

Study 2.4  
**BIOACCUMULATION**  
November 2010

## **1.0 Project Nexus**

Impoundment of water and operation of the Yuba County Water Agency's (YCWA or Licensee) Yuba River Development Project (Project) facilities have potential to increase the methylated mercury in the system, making it available for bioaccumulation through various trophic levels of the aquatic ecosystem.

## **2.0 Resource Management Goals of Agencies and Indian Tribes with Jurisdiction over the Resource Studied**

[Relicensing Participants - This section is a placeholder in the Pre-Application Document (PAD). Section 5.11(d)(2) of 18 CFR states that an applicant for a new license must in its proposed study "*Address any known resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied.*" During 2010 study proposal development meetings, agencies advised Licensee that they would provide a brief written description of their jurisdiction over the resource to be addressed in this study. If provided before Licensee files its Proposed Study Plan and Licensee agrees with the description, Licensee will insert the brief description here stating the description was provided by that agency. If not, prior to issuing the Proposed Study Plan, Licensee will describe to the best of its knowledge and understanding the management goals of agencies that have jurisdiction over the resource addressed in this study. Licensee]

## **3.0 Study Goals and Objectives**

The goal of the study is to characterize the concentration of methylmercury in edible-size fish in the Project's New Bullard's Bar Reservoir.

## **4.0 Existing Information and Need for Additional Information**

Available information consists of existing regulatory plans and advisories for the watershed, as well as water quality data collected to date in the Project Area.<sup>1</sup>

---

<sup>1</sup> The Project Area is defined as the area within the FERC Project Boundary and the land immediately surrounding the FERC Project Boundary (i.e., within about 0.25 mile of the FERC Project Boundary) and includes Project-affected reaches between facilities and downstream to the next major water controlling feature or structure.

## 4.1 Regulatory Status for Surface Water and Fish in the Project Area

Beneficial uses and water quality objectives for the Project Area are documented within the Central Valley Regional Water Quality Control Board's (CVRWQCB) *Water Quality Control Plan (Basin Plan) for the Sacramento and San Joaquin Rivers*, the fourth edition, which was initially adopted in 1998 and most recently revised in 2007 (CVRWQCB 1998). The Basin Plan's designations for Yuba River Development Project and the area downstream of the Project include freshwater aquatic habitat (COLD) and water contact recreation (REC-1), which incorporate the uses commercial or recreational collection of fish, shellfish, or organisms. Since the main concern with mercury is that it bioaccumulates in aquatic systems to levels that are harmful to fish and their predators, including humans, the presence of mercury in its bioavailable form (methylmercury) has the potential to impair Project waters due to toxicity.

The toxicity water quality objective states that “...all waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life.”

Section 303(d) of the Clean Water Act (CWA) requires that every two years each State submit to the United States Environmental Protection Agency (EPA) a list of impaired rivers, lakes and reservoirs for which pollution control or requirements have failed to provide for water quality. Based on a review of this list and its associated Total Maximum Daily Load (TMDL) Priority Schedule, in the Project Vicinity,<sup>2</sup> United States Army Corps of Engineer's (USACE) Englebright Reservoir has been identified by the State Water Resources Control Board (SWRCB) as CWA §303(d) State Impaired for potential toxicity due to mercury (SWRCB 2006). There are currently no approved TMDL plans for the Yuba River.

In 2009, the CVRWQCB recommended including additional surface waters in the Project Vicinity to the 303(d) list as impaired for mercury: New Bullards Bar Reservoir, the Middle Yuba River, the North Fork Yuba River from New Bullards Bar Dam to Englebright Reservoir, the South Yuba River from Lake Spaulding to USACE's Englebright Reservoir, and the Lower Yuba River from USACE's Englebright Reservoir to the Feather River (CVRWQCB 2009). These recommendations were based on fish tissue mercury data provided in SWRCB (2002) and Melwani et. al. (2007) [See Section 4.2.] and the potential impairment of beneficial uses due to toxicity. These recommendations must be approved by the SWRCB and the United States EPA before the list is modified.

Along a parallel regulatory path, using available fish tissue data and risk-based methodologies, the Office of Environmental Health Hazard Assessment (OEHHA) has issued species-specific fish ingestion advisories for trout, sunfish and bass caught in USACE's Englebright Reservoir (OEHHA 2003, OEHHA 2009). In the Project Vicinity, fish ingestion advisories previously issued for Deer Creek, a tributary to the Yuba River, and the Lower Yuba River from USACE's Englebright Reservoir to the Feather River were recently retracted (OHHEA 2009).

---

<sup>2</sup> The Project Vicinity is defined as the area surrounding the Project in the order of a United States Geological Survey 1:24,000 topographic quadrangle.

## 4.2 Existing Methylmercury Bioaccumulation Information

Existing, relevant and reasonably available information found at the Project Area was documented in Section 7.2.9 of the Licensee's Pre-Application Document and is summarized below

Since the early 1990's, the upper Yuba River watershed has been studied by University of California, Davis, and the United States Geological Survey (USGS) (Alpers et al. 2005; Hunderlach et al. 1999; May et al. 2000; Slotton et al. 1995 IN May et al. 2000; and Slotton et al, *in preparation IN OEHHA 2009*). Findings from these studies indicate that significant amounts of Gold Rush era mercury still exist in sediments, surface water and fish of the upper Yuba watershed. Sediments are being transported downstream into reservoirs on the Yuba River, where they are largely trapped (Hunderlach et al. 1999; Alpers et al. 2005). Findings from these studies also indicate that fish tissue concentrations of mercury the criteria established for protection of human health at some locations (Table 4.2-1).

**Table 4.2-1. Mercury measured in fish tissue in the Project Vicinity.**

Location	Species Sampled	Number of Fish	Mercury, Total (ppm) <sup>1</sup>	Total Length (mm)	Data Source
<b>UPSTREAM OF THE PROJECT AREA</b>					
North Yuba River near Canyon Creek	Rainbow trout	5	0.19 - 0.14 (avg 0.11)	236 - 311	Slotton et al. (1997)
Middle Yuba River one mile upstream of Plumbago Road	Rainbow trout	5	0.05 - 0.19 (avg 0.11)	292 - 415	Slotton et al. (1997) <i>IN CVRWQCB (2009)</i>
Middle Yuba River upstream of Kanaka Creek [one mile upstream of Tyler Foote crossing]	Rainbow trout	9	0.10 - 0.24 (avg 0.16)	210 - 387	
Middle Yuba River just upstream of Oregon Creek and Highway 49	Rainbow Trout	3	0.15-0.21 (avg 0.18)	204 - 278	
	Sacramento Pikeminnow	2	0.56 and 0.81	321 - 339	
Middle Yuba River one mile downstream of the Highway 49 crossing	Sacramento Pikeminnow	4 (composite)	0.64	≥ 150	SWRCB (2002) <i>IN CVRWQCB (2009)</i>
South Yuba River below Lake Spaulding	Brown trout	2	0.07 and 0.07	224 -249	Slotton et al. (1997) <i>IN CVRWQCB (2009)</i>
	Rainbow trout	3	0.06-0.11 (avg 0.080)	180 - 228	
South Yuba River at Washington	Rainbow trout	13	0.10 - 0.30 (avg 0.15)	183 - 345	Slotton et al. (1997) <i>IN CVRWQCB (2009)</i>
South Yuba River just downstream of Edwards Crossing	Rainbow trout	2	0.09 and 0.15	182 - 270	May et al. (2000) <i>IN CVRWQCB (2009)</i>
South Yuba River near Bridgeport	Smallmouth Bass	3 (composite)	0.69	≥ 150	SWRCB (2002) <i>IN CVRWQCB (2009)</i>
<b>WITHIN THE PROJECT AREA</b>					
New Bullards Bar Reservoir-- East Arm near its confluence with the West Arm	Smallmouth Bass	13	0.22 - 0.68 avg 0.39	≥ 150	SWRCB (2002) <i>IN CVRWQCB (2009)</i>

**Table 4.2-1. (continued)**

Location	Species Sampled	Number of Fish	Mercury, Total (ppm) <sup>1</sup>	Total Length (mm)	Data Source
<b>WITHIN THE PROJECT AREA (continued)</b>					
New Bullards Bar Reservoir-- East Arm near the Willow Creek inlet	Bluegill	3	0.12-0.39 (avg 0.21)	≥ 150	Melwani et al. (2007) <i>IN</i> CVRWQCB (2009)
	Carp	11	0.34-0.83 (avg 0.52)	≥ 150	
	Largemouth Bass	1	0.61	≥ 150	
	Smallmouth Bass	10	0.29-0.72 (avg 0.48)	≥ 150	
	Carp	6 (composite)	0.61	≥ 150	SWRCB (2002) <i>IN</i> CVRWQCB (2009)
	Smallmouth Bass	5 (composite)	0.63	≥ 150	
New Colgate Powerhouse Reach, approximately 1.3 miles upstream of USACE's Englebright Reservoir	Smallmouth Bass	5	0.27 - 0.56 avg of 0.38	≥ 150	SWRCB (2002) <i>IN</i> CVRWQCB (2009)
USACE's Englebright Reservoir—South Yuba Arm, Hogsback Ravine Arm, and mid-section.	largemouth smallmouth and spotted bass	56	0.45 (mean)	338 (mean)	May et al. (2000) and Slotton et al. (1997) <i>IN</i> CVRWQCB (2001); Slotton et. al. in press <i>IN</i> OEHH (2009)
	Bluegill and green sunfish	31	0.30 (mean)	161 (mean)	
	Rainbow trout	49	0.08 (mean)	290 (mean)	
	Carp	1	0.88	440	Slotton et al. (1997)
	Hardhead	1	0.47	540	
	Sacramento sucker	5	0.41-0.89	410-523	
Narrows 2 Powerhouse Reach, Lower Yuba River, approximately 2.2 miles downstream of Englebright Dam	Rainbow Trout	9	0.07 - 0.13 avg 0.10	≥ 150	Slotton et al. (1997) <i>in</i> CVRWQCB (2009)
Little Deer Creek at Pioneer Park, less than one mile from the confluence with Deer Creek (tributary to Yuba River)	Brown trout	6	0.23 - 0.39 avg 0.32	≥ 150	May et al. (2000); SWRCB (2002) <i>IN</i> CVRWQCB (2009)
<b>DOWNSTREAM OF THE PROJECT AREA</b>					
Daguerre Point Dam Reach, Lower Yuba River, approximately 0.9 miles upstream of its confluence with the Feather River	Rainbow Trout	1	0.02	≥ 150	SWRCB (2002) <i>IN</i> CVRWQCB (2009)
	Sacramento Pikeminnow	1	0.46		
	Sacramento Sucker	2	0.22 and 0.38		
	Smallmouth Bass	4	0.26-0.72 (avg 0.43)		
Lower Yuba River, approximately 3.6 miles upstream of its confluence with the Feather River	Sacramento Pikeminnow	2	0.31 and 1.43	≥ 150	Davis et al. (2002) <i>IN</i> CVRWQCB (2009)
	Sacramento Sucker	5 (composite)	0.39		
	Rainbow Trout	3	0.08-0.1 (avg 0.09)	310 (avg)	Grenier et al. (2007) <i>IN</i> CVRWQCB (2009)
	Sacramento Pikeminnow	5	0.19-1.58 (avg 0.84)	≥ 150	
	Sacramento Sucker	3	0.11-0.73 (avg 0.26)	420 (avg)	

<sup>1</sup>All concentrations are in wet-weight.

In the Project Area, Slotton et al. (1997) also observed notably lower invertebrate mercury concentrations below many of the foothill reservoirs, as compared to concentrations in similar biota upstream. Specifically, the invertebrates below New Bullard's Bar Dam were considerably lower in mercury than those collected upstream of the reservoir on the North Yuba River. Similarly, the invertebrates collected below the USACE's Englebright Reservoir were consistently far lower in mercury than samples collected upstream of the reservoir on the Middle and South Yuba River. In contrast, however, reservoir dwelling fish had higher mercury tissue concentrations than fish collected from Coastal Range reservoirs, near historic mercury mines. This would suggest that mercury in the Sierra Nevada reservoirs is in a more bioavailable form than mercury in the Coastal Range reservoirs (Slotton et al. 1997).

Historic data demonstrates mercury concentration in fish; however, additional information regarding some sport fish species in the Project's New Bullards Bar Reservoir would be useful.

## **5.0 Study Methods and Analysis**

The sampling and analysis plan (SAP) and quality assurance project plan (QAPP) of the SWRCB's Surface Water Ambient Monitoring Program's (SWAMP) on-going statewide survey of contaminants in lake and reservoir sport fish will be followed (Davis et al 2007; Bonnema 2007).

### **5.1 Study Area**

The study will be conducted within the reservoir habitat of New Bullards Bar Reservoir

### **5.2 General Concepts and Procedures**

The following general concepts and practices apply to the study:

- Personal safety is the most important consideration of each fieldwork team.
- Licensee will make a good faith effort to obtain permission to access private property where needed well in advance of entering the property.
- Field crews may make minor variances to the FERC-approved study in the field to accommodate actual field conditions and unforeseen problems. When minor variances are made, Licensee's field crew will follow the protocols in the FERC-approved study.
- When Licensee becomes aware of major variances to the FERC-approved study, Licensee will issue an e-mail to the Relicensing Contact List describing the variance and reason for the variance. Licensee will contact by phone the Forest Service (if the variance is on National Forest System land), USFWS, SWRCB and CDFG to provide an opportunity for input regarding how to address the variance. Licensee will issue an e-mail to the Relicensing Contact List advising them of the resolution of the variance. Licensee will summarize in the final study report all variances and resolutions.

- Licensee's performance of the study does not presume that Licensee is responsible in whole or in part for measures that may arise from the study.
- Global Positioning System (GPS) data will be collected using either a Map Grade Trimble GPS (sub-meter data collection accuracy under ideal conditions), a Recreation Grade Garmin GPS unit (3 meter data collection accuracy under ideal conditions), or similar units. GPS data will be post-processed and exported from the GPS unit into Geographic Information System (GIS) compatible file format in an appropriate coordinate system using desktop software. The resulting GIS file will then be reviewed by both field staff and Licensee's relicensing GIS analyst. Metadata will be developed for deliverable GIS data sets.
- Licensee's field crews will record incidental observations of aquatic and wildlife species observed during the performance of this study. All incidental observations will be reported in the appropriate Licensee report (e.g., incidental observations of special-status fish recorded during fieldwork for the Special-Status Turtles – Western Pond Turtle Study will be reported in Licensee's Stream Fish Populations Study report). The purpose of this effort is not to conduct a focus study (i.e., no effort in addition the specific field tasks identified for the specific study) or to make all field crews experts in identifying all species, but only to opportunistically gather data during the performance of the study.
- Field crews will be trained on and provided with materials (e.g., Quat) for decontaminating their boots, waders, and other equipment between study sites. Major concerns are amphibian chytrid fungus, and invasive invertebrates (e.g., zebra mussel, *Dreissena polymorpha*). This is of primary importance when moving: 1) between tributaries and mainstem reaches; 2) between basins (e.g., Middle Yuba River, Yuba River, and North Yuba River); and 3) between isolated wetlands or ponds and river or stream environments.

## 5.3 Methods

This study will include five steps: 1) sample collection, 2) laboratory analysis, 3) evaluation of measured methylmercury fish tissue concentrations for consistency with the screening-level human health protective thresholds, 4) quality assurance, and 5) report preparation. Each of the steps is described below.

### 5.3.1 Step 1 – Sample Collection

Field samples will be handled in a manner consistent with the SWRCB Surface Water Ambient Monitoring Program (SWAMP) Bioaccumulation Oversight Group (BOG) Quality Assurance Project Plan (QAPP) (Bonnema 2007). The SWAMP BOG QAPP incorporates the collection methods outlined in the California Environmental Protection Agency's (Cal EPA) *General Protocol for Sport Fish Sampling and Analysis* (Cal EPA 2005) and California Department of Fish and Game's (CDFG) Method #MPSL-102a (CDFG 2005) for handling of fish. Being consistent with the SWAMP BOG QAPP ensures that tissue results would be consistent with SWAMP's ongoing statewide fish tissue sampling campaign (Davis et al 2009; Davis et al. 2010).

The Marine Pollution Studies Laboratory (MPSL) of the CDFG at Moss Landing will collect the fish for this study. Fish will be collected by electroshocking, fishing line or gill nets over one or two visits. Resident salmonid species will be the target species, as mercury concentrations in smallmouth bass (*Micropterus dolomieu*) and other species have been studied and evaluated by the CVRWQCB and OEHHA (Table 4.2-1). As a goal, nine fish each will be collected of Kokanee salmon (*Oncorhynchus nerka*) and rainbow trout (*O. mykiss*), fish species most routinely sought by fishermen in New Bullards Bar. (Brady, pers. comm.; Table 5.3.1-1.)

**Table 5.3.1-1. Target fish species, sizes and numbers by location.**

Sampling Location	Species <sup>1</sup>	Target Number of Fish for Collection <sup>2</sup>	Edible Size <sup>3</sup> (minimum total length)
New Bullards Bar Reservoir	Smallmouth Bass	9	≥305 millimeters
	Kokanee salmon	9	≥200 millimeters
	Rainbow trout	9	≥200 millimeters

<sup>1</sup> Brady, pers. comm.

<sup>2</sup> OEHHA (2009)

<sup>3</sup> Appendix I of Cal EPA (2005)

For each fish collected, the following attributes will be recorded: species, total length or fork length in millimeters (mm), as appropriate, and weight in grams (g). Electroshock, gill net and line fishing sites will be recorded using a hand-held GPS unit.

### 5.3.2 Step 2 – Perform Analysis

Fish tissue samples will be delivered by the MPSL-CDFG to their laboratory in Moss Landing, California, a California-certified analytical laboratory. Analytical methods will be consistent with the SWRCB SWAMP BOG QAPP, which includes the criteria for data quality acceptability, testing (including deviations), calibration, and preventative and corrective measures (Bonnema 2007). Samples will be analyzed for total mercury, which is assumed to be comprised primarily of methylmercury.<sup>3</sup> The method and reporting limit for mercury in fish tissue is provided in Table 5.3.2-1.

**Table 5.3.2-1. Analytical methods and reporting limits.**

Metal	Analytical Method	Reporting Limit (µg/g wet-weight)
Mercury	EPA 7473 <sup>1</sup>	0.01

<sup>1</sup> EPA 7473 analyzes for mercury in solids and solutions by thermal decomposition, amalgamation and atomic absorption spectrometry (EPA 1998)

µg/g = micrograms per gram or parts-per-million

Results will be reported in wet-weight; however percent moisture will be measured and reported.

<sup>3</sup> Of the total amount of mercury found in fish muscle tissue, methyl mercury comprises more than 95 percent (ATSDR 1999; Bloom 1992).

### **5.3.3 Step 3 – Consistency with Human Health Protective Thresholds**

Methylmercury water quality objectives are expressed as fish tissue concentrations.<sup>4</sup> Consequently, results of mercury analyses will be compared to California's threshold level for determining the potential impairment of a body of water based on pollutants in fish tissue (Davis *et al.* 2009). Measured mercury tissue concentrations will be compared to the OEHHA's current Advisory Tissue Level (ATL) of 0.070 ppm mercury wet-weight (Klasing and Brodberg 2008). The threshold from Klasing and Brodberg (2008) corresponds to a concentration at which OEHHA would begin to consider advising limiting consumption by children and women of child-bearing age to fewer than eight meals per month. Similarly, OEHHA may recommend no consumption by children and women of child-bearing age when fish tissue methylmercury concentrations are greater than or equal to 0.44 ppm wet-weight. By way of comparison, the ATL for an adult male ingesting one serving of fish per week is 0.44 ppm to 1.3 ppm wet-weight.

### **5.3.4 Step 4 – Quality Assurance**

Field and laboratory quality assurance will be ensured by following standard protocols, consistent with the SWRCB SWAMP BOG QAPP (Bonnema 2007).

MPSL is a California-certified laboratory. Analytical methods will be consistent with the SWRCB SWAMP BOG QAPP (Bonnema 2007), which includes the criteria for data quality acceptability, testing (including deviations), calibration, and preventative and corrective measures. Laboratory quality assurance documentation will be attached to the report.

### **5.3.5 Step 5 – Prepare Report**

YCWA will prepare a report that includes the following sections: 1) Study Goals and Objectives; 2) Methods; 3) Results; 4) Discussion; and 5) Description of Variances from the FERC-approved study proposal, if any. Fish tissue concentrations greater than the mercury ATL will be highlighted. MPSL-DFG's field data, laboratory report, and quality assurance information will be attached. Mercury data will be available in Microsoft Excel format.

## **6.0 Study-Specific Consultation**

This study does not require any study-specific consultation.

## **7.0 Schedule**

Licensee anticipates the schedule to complete the study proposal as follows assuming FERC's Study Plan Determination is deemed final on October 20, 2011:

---

<sup>4</sup> For example, the Federal ambient water quality criterion for mercury is 0.3 mg/kg (or ppm) methylmercury/fish tissue wet-weight, regardless of a person's age or meal frequency (USEPA 2001).



Collect Data (Step 1).....	October-November 2011
Lab Analysis (Step 2).....	December 2011 – February 2012
Consistency with Thresholds (Steps 3).....	March – April 2012
Quality Assurance (Step 4).....	May - June 2011
Report Writing .....	September - October 2012

## **8.0            Consistency of Methodology with Generally Accepted Scientific Practices**

The study methods discussed above are consistent with the study methods followed in several other relicensings. The methods presented in this study plan also are consistent with those used in recent relicensings in California.

## **9.0            Level of Effort and Cost**

[Relicensing Participants – Licensee will include a cost range estimate for this study in its Proposed Study Plan. Licensee]

## **10.0          References Cited**

Alpers, C.N., M.P. Hunerlach, J.T. May, R.L. Hothem, H.E. Taylor, R.C. Antweiler, J.F. DeWild, and D.A. Lawler. 2005. Geochemical characterization of water, sediment, and biota affected by mercury contamination and acidic drainage from historical gold mining, Greenhorn Creek, Nevada County, California. 1999/2001: U.S. Geological Survey Scientific Investigation Report 2004-5251, 278p. URL: <pubs.usgs.gov/fs/2005/3014/>

Agency for Toxic Substances and Disease Registry (ATSDR). 1999. Toxicological profile for mercury (update). Prepared by Research Triangle Institute under contract no. 205-93-0606. Public Health Service, U.S. Department of Health and Human Services.

Bloom, N.S. 1992. On the chemical form of mercury in edible fish and marine invertebrate tissue. *Can. J. Fish. Aquat. Sci.* 49(5):1010-1017.

Bonnema, A. 2007. Quality Assurance Project Plan Screening Study of Bioaccumulation in California Lakes and Reservoirs. Moss Landing Marine Labs. Prepared for SWAMP BOG, 49 pages plus appendices and attachments. Revised January 2008. URL: <www.swrcb.ca.gov/water\_issues/programs/swamp/lakes\_study.shtml>

Brady, B. Bare Bones Guide Service. Personal communication with J. Passovoy, HDR|DTA, January 13, 2010.

California Department of Fish and Game (CDFG). 2005. Marine Pollution Studies Laboratory at Moss Landing Method #MPSL-102a.

- California Environmental Protection Agency (Cal EPA). 2005. General Protocol for Sport Fish Sampling and Analysis. Pesticide and Environmental Toxicology Branch, Office of Environmental Health Hazard Assessment, California Environmental Protection Agency. December 2005.
- Central Valley Regional Water Quality Control Board (CVRWQCB). 2009. Clean Water Act Sections 305(b) and 303(d) Integrated Report of the Central Valley Region. Draft Final Staff Report. May. URL: [www.swrcb.ca.gov/centralvalley/water\\_issues/tmdl/impaired\\_waters\\_list/303d\\_list.shtml](http://www.swrcb.ca.gov/centralvalley/water_issues/tmdl/impaired_waters_list/303d_list.shtml)
- \_\_\_\_\_. 2001. Final Staff Report on Recommended Changes to California's Clean Water Act Section 303(d) List. California Environmental Protection Agency. December 14. <[http://www.swrcb.ca.gov/centralvalley/water\\_issues/tmdl/impaired\\_waters\\_list/2006\\_303d\\_list.shtml](http://www.swrcb.ca.gov/centralvalley/water_issues/tmdl/impaired_waters_list/2006_303d_list.shtml)>
- \_\_\_\_\_. 1998. Basin Plan. The Sacramento River Basin and the San Joaquin River Basin, Fourth Ed. State of California Regional Water Quality Control Board, Central Valley Region. Revised in October 2007 with the Approved Amendments.
- Davis, J.A., A.R. Melwani, S.N. Bezalel, J.A. Hunt, G. Ichikawa, A. Bonnema, W.A. Heim, D. Crane, S. Swenson, C. Lamerdin, and M. Stephenson. 2010. Contaminants in Fish from California Lakes and Reservoirs, 2007-2008: Summary Report on a Two-Year Screening Survey. A Report of the Surface Water Ambient Monitoring Program (SWAMP). California State Water Resources Control Board, Sacramento, CA. URL: <[http://www.swrcb.ca.gov/water\\_issues/programs/swamp/lakes\\_study.shtml](http://www.swrcb.ca.gov/water_issues/programs/swamp/lakes_study.shtml)>
- Davis, J.A. 2009. Contaminants in Fish from California Lakes and Reservoirs: Technical Report on Year One of a Two-Year Screening Survey. A Report of the Surface Water Ambient Monitoring Program (SWAMP). California State Water Resources Control Board, Sacramento, CA. URL: <[http://www.swrcb.ca.gov/water\\_issues/programs/swamp/lakes\\_study.shtml](http://www.swrcb.ca.gov/water_issues/programs/swamp/lakes_study.shtml)>
- Davis, J.A., et al. 2007. Sampling and Analysis Plan for a Screening Study of Bioaccumulation in California Lakes and Reservoirs. Prepared by the Surface Water Ambient Monitoring Program (SWAMP) Bioaccumulation Oversight Group (BOG). San Francisco Estuary Institute, Oakland, CA. September 25. URL: <[http://www.swrcb.ca.gov/water\\_issues/programs/swamp/lakes\\_study.shtml](http://www.swrcb.ca.gov/water_issues/programs/swamp/lakes_study.shtml)>
- Davis, J.A., J. L. Grenier, A.R. Melwani, S. Bezalel, E. Letteney, and E. Zhang. 2007. Bioaccumulation of pollutants in California waters: a review of historic data and assessment of impacts on fishing and aquatic life. Prepared for the Surface Water Ambient Monitoring Program, California Water Resources Control Board, Sacramento, CA.
- Davis, J.A., B. K. Greenfield, G. Ichikawa and M. Stephenson. 2002. Mercury in Sport Fish from the Delta Region (Task 2A). Oakland, CA, San Francisco Estuary Institute / CALFED Final Project Report. 88 pp. <[http://www.sfei.org/other\\_reports0203.htm](http://www.sfei.org/other_reports0203.htm)>

- Grenier, J.L., A. Melwani, J. Hunt, S. Bezalel, J. Davis, G. Ichikawa, B. Jakl, W. Heim, A. Bonnema and M. Gassel. 2007. California Bay-Delta Authority Fish Mercury Project: Year 1 Annual Report Sport Fish Sampling and Analysis. San Francisco Estuary Institute, Oakland, CA. CBDA Project # ERP 02D-P67 May.  
<<http://www.sfei.org/cmrfishmercury/DocumentsPage.htm>>
- Hunerlach, M.P., J.J. Rytuba, and C. N. Alpers. 1999. Mercury Contamination from Hydraulic Placer-Gold Mining in the Dutch Flat Mining District, California. U.S. Geological Survey Water-Resources Investigations. Report 99-4018B, pp. 179-189. URL: <[ca.water.usgs.gov/mercury/dutch/index.html](http://ca.water.usgs.gov/mercury/dutch/index.html)>
- Klasing, S. and R. Brodberg. 2008. Development of Fish Contaminant Goals and Advisory Tissue Levels for Common Contaminants in California Sport Fish: Chloradane, DDTs, Dieldrin, Methylmercury, PCBs, Selenium, and Toxaphene. Pesticide and Environmental Toxicology Branch Office of Environmental Health Hazard Assessment, California Environmental Protection Agency. June.  
<http://www.oehha.org/fish/gtlsx/cmnr062708.html>
- May, J.T., R.L. Hothem, C.N. Alpers, and M.A. Law. 2000. Mercury Bioaccumulation in Fish in a Region Affected by Historic Gold Mining: The South Yuba River, Deer Creek, and Bear River Watersheds, California, 1999. U.S. Geological Survey Open-File Report 00-367. URL: <[ca.water.usgs.gov/archive/reports/ofr00367/ofr00367.pdf](http://ca.water.usgs.gov/archive/reports/ofr00367/ofr00367.pdf)>
- Melwani, A.R., S.N. Bezalel, J.A. Hunt, J.L. Grenier, G. Ichikawa, W. Heim, A. Bonnema, C. Foe, D.G. Slotton, and J.A. Davis. 2007. Spatial trends and impairment assessment of mercury in sport fish in the Sacramento-San Joaquin Delta Watershed. Final Technical Report. Fish Mercury Project. San Francisco Estuary Project. October. 39 pp.  
<http://www.sfei.org/cmrfishmercury/DocumentsPage.htm>
- Office of Environmental Health Hazard Assessment (OEHHA). 2009 Update of California Sport Fish Advisories. California Environmental Protection Agency. URL: <[www.oehha.ca.gov/fish/so\\_cal/index.html](http://www.oehha.ca.gov/fish/so_cal/index.html)>
- \_\_\_\_\_. 2003. Draft Report and Health Advisory for Fish from Selected Water Bodies in the Bear River, South Yuba River, and Deer Creek Watersheds (Nevada, Placer, and Yuba Counties); a fact sheet by Office of Environmental Health Hazard Assessment – California Environmental Protection Agency. February. URL: <[www.oehha.ca.gov/public\\_info/facts/fishfacts.html](http://www.oehha.ca.gov/public_info/facts/fishfacts.html)>
- Slotton, D.G., S.M. Ayers, and C.N. Alpers. *In preparation*. Mercury concentrations in fishes and zooplankton from Englebright Lake, Yuba River Watershed, California, 2002. U.S. Geological Survey Data Series Report. (Status: Draft report in preparation. USGS approval and publication expected during 2009.)
- Slotton, D.G., S.M. Ayers, J.E. Reuter, and C.R. Goldman. 1997. Gold mining impacts of food chain mercury in northwestern Sierra Nevada streams: Appendix B in Larry Walker Associates, 1997, Sacramento River watershed mercury control planning project: report for the Sacramento Regional County Sanitation District. 74 pp.

- \_\_\_\_\_. 1995. Gold mining impacts on food chain mercury in northwestern Sierra Nevada streams. Technical Completion Report for the University of California Water Resources Center, Project W-816, August 1995
- State Water Resources Control Board (SWRCB). 2006. 2006 Clean Water Act Section 303(d) List of Water Quality Limited Segments. Central Valley Regional Water Quality Control Board. Approved by the SWRCB: October 25, 2006. URL: <[www.swrcb.ca.gov/tmdl/303d\\_lists2006.html](http://www.swrcb.ca.gov/tmdl/303d_lists2006.html)>
- \_\_\_\_\_. 2002. Toxic Substances Monitoring Program: Freshwater Bioaccumulation Monitoring: TSM Program Data 1978-2000. State Water Resources Control Board, Division of Water Quality.
- United States Environmental Protection Agency (USEPA). 2001. Water Quality Criterion for the Protection of Human Health: Methylmercury. Office of Science and Technology Office of Water. Washington, D.C. EPA-823-R-01-001. January. URL: <[www.epa.gov/waterscience/criteria/methylmercury/document.html](http://www.epa.gov/waterscience/criteria/methylmercury/document.html)>