

Hetch Hetchy Reservoir Bioaccumulation Study (Hg)

July 2009

**Bioaccumulation Symposium
California Department of Public Health
Richmond, CA
December 17, 2012**

Mike Horvath

San Francisco Public Utilities Commission

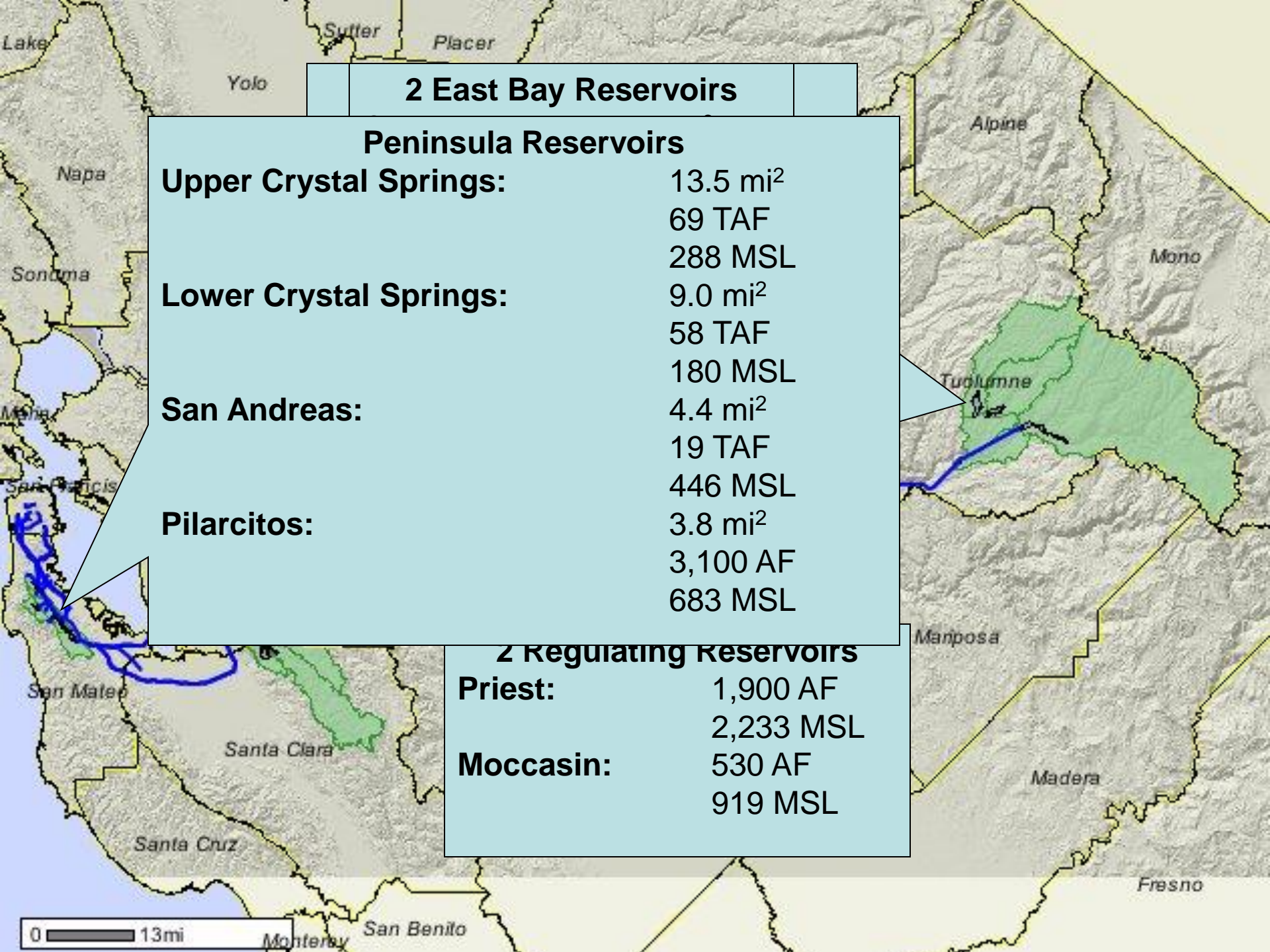
Natural Resources and Land Management Division

Moccasin, CA



Don't Eat the Fish



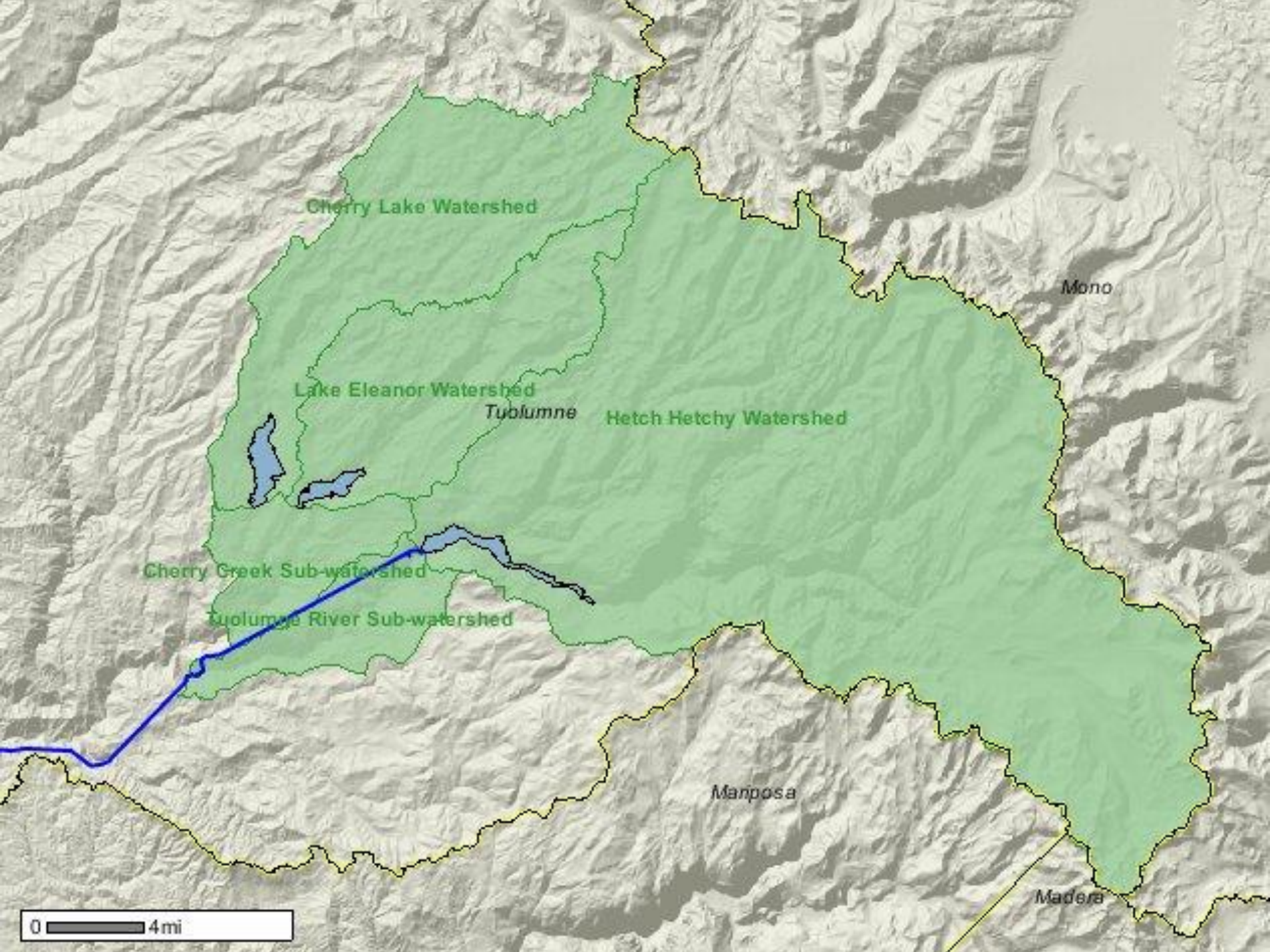


2 East Bay Reservoirs

Peninsula Reservoirs	
Upper Crystal Springs:	13.5 mi ² 69 TAF 288 MSL
Lower Crystal Springs:	9.0 mi ² 58 TAF 180 MSL
San Andreas:	4.4 mi ² 19 TAF 446 MSL
Pilarcitos:	3.8 mi ² 3,100 AF 683 MSL

2 Regulating Reservoirs	
Priest:	1,900 AF 2,233 MSL
Moccasin:	530 AF 919 MSL

0 13mi









TUOLUMNE
RIVER







BACKGROUND

- **2007 SWAMP study revealed high Hg in fish tissue (only two samples)**
- **SFPUC initiated study in 2009 to:**
 - **Validate SWAMP study (more samples)**
 - **Test fish length vs. mercury concentration**
 - **Compare rainbow and brown trout [Hg]**
 - **Test sediment mercury in 3 reaches**
 - **Test water mercury 3 reaches, 3 depths**
 - **Measure water quality parameters**

METHODS (Field)

- **Fish**
 - **Hook & line, downriggers, trolling**
 - **Bagged (2X) and immediately frozen**
- **Water**
 - **Teflon kemmerer**
 - **EPA clean hand / dirty hand method**
 - **Field / equipment blanks with ultrapure water**
- **Sediment**
 - **SS Ekman dredge, acid wash between samples**
 - **All samples double bagged**

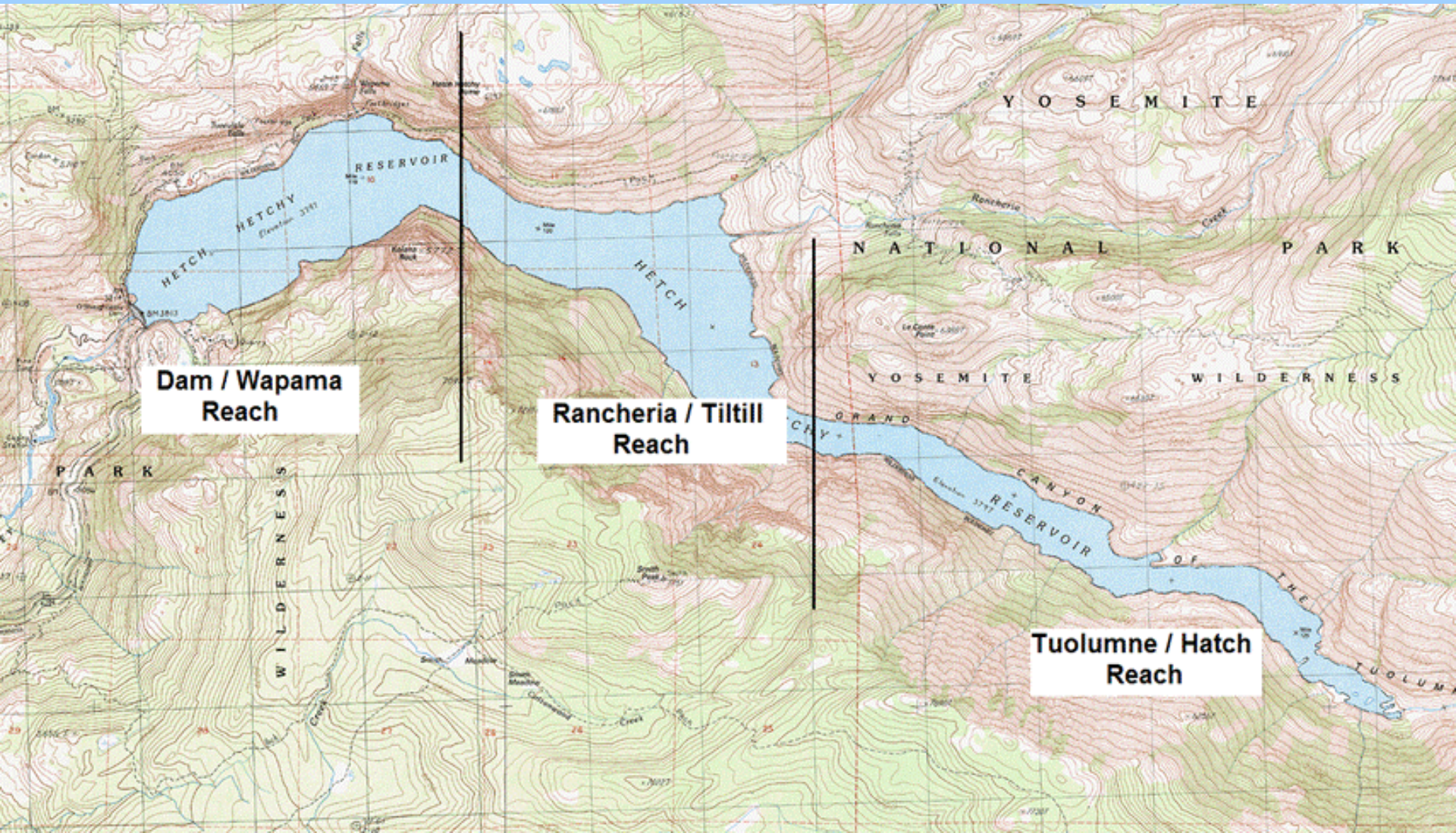
METHODS (SFPUC Southeast Laboratory)

- **Fish tissue**
 - **EPA 1631, Inductively coupled plasma mass spectrometry**
 - **Duplicates, spiked samples, low MDL**
- **Water**
 - **EPA 1631E, Mercury in Water by Oxidation, Purge and Trap, and Cold Vapor Atomic Fluorescence Spectrometry**
- **Sediment**
 - **EPA Method 7471A, Cold Vapor Atomic Absorption Method for solid/semi-solid**

Dam Wapama
Falls Creek
46 mi²

Rancheria Tiltill
65 mi²

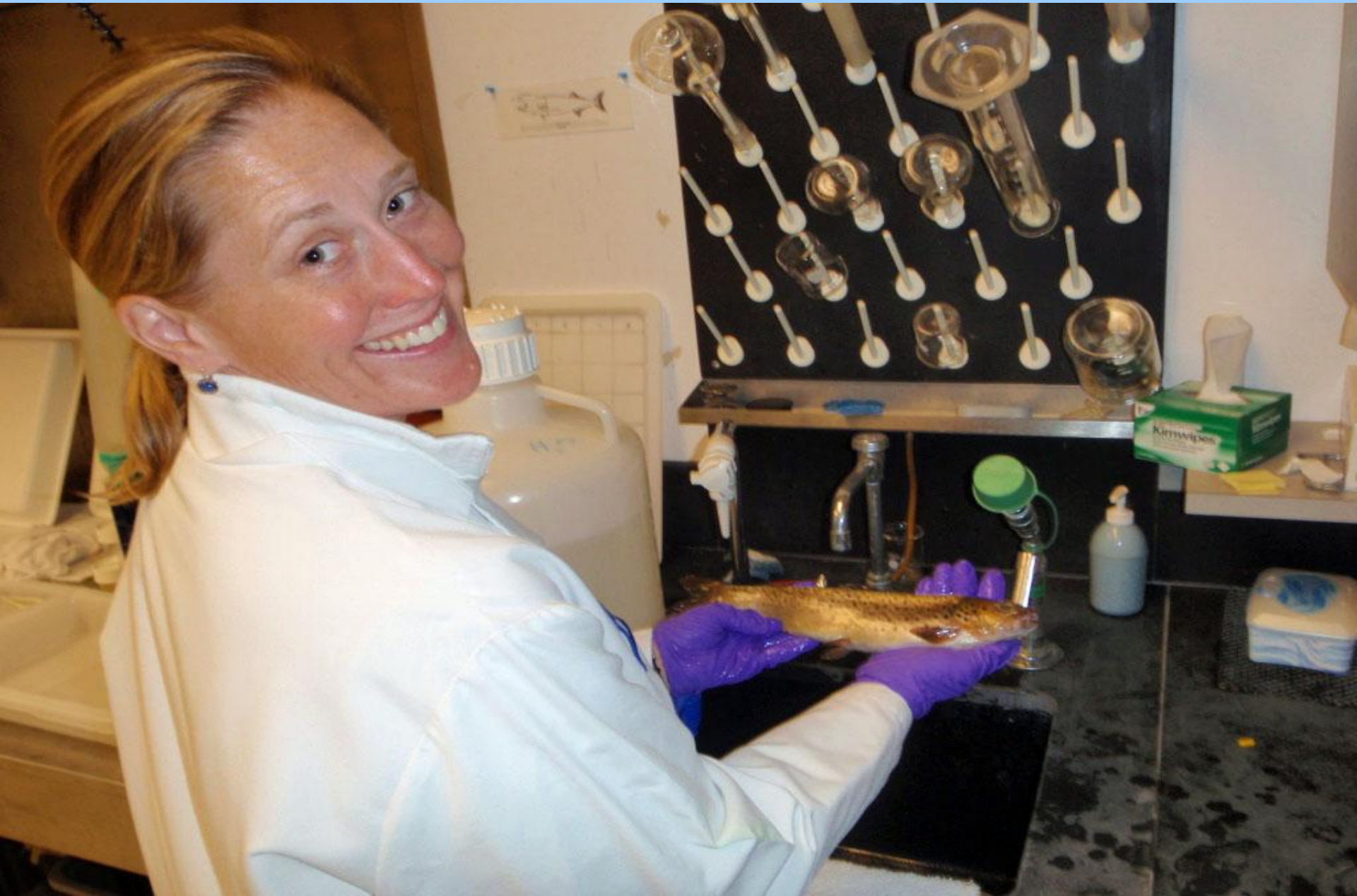
Tuolumne Hatch
(Tuolumne 301 mi²)
325 mi²



4 sed samples – problems with deployment – but good data



Cleaning – DI water wash & rinse



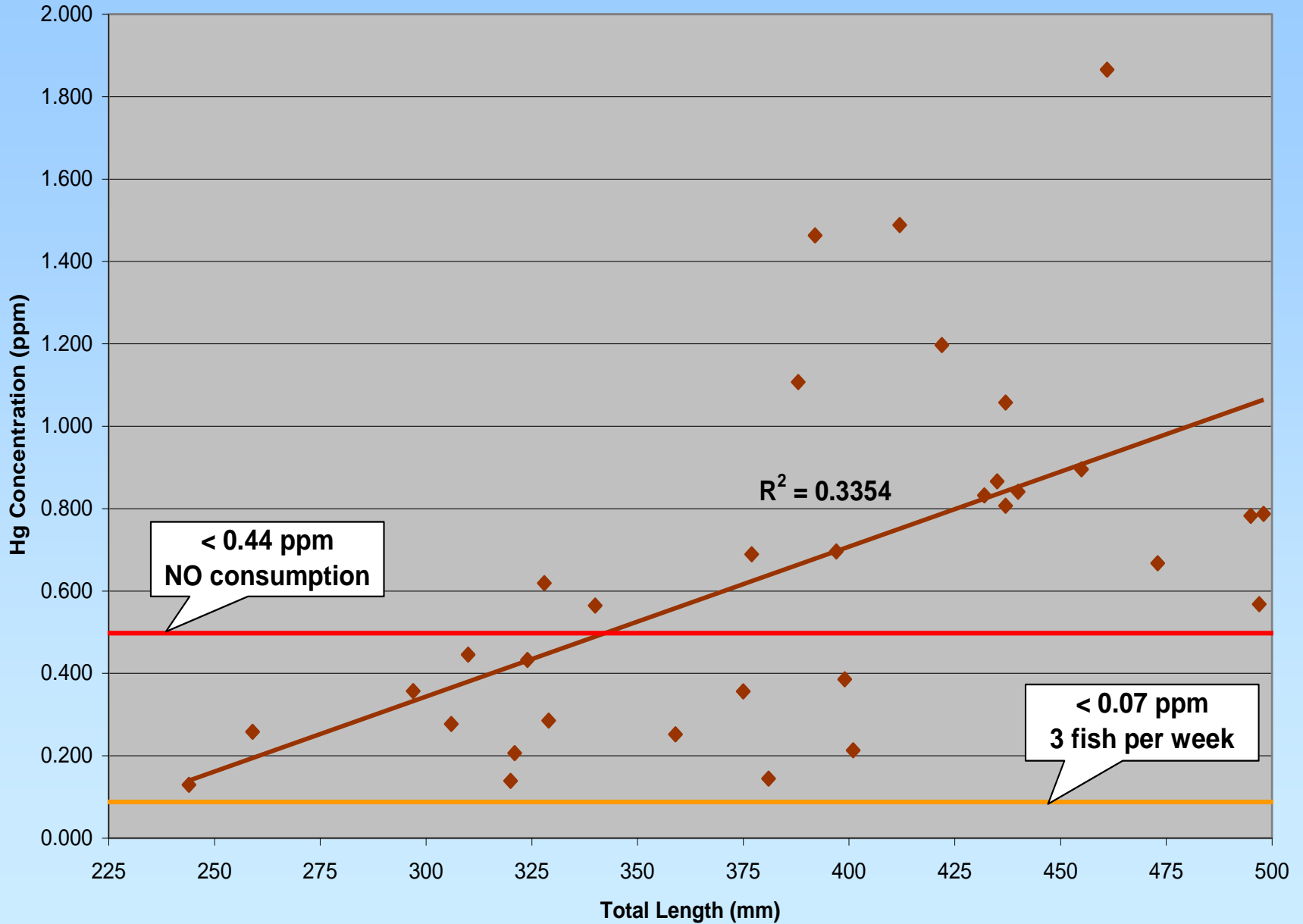
Tissue dissection – hood, nose breathe



**SWAMP 0.54 and 0.96 (brown trout, composites, Tuolumne Reach
 OEHHA 0.07 3 fish per week 0.44 NO consumption**

		BROWNS				RAINBOWS			
		ALL	HDW	RAN	WAP	ALL	HDW	RAN	WAP
both sexes	TL (mm)	386 (33)	422 (11)	383 (11)	353 (11)	331 (9)	7	1	1
	Hg (ppm)	0.66	0.64	0.74	0.59	0.22			
male	TL (mm)	380 (14)	405 (4)	405 (3)	355 (7)	321 (4)			
female		396 (16)	454 (5)	381 (7)	349 (4)	376 (4)			
male	Hg (ppm)	0.49	0.50	0.47	0.49	0.20			
female		0.88	0.92	0.92	0.76	0.29			
		3 unk	2 unk	1 unk		1 unk			

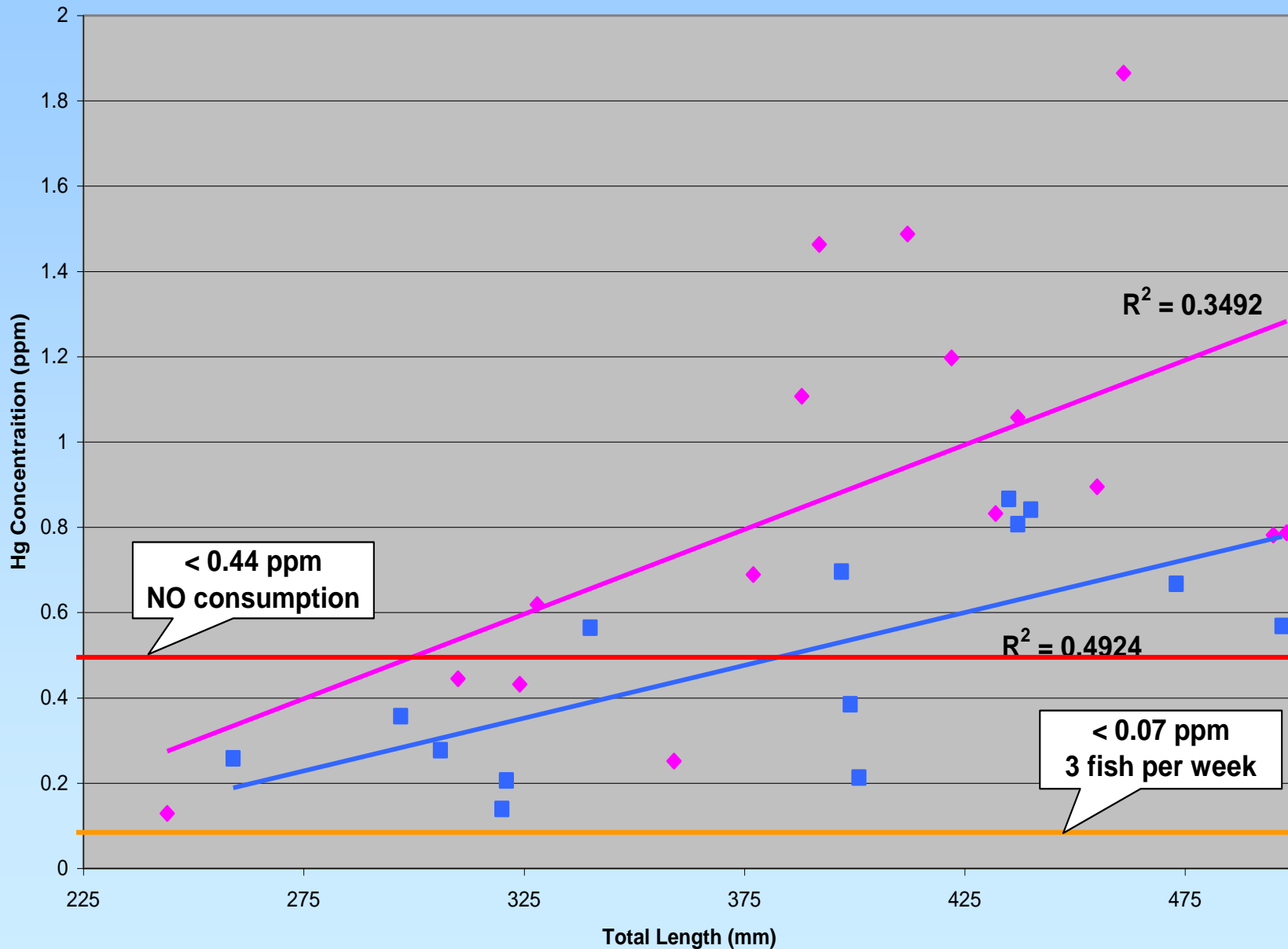
Hetch Hetchy Bioaccumulation Study Brown Trout Mercury Concentration (mg/Kg wet weight or ppm)



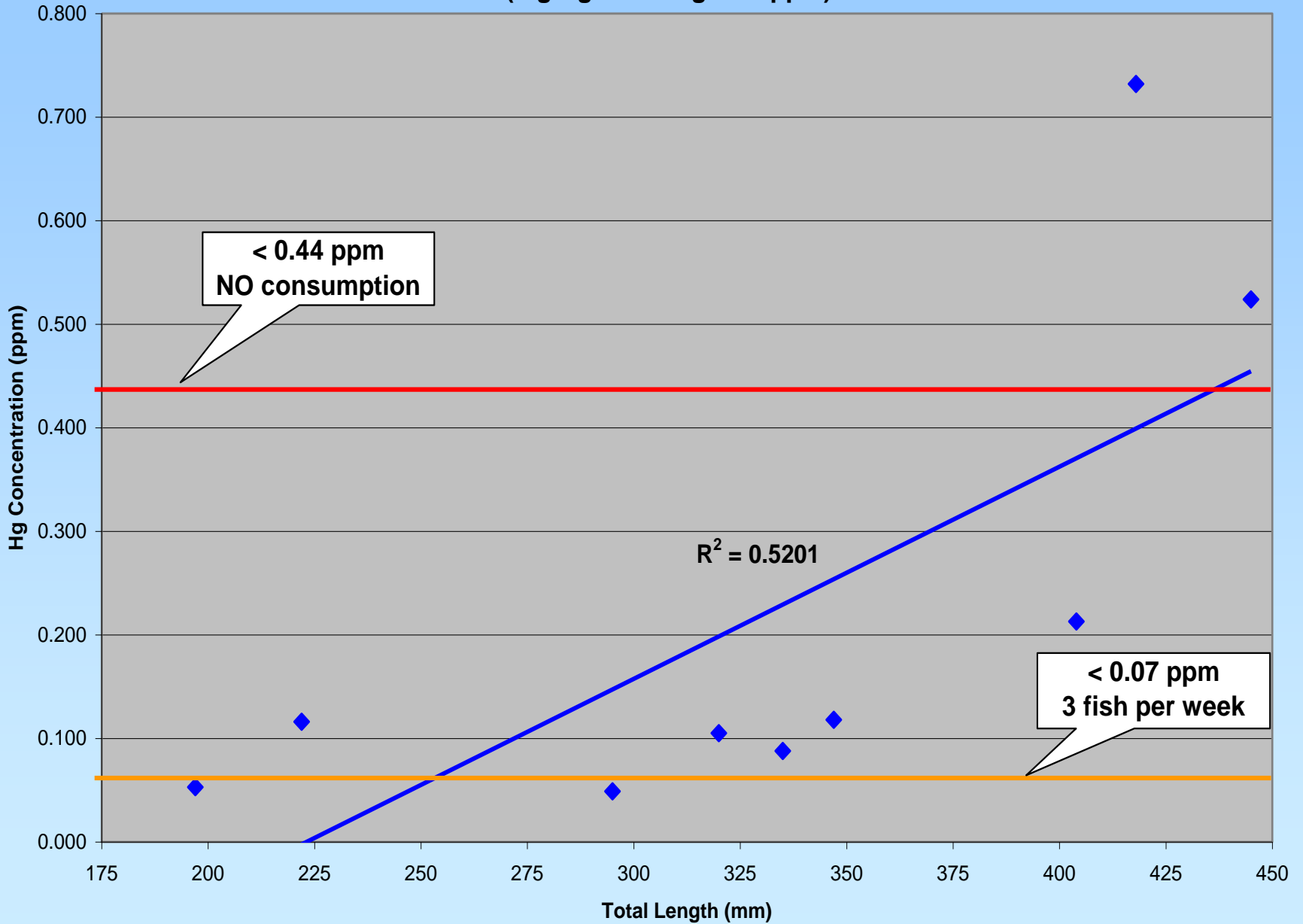
Hetch Hetchy Bioaccumulation Study

Brown Trout Mercury Concentration (ppm)

Male vs. Female

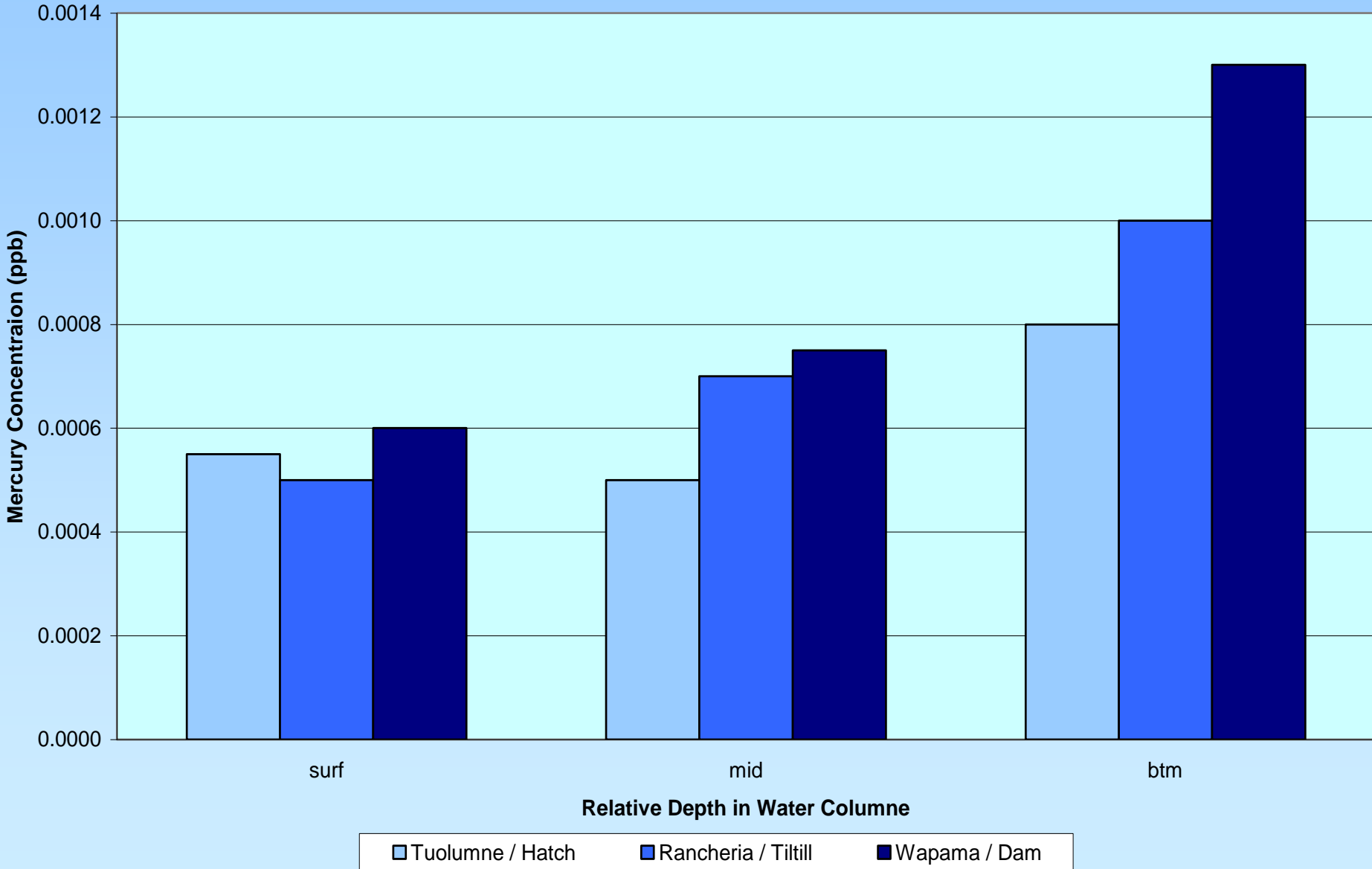


Hetch Hetchy Bioaccumulation Study Rainbow Trout Mercury Concentration (mg/Kg wet weight or ppm)



Drinking Water MCL = 2 ppb

Water Mercury Concentration by Reach and Depth



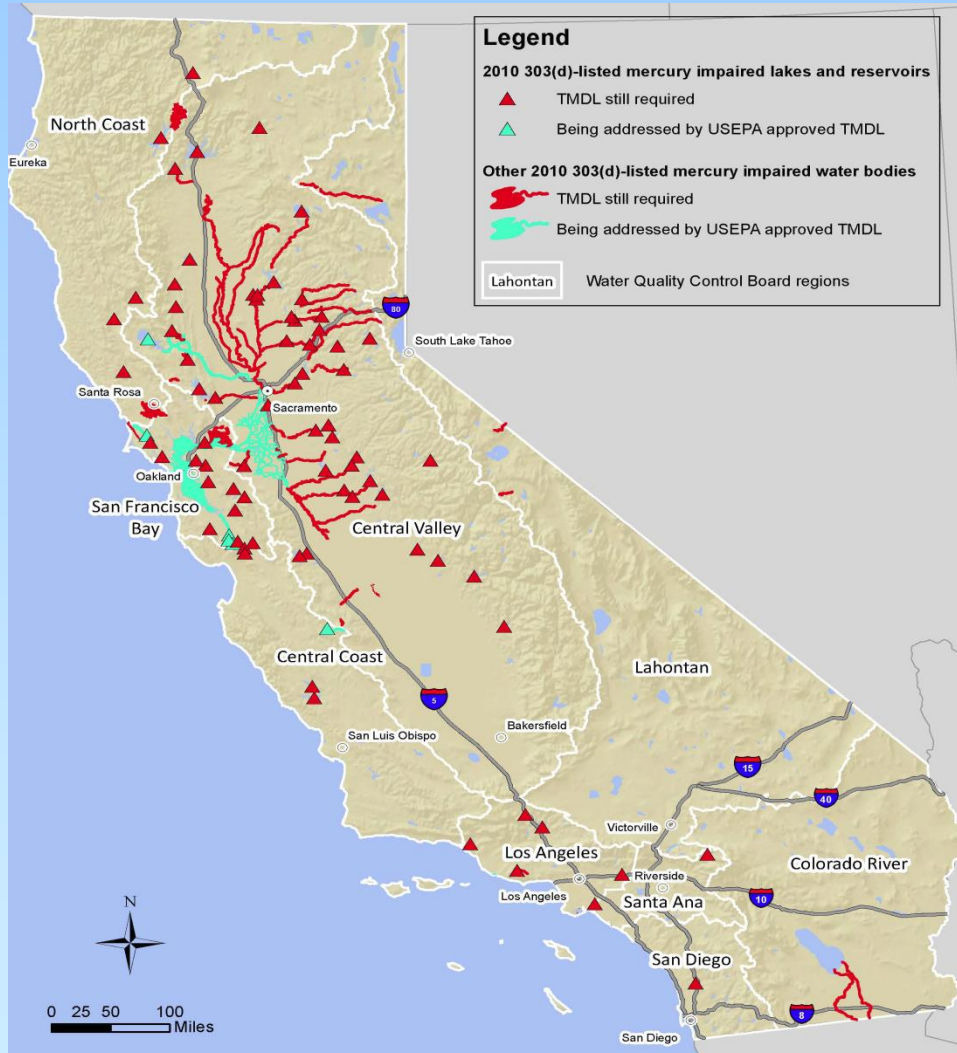
Sediment (only 4 samples) (ppm)



Lake Sediment Comparison

Sediment Mercury (total) ppb	Hetch Hetchy	
Dam Wapama	186	237
Rancheria Tiltill	165	
Tuolumne Hatch	31	
Other Remote Lakes		
Swedish forest lakes	50-300	
N. Wisconsin	63-289	
Rocky Mountain	90-100	
Finnish Ikaesw	134-277	
Lake Baikal	40	
Lake Superior	16-209	
Not so Remote (polluted)		
Onondaga Lake NY	1,000-50,000	
Clear Lake, CA	30,000-150,000	

WHAT NEXT?



CWA 303(d) listing

Development of TMDL

Consumption Advisories

Watershed Wide Study

Atmospheric deposition

Educate

National Park Service
U.S. Department of the Interior

Yosemite National Park



Mapping and Attributing Sources of Mercury Bioaccumulation in the Tuolumne River Watershed

April 23, 2012 Update

Heather McKenny, Leland Tarnay, Ninette Daniele (NPS)

Mike Horvath (SFPUC)

Study Objectives

- To quantify the magnitude & extent of Methyl mercury bioaccumulation at two trophic levels within lake, river and reservoir ecosystems
- Qualitatively identify the extent to which regional vs. global air pollutants may be contributing to bioaccumulation



Methods: Air Sampling

- Passive sampling
- Surrogate



EXPERIENCE YOUR AMERICA

Methods:

- Sampled water, fish, and zooplankton from:
 - 8 natural lakes stratified throughout the Tuolumne River Watershed
 - 2 locations on Tuolumne River (Lyell Fork and below the O'Shaughnessy Dam)
 - 2 reservoirs (Cherry and Eleanor)
- Samples are being analyzed by the SFPUC laboratory





Tilden

Wilma Lake

Kibbie Lake

Vernon

Benson

Cherry Lake

Eleanor Lake

McCabe Lakes

Below Hetch Hetchy Dam

Hetch Hetchy Reservoir

Dog Lake

120

Lyell Fork, Tuolumne River

Tioga St

Spillway

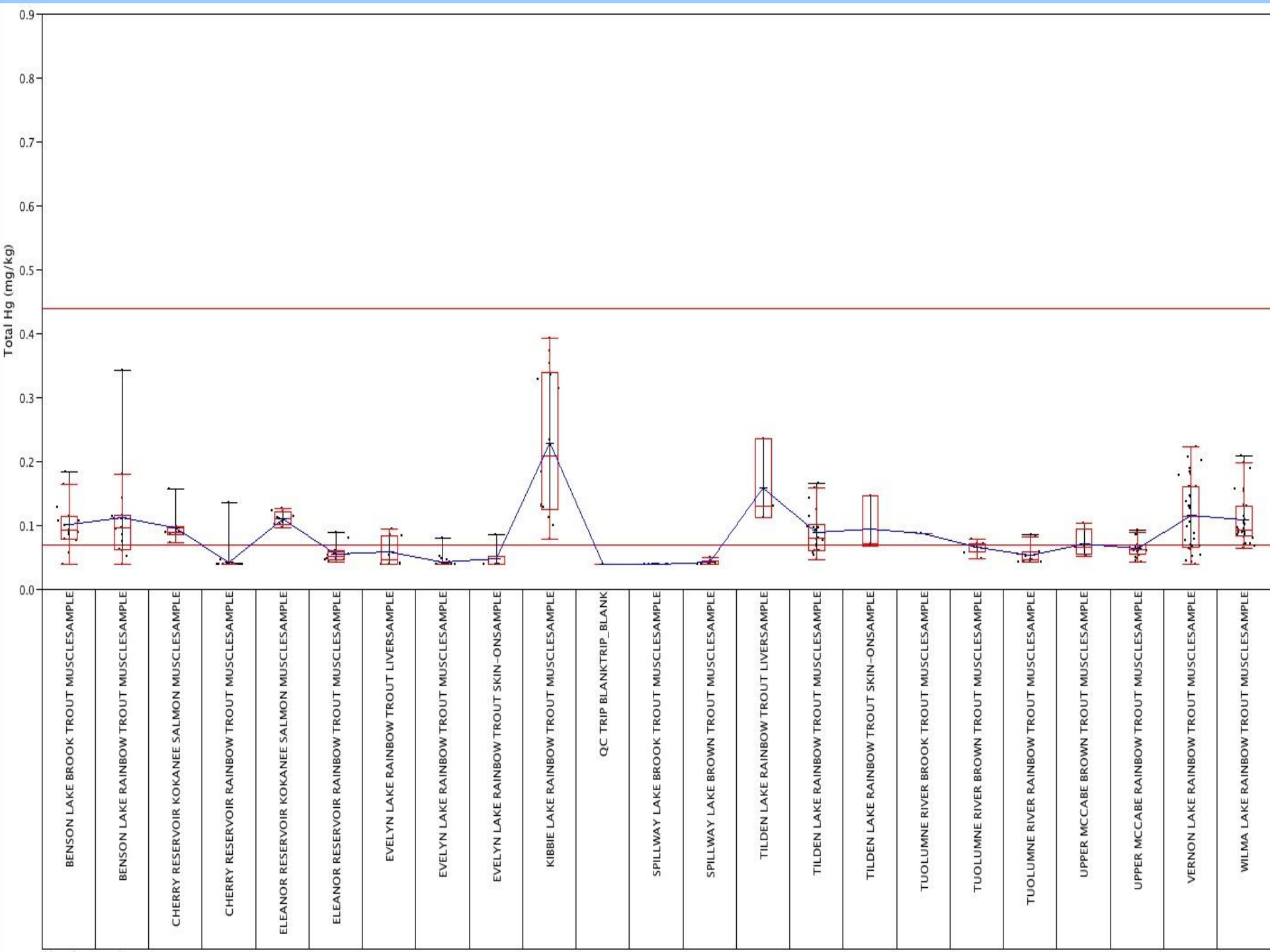
Evelyn Lake

Image © 2012 GeoEye
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Image USA Farm Service Agency

Google earth

Samples

Name	Rainbow Trout	Brown Trout	Brook Trout	Kokanee Salmon	Zooplankton	Water
<u>Kibbie Lake</u>	30	-	-	-	Yes	Yes
Tilden Lake	30	-	-	-	Yes	Yes
Wilma Lake	30	-	-	-	Yes	Yes
Lake Vernon	36	-	-	-	Yes	Yes
Benson Lake	15	-	15	-	Yes	Yes
Upper McCabe Lake	20	4	-	-	No	No
Spillway Lake	-	15	16	-	Yes	Yes
Evelyn Lake	30	-	-	-	Yes	Yes
Lyell Fork Tuolumne River	4	11	4	-	No	Yes
Tuolumne River below Dam	20	-	9	-	No	No
Cherry Lake	34	-	-	8	Yes	Yes
Lake Eleanor	12	-	-	13	Yes	Yes
Dog Lake	-	-	-	-	Yes	Yes



THE END (take 1)



just came from the doctor,
turns out i got humans



Acknowledgements

- **NRLMD Fisheries & Wildlife**
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 - **Dot Norris (Bio. II)**
 - **Diane O'Donohue (Bio II)**
 - **Heather Peterson (Bio. II)**
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 - **Tammy Egger (Bio. II)**
- **WQD Southeast Lab**
 - **Tony Rattonetti (Sen. Chemist)**
 - **Brian Kuhn (Water Quality Tech)**
 - **Maria Molloy Chem (WQ Tech)**
- **Hetch Hetchy Water & Power**
 - **Ken Brewer (Watershed Keeper)**
 - **Shop and Maintenance**
 - **Housekeeping and Custodial**