CORONA / TWIN PEAKS MINE REMEDIATION PROJECT: 2012 BASELINE STREAM BIOTA MERCURY MONITORING

Draft Data Report

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Monitoring and Report by

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INTRODUCTION

This data report summarizes mercury concentrations and related information from a series of aquatic biota collections made in May 2012 in the vicinity of the abandoned Corona and Twin Peaks mercury mines in Napa County, California. Small resident fish and aquatic insects were used as 'mercury biosentinels' to indicate relative mercury exposure levels and biological uptake. The aquatic biota monitoring was a part of a larger, multi-faceted, multi-investigator mine assessment and remediation project overseen by the environmental non-profit organization Tuleyome.

Aquatic biota monitoring was scheduled to occur once in 2012 prior to assessment and remediation work at the mine sites and then again in 2014 following that work. This data report provides an initial look at the pre-remediation 2012 monitoring.

Similar monitoring was conducted by this same project team 14 years earlier in 1998, prior to site cleanup work in place today. Comparative data from that effort are included below.

Nine sites were sampled in 2012 (Table 1, Fig. 1), including paired sites in Bateman Creek above and below the Twin Peaks mine, and paired sites in Kidd Creek above and below the Corona mine. Additional sites included a series of 3 downstream locations in James and Pope Creeks, and 2 comparison creeks in the watershed, one un-mined (Udnick Creek) and another downstream of the Aetna mercury mine (Swartz Creek). A total of 60 small fish were individually analyzed for mercury, and 45 multi-individual composite samples of aquatic insects, using species with broad spatial overlap where possible.

Following are the methods used and an initial presentation of the mercury data from the baseline survey.

Table 1. 2012 aquatic biota sampling sites.

Site Description	Sampling Date	GPS North	GPS West	Relative Location
Bateman Creek abv Twin Peaks Mine	5/3/12	38.66152	-122.53346	above Twin Peaks Mine
Bateman Creek blw Twin Peaks Mine	5/3/12	38.66574	-122.53069	below Twin Peaks Mine
Kidd Creek abv Corona Mine	5/7/12	38.67203	-122.53860	above Corona Mine
James Creek at Aetna Road	5/8/12	38.66928	-122.51872	app. 1 mile blw mines
James Creek blw Udnick Creek	5/9/12	38.67195	-122.47679	app. 3 miles blw mines
Udnick Creek	5/9/12	38.67853	-122.45182	un-mined control creek
Pope Creek at Barnett Rd	5/11/12	38.64327	-122.42028	app. 7 miles blw mines
Swartz Ck at Aetna Springs Rd	5/19/12	38.65333	-122.47640	mined control ck (blw Aetna)

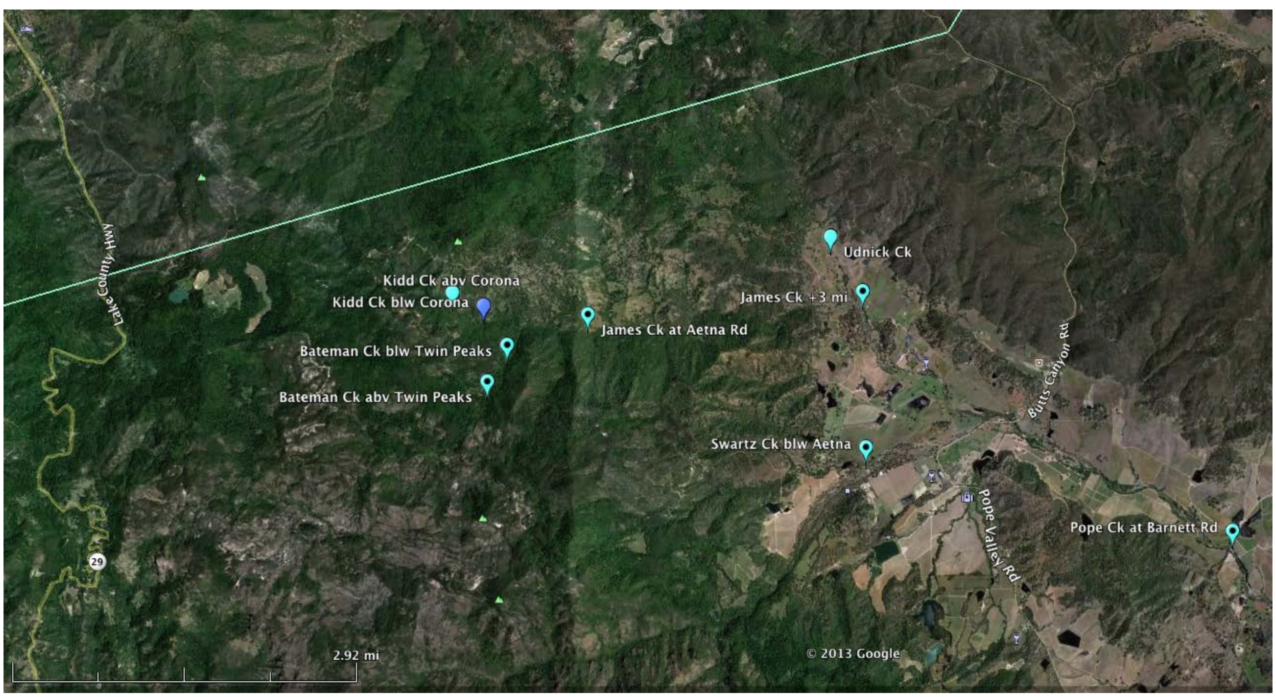

Figure 1. Map of May 2012 biota sampling sites in the Corona/Twin Peaks Mines watershed

METHODS

Fish were collected using a Smith-Root backpack electro-fishing unit, together with seines. This was done with two researchers wading in the creek, wearing non-conductive waders. Electro-fisher settings were carefully adjusted to match the conductance of each reach and to minimize any effects to fish beyond brief stunning. The effective field range was app. 5 feet. Any non-targeted fish were moved away, checked to assure quick recovery, and helped to revive in the unusual case where that was necessary. Aquatic insect samples were collected using a research kick screen in riffle areas and submerged vegetation.

Small fish were field identified, cleaned and sorted by species, bagged in labeled freezer weight, zip-close bags with air removed but a film of water surrounding, and field frozen using dry ice, a technique my group has found to maintain natural moisture levels through the freezing process, something that can be a problem for small fish samples. Pre-analytical processing included weighing and measuring each analyzed fish and drying the sample to constant weight in a laboratory oven at 55 °C. Solids percentage was calculated during this process, through sequential weighings of empty weigh tins, tins with wet sample, and tins with dry sample. Dried samples were homogenized to fine powders using a laboratory grinder.

Aquatic insect samples were field sorted and cleaned in laboratory pans with site water and transported to the lab on ice in glass jars with teflon lined caps. Within 24 hours, the live samples were sorted into replicate, multi-individual composites of similar-sized representatives of the same taxa, sizes and numbers were recorded, and the composites were transferred into pre-weighed vials. Weights were obtained with wet samples and following oven drying as above. Dried samples were homogenized to uniform powders using a glass mortar and pestle.

Small fish and aquatic insect composite samples were analyzed whole body, homogenized into dry powders for consistency as described above. Dry weight results were converted to original wet/fresh weight concentrations using the calculated % solids values. For all mercury analyses, samples were weighed into 20 ml digestion tubes and digested at 90 °C in a mixture of concentrated nitric and sulfuric acids with potassium permanganate, in a two-stage process. Digested samples were then analyzed for total mercury by standard cold vapor atomic absorption (CVAA) spectrophotometry, using a dedicated Perkin Elmer Flow Injection Mercury System (FIMS) with an AS-90 autosampler. The method is a variant of EPA Method 245.6, with modifications developed by our laboratory.

Extensive Quality Assurance / Quality Control (QAQC) samples were included in all analytical runs and tracked with control charts. Results for this project were all within control limits and are detailed in an accompanying Analytical Case Narrative.

RESULTS AND DISCUSSION

Small fish data from the 2012 collections are presented in Table 2. Comparable data from 1998 are shown in Table 3.

As in the earlier work, fish were not present at all of the sites, mainly due to barriers to migration created by some drops and falls in James Creek app. 0.5 km below the Corona mine. So, fish were not present immediately adjacent to the Twin Peaks mine in Bateman Creek or the Corona mine in Kidd Creek. Fish were present, however, downstream of the two mines in James Creek at Aetna Road, and continuing downstream in James and Pope Creeks, as well as in Udnick and Swartz Creeks. As in 1998, California roach (*Lavinia symmetricus*) were present at the James Creek and Udnick Creek sites. Also as in 1998, riffle sculpin (Cottus gulosus) were present at the lower James Creek location below Udnick Creek. Larval Sacramento suckers (*Catostomus occidentalis*) were collected from a number of watershed sites in 1998, but in May 2012 were not present in the sizes or numbers needed for meaningful samples, likely due to the timing of spawning. A significant change in local fish populations in 2012 included the presence of juvenile rainbow trout (*Oncorhynchus mykiss*) at most of the sampling sites. Samples were taken from both James Creek locations, Pope Creek at Barnett Road, and Swartz Creek.

The 2012 fish samples were analyzed individually, with 8 replicates for the trout samples (4 sites) and 7 for the California roach (3 sites) and riffle sculpin (1 site).

Juvenile rainbow trout ranged in whole body, wet weight mercury concentrations from a low of 46 ng/g (= ppb) in a fish from the upper James Creek site, to a high of nearly 3,000 ng/g in a young trout from the downstream James Creek site. A number of very high concentrations were seen from that site, though variability was high as well (4 fish at 165-310 ng/g and 4 at 685-2,991 ng/g). Concentrations were clearly lower at the more upstream James Creek site and in Swartz Creek, with levels ranging from 46-134 ng/g. Levels were somewhat higher at the downstream Pope Creek location, at 87-151 ng/g in 7 of 8 samples and one at 476 ng/g. It is very interesting that the trout from the location closest to the Corona and Twin Peaks mine impacts (Upper James Creek at Aetna Road) were substantially lower in mercury than similar fish taken downstream near Udnick Creek.

It is likely that total inorganic mercury in water and sediments is higher at the upper site, but this may not translate into higher bioavailability to the aquatic biota. We suspect that methylmercury (MeHg) production may be greater at the lower James Creek site and/or net MeHg availability may be greater due to the increased water clarity and corresponding lack of alternate binding sites. In May 2012, the upper site was notably impacted by iron-based floc clouding the water, though this was substantially down from 1998 conditions. The overall reduction in iron-based turbidity in James Creek is in fact a leading explanation for the successful reproduction and rearing of trout in this stream that contained no young trout in 1998. Juvenile and adult California giant salamanders (*Dicamptodon ensatus*) and foothill yellow-legged frogs (*Rana boylii*) were also notably more plentiful in 2012.

California roach were also higher in mercury at the lower James Creek site (171-505 ng/g) relative to the upper James Creek site (173-303 ng/g), but the difference was not as pronounced as in the trout. Concentrations were uniformly lower from Udnick Creek, at 96-158 ng/g.

Riffle sculpin, available at the lower James Creek location where the very elevated trout Hg occurred, had concentrations of 249-427 ng/g in 6 of 7 fish, with one individual much higher at 1,219 ng/g.

The 1998 data are presented in wet weight concentrations, converted to units of ng/g from the originally reported µg/g or ppm format. A coarser analytical technique was used at the time, with data reported to ± 10 ng/g. Similar to 2012, California roach in 1998 showed higher Hg at the downstream James Creek location (110-700 ng/g in composite samples, with a mean of 280 ng/g) than the upper site at Aetna Road (80-140 ng/g, with a mean of 110 ng/g). Concentrations in 2012 were similar at the downstream site and higher at the upstream location.

Riffle sculpin, taken from the downstream James Creek site, were 150 and 210 ng/g in 2 composite samples from 1998. Comparable 2012 sculpin from this site were higher, as described above.

Table 2. Small fish individual data from May 2012 collections.

Site	Fish Species	Length (mm total)	Weight (grams)	Solids %	**Hg** (ng/g = ppb) (DRY wt)	(WET wt)
James Creek 1	Rainbow Trout	46	1.04	18.1%	313	57
James Creek 1	Rainbow Trout	48	1.25	17.4%	341	59
James Creek 1	Rainbow Trout	49	1.20	19.1%	244	46
James Creek 1	Rainbow Trout	67	3.61	19.7%	603	119
James Creek 1	Rainbow Trout	73	4.97	22.6%	420	95
James Creek 1	Rainbow Trout	75	4.97	22.0%	449	99
James Creek 1	Rainbow Trout	75	4.86	22.0%	358	79
James Creek 1	Rainbow Trout	76	5.13	20.5%	447	92
James Creek 2	Rainbow Trout	51	1.38	17.2%	1,036	179
James Creek 2	Rainbow Trout	52	1.63	17.8%	926	165
James Creek 2	Rainbow Trout	52	1.79	19.3%	7,285	1,409
James Creek 2	Rainbow Trout	55	1.80	17.6%	4,759	839
James Creek 2	Rainbow Trout	58	2.09	17.6%	1,758	310
James Creek 2	Rainbow Trout	60	2.16	21.8%	13,749	2,991
James Creek 2	Rainbow Trout	62	2.69	20.3%	3,383	685
James Creek 2	Rainbow Trout	64	3.03	22.8%	1,130	258
Pope Creek	Rainbow Trout	50	1.46	20.8%	557	116
Pope Creek	Rainbow Trout	51	1.86	21.9%	415	91
Pope Creek	Rainbow Trout	54	1.87	22.1%	501	111
Pope Creek	Rainbow Trout	56	2.33	22.3%	2,131	476
Pope Creek	Rainbow Trout	59	2.85	22.7%	432	98
Pope Creek	Rainbow Trout	61	2.94	23.5%	371	87
Pope Creek	Rainbow Trout	63	3.10	24.0%	631	151
Pope Creek	Rainbow Trout	66	3.95	25.6%	498	127
Swartz Creek	Rainbow Trout	51	1.58	20.8%	342	71
Swartz Creek	Rainbow Trout	54	2.13	21.0%	563	118
Swartz Creek	Rainbow Trout	57	2.47	21.8%	275	60
Swartz Creek	Rainbow Trout	59	2.76	21.9%	312	68
Swartz Creek	Rainbow Trout	62	3.15	23.0%	323	74
Swartz Creek	Rainbow Trout	64	3.25	23.2%	576	134
Swartz Creek	Rainbow Trout	66	3.96	23.5%	283	66
Swartz Creek	Rainbow Trout	67	4.15	25.2%	385	97

(continued)

James Creek 1 = at Aetna Road; James Creek 2 = below Udnick Creek
Pope Creek at Barnett Road; Swartz Creek at Aetna Springs Road

Table 2 *(continued)*. **Small fish individual data from May 2012 collections.**

Site	**Fish Species**	**Length** (mm total)	**Weight** (grams)	**Solids %**	**Hg** (ng/g = ppb) (DRY wt)	(WET wt)
James Creek 1	California Roach	51	1.18	20.1%	998	200
James Creek 1	California Roach	52	1.44	23.7%	728	173
James Creek 1	California Roach	56	2.02	25.9%	678	176
James Creek 1	California Roach	58	2.04	21.2%	1,040	220
James Creek 1	California Roach	58	2.64	21.0%	1,167	245
James Creek 1	California Roach	61	2.92	20.3%	1,120	227
James Creek 1	California Roach	64	3.40	24.2%	1,252	303
James Creek 2	California Roach	52	1.38	22.7%	754	171
James Creek 2	California Roach	53	1.34	21.1%	1,158	245
James Creek 2	California Roach	55	1.74	21.2%	1,663	353
James Creek 2	California Roach	58	1.95	23.0%	1,054	243
James Creek 2	California Roach	60	2.24	21.6%	1,268	273
James Creek 2	California Roach	62	2.53	24.7%	1,335	330
James Creek 2	California Roach	64	2.52	20.8%	2,425	505
Udnick Creek	California Roach	52	1.54	20.9%	525	110
Udnick Creek	California Roach	54	1.68	23.4%	439	103
Udnick Creek	California Roach	55	1.66	22.2%	514	114
Udnick Creek	California Roach	57	1.98	22.5%	521	117
Udnick Creek	California Roach	59	2.43	22.9%	418	96
Udnick Creek	California Roach	61	2.27	21.0%	753	158
Udnick Creek	California Roach	64	2.53	22.0%	705	155
James Creek 2	Riffle Sculpin	52	2.18	22.3%	5,470	1,219
James Creek 2	Riffle Sculpin	53	2.19	21.7%	1,346	292
James Creek 2	Riffle Sculpin	56	2.32	23.9%	1,043	249
James Creek 2	Riffle Sculpin	62	3.95	20.8%	1,698	354
James Creek 2	Riffle Sculpin	66	3.95	27.7%	1,057	292
James Creek 2	Riffle Sculpin	68	4.92	24.8%	1,052	261
James Creek 2	Riffle Sculpin	74	5.39	19.4%	2,200	427

James Creek 1 = at Aetna Road; James Creek 2 = below Udnick Creek;
Udnick Creek app. 1 km abv James Creek.

Table 3. 1998 comparative small and juvenile fish composite mercury data.
(wet wt ng/g = ppb Hg in multi-individual, homogenized, whole-body composites)

Species	mean Weight *(g)*	mean Length *(mm)*	Individuals in Comp.	mean Hg *(wet wt ng/g, ppb)*
Site 6. James Ck (at Aetna Road)				
California Roach	0.6	39	n=3	80
" "	1.2	48	n=4	120
" "	1.1	47	n=4	80
" "	2.0	58	n=4	100
" "	6.6	84	n=3	140
			mean roach Hg =	**110**
Site 7. Udnick Ck				
California Roach	1.0	46	n=6	0.07
" "	1.0	47	n=6	0.08
" "	1.1	47	n=6	0.08
" "	2.0	55	n=3	0.07
			mean roach Hg =	**0.07**
Larval Sacramento Suckers	<0.3	<40	n=13	**0.02**
Site 8. James Ck below Udnick Ck				
California Roach	0.4	40	n=4	110
" "	1.0	46	n=6	140
" "	1.1	47	n=6	180
" "	1.2	47	n=6	270
" "	2.5	61	n=4	700
			mean roach Hg =	**280**
(Riffle) Sculpin	2.7	68	n=3	210
(Riffle) Sculpin	2.7	70	n=3	150
			mean sculpin Hg =	**180**
Larval Sacramento Suckers	<0.3	<40	n=4	**110**
Site 10. Swartz Ck				
Larval Sacramento Suckers	<0.3	<40	n=50	**70**
Site 13. Pope Ck (at Barnett Rd)				
Larval Sacramento Suckers	<0.3	<40	n=18	**60**

Aquatic Insect Samples

Aquatic insects were taken as a second type of 'mercury biosentinel'. They were present at a number of sites that did not contain fish. Insect data are presented in Table 4. Comparable data from the 1998 work are shown in Table 5. The insect data will be discussed in terms of dry weight concentrations, as in 1998 and as is typical for invertebrate mercury samples.

Rather than collecting and analyzing single composite samples of several invertebrate taxa, as in 1998, the 2012 work focused on triplicate replication of the most prevalent and inter-comparable groups. In particular, Ephemerellid mayfly nymphs and Perlid and/or Perlodid stonefly nymphs were targeted in 2012. Of the 8 sites containing aquatic insects, Ephemerellid mayflies were available for full triplicate samples at 6 sites. Perlid stoneflies were taken at 6 sites, with triplicate samples at 5 sites. Perlodid stoneflies provided additional information at 3 sites, as did mayflies of mixed taxa at 2 sites. As in 1998, very few insects were available at the upper Kidd Creek site above the Corona mine, and none were present in the heavy iron-precipitate floc at the site just downstream of that mine. Several of the sets of triplicates were confounded by high variability, often an issue at near-mine locations. These incidents were closely examined, but accompanying QA/QC was excellent (see Analytical Case Narrative), indicating that the variability was real.

In Bateman Creek, with sites positioned upstream and downstream of the Twin Peaks mine, extensive triplicate composite samples of Ephemerellid mayflies and Perlid stoneflies were taken at both locations. In dry weight concentrations, the mayflies ranged from 69-90 ng/g above the mine and were higher at the below mine site at 138, 203, and 718 ng/g. Comparable 1998 data from single composites were 80 ng/g at both sites, indicating no change at the upstream site in 2012 and an increase at the downstream site. Perlid stonefly composites in 2012 were a consistent 203-223 ng/g upstream of the mine and were also higher downstream, at 245-329 ng/g. Comparable 1998 data from single composites were 170 ng/g upstream and 330 ng/g downstream, very similar to 2012.

For the Corona Mine, as in 1998, aquatic insects were very scarce upstream of the mine in the steep, narrow canyon, probably due to poor habitat topographically. We were able to assemble triplicate samples of mixed mayflies (Ephemerellids, Baetids and Siphloneurids) and single composites of Perlid and Perlodid stoneflies. As in 1998, aquatic insect mercury was notably elevated at this site, despite its location clearly above the main Corona mine workings. The mayfly composites had 384, 567, and 2,928 ng/g Hg. The Perlid composite contained 349 ng/g and the Perlodids had 225 ng/g. These concentrations were similar to those seen in 1998, when an Ephemerellid mayfly composite was found to contain 360 ng/g and a Perlodid stonefly composite had 210 ng/g. These elevated concentrations in both rounds of monitoring suggest that there may have been additional mercury mining activity upstream along Kidd Creek.

Immediately downstream of the Corona Drain Tunnel Portal into the creek, the water quality as in 1998 was found to be too impacted by iron-based floc for there to be any macro-invertebrates present. As with the fish, macro-invertebrates were available app. 1 mile downstream at Aetna Road, and continuing downstream. Strong triplicate composite samples were taken of Ephemerellid mayflies and Perlid stoneflies at both James Creek locations. At the upper, Aetna Road location, the mayflies showed extremely elevated and variable concentrations: 3,761, 11,911, and 24,532 ng/g Hg. Levels were lower at the site below Udnick Creek, at 653, 675, and 3,310 ng/g. These compare to 1998 concentrations of 250 ng/g at Aetna Road and 400 ng/g below Udnick Creek, apparently indicating a substantial increase in 2012. The Perlid stoneflies, like the fish, were mostly lower at the Aetna Road site (375, 483, and 1,110 ng/g) than downstream below Udnick Creek (795, 824, and 876 ng/g). Comparable 1998 concentrations were 470 ng/g at the upper site and 520 ng/g at the lower. We note that the extreme concentrations seen in the 2012 Ephemerellid mayflies likely represent ingested inorganic mercury rather than methylmercury. Mayflies are herbivores and should contain lower MeHg than co-occurring predatory stoneflies. In the course of scraping diatom algae films off floc-encrusted rocks, they can ingest significant inorganic Hg if it is present.

Aquatic insect mercury concentrations and variability mostly settled down at the remaining sites located further from the mining influence. In downstream Pope Creek at Barnett Road, Ephemerellid mayfly composites contained 280-329 ng/g Hg. Perlodid stoneflies had 416, 458, and an outlier 1,752 ng/g. These were similar to 1998 collections which had 330 ng/g in Ephemerellid mayflies, 520 ng/g in Perlodid stoneflies, and 2,030 ng/g in Siphloneurid mayflies.

Swartz Creek in 2012 had very consistent within-composites concentrations: 220-249 ng/g in Ephemerellid mayflies, 329-417 ng/g in Perlid stoneflies, and 457-476 ng/g in Perlodid stoneflies. Comparable 1998 data in single composites included 970 ng/g in Ephemerellid mayflies, 460 ng/g in Perlodid stoneflies, 530 ng/g in Perlid stoneflies, and 1,610 ng/g in Siphloneurid mayflies. The decline apparent in some of the 2012 data was likely due to the 1998 collections being from drainage directly from the Aetna mine region, while the 2012 collections were made in Swartz Creek below this inflow, where it was diluted with non-Aetna flows.

Udnick Creek, clearly a seasonally dry stream, contained very few aquatic macro-invertebrates in 2012. The single composite of mixed mayflies, at 146 ng/g, was lower in mercury than all other 2012 insect samples excepting the mayflies from upper Bateman Creek. The 2012 level was similar to the 140-170 ng/g concentrations seen among 3 small samples of various taxa collected in 1998.

Perspective

The 2012 biota collections indicate the presence of residual elevated mercury downstream of the two abandoned mines, particularly in James Creek downstream of the project area. The effects of significant efforts by or for the landowner to improve overall water quality in Bateman and Kidd Creeks since 1998 were apparent in the thriving populations of California giant salamanders and foothill yellow-legged frogs in both creeks in 2012 and the presence of successfully reproducing rainbow trout throughout James Creek below a residual, reduced zone of heavy iron-based floc precipitate immediately downstream of the Corona Drain Tunnel Portal. As noted in 1998, the path to cleanup in this watershed may include some localized continued high or even increased mercury bioavailability, despite likely reductions in overall mercury loading to Pope Creek and Lake Berryessa. The increased presence of the salamanders, frogs, and trout indicate the importance of working toward continued improvements.

Table 4. Aquatic insect composites data from May 2012 collections.

Site	**Aquatic Insect Family**	**n** in comp	**Length** (av. mm)	**Weight** (av. mg)	**Solids** %	**Hg** (ng/g = ppb) (DRY wt)	(WET wt)
Bateman Creek 1	Ephemerellid mayflies	10	13	77	17.4%	69	12
Bateman Creek 1	Ephemerellid mayflies	10	13	73	19.2%	89	17
Bateman Creek 1	Ephemerellid mayflies	10	13	73	17.8%	90	16
Bateman Creek 2	Ephemerellid mayflies	10	13	74	16.6%	718	119
Bateman Creek 2	Ephemerellid mayflies	10	13	62	18.1%	138	25
Bateman Creek 2	Ephemerellid mayflies	10	13	67	18.7%	203	38
Upper Kidd Ck	(mixed mayflies)	6	9	45	25.7%	567	146
Upper Kidd Ck	(mixed mayflies)	6	9	50	26.7%	384	102
Upper Kidd Ck	(mixed mayflies)	6	9	43	28.1%	2,928	823
James Creek 1	Ephemerellid mayflies	10	11	37	19.4%	11,911	2,310
James Creek 1	Ephemerellid mayflies	10	11	37	22.2%	3,761	835
James Creek 1	Ephemerellid mayflies	10	11	39	23.2%	24,532	5,701
James Creek 2	Ephemerellid mayflies	10	10	40	24.1%	675	163
James Creek 2	Ephemerellid mayflies	10	10	40	23.8%	3,310	787
James Creek 2	Ephemerellid mayflies	10	10	39	22.2%	653	145
Pope Creek	Ephemerellid mayflies	10	12	79	27.1%	304	82
Pope Creek	Ephemerellid mayflies	10	12	76	25.8%	329	85
Pope Creek	Ephemerellid mayflies	10	12	74	25.4%	280	71
Swartz Creek	Ephemerellid mayflies	10	12	61	27.0%	220	60
Swartz Creek	Ephemerellid mayflies	10	12	58	24.6%	249	61
Swartz Creek	Ephemerellid mayflies	10	12	65	26.7%	223	60
Udnick Creek	(mixed mayflies)	20	8	16	22.8%	146	33

(continued)

Bateman Creek 1 = above Twin Peaks Mine; Bateman Creek 2 = below Twin Peaks Mine
James Creek 1 = at Aetna Road; James Creek 2 = below Udnick Creek
Pope Creek at Barnett Road; Swartz Creek at Aetna Springs Road; Udnick Creek app. 1 km abv James Creek

Table 4 *(continued)*. **Aquatic insect composites data from May 2012 collections.**

Site	**Aquatic Insect Family**	**n** in comp	**Length** (av. mm)	**Weight** (av. mg)	**Solids** %	**Hg** (ng/g = ppb) (DRY wt)	(WET wt)
Bateman Creek 1	Perlid Stoneflies	10	20	157	21.6%	203	44
Bateman Creek 1	Perlid Stoneflies	10	20	159	22.4%	216	48
Bateman Creek 1	Perlid Stoneflies	10	20	193	21.0%	223	47
Bateman Creek 2	Perlid Stoneflies	10	20	158	20.7%	329	68
Bateman Creek 2	Perlid Stoneflies	10	20	152	20.6%	327	67
Bateman Creek 2	Perlid Stoneflies	10	20	163	21.7%	245	53
Upper Kidd Ck	Perlid Stoneflies	6	11	34	17.9%	349	63
James Creek 1	Perlid Stoneflies	10	20	129	19.1%	483	92
James Creek 1	Perlid Stoneflies	10	20	135	17.1%	1,110	189
James Creek 1	Perlid Stoneflies	10	20	126	17.2%	375	64
James Creek 2	Perlid Stoneflies	10	21	132	27.2%	824	224
James Creek 2	Perlid Stoneflies	10	21	134	26.2%	795	208
James Creek 2	Perlid Stoneflies	10	21	138	25.7%	876	225
Swartz Creek	Perlid Stoneflies	2	23	260	30.1%	372	112
Swartz Creek	Perlid Stoneflies	3	23	248	30.5%	417	127
Swartz Creek	Perlid Stoneflies	3	23	197	29.6%	329	97
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Upper Kidd Creek	Perlodid Stoneflies	19	9	9	23.0%	225	52
Pope Creek	Perlodid Stoneflies	10	11	39	22.8%	458	104
Pope Creek	Perlodid Stoneflies	10	11	39	22.4%	416	93
Pope Creek	Perlodid Stoneflies	10	11	42	22.8%	1,752	400
Swartz Creek	Perlodid Stoneflies	10	12	34	23.2%	469	109
Swartz Creek	Perlodid Stoneflies	10	12	35	23.5%	457	107
Swartz Creek	Perlodid Stoneflies	10	12	33	23.7%	476	113

Bateman Creek 1 = above Twin Peaks Mine; Bateman Creek 2 = below Twin Peaks Mine
Upper Kidd Creek above Corona Mine; James Creek 1 = at Aetna Road; James Creek 2 = below Udnick Creek
Pope Creek at Barnett Road; Swartz Creek at Aetna Springs Road;

Table 5. 1998 comparative aquatic insect mercury data.
(DRY ng/g = ppb Hg in multi-individual, homogenized, whole-body, single composites)
*(Sites in **bold type** = sites also sampled in 2012)*

		HERBIVORES	DRIFT FEEDERS	FIRST ORDER PREDATORS	
Site #	Site Description	Ephemerellidae	Siphlo-neuridae	Perlo-didae	Perlidae
1	**Kidd Ck above Corona**	360	—	210	—
2	**Kidd Ck below Corona**	—	—	—	—
3	**Upper Bateman Ck**	80	—	—	170
4	**Lower Bateman Ck**	80	—	—	330
5	Lower Cedar Ck	—	—	—	100
6	**James Ck (at Aetna Rd)**	250	—	—	470
6A	Sm Ck below Oat Hill Reg.	—	—	320	—
6B	Ck below Oat Hill Ext. Reg.	510	—	—	—
7	**Udnick Ck**	—	170	140	160
8	**James Ck at Udnick**	400	—	—	520
9	Aetna Ck	2,320	—	—	2,160
10	**Swartz Ck**	970	1,610	460	530
11	Pope Ck below Swartz	310	1,490	—	430
12	Duvall Ck	1,610	750	950	—
13	**Pope Ck (at Barnett Rd)**	330	2,030	520	—
14	Pope Ck ~7 mi down	330	2,950	440	—
15	Burton Ck	140	200	240	—
16	Maxwell Ck	60	170	110	70
17	Pope Ck at Maxwell	230	670	300	—

Ephemerellidae: Mayfly nymphs
Siphloneuridae: "Swimming" mayfly
Perlodidae: Stonefly nymphs
Perlidae: Stonefly nymphs