

# Revisiting the 2003 Mercury Strategy for the Bay-Delta Ecosystem: Workshop Series

## Purpose

To create a shared understanding among scientists and managers of the current knowledge of mercury science, critical uncertainties, and associated priorities for research, monitoring, and evaluation to address challenges associated with mercury in the Delta ecosystem. Scientists will use the information presented to identify research needs and managers will use the knowledge gained to guide management decisions addressing mercury pollution. The workshop will also assess the progress made toward achieving the recommendations outlined in the 2003 Mercury Strategy.

## Dates

*Three 1-day technical workshops:* Week of January 26-28, 2016

*Synthesis workshop:* June 2, 2016 (the ISP will meet with the workshop leads in a closed, review session June 3)

## Organizing Committee (\*primary contacts)

### Coordination

*Sacramento-San Joaquin Delta Conservancy:* Shakoora Azimi-Gaylon

*Delta Stewardship Council, Science Program:* Darcy Austin, **Yumiko Henneberry\***

### Scientific program

*US Geological Survey:* **Jacob Fleck\***, Lisamarie Windham-Myers, Josh Ackerman, Collin Eagles-Smith, Roger Fujii (emeritus)

### Facilitation

*Center for Collaborative Policy at California State University Sacramento:* Juliana Birkhoff

## Independent Science Panel

*US Geological Survey:* David Krabbenhoft (chair)

*Smithsonian Environmental Research Center:* Cynthia Gilmour

*University of New Brunswick:* Karen Kidd

## Background

In 2002, an internationally-recognized independent science panel evaluated the current state of knowledge at that time regarding mercury in the Bay-Delta and developed a mercury strategy (hereon the “2003 Strategy”) to guide scientific research, monitoring plans, and management actions addressing restoration and adaptive management of the Bay-Delta with respect to mercury (Wiener et al., 2003). Since 2003, there have been considerable achievements in enhancing the understanding of mercury sources, cycling, and biotic effects within the Bay-Delta ecosystem. This new knowledge has initiated several management programs to mitigate and control mercury, as well as development of regulatory frameworks (Total Maximum Daily Load, TMDL, and Basin Plan Amendments) for mercury in both the Delta and San Francisco Bay regions (CVRWQCB, 2012; SFRWQCB, 2008).

One of the recommendations provided in the 2003 Strategy was to create opportunities for scientists, managers, and stakeholders to assess the progress made in achieving the management goals and supporting scientific objectives outlined in the strategy. Although there have been a few efforts addressing focused topics included in the strategy (Sierra Fund, 2015; Bay RMP, 2014), and the establishment of numerous Hg-based TMDLs in the greater watershed (Table 1), there has been no comprehensive review of the progress made over the past 12 years in identifying and understanding mercury sources, cycling, and biotic effects within the Bay-Delta ecosystem, particularly with respect to the recommendations outlined in the 2003 Strategy.

**Table 1. Completed Mercury TMDLs in the watershed and dates approved by U.S. EPA**

Clear Lake Mercury TMDL	Central Valley Region, 2003
Cache Creek, Bear Creek, and Harley Gulch Mercury TMDL	Central Valley Region, 2007
San Francisco Bay Mercury TMDL	San Francisco Bay Region, 2008
Sulphur Creek Mercury TMDL	Central Valley Region, 2009
Guadalupe River Watershed Mercury TMDL	San Francisco Bay Region, 2010
Sacramento-San Joaquin River Delta Methylmercury TMDL	Central Valley Region, 2011
Statewide Reservoir MeHg TMDL	In development

In response to this need, this inclusive workshop series is designed to assess the scientific progress made in meeting the recommendations outlined in the 2003 Strategy (Table 2). This series will bring together scientists and managers from various agencies and organizations in the Delta to share new and recently updated scientific information related to three general areas in the 2003 Strategy that have gained the most knowledge: mercury sources, cycling, and biotic effects. Presentations at the workshop will collectively provide an overview of the available knowledge with respect to mercury dynamics in the Bay-Delta ecosystem and identify conflicting evidence and information gaps, while also providing insight from globally relevant literature on mercury chemistry and exposure. In addition, during each workshop in the series the participants will have the opportunity to engage in a facilitated discussion where they can apply the knowledge gained to integrate and assess new information as well as identify and prioritize data gaps. The workshop deliverables will also be used to improve conceptual and numerical models and update monitoring and management approaches.

Table 2. 2003 Strategy core components, management goals and related technical workshops (Wiener et al., 2003)

Core Components	Management Goals	Technical Workshop
1. Quantification and evaluation of mercury and methylmercury sources	To identify mercury sources that <i>contribute most strongly</i> to the production and bioaccumulation of methylmercury	Sources
2. Remediation of mercury source areas	To identify remedial actions that can reduce loadings of mercury from sources to surface waters and decrease the exposure of aquatic biota to methylmercury	Sources Biogeochemistry
3. Quantification of effects of ecosystem restoration on methylmercury exposure	To document and understand the effects of ecosystem restoration in wetland, floodplain, and riverine habitats on the production and bioaccumulation of methylmercury in the Bay-Delta ecosystem	Biogeochemistry Biota
4. Monitoring of mercury in fish, health risk assessment, and risk communication	To protect human health by assessing and reducing exposure to methylmercury-contaminated fish To provide a “performance measure” to gage methylmercury contamination of the Bay-Delta ecosystem during restoration	Biota
5. Assessment of ecological risk	To protect fish and wildlife from adverse effects of methylmercury exposure	Biota
6. Identification and testing of potential management approaches for reducing methylmercury contamination	To identify and evaluate potential landscape management approaches for reducing the production and abundance of methylmercury in the ecosystem, as well as the associated exposure of resident biota	Sources/Biogeochemistry/Biota

### Workshop deliverable

The new information obtained during this workshop series will be incorporated into a multi-authored, peer-reviewed synthesis paper that will provide a record of our current understanding of mercury science within the Bay-Delta ecosystem. The document will also serve as a progress report stating the extent to which the advances in our understanding have contributed to meeting the goals and objectives in the 2003 strategy. Although this document is not another strategy, scientists can use the information presented to identify the most critical research needed to better predict the impacts of mercury contamination under natural and human-influenced conditions such that local managers, stakeholders including dischargers, and the public can use this knowledge to guide management decisions addressing mercury mitigation.

## Significance to future research and management actions in the Bay-Delta region

Both the workshop series and ensuing synthesis document will provide information that can be applied to improving current management actions and identifying priority research to address critical gaps in knowledge regarding mercury dynamics, as illustrated below.

*Guidance for restoration management efforts and research needs:* The past two decades have witnessed an increase in efforts to restore natural processes and improve the ecological functions of the Bay-Delta region. These restoration actions, such as the [Ecosystem Restoration Program \(ERP\)](#) and the more recent [California EcoRestore](#), however, call to expand the acreage of seasonal wetlands, tidal marshes, and floodplains, systems that favor mercury methylation. Such efforts are anticipated to increase with the issuance of the [2009 Delta Smelt Biological Opinion](#), which mandates 8,000 acres of tidal marsh restoration, and implementation of the Water Quality, Supply, and Infrastructure Improvement Act of 2014 (Proposition 1), which allocated \$1.495 billion towards multi-benefit ecosystem, watershed protection, and restoration projects. Over the next 10 years, multiple state agencies including California Department of Fish and Wildlife (CDFW) and the Delta Conservancy will administer Proposition 1 grant programs, many of which will address restoration efforts to expand ecological systems that are primary sources of methylmercury. It is thus imperative for measures that reduce methylmercury exposure to fish, wildlife, and humans to be integrated into the ecosystem restoration plans. This workshop aims to communicate the current state of knowledge related to mercury cycling to managers, stakeholders, and the public so that they have an understanding of how alterations in hydrology and sediment chemistry brought about by restoration efforts or management choices will affect mercury cycling, methylation, and transport. The presentations and discussions will highlight what is currently known about mercury dynamics while also identifying areas still lacking information and thus in need of further study. This combination of knowledge will provide managers and stakeholders with guidance to develop and improve mitigation measures and also make them aware of the key uncertainties that could be addressed in adaptive management plans.

*Contributions to the phase 1 Delta methylmercury TMDL and statewide mercury policy:* Presentations in the workshop series will include updates of a selection of control studies involved in the first phase of the Delta methylmercury TMDL. These studies, which must be conducted by various discharging entities, evaluate the scientific findings from established and potential control methods and also assess new measures to mitigate exposure of fish and other biota to inorganic and methyl mercury. Discussions stemming from these presentations that include preliminary results, new mitigation studies, and data gaps may contribute to a partial review of these control studies for the Water Boards and provide guidance to develop additional innovative methods to reduce mercury loads. New knowledge gained from this workshop series may also be applied towards the development of water quality objectives and additional mercury control plans for reservoirs to include in the statewide mercury policy.

*Relevance to the Delta Science Plan:* [The Delta Science Plan](#) promotes synthesis as a means to integrate components of a complex system to provide both scientists and managers with a clear overview of the current state of knowledge. Synthesis accelerates the understanding of a system and can also “inform the design and evaluation of alternative management and operational strategies thereby facilitating management decisions that will lead to improved outcomes.” The workshop series and synthesis document will highlight the present understanding of mercury, providing scientists and managers with the best available science to explore ways to

improve current management practices and develop alternative options for addressing methylmercury load reductions and exposure.

In addition to linking the current state of knowledge to management actions through synthesis, this workshop series also contributes to adaptive management, another primary component of the Delta Science Plan. Adaptive management requires timely scientific input and evaluation of the current state of knowledge so refinements to both scientific investigations and monitoring programs reflecting this information can be made. The 2003 Strategy provides recommendations for a periodic assessment of our understanding of mercury dynamics and evaluation of the progress made in achieving the goals set out in the strategy; however, such an assessment has not yet taken place. Outcomes from the workshops support several aspects of adaptive management including evaluation of the current state of knowledge with respect to mercury, information pertinent to updating numeric models, new developments to current conceptual models, identification of key uncertainties, and guidance for evaluation of ongoing projects and programs.

In addition, the 2003 Strategy was initially developed to provide guidance to ERP, which is administered jointly by CDFW, the US Fish and Wildlife Service, and National Marine Fisheries Service. The ERP has entered its second stage of implementation yet mercury and methylmercury are still listed as key stressors in the Bay-Delta ecosystem (CDFW et al., 2014). As stated in the ERP Conservation Strategy, "Success in achieving most of [the ERP] goals will hinge partly on the behavior and mitigation of mercury in the ecosystem." Mercury negatively affects native biotic communities, diminishes the value of fisheries, reduces the benefit of habitats, and degrades both water and sediment quality. Thus, information leading to improving mercury control is an important objective for CDFW and the other implementing agencies. Mercury is also listed as one of the issues under the ecosystem water quality program supported by CDFW and an important facet of the overall ERP effort. A significant number of studies to be discussed at the workshop series were either directly funded or stemmed from research that was supported by CDFW.

## **Participants**

Participation for this workshop will include those interested in mercury and methylmercury science in the Delta and how this information can be applied to management decisions. The presenters at the workshop will translate, wherever possible, the implications of the scientific results presented for management of systems to better control the production, transport and bioaccumulation of methylmercury in the Delta. Thus we expect that the assessment and synthesis of the information presented at the workshop will provide valuable knowledge to the scientists, managers and decision makers from State, Federal and local agencies with regulatory oversight. We anticipate that many others will have a keen interest in the results of the workshop including monitoring program managers, water management agencies, resource agencies, agricultural dischargers, publicly owned treatment works, and those from the wider Delta science community with interests related to mercury in the Delta.

## **Format of Workshop Series**

We have planned a series of four workshops that will reassess and respond to the 2003 Strategy. The workshops will be open to the public but will require registration so that participants can be provided workshop materials

to be reviewed and completed prior to the day(s) of the workshop(s) so as to provide a common and informed foundation for understanding and discussion during the workshops.

*Technical workshops:* Three consecutive workshops in January 2016 will review each of the three main themes in the 2003 Strategy: sources, biogeochemistry, and bioaccumulation. Each workshop will include a morning session of presentations addressing the current state of knowledge about a specific topic addressed in the 2003 Strategy. The afternoon session will involve a facilitated discussion that will identify information gaps and suggestions for potential improvements in mercury management in the Bay-Delta ecosystem. One of the pre-workshop tasks will be to complete a questionnaire to help guide the afternoon discussion.

*Synthesis Workshop:* The information from these three workshops will then be brought together in the synthesis workshop, to be held in June 2016. The first day of the synthesis workshop will include a series of summary presentations of the past three workshops in January and integration of this information into various model applications. The synthesis will involve a facilitated discussion with active input from workshop participants. Discussion will include evaluation of the current state of knowledge as compared to the 2003 strategy, an overview of data gaps that have been filled, identification of any new gaps, and potential strategies to control mercury.

The general timeline for the workshop series, as well as estimated number of participants is displayed in Table 3 below:

**Table 3.** Workshop timeline and estimated participant number

Workshop	No. of days/Potential date	Estimated number of participants
Sources	January 26, 2016	50
Biogeochemistry	January 27, 2016	50
Bioaccumulation	January 28, 2016	50
Synthesis	June 2, 2016	100

*Reporting:* The information and conclusions gathered in this effort will be compiled and evaluated in a “Synthesis” manuscript. The manuscript draft will be presented at the Bay-Delta Science Conference planned for November 15-17, 2016, in Sacramento, CA. (The call for abstracts for presentations and posters will be released in Spring 2016).

## References (in addition to hyperlinked text within document)

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