local communities may require less technical information but are also strongly invested in the topic and its role in decision-making. Their values, knowledge, interests, and other characteristics vary greatly. Examples of members of this audience include:

- Residents and community groups.
- Agricultural interests, commercial interests, and business owners.
- Environmental justice or other advocacy groups, interest groups (e.g., duck hunters, fishers, boaters).
- General members of the public.

Tribes

Tribes, tribal communities, and Traditional Knowledge-holders have their own unique knowledge systems, priorities, and decision-making processes. Federally recognized tribes are sovereign governments with inherent authority to govern their people and resources and should be engaged as governmental partners, not interested parties (Delta Stewardship Council, 2025). When consulting and engaging with tribal partners, consider:

- Management decisions may affect tribal resources, communities, and culture.
- Communication should go beyond "transmitting knowledge" and be an iterative and meaningful process of ongoing engagement and co-production that recognizes the value of Traditional Knowledge and is built on trust, respect, humility, and reciprocity.

EXAMPLES OF COMMUNICATION PRODUCTS AND METHODS

This section presents some general Delta-relevant communication methods, venues, and platforms, along with a few specific examples of how each is related to various audiences. These examples are merely illustrative and are not intended as a definitive list of communication methods, venues, or approaches in the Delta.

Scientific journals and publications

Historically, peer-reviewed articles in scientific journals have served as the primary means of communicating science to scientific audiences, such as researchers and other scientists. Peer review is also an important criterion for best available science, ensuring that scientific information has undergone rigorous evaluation by independent experts to ensure its credibility (Delta Stewardship Council, 2015). Peer-reviewed articles can also be an appropriate vehicle to reach decision-makers who use applied science to direct or otherwise inform their work – most commonly for program-level managers, but this may also include policy-focused decision-makers.

- San Francisco Estuary and Watershed Science[2] (SFEWS) – open-access journal with a large Bay-Delta science and policy audience; published with support from UC Davis and the Council.
- The State of Bay-Delta Science[3] (SBDS) – periodically released sets of peer-reviewed articles synthesizing recent science on management-relevant topics (e.g., extreme events in the Delta) to inform decision-making; coordinated by the Council's Delta Science Program.

Conferences, symposia, and webinars

Conferences and other organized events in the Delta frequently focus on sharing applied science and its impact on Delta management and policy. These venues provide important opportunities for dialogue among Delta scientists, decision-makers, and other interested parties. Such events can facilitate cross-pollination among many groups working in the Delta and catalyze new ideas and collaborations.

- Bay-Delta Science Conference[4] (BDSC) – biennial in Sacramento (typically held in years ending in an even number), co-sponsored by the Council and the U.S. Geological Survey.

Highlight: 2024 Bay-Delta Science Conference in Sacramento, CA. **Credit:** Lynn Takata.

2. https://escholarship.org/uc/jmie_sfews
3. https://sbds.deltacouncil.ca.gov/
4. https://www.baydeltascienceconference.com/

- **State of the San Francisco Estuary Conference**[5] – biennial in the San Francisco Bay Area (typically held in years ending in an odd number), organized by the San Francisco Estuary Partnership.
- **Council's Delta Science Program and UC Davis Coastal and Marine Sciences Institute joint symposia**[6] – regular free events that synthesize and share emerging science on a priority management topic (e.g., microplastics in the Bay-Delta).

Digital platforms

There are numerous online platforms and tools devoted to Delta science communication, many of which serve multiple audiences. Data dashboards and visualizations (e.g., **Shiny applications**[7] such as **those hosted by the Council's Delta Science Program**[8]) are particularly useful because often users can engage with them at various levels: viewing visualizations of pre-selected data, interacting with that data via a graphical interface, or downloading the underlying data to analyze elsewhere. These tools enable a wide range of audiences to explore scientific data and information, regardless of their experience with data analysis tools.

- **Delta Science Tracker**[9] – a website hosting profiles of scientific activities conducted in the Delta aimed at enhancing transparency and providing access to associated products (e.g., publications, reports, news articles, fact sheets, and videos); valuable for researchers looking for collaborators, program managers seeking insight on key topics, policy-focused decision-makers assessing the funding landscape, among other uses; hosted by the Council.
- **Bay-Delta Live**[10] – a decision support tool that federates and displays spatially explicit water and environmental data from hundreds of sources to facilitate analysis, monitoring, reporting, and resource management in the Bay-Delta; supported by the State Water Contractors.
- **Flood risk mapping tool**[11] – a tool that allows users to explore flood risk across the Delta in response to specified sea level rise scenarios and map other data layers of interest, including social vulnerability index and critical infrastructure; produced as part of **Delta Adapts**[12] by the Council.
- **Vulnerable Communities Platform**[13] – a map that allows users to look at the intersection of current and projected climate impacts with relevant social and demographic factors; produced by the California Governor's Office of Land Use and Climate Innovation.

Policy briefs, 'glossy summaries', and fact sheets

Numerous institutions produce policy-focused reports, or higher-level summaries of technical information, that are useful for decision-makers who may be time-limited and focused on synthesizing the big picture from multiple disparate sources.

- **Priorities for California's Water**[14] – well-designed and clearly written policy brief that highlights actionable takeaways for managers and policymakers, includes information aimed to be understood by informed lay audience, and provides links to further information for readers who need more specifics; produced by the Public Policy Institute of California.

5. https://www.sfestuary.org/about-soe/
6. https://marinescience.ucdavis.edu/events/cmsi-and-delta-stewardship-council-symposia
7. https://shiny.posit.co/
8. https://deltascience.shinyapps.io/Home/
9. https://sciencetracker.deltacouncil.ca.gov/
10. https://www.baydeltalive.com/home/new-homepage
11. https://deltascience.shinyapps.io/delta_flood_map/
12. https://www.deltacouncil.ca.gov/delta-plan/climate-change
13. https://vcp.lci.ca.gov/
14. https://www.ppic.org/publication/priorities-for-californias-water/

- **SBDS summaries**[15] – peer-reviewed SBDS articles are summarized into different forms intended for lay audiences; these booklets and summary sheets distill the key science and management takeaways for decision-makers, the public, and scientists in other fields; produced by the Council.

Online media

Online media publications, blogs, and newsletters play a similar role in the science communication ecosystem, delivering a mix of accessible science and policy journalism, as well as explainers, to informed audiences. One particularly useful approach to science storytelling is provided by ArcGIS StoryMaps – interactive, multimedia communication tools that are relatively easy to create and can present complex information through an engaging website with maps, photos, and other embedded visuals. Other engaging media formats for science communication include short-form videos and podcasts, which can feel less formal and more personal and allow for different information consumption patterns. These formats can help broaden the reach of scientific information and engage audiences who may not interact with more traditional scientific products.

- **Maven's Notebook**[16] – a comprehensive website and newsletter focused on providing information about California water; content includes original and curated news stories, stories/explainers, podcasts, and more; frequently considered essential reading for anyone involved with the Delta.
- **California WaterBlog**[17] – a blog sharing perspectives on California water resources management aimed at policy and educated lay audiences; produced by the UC Davis Center for Watershed Sciences.
- **Aquafornia**[18] – a newsletter curating a selection of top water news from California and the West each weekday; produced by the Water Education Foundation.
- **Weaving the Delta's Story: Research in Action**[19] – a visually compelling StoryMap highlighting research projects funded by the Council's Delta Science Program's 2020-2021 Delta Research Awards; intended to share key research activities and findings in an engaging and accessible format for all audiences.
- **Exploring the Heart of California Water**[20] – an informative and engaging StoryMap guide to the Delta; considered an excellent primer for the public, journalists, and non-experts in the policy and legislative realms.
- **The Delta Dispatch**[21] – a limited series podcast featuring conversations with experts to help explain the Delta Plan and its policies; produced by the Council in 2024-2025.

Participatory approaches

Participatory public workshops are an increasingly important venue for Delta science communication. Such workshops embrace a new paradigm of science and science communication that centers participation, engagement, and the co-production of knowledge by scientists and the audiences with whom they are communicating. This contrasts with more traditional top-down approaches, which view communication as the transmission of knowledge to less-informed parties to inform, reframe, or correct existing beliefs (Druckman et al., 2025). This bottom-up, participatory process of communication involves building relationships and actively soliciting and incorporating input from interested parties through ongoing dialogue throughout the project. It's essential to acknowledge that these interested parties can be anyone, including local community groups, tribes, decision-makers, and researchers.

15. https://sbds.deltacouncil.ca.gov/sites/default/files/2025-09-19-sbds-information-sheet.pdf
16. https://mavensnotebook.com/
17. https://californiawaterblog.com/
18. https://www.watereducation.org/aquafornia
19. https://storymaps.arcgis.com/stories/2722fd9914404a26aacfcac8ed6da853
20. https://storymaps.arcgis.com/stories/d68f8152af374dbcaf9198f751e18473
21. https://viewperformance.deltacouncil.ca.gov/index.php/Delta-Dispatch

- **Just Transitions in the Delta**[22] – a multi-institutional collaborative research project that uses public workshops and events, interviews, surveys, and field work to engage with diverse Delta communities and work with them to explore equitable water management strategies under different drought, salinity, and sea level rise scenarios.
- **Science for Communities**[23] – facilitates and fosters partnerships among Delta communities, tribes, local public agencies, and subject matter experts to collaborate on projects in the Delta region. This Council initiative promotes the sharing of knowledge, tools, and data to support relationship building, collaboration in addressing social-environmental issues, and access to funding for further research and training.

Conclusion

Science communication is not something that happens only at the end of a project. Rather, it is an ongoing, iterative, and collaborative process pursued in partnership with audiences and those who might benefit from, or be affected by, the outcomes of a project. It requires thinking deeply and with great intentionality about who you are communicating with, why the communication matters, and how to best engage with those audiences. Conducting science in an open manner is itself a valuable act of science communication. This process requires listening, flexibility, and intellectual humility, and can help to build trust and shared values within and across Delta communities. In doing so, science becomes embedded within a broader network of relationships that support effective decision-making and increase the likelihood of achieving meaningful real-world outcomes.

Resources for further exploration

A small selection of resources to learn more about science communication and the science of communication.

- **2025 Delta Research Engagement and Communication Plan Template**[24]
- **Capital Science Communicators**[25], a professional society supporting science communicators in the Sacramento region
- **Reimagining Science Communication in the COVID Era and Beyond**[26] (PNAS Special Feature)
- **Message framing strategies for effective marine conservation communication**[27] (Kolandai-Matchett & Armoudian, 2020)
- **Communication Approaches and Specialists that Can Improve Fisheries Management**[28] (Robison et al., 2024)
- **Why facts don't change minds: Insights from cognitive science for the improved communication of conservation research**[29] (Toomey, 2023)
- **Escape from the ivory tower: A guide to making your science matter**[30]

22. https://delta-just-transitions-ucdavis.hub.arcgis.com/
23. https://deltacouncil.ca.gov/science-for-communities
24. https://caseagrant.ucsd.edu/sites/default/files/2025%20DSP%20Engagement%20and%20Communication%20Plan%20Template.docx
25. https://capscicomm.org/
26. https://www.pnas.org/topic/575
27. https://onlinelibrary.wiley.com/doi/10.1002/aqc.3349
28. https://academic.oup.com/fisheries/article/49/7/319/7899715
29. https://www.sciencedirect.com/science/article/pii/S0006320722004396?via%3Dihub
30. https://press.princeton.edu/books/paperback/9781597266642/escape-from-the-ivory-tower?srsltid=AfmBOoqUtjEDiPlBP0MC0ndB6Gpxw1NUtriE3-aaVAlJ4eLcigTazWu4

- **COMPASS**[31] (including **the message box**[32], a tool for crafting your message)
- **International Association for Public Participation**[33]
- **Take Action Toolkit | American Association for the Advancement of Science (AAAS)**[34]
- **Trust in Science - Research and data from Pew Research Center**[35]

Suggested citation

Delta Stewardship Council, Delta Science Program. 2026. 2026 Delta Science Plan: Resource C: Science communication.

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Kappel, K., & Holmen, S. J. (2019). Why Science Communication, and Does It Work? A Taxonomy of Science Communication Aims and a Survey of the Empirical Evidence. *Frontiers in Communication*, 4.

Kolandai-Matchett, K., & Armoudian, M. (2020). Message framing strategies for effective marine conservation communication. *Aquatic Conservation: Marine and Freshwater Ecosystems*, 30(12), 2441–2463.

Robison, V., Jones, M. S., Erickson, B., & Biedenweg, K. (2024). Communication approaches and specialists that can improve fisheries management. *Fisheries*, 49(7), 319-326.

Toomey, A. H. (2023). Why facts don't change minds: Insights from cognitive science for the improved communication of conservation research. *Biological Conservation*, 278, 109886.

31. https://www.compassscicomm.org/
32. https://www.compassscicomm.org/leadership-development/the-message-box/
33. https://www.iap2usa.org/
34. https://www.aaas.org/resources/take-action-toolkit
35. https://www.pewresearch.org/topic/science/trust-in-science/

Highlight: Delta Science Fellow Sebastian Gonzales, in collaboration with ICF Fish and Aquatic Sciences Team, implants tiny acoustic trackers into Delta smelt. Sebastian's graduate work has focused on developing novel acoustic tagging methods for small, sensitive fish (e.g., Delta smelt and longfin smelt), and understanding the effects of tagging on fish behavior and performance. **Credit:** Peter Aronson.

Delta Science Plan 2026

RESOURCE D

Research funding

Introduction

Increased coordination among funding entities in the Sacramento-San Joaquin Delta and Suisun Marsh (collectively referred to herein as Delta; California Water Code § 85058), the San Francisco Bay-Delta (Bay-Delta) system, and the broader San Francisco Estuary can improve efficiency, reduce redundancy, and yield greater collective impact. The Delta Stewardship Council's (Council) Delta Science Program provides a tested and transparent model for aligning science with management needs – one that other funding entities can adapt or build upon.

The Delta Crosscut Budget Report provides a summary of state, federal, and local investments in science and restoration activities in the Delta during the State Fiscal Year (FY). In FY 2023–2024, the Delta Crosscut Budget reported that the Council contributed $8.2 million or 16% of the total $50.3 million spent on research and synthesis in the Delta. This relatively small share supports high-impact programs, such as the Delta Science Fellows, the Delta Research Awards, and Directed Actions. With the growing need for science and overall funding stagnating, collaboration is no longer optional – it is essential. Working together and leveraging funds creates a larger pool of resources and builds efficiencies to support the research needed to inform decision-making in the Delta. This research funding Resource is primarily intended to inform potential applicants interested in the Delta Science Program's research funding opportunities, but it also serves as a resource for public agencies

and other organizations interested in advancing research in the Delta. It outlines the Delta Science Program's research funding processes and offers guidance for effective and transparent investments in Delta research. By highlighting key considerations for improving coordination among funding entities, strategies for launching or refining funding programs, and a model approach for addressing emerging issues, this Resource promotes strategies to strengthen the pipeline of researchers working in the Delta.

The Delta Science Program's mission

Funding scientific research is one of the primary ways the Council's Delta Science Program fulfills its mission to provide the best possible unbiased scientific information to inform water and environmental decision-making in the Delta (California Water Code § 85280(b)(4)). The Delta Science Program supports research through contracts, such as the Delta Research Awards which are the Delta Science Program's periodic solicitation process for research in the Delta.

The Delta Science Program relies primarily on two pathways to fund research: proposal solicitations and Directed Actions (see sections below for more information). Regular proposal solicitations are generally considered the most robust and transparent way to fund research, providing a predictable source of funds for high-priority research in the Delta. Therefore, the Council's Delta Science Program prioritizes available funding for competitive research. The most appropriate funding pathway will depend on the availability of funds, the urgency of the information needed, and the specificity of the research questions. This flexibility enables the Council's Delta Science Program to address both long-term planning needs and time-sensitive management questions. The chosen pathway must also comply with laws applicable to state contracting.

The Delta lead scientist plays a central role in guiding the competitive research process, including providing scientific advice on:

- The content of solicitations
- Prioritizing proposed Directed Actions
- The selection of expert reviewers and leading review panels
- Awards, based on independent scientific review
- Research funding priorities

All proposals undergo both administrative and scientific peer review, with all reviewers screened for potential conflicts of interest (see Resource E: Conflict of interest considerations for reviewers, advisors, and applicants for details). In the 2025 Delta Research Awards solicitation, all proposals were independently scored with consistent criteria prioritizing scientific merit, relevance to the Science Action Agenda (SAA), and broader impacts and equitable engagement. Other criteria included feasibility, team qualifications, budget reasonableness, data management plan, and whether there was a social science component. This rigorous, transparent process ensures accountability and the integrity of funded research.

In recent years, the Delta Science Program has increasingly emphasized interdisciplinary approaches and the inclusion of social science, Traditional Knowledge, and co-production of knowledge – collaborative processes that involve scientists, managers, and community members in all phases of research. These approaches improve the relevance, credibility, and application of scientific findings.

Despite the strengths of the Delta Science Program's research funding, gaps remain. The Delta Science Program does not currently offer grants, which can be a more flexible and efficient mechanism for research. There is also limited capacity to respond rapidly to emerging issues due to limited funds and the time required to create contracts. Additional funds are needed to support adaptive management, synthesize existing research, communicate findings,

and coordinate science investments across agencies. Establishing regular funding coordination meetings and expanding convening roles could strengthen system-wide collaboration and improve strategic alignment of research funding in the Delta.

Proposal solicitations

The Council's Delta Science Program favors using a competitive process to distribute research funding when science needs are broad and crosscutting, as identified in the SAA. The SAA acts as the unifying framework, or the "glue", that brings together efforts across the Delta by identifying and prioritizing management-relevant science needs. The Delta Science Program leverages the SAA to strategically fill critical science gaps that other funding programs may overlook.

Funding may originate from various sources, including federal and state agencies, as well as other public entities. Each source often comes with unique constraints, such as indirect cost caps, specific focus areas, and eligibility requirements that must be considered during solicitation development and implementation.

To ensure alignment with funding priorities and to expand support for high-quality research, funding partners are actively engaged during both the planning and selection phases. **The Delta Science Program solicitations always receive more proposals than can be funded, so funding partners are encouraged to support proposals that align with their specific priorities within the SAA and financial capabilities.** This approach increases the total number of funded projects and streamlines the solicitation process by reducing the

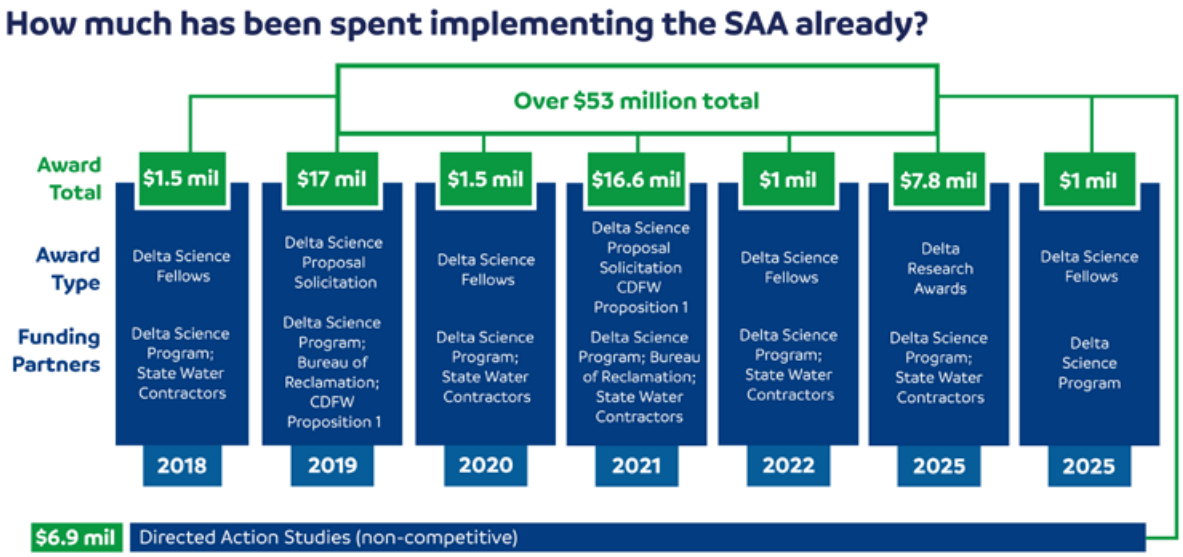

Figure D-1 | Dollars spent implementing the SAA across two iterations (2017-2021 and 2022-2026). The SAA forms the foundation for competitive and non-competitive funding decisions by the Delta Science Program and its funding partners. Adapted from **A Researcher's Guide to Funding & Tracking Priority Science**[1].

1. https://scienceactionagenda.deltacouncil.ca.gov/pdf/2023-02-13-a%20-researchers-guide-to-funding-and-tracking-priority-science.pdf

Figure D-2 | Five-step process for the Delta Research Awards: **(1)** Call for proposals based on the Science Action Agenda, **(2)** Individual reviews by multiple subject matter experts, **(3)** Panel review led by the Delta lead scientist, **(4)** Award consultation with the Delta lead scientist, and **(5)** Final award selection by the Delta Stewardship Council.

need for separate efforts by each funding partner. Figure D-1 shows how the Delta Science Program and partners are funding implementation of the SAA. Interested funding partners are encouraged to visit our **Research Funding and Fellowships web page**[2] or email researchfunding@deltacouncil.ca.gov.

All proposals must be submitted in accordance with the official solicitation instructions. Each proposal undergoes independent external scientific review to ensure transparency, rigor, and merit-based selection.

A critical component of this process is the partnership with third-party academic institutions, such as California Sea Grant. These partners can provide significant support and enhanced efficiency by leveraging existing online application portals, administering awards, and facilitating a more robust and independent review process.

Review of proposals

The Council's Delta Science Program typically posts a draft solicitation notice online for public comment, engages in related outreach, and may offer some assistance in facilitating research collaborations where permissible. To facilitate the review process, the Council's Delta Science Program typically requires a Letter of Intent before the full proposal stage. Eligible proposals are distributed to subject matter experts for scientific review. See Figure D-2 for an overview of the process for the Delta Research Awards.

2. https://deltacouncil.ca.gov/delta-science-program/research-funding-and-fellowships

Highlight: US Geological Survey (USGS) scientists collect water quality data during a Delta-wide boat survey in May 2022. Early support for this broader research effort, known as "Operation Baseline," came through the Delta Science Program's Directed Action process. **Credit:** Biogeochemistry Group, USGS California Water Science Center.

Directed Actions

Directed Actions are appropriate when one individual or team is qualified to do the work, scientific research or advice is needed quickly, and when an important opportunity would be lost if the proposal had to wait for the standard competitive proposal solicitation. This approach is similar to the National Science Foundation's "Rapid Response Grants" process. They may be procured on a non-competitive basis, as permitted by law.

Because Directed Actions are time-sensitive, approved proposals will be funded as quickly as possible when funds are available. Projects should be low-cost, high-impact, and typically last less than two years.

Directed Actions are generally categorized into the following groups based on the needs they address:

- **Rapid Response:** Urgent investigations launched in response to unusual or extreme events to quickly gather data and enhance understanding for timely decision-making in the Delta
- **Collaborative Science:** Science efforts that address pressing needs identified by interagency and collaborative groups, often outside the typical solicitation timeline
- **Novel Technology or Expertise:** Critical research that leverages unique or exclusive expertise or technology to explore innovative solutions
- **Broadening Opportunity:** Aims to improve equity in research funding by supporting underrepresented organizations or individuals through targeted projects, internships, or scholarships

Review and decision process

Council staff consult with the Delta lead scientist to determine whether a project idea aligns with the SAA and fits into one of the Directed Action categories. The Delta lead scientist determines whether, based on scientific considerations, the urgency and topic of the proposed research merit further consideration. Directed Action proposals are evaluated based on several criteria, including:

- Availability of funds
- Urgency and uniqueness of the project
- Scientific and technical merit
- Improvement to Bay-Delta knowledge
- Relevance to management or policy
- Collaborative and transparent proposal process with broad participation

The proposal will be reviewed according to the above criteria by a group that typically includes:

- One discipline-relevant external academic subject matter expert
- A federal, state, or public agency subject matter expert with direct knowledge of the relevance of the activity
- One or more of the Council's Delta Science Program subject matter expert(s)
- One of the Council's Planning & Performance Measures Division subject matter experts

Based on independent reviews, the Delta lead scientist may request revisions to the proposal. If the requested revisions are significant, the revised proposal may undergo a second round of review, generally with the same reviewers if they are available.

Suggested citation

Delta Stewardship Council, Delta Science Program. 2026. 2026 Delta Science Plan: Resource D: Research funding.

Highlight: An aerial view of South Mokelumne River, featuring Brack Tract, Sycamore Slough, and Terminous Tract.

RESOURCE E

Conflict of interest considerations for reviewers, advisors, and applicants

Introduction

As part of its mission to provide the best available scientific information to inform water and environmental decision-making in the Sacramento-San Joaquin Delta and Suisun Marsh (collectively referred to herein as Delta; California Water Code § 85058), the San Francisco Bay-Delta (Bay-Delta) system, and the broader San Francisco Estuary, the Delta Stewardship Council's (Council) Delta Science Program takes steps to ensure the integrity of its internal and external work products and peer review processes. The Delta Science Program is committed to transparency and strives to ensure consistency among the funding agencies with which it coordinates and collaborates.

This overview of the Delta Science Program's conflict of interest considerations is guided by state law and intended to prevent actual and perceived conflicts of interest that could undermine the integrity of the Delta Science Program funded science or peer review. This extends to actions or activities that could create the perception of bias, favoritism, influence, or unfair funding decisions.

See Table E-1 for an illustrative summary of conflict of interest laws and regulations.

A potential conflict of interest does not automatically disqualify an individual or organization from working with the Delta Science Program and may sometimes be managed through disclosure.

Situations that may have conflict of interest implications include:

- Submitting a bid, proposal, or application
- Reviewing proposals or applications
- Advising the Delta Stewardship Council
- Subject matter experts conducting peer review

Table E-1 | Summary of conflict of interest laws and regulations. This summary is for illustrative purposes only and is not intended to provide legal advice or interpretation or be representative of all potentially applicable laws.

LAW	SUMMARY
Government Code § 87100	Public officials must not make or influence decisions if they have a financial interest in the outcome of those decisions.
Government Code § 8920	High-level state officials must avoid actions that conflict with their personal or financial interests with their public responsibilities.
Incompatible activities: Government Code § 1125; Government Code § 19990	State employees are prohibited from engaging in outside work or activities that conflict with their official duties or create a potential conflict of interest.
Government Code § 1090	Officials and employees are prohibited from participating in the making of contracts if they or their agency has a financial interest in them.
Public Contract Code § 10365.5	If you have a consulting contract to help develop a plan or recommendation, you cannot then bid on work that stems from or is suggested by that plan.
Public Contract Code § 10410	State employees cannot be paid for work funded by the state unless it's part of their job, and they cannot independently contract with the state while still employed.
Public Contract Code § 10411	Former state employees are prohibited from entering into contracts related to their state service for a period of two years after leaving their state job. For one year after leaving a policymaking position, former employees are prohibited from contracting with their former agency in the same subject area, unless as an expert witness or for ongoing legal work.

Proposal and independent peer review

The Council's Delta Science Program develops contracts with independent experts to serve as peer reviewers for research proposals and scientific materials. To avoid financial, professional, and personal conflicts of interest or the perception of conflicts, the Delta Science Program selects reviewers who have no direct connections or perceived connections to the proposals that they review.

Independent peer reviewers are considered consultants and compensated through consulting services contracts. These contracts require reviewers to operate through businesses authorized to do business in California and to comply with applicable laws and regulations. In some cases, the contracts may be subject to additional requirements and restrictions under the Political Reform Act (see 'Advising the Delta Stewardship Council' section below).

Because potential conflicts of interest are not always apparent, the Delta Science Program requests that potential reviewers promptly disclose any direct or indirect financial, professional, personal, or other connection to proposals under review. The Delta Science Program uses this information to assess whether that reviewer is suitable to participate in the review of that specific proposal.

A reviewer is disqualified if they:

- Assisted in the development of the proposal to be reviewed in any way
- Will receive a direct or indirect financial benefit (e.g., income, cost recovery/avoidance) from the funded project
- Have a conflict of interest under California law (see e.g., Table E-1)

In addition, a reviewer may be disqualified if they have any of the following connections to a proposal applicant within the past four years.

- Collaboration on research
- Co-authorship of publication(s)
- Thesis or post-doctoral advisor/advisee relationship
- Supervisor/employee or independent contractor relationship
- Worked at the same federal, state, or local agency; university; or private firm – even if they are in different divisions
- A close personal relationship

These connections do not necessarily disqualify the reviewer. The submitted information regarding such connections in the proposal is reviewed to determine if the connections could compromise the objectivity of the reviewer. If any disclosed connection may result in bias, favoritism, or an unfair funding decision, the reviewer will be excluded from that proposal or review, and the Delta Science Program will reassign the proposal or review. Additionally, individuals selected to serve as reviewers are expected to complete unconscious bias training before the review.

Advising the Delta Stewardship Council

Serving as an advisor to the Council (including the Council's Delta Science Program) may affect eligibility for future funding or contract opportunities related to the advice provided. Individuals or organizations that participate in Council (including Delta Science Program) workgroups, committees, or advisory panels may be considered advisors under state conflict of interest rules, even if the role is unpaid or informal.

Examples of situations that may lead to ineligibility include:

- Providing input on topics or priorities for funding program(s)
- Independent scientific advice that provides direct recommendations for public policy

- Participation in Council committees or work groups that inform Council policy or its implementation (e.g., Delta Adapts, Tribal and Environmental Justice Issue Paper)

Individuals and organizations engaged in these roles should evaluate potential for advisory conflicts before submitting proposals. Early disclosure of participation in any Council committee or workgroup that advises on funding topics or priorities is strongly recommended to determine if participation could affect eligibility.

Suggested citation

Delta Stewardship Council, Delta Science Program. 2026. 2026 Delta Science Plan: Resource E: Conflict of interest considerations for reviewers, advisors, and applicants.

Highlight: Science symposium at the California Natural Resources Agency Auditorium.

RESOURCE F

Science governance and the collaborative Delta science-scape

Introduction

A key challenge for environmental management is the number and diversity of the actors involved, each with their own perceptions, interests, and resources (Fliervoet et al., 2016). To address this challenge, many collaborative venues and networks have been created. Network analyses can help us understand these different collaborative venues by providing insight into the position and role of different actors (organizations and venues) in the network and help to identify central, coordinating, and bridging entities (Fliervoet et al., 2016).

This resource provides an updated network analysis of the leading collaborative science venues in the Sacramento-San Joaquin Delta and Suisun Marsh (collectively referred to herein as Delta; California Water Code § 85058), the San Francisco Bay-Delta (Bay-Delta) system, and the broader San Francisco Estuary since this analysis was first shared in the 2019 Delta Science Plan. The analysis focuses on the existing structure of the collaborative Delta science-scape, as of late 2025, and serves as a starting point for visualizing and understanding the inherent complexity in a large social-ecological system. Reanalyzing the network enables an exploration of how the Delta's science landscape has changed

over the past seven years, which can help us identify new or long-standing gaps in the collaborative science landscape. This can also help us implement the Delta Science Plan, and other frameworks like it, by highlighting and working with venues where interdisciplinary knowledge is most valuable. The goal for these analyses is to serve as a tool to improve collaborative science governance in the Delta.

Future analyses of this updated network could include identifying changes in the engagement of different types of organizations, changes in venues and their scopes, and strategies for effectively governing future collaborative science in the Delta amidst a rapidly changing world.

Collaborative science governance

In a complex social-ecological system like the Delta, governance is not about one individual or organization making a decision, but rather multiple individuals within organizations and systems of linked organizations making decisions to advance the collective good. **Collaborative governance** refers to the processes and structures of public policy decision-making and management that engage people constructively across the boundaries of public agencies, levels of government, and/or the public, private, and civic spheres to carry out a public purpose that could not otherwise be accomplished (Emerson et al., 2012).

Collaborative science governance is a form of governance that strives to collectively prioritize research questions, determine how science is conducted, and review and distribute the results. Collaborative science governance encompasses a range of science activities, including the direction of funding to research programs aimed at achieving high-priority science goals, the establishment and communication of best practices for carrying out research, and the review and dissemination of science results to decision-makers and other users. The network analysis described here focuses on visualizing and understanding the existing structure of the organizations and venues in the collaborative Delta science-scape.

Science-scape network diagrams and a summary of relationships

The network diagrams (Figures F-1 and F-2) were created by identifying 12 core collaborative science venues in the Delta (see Table F-1) and compiling a list of all organizations that participate in each venue. This data was analyzed in R[1] using the sna[2] and network[3] packages to create a network where each organization formed a node and the connections between the venues and their participants formed the edges between nodes. Networks were visualized using the R package ggraph[4]. These visualizations show patterns of participation, but they do not reflect the nature or strength of interactions between organizations (e.g., who informs whom or who leads).

Figure F-1 presents the Full Network, which includes all 12 core venues and every organization that participates in at least one of these venues. This diagram provides a "big picture" view of the collaborative landscape, showing the full range of 186 participating organizations.

Figure F-2 shows the collaborative science Core Network, which includes only organizations that participate in more than one venue. Removing organizations that appear in only a single venue creates a more focused view of the 44 organizations most deeply connected across the collaborative Delta science-scape.

1. https://www.r-project.org/
2. https://cran.r-project.org/web/packages/sna/sna.pdf
3. https://cran.r-project.org/web/packages/network/vignettes/networkVignette.pdf
4. https://cran.r-project.org/web/packages/ggraph/ggraph.pdf

Table F-1 | The 12 collaborative science and policy venues in the Core Network. This is not an exhaustive list of all collaborative Delta science activities.

ACRONYM	FULL NAME	ROLE/PURPOSE	PRIMARY PARTICIPANTS
CAWQMC	California Water Quality Monitoring Council	Develop specific recommendations to improve the coordination and cost-effectiveness of water quality and ecosystem monitoring and assessment, enhance the integration of monitoring data across departments and agencies, and increase public accessibility to monitoring data and assessment information.	Federal and state entities; citizen monitoring groups; the public; and scientific, agricultural, regulated water, and water supply communities
COEQWAL	Collaboratory for Equity in Water Allocations	Build an open, collaborative modeling and engagement space to explore Delta water futures; compare scenario outcomes with fixed, equity-oriented thresholds; synthesize and communicate results to inform adaptive management and fair decision-making across agencies, tribes, communities, and water managers.	Multiple University of California campuses and California State University, Sacramento, working in partnership with state and federal government agencies, Native American tribes, community groups, water districts, and NGOs
CoP	Bay-Delta Social Science Community of Practice	Bring together social science scholars, practitioners, and allies who are committed to advancing applicable and relevant research on the human dimensions of the Bay-Delta. Facilitate collaborative social science research and interdisciplinary investigation, provide opportunities for the social sciences to inform management and policy, and advance our understanding of the estuary as a complex social-ecological system.	The CoP is coordinated by the Delta Stewardship Council's Social Science Integration Team and California Sea Grant Social Science Extension Specialist for the Delta, and is open to social science scholars, practitioners, and allies across the San Francisco Bay and Sacramento-San Joaquin Delta system
CWEMF	California Water and Environmental Modeling Forum	Increase the usefulness of models for analyzing California's water-related problems, facilitate the exchange of information, resolve technical disagreements, and ensure that technical work considers the interests of the parties and management needs. Also, a non-partisan clearing house for models and peer review.	Federal and state entities, other entities with interests in water, universities, environmental organizations, private consultants, and the public (over 100 individual member entities)
DIISC	Delta Interagency Invasive Species Coordination Team	Foster communication and collaboration among California state agencies, federal agencies, research and conservation groups, and other interested parties that detect, prevent, and manage invasive species and restore invaded habitats in the Sacramento-San Joaquin Delta.	California state agencies, federal agencies, research and conservation groups, and other interested parties

ACRONYM	FULL NAME	ROLE/PURPOSE	PRIMARY PARTICIPANTS
DPIIC	Delta Plan Interagency Implementation Committee	DPIIC strives to facilitate Delta Plan implementation through collaboration in support of shared national, statewide, and local goals for the Delta.	18 federal and state entities are involved in the Delta Plan implementation
Delta RMP	Delta Regional Monitoring Program	Better inform decisions on protecting and restoring beneficial uses of water by producing objective and cost-effective scientific information critical to understanding regional water quality conditions and trends in the Delta.	Federal and state agencies, cities in and around the Delta, special water districts and other relevant districts, and water quality coalitions
IAMIT	Interagency Adaptive Management Integration Team	Work in support of integrated adaptive management for ecosystem restoration and water management in the Yolo Bypass, Delta, and Suisun Marsh.	Federal, state, and local entities, and interested parties involved in planning, funding, implementing, or that have regulatory oversight of Delta habitat restoration projects
IEP	Interagency Ecological Program	Provide and integrate relevant and timely ecological information for management of the San Francisco Bay-Delta ecosystem and the water that flows through it. This task is accomplished through collaborative and scientifically sound monitoring, research, modeling, and data synthesis.	Nine federal and state entities
ITAG	Interagency Telemetry Advisory Group	To achieve a reliable coordinated acoustic telemetry program that leads to improved monitoring of several aquatic species of the California Central Valley (e.g., Chinook salmon, Steelhead, Sturgeon).	Eight federal and state agencies, two University of California campuses, and East Bay Municipal Utility District
SIT	Central Valley Project Improvement Act (CVPIA) Science Integration Team	A collaborative technical team composed of interested parties and scientists who use the structured decision-making process to support adaptive resource management for CVPIA Fish Resource Area activities.	A self-selected technical group of federal & state agency staff, academic researchers, and interested parties
WRMP	San Francisco Estuary Wetlands Regional Monitoring Program	Delivers coordinated regional monitoring of the San Francisco Estuary's wetlands to inform science-based decision-making for wetland restoration and adaptive management and increase the cost-effectiveness of permit-driven monitoring associated with wetland restoration projects.	Federal and state agencies, community and conservation organizations, and interested parties in the San Francisco Estuary restoration community

Table F-2 | Changes in the core 12 collaborative science venues included in this updated Core Network analysis.

REMOVED VENUES	NEWLY ADDED VENUES
Interagency Implementation and Coordination Group (IICG)	Collaboratory for Equity in Water Allocations (COEQWAL)
Integrated Modeling Steering Committee (IMSC)	Bay-Delta Social Science Community of Practice (CoP)
Nutrient Stakeholder and Technical Advisory Group (Nutrient STAG)	CVPIA Science Integration Team (SIT)
Collaborative Science and Adaptive Management Program/Collaborative Adaptive Management Team (CSAMP/CAMT)	San Francisco Estuary Wetlands Regional Monitoring Program (WRMP)
Water Operations Management Team (WOMT)	Interagency Telemetry Advisory Group (ITAG)

Although many venues share similar participants, each venue serves a different purpose and brings in different types of organizations. Seeing which organizations appear across multiple venues helps illustrate how information might move within the system and shows which venues tend to convene more interconnected actors versus those that serve as unique entry points for broader community involvement.

One measure to understand influence in a network is through degree centrality, which simply counts how many connections each node has. An organization with more connections appears closer to the center of the diagram, and venues whose participants are highly connected also appear more central. At the center of the collaborative network are the organizations involved in the greatest number of venues (mostly state and federal agencies) and the venues whose membership is primarily comprised of those central nodes. However, an organization's or venue's central position should not be interpreted as its "importance." Venues that appear more peripheral play crucial roles by connecting community groups, tribal organizations, local governments, and others who may not otherwise be represented in the more central parts of the network.

Table F-3 provides the number of organizations participating in the Full Network and the Core Network, and lists the average number of venues each organization is involved in. Federal agencies tend to be the most interconnected: across the Full Network, each of the nine federal agencies participates in an average of 4.8 venues, and the six federal agencies in the Core Network participate in an average of 6.7 venues. State agencies follow, with 20 state agencies in the Full Network participating in 2.8 venues on average, and nine state agencies in the Core Network participating in 4.9 venues on average. These averages help illustrate which types of organizations are most connected across the Delta science landscape and may help identify venues that serve as important bridges for information flow.

Table F-4 summarizes how many organizations participate in each venue for both the Full and Core Networks. Some venues have relatively few participants, all of whom also appear in the Core Network, meaning they primarily bring together already well-connected organizations. Others have large memberships but include many organizations that appear only once in the Full Network. These venues may offer unique and important opportunities for organizations with fewer touchpoints in the Delta science-scape to engage and participate.

Selecting collaborative science venues

This resource maps out the network of connections between 12 collaborative Delta science venues; however, it is important to state that more than 12 venues conduct collaborative science in and around the Delta, and this network does not represent the complete picture. These venues were selected based on the following criteria to be **main, active, collaborative science** venues in the **Delta**.

Main: The Delta is a highly networked socio-ecological system with many venues that actively engage in collaborative science. The 12 venues represented in this analysis had the highest number of captured connections and are therefore considered to be main collaborative venues.

Active: Each venue included in this analysis was actively meeting as of the publication of the draft 2026 Delta Science Plan in Fall 2025. Some venues included in the previous 2019 analysis are no longer active (i.e., CSAMP/CAMT), while others have emerged or become more active in the Delta since the last analysis. Table F-2 shows these changes in venue representation.

Collaborative: Venues needed to include multiple, varied parties. For example, a research project localized to a single agency or research institution would not qualify.

Science: The primary function of each venue needed to be conducting, utilizing, or supporting science, although the type or scope of science activities could, and did, vary. Venues with other primary functions, such as management or community engagement, serve critical roles in this system, but were not prioritized in this analysis.

Delta: The Delta needed to be a primary focus of work for each collaborative science venue. Venues with a significant emphasis on the Delta were prioritized over those in which the Delta was only a small part of their scope, or where only a portion of the Delta was included.

By using these keywords to guide venue selection, the analysis focused on 12 main, active, collaborative science venues in the Delta, which are detailed in Table F-1.

Identifying venue participants

The Delta science-scape network is composed of two types of entities (or nodes):

1. **Organizations:** The set of organizations participating in collaborative Delta science venues includes actors from multiple levels of government (federal, state, local), special water districts, tribes, universities, private consultants, NGOs/community groups, consortiums, etc.
2. **Venues:** Collaborative science venues are where multiple organizations engage in science governance. They can coordinate activities, develop research goals, select the means to meet those goals, and/or synthesize, review, and communicate the results.

Due to each collaborative science venue having a different governance structure, the process of identifying its regular participants varied slightly from venue to venue. In general, participating organizations were listed on each venue's website, but not in every case. In addition, some venues have a primary group of member organizations that participate consistently, while others are open to interested parties rotating in and out of attendance. Finally, some venues have multiple workgroups guided by a central Steering Committee, while others do not have any separate workgroups. An additional complexity is that the Interagency Ecological Program (IEP) serves as both a venue and an entity participating in other venues; therefore, it is counted in this analysis as both a venue and a participating organization. To accommodate these varied structures, numerous resources were used to identify regular participants in each venue, including:

- Member/participant lists on venue websites
- Meeting notes, publications, or other publicly available documents from venues
- Conversations with venue coordinators, directors, or other key points of contact

For the most part, all participants who were identified were included in the network analysis. However, for venues with multiple work groups, teams, or subcommittees guided by a central Steering Committee, the members of the Steering Committee were utilized as the central participants of those venues. Additionally, if organizations had participated in a venue in the past but had not regularly participated in the last two years, they were not included in this analysis.

The goal in all cases was to prioritize the most central and consistent participants of these venues, aligning with the priority established in the previous section to highlight the most central venues overall. Although every effort was made to accurately represent the central venues and participants in this network, this is a dynamic system, and not all elements may be captured at the time of analysis.

Collaborative science participants

Participants were sorted into ten categories, which are bolded below, color-coded in the network diagrams, and further explored in Tables F-3 and F-4. Throughout this Resource, references are made to the "Full Network" and the "Core Network." The Full Network comprises the whole list of participants involved in at least one venue, while the Core Network is comprised of only participants engaged in more than one venue. We recognize that this stipulation for the Core Network may miss those participants who are deeply involved in only one single venue, and future analyses may want to consider those participants explicitly.

The primary actors in the Delta science network are federal and state agencies with responsibilities towards water supply, water quality, wildlife management, and habitat restoration. One or more **federal agencies** are present in every venue, with a total of ten federal agencies in the Full Network and six in the Core Network. The six federal agencies in the Core Network are the National Marine Fisheries Service (NOAA Fisheries), the U.S. Army Corps of Engineers, the U.S. Bureau of Reclamation, the U.S. Environmental Protection Agency, the U.S. Fish and Wildlife Service, and the U.S. Geological Survey. One or more California **state agencies** are present in every venue, with a total of 20 state agencies involved, including nine in the Core Network. The nine California state agencies in the Core Network are the Department of Fish and Wildlife, Department of Food and Agriculture, Department of Parks and Recreation/State Parks, Department of Water Resources, Delta Protection Commission, Delta Stewardship Council, Sacramento-San Joaquin Delta Conservancy, San Francisco Bay Conservation and Development Commission, and the State Water Resources Control Board.

Many city and county government actors participate in the network and are categorized as **general local agencies**. In some cases, a county may have representatives from different parts of its government in separate venues, such as the County of Solano participating in one venue and the Solano County Agricultural Commissioner's Office participating in another. Where possible, these differing parts of one county's government were counted as the county – in this case, Solano County – and the county was represented in the Core Network as a participant in multiple venues.

One exception to this process is **special water districts**, which are categorized separately from other local agencies to reflect their specialized functions. They perform at least one of four specific duties: water delivery, waste disposal/sanitation, flood management, and water conservation. These districts may participate in the network individually or be represented by larger member associations, such as the Metropolitan Water District of Southern California (Metropolitan) or the State Water Contractors (SWC).

Eleven **tribal entities** participate in the full network, a significant increase from the two tribal entities included in the previous analysis (the Hoopa Valley and Yurok Tribes). However, since each of these tribal entities is included in only one venue, none are included in the Core Network diagram.

A wide variety of other actors participate in the collaborative science venues. **Non-governmental organizations (NGOs) and community groups** represent people such as fishermen, agricultural communities, and local community members, and issues including, but not limited to, habitat restoration and wildlife conservation. Academic institutions and research-oriented organizations are categorized under the **research category**. Numerous **consultants** are involved in various venues, and the organizations listed as **consortia** are collaborations between different types of agencies & organizations, such as the San Francisco Estuary Partnership (SFEP). Finally, one **private company**, Wonderful Orchards, is included. A complete list of entities included in the analysis can be found in Table F-5: Glossary of acronyms.

Future network analyses with the Delta Science Tracker

Since the production of the last network analysis, a new tool has been published that enables interactive exploration of collaborative science in the Delta: the **Delta Science Tracker**[5]. This tool can create network diagrams similar to the diagrams included in this Resource, and the data can be downloaded for further analysis. The Delta Science Tracker provides a window into current, past, and future research projects in the Delta, as well as the collaborations that make some of these highly interdisciplinary projects possible. These readily available network analyses can help us identify pathways to success and give us real-time pulse-checks on connectivity across the Delta science-scape. Researchers working in and around the Delta are invited to contribute to the Delta Science Tracker to ensure that the Science Tracker is up-to-date and complete. To contribute, email ScienceTracker@deltacouncil.ca.gov.

Conclusions

This resource aims to provide a valuable tool for understanding both the current state of the Delta's collaborative science landscape and its evolution since the 2019 Delta Science Plan. Future investigations could use these updated analyses to explore how the different collaborative venues function in the broader Delta science ecosystem. By addressing questions about science governance in the Delta, such as how the scopes and responsibilities of the venues in the system have changed, or how engagement of different communities has increased or decreased can help us pinpoint where funding or research attention could be directed to ensure that science governance is being addressed as effectively as possible. This information could also help identify where intentional linkages among the collaborative venues could be used to reduce fragmentation, avoid duplication, and strengthen trust and usability. This type of research is increasingly important in the complicated and evolving social-ecological system of the Delta.

5. https://sciencetracker.deltacouncil.ca.gov/

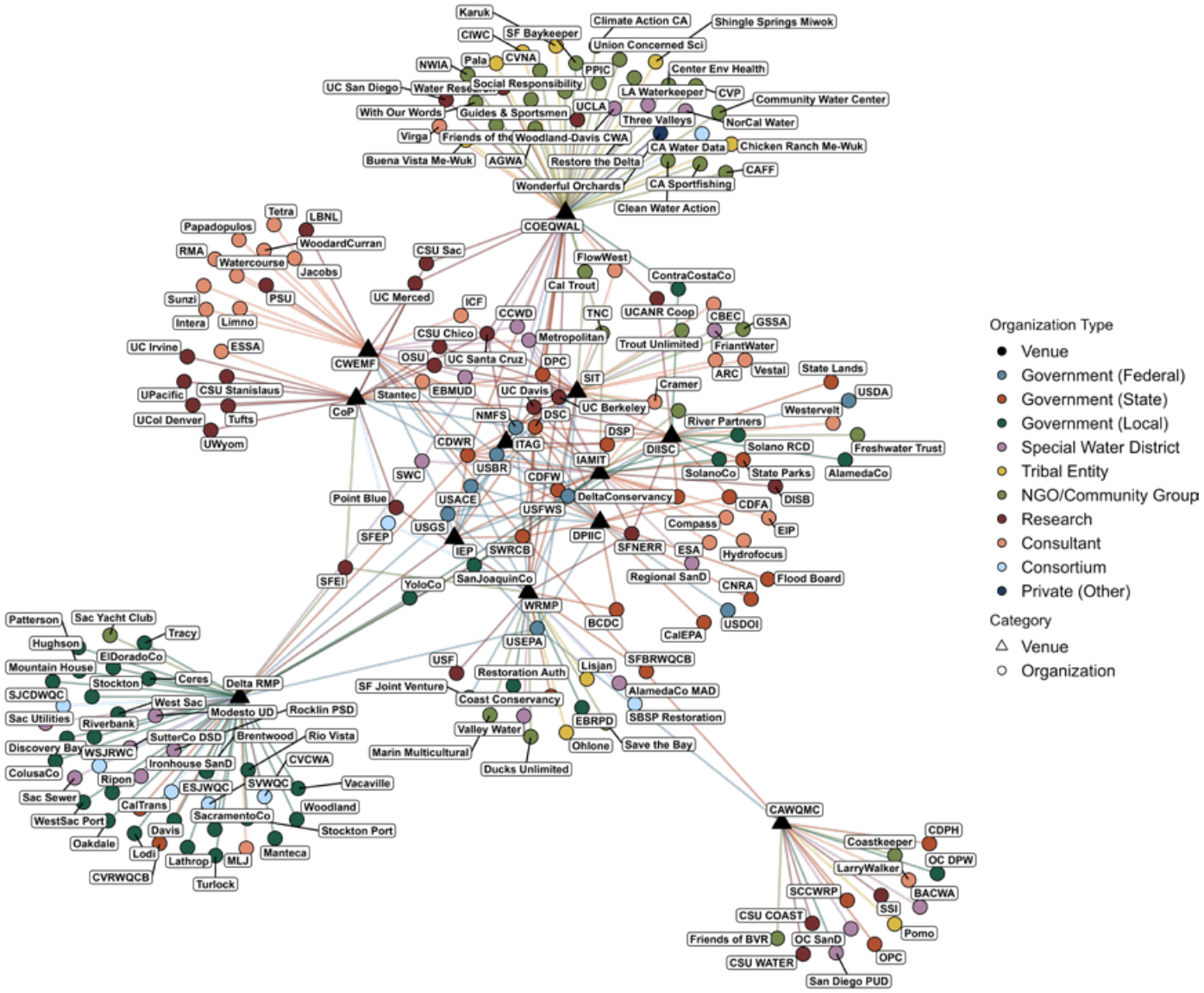

Figure F-1 | The Delta science governance Full Network. This network diagram illustrates the 12 core Delta science collaborative venues (triangles) and all of the organizations (circles) that participate in at least one of the selected venues. The more central an organization or venue is, the more connections they have. See Table F-5: Glossary of acronyms for full names of venues and organizations.

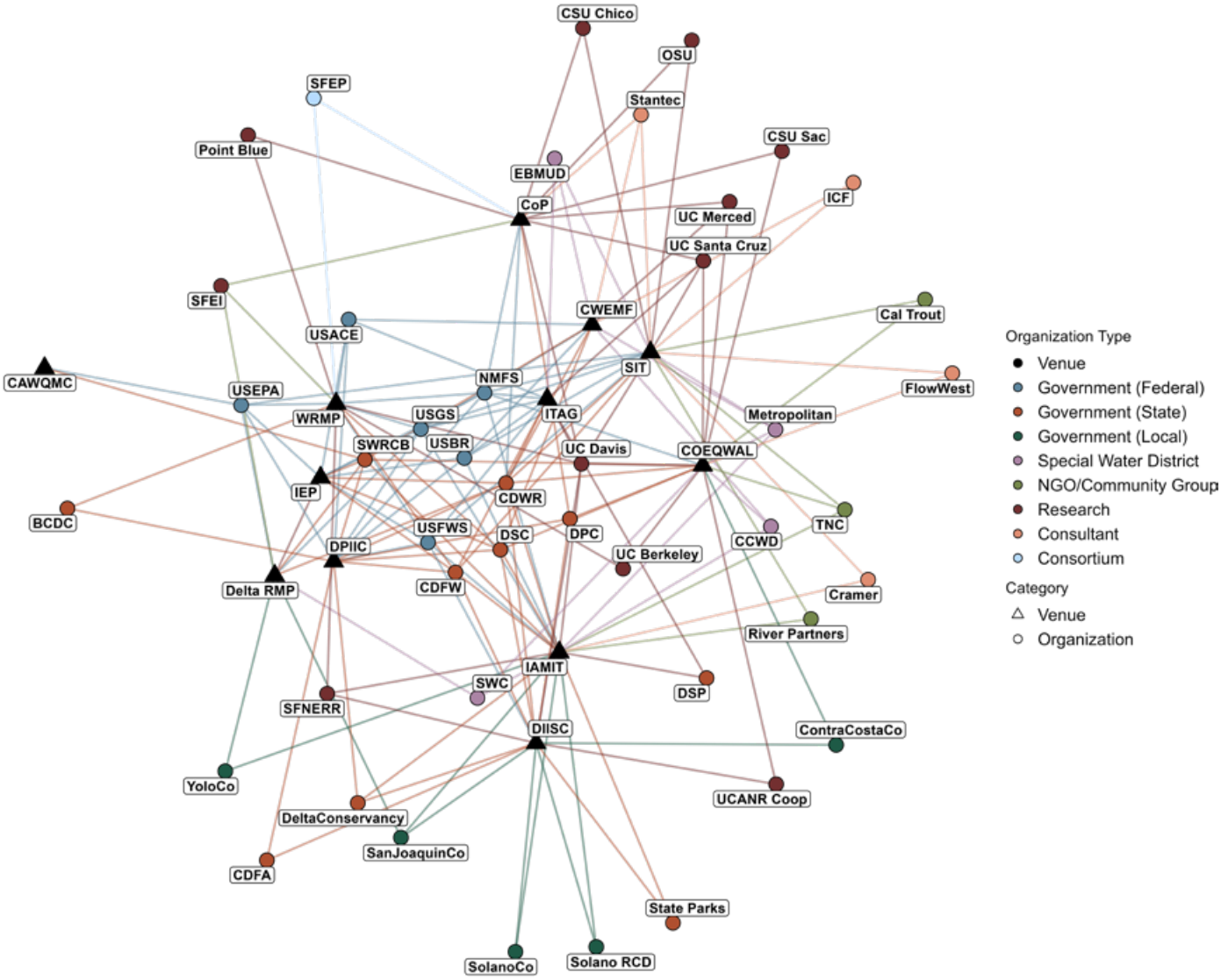

Figure F-2 | The Delta science governance Core Network. This network diagram illustrates each of the 12 core collaborative science venues and the organizations that participate in more than one of the selected venues. The more central an organization or venue is, the more connections they have. See Table F-5: Glossary of acronyms for full names of venues and organizations.

Table F-3 | Participation by organization type. The first column indicates the number of entities in each category that participate in either the Full Network or the Core Network. The second column displays the mean number of venues in which each type of participant is involved.

PARTICIPANT TYPE	NUMBER OF PARTCIPANTS	MEAN NUMBER OF VENUES
Full Network		
Government (Federal)	9	4.8
Government (State)	20	2.8
Government (General Local)	34	1.2
Special Water District	20	1.5
Tribal Entity	9	1.0
NGO/Community Group	31	1.1
Research	29	1.8
Consultant	25	1.2
Consortium	8	1.1
Private (Other)	1	1.0
Core Network		
Government (Federal)	6	6.7
Government (State)	9	4.9
Government (General Local)	5	2.2
Special Water District	4	3.3
Tribal Entity	0	0
NGO/Community Group	3	2.3
Research	12	2.8
Consultant	4	2.3
Consortium	1	2.0
Private (Other)	0	0

Table F-4 | Participation by venue. The first column displays the total number of participants in each venue in the Full Network, while the second column indicates the number of core participants involved in each venue.

VENUE	NUMBER OF PARTICIPANTS	
	Full	Core
COEQWAL: Collaboratory for Equity in Water Allocations	52	18
Delta RMP: Delta Regional Monitoring Program	49	8
IAMIT: Interagency Adaptive Management Integration Team	29	23
WRMP: San Francisco Estuary Wetlands Regional Monitoring Program	28	14
SIT: CVPIA Science Integration Team	26	20
CWEMF: California Water and Environmental Modeling Forum	23	12
DIISC: Delta Interagency Invasive Species Coordination Team	21	15
CoP: Bay-Delta Social Science Community of Practice	20	13
DPIIC: Delta Plan Interagency Implementation Committee	18	14
CAWQMC: California Water Quality Monitoring Council	16	2
ITAG: Interagency Telemetry Advisory Group	11	11
IEP: Interagency Ecological Program	10	10

Table F-5 | Glossary of acronyms.

AGWA: Alliance for Global Water Adaptation	**Center Env Health:** Center for Environmental Health
AlamedaCo: County of Alameda	**Ceres:** City of Ceres
AlamedaCo MAD: Alameda County Mosquito Abatement District	**Chicken Ranch Me-Wuk:** Chicken Ranch Rancheria Me-Wuk Indians
ARC: Aquatic Resource Consulting	**CIWC:** California Indian Water Commission
BACWA: Bay Area Clean Water Agencies	**Clean Water Action:** Clean Water Action
BCDC: Bay Conservation & Development Commission	**Climate Action CA:** Climate Action California
Brentwood: City of Brentwood	**CNRA:** California Natural Resources Agency
Buena Vista Me-Wuk: Buena Vista Rancheria of the Me-Wuk Indians	**Coast Conservancy:** California State Coastal Conservancy
Friends of BVR: Friends of Buena Vista Reservoir	**Coastkeeper:** Orange County Coastkeeper
CA Sportfishing: California Sportfishing Protection Alliance	**COEQWAL:** Collaboratory for Equity in Water Allocations
CA Water Data: California Water Data Consortium	**ColusaCo:** County of Colusa
Water Research: California Water Research	**Community Water Center:** Community Water Center
CAFF: Community Alliance with Family Farmers	**Compass:** Compass Resource Management
Cal Trout: California Trout	**ContraCostaCo:** County of Contra Costa
CalEPA: California Environmental Protection Agency	**CoP:** Bay-Delta Social Science Community of Practice
CalTrans: California Department of Transportation	**Cramer:** Cramer Fish Sciences
CAWQMC: California Water Quality Monitoring Council	**CSU Chico:** California State University, Chico
CBEC: CBEC Eco Engineering	**CSU COAST:** California State University - Council on Ocean Affairs, Science & Technology
CCWD: Contra Costa Water District	**CSU Sac:** California State University, Sacramento
CDFA: California Department of Food and Agriculture	**CSU Stanislaus:** California State University, Stanislaus
CDFW: California Department of Fish and Wildlife	**CSU WATER:** California State University - Water Advocacy Towards Education and Research
CDPH: California Department of Public Health	**CVCWA:** Central Valley Clean Water Association
CDWR: California Department of Water Resources	**CVNH:** Central Valley Neighborhood Harvest

CVP: Central Valley Partnership

CVRWQCB: Central Valley Regional Water Quality Control Board

CWEMF: California Water and Environmental Modeling Forum

Davis: City of Davis

Delta RMP: Delta Regional Monitoring Program

DeltaConservancy: Sacramento-San Joaquin Delta Conservancy

DIISC: Delta Interagency Invasive Species Coordination Team

DISB: Delta Independent Science Board

Discovery Bay: Town of Discovery Bay

DPC: Delta Protection Commission

DPIIC: Delta Plan Interagency Implementation Committee

DSC: Delta Stewardship Council

DSP: Delta Science Program

Ducks Unlimited: Ducks Unlimited

EBMUD: East Bay Municipal Utility District

EBRPD: East Bay Regional Park District

EIP: Ecosystem Investment Partners

ElDoradoCo: County of El Dorado

ESA: Environmental Science Associates

ESJWQC: East San Joaquin Water Quality Coalition

ESSA: ESSA Technologies Ltd

Flood Board: Central Valley Flood Protection Board

FlowWest: FlowWest

Freshwater Trust: The Freshwater Trust

FriantWater: Friant Water Authority

Friends of the River: Friends of the River

GSSA: Golden State Salmon Associates

Guides & Sportsmen: Nor-Cal Guides & Sportsmen's Association

Hughson: City of Hughson

Hydrofocus: HydroFocus, Inc.

IAMIT: Interagency Adaptive Management Integration Team

ICF: ICF Consulting

IEP: Interagency Ecological Program

Intera: INTERA, Inc.

Ironhouse SanD: Ironhouse Sanitary District

ITAG: Interagency Telemetry Advisory Group

Jacobs: Jacobs Engineering

Karuk: Karuk Tribe

LA Waterkeeper: LA Waterkeeper

LarryWalker: Larry Walker Associates

Lathrop: City of Lathrop

LBNL: Lawrence-Berkeley National Labs

Limno: LimnoTech

Lisjan: Confederated Villages of Lisjan

Lodi: City of Lodi

Manteca: City of Manteca

Marin Multicultural: Multicultural Center of Marin

Metropolitan: Metropolitan Water District of Southern California

MLJ: MLJ Environmental

Modesto UD: City of Modesto Utilities Department

Mountain House: City of Mountain House

NMFS: National Marine Fisheries Service/NOAA Fisheries

NorCal Water: Northern California Water Association

NWIA: National Women in Agriculture

Oakdale: City of Oakdale

OC DPW: Orange County Department of Public Works

OC SanD: Orange County Sanitation District

Ohlone: Association of Ramaytush Ohlone

OPC: Ocean Protection Council

OSU: Oregon State University

Pala: Pala Tribe

Papadopulos: S.S. Papadopulos & Associates, Inc.

Patterson: City of Patterson

Point Blue: Point Blue Conservation Science

Pomo: Big Valley Band of Pomo Indians

PPIC: Public Policy Institute of California

PSU: Portland State University

Regional SanD: Sacramento Regional County Sanitation District

Restoration Auth: San Francisco Bay Restoration Authority

Restore the Delta: Restore the Delta

Rio Vista: City of Rio Vista

Ripon: City of Ripon

River Partners: River Partners

Riverbank: City of Riverbank

RMA: Resource Management Associates

Rocklin PSD: City of Rocklin Public Services Department

Sac Sewer: Sacramento Area Sewer District

Sac Utilities: City of Sacramento Department of Utilities

Sac Yacht Club: Sacramento Yacht Club

SacramentoCo: County of Sacramento

San Diego PUD: City of San Diego Public Utilities Department

SanJoaquinCo: County of San Joaquin

Save the Bay: Save the Bay

SBSP Restoration: South Bay Salt Ponds Restoration Project

SCCWRP: Southern California Coastal Water Research Project

SF Baykeeper: San Francisco Baykeeper

SF Joint Venture: San Francisco Bay Joint Venture

SFBRWQCB: San Francisco Bay Regional Water Quality Control Board

SFEI: San Francisco Estuary Institute

SFEP: San Francisco Estuary Partnership

SFNERR: San Francisco Bay National Estuarine Research Reserve

Shingle Springs Miwok: Shingle Springs Band of Miwok Indians

SIT: CVPIA Science Integration Team

SJCDWQC: San Joaquin County and Delta Water Quality Coalition

Social Responsibility: Physicians for Social Responsibility

Solano RCD: Solano Resource Conservation District

SolanoCo: County of Solano

SSI: Sierra Streams Institute

Stantec: Stantec

State Lands: California State Lands Commission

State Parks: California Department of Parks and Recreation/State Parks

Stockton: City of Stockton

Stockton Port: Port of Stockton

Sunzi: Sunzi Consulting LLC

SutterCo DSD: Sutter County Development Services Department

SVWQC: Sacramento Valley Water Quality Coalition

SWC: State Water Contractors

SWRCB: State Water Resources Control Board

Tetra: Tetra Tech

Three Valleys: Three Valleys Mutual Water District

TNC: The Nature Conservancy

Tracy: City of Tracy

Trout Unlimited: Trout Unlimited

Tufts: Tufts University

Turlock: City of Turlock

UC Berkeley: UC Berkeley

UC Davis: UC Davis

UC Irvine: UC Irvine

UC Merced: UC Merced

UC San Diego: UC San Diego

UC Santa Cruz: UC Santa Cruz

UCANR Coop: UC Agriculture and Natural Resources Cooperative Extension

UCLA: UC Los Angeles

UCol Denver: University of Colorado, Denver

Union Concerned Sci: Union of Concerned Scientists

UPacific: University of the Pacific

USACE: U.S. Army Corps of Engineers

USBR: U.S. Bureau of Reclamation

USDA: U.S. Department of Agriculture

USDOI: U.S. Department of the Interior

USEPA: U.S. Environmental Protection Agency

USF: University of San Francisco

USFWS: U.S. Fish and Wildlife Service

USGS: U.S. Geological Survey

UWyom: University of Wyoming

Vacaville: City of Vacaville

Valley Water: Santa Clara Valley Water District

Vestal: Vestal Corporation

Virga: Virga Labs

Watercourse: Watercourse Engineering, Inc.

West Sac: City of West Sacramento

Westervelt: Westervelt Ecological Services

WestSac Port: Port of West Sacramento

With Our Words: With Our Words

Wonderful Orchards: Wonderful Orchards

WoodardCurran: Woodard & Curran

Woodland: City of Woodland

Woodland-Davis CWA: Woodland-Davis Clean Water Agency

WRMP: San Francisco Estuary Wetlands Regional Monitoring Program

WSJRWC: Westside San Joaquin River Watershed Coalition

YoloCo: County of Yolo

Acknowledgements

Many thanks to Ioana Seritan, Dr. Mateo Robbins, and Dr. Tara Pozzi for their contributions to this Resource.

Suggested citation

Delta Stewardship Council, Delta Science Program. 2026. 2026 Delta Science Plan: Resource F: Science governance and the collaborative Delta science-scape.

References

Emerson, K., Nabatchi, T., & Balogh, S. (2012). An integrative framework for collaborative governance. *Journal of Public Administration Research and Theory*, 22(1), 1-29.

Fliervoet, J. M., Geerling, G. W., Mostert, E., & Smits, A. J. (2016). Analyzing collaborative governance through social network analysis: a case study of river management along the Waal River in The Netherlands. *Environmental Management*, 57(2), 355-367.

Highlight: An aerial view of high water conditions at Lake Shasta and the dam in Shasta County, California. The Delta Science Program has coordinated several independent peer reviews on the dam's Water Temperature Modeling Platform (WTMP) which controls water releases from different depths of the reservoir to manage downstream water temperatures.

RESOURCE G

Delta Science Program services for independent scientific review and scientific advice

Background and objectives

The Delta Stewardship Council's (Council) Delta Science Program provides independent scientific review (review) and scientific advice (advice) for processes, programs, plans, and products as part of its mission "to provide the best possible unbiased scientific information to inform water and environmental decision-making in the Delta." (California Water Code § 85280(b)(4)). Independent scientific **review and advice services enhance the scientific rigor, transparency, and credibility of science** underpinning management and policy decisions in the Sacramento-San Joaquin Delta and Suisun Marsh (collectively referred to herein as Delta; California Water Code § 85058), the San Francisco Bay-Delta (Bay-Delta) system, and the broader San Francisco Estuary.

This document describes how the Delta Science Program facilitates scientific review and advice services in the Bay-Delta, providing context for those who may request or participate in Delta Science Program-facilitated reviews. Reviews and advice follow the same general process, but there are distinct differences between the two services. The key difference is that advice evaluates

processes, programs, plans, or products that are in development, while reviews evaluate processes, programs, plans, or products that are complete or nearly complete. Review panels are the most common type of panel organized by the Delta Science Program. For simplicity, the rest of the document will collectively refer to reviews/advice as 'reviews' and to reviewers/advisors as 'reviewers'.

It is important to note that, in addition to the review services described in this document, the Delta Science Program also supports the Delta Independent Science Board (Delta ISB) (California Water Code § 85280(a)). The Delta ISB is legislatively mandated to deliver independent scientific oversight of the monitoring, research, and programmatic efforts that underpin adaptive management in the Delta (California Water Code § 85280(a)(3)). Unlike the services outlined in this Resource, which are typically project-based, require specialized subject matter expertise, and are requested by an entity, the Delta ISB operates as a board composed of ten scientists representing a range of disciplines. The Delta ISB's role is not limited to reviewing work upon request; rather, it proactively evaluates scientific activities, identifies emerging issues, and offers recommendations on its own initiative. This ongoing, independent review function by the Delta ISB helps supplement the peer review and advice services provided in this resource. The Delta Science Program can help advise on which process is most appropriate for the task at hand.

Terminology

The Council's Delta Science Program peer review and advice services use the following terms.

- **Requesting party:** Agency or entity requesting the review to be conducted through the Council's Delta Science Program on behalf of the agency or entity. The requesting party is responsible for funding the project and for ensuring the review materials are ADA accessible before the start of the review process.
- **Independent scientific reviewers (reviewers):** Subject matter experts tasked with completing the review as individuals or as part of a panel.
- **Delta lead scientist:** The Delta Reform Act established the position of Delta lead scientist (California Water Code § 85280 (2024) (3)). In the context of peer review and advice, the Delta lead scientist is responsible for considering recommendations to and from the Delta Science Program and planning team and for providing independent final science-related recommendations on the Charge and reviewer participation. Working in concert with the Delta Science Program, the Delta lead scientist officially receives review requests and transmits final products to requesting parties.
- **Council's Delta Science Program project manager:** The Delta Science Program staff member that leads the facilitation of the review effort, coordinates all meetings throughout the process, manages contracts, and acts as the intermediary between the requesting party and the reviewers.
- **Planning Team:** Generally consists of members of the requesting party, authors of the document(s) up for review, and/or interested agency/entity representatives. The Planning Team members may weigh in at various stages of the review process, depending on the level of review sought.
- **Charge:** At a minimum, this includes background information, the questions to guide the reviewers, the review materials, tasks, and a timeline. Sometimes referred to as a charter.
- **Product:** The tangible deliverable required of the reviewers, as outlined in the Charge, for example, memos or reports.

General timeline

The duration of review efforts varies with the complexity and scope of the Charge but generally requires nine to twelve months to complete (see Figure G-1 for a generalized peer review timeline).

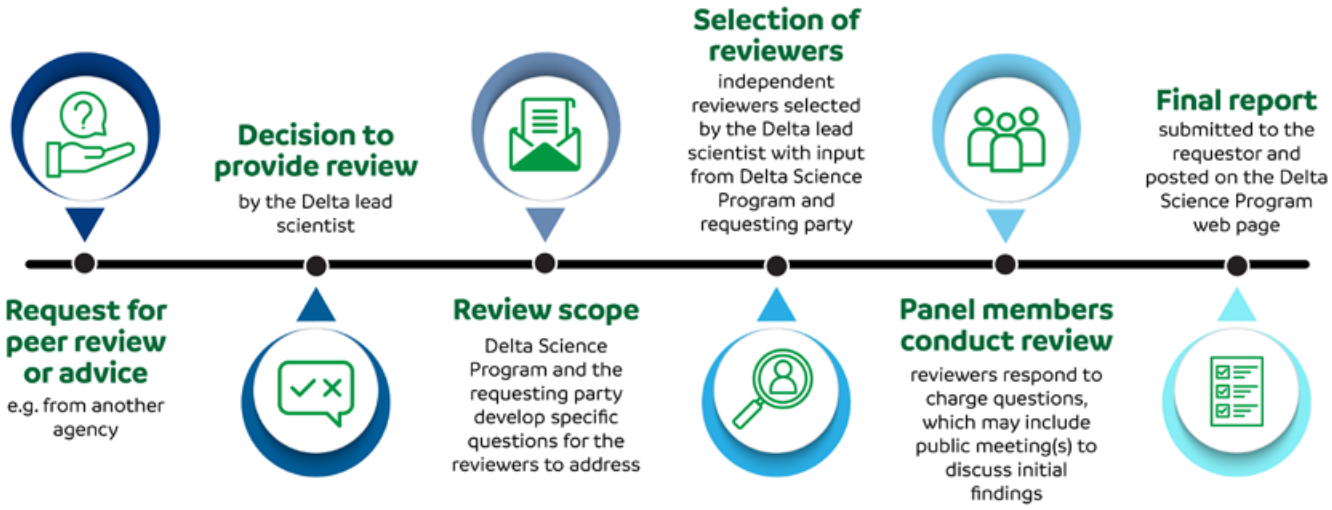

Figure G-1 | Peer review timeline.

The process includes the following steps:

- Request for review
- Decision to provide review
- Development of Charge for review
- Selection of and contracting with subject matter experts
- Experts conduct a review
- Release of final products

Details of these steps are explained in depth throughout this Resource.

Request and decision to provide review

Independent scientific review or advice may be requested by one or more entities, submitted via a request letter to the Delta lead scientist, and will focus on one or more written documents. The **requesting party** is financially responsible for the review services and, in most cases, requires a receivable agreement to be established with the Council.

The Delta Science Program's decision to provide review depends on capacity and how the request's goals and objectives align with those of the Council's mission. Moreover, the Delta Science Program will only agree to provide a review/advice panel if:

- There is sufficient funding available for the services **(services paid for by the requesting party)**
- There is sufficient time available to complete the review work and deliver the written product(s)
- Review materials provided by the requesting party are complete and ADA-compliant before starting the review

The final decision to provide a review rests with the Council, pursuant to consultation with the Delta lead scientist.

Planning meetings

Planning meetings are critical to ensure the review process stays on track and will occur at key decision points. Participants in the planning meetings include the Delta lead scientist, Delta Science Program project manager and staff, and members of the Planning Team.

Members of the Planning Team **may**:

- Communicate their expectations for the review
- Provide input on the Charge to the reviewers
- Inform the review schedule, public input format, and agenda, when applicable
- Identify desired expertise
- Recommend subject-matter experts to serve as reviewers, when appropriate
- Provide pertinent background documents or other materials to review – **only through the Council's Delta Science Program**

Members of the Planning Team **may not**:

- Speak directly to the reviewers (Council Delta Science Program staff will facilitate all communication between reviewers and the Planning Team)

Considering the input from the requesting party and planning team, the Delta lead scientist makes final decisions about the Charge and selection of subject matter experts.

Reviewers

Potential reviewers are identified through recommendations from Council's Delta Science Program staff, the Delta lead scientist, and members of the Planning Team. The Council's Delta Science Program is committed to improving and integrating diversity and inclusion in independent science reviews, and when selecting reviewers, aims to consider a variety of perspectives, including:

- An individual's standing in the scientific community
- Expertise in disciplinary areas
- Technical skills relevant to the documents and issues subject to review
- Absence of a demonstrated conflict of interest (see Resource E: Conflict of interest considerations for reviewers, advisors, and applicants)

Reviewers are expected to possess the necessary knowledge to complete the review and may hold some familiarity with the geographic region, physical processes, policy issues, ecosystems, and species-specific aspects for which scientific review is sought. The Delta lead scientist has the final recommendation for the selection of reviewers.

Reviewers can be contracted through the organization they're affiliated with, including public agencies, academic institutions, corporations, or sole proprietorships. Reviewers should verify the **California state requirements necessary to conduct business with the state**[1].

Reviewers may work independently or collectively as a panel to provide a scientific review. The panel type is discussed with the Planning Team and determined by the Delta lead scientist. Panels generally consist of no fewer than three members and include a "Panel Chair," who represents the panel, coordinates meetings, and organizes the panel's work, and a "Lead Author," who leads the report writing. These roles typically require extra hours and additional compensation. For individual letter reviews, reviewers contribute single-authored reports but are encouraged to discuss materials or findings with one another.

1. https://www.dgs.ca.gov/PD/Resources/Page-Content/Procurement-Division-Resources-List-Folder/How-to-do-business-with-the-state-of-California

Charge to the reviewers

The Charge specifies the purpose and background of the review and presents Charge questions. Charge questions guide how reviewers evaluate the documents at the focus of the review and help ensure the requesting party receives useful recommendations from the review.

Charge questions should be crafted to draw on applicable technical guidance, but not to solicit policy recommendations or prescriptions (e.g., specific numerical changes to a regulatory threshold). However, it is recognized that responses and other information in a review final report may be used in future decision-making by resource managers and policymakers because all final reports are publicly available online.

The scope of the Charge to the reviewers will include:

- Background information (including the legal, regulatory, and management background necessary to set the full policy context)
- Charge questions for the reviewers
- A description of the role of the reviewers and rules for its deliberations (if a panel)
- The form and scope of the final product
- Additional required or recommended reading materials (i.e., supplemental materials)
- A schedule of deliverables

The Delta lead scientist has the final authority for the language in the Charge to the reviewers.

Peer review public input process

The review and advice process shall be open and transparent to the extent possible and may include public-derived input, when necessary. Though maintaining the independence of a review panel is critical, public input may be essential to a review process. Government agencies exist to serve the public, whose collaborative participation in regulatory and programmatic efforts strengthens decision-making, improves outcomes, and builds trust among groups with a diverse set of perspectives.

DECISION TO INCLUDE PUBLIC INPUT

If a party requesting peer review also requests public input as part of the process, the Delta lead scientist determines whether to include public input as part of the review/advice effort based on the following factors:

- The scope of the review is relevant to multiple entities (e.g., **Water Temperature Model Platform Review**[2])
- The scale of the review is significant and the project impacts multiple entities (e.g., **Biological Goals Advisory Panel**[3])
- If there is sufficient time to receive public input

TYPES OF PUBLIC INPUT

Once the decision has been made to include public input in the review, two options (hybrid public meeting or written public input) for the format of public input are available. The means of public input will depend on whether there is adequate time, the Council's Delta Science Program capacity, and/or funding.

- **Hybrid public meeting (default) –** a hybrid public meeting occurs roughly halfway through the review process; panel members present their initial findings and receive presentations from the requesting party and/or other interested groups and hear public comment. Information from the meeting may inform the panel's final report at the panel's discretion.

2. https://deltacouncil.ca.gov/delta-science-program/water-temperature-model-development-independent-advisory-panel
3. https://deltacouncil.ca.gov/delta-science-program/biological-goals-advisory-panel

- **Written public input –** in lieu of a public meeting, written public input (not to exceed two written pages) can be submitted roughly halfway through the review process. Written public input is solicited via an email announcement to the Council's email list subscribers and posted on the review webpage. Submitted input is received via email (as PDF), U.S. mail, or in person. Input is screened for relevance to the Charge by the Delta Science Program staff and the Delta lead scientist, and (if relevant) provided to the panel as Additional Review Material and posted on the Council's Delta Science Program peer review web page. Written public input may inform the panel's final report at the panel's discretion.

Suggested citation

Delta Stewardship Council, Delta Science Program. 2026. 2026 Delta Science Plan: Resource G: Delta Science Program services for independent scientific review and scientific advice.

RESOURCE H

Guidance for science workshops

This Resource describes how the Delta Stewardship Council's (Council) Delta Science Program typically organizes science workshops and suggests steps for interested parties who want to conduct a workshop or request that the Delta Science Program conduct one. This Resource describes workshops that are not subject to the Bagley-Keene Open Meeting Act requirements and that are not part of an independent scientific review (see Resource G: Delta Science Program services for independent scientific review and scientific advice).

Background

As part of its mission to provide the best available scientific information to guide management and inform decision-making in the Sacramento-San Joaquin Delta and Suisun Marsh (collectively referred to herein as Delta; California Water Code § 85058), the San Francisco Bay-Delta (Bay-Delta) system, and the broader San Francisco Estuary, the Delta Science Program promotes, supports, and coordinates science workshops to communicate the state of scientific knowledge on topics of importance to decision-makers. Workshops focus on an important scientific topic with significant management or policy implications, drawing on published papers, reports, and other relevant information, along with professional judgment and experience, within a short period of time. Below is a description of how Delta Science Program science workshops are conducted. See Table H-1 for examples of recent workshops hosted or coordinated by the Delta Science Program.

Decision to hold a workshop

A science workshop may be requested by the Delta Science Program, Delta Independent Science Board (Delta ISB), and/or an agency or other interested party. The Delta Science Program regularly partners with other collaborative groups or academic institutions to hold workshops in partnership or on the behalf of others. Workshops take many forms and prioritize scientific information related to an important topic with management or policy implications. Workshops are an opportunity to bring together diverse perspectives on a scientific topic. Workshop attendees can include agency personnel, policymakers, researchers, community-based organizations (CBOs), and interested members of the public. Those requesting a workshop should prepare a proposal that defines the high-level goals, specific objectives, and audience for the workshop. The proposal should also demonstrate how the workshop advances the Council's statutory mission.

The decision to conduct a workshop will depend on capacity and the relevance of the workshop to the goals and objectives of the Council. Further, the need for a workshop may influence the type or format of a workshop, such as:

- Public input on a science initiative or project (e.g., Delta Science Plan Update)
- Regular forum for discussion and networking (e.g., Adaptive Management Forum)
- Requested workshop (e.g., Delta Harmful Algal Blooms Workshop) or emerging scientific topics (e.g., Microplastics Pollution)

See Table H-1 for more information about all of these examples. Moreover, the Delta Science Program will only agree to conduct a workshop if sufficient funding and time are available to complete and deliver a report, if applicable, and if there is enough scientific information or sufficient scientific need to justify it. The workshop must also be consistent with the Council's mission. The ultimate decision to conduct a workshop rests with the Council in consultation with the Delta lead scientist.

Workshop planning team

A workshop planning team (team) typically forms at least six months in advance of the workshop date and meets regularly to plan the agenda and logistics. The team may continue to meet after the workshop to create summary documents or other products. The team represents the workshop's audience to the extent possible and can include agency staff, academics, CBOs, environmental justice experts, and scientists. Opportunities to build and strengthen respectful relationships between tribes and the Council are explored within the scope of the subject matter. Participants in a team communicate their expectations for the pending workshop, provide input on topics to be covered, identify tasks to be completed in advance of the workshop, consider the workshop agenda and speakers, and provide pertinent background documents or other instructional scientific materials for the workshop through the Delta Science Program.

The Delta Science Program holds workshops in a hybrid setting when possible. Remote participation enables easier public access, increases participation, and provides a straightforward pathway to record sessions for future reference. In-person workshops often allow for more informal networking and small-group discussions, but they require participants to travel. Fully online workshops can be challenging for individuals without reliable internet service or those who are not comfortable with online platforms.

Workshop format and agenda

The team develops the agenda with consideration for the goals, objectives, and audience. A workshop can include a mix of oral presentations, panel discussions, small breakout groups, poster sessions, and/or online collaboration tools. Invited presenters may be included for their experience within the Delta or for expertise outside the Delta that has

applicable lessons. The workshop can also include a public solicitation for presentations or a call for public comments to allow broader participation. Presentations often provide necessary background and regulatory context, recent and ongoing scientific research, synthetic efforts by local experts, and scientifically based expert opinion.

Workshop materials

Providing materials to presenters or attendees in advance can enhance engagement by offering background information on the workshop topic or materials that will be discussed during the workshop. These might include a preliminary synthesis report prepared by or under the direction of Delta Science Program staff. Materials are often posted on the Council's website; however, they must comply with the Americans with Disabilities Act accessibility standards.

Workshop panels

When a panel is part of a workshop, it is recommended to have a broad range of institutions and expertise relevant to the workshop topic, which may include familiarity with the geographic region, physical processes, policy issues, social science, ecosystems, and species-specific aspects. The Delta Science Program aims to increase the interweaving of Traditional Knowledges into collaborative science, elevate community-based approaches, and strengthen partnerships with tribal and environmental justice communities. Panel selection reflects these priorities and diverse voices.

Public communication

A web page accessible through the Council's website provides background information on each workshop, meeting agendas, the membership of convened panels, all background materials and presentations, and any resulting products or recordings. To the extent possible, all materials are posted on the website. Scheduling and other information about the meeting and resulting workshop report(s) are sent through the Council's email announcements.

Table H-1 | Examples of workshops hosted or coordinated by the Delta Science Program.

TITLE	DATE	ORGANIZER	FREQUENCY	EXAMPLE PRODUCT	FORMAT
Accounting for Blue Carbon in the Bay–Delta: Science, Policy, and Practice[1]	March 2026	Delta Science Program and UC Davis	Standalone	Recording and summary forthcoming	Hybrid
Microplastic Pollution: Impact on the SF Bay Delta and Remediation Strategies[2]	May 2025	Delta Science Program and UC Davis	Standalone	Recording[3] and peer-reviewed publication (in review)	Hybrid
Delta Science Plan Workshop[4]	February 2025	Delta Science Program	As needed	Day 1 Recording[5], Day 2 Recording[6]	Hybrid
Science for Communities[7]	July 2024	Delta Stewardship Council Staff	Standalone	Recording[8]	Hybrid
Salinity Management Workshop[9]	March 2024	Delta Science Program	Standalone	Recording[10]	Online
Adaptive Management Forum[11]	May 2023	Delta Science Program	Bi-annually	Summary report[12]	Hybrid
Integrated Modeling Framework Workshop[13]	February-March 2023	Delta Science Program	Standalone	Day 1 Recording[14], Day 2 Recording[15], Summary Report[16]	Hybrid
Delta HABs Workshop[17]	November 2022	Various	Standalone	Day 1 Recording[18], Day 2 Recording[19]	Hybrid
Science Synthesis Workshops	Various	Various	As needed	Examples[20]	Various

1. https://marinescience.ucdavis.edu/events/blue-carbon
2. https://airtable.com/appEOgQ4D9g6QsZqP/pagPFvLQjDcaITtYz/form?mc_cid=b289fced42&mc_eid=UNIQID
3. https://www.youtube.com/watch?v=vUWDuOXGuJM
4. https://www.deltacouncil.ca.gov/pdf/science-program/agenda/2025-02-20-21-delta-science-plan-workshop-draft-agenda.pdf
5. https://www.youtube.com/watch?v=z8elYmMC9m4&t=11923s
6. https://www.youtube.com/watch?v=WntiNemmWEI
7. https://deltacouncil.ca.gov/science-for-communities
8. https://www.youtube.com/watch?v=ZUp4NIUfxtw
9. https://deltacouncil.ca.gov/pdf/science-program/flyers/2024-01-08-salinity-management-workshop-2024-save-the-date-flyer.pdf
10. https://www.youtube.com/watch?v=LHJtLe9z0HA
11. https://www.deltacouncil.ca.gov/pdf/science-program/agenda/2023-04-18-adaptive-management-forum-agenda.pdf
12. https://www.deltacouncil.ca.gov/pdf/science-program/reports/2025-03-18-2023-adaptive-management-forum-summary-report.pdf
13. https://deltacouncil.ca.gov/delta-science-program/collaborative-modeling
14. https://www.youtube.com/watch?v=ledUyQ0oP4Q&list=PLqTHCliW1HhpXrGF1gI9jjC4lpHZNJWNM&index=3
15. https://www.youtube.com/watch?v=-BIoczqg_Sc&list=PLqTHCliW1HhpXrGF1gI9jjC4lpHZNJWNM&index=2
16. https://deltacouncil.ca.gov/pdf/science-program/2023-07-25-2023-integrated-modeling-framework-workshop-summary.pdf
17. https://deltacouncil.ca.gov/pdf/science-program/information-sheets/2022-07-15-delta-harmful-algal-blooms-workshop-information-sheet.pdf
18. https://www.youtube.com/watch?v=ntwxK7S1JSE
19. https://www.youtube.com/watch?v=KPllco_FlVg
20. https://deltacouncil.ca.gov/delta-science-program/science-synthesis

Suggested citation

Delta Stewardship Council, Delta Science Program. 2026. 2026 Delta Science Plan: Resource H: Guidance for science workshops.

Coequal Goals

The Delta Stewardship Council was created in legislation to achieve the state mandated coequal goals for the Delta. "'Coequal goals' means the two goals of providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem. The coequal goals shall be achieved in a manner that protects and enhances the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place."

(CA Water Code §85054)

Delta Science Program

DELTA STEWARDSHIP COUNCIL

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