Placer County Water Agency
Middle Fork American River Project
(FERC No. 2079)

FINAL

AQ 11 – CONTINGENCY WATER QUALITY TECHNICAL STUDY REPORT: METHYLMERCURY FISH TISSUE SAMPLING (2007 AND 2008)

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1.0 INTRODUCTION

This report describes the methylmercury sampling study results from the 2007 AQ 11 – Water Quality Technical Study Plan (TSP) and the 2008 AQ 11 – Water Quality Contingency Study (Contingency TSP) conducted by the Placer County Water Agency (PCWA) in 2007 and 2008 in accordance with the AQ 11 – TSP (PCWA 2007) and AQ 11 – Contingency TSP (PCWA 2008). The AQ 11 – TSP was included in the Supporting Document (SD) H of the Pre-Application Document (PAD) for the Middle Fork American River Project (MFP or Project) (PCWA 2007).

The AQ 11 – TSP included a screening level assessment of methylmercury concentrations in sport fish muscle tissue at the four Project reservoirs and in the Middle Fork American River downstream of Ralston Afterbay near Otter Creek. The results of the 2007 study were provided to the Aquatic Technical Working Group (TWG) in the AQ 11 – Water Quality Technical Study Report (TSR) (PCWA 2008) on February 1, 2008 for a 60 day comment period. The comment period ended on April 4, 2008. Comments were addressed in the final 2007 report which was distributed in June 30, 2008 (PCWA 2008).

Numerous fish tissue samples analyzed in 2007 exceeded California's Office of Environmental Health Hazard Assessment (OEHHA) screening guidelines for methylmercury of 0.08 ppm (PCWA 2008). The AQ 11 – TSP specified a contingency study process that would be implemented if methylmercury concentrations exceeded the screening guidelines. The process is as follows:

- *If methylmercury in fish tissue exceeds the OEHHA guidelines of 0.08 ppm (Cal EPA 2005; Klasing and Brodberg 2006) during the initial sampling, the Aquatic TWG will be consulted concerning the need for additional sampling. If additional sampling is deemed appropriate, a sampling protocol will be developed.*

The results of the 2007 AQ 11 – TSR were discussed during the March 10, 2008, May 5, 2008, and June 2, 2008 Aquatic TWG meetings. The Aquatic TWG determined that additional sport fish tissue methylmercury sampling was warranted. PCWA developed a draft AQ 11 – Contingency TSP. The scope of work incorporated recommendations provided by Russ Kanz, State Water Board, based on his discussions with OEHHA. The final draft AQ 11 – Contingency TSP was distributed for a ten day comment period to the stakeholders on September 16, 2008 with a stipulation that if no comments were received, the scope of work would be considered final. No comments were received. The stakeholder-approved AQ 11 – Contingency TSP was included in the 2008 Study Implementation Progress Report for the MFP (FERC Project No. 2079) filed with the Federal Energy Regulatory Commission (FERC or Commission) on January 21, 2009 (PCWA 2009).

This report presents the 2008 AQ 11 – Contingency TSP methylmercury fish sampling results, combined with the previous 2007 AQ 11 – TSP study results. The report includes a description of the study objectives, study implementation, extent of study area, study approach, and study results.

2.0 STUDY OBJECTIVE

The objective of the original AQ 11 – TSP was to do a screening level analysis of methylmercury concentration in sport fish tissue and the objective of the follow-up AQ 11 – Contingency TSP was to sample a target number of each sport fish species that could be used to develop safe eating guidelines (if necessary). The overall water quality study objective described in the AQ 11 – TSP and the related 2007 fish tissue analysis study task was to:

- Characterize physical, chemical, and bacterial water quality conditions in the bypass reaches and the peaking reach, comparison reaches, and Project reservoirs, Ralston Afterbay, and Middle Fork Interbay and compare to the Central Valley Regional Water Quality Control Board (CVRWQCB) Basin Plan objectives and water quality standards (Fourth Edition revised February 2007).
    - Fish Tissue Analysis Task: Collect a total of 10 native (non-hatchery) sport fish of edible size, if present, from each of the following locations: French Meadows Reservoir, Hell Hole Reservoir, Middle Fork Interbay, Ralston Afterbay, and one location in the Middle Fork American River below Ralston Afterbay.

The study objective of the AQ 11 – Contingency TSP and the related study task was to:

- Collect and sample additional methylmercury concentrations in sport fish muscle tissue following OEHHA guidelines (Cal EPA 2005) that could be used to develop safe eating guidelines for the locations in the study area.
    - Fish Tissue Analysis Task: Collect a total of 9–12 edible size sport fish of each target species present in the following locations: French Meadows Reservoir, Hell Hole Reservoir, Middle Fork Interbay, Ralston Afterbay, and the Middle Fork American River at Otter Creek. The total number of fish includes fish already sampled during the 2007 field season.

Figure AQ 11-1 shows the AQ 11 – TSP and AQ 11 – Contingency TSP objectives and study elements and activities that relate to the completion of the studies. Figure AQ 11-1 also shows how the information developed during the studies was documented and provided to stakeholders.

3.0 STUDY IMPLEMENTATION

Study elements described in the AQ 11 – TSP (PCWA 2007) were initiated in 2007 and were completed in 2008. The study elements described in the AQ 11 – Contingency TSP were initiated in 2008 and completed in 2009. The AQ 11 – Contingency TSP study elements that have been completed, deviations from the technical study plan, proposed modifications to the technical study plan, and outstanding study elements are discussed below.

3.1. STUDY ELEMENTS COMPLETED

The following methylmercury fish tissue sampling study elements from the AQ 11 – TSP were completed in 2007 and early 2008:

- Collected 42 fish samples for methylmercury screening at Project reservoirs (Hell Hole, French Meadows, Ralston Afterbay, and Middle Fork Interbay) and at one river site (Middle Fork American River downstream of Ralston Afterbay near Otter Creek).
- Provided fish tissue samples to a State-certified laboratory approved by the State Water Board for chemical analyses (Brooks Rand Laboratory, Seattle, Washington).
- Compared fish tissue results to the OEHHA guidelines.

The following study elements from the AQ 11 – Contingency TSP were completed in 2008 and early 2009:

- Collected 81 additional edible sized sport fish from French Meadows Reservoir, Hell Hole Reservoir, Ralston Afterbay, Middle Fork Interbay, and the Middle Fork American River near Otter Creek.
- Collected crayfish from French Meadows and Hell Hole reservoirs.
- Submitted fish and crayfish to the same laboratory used for the 2007 analyses (Brooks Rand Laboratory Seattle, Washington) for individual fish and crayfish muscle tissue methylmercury analyses.
- Consulted with the Aquatic TWG on how to proceed for the locations where the target numbers of individuals were not collected during the 2008 field season.

3.2. DEVIATIONS FROM THE TECHNICAL STUDY PLAN

The target numbers of sport fish and crayfish species (9 to 12 edible sized fish and crayfish) were caught and analyzed at all locations except the following:

- French Meadows Reservoir: 3 rainbow trout were analyzed (6 remaining);
- Hell Hole Reservoir: 3 lake trout (6 remaining) and 1 rainbow trout (8 remaining) were analyzed;
- Ralston Afterbay: 7 rainbow trout were analyzed (2 remaining); and
- Middle Fork American River: 1 brown trout was analyzed (8 remaining).

A total of 123 individual fish and crayfish of legal and/or edible size were collected (42 in 2007 and 81 in 2008). However, a total of 30 fish targeted for collection in 2008 were not collected (Table AQ 11-1). In some locations fish species were in low abundance and difficult to collect in spite of a substantial sampling effort.

3.3. PROPOSED MODIFICATIONS TO THE TECHNICAL STUDY PLAN

The 2008 sampling results were presented to the Aquatic TWG on February 3, 2009 and the locations where target numbers of certain species were not achieved was discussed. Based on the difficulty of obtaining target fish samples at these locations, the following modification to the AQ 11 – Contingency TSP was approved by the Aquatic TWG: (1) reduce the number of target fish required at some locations; and (2) continue fish sampling in 2009 to collect the remaining target fish.

The Aquatic TWG approved modification to AQ 11 – Contingency TSP is provided in the Table AQ 11-1. The approved modification corresponds to the following changes in the AQ 11 – Contingency TSP:

- The target number of rainbow trout to be sampled from Hell Hole Reservoir in 2008 changed from eight fish to zero fish.
- The target number of rainbow trout to be sampled from Ralston Afterbay in 2008 changed from eight fish to six fish.

All other fish targeted for sampling in 2008, but that were not successfully captured (total 20 fish), will be collected in 2009 (Table AQ 11-1). These include the following:

- Six additional rainbow trout from French Meadows Reservoir;
- Six additional lake trout from Hell Hole Reservoir; and
- Eight additional brown trout from the Middle Fork American River (near Otter Creek).

A draft AQ 11 – Contingency Technical Study Report (TSR) (this report) was provided to the Aquatic TWG for comment (May 2009). Following completion of the additional 2009 fish collection/analysis, the report will be updated and a final draft Technical Study Report will be provided to the Aquatic TWG for comment (October 2009).

3.4. OUTSTANDING STUDY ELEMENTS

The outstanding study elements to be completed are as follows:

- Collect and analyze 20 fish in 2009 as identified in the Aquatic TWG approved modification to the AQ 11 – Contingency TSP (Section 3.3).
- Incorporate this data into a final draft report (Draft Final AQ 11 – Contingency TSR) and distribute to the Aquatic TWG for comment in October 2009.

4.0 EXTENT OF STUDY AREA

The study area included French Meadows Reservoir, Hell Hole Reservoir, Middle Fork Interbay, Ralston Afterbay, and the Middle Fork American River at Otter Creek (Map AQ 11-1).

5.0 STUDY APPROACH

In 2007 as part of the AQ 11 – TSP, a screening level study of methylmercury concentrations in sport fish muscle tissue was conducted at selected locations in the study area. As identified in the AQ 11 – TSP, at least 10 non-hatchery sport fish of edible size were targeted for collection from each of the following locations: Hell Hole Reservoir, French Meadows Reservoir, Middle Fork Interbay, Ralston Afterbay, and the Middle Fork American River near the Otter Creek confluence. Larger fish and species with greater potential for bioaccumulation were targeted for collection and analysis. The initial goal of the study was to collect five fish each of two different species from each location based on the following priority ranking. The two species present with the highest priority ranking would be targeted for collection (1 = highest priority) as follows:

1) bass;
2) pikeminnow;
3) lake trout;
4) brown trout; and
5) rainbow trout.

If five fish of two different species were not caught, then fish from a third species was included in the analysis.

As part of the 2008 AQ 11 – Contingency TSP, the overall fish tissue sampling goal was increased to collect and analyze methylmercury from a total of 9–12 edible size sport fish of each target species present in French Meadows Reservoir, Hell Hole Reservoir, Middle Fork Interbay, Ralston Afterbay, and the Middle Fork American River at Otter Creek. Crayfish were also collected and analyzed from French Meadows and Hell Hole reservoirs in 2008.

The minimum size (edible) of each species that was collected for analysis in 2008 is provided in Table AQ 11-2. Some fish that were collected and analyzed in 2007 were smaller than the minimum size of the fish in the AQ 11 – Contingency TSP. These smaller fish were not included in the total number of fish analyzed in this report.

A total of nine to twelve fish of each species was targeted for collection and individual fish tissue analysis (combined 2007 and 2008 samplings). The total number of each target fish species analyzed in 2007 and 2008 and the number remaining to be caught are summarized in Table AQ 11-1. Two composite samples (comprised of five brown trout each) were also analyzed in 2007. Locations where composite fish analyses were conducted or where fish smaller than the 2008 minimum size limit are also summarized in Table AQ 11-1.

Fish and crayfish were captured using a combination of methods. At the four reservoirs, fish and crayfish (only in French Meadows and Hell Hole reservoirs) were captured in clean nylon gill nets. In 2008, fish were also caught with hook-and-line. In the Middle Fork American River near Otter Creek, fish were captured by electrofishing, gill netting,

and hook-and-line sampling. For each fish collected, the species, fork length, total length, and weight were recorded. For crayfish, the total length, carapace length, and weight were recorded.

The field handling procedures used in 2007 and 2008 were consistent with those outlined in California Environmental Protection Agency (Cal EPA 2005) and those used at the Department of Fish and Game Marine Pollution Studies Laboratory at Moss Landing (Method # MPSL-102a). All fish and crayfish were handled with polyethelene gloves. Each sample was placed into a labeled zipper-closure bag (double bagged and double labeled) and placed immediately on ice in a cooler (Mark Stephenson and Amy Byington, Pers. Comm. 2008). The fish and crayfish were then stored in a freezer prior to shipment to the analytical laboratory. All fish and crayfish were shipped in an ice chest packed with ice and delivered by an overnight courier to Brooks Rand Laboratory (Seattle, Washington). Each cooler was shipped with a chain of custody form showing the sample identification number and collection date and time of each sample.

Muscle tissue from individual fish (fillet with skin off and homogenized) and crayfish (tail only) was analyzed for concentrations of methylmercury in accordance with the General Protocol for Sport Fish Sampling and Analysis developed by the Cal EPA (2005) and with methods comparable to those used at the Department of Fish and Game Marine Pollution Studies Laboratory at Moss Landing. The results of the fish fillet analyses were reported in ng/g. These were converted to mg/kg (ppm) to be consistent with the OEHHA guidelines.

6.0 RESULTS

The following section provides the results of the 2007 and 2008 fish tissue analysis from the study area. The 2007 results were also reported in the 2007 AQ 11 – TSR (PCWA 2008). The summary data presented (e.g., averages) include only fish that met the minimum size requirements (Table AQ 11-2)[1].

A total of 136 (including the 10 fish analyzed as a composite and 3 fish analyzed in 2007 that were smaller than the minimum size)[1] sport fish and crayfish from the five sampling locations were caught and analyzed in 2007 and 2008. Methylmercury concentrations in at least one fish and crayfish from each location exceeded the OEHHA screening value of 0.08 mg/kg.

Fifty-three of the 99 individual fish analyzed exceeded the screening value. The highest concentrations (up to 2.31 mg/kg) were measured in fish from Hell Hole Reservoir, where the largest fish were caught. The lowest concentrations were found in the Middle Fork American River near the Otter Creek confluence. A summary of the fish that were caught and analyzed, including the species, fork and total lengths, and weight, is provided in Table AQ 11-3. The relationship between methylmercury concentration and the weight of the fish for each of the sampling locations is shown in Figure AQ 11-2.

[1] A few fish reported in the 2007 results were smaller than the minimum size specified in the 2008 AQ 11 – Contingency TSP. The locations where these fish were analyzed are identified in Table AQ 11-2.

Fifteen of the 24 crayfish analyzed from Hell Hole and French Meadows reservoirs exceeded the screening value of 0.08 mg/kg. The highest concentrations were from Hell Hole Reservoir (up to 0.264 mg/kg). The results of the crayfish analyses are summarized in Table AQ 11-4. Figure AQ 11-3 shows that there was no observable relationship between crayfish weight and methylmercury concentration.

The average and maximum methylmercury concentrations by location and species are summarized below in order of locations with the highest to the lowest concentrations (Tables AQ 11-3, AQ 11-4, and AQ 11-5).

- Hell Hole Reservoir

  Fish

  - The average methylmercury concentration for all fish samples was 0.554 mg/kg, with the highest concentrations found in brown trout (1.032 mg/kg on average).
  - Methylmercury concentrations in 24 of the 28 individual fish analyzed (brown trout, lake trout, kokanee, and rainbow trout, as well as the composite sample of brown trout (analyzed in 2007)), exceeded the OEHHA screening value.
  - All the brown trout, lake trout, and kokanee except for one fish of each species exceeded the screening level. The highest concentration was in a 3.5 lbs brown trout (2.310 mg/kg)
  - The methylmercury concentration in the one rainbow trout analyzed was lower than the OEHHA screening value.

  Crayfish

  - Average methylmercury concentration for crayfish was 0.223 mg/kg. The highest individual concentration was 0.264 mg/kg. All of the crayfish captured exceeded the screening value.

- French Meadows Reservoir

  Fish

  - The average methylmercury concentration for all fish samples was 0.187 mg/kg, with the highest concentrations found in brown trout (0.211 mg/kg on average).
  - Methylmercury concentrations in all the brown trout and one of the three rainbow trout exceeded the screening value.
  - The composite sample of five brown trout also exceeded the screening value.
  - The highest fish methylmercury concentration measured was 0.357 mg/kg (large 8.6 lbs brown trout).

Crayfish

- The average methylmercury concentration for crayfish was 0.072 mg/kg (3 of the 12 crayfish exceeded the screening value). The highest concentration in an individual was 0.119 mg/kg.

- Ralston Afterbay
  - The average methylmercury concentration for all fish samples was 0.097 mg/kg, with the highest concentrations found in Sacramento pikeminnow (0.247 mg/kg on average).
  - Methylmercury concentrations in all the Sacramento pikeminnows and in 6 of the 12 brown trout exceeded the screening value. The highest brown trout concentration was (0.150 mg/kg) and the overall highest concentration was in a Sacramento pikeminnow (0.348 mg/kg).
  - None of the rainbow trout analyzed had methylmercury concentrations that exceeded the screening value.

- Middle Fork Interbay
  - The average methylmercury concentration for all fish samples was 0.070 mg/kg, with the highest concentrations found in brown trout (0.079 mg/kg on average).
  - Methylmercury concentrations in only one of the twelve brown (0.061 mg/kg) and two of the nine rainbow trout analyzed exceeded the screening value (0.135 and 0.203 mg/kg).

- Middle Fork American River near Otter Creek
  - The average methylmercury concentration for all fish samples was 0.052 mg/kg.
  - Methylmercury concentrations in four of the twelve fish caught exceeded 0.08 mg/kg (brown and rainbow trout). The only brown trout caught exceeded the screening value.
  - The highest concentration measured in fish from the Middle Fork American River was 0.130 mg/kg (in the largest rainbow trout caught, 1.0 lbs).

7.0 REFERENCES

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). 1998. Basin Plan. Fourth Edition, The Sacramento River Basin and the San Joaquin River Basin. September 1998, revised February 2007.

Klasing, S. and R. Brodberg. 2006. Draft Development of Guidance Tissue Levels and Screening Values 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. http://www.oehha.ca.gov/fish/gtlsv/pdf/draftGTLSVchddt.pdf

Marine Pollution Studies Laboratories (MPSL). 2005. Sampling marine and freshwater bivalves, fish and crabs for trace metal and synthetic organic analysis. Method # MPSL-102a.

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PCWA. 2008. AQ 11 – Water Quality Technical Study Report – 2007. Final. June 2008.

PCWA. 2009. 2008 Study Implementation Progress Report for the Middle Fork American River Project (FERC Project No. 2079) per 18 CFR § 5.15 (c)(1). Attachment F. AQ 11 – Water Quality Contingency Sampling Protocol (Contingency Study).

Personal Communication

Mark Stephenson. Personal communication with Director of the Marine Pollution Studies Laboratories - Department of Fish and Game. Moss Landing California. August 11, 2008.

Amy Byington. Personal communication with Research Technician at Marine Pollution Studies Laboratories - Department of Fish and Game. Moss Landing California. August 11, 2008.

TABLES

Table AQ 11-1. Total Number of Each Fish Species Analyzed and Remaining for Methylmercury Sampling by Location.

Sampling Location	Species	Total Analyzed 2007 – 2008[3]	Fish Remaining/per AQ 11 Contingency TSP	Fish Remaining per Aquatic TWG Approved Modifications to AQ 11 Contingency TSP
French Meadows Reservoir	Brown Trout	12 (5)[1]	0	--
	Rainbow Trout	3	6	6
	Crayfish	12	0	--
Hell Hole Reservoir	Brown Trout	12 (5)[1]	0	--
	Lake Trout	3 (2)[2]	6	6
	Kokanee	12	0	--
	Rainbow Trout	1[5]	8	0
	Crayfish	12	0	--
Middle Fork Interbay	Brown Trout	12	0	--
	Rainbow Trout	9	0	--
Ralston Afterbay	Brown Trout	12	0	--
	Rainbow Trout	7[5]	2	0
	Sacramento Pikeminnow	4 (1)[2]	NA[4]	NA[4]
Middle Fork American River (Otter Creek)	Brown Trout	1	8	8[6]
	Rainbow Trout	11	0	--

[1]Fish that were analyzed as one composite in 2007.

[2]Fish that were analyzed in 2007, but were smaller than the 2008 edible size limit (see Table AQ 11-2).

[3]Total number of fish analyzed as part of the of AQ – 11 TSR and the (AQ – 11 Contingency TSP

[4]No Sacramento pikeminnow were targeted for analysis in the AQ 11 – Contingency TSP.

[6]Low abundance of this species at the sampling location made it difficult to collect the target number of individuals; a good-faith effort was made to collect the target number of individuals in 2009.[7]

Table AQ 11-2. 2008 Legal and/or Edible Size Limits for Target Species.

Legal/edible Size Limits	Minimum Size (mm)
Brown Trout	200
Rainbow Trout	200
Lake Trout	350
Kokanee	200
Crayfish	30

Table AQ 11-3. Summary Methylmercury Results for Fish Specimens Collected for Methylmercury Tissue Analysis in 2007 and 2008.
A bold number indicates that the screening level criteria of 0.08 mg/kg were exceeded (based on Cal EPA 2005 and Klasing and Brodberg 2006).

Species	Fish Sample ID[2]	Date Collected	Time Collected	Total Length (mm)	Fork Length (mm)	Weight (g)	Weight (lbs)	Methyl-mercury concen-tration (mg/kg)
Individual Fish Analysis								
Hell Hole Reservoir								
Brown Trout	HH-1-DS-1-BNT-2	10/11/2007	1330	398	393	650	1.430	**0.662**
	HH-1-US2-BNT-2	10/11/2007	930	422	415	925	2.035	**0.596**
	HH-1-US2-BNT-3	10/11/2007	930	477	470	1075	2.365	**1.030**
	HH-1-MID3-BNT-3	10/11/2007	1030	495	490	1175	2.585	**0.921**
	HH-1-MID1-BNT-1	10/11/2007	1150	485	480	1200	2.640	**1.080**
	HH-3B-BT-1	9/11/2007	1420	571[(1)]	561	2150	4.730	**1.140**
	HH-1B-BNT-1	9/18/2008	820	310	310	348	0.766	0.010
	HH-1B-BNT-2	9/18/2008	820	505	505	1661	3.654	**1.900**
	HH-2-BNT-1	9/17/2008	950	420	420	898	1.976	**0.463**
	HH-2-BNT-2	9/17/2008	950	510[(4)]	≈ 505[(5)]	1567	3.447	**2.310**
	HH-3-BNT-1	9/17/2008	1640	500	500	1640	3.608	**1.920**
	HH-6B-BNT-3	9/18/2008	1030	402	402	738	1.624	**0.356**
Lake Trout	HH-1-MIDL-LT-1	10/11/2007	1150	360	330	450	0.990	0.004
	HH-1-MID3-LT-1	10/11/2007	10:30	265	235	160[(3)]	0.352	**0.243**
	HH-1-US1-LT-1	10/11/2007	8:30	270	245	125[(3)]	0.275	**0.213**
	HH-2-LT-1	9/17/2008	950	350	330	421	0.926	**0.217**
	HH-LT-2	10/18/2008	1550	420	380	576	1.267	**0.845**
Rainbow Trout	HH-1-US2-RBT-1	10/11/2007	930	230	220	125	0.275	0.049
Kokanee	HH-1-KOK-1	9/17/2008	939	374	350	470	1.034	0.050
	HH-5b-KOK-2	9/17/2008	1720	405	385	619	1.362	**0.110**
	HH-1-KOK-shock	10/24/2008	1045	415	402	628	1.382	**0.131**
	HH-2-KOK-shock	10/24/2008	1045	365	355	442	0.972	**0.207**
	HH-3-KOK-shock	10/24/2008	1045	385	375	555	1.221	**0.177**
	HH-4-KOK-shock	10/24/2008	1045	380	368	476	1.047	**0.194**
	HH-5-KOK-shock	10/24/2008	1045	386	373	386	0.849	**0.184**
	HH-6-KOK-shock	10/24/2008	1045	395	380	562	1.236	**0.158**
	HH-7-KOK-shock	10/24/2008	1045	385	375	625	1.375	**0.206**
	HH-8-KOK-shock	10/24/2008	1045	390	370	574	1.263	**0.153**
	HH-10-KOK-shock	10/24/2008	1045	425	405	593	1.305	**0.210**
	HH-11-KOK-shock	10/24/2008	1045	372	364	478	1.052	**0.221**

Table AQ 11-3. Summary Methylmercury Results for Fish Specimens Collected for Methylmercury Tissue Analysis in 2007 and 2008 (continued).

A bold number indicates that the screening level criteria of 0.08 mg/kg were exceeded (based on Cal EPA 2005 and Klasing and Brodberg 2006).

Species	Fish Sample ID[2]	Date Collected	Time Collected	Total Length (mm)	Fork Length (mm)	Weight (g)	Weight (lbs)	Methyl-mercury (mg/kg)
French Meadows Reservoir								
Brown Trout	FM-2B-BT-3	9/12/2007	1550	615[(1)]	605	2000	4.400	**0.210**
	FM-2C-BT-1	9/13/2007	1020	740	730	3900	8.580	**0.357**
	FM-4-BNT-1	9/19/2008	830	490	485	1266	2.785	**0.324**
	FM-7-BNT-3	9/19/2008	920	443	440	950	2.090	**0.170**
	FM-5-BNT-2	9/19/2008	845	375	365	444	0.977	**0.171**
	FM-BNT-1	11/23/2008	650	420	430	748	1.646	**0.276**
	FM-BNT-2	11/23/2008	705	395	415	525	1.155	**0.125**
	FM-BNT-3	11/23/2008	715	380	400	611	1.344	**0.216**
	FM-BNT-4	11/23/2008	730	425	440	817	1.797	**0.151**
	FM-BNT-5	11/23/2008	743	460	480	995	2.189	**0.153**
	FM-BNT-6	11/23/2008	800	475	490	1092	2.402	**0.301**
	FM-BNT-7	11/23/2008	810	415	430	759	1.670	**0.084**
Rainbow Trout	FM-1E-RT-1	9/13/2007	1700	240	230	100	0.220	0.053
	FM-2F-RT-1	9/13/2007	1530	290	280	180	0.396	0.071
	FM-3D-RT-2	9/13/2007	1124	335	325	270	0.594	**0.176**
Middle Fork Interbay								
Brown Trout	I-U2-BNT-1	9/20/2007	1456	323	315	390	0.858	0.050
	I-US-1-BNT-3	9/21/2007	1030	320	310	420	0.924	0.029
	I-US2-BNT-3	9/21/2007	1115	330	320	430	0.946	0.013
	I-US-1-BNT-1	9/20/2007	1446	345	338	450	0.990	0.024
	I-US-2-BNT-2	9/21/2007	1115	355	350	570	1.254	0.027
	I-US1-BNT-2	9/21/2007	1030	370	360	625	1.375	0.032
	I-2-BNT-1	9/23/2008	1005	230	219	113	0.249	0.019
	I-2-BNT-3	9/23/2008	1005	419	419	629	1.384	0.039
	I-1-BNT-2	9/23/2008	950	367	358	446	0.981	0.045
	I-2-BNT-2	9/23/2008	1005	375	375	491	1.080	0.046
	I-1-BNT-1	9/23/2008	950	585	580	2267	4.987	**0.609**
	I-3-BNT-2	9/23/2008	1020	338	326	262	0.576	0.009

Table AQ 11-3. Summary Methylmercury Results for Fish Specimens Collected for Methylmercury Tissue Analysis in 2007 and 2008 (continued).

A bold number indicates that the screening level criteria of 0.08 mg/kg were exceeded (based on Cal EPA 2005 and Klasing and Brodberg 2006).

Species	Fish Sample ID[2]	Date Collected	Time Collected	Total Length (mm)	Fork Length (mm)	Weight (g)	Weight (lbs)	Methyl-mercury (mg/kg)
Middle Fork Interbay (continued)								
Rainbow Trout	I-US1-RBT-1	9/21/2007	1030	285	270	200	0.440	0.018
	I-US2-RBT-5	9/21/2007	1115	263	253	210	0.462	0.026
	I-L1-RBT-1	9/21/2007	1115	255	245	225	0.495	0.028
	I-US2-RBT-1	9/21/2007	1115	315	307	410	0.902	**0.135**
	I-1-RBT-1	9/23/2008	950	221	212	119	0.262	**0.203**
	I-3-RBT-1	9/23/2008	1020	347	345	143	0.315	0.037
	I-4-RBT-2	9/23/2008	1045	270	260	181	0.398	0.032
	I-4-RBT-1	9/23/2008	1045	235	230	131	0.288	0.023
	I-5-RBT-1	9/23/2008	1058	250	240	135	0.297	0.027
Ralston Afterbay								
Brown Trout	RA-2A-BT-14	9/14/2007	1305	476	465	925	2.035	**0.085**
	RA-2A-BT-7	9/14/2007	1240	470	464	1050	2.310	**0.104**
	RA-3B-BT-7	9/14/2007	1450	462	460	1100	2.420	0.063
	RA-2B-BT-6	9/14/2007	1330	477	474	1250	2.750	**0.107**
	R-BNT-1	6/27/2008	1315	444	426	902	1.984	0.049
	R-BNT-2	6/27/2008	1130	435	432	784	1.725	0.067
	R-BNT-3	9/4/2008	1130	480	≈ 472[(5)]	1353	2.977	**0.090**
	R-BNT-4	6/27/2008	1129	555	545	1670	3.674	**0.150**
	R-BNT-5	9/5/2008	1050	453	435	903	1.987	**0.097**
	R-BNT-6	9/4/2008	not recorded	450	≈ 441[(5)]	826	1.817	0.058
	R-BNT-7	6/27/2008	not recorded	515	510	1010	2.222	0.057
	R-BNT-8	6/27/2008	not recorded	515	510	911	2.004	0.067
Rainbow Trout	RA-3B-RT-19	9/14/2007	1510	375	365	550	1.210	0.042
	R-RBT-1	9/5/2008	1215	381	355	466	1.025	0.026
	R-RBT-2	9/5/2008	1100	365	345	426	0.937	0.044
	R-RBT-3	9/5/2008	1100	335	320	342	0.752	0.028
	R-RBT-4	9/5/2008	1215	355	334	365	0.803	0.046
	R-RBT-5	9/5/2008	1050	355	345	445	0.979	0.040
	R-RBT-6	9/4/2008	not recorded	260	252	188	0.414	0.031

Table AQ 11-3. Summary Methylmercury Results for Fish Specimens Collected for Methylmercury Tissue Analysis in 2007 and 2008 (continued).

A bold number indicates that the screening level criteria of 0.08 mg/kg were exceeded (based on Cal EPA 2005 and Klasing and Brodberg 2006).

Species	Fish Sample ID[2]	Date Collected	Time Collected	Total Length (mm)	Fork Length (mm)	Weight (g)	Weight (lbs)	Methyl-mercury (mg/kg)
Ralston Afterbay (continued)								
Sacramento Pikeminnow	RA-3A-SPM-21	9/14/2007	1430	260	245	50	0.110	**0.117**
	RA-1D-SPM-4	9/14/2007	1619	405[(1)]	385	510	1.122	**0.314**
	RA-2B-SPM-8	9/14/2007	1335	405	384	640	1.408	**0.209**
	RA-2B-SPM-7	9/14/2007	1331	470	445	840	1.848	**0.348**
	RA-3A-SPM-20	9/14/2007	14:25	239	225	100[(3)]	0.22	**0.114**
Middle Fork American River near Otter Creek								
Brown Trout	OC-1-BNT-1	10/9/2007	940	390[(1)]	385	634	1.395	**0.085**
Rainbow Trout	OC-1-RBT-2	10/2/2007	1130	202	193	65	0.143	0.012
	OC-1-RBT-3	10/2/2007	1130	202	200	66	0.145	0.017
	OC-1-RBT-4	10/2/2007	1130	249	238	139	0.306	0.021
	OC-1-RBT-5	10/2/2007	1130	303	311	236	0.519	0.041
	OC-1-RBT-1	10/2/2007	1130	308	300	282	0.620	0.029
	OC-1-RBT-7	10/9/2007	1030	310[(1)]	300	282	0.620	0.032
	OC-RBT-1	10/16/2007	morning	365	344	380	0.836	**0.081**
	OC-1-RBT-6	10/2/2007	1130	374	363	463	1.019	0.078
	OC-1-RBT-8	10/9/2007	1330	415[(1)]	395	468	1.030	**0.130**
	OC-1-RBT	11/17/2008	1445	392	375	392	0.862	0.051
	OC-2-RBT	11/17/2008	1445	376	356	441	0.970	0.046

Table AQ 11-3. Summary Methylmercury Results for Fish Specimens Collected for Methylmercury Tissue Analysis in 2007 and 2008 (continued).

A bold number indicates that the screening level criteria of 0.08 mg/kg were exceeded (based on Cal EPA 2005 and Klasing and Brodberg 2006).

Composited Fish Analysis								
Hell Hole Reservoir								
Brown Trout	Composite-HH-BT-1							**1.070**
	HH-1A-BT-34	*9/11/2007*	*1000*	*449*[1]	*432*	*940*	2.068	
	HH-1B-BT-15	*9/11/2007*	*1100*	*483*[1]	*473*	*1040*	2.288	
	HH-2A-BT-6	*9/11/2007*	*1215*	*419*[1]	*411*	*760*	1.672	
	HH-3A-BT-3	*9/11/2007*	*1345*	*485*[1]	*475*	*1260*	2.772	
	HH-2C-BT-1	*9/11/2007*	*945*	*360*	*350*	*310*	0.682	
Species	**Fish Sample ID**[2]	**Date Collected**	**Time Collected**	**Total Length (mm)**	**Fork Length (mm)**	**Weight (g)**	**Weight (lbs)**	**Methyl-mercury (mg/kg)**
French Meadows Reservoir								
Brown Trout	Composite-FM-BT-1							**0.183**
	FM-2B-BT-4	*9/12/2007*	*1550*	*360*[1]	*353*	*420*	0.924	
	FM-2A-BT-2	*9/12/2007*	*1620*	*355*	*348*	*430*	0.946	
	FM-1A-BT-1	*9/12/2007*	*1830*	*410*	*400*	*470*	1.034	
	FM-1D-BT-1	*9/13/2007*	*950*	*408*	*392*	*590*	1.298	
	FM-3D-BT-3	*9/13/2007*	*1130*	*400*	*393*	*600*	1.32	

[1]Total length was not measured in the field, but estimated based on fish size, species, and fork length.
[2]BNT: brown trout; RBT: rainbow trout; LT: lake trout; KOK: kokanee; SPM: Sacramento pikeminnow.
[3]The fish were analyzed in 2007, but were smaller than the minimum size collected in 2008. The fish was not included in the results presented in this report.
[4]Fish total length was recorded as 610 mm. Regression analyses suggest that the length should be approximately 510 mm.
[5]Fork length was not measured in the field, and was calculated from a regression analysis.

Table AQ 11-4. Summary Methylmercury Results for Crayfish Specimens Collected for Methylmercury Tissue Analysis in 2008.

A bold number indicates that the screening level criteria of 0.08 mg/kg were exceeded (based on Cal EPA 2005 and Klasing and Brodberg 2006).

Species	Fish Sample ID	Date Collected	Time Collected	Carapace Length (to tip of rostrum) (mm)	Carapace Length (to back of eye) (mm)	Weight (g)	Weight (lbs)	Methyl-mercury (mg/kg)
Individual Crayfish Analysis								
Hell Hole Reservoir								
Crayfish	HH-1B-CF-1	9/17/2008	950	62	47	50	0.110	**0.262**
	HH-2-CF-1	9/17/2008	950	60	47	61	0.134	**0.730**
	HH-2-CF-2	9/17/2008	950	45	32	18	0.040	**0.111**
	HH-2-CF-4	9/17/2008	950	48	37	28	0.062	**0.172**
	HH-2-CF-5	9/17/2008	950	40	30	15	0.033	**0.206**
	HH-5B-CF-2	9/17/2008	1720	57	41	59	0.130	**0.136**
	HH-5B-CF-3	9/17/2008	1720	55	40	44	0.097	**0.143**
	HH-5B-CF-4	9/17/2008	1720	50	32	24	0.053	**0.150**
	HH-5B-CF-5	9/17/2008	1720	51	40	29	0.064	**0.194**
	HH-5B-CF-6	9/17/2008	1720	55	37	31	0.068	**0.140**
	HH-6-CF-6	9/17/2008	1720	52	42	39	0.086	**0.172**
	HH-5B-CF-7	9/17/2008	1720	46	36	23	0.051	**0.264**
French Meadows Reservoir								
Crayfish	FM-1-CF-1	9/18/2008	1410	52	38	33	0.073	0.066
	FM-1-CF-2	9/18/2008	1410	59	45	52	0.114	0.073
	FM-1-CF-3	9/18/2008	1410	65	41	61	0.134	0.077
	FM-1-CF-4	9/18/2008	1410	50	39	31	0.068	0.038
	FM-1-CF-5	9/18/2008	1410	50	38	37	0.081	0.062
	FM-1-CF-6	9/18/2008	1410	51	39	38	0.084	0.064
	FM-1-CF-7	9/18/2008	1410	53	43	49	0.108	**0.119**
	FM-1-CF-8	9/18/2008	1410	57	40	40	0.088	0.060
	FM-1-CF-9	9/18/2008	1410	47	36	32	0.070	**0.113**
	FM-1-CF-10	9/18/2008	1410	49	36	27	0.059	0.060
	FM-1-CF-11	9/18/2008	1410	47.5	35	25	0.055	0.050
	FM-1-CF-12	9/18/2008	1410	47	39	30	0.066	**0.086**

Table AQ 11-5. Average Methylmercury Concentrations (mg/kg) and Number of Individuals for Each Species Analyzed by Sampling Location.

A bold number indicates that the screening level criteria of 0.08 mg/kg were exceeded (based on Cal EPA 2005 and Klasing and Brodberg 2006).

Species	French Meadows Reservoir	Hell Hole Reservoir	Middle Fork American River near Otter Creek	Middle Fork Interbay	Ralston Afterbay	Species Average
Fish Species						
Brown Trout (No.)	**0.211** (12)	**1.032** (12)	**0.085** (1)	0.079 (12)	**0.083** (12)	**0.346** (49)
Lake Trout (No.)	-	**0.355** (3)	-	-	-	**0.355** (3)
Rainbow Trout (No.)	**0.100** (3)	0.049 (1)	0.049 (11)	0.059 (9)	0.037 (7)	0.054 (31)
Kokanee (No.)	-	**0.167** (12)	-	-	-	**0.167** (12)
Sacramento Pikeminnow (No.)	-	-	-	-	**0.247** (4)	**0.247** (4)
Fish Average	**0.187** (15)	**0.554** (28)	0.052 (12)	0.070 (21)	**0.097** (23)	**0.229** (99)
Crayfish						
Crayfish (No.)	0.072 (12)	**0.223** (12)	-	-	-	**0.148** (24)

FIGURES

Figure AQ 11-1. 2007 and 2008 Methylmercury Fish Sampling Objectives and Related Study Elements and Reports.

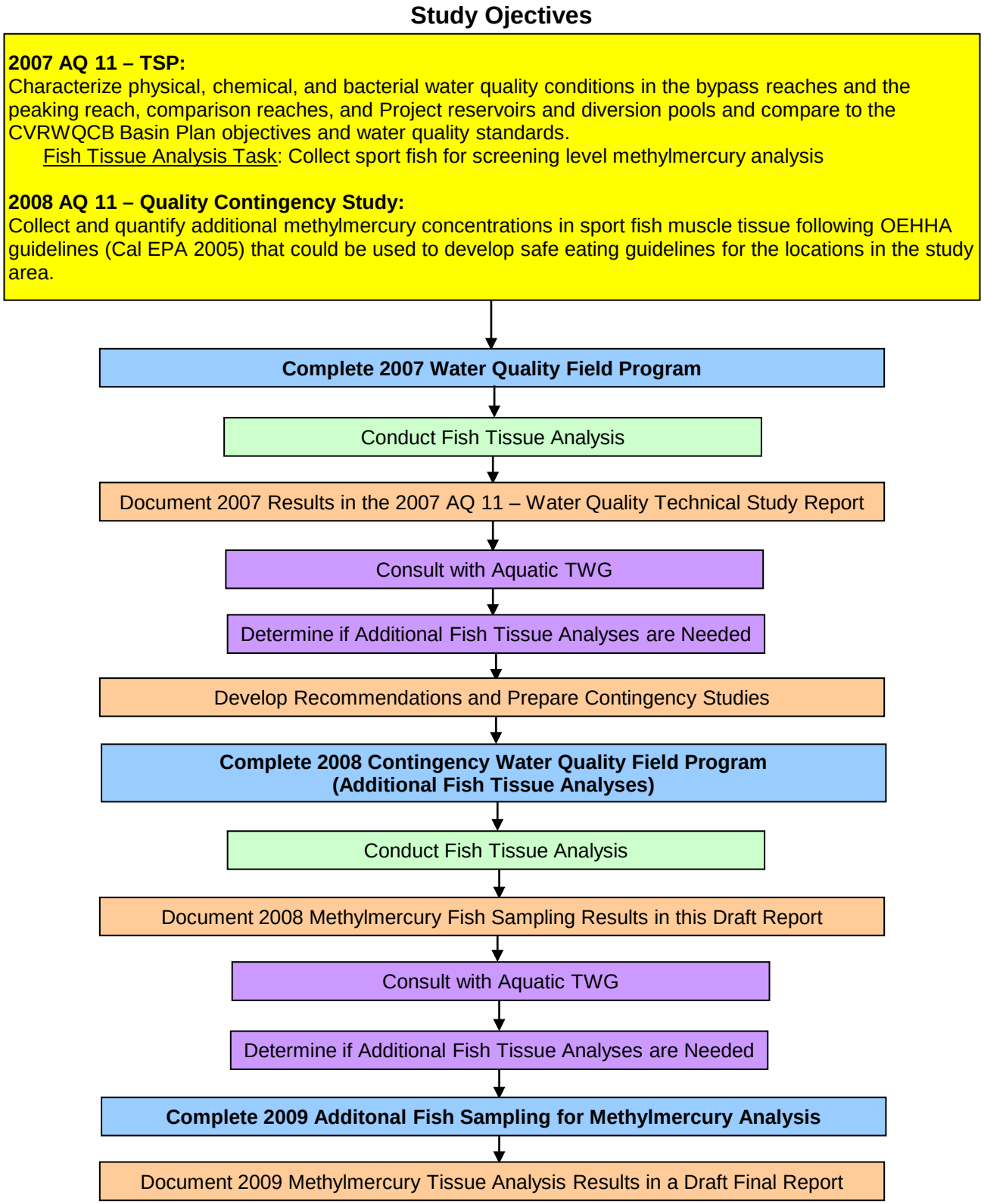


Figure AQ 11-2. Methylmercury Fish Tissue Analysis Results by Sampling Location and Species.

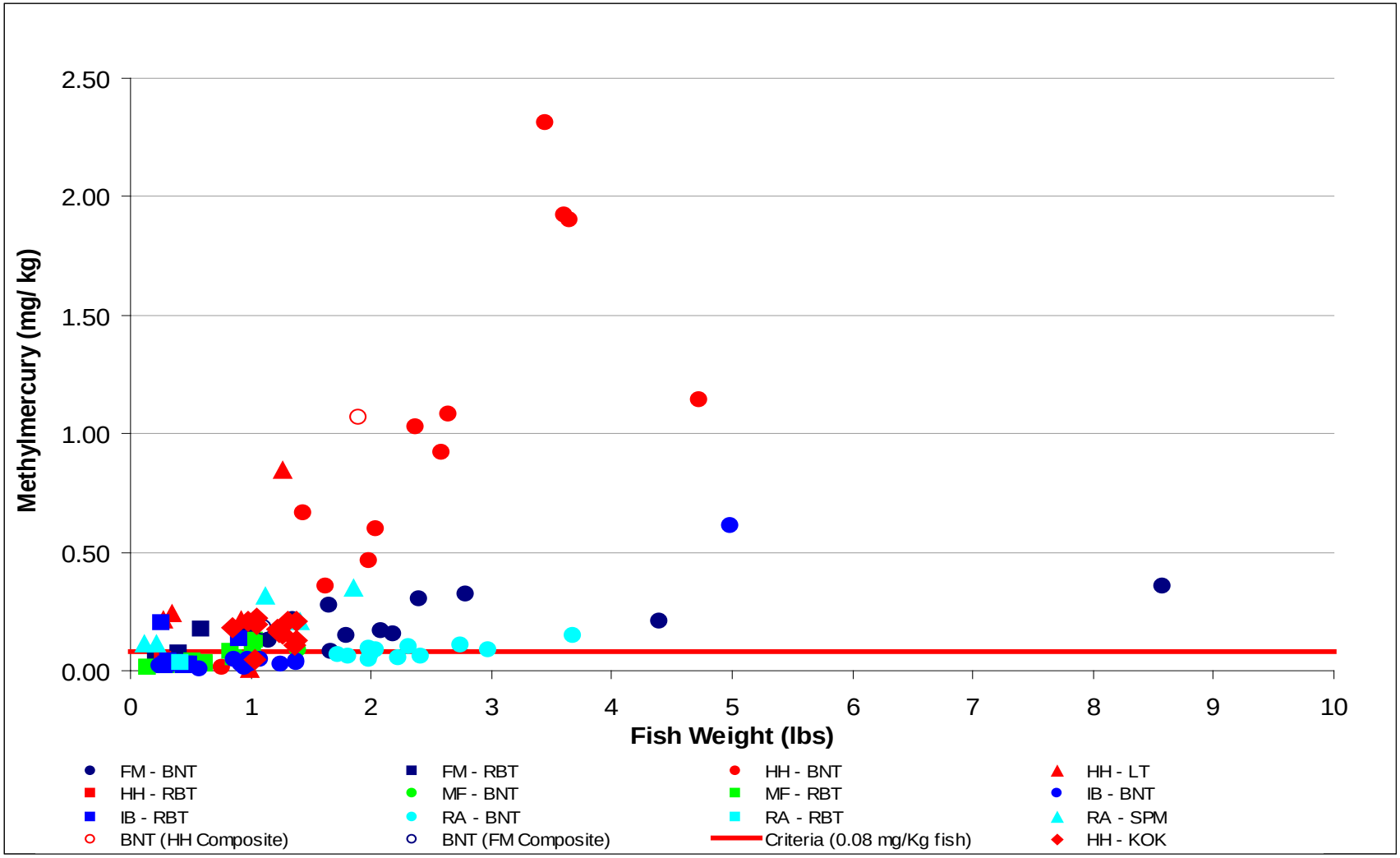
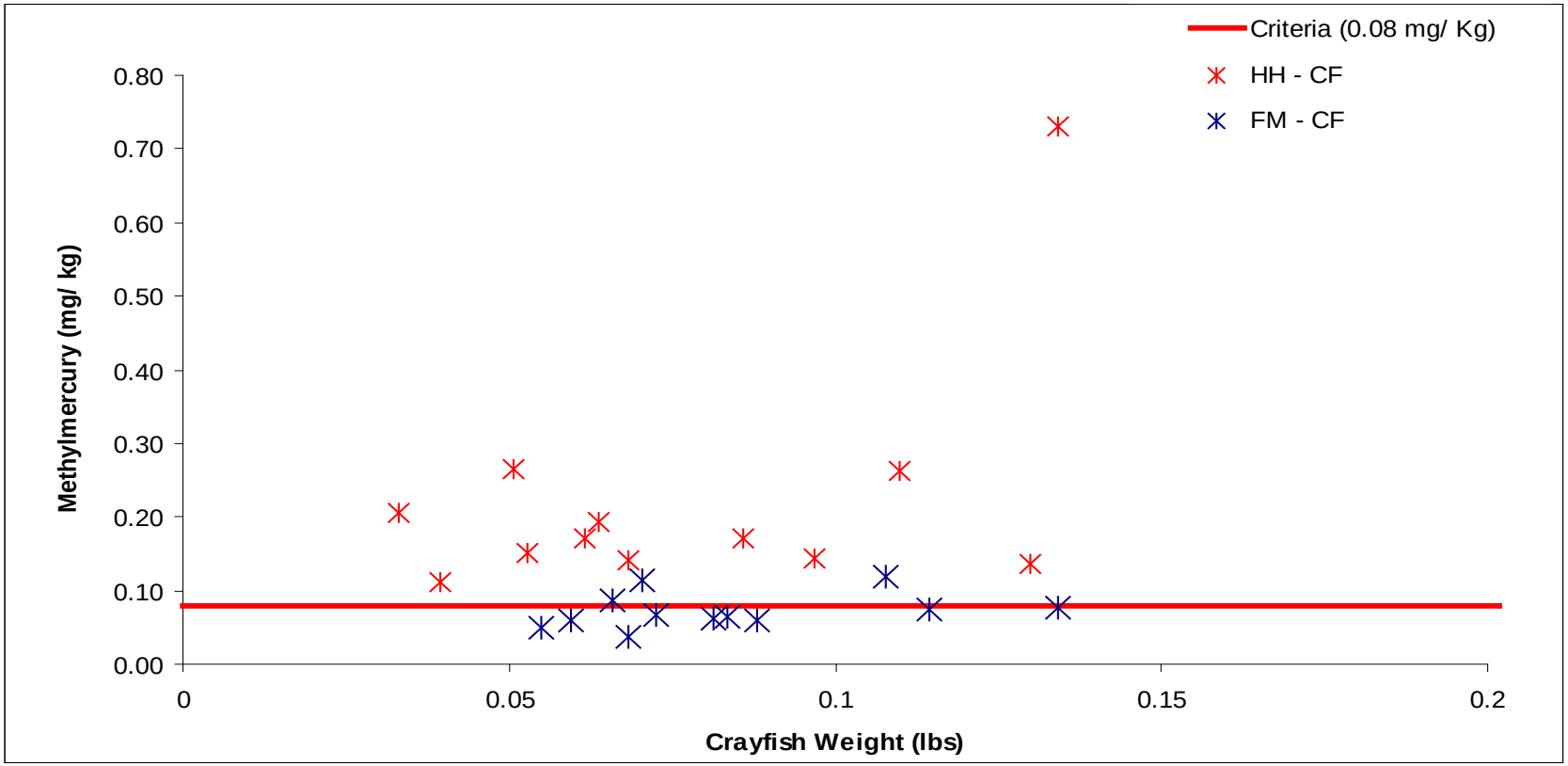
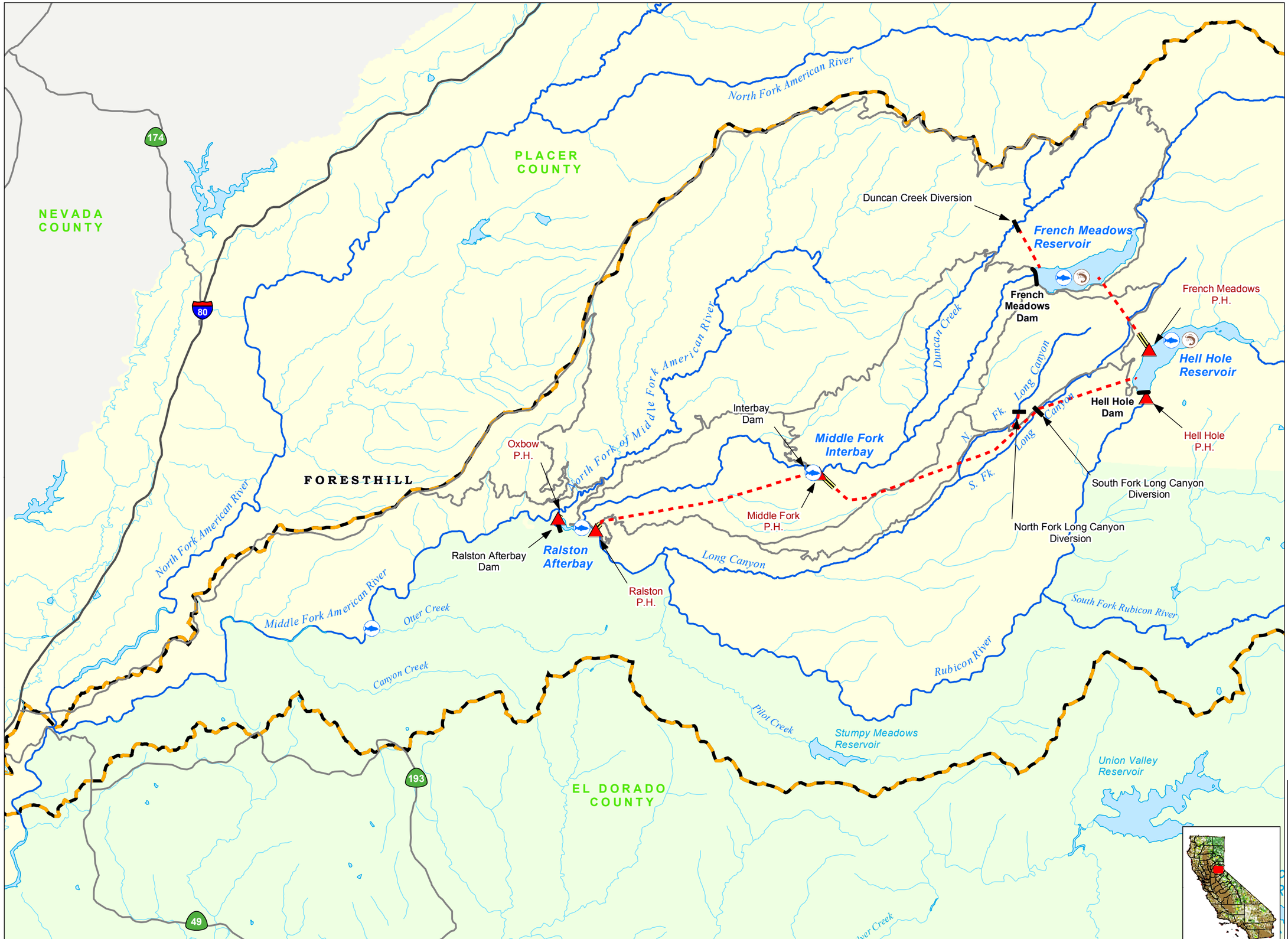


Figure AQ 11-3. Methylmercury Crayfish Tissue Analysis Results by Sampling Location.



MAP



Project Facilities

- Powerhouse
- Dam
- Tunnel
- Penstock

Transportation

- Major Road
- Minor Road

Hydrography

- Watercourse
- Water Body
- Middle Fork American River Watershed*

*Modified from Calwater Ver. 2.2 to represent drainage above high-water mark of Folsom Lake

Methylmercury Sampling Locations

- 2007 and 2008 Fish Sampling Locations
- 2008 Crayfish Sampling Locations

PCWA

Placer County Water Agency
Middle Fork American River Project

Map AQ11-1

Fish and Crayfish Methylmercury Sampling Locations (2007 and 2008)

0 1 2 3 Miles

Date: 1/26/09

Projection: CA State Plane, Zone 2
Datum: NAD 83

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