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Interagency
Ecological Program

May 16, 2025

Delta Independent Science Board
715 P Street, 15-300
Sacramento, CA 95814

Subject: Contaminant Project Work Team Feedback on Delta Independent Science Board Draft Prospectus (Contaminant Monitoring)

Dear Members of the Delta Independent Science Board,

We appreciate the Delta Independent Science Board's (Delta ISB's) efforts to conduct this review to assess current Delta contaminant monitoring programs. We are hopeful that this review will support the needs and goals of the Contaminants Project Work Team (PWT) as outlined in our Charter. On behalf of the PWT and participants in our scientific brainstorming session held during the PWT meeting on May 2, 2025, we are pleased to submit this structured summary of comments on the Delta Independent Science Board's draft prospectus: "Contaminant Monitoring in the Sacramento-San Joaquin Delta to Inform Environmental Management." The comments were collected through a Mural whiteboard exercise and are organized by the goals as outlined in the draft prospectus. In addition to the goal-specific feedback, general or cross-cutting comments that did not align directly with the predefined goals in the draft prospectus were also collected and summarized. To support synthesis, we used ChatGPT and Gemini (AI language models developed by OpenAI and Google DeepMind, respectively) to assist in summarizing the input. While this letter provides a structured synthesis of key input, a complete, non-exhaustive list of all comments is available in Appendix A. This document captures every submission and offers additional context for the Board's consideration; however, this is not a consensus document and comments within this review represent a range of perspectives that do not reflect the opinion of every contributor. Participants in the May 2, 2025, meeting included representatives from academic institutions, state and federal agencies, nonprofits, private industry and other scientific stakeholders. Participants who contributed to the comments have reviewed and are copied to this letter. We appreciate the Delta ISB's efforts to

incorporate external input into this important prospectus and hope this feedback is helpful as you refine your review. Please don't hesitate to reach out for clarification or further contributions from our group.

Sincerely,

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Co-Chairs Contaminants Project Work Team
Interagency Ecological Program
c.c. Contaminants Project Work Team Member contributors:
Dr. Shawn Acuna; Selina Cole; Daniel Ellis, M.S.; Anna Feerick; Joy Foluso, M.S.; Stephanie Fong, M.S.; Cameron Irvine, M.S.; Dr. Valeria La Saponara; Tricia Lee, M.S.; Dr. Michael Lydy; Dr. Tim Mussen; Dr. David Ostrach; Robert Pangle, and several anonymous.

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Summary of the Feedback

Feedback was collected via Mural and organized under the key questions associated with this goal. Below is a synthesis of the contributions.

Goal 1: Assess current contaminant monitoring programs to determine the degree to which they are able to provide a comprehensive picture of the ecological risks of contaminants in the Delta

1.1 Monitoring programs that should be included in the analysis

Participants recommended a wide range of programs for inclusion in the DISB's analysis. These include bioassessment and biomonitoring initiatives such as Biomonitoring California, the Delta RMP, and herbicide use and post-application monitoring data (NPDES Data) conducted by the Department of Boating and Waterways. Irrigated Lands monitoring data, pesticide use reports, and TMDL-related monitoring were also cited. Additionally, USGS programs like NAWQA, and local Vector Control Programs were considered important data sources to include. One participant noted that, while not a monitoring program, there may be special studies collecting relevant data that are not well-publicized or formally integrated into state or regional monitoring efforts and it may be worthwhile to include these in the analysis as well.

1.2 Opportunities: What factors should be considered?

There was strong support for considering how monitoring data can be linked to biological outcomes and management decision-making frameworks. It was noted that identifying areas of uncertainty or information gaps could help to inform prioritization and future opportunities. One commenter indicated that expanding effect-based approaches is key. Participants also provided a range of thoughtful suggestions regarding how monitoring efforts could be prioritized, refined, and expanded to better support ecological understanding and management decisions. These are listed below:

- Prioritization of monitoring targets: Monitoring should focus on compounds and species that address priority ecological and regulatory goals, ensuring alignment with the most critical information gaps and management needs.
- Conceptual clarity: Clear definitions of "comprehensive ecological risk" and what is considered "unacceptable ecological risk" are needed to provide consistent direction and ensure shared understanding across programs.
- Multistressor and Legacy contaminants: Participants suggested prioritizing an approach that considers multi-stressor effects on the environment, including interactions among various stressors. They also recommended evaluating the

downstream effects of legacy contaminants on marine species and examining the role of historical contaminants that are no longer in use.

- Species sensitivity and Bioaccumulation: Understanding species-specific tolerances and the potential for biomagnification is essential for identifying ecological vulnerabilities and informing protective measures.

1.3 Challenges – What constraints will limit the analysis?

Participants identified a range of constraints that could limit the ability to produce a comprehensive analysis of ecological risk from contaminants in the Delta. They emphasized that such an analysis must consider multiple stressors, including chemical, physical, and biological factors such as habitat alterations, temperature changes, hypoxia, invasive species, pathogens, and harmful algal blooms. Challenges include the complexity of mixture effects, limited knowledge about the toxicity of breakdown products (that may be more toxic than the original chemicals), and the difficulty of interpreting combined biotic and abiotic interactions. Spatial and temporal disparities in data collection such as differing sampling frequencies across regions and endpoints introduce additional uncertainty. The tidal nature of the Delta complicates source attribution, as contaminants move from both upstream and downstream. Furthermore, data from pollutant sources do not always align with exposure points relevant to ecological health used for assessing ecological risks. Moreover, most existing monitoring programs are structured to assess status and trends rather than to evaluate comprehensive ecological risk. Given these limitations, one suggestion was to focus the review at a higher level, assuming individual programs meet their internal goals, and instead assess how well the overall system addresses integrated risk management needs.

1.5 Data Sources

Participants identified several key data platforms that should be reviewed, including CEDEN, SWAMP, the DWR Water Data Library, CWQIS for upstream NPDES data, and SURF for stormwater data. These sources were considered foundational for understanding the current state of contaminant monitoring in the Delta. One commenter noted that it may be useful to assess the alignment of routine monitoring data with findings from targeted special studies and determine if existing monitoring program's scope and scale are robust enough to detect management-relevant trends identified in published research.

Goal 2: Understand how monitoring can better inform management decisions

2.1. Provide examples where monitoring effectively informs decision making (local or not)

Several examples illustrate how monitoring effectively informs decision-making. For instance, one commenter noted that compliance monitoring ensures adherence to regulations. The Delta Regional Monitoring Program (RMP) was also highlighted as a potential example, with another commenter suggesting that it has been responsive to prior Delta Independent Science Board (DISB) review conclusions. Furthermore, a commenter pointed to the North Delta Foodweb Subsidy Action as an instance where monitoring guides targeted ecological interventions. The adaptive management approach used in tidal wetland and forthcoming Harmful Algal Bloom (HABs) monitoring, where management questions are set and refined through data collection, was also mentioned. Another commenter stated that regulatory frameworks like Total Maximum Daily Loads (TMDLs) rely on monitoring data. The crucial role of appropriate monitoring data in informing environmental impact analyses to assess harm to endangered species and identify mitigation strategies was also underscored. Finally, one commenter gave the example of the development of Response Spectrum Models, which link internal contaminant levels to their effects, as a way monitoring contributes to predictive capabilities for better management. Monitoring types noted by commenters that are structured to inform decision making could be categorized as follows:

- Compliance: to ensure adherence to regulations (Compliance Monitoring).
- Adaptive Management: Monitoring data to inform adjustments and improvements based on prior findings (e.g. Delta RMP responding to DISB review, tidal wetland/HABs monitoring). This involves using data to refine management questions and future data collection.
- Targeted Actions: Monitoring can guide specific interventions to address ecological issues (e.g. North Delta Foodweb Subsidy Action).
- Regulatory Frameworks: Required monitoring that provides the necessary data for establishing and evaluating environmental standards (TMDLs).
- Impact Assessment: The right monitoring data is crucial for analyzing the environmental consequences of actions, especially concerning endangered species, and for identifying mitigation strategies.
- Predictive Modeling: Monitoring data can be used to develop models that link contaminant levels to their effects, aiding in risk assessment and management (Development of Response Spectrum Models).

2.2. Opportunities: What types of data/monitoring best support adaptive management?

One commenter highlighted that real-time responses to immediate issues are sometimes referred to as adaptive management but could more accurately be referred to as reactive

management or managing adaptively. True adaptive management is an iterative process that entails substantive, long-term adjustments based on observed trends. For long-term adaptive management, multiple commenters supported more robust long-term monitoring across taxa and one commenter emphasized the critical need to link contaminant-related sampling with the spatial and temporal context of existing biological monitoring to facilitate analyses of factors affecting ecosystem-level changes. Conversely, for real-time responses, a commenter suggested that extremely comprehensive sampling would be necessary, potentially focused on critical habitats like the Sacramento Deep Water Ship Channel. Several commenters agreed that monitoring specifically designed to inform the adaptive management effort is essential, as ambient monitoring is often inadequate for this purpose. Furthermore, one commenter stressed the importance of real-time flow, temperature, and HAB monitoring, along with the ability to analyze trends in relation to mitigation efforts. Finally, commenters also pointed out the necessity of clearly separating monitoring efforts intended for different purposes and the crucial role of a QAPP and EPA QSM for water quality monitoring.

2.3. Challenges: What are the limitations to environmental monitoring data?

Participants noted that beyond design and environmental complexity, several practical and analytical limitations affect environmental monitoring data. Cross-lab comparisons and the usability of data across different years can be hampered by QA/QC issues, sometimes rendering entire datasets unusable. Commenters pointed out that while combining existing sampling efforts might seem efficient, the resulting resolution often falls short of management needs, limiting the spatial and temporal applicability of even robust contaminant monitoring. It was added that funding constraints and methodological limitations can restrict the scope of monitoring, potentially preventing the analysis of crucial contaminants or stressors. Furthermore, monitoring efforts often struggle to identify the specific sources of contamination or to directly translate environmental concentrations to biological effects in organisms like fish, highlighting the need to link internal contaminant levels to real-time effects. Even with adequate data, monitoring alone doesn't guarantee management solutions. Participants commented that selecting appropriate indicators that effectively represent contaminant risk within resource limitations, as well as accounting for inherent temporal and regional variations, adds further complexity to the interpretation and application of environmental monitoring data.

2.4. What management decisions should contaminant monitoring inform in the Delta

One participant commented that contaminant monitoring in the Delta should inform fundamental management decisions around two basic pathways of treat or prevent contamination (see fundamental objective diagram in Appendix B), and that the value of

collecting various forms of monitoring data could potentially be assessed through a Value of Information Analysis. It was emphasized that defining the specific reasons for needing to make a decision and identifying the target beneficiaries (e.g., ecosystem health, listed species) are crucial first steps in scoping the management objectives. Subsequently, monitoring data should guide decisions related to a variety of management actions such as flow operations, the management of listed species, and the regulation of permitted pesticides and their usage. Some participants added that it should also inform stormwater and wastewater permitting and any necessary mitigation actions. Two key areas for management action noted by participants include informing the 303d listing process, which can trigger TMDL development leading to source identification and control, and providing data to the Department of Pesticide Regulation (DPR) to potentially limit or better specify pesticide use. Finally, a commenter noted that contaminant monitoring should also guide decisions on where to restore wetlands and how to manage existing ones.

Goal 3: Review advanced and emerging technologies, methods, and approaches that could improve understanding of contaminants and their effects in the Delta

3.1. In existing programs, how are newer/advanced tools being used effectively?

Participants commented on examples where newer and advanced tools are being effectively integrated into existing monitoring programs to enhance assessment and inform resource management decisions. One example provided is non-target analysis that is being piloted in California's stream pollution trends program to identify contaminant trends linked to observed toxicity, moving beyond traditional targeted monitoring. Another example noted was the state's Recycled Water CEC monitoring program that utilizes bioassays to detect contaminant suites, a more efficient and cost-effective approach to single-analyte methods. Commenters added that there's a focus on reviewing advancements in source control education, chemical reformulations, and regulations, raising the important question of what motivates manufacturing companies to develop less impactful chemical compounds. These examples demonstrate a move towards more comprehensive and ecologically relevant monitoring strategies, alongside a consideration of preventative measures and the drivers behind them.

3.2. Opportunities: Tools that would enhance the efficacy of monitoring programs?

To enhance the efficacy of monitoring programs, participants noted several tools and approaches that could be valuable. Further research into methods for integrating chemical analysis data to predict toxicological outcomes, effectively creating a "pseudo-tox testing result," could provide a more holistic understanding of potential impacts. Additionally,

incorporating more quantitative measures of sublethal effects, such as quantifying changes in swim activity (e.g., percent reduction or hyperactivity), could offer more sensitive indicators of contaminant stress. Ultimately, a critical tool is a clearer understanding of the specific information gaps that currently increase uncertainty in decision-making processes, allowing monitoring efforts to be more targeted and impactful.

3.3. Challenges: What are the obstacles and limitations in using more advanced (e.g. effect-based) methods?

Commenters pointed out that implementing more advanced, effect-based monitoring methods faces several obstacles and limitations. A key challenge that was mentioned is the need for standardization and accuracy to ensure the data can reliably inform regulatory actions, although full accreditation may not always be necessary. The cost-benefit analysis of adopting new methods can be unfavorable if the implementation is difficult and the improvement in decision-making is unclear. Also noted, limited funding further restricts the widespread adoption of these often more complex and expensive techniques and the lack of established method standardization and lab accreditation for novel approaches also poses a significant hurdle. Commenters pointed out that existing monitoring programs often rely on well-established methods to ensure consistency in evaluating environmental status and trends over time, making the integration of new, unproven methods challenging. Addressing these limitations may require increased financial support, such as through grants specifically for contaminant effects method development, to facilitate standardization and demonstrate the clear benefits of these advanced approaches.

3.4. Besides effect-based methods, what new technologies, methods, and approaches should be considered?

Beyond effect-based methods, participants commented that several new technologies, methods, and approaches warrant consideration. Among those mentioned, non-targeted analysis could be strategically employed to identify potential gaps in current monitoring programs by revealing contaminants that targeted approaches might miss. Additionally, bioremediation, particularly using fungi for their broad-spectrum degradation capabilities across various contaminant types (including pesticides, herbicides, pharmaceuticals, heavy metals, and even nuclear waste), deserves more attention, especially considering the extensive lab-scale data accumulated over

decades and the potentially lower costs compared to landfilling. Investing in scaling up these bioremediation methods could offer a significant advancement in contaminant management.

Goal 4: Identify shortcomings and critical gaps

4.1. Methods and approaches

Participants suggested exploring advanced statistical approaches, such as Bayesian statistics and Bayesian networks, as tools to better manage the complexity and variability inherent in contaminant monitoring data, while acknowledging the limitations of such models. They also recommended prioritizing established methods that have demonstrated connections to management decisions, which can support more actionable outcomes. Expanding the scope of source control strategies was proposed as a necessary step to better address contaminant inputs. Concerns were raised about the lack of spatial and temporal coverage, which may limit the representativeness and utility of current data. Additionally, participants questioned which species are being monitored, and whether they could serve as effective proxies for unmonitored species, potentially enhancing ecological insight. Finally, there was a suggestion that improving the availability and relevance of effect concentration (EC) and lethal concentration (LC) data would support the development of more robust numerical models to guide analysis and prediction.

4.2 Toxicants, contaminants, and stressors

Participants emphasized the need to expand monitoring to include contaminants of emerging concern (CECs) and pollutants not currently covered under the EPA's Contaminant Candidate List (CCL). There was strong interest in better understanding the impacts of complex contaminant mixtures, especially when combined with highly variable stress responses in aquatic species. Several comments pointed to the limited understanding of contaminant sources, which presents challenges in targeting mitigation. Participants called for more dose-response and mixture effect studies involving species relevant to the Delta ecosystem. Both legacy contaminants and newly emerging compounds were identified as essential components of a complete monitoring strategy. A critical gap highlighted was the need to identify the specific contaminants linked to observed toxicity; without this linkage, management interventions may be limited in scope or effectiveness. Others stated the need for a better linkage between contaminant concentrations in fish and effects. Finally, it was suggested that non-chemical stressors, which can modulate chemical impacts or independently drive ecological risk, should be better incorporated into monitoring designs.

4.3 Data accessibility and application

Participants highlighted challenges related to the accessibility, coordination, and practical use of contaminant data. It was noted that there are too many independent groups collecting data without sufficient coordination, which can lead to duplication,

inefficiencies, and missed opportunities for integration. Additionally, not all data are publicly accessible, limiting transparency and broader scientific or management use. A key recommendation was to first identify what contaminant data are actually being used in decision-making and then assess whether additional information is needed to fill those gaps or improve management relevance. Additionally, participants mentioned that there may be special studies collecting relevant data that are not well-publicized or formally integrated into state or regional monitoring efforts.

5: Additional goals not explicitly covered in the draft prospectus

This section reflects additional goals submitted by participants that do not align directly with the predefined goals but highlight important gaps in the draft prospectus and potential areas of expansion.

Participants emphasized that the monitoring review should assess the effectiveness of current monitoring programs in directly addressing key management questions and informing actual Delta management decisions. The review should also explore opportunities to design monitoring efforts that can serve multiple goals simultaneously, such as informing both human and ecosystem health considerations. Clear communication regarding existing knowledge and the most significant unknown factors posing risk is also crucial. Furthermore, the review should consider how monitoring data can be effectively conveyed to the legislature to drive the implementation of source control measures. The potential need for public health advisories based on monitoring findings could be evaluated. Finally, the review could address the fundamental question of identifying the priority management decisions that contaminant monitoring should primarily support and whether to focus on human health, ecosystem health, listed species, or other relevant objectives.

6: What would it take to fill in the gaps (other than money)?

Participants offered a range of practical, non-financial solutions to strengthen contaminant monitoring, improve data use, and support effective management.

- Health and Decision-Making Priorities: Participants emphasized the need for a better understanding of health impacts to help prioritize mitigation strategies and support more informed decision-making. Elevating the overall priority of contaminant reduction within regulatory and planning frameworks was also suggested.
- Accountability and Enforcement: There was strong support for greater accountability through meaningful consequences, including higher fines for repeat

offenders. Several participants called for stronger legislation with real enforcement power, rather than symbolic or minimal penalties.

- Governance and Policy tools: Several participants highlighted the need for clear prioritization of compounds and better understanding of contaminant sources, as well as identifying effective mitigation options. They also supported using Water Board Resolutions to clarify key drivers of impairment and stressed the importance of broader legislative support to institutionalize action.
- Monitoring capacity and Accessibility: To expand capacity, comments called for standardized methods, sufficient laboratory resources, and well-trained analysts. Several participants also recommended making monitoring tools as affordable and accessible as possible, including through subsidized training programs that support the involvement of citizen scientists.
- Cultural shift: Finally, several participants stressed the importance of a shift in mindset within the regulated community, from one focused on fiscal limitations and minimal monitoring to one centered on protecting public and environmental health.

7: Suggested individuals for interview

During the brainstorming session, participants identified key individuals with expertise in contaminant science, regulatory policy, or Delta-specific monitoring programs who may provide valuable insights to inform the Delta ISB's review.

The following individuals were suggested for interview consideration:

- Adam Laputz
- Dave Tamayo
- Ellen Preece
- Janis Cooke
- Jim Orlando
- Kelly Moran
- Michelle Hladik
- Mike Johnson
- Stephanie Fong
- Tamara Kraus
- Michael Lydy
- David Ostrach
- Jennifer Teerlink

These individuals were recommended based on their roles in state and regional water boards, scientific monitoring programs, and Delta-related research. Engaging these experts

could provide both technical knowledge and practical perspectives on monitoring design, data application, and regulatory integration. It would also be helpful for the Delta ISB review to receive diverse perspectives that includes representatives from stormwater, agriculture, and treated wastewater stakeholders.

8: Additional general comments and observations

This section includes standalone comments that did not correspond directly to the existing goals in the draft prospectus but raise important cross-cutting concerns and reflections for the Delta ISB's consideration, prompted by the questions, "What do you think is positive/negative regarding the current contaminant monitoring in the Delta and what is missing/where are the gaps?"

One participant developed a "fundamental objective diagram" depicting the process for determining how to assess the risk or hazard of contaminant stressors and manage those stressors accordingly. This diagram is provided in Appendix B.

Participants questioned whether the scope and robustness of current monitoring data are adequate to support statistically meaningful comparisons across such a highly variable system. Concerns were raised about the ability to detect change or assess risk when monitoring is spatially and temporally inconsistent.

One suggestion was for the DISB to consider whether the Delta Plan's definition of a "healthy ecosystem" is an appropriate benchmark for this review, or whether an adapted or alternate definition should be applied.

Participants generally indicated that current contaminant monitoring in the Delta presents a mixed picture. While there is considerable information on pesticide inputs, significant gaps and limitations exist. The quantity and scope of data were questioned regarding their robustness for statistically significant comparisons in such a variable system, and monitoring effort is often inconsistent spatially and temporally. Multiple comments noted the lack of information on nonpesticide contaminants entering the Delta. Others indicated that it's unclear how current monitoring data is being effectively used in management decisions, and that the focus tends to be heavily on pesticides, neglecting other stressors that management should consider. Additionally, the absence of Water Quality Criteria/Objectives for Contaminants of Emerging Concern (CECs) is a significant gap, and applying contaminant monitoring for source identification proves challenging. Existing Water Quality standards, often based on model organisms, may not adequately protect more sensitive native species or critical life stages. One commenter added that while monitoring legacy pollutants like mercury continues, the emphasis should shift towards remediation rather than solely further data collection. Finally, it was offered that a review of

the specific management questions that current contaminant monitoring programs aim to address would be beneficial to assess their relevance and efficacy.

Appendices

Appendix A: Complete list of collected Comments during the Mural Brainstorming on May 2, 2025

Text	Tags	Note
1. Assess current contaminant monitoring programs to determine the degree to which they are able to provide a comprehensive picture of the ecological risks of contaminants in the Delta.	Goal 1	
1.1 Data: Monitoring programs that should be included in the analysis	Question 1	
Bioassessment	comments	
Biomonitoring California	comments	
Delta RMP	comments	
Dept Boating and Waterways herbicide use data and post application monitoring data (NPDES data)	comments	
Irrigated Lands monitoring data	comments	
Pesticide Use Data	comments	
TMDL	comments	
USGS monitoring programs (SPoT and NAWQA?)	comments	
Vector Control Programs	comments	
1.2 Opportunities: What factors should be considered?	Question 2	

Text	Tags	Note
Consider which compounds and/or species can best inform a broad set of priorities where possible. Are the current efforts able to address current information gaps?	comments	
Current monitoring plans don't capture multi stressor effects on the environment well- contaminant monitoring needs an overhaul in general but how do we do this in a prioritized way?	comments	
Define "comprehensive ecological risks"	comments	
Define what is an unacceptable ecological risk	comments	
Identify areas of uncertainty or information gaps. Those gaps could then be prioritized and inform future opportunities	comments	
The downstream effects of legacy contaminants on marine spp.	comments	
Understand biomagnification in Delta species and individual species tolerances.	comments	
What is the role of historical contaminants no longer permitted for use?	comments	
Your intent to focus on effect-based is absolutely key.	comments	
The management decision	comments	

Text	Tags	Note
1.3. Challenges: What constraints will limit the analysis?	Question 3	
A "comprehensive picture of env. risk" needs to consider all stressors (chemicals, physical habitat, temperature, hypoxia, invasive species, pathogens, HABs, etc)	comments	
Assessing breakdown products that may be more toxic than the parent.	comments	
Identifying the scale at which you are examining risks.	comments	
It's difficult to interpret effects of biotic plus abiotic effects (e.g., temp effects on the toxicity of certain chems)	comments	
Mixture effects are complex and knowledge is limited	comments	
Monitoring programs are typically designed to assess status and trends not assess comprehensive ecological risks	comments	
Source of contaminants is difficult to determine given the tidal system and contaminants coming from both up and downstream of the Delta.	comments	
Sources (e.g., wastewater, ag runoff, stormwater) are not the same as environmental exposures (surface water, sediment) that affect beneficial uses	comments	

Text	Tags	Note
Spatial and temporal disparities in a variety of data and endpoints increase the uncertainty of the analysis. i.e. Monthly contaminant monitoring in the tributaries and fish data on a bi-weekly rate in the middle of the Delta.	comments	
This may make your task too large. It may be best to say you'll assume the individual programs ARE meeting their goals and assess the higher-level needs.	comments	
1.4. List of current contaminant monitoring programs	Question 4	
Delta RMP (e.g., current use pesticides)	comments	
Unknown special studies	comments	
1.5. Data Sources	Question 5	
CEDEN	comments	
DWR Water Data Library	comments	
NPDES upstream data from CWQIS if it isn't now in CEDEN	comments	
SURF	comments	
SWAMP	comments	
Special Studies - consider whether existing monitoring program data aligns with and is robust enough to pull out trends identified in special studies/published research	comments	
2. Understand how monitoring can better inform decision making, i.e. how	Goal 2	

Text	Tags	Note
monitoring data are used in designing and taking management actions.		
2.1. Provide examples where monitoring effectively informs decision making (local or not)	Question 1	
Compliance Monitoring	comments	
Delta RMP (hopefully) as it was responsive to prior DISB review conclusions	comments	
North Delta Foodweb Subsidy Action	comments	
Tidal wetland monitoring and forthcoming HABs monitoring efforts follow an adaptive approach to set management questions and follow with data collection to refine further management questions	comments	
TMDLs	comments	
The availability of the right kind of monitoring data can inform environmental impact analyses that determine whether actions are detrimental to endangered species and if there are adjustments that can reduce impacts	comments	

Text	Tags	Note
Development of Response Spectrum Models linking internal contaminant levels to effects	comments	
2.2. Opportunities: What types of data/monitoring best support adaptive management?	Question 2	
Adaptive management takes two forms; we should clearly define the form we are referring to, i.e. (A) Adaptive management in real time as a response to temporally sensitive spill / issue and (B) a longer-term adaptive management such as linking rice field herbicides with smelt mortality and changing application procedures for the next years to come.	comments	The first one is not technically Adaptive Management. It is called Reactive Management or Managing Adaptively. Using a very different format is the basis of most of the management in the Delta.
For long-term adaptive management: absolutely critical to link sampling with space-time of existing biological sampling network or determining mechanisms behind ecosystem change wont be possible.	comments	
For real time responses: extremely comprehensive sampling would be needed; probably this would only be done in critical habitat e.g. DWSC	comments	
Long term monitoring across taxa to show ecosystem level risk, preferably comparable to other programs for comparison across spatial scales	comments	

Text	Tags	Note
real-time flow, temp, HAB monitoring	comments	
The ability to look at trends over time and how those relate to mitigation/restoration efforts (whether successful in reducing load in the environment/bioaccumulation)	comments	
The monitoring that was designed to inform the Adaptive Management effort. Using ambient monitoring is usually ill equipped to be used in an adaptive management context. they are not designed for that.	comments	
There needs to be a clear separation of anything used for different purposes so things don't get confused. People will try to change monitoring to address another need because it partially addresses their need, only to make it less informative for the original goal(s).	comments	
Use of a QAPP and EPA QSM are crucial for WQ monitoring	comments	
2.3. Challenges: What are the limitations to environmental monitoring data?	Question 3	
Cross lab comparisons between monitoring programs or across monitoring years. Entire years of contaminant monitoring may unable to	comments	

Text	Tags	Note
be used due to QA/QC concerns. Having robust checks before lab selection can help this issue		
Existing sampling efforts, when combined, often are not resolved enough for management needs (ex: zooplankton sampling) so we should be realistic that even the best contaminant monitoring program will have limitations in application spatially/temporally	comments	
Funding; methodology (can we even test for the things we need to know about); monitoring doesn't always create a management solution- just creates data;	comments	
Identifying the sources of contaminant inputs, particularly those that can be mitigated	comments	
Limited number of contaminants or analytes may be missing important chemicals or stressors	comments	
Scope of the monitoring tends not to have the ability to identify sources of contaminants.	comments	
Selecting the appropriate indicators that are able to represent contaminant risk with limited resources.	comments	
Temporal and regional variations	comments	

Text	Tags	Note
It is challenging to link water or sediment concentrations to effects in fish. Need to link internal contaminant levels to effects in real time.	comments	
2.4 What management decisions should contaminant monitoring inform in the Delta	Question 4	
Basic decision is to decide whether to Treat and/or Prevent.	comments	
Also need to decide why one would need to make a decision and who are the target(s).	comments	
Value of information Analysis could be used to evaluate the value of contaminant monitoring	comments	
Once you have determined all the why, you will have your fundamental objectives and a way to scope out the management decision.	comments	Note 1: I don't think contaminant monitoring can be used in a real time situation for operation of the Projects. The data would be too pulsed and by the time it's seen, that plug of water will be long gone. It's much more suitable for longer-term assessments and managing more controlled areas like restoration sites. Note 2: I agree. The turnaround time for this kind of monitoring is too long. Also we should not limit ourselves to just flow management although they should be included.
Flow operations	comments	

Text	Tags	Note
Human Health	comments	
Listed Species Management	comments	
Permitted pesticides and regulations around their usage	comments	
Stormwater and wastewater permitting and/or mitigation decisions.	comments	
There's essentially two main things to inform: 303d Listing and DPR use. If we have something Listed, it will trigger a TMDL that will then lead to source identification and control. If we can inform DPR so they can limit or better specify use, those are the main management actions we have for contaminants.	comments	Note 1: Could there not be a "take" mechanism as well? Note 2: If CDFW and USFWS wanted to interpret toxicity as "harm," there might be, but this hasn't been their perspective thus far.
Where to restore wetlands / how to manage those wetlands	comments	
3. Review advanced and emerging technologies, methods, and approaches.	Goal 3	
3.1. In existing programs, how are newer/advanced tools being used effectively?	Question 1	

Text	Tags	Note
Advanced and emerging methods are appropriate for assessment and to determine additions to monitoring programs, as appropriate to support resource management questions/decisions	comments	
Review advancements in source control education, chemical reformulations, and regulation. What is the motivation for manufacturing companies to produce less impactful compounds?	comments	
The stream pollution trends program (CAwide sediment monitoring program) has been piloting the integration of nontarget analysis into contaminant monitoring to uncover contaminant trends associated with observed toxicity in test organisms.	comments	
CEC monitoring program for Recycled Water in CA uses bioassays to detect suites of contaminants instead of single targets	comments	
3.2. Opportunities: Tools that would enhance the efficacy of monitoring programs?	Question 2	
Additional study into how to best combine chem analysis data to create a pseudo-tox testing result based on the chem analysis alone.	comments	

Text	Tags	Note
More quantification of sublethal effects like using percent reduction of swim activity or hyperactivity	comments	
Need to know what information that is missing that would be able to reduce the uncertainty in making a decision.	comments	
Challenges: What are the obstacles and limitations in using more advanced (e.g. effect-based) methods?	Question 3	
Agree, standardization (but not always to the point of accreditation) and accuracy are needed to be able to base regulatory actions on that data.	comments	
Cost/ benefit. The new method can be difficult to implement and it is hard to tell whether it improved the decision.	comments	
Funding; method standardization/lab accreditation	comments	
Monitoring programs typically use established methods to evaluate status and trends over time.	comments	
Need more STAR grants and other awards for method dev specifically for contaminant effects.	comments	
3.4. Besides effect-based methods, what new technologies, methods, and approaches should be considered?	Question 4	
Consider where non-targeted methods may be appropriate to check for gaps in monitoring. What we may be missing with targeted approaches.	comments	

Text	Tags	Note
Bioremediation is still not getting enough attention. We have 50 years worth of labscale data, the cost of investigating scaling methods is a fraction of landfilling. Also, these are broad spectrum methods. Fungi can break down many contaminant types at the same time (pesticides, herbicides, pharmaceuticals, heavy metals, even nuclear waste).	comments	
4. Identify shortcomings and critical gaps.	Goal 4	
4.1 Methods and approaches	Question 1	
Are there statistical approaches that could better handle the complexity and variability in contaminant monitoring data. Like Bayesian statistics. Also Bayesian networks to some degree, acknowledging it's limitations.	comments	
Established methods with proven links to management decisions	comments	
Source control needs to be more broad	comments	
There is not enough spatial or temporal coverage.	comments	

Text	Tags	Note
What species are included and how can they be used as proxies for others (perhaps better in a dift section)	comments	
With more relevant EC and LC data, we could build more numerical models	comments	
4.2. Toxicants, contaminants, and stressors	Question 2	
CECs; pollutants outside of the EPA CCL;	comments	
Complex mixtures of contaminants and stressors combined with complex stress responses in fish/aquatic species with high variability	comments	
Contaminant sources are not fully understood	comments	Sources are so different for different areas. The Delta has such a complex land use and variable across a small geographical space.
Dose-response relationships and mixture effect studies with organisms relevant to the Delta	comments	
Include both legacy and emerging compounds	comments	
Need to identify the contaminant that is being linked to a toxicity in order for much of the decisions on prevention to be implemented. We were told that without knowing the contaminant there was not much California agencies can do.	comments	I think this is a shortcoming of managing as we have in the past. We need someone to be brave and propose and support managing differently because the past/current ways of managing aren't working. If we focused on the presence/absence of toxicity for 303d Listing and could let the

Text	Tags	Note
		Responsible Parties be the ones responsible for figuring out what in their area was causing the issue and then their own source control, we wouldn't have to work at the single chemical level.
Need a better linkage between contaminant concentrations in fish and effects	comments	
What stressors other than chemicals are key drivers of eco risk in the Delta / modulate effects of chemicals and should be included in monitoring?	comments	
4.3 Data accessibility and application	Question 3	
There are too many groups that are not coordinating their efforts.	comments	
Not all publicly accessible	comments	
Find out what (if any) contaminant data is being used to inform a decision. Then determine whether more information is needed.	comments	

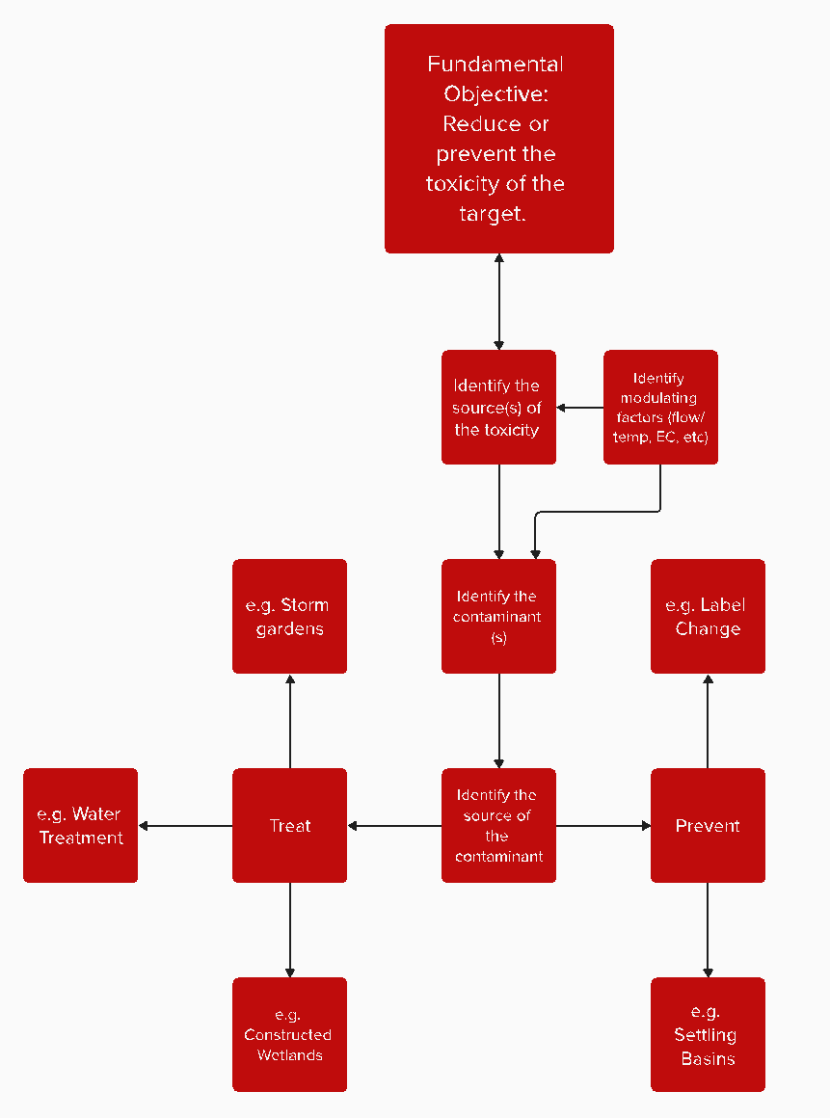
Text	Tags	Note
5. Another Goal?	5. Additional Goals	
Assess the effectiveness of monitoring programs to address management questions and inform Delta management decisions.	comments	
Building on the comment prior- consider where monitoring can be used to inform multiple decisions/goals (e.g. human and ecosystem health)	comments	
Communication on what is currently known and what unknown factors pose the greatest risk.	comments	
Get data back to the legislature to implement source control	comments	
Public health advisories, if relevant?	comments	
What are the priority management decisions? Is it human health, ecosystem health, listed species, or other?	comments	
6. What would it take to fill in the gaps (other than money)?	6. Fill the gaps	
A better understanding of health impacts to help prioritize mitigation/decision making	comments	
Actual consequences: high fines, particularly for repeated offenders. The fines for dairy runoffs in municipal waters are ridiculously low. Legislation	comments	

Text	Tags	Note
must have serious teeth, not just give small slaps on the wrists.		
Elevation in priorities for reducing contaminants	comments	
It would require a prioritization of compounds and also understanding of inputs - the sources and possible mitigation actions that may be effective	comments	
Legislation	comments	
Monitoring methods need to be as cheap as possible and subsidized (with training) to recruit citizen scientists	comments	
Standardized methods, sufficient laboratories, and trained analysts	comments	
Water Board Resolutions identifying key drivers of impairment	comments	
Willingness by the regulated community- it can be done! A mentality shift from "fiscal responsibility/less monitoring" to "protection of public and environmental health"	comments	
7. Interviews (names)	7. Interviews	
Adam Laputz	comments	
Dave Tamayo	comments	
Ellen Preece	comments	

Text	Tags	Note
Janis Cooke	comments	
Jim Orlando	comments	
Kelly Moran	comments	
Michelle Hladik	comments	
Mike Johnson	comments	
Stephanie Fong	comments	
Tamara Kraus	comments	
Michael Lydy	comments	
David Ostrach	comments	
Jennifer Teerlink	comments	
8. Random comments	8. Random comments	
Is the quantity and scope of data that is currently being collected sufficiently robust to provide statistically significant comparisons in such a variable system?	comments	
Consider whether the Delta Plan's definition of a healthy ecosystem is useful (or if a variation on the definition for the purpose of this review is necessary)	comments	
Inconsistent monitoring effort in space and time.	comments	
Virtually no information on non-pesticides entering the Delta	comments	

Text	Tags	Note
In addition to preventing and treating, management can and should also take multiple stressors into account in decision making	comments	
Not sure how the current monitoring is being used in decisions.	comments	
Tends to be focused on pesticides	comments	
Lots of information on inputs into the Delta of pesticides	comments	
lack of WQC/Objectives for CECs	comments	
Hard to apply contaminant monitoring to source identification	comments	
WQ standards are determined by model organisms and resident/native species may be more sensitive (e.g., coho salmon and 6PPD)	comments	Sensitive life stages should also be part of this since it's not always that younger is more sensitive.
Legacy pollutants are often the most important yet not adequately cleaned up- we don't need more monitoring on mercury to know it is impacting the ecosystem, we need to remediate.	comments	
It would be helpful to review the current management questions that contaminating monitoring programs in the Delta are addressing.	comments	

Appendix B: Fundamental Objective Diagram



The image above may not be accessible for those using a screen reader. Below are the text within the image

Fundamental Objective: Reduce or prevent the toxicity of the target

- Identify the source(s) of the toxicity
- Identify modulating factors (flow/temp, EC, etc)
- Identify the contaminant(s)
- Identify the source of the contaminant
- Treat (e.g. Storm gardens, Water treatment, Constructed wetlands)
- Prevent (e.g. Label change, Settling basins)