

Grand Challenges to Delta Science

Information Sheet



Delta
Science
Program

DELTA STEWARDSHIP COUNCIL

The Delta Science Program proposes framing its next update of the Delta Science Plan around grand challenges to science in the Sacramento-San Joaquin Delta. This approach will support the development of vision, principles, and approaches to better coordinate science and the long-term attainment of the coequal goals¹ through the shared framework of the Delta Science Plan.

The four Delta grand challenges are:

- **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.

¹ “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 (Cal. Wat. Code section 85054)

Background

California's climate is defined by extremes that create inherent and complex social and ecological challenges that are only increasing with climate change².

Challenges in the Delta have many dimensions (e.g., physical, socioeconomic, water supply) and sometimes conflicting solutions, so much so that Luoma et al., 2015³ describes managing them as "Problems like the Delta are formally 'wicked' problems that cannot be 'solved' in the traditional sense, but they can be managed with appropriate knowledge and flexible institutions." The term grand challenges (Box 1) for this purpose is

inspired by a 2001 report by the National Research Council (NRC)⁴ identifying the most important environmental research challenges of the next generation.

The Delta Science Plan⁵ is updated every five years, and the Delta Science Program is in the process of developing the third iteration. The Delta Science Plan, recommended in the Delta Plan⁶, is collaboratively developed with the Delta science community and aims to provide the vision, principles, and approaches for coordinating interested parties for science in the Delta and communicating the outcomes of science activities and their management implications to decision-makers. Given the dynamic nature of the Delta and drawing inspiration from Luoma et al., 2015 and the NRC's report, the Delta Science Program proposes framing its next update of the Delta Science Plan around grand challenges in Delta science.

Box 1: Criteria for Grand Challenges

Following the National Research Council (2001), problem must be:

- Compelling for intellectual and practical reasons and offer the potential for major breakthroughs in science or science governance (i.e., potential for impact).
- Feasible to address given current capabilities and assuming a significant infusion of resources.

² Franklin, J. and MacDonald, G.M. 2024. Climate change and California sustainability -Challenges and solutions. PNAS 121(32) e2405458121. <https://doi.org/10.1073/pnas.2405458121>

³ Luoma, S.N., Dahm, C.N., Healey, M, Moore, J.N. 2015. Challenges Facing the Sacramento-San Joaquin Delta: Complex, Chaotic, or Simply Cantankerous?. San Francisco Estuary and Watershed Science 13(3):2. <https://doi.org/10.15447/sfews.2015v13iss3art7>

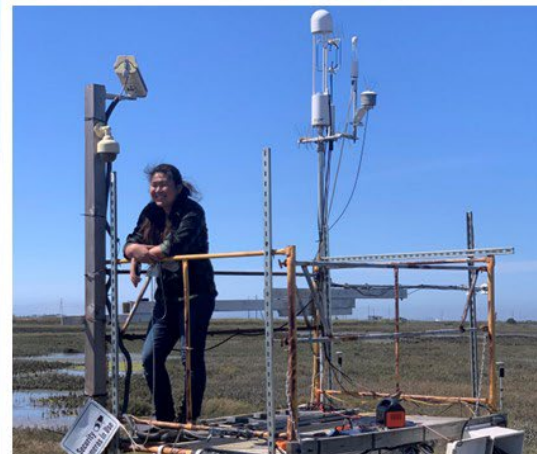
⁴ National Research Council. 2001. Grand challenges in environmental sciences. National Academies Press. <https://nap.nationalacademies.org/catalog/9975/grand-challenges-in-environmental-sciences>

⁵ <https://deltascienceplan.deltacouncil.ca.gov/>

⁶ Delta Stewardship Council (DSC). 2013. Delta Plan. <https://deltacouncil.ca.gov/delta-plan/>

To gather and distill the grand challenges in Delta science, the Delta Science Program conducted a literature review and synthesis of grand challenges to orient the community around common goals. The authors reviewed visionary documents that are widely referenced by scientists and managers that are relevant to the science of the Delta, its watershed, and the broader San Francisco Estuary. This literature review brought together ideas from diverse voices and organizations to curate a list of overarching gaps and challenges to Delta science.

The first three grand challenges are drawn from the literature review. The fourth grand challenge was not well reflected in the visionary documents reviewed but is supported by the broader scientific literature, including recent agency documents and policies.



The Delta's Grand Challenges

- **Grand Challenge #1 – Scientists and managers must anticipate a world in which environmental conditions and regulations may be fundamentally different from those faced today.** Layered stressors threaten our natural resources and novel regulations are being created to address these threats. We must expect that these layered stressors will interplay in complex and unpredictable ways.
- **Grand Challenge #2 – Environmental change is outpacing the traditional pace of science** requiring decisions to be made under greater uncertainty. Approaches to managing this challenge can focus on quicker decision-making or prolonging environmental tipping points and minimizing surprises.
- **Grand Challenge #3 – Flows of scientific information remain decentralized and poorly connected to communities and decision-makers** with a vested interest in the Delta. Promoting science-based collaborative forums, increasing transparency where scientific uncertainties exist in regulations, and communicating widely about ongoing improvements in ecosystem knowledge are instrumental to addressing this grand challenge.
- **Grand Challenge #4 – Other ways of knowing, especially Traditional Knowledge, remain siloed from decision-making** yet offer important contributions to understanding of complex social-ecological systems. Tribal Nations and many communities, including frontline and environmental justice communities, are instrumental in implementing and establishing resilient social-ecological systems^{7,8,9}.

⁷ Metcalf, E.C., Mohr, J.J., Yung, L., Metcalf, P., Craig, D. 2015. The role of trust in restoration success: public engagement and temporal and spatial scale in a complex social-ecological system. *Restoration Ecology* 23(3): 315-324. <https://doi.org/10.1111/rec.12188>

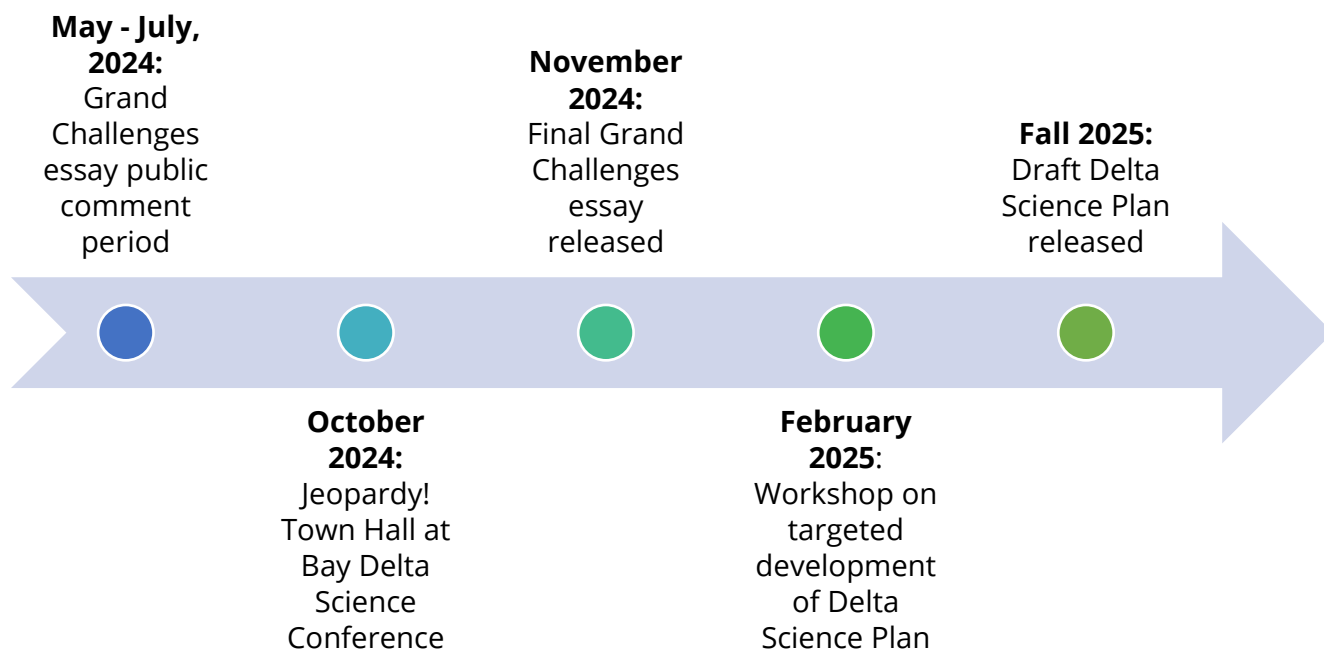
⁸ Sterling, E., Ticktin, T., Morgan, T.K.K., Cullman, G., Alvira, D., Andrade, P., Bergamini, N., Betley, E., Burrows, K., Caillon, S., Claudet, J., Dacks, R., Eyzaguirre, P., Filardi, C., Gazit, N., Giardina, C., Jupiter, S., Kinney, K., McCarter, J., Mejia, M., Morishige, K., Neweel, J., Noori, L., Parks, J., Pascua, P., Ravikumar, A., Tanguay, J., Sigouin, A., Stege, T., Stege, M., Wali, A. 2017. Culturally grounded indicators of resilience in social-ecological systems. *Environment and Society* 8(1):33 pp.

⁹ Conallin, J., Campbell, J., Baumgartner, L. 2018. Using strategic adaptive management to facilitate implementation of environmental flow programs in complex social-ecological systems. *Environmental Management* 62: 955-967. [doi: 10.1007/s00267-018-1091-9](https://doi.org/10.1007/s00267-018-1091-9)

Next Steps

The grand challenges are intended to be a starting point for conversation among Delta scientists, communities, and decision-makers. The Delta Science Program seeks to use these grand challenges as scaffolding upon which we will build the next Delta Science Plan. The draft Grand Challenges essay was released for a 45-day public comment period. The comments received were included in the final version released in November 2024 to greatly improve the document. Public engagement will continue throughout the development of the 2025 Delta Science Plan, especially to garner input on strategies, tools, and actions to address the grand challenges. **The final version of this essay is now available.**

The Delta Science Program is hosting a public workshop in February 2025 to engage with the Delta science community and develop strategies and tools to address the grand challenges. In fall 2025, the draft Delta Science Plan is expected to be released for public comment and a presentation will be made to the Delta Stewardship Council.



Questions/ Stay Engaged

For questions regarding the Delta Science Plan update please contact CollaborativeScience@deltacouncil.ca.gov. To stay informed and to participate in any further engagement in developing the Delta Science Plan please sign up for our email contact list at <https://lp.constantcontactpages.com/su/UZzT2rz>.