

The Delta Science Program facilitated the collaborative development of 65 Top Management Questions for the Sacramento-San Joaquin Delta (Delta), as part of the update to the Science Action Agenda (SAA). This list will help to catalyze science and science investments to inform pressing Delta-wide management needs. To learn more about the development of the Top Management Questions and 2022-2026 SAA, please visit scienceactionagenda.deltacouncil.ca.gov.

<h1>Top Management Questions</h1> <p>sorted by number of relevant themes and weighted average</p>		Delta as an Evolving Place	Flood Risk and Land Use Management	Habitat Management	Invasive/Non-native Species Management	Native Species Management	Science Governance	Water Quality Management	Water Supply Management
1	How can large-scale experiments (e.g., pulse flows, aquatic vegetation removal) be coordinated among stakeholders and implemented to test conceptual model assumptions and hypotheses and to inform future management?	X	X	X	X	X	X	X	X
2	How can monitoring efforts be better designed, facilitated, integrated, and standardized to achieve status and trend monitoring objectives (e.g., for aquatic and terrestrial species), and to fit the scale of management actions, timing of ecosystem processes, and climate change challenges?	X	X	X	X	X	X	X	X
3	How can we achieve floodplain inundation for species recovery, improved ecological processes, and flood control while balancing needs for agriculture, recreation, and other human uses?	X	X	X	X	X	X	X	X
4	How can environmental justice principles, values of Delta communities, and traditional ecological knowledge be incorporated into the Delta science enterprise to support management activities and policy decision-making in the Delta?	X	X	X	X	X	X	X	X
5	How will projected environmental changes in the Delta impact human communities, and how can these impacts be communicated and incorporated into proactive, effective, and equitable Delta management decisions?	X	X	X	X	X	X	X	X

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6 How can collaborative science efforts (e.g., Collaborative Adaptive Management Team, Interagency Ecological Program, Integrated Modeling Steering Committee) and decision-support tools be better supported, communicated, and integrated into management processes to inform science-based decisions?	X	X	X	X	X	X	X	X
7 How can the Delta science enterprise integrate new tools and real-time forecasting and observations into decision-making for water and ecosystem management?	X	X	X	X	X	X	X	X
8 What institutional structures are required to support the full integration of social science into the Delta science enterprise?	X	X	X	X	X	X	X	X
9 How might additional diversion conveyance facilities in the Delta affect operational flexibility, water supply and quality, and ecosystems?	X	X	X	X	X	X	X	X
10 In what ways do different management actions (e.g., restoration, water operations, levee maintenance) affect the risk of species invasions or spread, and what best management practices can minimize that risk?	X	X	X	X	X	X		X
11 How can models and tools necessary to integrate water supply, groundwater, and flood management be supported and developed in order to evaluate scenarios for SGMA implementation, climate change adaptation, and management of the Delta for the coequal goals?	X	X	X		X	X	X	X
12 How are the ecosystem services and disservices distributed across the Delta, and what are the drivers of this distribution?	X	X	X	X	X		X	X
13 How are costs and benefits of economic development and ecosystem management distributed across Delta communities?	X	X	X	X	X		X	X
14 How will land use changes, sea level rise, and climate change impact the long-term resilience of critical Delta ecosystem services and native species?	X	X	X	X	X		X	

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15 How can factors (e.g., water flow and residence time, turbidity, water temperature, nutrient concentrations) be managed to encourage productivity in lower trophic food webs while also preventing harmful algal blooms, taste and odor issues, and macrophyte growth?	X	X	X	X			X	X
16 What abiotic and biotic metrics and integrated models (e.g., hydrodynamic with fish life-cycle models, conceptual models) are needed to assess how exports and flow influence fish viability, behavior, entrainment, and predation?			X	X	X	X	X	X
17 How and why do risk perceptions related to climate and environmental changes vary across the Delta's diverse human communities?	X	X	X	X			X	X
18 What are the impacts of existing and changing environmental factors (abiotic and biotic), in combination with other stressors, on the overall viability of all life stages of native species?			X	X	X		X	X
19 What management actions in non-wet years including flow and non-flow actions (e.g., salinity barriers, spring/summer flows, habitation restoration), individually and in combination, can provide similar ecological benefits to wet year flows?			X	X	X		X	X
20 What are the tradeoffs to native species and ecosystems among the management actions intending to address the impacts of increased temperature?			X	X	X		X	X
21 What fundamental aquatic and terrestrial environmental datasets that could improve project planning, evaluation, and regional synthesis across the system are missing, out of date, or not consistently collected, and what are the best ways to analyze that data?			X	X	X	X	X	
22 How do water quality and the multiple elements that contribute to water quality change under different management scenarios, and where is coordinated monitoring needed?		X	X			X	X	X

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23 What factors would effectively motivate landowners to create managed wetlands or cultivate rice to stabilize land subsidence and reduce carbon emissions?	X	X	X			X	X	
24 Where, and under what conditions (e.g., habitat, water temperature, trophic interactions, flow, including at known hotspots), do we find increased predation pressure on native aquatic species in the Delta, and can those conditions be altered to reduce this pressure?			X	X	X		X	X
25 How can ecological conditions and processes that support self-sustaining natural communities and benefits to public health, safety, and recreation be enhanced to support resilience to climate change?	X	X	X		X		X	
26 What is the relative magnitude of temperature-dependent mortality of juvenile salmonids compared to other sources of mortality, and what are the interactive effects of multiple stressors on mortality?			X	X	X		X	X
27 What water quality data (e.g., contaminant bioavailability and toxicity, nutrients, water temperature) should be prioritized to add to Delta ecosystem models in order to evaluate future ecosystem and management changes?			X		X	X	X	X
28 How do management actions (e.g., source control practices or managed flows) and habitat type influence nutrients, carbon, contaminants, and sediment fluxes in the Delta?		X	X				X	X
29 What are the effects of extreme climatic conditions (e.g., drought, atmospheric rivers) on food web dynamics and aquatic and terrestrial species habitat, survival, and migration patterns?			X		X		X	X
30 How can funding for long-term terrestrial and aquatic monitoring and adaptive management be secured to support Delta management?			X		X	X	X	
31 How and why do zooplankton communities and primary productivity change with environmental factors, flow actions, and over space and time?			X		X		X	X

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32 How do we monitor and evaluate ecosystem restoration outcomes (e.g., for species recovery and ecosystem services), including benefits, detriments, and landscape-scale effects?	X	X	X		X			
33 What are the sources, exposure pathways, and impacts of contaminant mixtures on all life stages of native fish species and their food sources in the Delta?		X	X		X		X	
34 How do patterns of Delta water use and adoption of technologies influence reliance on water exports, water use efficiency, access to new water sources, and likelihood of adopting additional conservational measures or technologies (e.g., water recycling and potable reuse)?	X	X				X		X
35 How should carry-over storage targets be reevaluated and changed in light of climate change projections and modified biological objectives?					X	X	X	X
36 What degree of control keeps invasive populations at a level that allows for desired and cost-effective management outcomes (e.g., boating access, fish habitat, food production)?	X			X	X		X	
37 What are the population effects of water operations, migration barriers, flow, and temperature on spawning distribution, migration, recruitment, behavior, life history, and production of understudied native species (e.g., White and Green Sturgeon)?			X		X		X	X
38 What are the water supply issues faced by disadvantaged communities within the Delta watershed, and how can they equitably be addressed?	X	X					X	X
39 How and why are different human communities in the Delta currently adapting or not adapting to climate change, and what are the barriers communities face to adaptation?	X	X	X			X		

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40 What source control actions for contaminants (e.g., mercury, selenium, personal care products, or other emerging contaminants) would reduce health impacts to both fish and consumers of fish in the Delta?	X	X			X		X	
41 How does restoration in key tributaries and the Delta (e.g., wetland habitat) affect food web dynamics and at-risk species recovery, diversity, distribution, and trends?			X		X		X	
42 What are best management practices for levees and floods to create or enhance habitat along Delta and Suisun Marsh channels, river corridors, and riparian zones?		X	X		X			
43 How do invasive species (e.g., plants, invertebrates) influence tidal marsh ecosystem functions critical to ESA-listed species recovery?			X	X	X			
44 What are successful frameworks for early detection and rapid response (including integrated control strategies) to new invaders and what are the opportunities for improving prevention, monitoring, reporting, and control within the Delta?	X			X		X		
45 How can upper watershed flows and access for native aquatic migratory species be increased?			X		X			X
46 How do microbial communities (e.g., bacteria, picoplankton, and microzooplankton) contribute to trophic interactions in the SF Bay-Delta, and what monitoring efforts are needed to understand their role in the estuarine food web?			X		X		X	
47 How is the cumulative implementation of SGMA, though local projects and strategies, likely to impact inflows to and through the Delta, exports from the Delta, and achievement of the coequal goals?	X					X		X

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48 What are the interactions between flow and aquatic and tidal habitat, and how do other stressors influence those interactions (e.g., contaminants, other water quality changes, climate change problems)?			X				X	X
49 How can data availability, analysis, and communication be improved to minimize the effects of CVP and SWP water operations to ESA-listed species and improve water supply reliability?					X	X		X
50 What new species are likely to invade regions of the Delta, and what are the most important vectors of invasive species introductions beyond ship-mediated transport to target for prevention and outreach?	X			X		X		
51 What social, cultural, and political factors must be understood to design and implement effective invasive species management plans?	X			X		X		
52 What management actions should be prioritized to address seismic risk to the integrity of the Delta's levee system?	X	X	X					
53 What type/category of investments by urban and agricultural water suppliers are achieving the greatest reduction in water demand?	X	X						X
54 How do storms impact the tradeoff between reservoir operations, Flood-Managed Aquifer Recharge, and other management decisions related to water supply?		X				X		X
55 What land management actions maximize benefits for sequestering carbon, reducing or reversing subsidence, and reducing flood risk?	X	X	X					
56 How do biological invasions interact with biogeochemical factors (e.g., nutrients, microbes, organic carbon, salinity)?			X	X			X	
57 What aspects of the Delta are integral to the values, beliefs, and practices of different human communities, how have those values, beliefs, and practices changed over time?	X	X				X		

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58 What factors drive the extent to which different Delta communities trust scientists, management agencies, and other stakeholders in the Delta, and what are the most effective approaches for earning and/or building trust?	X					X		
59 What are critical elements or approaches to collaborative development of hatchery genetic management plans to ensure they serve to enhance wild salmon viability?					X	X		
60 What information is needed to develop robust juvenile production estimates (JPEs) for listed salmonids in each of the Central Valley rivers, and how should JPEs be used to achieve salmon recovery?					X	X		
61 How will invasive species management approaches need to adapt to climate change?				X		X		
62 How do growth and survival of wild juvenile Chinook salmon and steelhead vary across the Delta watershed's multiple habitat types?			X		X			
63 What key psychological, social, and structural barriers inhibit institutional learning, coordination across diverse stakeholders and agencies, and collaborative management in the Delta?	X					X		
64 By which direct and indirect mechanisms do export facilities and their related management practices affect the fate of native species that enter the south Delta?					X			X
65 What factors explain how information is communicated and used in Delta decision-making processes?						X		