March 22, 2018

Paul Hann, Environmental Program Manager
State Water Resources Control Board
Division of Water Quality
1001 I Street, 15th Floor
Sacramento, CA 95814

SUBJECT: REQUEST FOR EXTERNAL PEER REVIEW OF PROPOSED REVISIONS TO SEDIMENT QUALITY PROVISIONS CONTAINED IN THE WATER QUALITY CONTROL PLAN FOR ENCLOSED BAYS AND ESTUARIES OF CALIFORNIA

Dear Mr. Hann,

This letter responds to the attached January 5, 2018 request for external scientific peer review for the subject noted above. The review process is described below. All steps were conducted in confidence. Reviewers' identities were not disclosed.

To begin the process for selecting reviewers, I contacted the University of California, Berkeley (University) and requested recommendations for candidates considered qualified to perform the assignment. This service is supported through an Interagency Agreement co-signed by CalEPA and the University. The University was provided with the request letter and attachments. No additional material was asked for. The University interviews each promising candidate.

Each candidate who was both qualified and available for the review period was asked to complete a Conflict of Interest (COI) Disclosure form and send it to me for review, with Curriculum Vitae. The cover letter for the COI form describes the context for COI concerns that must be taken into consideration when completing the form. "As noted, staff will use this information to evaluate whether a reasonable member of the public would have a serious concern about [the candidate's] ability to provide a neutral and objective review of the work product."

In subsequent letters to candidates approved as reviewers, I provided the attached January 7, 2009 Supplement to the CalEPA Peer Review Guidelines, which, in part, serves two purposes: a) it provides guidance to ensure confidentiality through the course of the external review, and b) it notes reviewers are under no obligation to discuss their comments with third-parties after reviews have been submitted. We recommend they do not. All outside parties are provided opportunities to address a proposed regulatory action, or potential basis for such, through a well-defined rulemaking process.

Later, I sent letters to reviewers to initiate the review. These letters provided access instructions to a secure FTP site where all material to be reviewed was placed. Attachment 2 to the request memorandum was highlighted as the focus for the review. Each initiating letter identified specific conclusions which that reviewer committed to address. This commitment is detailed in the paragraph

following “Attachment 2”, appearing on page 2 of the letter. Thirty days were provided for the review. I also asked reviewers to direct enquiring third-parties to me after they have submitted their reviews.

Approved reviewers:

1. Gary A. Buchanan, Ph.D.
   New Jersey Department of Environmental Protection
   Division of Science, Research and Environmental Health
   P.O. Box 420
   Trenton, NJ 08625-0420

2. Elaine M. Faustman, Ph.D.
   Professor, Dept. of Env. & Occ. Health Sciences
   School of Public Health
   University of Washington
   4225 Roosevelt Way NE
   Seattle, WA 98105

3. Valery E. Forbes, Ph.D.
   Dean, College of Biological Sciences
   University of Minnesota
   123 Snyder Hall
   1475 Gortner Avenue
   St. Paul, MN 55108

4. Robert J. Letcher, Ph.D.
   Adjunct Research Professor
   Departments of Biology and Chemistry
   Carleton University
   1125 Colonel By Drive (Raven Road)
   Ottawa, ON Canada K1A 0H3

If you have any questions, or require clarification from the reviewers, please contact me directly.

Regards,

Gerald W. Bowes, Ph.D.
Manager, Cal/EPA Scientific Peer Review Program
Office of Research, Planning and Performance
State Water Resources Control Board
1001 “I” Street, 16th Floor
Sacramento, California 95814

Telephone: (916) 341-5567
Fax: (916) 341-5284
Email: Gerald.Bowes@waterboards.ca.gov

Attachments

(1) January 5, 2018 Request by Paul Hann for Scientific Peer Review
(2) Letters to Reviewers Initiating the Review
    (1) Gary A. Buchanan, Ph.D.
    (2) Elaine M. Faustman, Ph.D.
    (3) Valery E. Forbes, Ph.D.
    (4) Robert J. Letcher, Ph.D.
(3) January 7, 2009 Supplement to Cal/EPA Peer Review Guidelines
(4) Curriculum Vitae
    (1) Gary A. Buchanan, Ph.D.
    (2) Elaine M. Faustman, Ph.D.
    (3) Valery E. Forbes, Ph.D.
    (4) Robert J. Letcher, Ph.D.
(5) Reviews
    (1) Gary A. Buchanan, Ph.D.
    (2) Elaine M. Faustman, Ph.D.
    (3) Valery E. Forbes, Ph.D.
    (4) Robert J. Letcher, Ph.D.

cc: Chris Beegan, Engineering Geologist, DWQ
Marleigh Wood, Sr. Staff Counsel, OCC
Annalisa Kihara, Senior WRC Engineer, DWQ

State Water Resources Control Board

TO: Gerald Bowes, Ph.D.
Manager, Cal/EPA Scientific Peer Review Program
OFFICE OF RESEARCH, PLANNING AND PERFORMANCE

FROM: Paul Hann
DIVISION OF WATER QUALITY

DATE: January 5, 2018

SUBJECT: REQUEST FOR EXTERNAL PEER REVIEW OF PROPOSED REVISIONS TO SEDIMENT QUALITY PROVISIONS CONTAINED IN THE WATER QUALITY CONTROL PLAN FOR ENCLOSED BAYS AND ESTUARIES OF CALIFORNIA

The State Water Resources Control Board – Division of Water Quality (State Water Board) requests that you initiate the process to identify reviewers to provide external peer review for the proposed amendments per the requirements of Health and Safety Code section 57004. The proposed provisions are tentatively scheduled to be considered by the State Water Board in April 2018. The draft staff report and supporting technical documents are currently ready for review.

Background and Basis for Provisions

In 1989, Porter-Cologne Water Quality Control Act was amended to require the State Water Board to develop sediment quality objectives (SQOs) as part of the Bay Protection and Toxic Hotspots Cleanup Program, a comprehensive program to protect existing and future beneficial uses within California's enclosed bays and estuaries. Several factors prevented the State Water Board from developing SQOs during the ten years that the Bay Protection Program was funded. In 1999, a lawsuit was filed against State Water Board for failing to adopt SQOs in accordance with Porter-Cologne. As a result the Court agreed with the petitioners, and required the State Water Board to develop adopt and submit the SQOs to the Office of Administrative Law in 2008. The proposed provisions are applicable only to enclosed bays and estuaries of California.

Goals of Proposed Amendments

1. Protect and restore those beneficial uses at risk from pollutants in sediments within California's enclosed bays and estuaries through the refinement of sediment quality assessment, interpretive tools and policy of implementation.
2. Comply with California Water Code §13393 which requires the State Water Board to adopt SQOs for toxic pollutants that have been identified in toxic hot spots as part of the Bay Protection and Toxic Cleanup Program (BPTCP) and for other toxic pollutants of

concern including contaminants that may pose risk to human consumers of fish and shellfish.

3. Provide regulators, stakeholders, and interested parties with a transparent, and scientifically sound process to better assess the effects caused by pollutants in sediments within California's enclosed bays and estuaries.
4. Provide regulators, stakeholders, and interested parties with an effective process that will promote the protection of sediment quality as well as the management of sediments that do not meet the SQOs.
5. Avoid imposing monitoring and regulatory requirements that are more stringent than necessary to demonstrate that sediment associated beneficial uses are protected and requirements that could have unreasonable costs relative to their environmental benefits.

Requested Review Period

We request that scientific peer review be accomplished within the normal review period of thirty (30) days.

Length of Documents and References

The primary documents consist of:

- Draft Staff Report and Substitute Environmental Document is approximately 245 pages, including appendices.
  https://www.waterboards.ca.gov/water_issues/programs/bptcp/docs/sediment/sed.pdf
    - Proposed Amendments to the Water Quality Control Plan for Enclosed Bays and Estuaries are included as Appendix A (proposed revisions provided in strikeout/underline)
      https://www.waterboards.ca.gov/water_issues/programs/bptcp/docs/sediment/draft_amendments_underlinestrikeout.pdf

There are four supporting documents to be reviewed and these are as follows:

1. Steven M. Bay, Ashley N. Parks, Aroon R. Melwani, and Ben K. Greenfield (2017), Development of a Sediment Quality Assessment Framework for Human Health Effects Southern California Coastal Water Research Project Technical Report 1000 (175 pages)
   https://www.waterboards.ca.gov/water_issues/programs/bptcp/docs/sqo_human_health_framework.pdf

2. Ben K Greenfield, Aroon R Melwani, and Steven M Bay (2015), A Tiered Assessment Framework to Evaluate Human Health Risk of Contaminated Sediment, Integrated Environmental Assessment and Management
3. Gobas, Frank and Jon A. Arnot, 2010. Food Web Bioaccumulation Model for Polychlorinated Biphenyls in San Francisco Bay, California, USA. Environmental Toxicology and Chemistry, Vol. 29, No. 6, pp. 1385–1395, 2010
4. Office of Environmental Health Hazard Assessment (2008), Development of Fish Contaminant Goals and Advisory Tissue Levels for Common Contaminants in California Sport Fish: Chlordane, DDTs, Dieldrin, Methylmercury, PCBs, Selenium, and Toxaphene. June 2008. Authors Susan Klasing and Robert Brodberg
   https://oehha.ca.gov/media/downloads/fish/report/atlmhgandothers2008c.pdf

Suggested Expertise of Reviewers

We recommend reviewers be solicited with expertise in aquatic food web models and bioaccumulation, public health toxicology, marine and estuarine fish ecology, and environmental chemistry.

Attachments

Attachment 1 provides a summary of the proposed revisions to the Water Quality Control Plan. Attachment 2 contains scientific and policy elements require peer review. Attachment 3 contains a list of the persons who have participated in the development of this proposal. Attachment 4 contains the list of references used in the development of the staff report. Peer reviewers are not expected to review these documents but all the references will be available to the peer reviewers.

If you have any questions, please contact Chris Beegan at either (916) 341-5912 or chris.beegan@waterboards.ca.gov.

Attachments

cc: Chris Beegan, Division of Water Quality, State Water Resources Control Board, Sacramento

Attachment 1

Summary of the Proposed Revisions

The proposed amendments affect how two narrative sediment quality objectives (SQO) are applied and implemented. The amendments associated with each SQO are summarized below.

- Application and implementation of the SQO protecting human consumers of resident sportfish from contaminants that bioaccumulate from sediment into fish tissue, including
    - Revisions to the assessment framework and policy of implementation that would replace the existing approach with a prescriptive framework to assess risk to human consumers of resident sportfish and evaluate the linkage to contaminants in sediment within enclosed bays and estuaries of California.
    - Description of how this revised assessment framework shall be applied within Water Board programs including:
        - Dredged materials
        - Listing and delisting impaired waterbodies
        - Application in permits as receiving water limits for control of point source discharges
        - Development of management targets as well as some factors to consider in the potential application of targets
    - The technical tools and assessment thresholds associated with this SQO protecting human consumers of resident sportfish from contaminants that bioaccumulate from sediment into fish tissue are only applicable to organochlorine pesticides and polychlorinated biphenyls (PCBs)
    - Assessment for other contaminants of concern would rely on the existing approach to implement this SQO.
- Application and implementation of the SQO protecting benthic communities from direct exposure to pollutants in sediment:
    - Replace the existing frequency based “binomial” approach for listing and delisting of impaired water bodies and exceedance of receiving water limits with an approach based on percent area and category of impact
    - Change the minimum frequency required of Regional Monitoring Programs
    - Corrections to Equation 2 of Sediment Quality Provisions
    - Corrections to polycyclic aromatic hydrocarbon and three organochlorine pesticide values applied to the Chemical Index Score included in Table 6 of Sediment Quality Provisions

Attachment 2
Description of Scientific Conclusions to be Addressed by Peer Reviewers

The State mandate for external scientific peer review (Health and Safety Code Section 57004) states that the reviewer's responsibility is to determine whether the scientific portion of the proposed rule is based upon sound scientific knowledge, methods and practices. We request that you make this determination for each of the following issues that constitute the scientific basis of the proposed regulatory action. An explanatory statement is provided for each issue to focus the review.

A. The proposed assessment framework to assess sediment quality in relation to narrative sediment quality objective (SQO) protecting human consumers from contaminants that bioaccumulate from sediment into fish tissue is appropriate and based on a sound approach and developed using sound scientific information and methods. The specific scientific findings, assumptions and conclusions to be evaluated for their basis in sound scientific knowledge, methods and practices are detailed below

This narrative SQO states: Pollutants shall not be present in sediments at levels that will bioaccumulate in aquatic life to levels that are harmful to human health in bays and estuaries of California. Since adopted by the State in 2008, this SQO has been assessed and evaluated on a case-by-case basis, with little guidance other than a requirement to be based upon a human health risk assessment. Since 2009, the State Water Board's technical team has been developing an assessment framework based on a conceptual approach that addresses two fundamental questions:

- Do contaminants in resident fish tissue pose an unacceptable health risk to humans consuming those fish?

- Are sediment-associated contaminants at the site or area of interest contributing to the contaminant burden in fish tissue?

1. **Evaluation of health risk to humans is based on comparison to tissue contamination thresholds established by the State of California to protect consumers of local fish.** In order to address the first question, the assessment framework requires a comparison of average fish tissue contaminant concentrations to contamination goals and advisory tissue levels used to develop fish tissue consumption advisories for California sportfish derived by the California Environmental Protection Agency's Office of Environmental Health Hazard Assessment (OEHHA). **Suggested Expertise:** Public Health Toxicologist and Environmental Chemist. **Suggested References:** Draft Amendments Tables 16 and 20, Draft Staff Report (Sections 3.2, 4.2.4 and 6.2), OEHHA's Development of Fish Contaminant Goals and Advisory Tissue Levels for Common Contaminants in California Sport Fish, and Bay et al, 2017, Development of Sediment Quality Assessment Framework for Human Health Effects (Section 2.1 thru 2.4)

2. **Health risk evaluation is based solely on fish likely to live within the site of interest and be consumed by the local population.** To ensure the tissue data fulfill the requirements of the assessment framework, only those bay and

estuarine fish species that exhibit some level of site fidelity, consume benthic macrofauna as part of their diet and are commonly consumed by humans are considered in this framework. **Suggested Expertise:** Public Health Toxicologist and Fish Ecologist. **Suggested References:** Draft Amendments Section IV. A.2.b, Appendix A-5 and A-6, Draft Staff Report (Sections 3.2, 4.2.4 and 6.2) and Bay et al, 2017, Development of Sediment Quality Assessment Framework for Human Health Effects (Section 2.1 thru 2.6, 6.1, Appendix 2 and 3)

3. **The relative influence of site sediment contamination on fish contamination is an appropriate indicator of the contribution of site sediment contamination.** In order to address the second question, the assessment framework requires an evaluation of site linkage; the proportion of measured tissue contaminant concentration estimated to result from site sediment contamination, calculated as a ratio of the estimated tissue concentration and the measured tissue concentration. **Suggested Expertise:** Bioaccumulation Modeler, Environmental Chemist. **Suggested References:** Draft Amendments Section IV. A.2.d.1), 2), 4), 5), 6), 7), Tables 18 and 21, Appendix A-5, A-6, A-7 and A-8, Draft Staff Report (Sections 3.2, 6.5.1 thru 6.5.5) and Bay et al, 2017, Development of Sediment Quality Assessment Framework for Human Health Effects (Section 2.1 thru 2.6, 4.2, 6.2, 6.3, 6.4 and Appendix 1) Gobas, Frank and Jon A. Arnot, 2010, Food Web Bioaccumulation Model for Polychlorinated Biphenyls in San Francisco Bay, California, USA. Environmental Toxicology and Chemistry, Vol. 29, No. 6, pp. 1385–1395, 2010

4. **Bioaccumulation modeling is an appropriate method to evaluate site sediment linkage**. Estimated tissue concentrations are obtained using the steady state Gobas Food Web Model, calibrated for eight different feeding guilds. These feeding guilds encompass a variety of fish and their associated dietary preferences within California enclosed bays and estuaries. **Suggested Expertise:** Bioaccumulation Modeler, Fish Ecologist. **Suggested References:** Draft Amendments Section IV. A.2.d.1), 2), 4), 5), 6), 7), Tables 18 and 21, Appendix A-5, A-6, A-7 and A-8, Draft Staff Report (Sections 3.2, 6.5.1 thru 6.5.5) and Bay et al, 2017, Development of Sediment Quality Assessment Framework for Human Health Effects (Section 2.1 thru 2.6, 4.2, 6.2, 6.3, 6.4 and Appendix 1), Gobas, Frank and Jon A. Arnot, 2010, Food Web Bioaccumulation Model for Polychlorinated Biphenyls in San Francisco Bay, California, USA. Environmental Toxicology and Chemistry, Vol. 29, No. 6, pp. 1385–1395, 2010

5. **Site specific and species-specific data are required to assess sediment linkage.** Measured site sediment concentrations, dissolved water concentrations, sediment total organic carbon, fish forage area, and site area represent key bioaccumulation model inputs. **Suggested Expertise:** Bioaccumulation Modeler, Environmental Chemist. **Suggested References:** Draft Amendments Section IV. A.2.d.2) Table 18, Appendix A-5, A-8, Draft Staff Report (Section 6.5.1 thru 6.5.5) and Bay et al, 2017, Development of Sediment Quality Assessment Framework for Human Health Effects (Sections 4.2, 4.3, 4.4 and 4.5, Appendix 1), Ben K Greenfield, Aroon R Melwani, and Steven M Bay (2015), A Tiered Assessment Framework to Evaluate Human Health Risk of Contaminated Sediment, Integrated Environmental Assessment and Management.

6. **The approach, methods and assumptions set forth in the optional Tier 1 Screening Evaluation are appropriate for screening low risk sites or waterbodies.** The assessment framework consists of three tiers to address varying site conditions and situations from the simple (Tier 1) to complex (Tier 3). The optional Tier 1 is a conservative screening evaluation intended to distinguish low risk sites that clearly meet the SQO from those sites that require the full analysis of Tier 2 to make a confident assessment. Tier 1 uses either sediment or tissue data to directly compare tissue concentrations to OEHHA tissue thresholds. A table of model generated biota-sediment accumulation factors is used to convert sediment concentrations to expected tissue concentrations for comparison with tissue thresholds. The two possible outcomes from Tier 1 are Pass (sediment is unimpacted and meets the SQO) or conduct Tier 2 assessment. **Suggested Expertise:** Environmental Risk Assessor, Public Health Toxicologist, and Bioaccumulation Modeler. **Suggested References:** Draft Amendments Section IV. A.2.b, c, e, f, Draft Staff Report (Section 6.3, 6.4, 6.5, 6.6) and Bay et al, 2017, Development of Sediment Quality Assessment Framework for Human Health Effects (Sections 2, 3, 4, 5), Ben K Greenfield, Aroon R Melwani, and Steven M Bay (2015), A Tiered Assessment Framework to Evaluate Human Health Risk of Contaminated Sediment, Integrated Environmental Assessment and Management.

7. **The approach, methods and assumptions set forth in Tiers 2 and 3 are appropriate for designating sites as either impacted or unimpacted.** Tiers 2 and 3 require analysis of both sediment and tissue chemistry data to assess whether site sediments meet or exceed the narrative objective; these tiers differ in the level of standardization and incorporation of site-specific parameters or conditions. A logic matrix is used for Tiers 2 and 3 in order to integrate the outcomes of the two indicators into site categories of Unimpacted, Likely Unimpacted, Possibly Impacted, Likely Impacted and Clearly Impacted. Sediments designated as Unimpacted and Likely Unimpacted meet the SQO, while sediment categorized Possibly Impacted, Likely Impacted and Clearly Impacted do not meet the SQO. **Suggested Expertise:** Environmental Risk Assessor, Public Health Toxicologist. **Suggested References:** Draft Amendments Section IV. A.2.d, e, Draft Staff Report (Section 6.5, 6.6) and Bay et al, 20107, Development of Sediment Quality Assessment Framework for Human Health Effects (Sections 4, 5), Ben K Greenfield, Aroon R Melwani, and Steven M Bay (2015), A Tiered Assessment Framework to Evaluate Human Health Risk of Contaminated Sediment, Integrated Environmental Assessment and Management

B. The proposed approach to designate impaired sediment quality in relation to the SQO protecting benthic communities from direct exposure to contaminants in sediment is appropriate and scientifically sound.

This narrative SQO states: Pollutants in sediments shall not be present in quantities that, alone or in combination, are toxic to benthic communities in bays and estuaries of California. This narrative is assessed by evaluating sediment toxicity, sediment chemistry and biological condition at each station and integrating the responses into station categories consisting of; Unimpacted, Likely Unimpacted, Possibly Impacted, Likely Impacted and Clearly Impacted.

1. **Use of severity of effects and spatial extent is appropriate when evaluating whether sediment dependent beneficial uses are supported in waterbodies.** The State Water Board is proposing a new approach that considers severity (any station classified as clearly impacted) and percent area of impact (stations classified as likely or possibly impacted, not to exceed 15 percent). The State Water Board currently relies on a frequency of exceedance approach based on the binomial statistic that was originally intended for water column applications. **Suggested Expertise:** Environmental Risk Assessor, Environmental Chemist. **Suggested References:** Draft Amendments Section IV. A.4. c. 2) and e.1), Draft Staff Report (Section 6.7.1).

C. Additional Issues related to the big picture

Reviewers are not limited to addressing only the specific conclusions presented above, and are asked to contemplate the following questions:

1. In reading the Draft Staff Report and proposed rule, are there any additional scientific findings, assumptions, or conclusions that are part of the scientific basis of the proposed rule not described above?
2. Taken as a whole, is the scientific portion of the proposed rule based upon sound scientific knowledge, methods, and practices?

Reviewers should also note that some proposed actions may rely significantly on professional judgment where available scientific data are not as extensive as desired to support the statute requirement. In these situations, the proposed course of action is favored over no action. The preceding guidance will ensure that reviewers have an opportunity to comment on all aspects of the scientific basis of the proposed rule.

At the same time, reviewers should recognize that the State Water Board has a legal obligation to consider and respond to all feedback on the scientific portions of the proposed rule. Because of this obligation, reviewers are encouraged to focus feedback on scientific conclusions that are relevant to the central regulatory elements being proposed.

Attachment 3

Persons Associated with the Development of the Draft Provision

State and Regional Water Quality Control Board

Chris Beegan, State Water Board
Mariela Paz Carpio-Obeso, State Water Board
Julie Chan, San Diego Regional Water Board
Katherine Faick, State Water Board
Naomi Feger, San Francisco Bay Regional Water Board
Jason Freshwater, Santa Ana Regional Water Board
Paul Hann, State Water Board
Christine Joab, Central Valley Regional Board
Annalisa Kihara, State Water Board
CP Lai, Los Angeles Regional Water Board
Richard Looker, San Francisco Bay Regional Water Board
Jamie Lu, Central Valley Regional Board
LB Nye, Los Angeles Regional Water Board
Daniel McClure, Central Valley Regional Board
Tom Mumley San Francisco Bay Regional Board
Thanhloan Nguyen, Los Angeles Regional Water Board
Terry Reeder, Santa Ana Regional Water Board
Marleigh Wood, State Water Board
Shana Rapoport, Los Angeles Regional Water Board
Chad Loflen, San Diego Regional Water Board

Technical Team

Mr. Steve Bay, Technical Team Leader, Principal Scientist at Southern California Coastal Water Research Project
Dr. Ben Greenfield, *Southern Illinois University Edwardsville, Edwardsville, IL*
Dr. Aroon Melwani, *Applied Marine Sciences, Livermore, CA* formerly with San Francisco Estuary Institute
Dr. Michael Connor, formerly with San Francisco Estuary Institute
Dr. Doris Vidal Dorsch, formerly with Southern California Coastal Water Research Project
Dr. Ashley Parks, Southern California Coastal Water Research Project
Mr. Darrin Greenstein, Southern California Coastal Water Research Project
Ms. Shelly Moore, Southern California Coastal Water Research Project
Dr. Stephen Weisberg, Southern California Coastal Water Research Project
Ms. Valerie Raco-Rands, *Southern California Coastal Water Research Project, Costa Mesa, CA*

Scientific Steering Committee

Dr. Peter Landrum, Committee Chair: Research Chemist NOAA/Great Lakes (retired) Environmental Research Laboratory, Ann Arbor, MI
Dr. Todd Bridges, Waterways Experiment Station (WES) U.S. Army Corps of Engineers, Engineer Research and Development Center, Vicksburg, MS
Dr. Robert Burgess, U.S. EPA's Office of Research and Development, Narragansett, RI
Dr. Charles Menzie, Exponent Inc.
Dr. Jim Shine, Harvard School of Public Health

Dr. Donna Vorhees, The Science Collaborative-North Shore
Dr. Bruce Hope, CH2MHill, Portland, OR
Dr. Bob Van Dolah, Marine Resources Institute, South Carolina Department of Natural Resources, Charleston, SC.
Tom Gries, Washington Department of Ecology, Olympia, WA.

Scientist consulted on specific issues

Dr. M. James Allen (retired), *Southern California Coastal Water Research Project, Costa Mesa, CA*
Dr. Frank Gobas, Simon Frasier University, British Columbia, Canada
Dr. Jon Arnot, University of Toronto, Ontario, Canada
Dr. Chris Lowe, California State University at Long Beach, California
Dr. Bob Brodberg, CalEPA - Office of Environmental Health Hazard Assessment
Dr. Susan Klasing, CalEPA - Office of Environmental Health Hazard Assessment
Greg Pelletier, Washington Department of Ecology, Olympia, WA
Peter Kozelka, US EPA, Region 9
Terry Fleming, USEPA, Region 9
Lawrence Burkhard, US EPA

Advisory Committee members and interested parties

Brock Bernstein, Committee Chair
Howard Bailey, Nautilus Environmental
Nanette Bailey, Sacramento Regional Sanitation District
Mark Baker, Physis Environmental Labs
Louis Brzuzy, Shell Oil Products
Geremew Amenu, Los Angeles County Department of Public Works
Shelly Anghera, Latitude Environmental, Inc.
Chuck Anthony, Lathum Wakins
Jennifer Arblaster, Environ
Matthew Arms, Port of Long Beach
Scott Bodensteiner, Weston Solutions
Sean Bothwell, California Coastkeeper Alliance
Kevin Buchan, Western State Petroleum Association
Jennifer Casler-Goncalves, Lathum Watkins
Bart Chadwick, SPAWAR, U.S. Navy, San Diego
Sejal Choksi-Chugh, San Francisco Baykeeper
Adrienne Cibor, Nautilus
Stephen Clark, Pacific Ecorisk
Jason Condor, Geosyntec
John Connolly, Anchor QEA
Karen Cowan, Larry Walker and Associates
Molly Coyle, Citrix
Andrea Crumpacker, Weston
Kathryn Curtis, Port of Los Angeles
Elaine Darby, Anchor QEA
Bridgette Deshields, Integral Consulting
Linda Dorn, Sacramento Regional Sanitation District
Tess Dunham Somach, Simmons & Dunn, Sacramento CA
Will Gala, Chevron USA

Karen Gehrts, California Department of Water Resources
Phillip Gibbons, Port of San Diego
David Glaser, Anchor QEA
Molly Gonzalez, Citrix
Rich Gossett, Physis Labs
Sharon Green, Sanitation Districts of Los Angeles County
Joe Gully, Sanitation Districts of Los Angeles County
Sandor Halvax, Southwest Marine
Lisa Haney, Orange County Sanitation District
Ray Hiemstra, Orange County Coast Keeper
Brian Hitchens, Geosyntec Consultants
Sheila Holt, Weston Solutions
Wendy Hovel, Anchor QEA
Emiko Innes, Los Angeles County Public Works
Andrew Jirik, Port of Los Angeles
Scott Johnson, ABC
Ed Kimura, San Diego Sierra Club
Dawn Koepke., McHugh, Koepke and Associates
Ruth Kolb, City of San Diego
Jim Leather, SPAWAR, U.S. Navy, San Diego
Fred Lee, G.Fred Lee and Associates
Chris Lieder, Geosyntec Consultants
Eileen Maher, Port of San Diego
Shokoufe Marashi, City of Los Angeles Department of Public Works
Phil Markle, Sanitation Districts of Los Angeles County
Sandy Mathews, Larry Walker and Associates
Sally Mathison, Sanitation Districts of Los Angeles County
Matt McDonald, Brown and Winters
Eric Miller, MBC
Chris Minton Larry Walker and Associates
Fazi Mofidi, Los Angeles Department of Water and Power
David Moore, formerly Weston, now at Army Corps of Engineers
Taraneh Nik-Khah, City of Los Angeles
Scott Ogle, Pacific Ecorisk
Marilyn O'Neill, Nautilus
Jeff Orrell, Brown and Winters
Steven Overman, Shell oil Products
Susan Paulsen, Exponent
Jian Peng, Orange County Public Works
Renee Pinel, Western Plant Health Association
Ying Poon, Everest Environmental Consultants
John Prall, Port of Oakland
Dan Riordan, California Department of Water Resources
Bonnie Rogers, U.S. Army Corps of Engineers
John Rudolph, AMEC
Jeff Sickenger, KP
Paul Singarella, Latham Watkins
Barry Snyder, AMEC

Chris Stransky, AMEC
Curtis Swanson, Central Contra Costa Sanitation District
Kelly Tait, Port of San Diego
Chi-Li Tang, Sanitation Districts of Los Angeles County
Jeanette Thomas, Stockton East Water District
William Thomas, S. San J. Valley Water Qual. Coal
Usha Vedagiri, URS Corporation
James Vernon, Port of Long Beach
Lysa Voight, Sacramento Regional Sanitation District
Dan Waligora, California Department of Fish and Wildlife
Jo Ann Weber, County of San Diego
John Wolfe, LimnoTech
Gary Wortham, Tetra Tech
Ian Wren, San Francisco Baykeeper
Matt Yeager, CASQA
Vada Yoon, Anchor QEA
Clayton Yoshida, Los Angeles Department of Water and Power
Charlie Yu, City of Los Angeles

Attachment 4
List of References
Relied Upon to Prepare Staff Report

Arnot, J.A. and F.A.P.C. Gobas. 2004. A food web bioaccumulation model for organic chemicals in aquatic ecosystems. *Environmental Toxicology and Chemistry* 23:2343-2355.

Barber, M. C. 2008. Dietary uptake models used for modeling the bioaccumulation of organic contaminants in fish. Environmental Toxicology and Chemistry **27**:755-777.

Bay, S.M, B. Greenfield, and A.N. Parks. 2017. Development of a Sediment Quality Assessment Framework for Human Health Effects. Technical Report. Southern California Coastal Water Research Project. Costa Mesa, CA.

Bay, Steven M, Darrin J. Greenstein, Ashley Parks, David Gillett and Shelly Anghera, 2016, Final Report Marina Del Ray Harbor Sediment Stressor Identification Study

Bight '13 Contaminant Impact Assessment Planning Committee, Southern California Bight 2013 Regional Monitoring Program: Volume VIII. Contaminant Impact Assessment Synthesis Report, SCCWRP Technical Report 973

Brown, Jeffrey and Steven Bay, 2011 Temporal Assessment of Chemistry, Toxicity and Benthic Communities in Sediments at the Mouths of Chollas Creek and Paleta Creek, San Diego Bay *Southern California Coastal Water Research Project Technical Report 668*

Burkhard, L.P., P.M. Cook, and M.T. Lukasewycz. 2010. Direct application of biota-sediment accumulation factors. *Environmental Toxicology and Chemistry* 29:230-236.

Gobas, F.A.P.C. and J. Arnot. 2010. Food web bioaccumulation model for polychlorinated biphenyls in San Francisco Bay, California, USA. *Environmental Toxicology and Chemistry* 29:1385-1395.

Kim, J., F.A.P.C Gobas, J.A. Arnot, D.E. Powell, R.M. Seston, and K.B. Woodburn. 2016. Evaluating the roles of biotransformation, spatial concentration differences, organism home range, and field sampling design on trophic magnification factors. Science of the Total Environment 551-552:438-451.

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February 8, 2018

Gary A. Buchanan, Ph.D.
Director, Division of Science, Research, and Environmental Health
New Jersey Department of Environmental Protection
Mail code 428-01, P.O. Box 420
Trenton, NJ 08625

SUBJECT: INITIATION OF EXTERNAL PEER REVIEW OF PROPOSED REVISIONS TO SEDIMENT QUALITY PROVISIONS CONTAINED IN THE WATER QUALITY CONTROL PLAN FOR ENCLOSED BAYS AND ESTUARIES OF CALIFORNIA

Dear Dr. Buchanan,

The purpose of this letter is to initiate the external review.

The State Water Resources Control Board - Division of Water Quality will receive reviewers' comments and curriculum vitae from me after the review has concluded, and not be a party to the process.

Documents for review are being provided through a secure FTP site. Sections I and II below give instructions for accessing the FTP site and list the documents on the site.

You can access this site through the one month period of review. The URL, username and password are as follows:

I. https://ftp.waterboards.ca.gov/

Username: PRFTP2

Password: 2rMEa7

II. List of Documents at FTP site:

A. January 5, 2018 Memorandum signed by Paul Hann, : "Request for an External Peer Review of Proposed Revisions to Sediment Quality Provisions contained in the Water Quality Control Plan for Enclosed Bays and Estuaries of California."

Attachment 1: Summary of the Proposed Revisions.

Attachment 2: Description of Scientific Conclusions to be addressed by Peer Reviewers.

These are the focus for the review. You indicated in a January 31, 2018 communication that you would be able to address in particular Conclusions A6, A7, and B1 with confidence. (The Conclusions are described in Attachment 2 of the January 5, 2018 request for peer review to me). Please do so. You noted you could also address A5, if needed. That would be appreciated. I recommend distinguishing the comments that are presented with confidence from those based on perhaps less knowledge. This distinction could be presented in an introductory preface.

Attachment 3: List of People Involved in development of the revisions.

Attachment 4: List of References relied upon for Staff Report.

Attachment 5: Draft Staff Report and Substitute Environmental Documentation.

Attachment 6: Proposed Amendments in Underline/Strikeout

Attachment 7: Steven M. Bay, Ashley N. Parks, Aroon R. Melwani, and Ben K. Greenfield (2017), Development of a Sediment Quality Assessment Framework for Human Health Effects Southern California Coastal Water Research Project Technical Report 1000

Attachment 8: Ben K Greenfield, Aroon R Melwani, and Steven M Bay (2015), A Tiered Assessment Framework to Evaluate Human Health Risk of Contaminated Sediment, Integrated Environmental Assessment and Management.

Attachment 9: Gobas, Frank and Jon A. Arnot, 2010. Food Web Bioaccumulation Model for Polychlorinated Biphenyls in San Francisco Bay, California, USA. Environmental Toxicology and Chemistry, Vol. 29, No. 6, pp. 1385–1395, 2010

Attachment 10: Office of Environmental Health Hazard Assessment (2008), Development of Fish Contaminant Goals and Advisory Tissue Levels for Common Contaminants in California Sport Fish: Chlordane, DDTs, Dieldrin, Methylmercury, PCBs, Selenium, and Toxaphene. June 2008. Authors Susan Klasing and Robert Brodberg

B. Copies of references cited in Appendix A-8 of Proposed Amendments.

C. January 7, 2009 Supplement to the CalEPA Peer Review Guidelines. This Supplement provides guidance to ensure the review is kept confidential through its course. The Supplement notes reviewers are under no obligation to discuss their comments with third-parties after reviews have been submitted. We recommend they do not. All outside parties are provided opportunities to address a proposed regulatory action through a well-defined regulatory process. Please direct third parties to me.

Please send your review to me on March 8, 2018 at the latest, or before if you can accommodate this schedule.

Questions about the review should be for clarification, in writing – email is fine, and addressed to me. My responses will be in writing also. All this information will be posted at the Water Boards program web site for this proposal. Your acceptance of this review assignment is most appreciated.

Questions about the review should be for clarification, in writing – email is fine, and addressed to me. My responses will be in writing also. All this information will be posted at the Water Boards program web site for this proposal, and at the State and Regional Water Boards' statewide peer review web site. Your acceptance of this review assignment is most appreciated.

Sincerely,

Gerald W. Bowes

Gerald W. Bowes, Ph.D.
Manager, Cal/EPA Scientific Peer Review Program
Office of Research, Planning and Performance
State Water Resources Control Board
1001 "I" Street, MS-16B
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February 20, 2018

Elaine M. Faustman, Ph.D.
Professor, Dept. of Env. & Occ. Health Sciences
School of Public Health
University of Washington
4225 Roosevelt Way NE
Seattle, WA 98105

SUBJECT: INITIATION OF EXTERNAL PEER REVIEW OF PROPOSED REVISIONS TO SEDIMENT QUALITY PROVISIONS CONTAINED IN THE WATER QUALITY CONTROL PLAN FOR ENCLOSED BAYS AND ESTUARIES OF CALIFORNIA

Dear Prof. Faustman,

The purpose of this letter is to initiate the above-named external review.

The State Water Resources Control Board - Division of Water Quality will receive reviewers' comments and curriculum vitae from me after the review has concluded, and not be a party to the process.

Documents for review are being provided through a secure FTP site. Sections I and II below give instructions for accessing the FTP site and list the documents on the site.

You can access this site through the one month period of review. The URL, username and password are as follows:

I. https://ftp.waterboards.ca.gov/

Username: PRFTP2

Password: 2rMEa7

II. List of Documents at FTP site:

A. January 5, 2018 Memorandum signed by Paul Hann, : "Request for an External Peer Review of Proposed Revisions to Sediment Quality Provisions contained in the Water Quality Control Plan for Enclosed Bays and Estuaries of California."

Attachment 1: Summary of the Proposed Revisions.

Attachment 2: Description of Scientific Conclusions to be addressed by Peer Reviewers.

These are the focus for the review. You indicated in your February 10, 2018 email that you would be able to address in particular Conclusions A1 and A2 with confidence. (Both Conclusions are described in Attachment 2 of the January 5, 2018 request for peer review available on the FTP site).

Attachment 3: List of People Involved in development of the revisions.

Attachment 4: List of References relied upon for Staff Report.

Attachment 5: Draft Staff Report and Substitute Environmental Documentation.

Attachment 6: Proposed Amendments in Underline/Strikeout

Attachment 7: Steven M. Bay, Ashley N. Parks, Aroon R. Melwani, and Ben K. Greenfield (2017), Development of a Sediment Quality Assessment Framework for Human Health Effects Southern California Coastal Water Research Project Technical Report 1000

Attachment 8: Ben K Greenfield, Aroon R Melwani, and Steven M Bay (2015), A Tiered Assessment Framework to Evaluate Human Health Risk of Contaminated Sediment, Integrated Environmental Assessment and Management.

Attachment 9: Gobas, Frank and Jon A. Arnot, 2010. Food Web Bioaccumulation Model for Polychlorinated Biphenyls in San Francisco Bay, California, USA. Environmental Toxicology and Chemistry, Vol. 29, No. 6, pp. 1385–1395, 2010

Attachment 10: Office of Environmental Health Hazard Assessment (2008), Development of Fish Contaminant Goals and Advisory Tissue Levels for Common Contaminants in California Sport Fish: Chlordane, DDTs, Dieldrin, Methylmercury, PCBs, Selenium, and Toxaphene. June 2008. Authors Susan Klasing and Robert Brodberg

B. Copies of references cited in Appendix A-8 of Proposed Amendments.

C. January 7, 2009 Supplement to the CalEPA Peer Review Guidelines. This Supplement provides guidance to ensure the review is kept confidential through its course. The Supplement notes reviewers are under no obligation to discuss their comments with third-parties after reviews have been submitted. We recommend they do not. All outside parties are provided opportunities to address a proposed regulatory action through a well-defined regulatory process. Please direct third parties to me.

Please send your review to me on Tuesday, March 20, 2018 at the latest, or before if you can accommodate this schedule. Questions about the review should be for clarification, in writing – email is fine, and addressed to me. My responses will be in writing also. All this information will be posted at the Water Boards program web site for this proposal, and at the State and Regional Water Boards' statewide peer review web site. Your acceptance of this review assignment is most appreciated.

Thank you for your participation in this important peer review.

Sincerely,

Gerald W. Bowes

Gerald W. Bowes, Ph.D.
Manager, Cal/EPA Scientific Peer Review Program
Office of Research, Planning and Performance
State Water Resources Control Board
1001 "I" Street, MS-16B
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February 8, 2018

Valery E. Forbes, Ph.D.
Dean, College of Biological Sciences
University of Minnesota
123 Snyder Hall
1475 Gortner Avenue
St. Paul, MN 55108

SUBJECT: INITIATION OF EXTERNAL PEER REVIEW OF PROPOSED REVISIONS TO SEDIMENT QUALITY PROVISIONS CONTAINED IN THE WATER QUALITY CONTROL PLAN FOR ENCLOSED BAYS AND ESTUARIES OF CALIFORNIA

Dear Dean Forbes,

The purpose of this letter is to initiate the external review.

The State Water Resources Control Board - Division of Water Quality will receive reviewers' comments and curriculum vitae from me after the review has concluded, and not be a party to the process.

Documents for review are being provided through a secure FTP site. Sections I and II below give instructions for accessing the FTP site and list the documents on the site.

You can access this site through the one month period of review. The URL, username and password are as follows:

I. https://ftp.waterboards.ca.gov/

Username: PRFTP2

Password: 2rMEa7

II. List of Documents at FTP site:

A. January 5, 2018 Memorandum signed by Paul Hann, : "Request for an External Peer Review of Proposed Revisions to Sediment Quality Provisions contained in the Water Quality Control Plan for Enclosed Bays and Estuaries of California."

Attachment 1: Summary of the Proposed Revisions.

Attachment 2: Description of Scientific Conclusions to be addressed by Peer Reviewers.

These are the focus for the review. You indicated in a January 25, 2018 communication that you would be able to address in particular Conclusions A6 and A7 with confidence. (Both Conclusions are described in Attachment 2 of the January 5, 2018 request for peer review to me). Please do so. Feel free also to address A3, A4, A5, and B1 for which you indicated knowledge. I recommend distinguishing the two groups of comments in this context in a preface preceding your review comments.

Attachment 3: List of People Involved in development of the revisions.

Attachment 4: List of References relied upon for Staff Report.

Attachment 5: Draft Staff Report and Substitute Environmental Documentation.

Attachment 6: Proposed Amendments in Underline/Strikeout

Attachment 7: Steven M. Bay, Ashley N. Parks, Aroon R. Melwani, and Ben K. Greenfield (2017), Development of a Sediment Quality Assessment Framework for Human Health Effects Southern California Coastal Water Research Project Technical Report 1000

Attachment 8: Ben K Greenfield, Aroon R Melwani, and Steven M Bay (2015), A Tiered Assessment Framework to Evaluate Human Health Risk of Contaminated Sediment, Integrated Environmental Assessment and Management.

Attachment 9: Gobas, Frank and Jon A. Arnot, 2010. Food Web Bioaccumulation Model for Polychlorinated Biphenyls in San Francisco Bay, California, USA. Environmental Toxicology and Chemistry, Vol. 29, No. 6, pp. 1385–1395, 2010

Attachment 10: Office of Environmental Health Hazard Assessment (2008), Development of Fish Contaminant Goals and Advisory Tissue Levels for Common Contaminants in California Sport Fish: Chlordane, DDTs, Dieldrin, Methylmercury, PCBs, Selenium, and Toxaphene. June 2008. Authors Susan Klasing and Robert Brodberg

B. Copies of references cited in Appendix A-8 of Proposed Amendments.

C. January 7, 2009 Supplement to the CalEPA Peer Review Guidelines. This Supplement provides guidance to ensure the review is kept confidential through its course. The Supplement notes reviewers are under no obligation to discuss their comments with third-parties after reviews have been submitted. We recommend they do not. All outside parties are provided opportunities to address a proposed regulatory action through a well-defined regulatory process. Please direct third parties to me.

Please send your review to me on March 8, 2018 at the latest, or before if you can accommodate this schedule.

Questions about the review should be for clarification, in writing – email is fine, and addressed to me. My responses will be in writing also. All this information will be posted at the Water Boards program web site for this proposal. Your acceptance of this review assignment is most appreciated.

Questions about the review should be for clarification, in writing – email is fine, and addressed to me. My responses will be in writing also. All this information will be posted at the Water Boards program web site for this proposal, and at the State and Regional Water Boards' statewide peer review web site. Your acceptance of this review assignment is most appreciated.

Sincerely,

Gerald W. Bowes, Ph.D.
Manager, Cal/EPA Scientific Peer Review Program
Office of Research, Planning and Performance
State Water Resources Control Board
1001 "I" Street, MS-16B
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February 8, 2018

Robert Letcher, Ph.D.
Adjunct Research Professor
Departments of Biology and Chemistry
Carleton University
1125 Colonel By Drive (Raven Road)
Ottawa, ON Canada K1A 0H3

SUBJECT: INITIATION OF EXTERNAL PEER REVIEW OF PROPOSED REVISIONS TO SEDIMENT QUALITY PROVISIONS CONTAINED IN THE WATER QUALITY CONTROL PLAN FOR ENCLOSED BAYS AND ESTUARIES OF CALIFORNIA

Dear Professor Letcher,

The purpose of this letter is to initiate the external review.

The State Water Resources Control Board - Division of Water Quality will receive reviewers' comments and curriculum vitae from me after the review has concluded, and not be a party to the process.

Documents for review are being provided through a secure FTP site. Sections I and II below give instructions for accessing the FTP site and list the documents on the site.

You can access this site through the one month period of review. The URL, username and password are as follows:

I. https://ftp.waterboards.ca.gov/

Username: PRFTP2

Password: 2rMEa7

II. List of Documents at FTP site:

A. January 5, 2018 Memorandum signed by Paul Hann, : "Request for an External Peer Review of Proposed Revisions to Sediment Quality Provisions contained in the Water Quality Control Plan for Enclosed Bays and Estuaries of California."

Attachment 1: Summary of the Proposed Revisions.

Attachment 2: Description of Scientific Conclusions to be addressed by Peer Reviewers.

These are the focus for the review. You indicated in a February 2, 2018 communication that you would be able to address in particular Conclusions A3, A4, A5, A6, A7, and B1, with confidence and insight. (The Conclusions are described in Attachment 2 of the January 5, 2018 request for peer review to me). Please do so. Feel free also to address the Big Picture considerations.

Attachment 3: List of People Involved in development of the revisions.

Attachment 4: List of References relied upon for Staff Report.

Attachment 5: Draft Staff Report and Substitute Environmental Documentation.

Attachment 6: Proposed Amendments in Underline/Strikeout

Attachment 7: Steven M. Bay, Ashley N. Parks, Aroon R. Melwani, and Ben K. Greenfield (2017), Development of a Sediment Quality Assessment Framework for Human Health Effects Southern California Coastal Water Research Project Technical Report 1000

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Attachment 10: Office of Environmental Health Hazard Assessment (2008), Development of Fish Contaminant Goals and Advisory Tissue Levels for Common Contaminants in California Sport Fish: Chlordane, DDTs, Dieldrin, Methylmercury, PCBs, Selenium, and Toxaphene. June 2008. Authors Susan Klasing and Robert Brodberg

B. Copies of references cited in Appendix A-8 of Proposed Amendments.

C. January 7, 2009 Supplement to the CalEPA Peer Review Guidelines. This Supplement provides guidance to ensure the review is kept confidential through its course. The Supplement notes reviewers are under no obligation to discuss their comments with third-parties after reviews have been submitted. We recommend they do not. All outside parties are provided opportunities to address a proposed regulatory action through a well-defined regulatory process. Please direct third parties to me.

Please send your review to me on March 8, 2018 at the latest, or before if you can accommodate this schedule.

Questions about the review should be for clarification, in writing – email is fine, and addressed to me. My responses will be in writing also. All this information will be posted at the Water Boards program web site for this proposal. Your acceptance of this review assignment is most appreciated.

Questions about the review should be for clarification, in writing – email is fine, and addressed to me. My responses will be in writing also. All this information will be posted at the Water Boards program web site for this proposal, and at the State and Regional Water Boards' statewide peer review web site. Your acceptance of this review assignment is most appreciated.

Sincerely,

Gerald W. Bowes

Gerald W. Bowes, Ph.D.
Manager, Cal/EPA Scientific Peer Review Program
Office of Research, Planning and Performance
State Water Resources Control Board
1001 "I" Street, MS-16B
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January 7, 2009

Supplement to Cal/EPA External Scientific Peer Review Guidelines – "Exhibit F" in Cal/EPA Interagency Agreement with University of California Gerald W. Bowes, Ph.D.

Guidance to Staff:

1. Revisions. If you have revised any part of the initial request, please stamp "Revised" on each page where a change has been made, and the date of the change. Clearly describe the revision in the cover letter to reviewers, which transmits the material to be reviewed. The approved reviewers have seen your original request letter and attachments during the solicitation process, and must be made aware of changes.

2. Documents requiring review. All important scientific underpinnings of a proposed science-based rule must be submitted for external peer review. The underpinnings would include all publications (including conference proceedings), reports, and raw data upon which the proposal is based. If there is a question about the value of a particular document, or parts of a document, I should be contacted.

3. Documents not requiring review. The Cal/EPA External Peer Review Guidelines note that there are circumstances where external peer review of supporting scientific documents is not required. An example would be "A particular work product that has been peer reviewed with a known record by a recognized expert or expert body." I would treat this allowance with caution. If you have any doubt about the quality of such external review, or of the reviewers' independence and objectivity, that work product – which could be a component of the proposal - should be provided to the reviewers.

4. Implementation review. Publications which have a solid peer review record, such as a US EPA Criteria document, do not always include an implementation strategy. The Cal/EPA Guidelines require that the implementation of the scientific components of a proposal, or other initiative, must be submitted for external review.

5. Identity of external reviewers. External reviewers should not be informed about the identity of other external reviewers. Our goal has always been to solicit truly independent comments from each reviewer. Allowing the reviewers to know the identity of others sets up the potential for discussions between them that could devalue the independence of the reviews.

6. Panel Formation. Formation of reviewer panels is not appropriate. Panels can take on the appearance of scientific advisory committees and the external reviewers identified through the Cal/EPA process are not to be used as scientific advisors.

7. Conference calls with reviewers. Conference calls with one or more reviewers can be interpreted as seeking collaborative scientific input instead of critical review. Conference calls with reviewers are not allowed.

Guidance to Reviewers from Staff:

1. Discussion of review.

   Reviewers are not allowed to discuss the proposal with individuals who participated in development of the proposal. These individuals are listed in Attachment 3 of the review request.

   Discussions between staff and reviewers are not permitted. Reviewers may request clarification of certain aspects of the review process or the documents sent to them.

   Clarification questions and responses must be in writing. Clarification questions about reviewers' comments by staff and others affiliated with the organization requesting the review, and the responses to them, also must be in writing. These communications will become part of the administrative record.

   The organization requesting independent review should be careful that organization-reviewer communications do not become collaboration, or are perceived by others to have become so. The reviewers are not technical advisors. As such, they would be considered participants in the development of the proposal, and would not be considered by the University of California as external reviewers for future revisions of this or related proposals. The statute requiring external review of science-based rules proposed by Cal/EPA organizations prohibits participants serving as peer reviewers..

2. Disclosure of reviewer Identity and release of review comments.

   Confidentiality begins at the point a potential candidate is contacted by the University of California. Candidates who agree to complete the conflict of interest disclosure form should keep this matter confidential, and should not inform others about their possible role as reviewer.

   Reviewer identity may be kept confidential until review comments are received by the organization that requested the review. After the comments are received, reviewer identity and comments must be made available to anyone requesting them.

   Reviewers are under no obligation to disclose their identity to anyone enquiring. It is recommended reviewers keep their role confidential until after their reviews have been submitted.

3. Requests to reviewers by third parties to discuss comments.

   After they have submitted their reviews, reviewers may be approached by third parties representing special interests, the press, or by colleagues. Reviewers are under no obligation to discuss their comments with them, and we recommend that they do not.

   All outside parties are provided an opportunity to address a proposed regulatory action during the public comment period and at the Cal/EPA organization meeting where the proposal is considered for adoption. Discussions outside these provided avenues for comment could seriously impede the orderly process for vetting the proposal under consideration.

4. Reviewer contact information.

The reviewer's name and professional affiliation should accompany each review. Home address and other personal contact information are considered confidential and should not be part of the comment submittal.

Gary A. Buchanan, Ph.D.

New Jersey Department of Environmental Protection
Division of Science, Research and Environmental Health
P.O. Box 420
Trenton, NJ 08625-0420

EDUCATION

Ph.D., Environmental Science - Rutgers University (1995)
M.A., Biology - Montclair State College (1983)
B.S., Biology - Montclair State College (1978)

AWARDS

State of New Jersey Professional Achievement Award, NJDEP, 2008

EMPLOYMENT HISTORY

5/2015 – Present	Director (Manager 1), Division of Science, Research and Environmental Health, New Jersey Department of Environmental Protection
4/2009 – 4/2015	Manager (Manager 3), Office of Science, NJDEP
6/2004 – 4/2009	Bureau Chief (Manager 4), Bureau of Natural Resources Science, Division of Science, Research & Technology, NJDEP
11/2002 – 4/2004	Research Scientist 1, Bureau of Risk Analysis, DSRT, NJDEP
3/1999 – 11/2002	Research Scientist (unclassified), Bureau of Risk Analysis, DSRT, NJDEP
1990 – 3/1999	Senior Section Manager/Principal Project Manager, Roy F. Weston, Inc., Edison, NJ
1985 - 1990	Senior Scientist/Project Manager, IT Corporation, Edison, NJ
1984 - 1985	Aquatic Biologist/Field Supervisor, Princeton Aqua Science, N. Brunswick, NJ
1984	Lead Fisheries Biologist, New Jersey Marine Sciences Consortium, Jersey City, NJ
1983	Environmental Technician, Ecological Analysts, Inc., Roseton, NY
1978-1980	Field/Laboratory Technician, Montclair State College, Upper Montclair, NJ

PROFESSIONAL ASSOCIATIONS

Society of Environmental Toxicology and Chemistry (SETAC), Member (1989 - present)
Hudson Delaware Chapter, SETAC, Board Member (2015 - present)
Coastal Education & Research Foundation, Inc. (CERF), Member (2017- present)

PROFESSIONAL SUMMARY

- More than **35 years** of technical, personnel, and project management experience.
- Directly managed more than 45 environmental field projects; managed technical groups that completed more than **300 environmental projects**.
- Nine years as Director of the NJDEP's Division of Science, Research & Environmental Health/Office of Science. Directs, coordinates and administers the science and research programs,

activities, & staff including the Bureau of Risk Analysis, the Bureau of Environmental Assessment and the Environment & Health Assessment Program.

- Twelve years managing and conducting hazardous waste site investigations under RCRA and Superfund including ecological/biological assessments, risk assessments, remediation, contaminant fate and transport, and providing technical support to USEPA (Environmental Response Team and Region 2).
- Research interests include bioaccumulation of contaminants from sediments, fish biomarkers, contaminants of emerging concern, and concentrations and trends of contaminants in fish tissue including mercury, PCBs, dioxins/furans and other organic chemicals.

CREDENTIALS

- Certified Associate Fisheries Scientist: American Fisheries Society (1986)
- OSHA 40-hr Health and Safety Training Certification, U.S. EPA (1987)
- Certified SCUBA Diver, N.A.U.I.
- Bayesian Monte Carlo Analysis in Ecological Risk Assessment
- Wetland Classification: U.S. Fish & Wildlife Service
- Principles and Techniques of Electrofishing: U.S. Fish & Wildlife Service
- Understanding Contaminated Sediment - University of Wisconsin-Madison, College of Engineering
- Water Quality Modeling – Sediment Contamination and Remediation of Toxic Organic Contaminants and Metals. 56th Institute in Water Pollution Control, Manhattan College, 2011.

RELEVANT EXPERIENCE

Response, Engineering and Analytical Contract (REAC) for U.S. EPA, Biology Group Leader.
Supervised a staff of up to 7 biologists in performing ecological/biological assessments and investigations at hazardous waste sites. Projects included wetland delineations, habitat surveys, wildlife observations/species lists, fishery investigations, benthic invertebrate collections, small mammal trapping, plant community assessments, tissue analysis, histopathological studies, and other biological data collection activities. Responsible for program and personnel development to meet the needs of EPA in determining impacts and risks of hazardous waste sites on the environment. Successfully managed and directed more than 30 projects at sites across the country.

Routine Monitoring Program for Fish, Co-Project Manager, NJDEP. The primary objectives of the monitoring program are to: 1) Provide current and more comprehensive data on concentrations of toxic contaminants in fish and shellfish, in order to assess human health risks and thus update/recommend fish consumption advisories; and 2) Provide data to develop environmental indicators to assess the progress of environmental management actions. Dr. Buchanan's responsibilites include project coordination, data analysis and report preparation, as well as occasional electrofishing.

Interstate Technology & Regulatory Council (ITRC) – Sediment Contaminant Bioavailability Alliance (SCBA) Regulatory Advisory Team, Member, NJDEP. One of five state members on this national team that examined the bioavailability and toxicity of PAHs in sediment based on new methods proposed by the SCBA. Examined science and risk basis for the methods, coordinated with regulatory staff at NJDEP and participated in several meetings held around the country. Examined potential regulatory and policy implications of using new methods. Made recommendations for additional data collection and analysis.

Interagency Toxics in Biota Committee, NJDEP, Chair, 2000-Present. Oversees this interagency committee consisting of NJDEP, NJDOH, and NJ Department of Agriculture; responsible for review and summary of data regarding the presence of toxic substances detected in biota in New Jersey; providing guidance on procedures for the collection, processing and analysis of biota tissue samples; development of recommended procedures and preparation of technical assessments for assessing the human health risk associated with the consumption of contaminated biota harvested in New Jersey; recommendation of possible management actions; and updating of fish advisories contained in the public information materials. Reviewed and statistically analyzed tissue contaminant data, and developed revisions to fish consumption advisories for management review and approval.

Marathon Battery Superfund Site, Foundry Cove, New York, Client - New York State Department of Environmental Conservation, Field Supervisor. Assisted in managing extensive field operations during an RI/FS investigation of the Superfund site at Foundry Cove, New York. This involved biological sampling of benthic invertebrates, fish, turtles, ducks and vegetation, as well as bioaccumulation studies using caged fish and invertebrates for contaminant analysis. Sediment surface and core sample collection, data analysis, report preparation, and risk assessment concerning the impacts of cadmium, nickel, and cobalt wastes on all the trophic levels of a Hudson River tidal **wetland.**

Biological Assessment, Soda Butte Creek, Montana, Client - U.S. EPA, Project Manager. Designed, performed, and directed a bioassessment of a mine tailings pile upon a Montana stream tributary to Yellowstone National Park. Conducted **sediment quality triad** testing including benthic invertebrate sampling and community analysis, sediment sampling for chemical analysis, and acute and chronic toxicity testing, as well as water and soil chemical analysis, and small mammal trapping. Examined impacts of the acid mine drainage on benthic invertebrates and fish species including the cutthroat trout *(Salmo clarki)* and rainbow trout *(Oncorhynchus mykiss).*

Dredging Assessment, Bayou Bonfouca, LA, Client - U.S. EPA, Project Manager. Managed and conducted this assessment of the effects of dredging creosote contaminated sediment on the surrounding water quality. As part of a Superfund remedial action, EPA was removing contaminated sediments from this site to reduce impacts to the environment. Project involved water quality monitoring, water sampling, and toxicity testing to determine the presence and extent of impacts during dredging operations. Quick turnaround results were used to determine that containment measures (i.e., silt curtain) were effective in minimizing water quality impacts adjacent to the dredging area.

Sullivan's Ledge Superfund Site, New Bedford, Massachusetts, Client - USEPA, Project Manager.
Investigated the impacts of a PCB-contaminated wetland in Massachusetts upon the biological community. Water, sediment, mammal, invertebrate, and plant tissues were analyzed. The study was designed to examine uptake, bioaccumulation, PCB effects, and food chain impacts to the biota of the marsh. Another concern was to determine the minimum area to be remediated to minimize the impacts of remedial efforts on the environment and wildlife.

Organization Group Member and Lead of the Data Work Group, NJDEP: for the Feasibility of a Coastal Advisory for Consumption of Striped Bass and Bluefish Based on PCBs. This multi-state effort involved state agencies from Maine to Florida along with federal agency input including USEPA, FDA and NOAA.

- Directed and assisted with development of the data chapter on levels of PCBs in fish coastwide.
- Assisted in editing the report, and finalizing report recommendations and conclusions

Harbor Estuary Program (HEP), Ecotoxicologist, NJDEP. Responsible for technical support of the New York-New Jersey Harbor Estuary Program including:

- Ecotoxicologist on the NJ Toxics Reduction Work Plan – provide technical support for this complex multi-phased $8 million source trackdown project for contaminated sediment.

- Member of the Toxics Work Group – completed ecotoxicological assessments for lead and tributyltin for the harbor.

Research Project, **Bioaccumulation Factors for Ecological Risk Assessment, Project Manager, NJDEP.** In ecological risk assessments, bioaccumulation factors (BAFs) are used in terrestrial exposure models to calculate doses of contaminants that would be available to small mammal and avian species. This two-phased research project provided data on New Jersey-specific bioaccumulation factors for a number of soil contaminants and soil types. This data greatly enhanced the risk assessment process and the ability of the Site Remediation Program to determine adverse ecological effects at contaminated sites in the State. The data were used to ensure that remediation of sites is protective of ecological receptors and resources.

NJ Comparative Risk Project, Ecological Quality Technical Work Group, Chair and Technical Author, NJDEP. Organized and managed this technical work group investigating the comparative risk of the impacts of stressors to ecological quality within New Jersey's ecosystems. The work group, including DEP and **external scientists**, developed more than 70 risk assessments examining inorganic and organic contaminants, radiation, invasive species, microorganisms, overuse of natural resources, and physical transformations of the land/waterscape. Authored or co-authored several assessments including mercury, Asian longhorned beetle, tin, and others.

Natural Resource Investigations, Water Quality Studies, Wetland Studies, Environmental Assessments, and Ecological Studies, Senior Project Scientist, Various Locations/Clients: Performed ecological surveys and characterizations for several proposed development sites on the estuarine Hudson River waterfront. Tasks included benthic invertebrate and fish sampling, biota identification, data analysis, and report preparation. Assisted in numerous lake and pond ecological studies involving lake and watershed management, lake restoration in New York, New Jersey, Massachusetts, and Pennsylvania. Studies included fishery, plankton, and benthic invertebrate surveys, water quality and sediment sampling, watershed characterization, bathymetric surveys, stormwater sampling, and hydrology investigations. Also:

- Conducted an extensive transect survey of benthic invertebrates in the Delaware River and Bay. Tasks included field sampling, laboratory identification, and population density estimates.
- Conducted a field investigation of a creosote-contaminated wetland in Virginia to determine cleanup criteria based on chemical and toxicity testing data.
- Completed a bioassessment of a Wisconsin wetland near an electroplating plant discharge. Assisted in the determination of cleanup criteria, based on chemical and toxicity testing data.

PEER REVIEW

- Archives of Environmental Contamination and Toxicology
- Environmental Science & Technology
- Journal of Coastal Research
- Science of the Total Environment

SELECT PRESENTATIONS, REPORTS AND PUBLICATIONS

Gary A. Buchanan, Anne Hayton, Greg Neumann and Dan Millemann. 2016. *Review of Sediment Remedial Caps: Types, Goals and Long-Term Monitoring Programs*. Poster presented at the Passaic River Symposium VII, October 2016, Montclair, NJ.

Pflugh, K.K, A. H. Stern, L. Nesposudny, L. Lurig, B. Ruppel & G. A. Buchanan. 2011. *Consumption Patterns and Risk Assessment of Crab Consumers from the Newark Bay Complex, New Jersey, U.S.A.* Science of the Total Environment (2011), doi:10.1016/j.scitotenv.2011.07.017.

Stern, A.H., G. B. Post, G. A. Buchanan, L. R. Korn, and B. Ruppel. 2010. *Estimated Lifetime Cancer Risk from Dioxin Contamination in Commonly Consumed Fish and Crabs from New Jersey Waters*, Final Report. Submitted to: Cancer Institute of New Jersey. Office of Science, NJDEP, Trenton, NJ.

Buchanan, G.A. 2009. *Human Health Water Quality Criterion for Mercury Based on Fish Tissue Concentrations.* Presented at the Federal–State Toxicology and Risk Analysis Committee (FSTRAC) meeting, October 21-23, 2009, Princeton, NJ.

Buchanan, G. A. and K. R. Cooper. 2008. Integrated Biomarkers for Assessing the Exposure and Effects of Endocrine Disruptors and Other Contaminants on Marine/Estuary Fish, Research Project Summary. NJDEP Division of Science, Research & Technology. http://www.state.nj.us/dep/dsr/ecological/integrated-biomakers.pdf

Buchanan, G.A. & N. Hamill. 2008. *Overview of NJDEP's Use of Fish and Wildlife Tissue Residues in Regulatory & Advisory Programs*. Invited speaker, Hudson-Delaware Chapter of the Society of Environmental Toxicology & Chemistry workshop: *Perspectives on Regulatory Criteria and Screening Levels Based on Fish and Wildlife Tissue Residues*, September, 2008, Bordentown, NJ.

Buchanan, G.A., D.W. Russell, and D.A. Thomas. 2001. Derivation of New Jersey-Specific Wildlife Values as Surface Water Quality Criteria for PCBs, DDT, Mercury, July 2001. NJDEP, USFWS and USEPA.

Buchanan, G. 1995. "The Effects of Bioturbation on the Bioaccumulation of Metals from Contaminated Sediment *by Fundulus heteroclitus* Larvae." Doctoral Dissertation, Rutgers University, New Brunswick, New Jersey.

Buchanan, G. and M. Sprenger. 1991. "Collection of Baseline Bioaccumulation and Toxicity Data at an Aquatic Superfund Site for Post-Remedial Comparison." Presented at the SETAC 12th Annual Meeting, Seattle, WA.

Buchanan, G., D. Charters, and R. Henry. 1989. "Use of Toxicity Tests in the Examination of a Creosote Impacted Wetland at a Superfund Site." Presented at the SETAC 10th Annual Meeting, Toronto, Canada.

Buchanan, G. and D. Charters. 1988. "Integrated Investigation of the Impacts of a Mine Tailings Pond Upon Soda Butte Creek, Montana." Presented at the 9th Annual SETAC Conference, Arlington, VA.

Buchanan, G.A. 1988. Environmental Assessment of the North Branch of Squankum Brook, Bog Creek Farm Site, Howell Township, New Jersey. Investigation of the presence and toxicity of contaminants in sediments of Squankum Brook. Submitted to ERT, USEPA under REAC Contract, Roy F. Weston, Inc.

BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors.
Follow this format for each person. DO NOT EXCEED FIVE PAGES.

NAME: Faustman, Elaine M.

eRA COMMONS USER NAME (credential, e.g., agency login): faustman

POSITION TITLE: Professor, Director, Institute for Risk Analysis and Risk Communication

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
Hope College, Holland, MI	BA	1976	Chemistry, Zoology
Michigan State University, East Lansing, MI	PhD	1980	Pharm., Toxicology
University of Washington, Seattle, WA	Post-Doc	1981-1983	Pathology, Toxicology, Pediatrics

A. Biographical Summary

Dr. Elaine M. Faustman, Professor and Director of the Institute of Risk Analysis and Risk Communication, School of Public Health, University of Washington, Seattle. Dr. Faustman directs the Center for Children's Health Research and directed the Pacific Northwest Center for the National Children's Study and the Oceans and Human Health Center. She is an elected fellow of the American Association for the Advancement of Science and the Society for Risk Analysis. She has served on the USEPA Science Advisory Board and chaired the National Academy of Sciences Committee on Developmental Toxicology. She has also served on the National Advisory Environmental Health Sciences Council, NIEHS-NTP Board of Scientific Counselors and Committee on Alternative Toxicology Methods, National Academy of Sciences Committee in Toxicology and the Institute of Medicine Upper Reference Levels of Nutrient Subcommittee of the Food and Nutrition Board. She has served as the Secretary General for the International Union of Toxicology(IUTOX) and is currently a member of the International Science Council (ICSU) World Data Systems Advisory Board. For over 2 decades she has been involved and directed Stakeholder forums and Community Based Participatory Research for DOE, EPA and NIH. She currently serves on the ICSU CODATA Citizen Sciences Taskgroup. Her research expertise is on integrative scientific approaches including identifying molecular mechanisms of developmental, reproductive, and neuro toxicants, characterizing in vitro techniques for toxicology assessment, and developing biological and exposure based dose-response models. She has over 200 peer reviewed research publications and reports.

B. POSITIONS AND HONORS

Positions and Employment

1988-1993 Associate Professor, Dept of Env and Occupational Health Sciences (DEOHS), Univ of WA
1993-1996 Associate Chair, Dept of Env and Occupational Health Sciences, Univ of WA
1993-Present Professor, Dept of Env and Occupational Health Sciences, Univ of WA
1996-Present Director, Institute of Risk Analysis and Risk Communication, Univ of WA
2001-2008 Affiliate Professor, Dept of Engineering and Public Policy, Carnegie-Mellon Univ
2003-Present Adjunct Professor, Evans School of Public Affairs, Univ of WA

Other Experience and Professional Memberships

1984 Diplomate, American Board of Toxicology (Board Certification)
1989-1997 Editorial Board, Reproductive Toxicology
1990-1993 Program Committee, Society of Toxicology
1991-1994 Editorial Board, Proceedings of the Society for Experimental Biology and Medicine

1992-1997	Associate Editor, Fundamental and Applied Toxicology
1995-2000	Member, Committee on Tox, Board on Env Studies and Tox, Nat Academies of Science
1995-Present	Fellow (elected), American Association for the Advancement of Science
1997-2001	Chair, Committee on Developmental Toxicology, National Academies of Science
2002-Present	Fellow (elected), Society for Risk Analysis
2003-2007	Member, NIEHS, Nat Adv Env Health Sci Council, NTP Board of Sci Counselors
2004-2006	Council, Society of Toxicology
2006-2007	President, Teratology Society; Secretary, Teratology Society (1991-1994)
2010-2016	Secretary General, International Union of Toxicology (IUTOX)
2014-2015	President, Carcinogenesis Specialty Section, Society of Toxicology
2014-Present	Board Member, Alternatives Congress Trust (ACT)
2015-Present	Member, International Science Council, World Data Systems
2015-Present	Member, PhenX Steering Committee
2016-2016	Member, National Academy of Medicine Longitudinal Cohort Study Expert Meeting, Health Levers Across the Lifecourse
2017- Present	Member, National Academy of Medicine, Gulf War Health, Vol. 11: Generational Health Effects

Honors

1989, 2008	Outstanding Teaching Award, School of Public Health, University of WA
2011	National Children's Study Outstanding Contribution Award
2014	Society for Risk Analysis (SRA) Distinguished Achievement Award
2015	Outstanding Faculty Mentor, DEOHS Graduate Student Committee, University of WA
2016	Josef Warkany Lecture, Invited, Teratology Society 56th Annual Meeting
2017	Nominated for the University of Washington Distinguished Teaching Award

1. Assessing human health impacts for Domoic Acid Exposure
   a. Kite-Powell, H., L. Fleming, L. Backer, E. Faustman, P. Hoagland, A. Tsuchiya, L. Younglove, B. Wilcox, and R. Gast, Linking the oceans to public health: Where is the "human health" in "oceans and human health"? Environmental Health, 2008. 7(Supp2).
   b. Costa, LG, Giordano, G and Faustman, EM. 2010. Domoic acid as a developmental neurotoxin. Neurotoxicology. 31(5): 409-423.
   c. Grant, KS, Burbacher, TM, Faustman, EM and Gratttan, L. 2010. Domoic acid: neurobehavioral consequences of exposure to a prevalent marine biotoxin. Neurotoxicol Teratol. 32(2): 132-41.
   d. Griffith, W.C., F. Krogstad, and E.M. Faustman, A Model for Evaluating Sampling Protocols for Domoic Acid Concentration in Shellfish. Proceedings of Coastal Zone 07, 2007. July 22 - 26.
2. Developing quantitative models for biomarkers has greatly improved our ability to integrate and identify significant changes across lifestage and platform.
   a. Yu XZ, Hong SW and Faustman EM. Cadmium-induced activation of stress signaling pathways, disruption of ubiquitin-dependent protein degradation and apoptosis in primary rat Sertoli cell-gonocyte cocultures. Toxicological Sciences. 2008; 104(2): 385-396. PMID: 18463101.
   b. Faustman EM, Gohlke J, Judd NL, Lewandowski TA, Bartell SA, Griffith WC. Modeling developmental processes in animals: applications in neurodevelopmental toxicology. Environ Toxicol Pharmacol. 2005 May;19(3):615-24. PubMed PMID: 21783534.
   c. Gohlke JM, Griffith WC, Faustman EM. A systems-based computational model for dose-response comparisons of two mode of action hypotheses for ethanol-induced neurodevelopmental toxicity. Toxicol Sci. 2005 Aug;86(2):470-84. PubMed PMID: 15917484.
   d. Gohlke JM, Griffith WC and Faustman EM. Computational models of neocortical neuronogenesis and programmed cell death in the developing mouse, monkey, and human. Cerebral Cortex. 2007; 17(10): 2433-2442. PMID: 17204816.
3. Assessing Seafood Safety
   a. Scherer, AC, Tsuchiya, A, Younglove, LR, Burbacher, TM and Faustman, EM. 2008. A Comparative Analysis of State Fish Consumption Advisories Targeting Sensitive Populations. Environmental Health Perspectives. 116(12): 1598-1606.
   b. Judd, N.L., C.H. Drew, C. Acharya, T.A. Mitchell, J.L. Donatuto, G.W. Burns, T.M. Burbacher, and E.M. Faustman, Framing scientific analyses for risk management of environmental hazards by communities:

Case studies with seafood safety issues. Environmental Health Perspectives, 2005. 113(11): p. 1502-1508.

c. Tsuchiya, A, Hinners, TA, Krogstad, F, White, JW, Burbacher, TM, Faustman, EM and Marien, K. 2009. Longitudinal mercury monitoring within the Japanese and Korean communities (United States): implications for exposure determination and public health protection. Environ Health Perspect. 117(11): 1760-6.

4. Transcriptomic profiles can improve our assessments across lifecourse and identify key environmental developmental neurotoxicants.
   a. Robinson JF, Yu X, Hong S, Zhou C, Kim N, DeMasi D, Faustman EM. Embryonic toxicokinetic and dynamic differences underlying strain sensitivity to cadmium during neurulation. Reprod Toxicol. 2010 Jun;29(3):279-85. PubMed PMID: 20025959.
   b. Robinson JF, Guerrette Z, Yu X, Hong S, Faustman EM. A systems-based approach to investigate dose- and time-dependent methylmercury-induced gene expression response in C57BL/6 mouse embryos undergoing neurulation. Birth Defects Res B Dev Reprod Toxicol. 2010 Jun;89(3):188-200. PubMed PMID: 20540155.
   c. Moreira EG, Yu X, Robinson JF, Griffith W, Hong SW, Beyer RP, Bammler TK, Faustman EM. Toxicogenomic profiling in maternal and fetal rodent brains following gestational exposure to chlorpyrifos. Toxicol Appl Pharmacol. 2010 Jun 15;245(3):310-25. PubMed PMID: 20350560.
   d. Robinson JF, Yu X, Moreira EG, Hong S, Faustman EM. Arsenic- and cadmium-induced toxicogenomic response in mouse embryos undergoing neurulation. Toxicol Appl Pharmacol. 2011 Jan 15;250(2):117-29. PubMed PMID: 20883709.
5. Understanding Gene times Exposure (GxE) relationships is critical for determining susceptibility to environmental impacts.
   a. Turner TN, Hormozdiari F, Duyzend MH, McClymont SA, Hook PW, Iossifov I, Raja A, Baker C, Hoekzema K, Stessman HA, Zody MC, Nelson BJ, Huddleston J, Sandstrom R, Smith JD, Hanna D, Swanson JM, Faustman EM, Bamshad MJ, Stamatoyannopoulos J, Nickerson DA, McCallion AS, Darnell R, Eichler EE. Genome Sequencing of Autism-Affected Families Reveals Disruption of Putative Noncoding Regulatory DNA. Am J Hum Genet. 2016 Jan 7;98(1):58-74. PMID: 26749308.
   b. Robinson JF, Griffith WC, Yu X, Hong S, Kim E, Faustman EM. Methylmercury induced toxicogenomic response in C57 and SWV mouse embryos undergoing neural tube closure. Reprod Toxicol. 2010 Sep;30(2):284-91. PubMed PMID: 20493249.
   c. McMillin, MJ, Below, JE, Shively, KM, Beck, AE, Gildersleeve, HI, Pinner, J, Gogola, GR, Hecht, JT, Grange, DK, Harris, DJ, Earl, DL, Jagadeesh, S, Mehta, SG, Robertson, SP, Swanson, JM, Faustman EM, Mefford, HC, Shendure, J, Nickerson, DA and Bamshad, MJ. 2013. Mutations in ECEL1 cause distal arthrogryposis type 5D. Am J Hum Genet. 2013 92(1): 150-6. PubMed PMID: 23261301.
   d. Below JE, Earl DL, Shively KM, McMillin MJ, Smith JD, Turner EH, Stephan MJ, Al-Gazali LI, Hertecant JL, Chitayat D, Unger S, Cohn DH, Krakow D, Swanson JM, Faustman EM, Shendure J, Nickerson DA, Bamshad MJ; University of Washington Center for Mendelian Genomics. 2013. Whole-Genome Analysis Reveals that Mutations in Inositol Polyphosphate Phosphatase-like 1 Cause Opsismodysplasia. Am J Hum Genet. 92(1): 137-43. PubMed PMID: 23273567.
6. Environmental Risk Assessment
   a. Robinson JF, Port JA, Yu X, Faustman EM. Integrating genetic and toxicogenomic information for determining underlying susceptibility to developmental disorders. Birth Defects Research Part A: Clinical and Molecular Teratology. 2010 Oct 1;88(10):920-30. PMID: 20706997.
   b. Port JA, Wallace JC, Griffith WC, Faustman EM. Metagenomic profiling of microbial composition and antibiotic resistance determinants in Puget Sound. PLoS One. 2012 Oct 29;7(10):e48000. PMID: 23144718.
   c. Port JA, Parker MS, Kodner RB, Wallace JC, Armbrust EV, Faustman EM. Identification of G protein-coupled receptor signaling pathway proteins in marine diatoms using comparative genomics. BMC genomics. 2013 Jul 24;14(1):503. PMID: 23883327.
   d. Port JA, Cullen AC, Wallace JC, Smith MN, Faustman EM. Metagenomic frameworks for monitoring antibiotic resistance in aquatic environments. Environmental Health Perspectives (Online). 2014 Mar 1;122(3):222. PMID: 24334622.
   e. Wallace JC, Port JA, Smith MN, Faustman EM. FARME DB: a functional antibiotic resistance element database. Database: The Journal of Biological Databases and Curation. 2017;2017. PMID: 28077567.

f. Judd N+, Griffith WC and Faustman EM+++. Contribution of PCB exposure from fish consumption to total dioxin-like dietary exposure. Regulatory Toxicology and Pharmacology. 2004; 40(2): 125-135.
g. Wong EY, Gohlke J+, Griffith WC, Farrow S and Faustman EM+++. Assessing the health benefits of air pollution reduction for children. Environmental Health Perspectives. 2004; 112(2): 226-232.
h. Kramer CB+, Cullen AC and Faustman EM+++. Policy implications of genetic information on regulation under the Clean Air Act: The case of particulate matter and asthmatics. Environmental Health Perspectives. 2006; 114(3): 313-319.

Complete List of Published Work in My Bibliography:
http://www.ncbi.nlm.nih.gov/sites/myncbi/elaine.faustman.1/bibliography/45112588/public/?sort=date&direction=ascending

Brief Curriculum Vitae for Valery Forbes

Present Position: 2015-Present; Dean of the College of Biological Sciences, University of Minnesota-Twin Cities, 123 Snyder Hall, 1475 Gortner Ave, St. Paul, MN 55108; T: 612-624-7747; E: veforbes@umn.edu

Education: 1988 Ph.D., Coastal Oceanography, State University of New York at Stony Brook; 1984 M.S., Marine Environmental Science, State University of New York at Stony Brook; 1983 B.A. Biology; B.A. Geology, State University of New York at Binghamton

Previous Positions: 2011-2015: Director of School of Biological Sciences, University of Nebraska-Lincoln; 2006-2010: Founding Chair of Department of Environmental, Social and Spatial Change, Roskilde University, Denmark; 2004-2008: Director and Chairman of the Board of the Graduate School of Environmental Stress Studies (GESS), DK; 2001-2006: Professor, Dept of Life Sciences and Chemistry, Roskilde University, DK; 1996-2001: Associate Professor, Dept of Life Sciences and Chemistry, Roskilde University, DK; 1993-1996: Assistant Professor, Department of Life Sciences and Chemistry, Roskilde University, DK; 1993-1995: Assistant Professor, Denmark's International Study Program, DK; 1991-1993: Research Associate, National Environmental Research Institute, DK; 1989-1991: Research Assistant Professor, Odense University, DK

Recent Grants

Syngenta – UMN Collaborative Grant; Assessing the risks of herbicides to threatened & endangered plant species through population modeling – dealing with data gaps; May 2016 – April 2018; role PI

NIMBioS Working Group on 'Dynamic models to link organism performance to ecosystem service delivery for ecological risk assessment of chemicals'; Sep 2015 – Sep 2017; role PI

Syngenta; 'Assessing the risks of herbicides to threatened and endangered plant species – a case study and proof of concept'; Nov 2014-Feb 2016; role PI

NIMBioS Investigative Workshop on Predictive Models for Ecological Risk Assessment, 28 – 30 April, 2014, Knoxville, TN; role PI

EU 7th Framework Grant; 'Modelling nanoparticle toxicity: Principles, methods, novel approaches' (ModNanoTox); with 5 partners; Dec 2011 – Nov 2013; role Work Package Leader

EU 7th Framework Initial Training Network Grant; 'Mechanistic effect models for ecological risk assessment of chemicals' (CREAM); with 12 partners;1 Sep 2009 – 31 Aug 2014; role Work Package Leader

EU 7th Framework Grant; 'The reactivity and toxicity of engineered nanoparticles: risks to the environment and human health'(ModNanoTox); with 11 partners; Dec 2008 - 2012; role Work Package Leader

Additional Professional Activities During 2017-2018

- Named Helmholtz International Fellow in 2018
- Member of the Board of Directors, Minnesota Freshwater Society
- Scientific Adviser to DuPont
- Editorial Board, *PeerJ*, since 2017
- Editorial Board, *Integrated Environmental Assessment and Management*, since 2018
- Editorial Board, *Human and Ecological Risk Assessment*, since 2005
- Editorial Board, *Marine Environmental Research*, since 2000
- External evaluator for US EPA, ORD, scientific staff promotion evaluation
- SETAC Best Student Paper Award Evaluation Committee
- Reviewer for Strategic Environmental Research and Development Program (SERDP), Department of Defense – Conservation and Resiliency Proposals

Masters and Ph.D. Students:

I have graduated ca. 50 Masters and Ph.D. students since 1996. I am presently supervising 4 postdocs.

Total publications on Web of Science 152; h-index: 35; total citations: 4262
Total publications on Google Scholar 311; h-index: 45; total citations: 7091

Selected Publications:

Forbes VE, Salice CJ, Birnir B, Bruins RJF, Calow P, Ducrot V, Galic N, Garber K, Harvey BC, Jager H, Kanarek A, Pastorok R, Railsback SF, Rebarber R, Thorbek P. 2017. A framework for predicting impacts on ecosystem services from (sub)organismal responses to chemicals. *Environ Toxicol Chem* 36: 845-859.

Forbes VE, Galic N, Schmolke A, Vavra J, Pastorok R, Thorbek P. 2016. Assessing the risks of pesticides to threatened and endangered species using population modeling: a review and recommendations for future work. *Environ Toxicol Chem.* 35: 1904-1913. **[Recipient of *ET & C*'s Exceptional Paper Award]**

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Ramskov T, **Forbes VE**, Gilliland D, Selck H. 2015. Accumulation and effects of sediment-associated silver nanoparticles to sediment-dwelling invertebrates. *Aquat Toxicol* 166: 96-105.

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Dr. Robert J. Letcher is a Senior Research Scientist with the Science and Technology Branch of Environment and Climate Change Canada (ECCC) at the National Wildlife Research Centre (NWRC) at Carleton University, Ottawa, Ontario, Canada. He received an (Hon.) B.Sc. (1987) from U. of Toronto, his M.Sc. (1991) and Ph.D. (1996) from Carleton University, and was a Post-Doctoral Fellow (1997-2000) at the Institute for Risk Assessment Sciences (IRAS), Utrecht University, Wageningen Agricultural University, and the Netherlands Institute for Sea Research. Dr. Letcher heads the Organic Contaminants Research Laboratory (OCRL) and research group at the NWRC. For the last 25 years his research has been in the areas of environmental chemistry (including spatial and temporal trends in various environmental matrices including soil and sediment) and (eco)toxicology, and analytical chemistry of legacy and emerging contaminants, which involves determination of persistent contaminants and biochemical endpoints of relevant (e.g., endocrine) biological effects, e.g., in top predator and trophic level wildlife and their aquatic and terrestrial food webs/ecosystems from freshwater (e.g., Great Lakes) and marine (e.g., Arctic) ecosystems.

For the last 13 years he has been Associate Review Editor of *Environ. Int*. (IF=7.088 as of 2017). Since 2005, Dr. Letcher has been an Adjunct Professor in the Departments of Chemistry and Biology at Carleton University, and is an Associate Research Faculty member at the University of Guelph. For the last 9 years, Dr. Letcher has also been Associate Coordinator of the Ottawa-Carleton University Chemical and Environmental Toxicology Program. Dr. Letcher has supervised (or co-supervised) numerous graduate students and Post-Doctoral Fellows (PDFs) on various (e.g. Arctic) projects over the last 17 years, and he currently supervises 4 M.Sc. students as well as 1 PDF. The impact of Dr. Letcher's research is evident from his inclusion in Thomson-Reuters list of the top 1% most cited scientists globally, in the field of Environment/Ecology for 2014 and 2015. This places him among the top 10 most cited scientists in Canada in this field for publications over 2002 to 2013. As of December 2017, his H-Index of 73 and 18,000 citations (Google Scholar) indicates his research impact. He has > 330 peer reviewed scientific articles over his 22 year career post-PhD. He has made major contributions to the assessment and management of chemicals in Canada and abroad. The global impact of his work is evident from the citations of his papers in Risk Profiles for 16 new chemicals listed in the Stockholm Convention on Persistent Organic Pollutants (POPs) since 2009 (http://www.pops.int/). A major focus of Dr. Letcher's studies is on new POPs in polar bears for which he is the scientific lead in Canada under the NCP. Dr. Letcher has communicated his work to the public especially to arctic communities, which he visits annually for consultations on polar bears, through presentations and news articles. His work has been featured in 20 scientific news articles in Chemical & Engineering News, Discovery Magazine, etc. in the past 6 years.

Selected Publications / Reviews of R.J. Letcher (5 year total (2012-2018) = 149)

K.L. Hill, Å.K. Mortensen, D. Teclechiel, W.G. Willmore, I. Sylte, B.M. Jenssen, **R.J. Letcher**. 2018. *In vitro* and *in silico* competitive binding of brominated polyphenyl ether contaminants with human and gull thyroid hormone transport proteins. *Environ. Sci. Technol.* In press, ASAP on-line Dec. 28, 2017. **DOI:** 10.1021/acs.est.7b04617.

A. Strobel, **R.J. Letcher**, W.G.Willmore, C. Sonne, R. Dietz. 2018. Organophosphate esters in East Greenland polar bears and ringed seals: adipose tissue concentrations and *in vitro* depletion and metabolite formation. *Chemosphere* 196:240-250.

A.K. Greaves, **R.J. Letcher**. 2017. Organophosphate Esters: A review on wildlife distribution, fate and ecotoxicology. *Bull. Environ. Contam. Toxicol.* 98:2-7.

G. Li, H. Ye, G. Su, Z. Han, C. Xie, B. Zhou, **R.J. Letcher**, J.P.Giesy, H. Yu, C. Liu. 2017. Establishment of a three-step method to evaluate effects of chemicals on development of zebrafish embryo/larvae. *Chemosphere. 186:209-217.*

G. Su, **R.J. Letcher**, D. McGoldrick, S. Backus. 2017. Halogenated flame retardants in predator and prey fish from the Laurentian Great Lakes: Age-dependent accumulation and trophic transfer. *Environ. Sci. Technol.* 51:8432-8441.

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Z. Lu, **R.J. Letcher**, S.G. Chu, J.J.H. Ciborowski, G.D. Haffner, K.G. Drouillard, S.L. MacLeod, C.H. Marvin. 2015. Spatial distributions polychlorinated biphenyls, polybrominated diphenyl ethers, tetrabromobisphenol A and bisphenol A in bottom sediments from Lake Erie. *J. Great Lakes Res.* 41(3):808-817.

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Review of Proposed Revisions to Sediment Quality Provisions
contained in the
Water Quality Control Plan for Enclosed Bays and Estuaries in California

Gary A. Buchanan, Ph.D., NJDEP
March 5, 2018

Note: Dr. Buchanan is the Director for the Division of Science, Research and Environmental Health for the New Jersey Department of Environmental Protection. The opinions expressed are those of the author as an independent reviewer, were not conducted as part of his official duties, and do not necessarily reflect the opinions or policy of the New Jersey Department of Environmental Protection.

General Comment/Introduction:

The two primary documents, *Draft Staff Report Including Draft Substitute Environmental Documentation Amendments to the Water Quality Control Plan for Enclosed Bays and Estuaries – Part 1 Sediment Quality (Sediment Quality Provisions)* and *AMENDMENTS TO THE WATER QUALITY CONTROL PLAN FOR ENCLOSED BAYS AND ESTUARIES OF CALIFORNIA, Sediment Quality Provisions* were reviewed in depth. The four supporting documents were also reviewed to confirm that they corroborated the primary documents and that information was consistent among the documents. The focus of my review was on whether Conclusions A5, A6, A7 and B1 were based upon sound scientific knowledge, methods and practices. I am fully confident that my expertise and experience in studying and assessing contaminated sediments, evaluating benthic invertebrate and fish contaminant data, and related efforts allows me to effectively peer review the subject Conclusions listed below.

In general, the primary documents were well-written, science based, supported by local, regional or state data, as well as substantiated by the supporting documents and appropriate peer-reviewed literature. Overall, the scientific portion of the proposed rule is based upon sound scientific knowledge, methods and practices. The only concern is with small sample size for Tier 1 evaluations as detailed in the specific comments.

Summary evaluation comments are provided under each conclusion. Specific comments for each primary review document are provided after these summary comments. These specific comments fall into the categories of clarification, concerns and minor edits/corrections.

Conclusion A5 – *Site-specific and species-specific data are required to assess sediment linkage.*

This conclusion is fully supported by the science as detailed in the documents reviewed. Site-specific and species-specific data are critical in the assessment of sediment linkage. Appendix 4, Sensitivity Analysis for Indirect Effects Assessment (Bay et al., 2017) provides evidence of the importance of obtaining site-specific data for sediment contaminant concentration and

sediment total organic carbon. Having species-specific data are important to confirm that appropriate species are selected for the assessment and that they are based on a sediment-related diet and appropriate home range. There is a sound scientific basis as detailed in Bay et al. (2017), e.g., Appendix 2 and 3.

Conclusion A6 – *The approach, methods and assumptions set forth in the optional Tier 1 Screening Evaluation are appropriate for screening low-risk sites or waterbodies*.

The Tier 1 approach, methods and assumptions are appropriate as a screening step in distinguishing low-risk sites. The conservative assumptions are generally appropriate for this initial assessment that would typically use available and potentially limited data. The use of C_{Tis95} data from the site to compare to the OEHHA ATL3 range maximum tissue threshold concentrations is appropriate and conservative. The sediment screening threshold that is based on the tissue screening threshold and BSAF for a range of sediment TOC is also appropriate and conservative. However, please see comment below for page 82 of the *Draft Staff Report* concerning the use of 'maximum concentration'. The use of less than 3 samples may not be appropriate or conservative depending on the size of the site, type of sample (composite or individual) and number of species tested. Clarification is recommended.

Conclusion A7 – *The approach, methods and assumptions set forth in Tiers 2 and 3 are appropriate for designating sites as either impacted or unimpacted.*

The more robust Tiers 2 and 3 are appropriate for designating sites as either impacted or unimpacted. The State of California has conducted significant research and a large volume of supporting information and data. The approach, methods and assumptions are clearly explained in the primary and supporting documents. I would consider this approach as setting a more concise, contemporary and scientifically supported benchmark for the assessment of sediments contaminated with organochlorine pesticides and PCBs.

Conclusion B1 – *The proposed approach to designate impaired sediment quality in relation to the SQO protecting benthic communities from direct exposure to contaminants in sediment is appropriate and scientifically sound. Use of severity of effects and spatial extent is appropriate when evaluating whether sediment dependent beneficial uses are supported in waterbodies.*

The existing use of multiple lines of evidence (MLOE) is appropriate and scientifically sound. This is further supported by the already developed indices for the benthic community, i.e., Benthic Response Index, Index of Biotic Integrity, Relative Benthic Index and River Invertebrate Prediction and Classification System.

The use of the severity of effects, i.e., clearly impacted, to demonstrate exceedance of a receiving water limit at any station within a site is appropriate, as this reflects the highest severity of impacts based on the scientifically sound assessment approach. The use of 'possible impacted' and/or 'likely impacted' for total percent area greater than 15 percent for

exceedance determinations is appropriate. While the chosen specific percent value for area is a policy decision, this level would generally be protective. The requirement that the "calculation of percent area shall be based on data from spatially representative samples selected using a randomized study design or equivalent spatial analysis" provides a scientifically sound basis for this approach.

Other Comments:

Draft Staff Report Including Draft Substitute Environmental Documentation Amendments to the Water Quality Control Plan for Enclosed Bays and Estuaries – Part 1 Sediment Quality (Sediment Quality Provisions)

Page 15, next to last sentence: Suggest removing the reference to methyl mercury, since it is distributed throughout the body and is not lipophilic.

Page 74, 6.2.4, Alternative 3: Staff recommendation is alternative 3 and references Appendix A, C-6 (mislabeled (?) and assumed to be *Draft Amendments* Appendix A-6). However Alternative 3 recommends skin-on fillets, and Appendix A-6 lists skin-off fillets, which appears to support Alternative 4. This needs to be corrected and consistent in both primary review documents.

Page 80: Reference to Fig 5.1 is a map and does not match the text description. Typo?

Page 80 and 82, Tiered Assessment Framework: Page 80 states that "Tier 1 consists of a preliminary evaluation of either tissue data **or** sediment data…". Page 82 (6.4) states "or" and "or both" for Tier 1. Suggest making the sentences consistent or explaining the rationale more clearly.

Page 82, 6.4.1, use of maximum concentration: Less than three individual samples is not appropriate for a screening evaluation. One or two samples, even if using the maximum concentration, are not representative of conditions at a site and is not scientifically supported. This may be appropriate if the one or two samples were composites, i.e., multiple sites/fish combined in one sample and only for relatively small sites. If only one or two individual samples are available, recommend requiring a Tier 2 assessment. The other alternative is to allow this assessment with minimum data only if the data indicates that a Tier 2 assessment is required, i.e., data that indicates no impact is not sufficient to characterize the site as unimpacted. While use of composite samples is mentioned elsewhere, it is not clear if that is the intent in this section of the document. In the Bay et al. (2017) supporting document (p. 44) state that OEHHA recommendations for screening surveys should be followed "…a minimum of three composite samples should be collected and analyzed for each target species…". Additional explanation/clarification should be added to both primary review documents.

Page 83, 6.4.3:

- References for BSAF are not listed on the References page or listed incorrectly in the text – Bay and Greenfield, 2015 and Greenfield et al, 2015.
- The description of BSAF is adequate for the layman, but it does not follow the scientific definition for organic chemicals. BSAF is the ratio of the chemical concentration in the organism (normalized to the lipid fraction) to the chemical concentration in the sediment (normalized to the sediment organic carbon content) (Burkhard, 2009). It appears that the lipid and organic carbon content are accounted for in the Decision Support Tool and/or the bioaccumulation model in the calculation of the BSAF. If accurate, this should be noted in the document (e.g., footnote).

Page 85, 6.4.4: Alternative 2 may not be adequately conservative in some instances, i.e., when tissue data shows no impact, but sediment sample size is small. See comment for section 6.4.1.

Page 91, Table 6.4: No footnote for "m" for lipid row. Does this indicate "modeled"?

Page 133, last paragraph: The first two sentences are repeated in the next two sentences.

Page 137, Mitigation: The fifth bullet in repeated further down on this page.

AMENDMENTS TO THE WATER QUALITY CONTROL PLAN FOR ENCLOSED BAYS AND ESTUARIES OF CALIFORNIA, Sediment Quality Provisions

Table of Contents: Appendix A-1 is not listed. Table 17 is listed twice.

Page 4, III.A.1.d. Applicable Sediments: This states that the Sediment Quality Provisions apply to subtidal surficial sediments…seaward of the intertidal zone. Is the intertidal zone covered under another control plan? The sediments in intertidal zones can be a source of contamination to benthos and fish, e.g., during foraging at high tide.

Page 18, IV.A.2.b. In the last sentence under Tier 3, Chapter IV.A.2.b.7 is referenced. This section was not found in the document.

Page 20, IV.A.2.c.3. and Page 21, IV.A.2.c.4: same comment as Page 82, 6.4.1, use of maximum concentration, for the Draft Staff Report (see above).

Page 23, Table 17: It appears that the contaminant names in the second row on the table have shifted since "Chlor" is repeated twice under Benthic with piscivory, i.e., names are incorrect for that portion of the table.

Page 54, Appendix A-5, consumption rates: Recommend that when identifying available information on local consumption rates that the effect of any fish consumption advisories in effect for the site on the consumption rate be considered. Fish advisories can reduce the consumption rate for some anglers, i.e., as compared to their consumption rate if there were no fish advisories for that waterbody, thus artificially reducing consumption rates for the assessment.

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March 21, 2018

Overall statement by Reviewer—
This reviewer would state that the Proposed Revisions to Sediment Quality Provisions contained in the Water Quality Control Plan for Enclosed Bays and Estuaries of California are based on "sound scientific knowledge, methods and practices." My review focused on Conclusions A1 and A2 with a few comments relevant for human health across the other conclusions. I have organized my comments by Conclusion number below.

Question A. The proposed assessment framework to assess sediment quality in relation to narrative sediment quality objective (SQO) protecting human consumers from contaminants that bioaccumulate from sediment into fish tissue is appropriate and based on a sound approach and developed using sound scientific information and methods. The specific scientific findings, assumptions and conclusions to be evaluated for their basis in sound scientific knowledge, methods and practices are detailed below

This narrative SQO states: Pollutants shall not be present in sediments at levels that will bioaccumulate in aquatic life to levels that are harmful to human health in bays and estuaries of California. Since adopted by the State in 2008, this SQO has been assessed and evaluated on a case-by-case basis, with little guidance other than a requirement to be based upon a human health risk assessment. Since 2009, the State Water Board's technical team has been developing an assessment framework based on a conceptual approach that addresses two fundamental questions:

- Do contaminants in resident fish tissue pose an unacceptable health risk to humans consuming those fish?
- Are sediment-associated contaminants at the site or area of interest contributing to the contaminant burden in fish tissue?

Charge to the review was to assess:

1. **Evaluation of health risk to humans is based on comparison to tissue contamination thresholds established by the State of California to protect consumers of local fish.** In order to address the first question, the assessment framework requires a comparison of average fish tissue contaminant concentrations to contamination goals and advisory tissue levels used to develop fish tissue consumption advisories for California sportfish derived by the California Environmental Protection Agency's Office of Environmental Health Hazard Assessment (OEHHA). **Suggested Expertise:** Public Health Toxicologist and Environmental Chemist. **Suggested References:** Draft Amendments Tables 16 and 20, Draft Staff Report (Sections 3.2, 4.2.4 and 6.2), OEHHA's Development of Fish Contaminant Goals and Advisory Tissue Levels for Common Contaminants in California Sport Fish, and Bay et al, 2017, Development of Sediment Quality Assessment Framework for Human Health Effects (Section 2.1 thru 2.4)

Reviewer Responses: The documents given to the reviewer provided excellent, detailed but very clear justification for assumptions made, equations proposed and tiered approaches for assessment that are both scientifically justifiable, human health protective but also cognizant

of need for prioritization in a cost and labor efficient manner.
The assessment framework presented and the alternatives chosen in all cases provide an improved approach to evaluate whether contaminants in resident fish tissue pose an unacceptable health risk to humans who eat sport fish. This reviewer agreed with almost all of the alternatives chosen and these provided guideline users a better, more site specific set of options to evaluate California contaminated enclosed bays and Estuaries. Examples were given that supported the translation of these guidelines. When this reviewer has some issues that needed clarification, the issues are detailed below.

One set of questions that this reviewer had was addressed for several of the initial key assumptions. These questions should be clarified in the document to ensure that all users are aware of potential challenges to the assumptions made. In no cases are these requested clarifications "show-stoppers" but rather require some responses to ensure all initial assumptions are put into the site specific context, the focus of the written amendments.

For example, this reviewer read with great interest Section 3.2 that establishes the Receptors and Exposure Pathways and Direct Effects to Benthic Communities and Indirect Effects on the Human Consumers of Fish. In general, this section established the rationale for site directed considerations. These are important and this reviewer does not dispute these approaches. Where this reviewer requests some additional acknowledgement is when these site based assessment fail. For example, fishing rates in areas where there are already restricting fish consumption advisories cannot reflect true fish consumption as this has already been suppressed by the advisory and pollution in place. Thus the use of the site specific consumption values is very limited and would bias towards not cleaning up a site when it is needed.
Another example that needs to be clarified for the site specific basis of the sediment standards is the lack of discussion on tribal "usual and accustomed uses" of these sites. In section 4.1.4 on Native American Consultation there is a discussion of outreach to Tribal governments for their input in this document. However, I did not see any discussion of legally mandated access. A brief review of the Tribal governance literature for the Pacific Coast would suggest that such considerations should be address and discussed within the initial context for these revised amendments. There is a literature that suggests that if sediment assessments and clean-up efforts are not sufficient to ensure "usual and accustom use of sites" then this would be considered as an "environmental taking "as the fish would be contaminated and not of use. In addition, the emphasis on sport fish is rather irrelevant for these tribal assessments as again the literature suggests a much broader portfolio of fish consumption and use. Regardless, these considerations need to be discussed and stated upfront as the assumptions for use that need to be considered.
By using site specific "use" data the assumption is made that this is a relatively "stable" condition. Although some limitations are discussed, (For example, section 6.5.4 addresses both lack of knowledge and variability in fish movement) this reviewer would suggest adding several additional statements.
In this era of anticipated climate changes, it would also be good to state that site specific changes would be anticipated to change as well. In the document climate changes could be considered as part of needs assessment for remediation actions. Again the report could make a statement on the time context for considering the "site specific" conditions.

Other considerations for fish consumption should be the types of fish that subsistence fisherpersons consume. Again these can be quite different than sport fish lists and can be more determined on cultural differences, availability of fish and ease of catching fish. Some individuals desire to optimize their omega 3 fatty acid intake and although there was some discussion of these factors in the document, minimal information was presented on how such information would be integrated or affect site prioritization.

In Section 3.2 there is a good background to the concepts regarding habitats and life histories

of resident fish as well as anadromous fish and the approaches proposed in the document are sophisticated and accurate for how to address these differences in relationship to quantitation of contaminant loading. Other factors that could be mentioned include hatchery raised fish. Are these present in these waters covered by this document? If so some recognition regarding changes and shifts in husbandry should be mentioned. Changes in these practices can shift the loyalty of the fish to specific regions and can increase fishes return and time spent in local sites and thus increase their load of local contaminants. This should at least be mentioned and would support many of the revisions to accept site by site considerations.

Section 4.2.4 discusses regional monitoring and assessment programs. This section is very impressive and the importance of these programs in providing site specific information is great. It would be good to see a set of summary tables that summarize in tabular form the information on dates each program has been in place, frequency of sampling, what is sampled and results and availability to public. For example, monitoring data presented in Appendix 6 of Attachment 7 “Development of Sediment Quality Assessment Framework for Human Health Effects” presents some of this data. Please provide a link and possibly add to this information details about sampling frequency and timing.

Section 4.2.4 also provides some specific highlighted examples from the monitoring program. For example, the Central Coast Long-term Environmental Assessment Network (CCLEAN) discussion describes sea otter issues and impacts. It is surprising given this example and the other numerous published reports on sea otters, that these species are not identified in Figure 3.3 as they are resident vertebrates with high local food consumption fish consumption (primary diet is macro invertebrates and epidentic fish and shellfish) and they have been noted as being affected by pollutants including PCBs in the relevant areas of this report. (See comments below about ecological impacts for Goals 3 and 4)

Appendix 2 of the “Development of Sediment Quality Assessment Framework for Human Health Effects” presents the Dietary guild and Target Species Development. This was a very informative section and presented rationale for target species considered in the sediment assessments.

Equations presented in Section 4.2.4 for both Carcinogens and Non-carcinogens are accurate and scientifically defensible.

Question 2. Health risk evaluation is based solely on fish likely to live within the site of interest and be consumed by the local population. To ensure the tissue data fulfill the requirements of the assessment framework, only those bay and

macrofauna as part of their diet and are commonly consumed by humans are considered in this framework. **Suggested Expertise:** Public Health Toxicologist and Fish Ecologist. **Suggested References:** Draft Amendments Section IV. A.2.b, Appendix A-5 and A-6, Draft Staff Report (Sections 3.2, 4.2.4 and 6.2) and Bay et al, 2017, Development of Sediment Quality Assessment Framework for Human Health Effects (Section 2.1 thru 2.6, 6.1, Appendix 2 and 3)

Reviewer responses: This reviewer had some conceptual questions on this statement. The report provides an excellent strategy to address the fundamental question of "Are sediment-associated contaminants at the site or area of interest contributing to the contaminate burden in fish tissue?" A detailed and scientifically justifiable set of approaches is presented. However this reviewer also read as two of the goals of these amendments was to (Goal 3) "Provide regulators, stakeholders and interested parties with transparent and scientifically sound process to better assess the effects caused by pollutants in sediments within California's enclosed bays and estuaries and (Goal 4) Provide regulators, stakeholders and interested parties with an effective process that will promote the protection of sediment quality as well as management of sediments that do not meet the SQOs." To meet these goals, the assessment and proposed amendments should expand and consider impacts on other consumers than humans of organisms associated with contaminated sediments. Please see my example of sea otters as one excellent example where it is unclear that protecting just human health will achieve the same protections for these sea mammals (vertebrate resident consumers) as called for in Goals 3 and 4. In the state of Wa for example water quality standards are driven by pesticide levels and toxicity for salmon not for toxicity in human eating salmon. Please expand or highlight the sections that meet these goals. Just evaluating the most frequently consumed sport fish species for humans will not ensure that these two goals are met. Note also that in the case of sea otters they are endangered species in California regions (See Table 7.8).

Section 6 of the report addresses point my point alternatives and presents the recommended alternatives for the revisions. This reviewer felt that the alternative identified were rationale and agreed with choice of all except for a few discussion points listed below.

For section 6.2.2 on fish species used in evaluation of chemical exposure this reviewer had several questions. Please see my note above about expanding beyond "sport fish".

For section 6.2.3 on species to be monitored and assessed please see my comments above regarding suppression of fish consumed by current fish advisories thus for this change I would suggest broadening the input to choose fish species beyond just site specific info. Use of different dietary guilds is good.

For section 6.2.4 on tissue types to be used, several factors need to be considered. First there are cultural difference in how the fish is consumed. For example, many south east Asian communities leave the head on the fish. Note that other consumers of the local fish (i.e. non-human consumers) do not know that they are supposed to remove the internal organs before consuming so to address goals 3 and 4 and not just human associated impact from sediment contamination these whole fish estimates

should be retained.

For section 6.2.7 on application of OEHHA Tissue Advisories and Goals and Section 6.2.8, I would concur with the choice of Alternative 3 for 6.2.7 however the fish consumption values used in setting the OEHHA guidelines need to updated to reflect more reasonable estimates of fish consumption. Only the three 8 oz. consumption levels approach levels that both WA and Oregon will use. Note that using site specific consumption rates for previously contaminated sites represent repressed levels. Also need to consider both Tribal as well as subsistence fisher people. Hence I would support alternative 2 for section 6.2.8 Is this where some considerations of health benefits of fish should be considered? How? I think more clarity is needed in these two sections.

For section 6.2 Tiered Decision Frameworks—I am supportive of these prioritization schema except for the assumptions and alternative chosen in 6.4.2 where I would support alternative 2 and not 3 as proposed for the reasons listed above.
For Section 6.4.4 evaluation of impact, this reviewer would have preferred to see more information in this document about acceptable sampling plans to consider the site has been sufficiently evaluated for site specific information to be included in the assessments. This reviewer supports the use of tissue level contaminate values to drive the decision for action when there are differences between tissue levels and site contamination.

For section 6.5.3 on food web variation I am supportive of the third alternative however this guidance of using “multiple” bioaccumulation models maybe too unrestricted. Perhaps some specific model use could be included as a part of this assessment.

For section 6.5.8 on protective condition, I was supportive of alternative 2 as I have had experience with the risk matrix approach and have found the 3 options as better able to clarify differences in scenarios and level of protection. Please note however I was surprised to see in the matrix only one cell with “possibly impacted” as it appears to be a lopsided example.

For section 6.6.1 this reviewer would suggest a recommendation to use Value of Information approaches to estimate the overall value in missing or confounded site information. Sensitivity analysis could identify key drivers in these comparisons and further support the tiered approaches.

In summary, the overall document is exceptionally well done, clear, comprehensive and scientifically robust. Please feel free to use my suggestions to slightly adjust the alternative and discussion. Please see also my suggestion on expanding the context for assessment in order to address both the goals and the two questions posed to the reviewers.

Cal EPA Review: Proposed revisions to sediment quality provisions contained in the water quality control plan for enclosed bays and estuaries in California.

Valery E. Forbes
College of Biological Sciences
University of Minnesota
March 5, 2018

As stated in the supporting documentation provided with the review materials (letter dated February 8, 2018), the goals of the proposed amendments are to: 1) protect and restore beneficial uses at risk from pollutants in sediments within California's enclosed bays and estuaries, 2) comply with California Water Code Section 13393 which requires the State Water Board to adopt Sediment Quality Objectives, 3) provide regulators and stakeholders with a transparent and scientifically sound process to better assess effects, 4) provide regulators and stakeholders with an effective process that will promote protection of sediment quality, and 5) avoid imposing monitoring and regulatory requirements that are more stringent than necessary. In my review of the conclusions to be addressed by the peer reviewers, I consider the extent to which the proposed amendments are consistent with the above goals and focus in particular on Conclusions A6 and A7. These conclusions refer to the tiered approach that has been developed for assessing risks to human consumers of resident sportfish from contaminants that bioaccumulate from sediment into fish tissue. The approach is described in detail in Greenfield et al. 2015, IEAM, 11: 459-473).

Comments on Conclusion A6: The approach, methods and assumptions set forth in the optional Tier 1 Screening Evaluation are appropriate for screening low risk sites or waterbodies.

The proposed amendment replaces a case-by-case human health risk assessment that did not require consistent and standardized implementation to fulfill the Sediment Quality Objective (SQO) to ensure that, "Pollutants shall not be present in sediment at levels that will bioaccumulate in aquatic life to levels that are harmful to human health in enclosed bays and estuaries of California." Thus, the aim of the amendment is to provide a consistent and standardized approach to meet this SQO in a way that is in keeping with the above 5 goals.

The amendment uses a tiered approach which aims to minimize the amount of effort and resources directed toward assessing no/low-risk situations so that more effort and resources can be directed toward obtaining accurate assessments of risk for situations of higher concern. The assessment framework applies only to specific nonpolar chlorinated hydrocarbons (i.e., DDTs, PCBs, chlordane and dieldrin). Tier 1 is intended to be a conservative screening assessment that allows for rapid site assessment and has low data requirements. In this tier, site sediments are evaluated for their potential to result in contamination of sportfish at levels that exceed standardized, conservative thresholds. If thresholds are not exceeded, no additional detailed assessments (Tier 2 & 3) are needed, and sites would be determined to meet the SQO without a

requirement for further assessment. Because this is a screening-level assessment, it is important that it is based on sufficiently conservative assumptions to minimize the chance of concluding that unacceptable chemical exposure does not exist when in fact it does. However, the Tier 1 assessment should not be so conservative that it is not able to screen out low-risk situations from further analysis. Tier 1 can be based on sediment contaminant concentrations (and total organic carbon), sportfish tissue concentrations or both. If Tier 1 indicates that a potential hazard exists, the analysis would proceed to Tier 2.

Overall, the approach, methods and assumptions proposed for Tier 1 seem appropriate in being standardized, require minimal data, are simple to apply, and are based on accepted human health thresholds for contaminant consumption.

It has been proposed that the 95th upper confidence limit of the mean sediment contaminant concentration be used when there are three or more sediment samples, and the maximum sediment concentration when there are fewer than three samples. To potentially base a Tier 1 assessment on only one or two sediment samples seems inadequate, particularly if the samples are below threshold, meaning that no further assessment would be required and potentially no further monitoring would be done for 5 years. If a Tier 1 assessment based on 1-2 sediment samples exceeds threshold and triggers a Tier 2 assessment, this is less problematic (though could still potentially result in a less efficient use of resources than a Tier 1 assessment based on a larger sample size). In my view there should be some minimum amount of information required at Tier 1 in order for a "no further assessment needed" decision to be made. For example, it should not be possible to conclude that a site is not degraded based on a Tier 1 assessment of one or two sediment samples alone (i.e., without corresponding fish tissue samples). If there are fish samples as well, and these support the conclusion based on the one or two sediment samples, this is probably sufficiently conservative for a Tier 1 assessment. Since a study design and workplan, based on a Conceptual Site Model (CSM), must be developed before sampling commences, the minimum number and spatial distribution of sediment samples would presumably be defined in this step. It would seem unlikely that a reasonable CSM would result in a study design that included only one or two sediment samples, so possibly this concern is unwarranted. However, whereas Tier 2 requires a minimum of 5 sediment samples per site in addition to a minimum of 3 tissue samples from at least two sportfish species, it would seem reasonable to set some minimum number of samples for Tier 1 as well. Potentially sites that are known to be unimpacted on the basis of previous monitoring studies and/or are located far from sources of contamination would warrant less sampling than other sites. The addition of guidance to this effect could potentially increase the efficiency of Tier 1 assessments further.

For fish tissue, the mean of the 95% upper confidence limit of the mean tissue concentration for each species is used. If there are fewer than three samples for a given species the maximum concentration for that species should be used. Whether this is sufficiently protective will depend on whether/how many fish species are used in the Tier 1 assessment. This is not entirely clear from the document.

The Tier 1 screening thresholds are based on Office of Environmental Health Hazard Assessment Advisory Tissue Levels based on three or five (for subsistence fishers) servings of

fish per week. The 95% UCL of the mean tissue concentration for sportfish is compared to the screening thresholds directly. For sediments, the 95% UCL of the mean site sediment concentration is compared to a sediment threshold calculated as the tissue threshold divided by the highest biota-sediment accumulation factor (BSAF) for the dietary guilds identified in the Conceptual Site Model. This seems a reasonable and conservative approach.

The Tier 1 data requirements state that sediment and tissue data shall be no more than 6 years old at the time of the assessment and collected within site boundaries. This seems an arbitrary age that is given without any justification or reference to the published literature as far as I could tell. Also, this requirement says nothing about how the sediment or tissue samples should be stored prior to analysis although the document is rather explicit as to other aspects of sediment sampling such as method of collection, depth of sampling, etc.

Comments on Conclusion A7: The approach, methods and assumptions set forth in Tiers 2 and 3 are appropriate for designating sites as either impacted or unimpacted.

In Tier 2, some default assumptions and parameters used in Tier 1 are replaced with more realistic parameters and assumptions that are relevant to the site characteristics. Tier 2 requires site-specific information on sediment and sportfish tissue chemistry, sediment organic carbon content, and fish tissue lipid content. In addition, Tier 2 estimates the probability distribution of linkage between the contaminants in sportfish and sediment. Evaluation of the sediment linkage utilizes a mechanistic food web model to estimate tissue concentrations derived from measured sediment concentrations. The probabilistic approach to determine the site linkage factor is based on Monte Carlo simulation to calculate the sediment linkage factor accounting for variability or uncertainty in measured sediment concentration data, measured fish tissue concentration data, fish home range and BSAF calculation.

A BSAF is estimated for each fish species based on the Arnot and Gobas (2004, ET&C 23: 2343-2355) and Gobas and Arnot (2010, ET&C 29: 1385-1395) food web model, with some modifications. This model has the advantages of being mechanistic, relatively simple, open source and publicly available. In addition, model-predicted BSAF values have been shown to compare reasonably well with observed BSAF values in multiple studies (e.g., Gobas and Arnot 2010, ET&C 29: 1385-1395; Fig 3; Greenfield et al. 2015, IEAM 11: 459-473).

The required Tier 2 site-specific information, including the minimum number and type of sediment and fish tissue samples, is clearly spelled out in Table 18 of the amendment. Assuming that there are multiple sediment samples taken at each site (as indicated in Table 18; a minimum of 5), it is not clear how these data enter into the subsequent calculations to estimate $\sum C_{sed}$, BSAF, and the sediment linkage factor. It sounds as if the first two might be based on a single estimate of sediment concentration, whereas the latter attempts to incorporate the variability in sediment concentration measurements at a site. This needs further clarification.

Interpretation of Table 21 is somewhat difficult to follow, and an example in the text would help to add clarity. For example (and assuming I understand this correctly), if the estimated fish tissue concentration is less than half of the observed fish tissue concentration (i.e., linkage threshold < 0.5) for 75% or more of the samples, then the site sediment linkage (outcome in Table 21) is

categorized as “very low”. Possibly, addition of Figure 7 from Greenfield et al. (2015) would add clarity. A combination of the chemical exposure evaluation (Table 20) and the site sediment linkage evaluation (Table 21) is used to determine the overall site assessment over a range from “unimpacted” to “clearly impacted” (Table 22). Use of these multiple categories is much better than a simple binary impacted vs. unimpacted categorization.

A Tier 3 assessment may be triggered when there are unique conditions associated with a site, to incorporate spatiotemporal factors into the assessment, to test Tier 2 assumptions, or to increase the accuracy or precision of a Tier 2 assessment. The intent is to allow for greater flexibility by allowing some of the parameters held constant at Tier 2 to be modified while keeping the overall decision framework indicators and decision criteria the same (important for ensuring consistency and transparency). Approval from the Regional Board is required in order for a Tier 3 assessment to be conducted and any changes in parameters compared to Tier 2 must also be approved. The strategy to only require added Tier 3 refinements when the specific site situation requires them, and that any such refinements need prior approval, is clearly in line with goals 3, 4, and 5 above.

General Comments on Proposed Amendments

The proposed amendments associated with the SQO for human health are based on well-developed and published methods and employ a tiered approach. The models and methods have been thoroughly evaluated in the peer-reviewed literature and demonstrated to be scientifically sound. The tiered approach is cost effective and designed to minimize unnecessary testing, monitoring, and assessment. Likewise, the weight of evidence approach to determine impacts on benthic communities that combines toxicity, benthic community condition, and sediment chemistry is a reasonable and pragmatic approach that has a long history of use. Thus, the proposed amendments fulfill the five goals outlined above.

In general, the proposed amendments do an excellent job of minimizing reliance on best professional judgement compared to current practice (Attachment 6 – Draft Staff Report). This is an important improvement that will enhance consistency and transparency of the assessment process.

The most important limitation of the approach is that it is restricted to a few legacy chemicals, and other groups of chemicals will continue to be assessed using current methods. As the revised approach begins to be implemented, it could be worthwhile to estimate the actual benefits (time, effort, money saved) of the revised approach as well as any improvements to beneficial uses of California’s enclosed bays and estuaries compared to historical practices.

Clearly the Conceptual Site Model development (Appendix A-5) is a key part of the overall process. Based on the description, it would seem that this could possibly be the most time-consuming step in a site assessment. Presumably, the largest effort would be required the first time that a site was being considered for assessment, and future assessments would only require minor revisions to existing CSMs. Since my understanding is that a goal of the amendments is to promote the efficient use of resources, it might be worth adding some text to this effect to Appendix A-5. Why is there no corresponding Appendix to address the aquatic life SQO?

Overall, the proposed amendments document (Attachment 6) is rather difficult to follow with multiple cross-listings to various appendices. This is not facilitated by the rather complicated structure of the document, e.g., Chap IV.A.4.d.5. A more logical and hierarchical structure could be: Chap 1; section 1.1; subsection 1.1.1, etc.

Additional Specific Comments:

The proposed amendment document contains a mix of Roman and Arabic numerals to describe the Tiers (e.g., 2 or II). This should be cleaned up for consistency.

It is unclear how the weighting factors were derived for the CSI in Table 6. This should be explained.

For ease of reference, a table should be provided with the OEHHA Advisory Tissue Levels based on 5 day consumption rates for subsistence fishers along with Table 16.

External Peer Review of Proposed Revisions to Sediment Provisions contained in the Water Quality Control Plan for Enclosed Bays and Estuaries of California

Re: External Peer Review by Dr. Robert J. Letcher
(Environment and Climate Change Canada, Departments of Chemistry and Biology, Carleton University, Ottawa, Ontario, Canada)

Date: March 8, 2018

As detailed in Attachment 1 (Summary of the Proposed Revisions), proposed amendments to two narrative sediment quality objectives (SQOs) are described and in relation to how these SQOs are applied and implemented. The proposed amendments are with respect to: 1) the application and implementation of the SQO protecting human consumers of resident sport fish from contaminants that bioaccumulate from sediment into fish tissue, and 2) the application and implementation of the SQO protecting benthic communities from direct exposure to pollutants in sediment.

As agreed between this external peer reviewer (Dr. Robert J. Letcher) and the manager of the Cal/EPA Scientific Peer Review Program (Dr. Gerald W. Bowes), the present review evaluates the following scientific conclusions listed in Attachment 2, A-3, A-4, A-5, A-6, A-7, B-1 and C (additional issues related to the big picture). This review evaluates whether the scientific findings, assumptions and conclusions to be evaluated are based on sound scientific knowledge, methods and practices. The conclusions in Attachment A for issues A-3, A-4, A-5, A-6 and A-7 address the narrative SQO state that `*Pollutants shall not be present in sediments at levels that will bioaccumulate in aquatic life to levels that are harmful to human health in bays and estuaries of California*.`. Each of these conclusions address two fundamental questions, namely:
1) Do contaminants in resident fish tissue pose an unacceptable health risk to humans consuming those fish?
2) Are sediment-associated contaminants at the site or area of interest contributing to the contaminant burden in fish tissue?

The conclusions under `A` that are presently evaluated are specific to the second question, in reference to the Draft Staff Report (Attachment 5; in Sections 3 and/or 6), and the Proposed Amendments/Revisions (Attachment 6; specifically in Section IV). Relevant journal references in connection with the present evaluation are:
Ben K Greenfield, Aroon R Melwani, and Steven M Bay (2015), A Tiered Assessment Framework to Evaluate Human Health Risk of Contaminated Sediment, Integrated Environmental Assessment and Management.
Gobas, Frank and Jon A. Arnot, 2010, Food Web Bioaccumulation Model for Polychlorinated Biphenyls in San Francisco Bay, California, USA. Environmental Toxicology and Chemistry, Vol. 29, No. 6, pp. 1385–1395, 2010.

In the course of the present review, other applicable and relevant reference are cited and are listed at the end of the review document.

A-3. The relative influence of site sediment contamination on fish contamination is an appropriate indicator of the contribution of site sediment contamination.
In order to address the second question, the assessment framework requires an evaluation of site linkage; the proportion of measured tissue contaminant concentration estimated to result from site sediment contamination, calculated as a ratio of the estimated tissue concentration and the measured tissue concentration.

R. Letcher review:
The assessment framework for this SQO relies on the chemical exposure indicator for measures of sport fish contamination from the site and in comparison to consumption advisory thresholds. The SQO also relies on the site linkage indicator, which compares sport fish contamination measurements to estimated sport fish concentrations that would result from site exposure. The relative influence of site sediment contamination on fish contamination is an appropriate indicator of the contribution of site sediment contamination. The site linkage is sound based on the proportion of measured tissue contaminant concentration as a good estimate from site sediment contamination, which is calculated as a ratio of the estimated tissue concentration and the measured tissue concentration. The reasons for this agreement by the reviewer are described, and in the context of the tiered assessment framework in the subsequent conclusions. However, some additional factors to consider and recommendations are also detailed.

With respect to the chemical exposure indicators, and in the context of the actual chemical contaminants to which the assessment framework applies, the target chemicals represent but of fraction of the known and unknown substances (Appendix A-7). Since the framework is specific to non-polar (or more lipophilic) chlorinated hydrocarbons (e.g. DDTs, PCBs, chlordanes and Dieldrin), these chemicals do not necessarily reflect the complexity of sediment contamination, which may be contributing to the contaminant burden in exposed fish. Numerous emerging and new chemicals have been reported in marine and freshwater sediment and in biota (including fish) in respective sites and ecosystems. Many of these new contaminants are more polar in nature and in many cases are short abiotic and biotic half-lives due to their instability to e.g. photolytic, microbial and metabolic degradation processes. Furthermore, many new chemicals are less lipophilic and thus bioaccumulation factors from sediment will be much lower than e.g. PCBs and also are likely to be cleared and depurated more rapidly. Such new chemical contaminants include emerging flame retardants (Chen et al. 2015), and pharmaceutical and personal care products (PPCPs). PPCPs currently number in the thousands of different compounds (e.g., antibiotics, blood lipid regulators, analgesics/anti-inflammatory agents, antidepressants, antiepiletics, and antineoplastics), and they comprise a wide range of different chemical structures (Hua et al. 2006). PPCPs are viewed as emerging or newly established environmental contaminants and have experienced decades of unrestricted discharge to the environment. Point sources, such as wastewater and sewage treatment plants as well as surface runoff, are the main sources of PPCPs to the aquatic environment have been reported in WSTP effluent, surface waters and groundwaters. Organophosphate esters (OPEs) are current-use and high production volume chemicals, and are a good example of contaminants that have been shown recently to be unstable in aquatic media (e.g. Su et al. 2016) and via rapid metabolism in wildlife and fish (Greaves and Letcher 2017; Greaves et al. 2016a, 2016b).

It is true that organisms can be exposed to and affected by sediment contaminants by multiple pathways that are both direct and indirect. Contamination in organisms can occur via direct contact with the sediment and sediment ingestion. Organisms living in the sediment are also exposed through the uptake of contaminants from pore water and via ingestion of sediments and subsequent accumulation by desorption during digestive processes in the gut, and via the consumption of contaminated prey. It is correct that the direct affect of the benthic community present at a site may be altered by a variety of environmental factors in addition to adverse effects from contaminants. Therefore, it is necessary to understand how these environmental factors affect benthic communities before the effects of contaminants can be discerned. The tools used to determine benthic community condition (benthic indices) should be calibrated to specific habitat types in order to provide an accurate assessment of biological condition of a site-specific community.

Described in the Draft Amendments Section, Chapter IV (A. 2. b3) are the field procedures for the assessment framework for the SQO components of chemical exposure indicators and site linkage indicators. The field procedures for sediment and fish collections are comprehensive and well designed. Grab sampling of surface sediment from the upper 5 cm for chemistry analyses is logical as the upper 5-10 cm best reflects the benthic community exposure and the real-time variations in the sediment contamination as this top layer is subject to continuous changes to the physical and ecological aspects and the aquatic system and site. Such surface sediment sampling is routine for ongoing contaminant monitoring in Great Lakes jurisdictions by e.g. the US EPA and Environment and Climate Change Canada. A good example of Canada-U.S. cooperation in this regard is the study of flame retardant and other chemicals in sediment from several important sites in the Great Lakes (Letcher et al. 2015; Lu et al. 2015; Trouborst et al. 2015).

The eight dietary guilds and the nine primary guild fish species identified in Appendix A-6 for sampling, is a comprehensive design to provide a good coverage of the sport fish species and the dietary exposure pathways from sediment, which are inherent to the bays and estuaries of California. It is also wise to have an alternate list of relevant and harvestable secondary species in the event that a primary species cannot be collected from the given site. Unless there are compelling reasons to do so, such alternate species inclusions should be keep to a minimum so that there is maximum similarities on the suite of species tested for optimal comparisons between affected sites.

As for the sediment and tissue chemical analysis to be included as per Appendix A-7, see this reviewer`s earlier concern regarding the breath of chemicals of aquatic concern, which should include priority substances that are not necessarily nonpolar and lipophilic with respect to bioaccumulation. The attention to sampling design details is supported by this reviewer. That is, before commencing with sample collection, a study design and work plan must be developed and approved by the Regional Board, but with a conceptual site model serving as the basis for the study design, define the site boundaries, guide selection of sport fish species to evaluate, and identify appropriate sediment contamination data.

Finally, it is stated that all (fish and sediment) samples are tested in accordance with USEPA or American Society for Testing and Materials (ASTM) methodologies where such methods exist.

As listed in Table 15 in the Draft Amendments Section, Chapter IV (A. 2. b4), such testing is specific only for selected organochlorine pesticides (DDTs, chlordanes and Dieldrin) and a suite of PCB congeners (Appendix A-7). As mentioned previously, there are no details for the testing inclusion for newer and current-use chemicals (e.g. flame retardants and PPCPs) that are produced in high volume and found to be globally ubiquitous in aquatic environments, and particularly ones that receive heavy inputs from densely populated centers such as for bays and estuaries of California. It appears that some allowance for other priority contaminants is insinuated in the statement that where no EPA or ASTM methods exist, the Water Boards shall approve the use of other methods. It is strongly encouraged by this reviewer that this statement be expanded to include details that allow for the sediment and fish testing of newer chemicals that have been established as (aquatic) environmental pollutants. Further, to indicate some testing flexibility in this regard where new contaminant issues specific to certain bays and estuaries of California are warranted and represent a proven or potential exposure issue for benthic sediment communities and the primary and secondary gild fish species that exist in these affected sites. For sediment exposed aquatic organisms, the approach is sound that laboratory toxicity tests be used to assess the direct effects of, as well as the bioavailability of, sediment contaminants are based on lethal or sublethal responses of test species exposed to the sediment under controlled conditions.

A-4. Bioaccumulation modeling is an appropriate method to evaluate site sediment linkage. Estimated tissue concentrations are obtained using the steady state Gobas Food Web Model, calibrated for eight different feeding guilds. These feeding guilds encompass a variety of fish and their associated dietary preferences within California enclosed bays and estuaries.
Suggested References:

R. Letcher review:
The eight dietary or feeding guilds and the nine primary guild fish species are identified in Appendix A-6. There is also an alternate list of relevant and harvestable secondary species in the event that a primary species cannot be collected from the given site. The assessment framework estimates fish tissue concentrations of the prioritized contaminants (Appendix A-7) using the steady state Gobas Food Web Model. It is true that chemical indicator-site linkage is typically evaluated by calculation of an empirical biota-sediment accumulation factor (BSAF; Gobas and Arnot 2010), using available field data as well as calculation methods. Although useful for risk assessment screening and planning purposes, BSAFs are indeed influenced by factors not directly related to sediment contamination at the site of interest, such as atmospheric inputs, currents, watershed runoff, and fish migration from other sites. The influence of various unknown site-specific and biological factors can be substantial. As a consequence it is true that BSAFs have been shown to vary by an order of magnitude or more between sites for similar chemicals and species. It is agreed that the determination of site linkage for the purposes of SQO assessment represents a special situation that may not be effectively represented by the BSAF. Since the SQO is intended to protect sediment quality at the site, it is important to distinguish the influence of site sediment contamination on the seafood from that due to other sources (e.g., off site contamination).

As described in the Draft Amendments Section, Chapter IV (A. 2. d4) for determination of the site linkage, using an alternate approach rather than using BSAF values alone (Gobas and Arnot, 2010), is sound as it considers the possible influence of various unknown site-specific and biological factors for a given contaminant. That is, comparing tissue concentrations estimated from site sediments to the observed sport fish tissue contaminant concentration for a given fish species used in the chemical exposure evaluation. The use of the Monte Carlo simulation is appropriate and sound to generate a cumulative distribution of the site linkage factor. This reviewer is in agreement with seafood bioaccumulation from site sediment contamination should be model-based and relative to bioaccumulation derived from all field data sources that are available and applicable.

As for quantification of site-related accumulation of contaminants, it is true that the food web bioaccumulation model for PCBs (or Gobas food web model) has been validated for several fish species relevant to assessing human health impacts (Gobas and Arnot 2010). Furthermore, this model has been shown to be effective in estimating PCB bioaccumulation from sediment in fish and wildlife. While it is true that the structure of this model is adaptable for other fish species, this reviewer notes a few caveats that should be considered in this assumption that the model can be applied to other chemical contaminants. This model is proven for contaminants such as PCBs that are among the more recalcitrant and bioaccumulative environmental contaminants in biota including in fish. However, for many emerging chemicals of concern there remains a dearth of available information on physico-chemical properties, environmental persistence, bioaccumulation, fate and other behaviors, as well as compound-specific information on uptake, deposition and depuration processes in exposed biota and including for fish. Many of these `new` contaminants are biotically and abiotically unstable including enzyme-mediated metabolism and other species-specific depuration pathway in exposed organisms. A prime example are organophosphate ester (OPE) flame retardants and plasticizers, which have been shown to be rapidly metabolized in a limited number of studies that are field and lab (*in vivo* and *in vitro*) based for exposed mammal, bird and fish species from both marine and freshwater aquatic environments (Fernie et al. 2015; Greaves et al. 2016a, 2016b; Greaves and Letcher, 2017). This is also true of many of the new flame retardant chemicals that have been mostly regulated (e.g. polybrominated diphenyl ethers and hexabromocyclododecane) but more so for the (brominated) chemicals that are replacement and in current-use and that have been identified as contaminants in aquatic environments and ecosystems (e.g, Chen et al. 2015; Giraudo et al. 2017; Su et al. 2017). An important point to mention is that if food web bioaccumulation models that do not adequately account for (e.g. fish) metabolism for a given chemical contaminant, than the (Gobas) food web model may be underestimating the sediment-based exposure and accumulation in fish, and thus an accurate categorization of the chemical exposure-site linkage.

A-5. Site specific and species-specific data are required to assess sediment linkage.
Measured site sediment concentrations, dissolved water concentrations, sediment total organic carbon, fish forage area, and site area represent key bioaccumulation model inputs.

R. Letcher review:
I fully concur that measured site sediment concentrations, dissolved water concentrations, sediment total organic carbon, fish forage area, and site area represent key bioaccumulation

model inputs. Exposure of fish to sediment contamination within the assessment site has a major influence on the strength of the linkage between site sediment contamination and bioaccumulation. Other important factors are home range (in conjunction with the size of the area selected for assessment), and fish movements, foraging area and habitat quality. Also, variability in sediment chemical concentration is influenced by heterogeneity, gradients, hotspots and the physio-chemical properties of the contaminant in question such as the variability of bioaccumulation factors for nonpolar organics in aquatic organisms. It is good practice that using an expansion of the site area of the assessment provides greater confidence that the home range of a given fish species is included to reduce the sensitivity of the assessment to detect a significant site linkage.

As described in the Draft Amendments Section, Appendix A and Chapter IV (A. 2. d4) for site specific and species-specific data to assess sediment linkage, the recommendation of using alternate 2 is an appropriate choice. That is, adjust the site linkage calculation for offsite foraging through use of a site use factor and consider fish movement and sediment contamination heterogeneity in selection of site boundaries (as per Table 6.5).

A-6. The approach, methods and assumptions set forth in the optional Tier 1 Screening Evaluation are appropriate for screening low risk sites or waterbodies. The assessment framework consists of three tiers to address varying site conditions and situations from the simple (Tier 1) to complex (Tier 3). The optional Tier 1 is a conservative screening evaluation intended to distinguish low risk sites that clearly meet the SQO from those sites that require the full analysis of Tier 2 to make a confident assessment. Tier 1 uses either sediment or tissue data to directly compare tissue concentrations to OEHHA tissue thresholds. A table of model generated biota-sediment accumulation factors is used to convert sediment concentrations to expected tissue concentrations for comparison with tissue thresholds. The two possible outcomes from Tier 1 are Pass (sediment is unimpacted and meets the SQO) or conduct Tier 2 assessment.

R. Letcher review:

As described in the Draft Amendments Section, Chapter IV (A. 2. b and c), Tier I screening assessment allows for the rapid site assessment and uses conservative assumptions with low data requirements for assessments of low risk sites and waterbodies. The Tier 1 Screening Evaluation uses standardized conservative methods to evaluate the potential chemical exposure to human consumers of sport fish. The purpose of this tier is to determine whether site sediments pose a sufficient risk to warrant a complete (i.e., Tier 2) site assessment.

An upper confidence limit (UCL) of 95% of the arithmetic mean is generally used as a conservative assumption in risk assessment. It was initially suggested that for a Tier 1 assessment that the 95% URL be used for contaminant concentrations from sediment or tissue data. A drawback is that such an assessment uses available data and for cases where a small sample size is used to calculate the contaminant concentration. As recommended in the Staff Draft Report (pg. 83), the alternative 3 approach is recommended where the 95% UCL of the mean is used to estimate a contaminant concentration, but in cases where the sample size is less than three use the maximum concentration. This reviewer agrees that because of the increasing uncertainty associated with smaller sample sizes, it would be more logical to use the more

conservative maximum concentration in place of the 95% UCL for a given chemical. However, this reviewer recommends caution in the use of maximum concentration for assessment at the Tier 1 level for data from very small sample sizes. For sample sized below 10, it becomes increasingly likely that a maximum concentration for a given sample may not be representative of the sample set and could possibly be an outlier. There would be greater confidence in the maximum concentration approach is for e.g. 3 samples there was a clear consensus in the values where perhaps a 20% variation exists among the three measurements.

Tier 1 sediment evaluation is based on chemical exposure and is performed by comparing the measured contaminant concentration in sediment to the sediment thresholds (listed in Table 16 of the Draft Amendments Section, Chapter IV). The sediment threshold is calculated by dividing the tissue threshold by the BSAF. In general, this reviewer agrees the recommendation of alternate 2 (Draft Staff Report, pg. 83) to calculate standardized Tier 1 BSAF results for each contaminant in each dietary guild, at incremental organic carbon intervals to be used in determining sediment thresholds. It was previously commented in conclusion A-4 that it is true that the structure of the Gobas food web model is based on PCBs and may be adaptable for multiple fish species and to DDTs and chlordanes. A note that the sediment contaminant complexity goes well beyond PCB a few legacy pesticides (Appendix A-7). There are many new and emerging aquatic contaminants and ones of priority to a given site should (eventually) be considered. For a given emerging contaminant, caution and the testing and further validation of the Gobas food web model is recommended, and the model is not likely to be well suited for chemicals of concern that are more polar, lipophilic and environmentally unstable.

Any Tier 1 interpretation in considering fish tissue or sediment concentrations in samples are made relative to threshold levels (Draft Amendments, Table 16). As per Table 6.2 (pg. 84) in the Draft Staff Report, for all eight sediment and tissue evaluation scenarios it is only when above scenario six (sediment impacted, tissue potentially impacted) that Outcome Approaches 1 and 2 differ. This reviewer agrees with alternative 2 for scenario seven (sediment potentially impacted, tissue not impacted) that an assessment should not advance to Tier 2. This makes sense because the contaminant exposure from the sediment my exceed the threshold but the concentration in the fish tissue is not high enough to warrant Tier 2 concern. This may be due to some pathway-specific inefficiency in the uptake of the contaminant in the fish, or possibly an relatively efficient rate of clearance results in lower tissue concentrations in the fish.

A-7. The approach, methods and assumptions set forth in Tiers 2 and 3 are appropriate for designating sites as either impacted or unimpacted. Tiers 2 and 3 require analysis of both sediment and tissue chemistry data to assess whether site sediments meet or exceed the narrative objective; these tiers differ in the level of standardization and incorporation of site-specific parameters or conditions. A logic matrix is used for Tiers 2 and 3 in order to integrate the outcomes of the two indicators into site categories of Unimpacted, Likely Unimpacted, Possibly Impacted, Likely Impacted and Clearly Impacted. Sediments designated as Unimpacted and Likely Unimpacted meet the SQO, while sediment categorized Possibly Impacted, Likely Impacted and Clearly Impacted do not meet the SQO.

R. Letcher review:

As described in the Draft Amendments Section, Chapter IV (A. 2. d and e), Tier 2 screening assessment is the main approach proposed for evaluating sediment quality in relation to the human health narrative SQO. Tier 2 consists of an evaluation of both tissue data and sediment data to determine potential hazard to human health, using available site-specific information. For SQO assessment, a method is needed to determine the relative influence of site sediment contamination on tissue burden, in comparison to other sources not associated with the site. Bioaccumulation models can theoretically be used to estimate the relative influence of site vs. offsite exposure sources on tissue burden (e.g., by comparing estimated tissue concentrations for each type of source), but modelling of offsite sources can be very complex and the needed data are rarely available. As noted in the Draft Staff Report, this reviewer agrees with alternative 4 where the proportion of seafood bioaccumulation determined from site sediment contamination (model-based) is relative to bioaccumulation derived from all filed data sources.

The Tier 2 evaluation utilizes a combination of site specific variables presented in Table 18 (Draft Amendments Report) and fixed model input parameters. In addition to tissue and sediment contaminant concentrations, the Tier 2 evaluation depends on four other variable plus three optional variables, which define the specific site. Tissue samples are from the nine primary fish species for each dietary guild shall (Appendix A-6), which are California halibut, Spotted sand bass, White catfish, Queenfish, White croaker, Shiner perch, Common carp, Topsmelt and Striped mullet. The fish tissue threshold concentrations in Table 19 are the basis of the Chemical Exposure Evaluation, and based on human consumption serving of one, two and three 8-ounce servings over the course of a week. Tissue categories and outcomes are presented in Table 20. Tier 2 also employs the Gobas food web model to calculate the BSAF for each of the fish guild species. These approaches and methods are reasonable and sound but as previously mentioned, the Gobas food web model as applied to PCBs does not account for metabolic processes and assumes that PCBs in the model are driven by uptake only. This means that there is some limitations to the BSAF for PCBs as well as for DDTs, chlordanes and Dieldrin, and some BSAF over-estimation is possible. Also, many of `new` contaminants are biotically and abiotically unstable including enzyme-mediated metabolism and other species-specific depuration pathway in exposed organisms.

A Monte Carlo simulation is conducted using many random subsamples of the contaminant concentration and BSAF distributions on a log normal basis. Since there are various unknown site-specific and biological factors for a given contaminant, the use of the Monte Carlo simulation is appropriate and sound to calculated cumulative distribution of the site linkage factor. This reviewer is in agreement with seafood bioaccumulation from site sediment contamination should be model-based and relative to bioaccumulation derived from all field data sources that are available and applicable. The sediment linkage thresholds (Table 19) for PCBs, Dieldrin and chlordanes is used to determine the site linkage category (Table 21 in the Draft Amendments Report). The overall site assessment category is determined using the decision matrix presented in Table 22 (or Table 6.7 in the Draft Staff Report). As noted in the Draft Staff Report, this reviewer agrees with alternative 3 where a logic matrix is used to provide a standardized interpretation of each indicator combination relating to multiple categories of impact.

Tier 3 assessment is intended to provide flexibility in the assessment approach to address special circumstances or complex situations where the standardized Tier 2 assessment is not able to provide an accurate result. As a Tier 3 assessment uses nonstandard methods for determining chemical exposure and/or site linkage, such an assessment may require substantially more time and cost to implement. Also, the results may not be comparable with assessments based on the Tier 2 approach, resulting in difficulty in comparing conditions among sites and prioritizing the need for management actions.

This reviewer agrees with the stated criteria to proceed with Tier 3 assessment (pg. 30, Draft Amendments Report) where a site must meet one of several conditions that are based on the variation in factors or processes are present that affect contaminant bioaccumulation from sediment, and resulting in a difference in Sediment Linkage category. An important factor is when there are differences in physiological processes affecting bioaccumulation model performance, such as growth rate or assimilation efficiency. Another important factor is when the measured sediment concentrations are not representative of actual fish forage area due to spatial or temporal variations in sediment contaminant distribution, fate, or transport.

B-1. Use of severity of effects and spatial extent is appropriate when evaluating whether sediment dependent beneficial uses are supported in waterbodies. The State Water Board is proposing a new approach that considers severity (any station classified as clearly impacted) and percent area of impact (stations classified as likely or possibly impacted, not to exceed 15 percent). The State Water Board currently relies on a frequency of exceedance approach based on the binomial statistic that was originally intended for water column applications.

R. Letcher review:

The implementation of the SQOs is to be conducted in accordance with several provisions. Each addresses a different receptor and/or exposure pathway, and sediments that meet one objective may not meet the other objective. It is logical that compliance with aquatic life objective is determined based on the individual assessment of two or more stations within a site. It also makes sense that compliance with the sport fish objective is based on an overall assessment of a site that encompasses multiple sediment and tissue samples from the site. Therefore, assessment of sediment quality relative to each objective may require a unique study design

Detailed on pages 32 and 33 of the Draft Amendment Report are the exceedances of a receiving water limit to protect aquatic life. The total percent area categorized as Possibly Impacted and/or Likely Impacted equals or exceeds 15 percent of the site area over the duration of a permit cycle. It is reasonable that the calculation of percent area be based on data from spatially representative samples selected using a randomized study design or equivalent spatial analysis.

As detailed in the Draft Staff Report on pages 104-106, the existing approach adopted to apply the SQO protecting benthic communities from pollutants in sediment relies on the binomial statistic to assess whether sediment quality is impaired and whether an exceedance of the receiving water limit has occurred. It is agreed that there is one important difference between the two applications. That is, implementation of the receiving water limitation requires that the degradation must be linked with the discharge. it is agreed that in a case where two stations are

categorized as Possibly, Likely or Clearly Impacted within a single waterbody or segment that has two to twenty-four sediment quality stations monitored, a listing would be required. This reviewer agrees that for delisting a waterbody or segment, the minimum number stations required is twenty-eight stations with a maximum of two stations categorized as Possibly, Likely or Clearly Impacted. As recommended in the Staff Draft Report (pg. 106), this reviewer agrees with the alternative 2 approach recommendation to develop an approach based on size of area impacted and severity of impact.

C. Additional Issues related to the big picture

Questions:
1) In reading the Draft Staff Report and proposed rule, are there any additional scientific findings, assumptions, or conclusions that are part of the scientific basis of the proposed rule not described above?

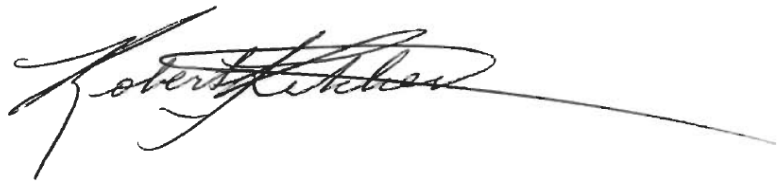
R. Letcher response:
In the context of the SQOs, and as detailed earlier, sediment and fish associated contaminants are complex and not simply restricted to lipophilic and nonpolar compounds such as PCBs, chlordanes, DDTs and Dieldrin. These all constitute historical or legacy contaminants, and do not reflect the complexity of pollutants in aquatic environment where there are many emerging contaminants and where many are currently is use. Many of these new chemicals are less lipophilic and although could accumulated in fish, metabolic and other depuration processes can result in more rapid clearance and different toxicities due to such degradation products. New chemical contaminants include emerging flame retardants, and PPCPs. PPCPs currently number in the thousands of different compounds (e.g., antibiotics, blood lipid regulators, analgesics/anti-inflammatory agents, antidepressants, antiepiletics, and antineoplastics), and they comprise a wide range of different chemical structures (Hua et al. 2006). Another important classes of aquatic contaminants from WSTP discharges and run-off are antimicrobials such as triclosan (Hua et a. 2005). PPCPs are viewed as emerging or newly established environmental contaminants and have experienced decades of unrestricted discharge to the environment. Point sources, such as wastewater and sewage treatment plants as well as surface runoff, are the main sources of PPCPs to the aquatic environment have been reported in WSTP effluent, surface waters and groundwaters. Therefore, the scientific basis of the proposed rule in the present proposed amendments to the SQOs should not assume that this rather small suite of contaminants (OCBs, chlordanes, DDTs and Dieldrin) is entirely reflective of accumulated burden of contaminants in biota and fish from the bays and estuaries of California, and what constitutes contaminant exposure to the people that consume these sport fish.

2) Taken as a whole, is the scientific portion of the proposed rule based upon sound scientific knowledge, methods, and practices?

R. Letcher response:
On the whole, this reviewer agrees that the scientific portion of the proposed rule is based upon sound scientific knowledge, methods, and practices. The approaches, methods and assumptions that form the basis of the Tier 1, 2 and 3 assessments of sediment and fish tissue contaminant

concentrations and biota-sediment bioaccumulation and the resulting evaluation outcomes are well designed. This include a comprehensive array of scientifically proven justifications to meet the SQOs for designating and categorizing assessed sites as Unimpacted, Likely Unimpacted, Possibly Impacted, Likely Impacted and Clearly Impacted.

Signed on March 8, 2018



Robert J. Letcher, PhD

Note: *Dr. Robert J. Letcher is Senior Research Scientist with the Canadian federal government department, Environment and Climate Change Canada. The opinions expressed are those of the author as an independent reviewer, were not conducted as part of his official duties, and do not necessarily reflect the opinions or policy Environment and Climate Change Canada.*

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