California Department of Fish and Game
Office of Spill Prevention and Response
Pesticide Investigations Unit
OSPR Administrative Report 08-01

CHEMICAL RESIDUES IN WATER AND SEDIMENT FOLLOWING ROTENONE APPLICATION TO LAKE DAVIS, CALIFORNIA 2007

Suggested citation format:

McMillin, S. and B.J. Finlayson. 2008. Chemical residues in water and sediment following rotenone application to Lake Davis, California 2007. California Department of Fish and Game, Pesticide Investigations Unit, OSPR Administrative Report 08-01, Rancho Cordova, California.

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ACKNOWLEDGEMENTS

The author of this paper would like to thank CDFG field staff Mike Schommer, Amber Rossi, Craig Haffner, Carol Oz, Darin Olsen, Janna Rinderneck, Annie Nelson, Bob Todd and Zeke Awbrey. We would also like to thank CDFG chemists Abdou Mekebri, Bob Todd, and Jim McCall and Department of Public Health chemists Kusum Perera, Howard Okamoto, Roger Ho, Bill Draper, and Raimund Roehl. Finally, we would like to thank David Kline and Jerry Sipe from Plumas County Department of Environmental Health and Steve Watson from Department of Public Health for their assistance in sampling.

SUMMARY

Lake Davis, a reservoir in Plumas County, California, was treated with rotenone formulation CFT Legumine™ (5% rotenone) between September 25 and 28, 2007 to eradicate northern pike *Esox lucius*. Tributaries to Lake Davis were treated with CFT Legumine™ twice, between September 10 and 14, and between September 24 and 27, 2007. A total of 16,830 gallons was applied to 41,800 acre-feet volume of the reservoir resulting in a treatment rate of 1.24 mg/L CFT Legumine. A total of 112.84 and 52.26 gallons of CFT Legumine™ were used during the first and second tributary treatments, respectively. Water was held in the reservoir for approximately four months following treatment before the dam outlet was reopened to allow discharge into Big Grizzly Creek.

Water in Lake Davis and upstream tributaries were monitored for concentrations of rotenone and other constituents of CFT Legumine™. Rotenone persisted for approximately 30 days and had a half-life of 5.6 days in Lake Davis. Other constituents of CFT Legumine in Lake Davis persisted for roughly 30 days (methyl pyrrolidone), 60 days (diethylene glycol ethyl ether), and 90 days (Fennedefo 99). Based on known dilution of CFT Legumine™ in Lake Davis, the initial expected concentration of rotenone was 63 µg/L; the initial mean concentration of rotenone measured in Lake Davis was 58 µg/L. Rotenone concentrations in the tributaries generally were between 10 and 100 µg/L. Rainbow trout *Oncorhynchus mykiss* (used as sentinels during the treatments) are slightly less sensitive than northern pike to rotenone (rainbow trout 24-h LC_{50} value = 3.4 µg/L; northern pike 24-h LC50 value = 2.2 µg/L). Concentrations of rotenone were present for sufficient durations in Lake Davis and the tributaries to eradicate northern pike. This was confirmed by observations of caged sentinel fish in Lake Davis and the tributaries and the absence of dead fish (with one exception) in the tributaries during the second treatment.

INTRODUCTION

Background

On September 25 through 28, 2007, the California Department of Fish and Game (CDFG) treated Lake Davis with CFT Legumine™ (EPA Reg. No. 75338-2-AA) to eradicate northern pike *Esox lucius*, a non-native invasive species. Lake Davis is a reservoir located on Big Grizzly Creek, a tributary to the Middle Fork Feather River. The reservoir has the capacity of 84,371 acre-feet and contained 41,800 acre-feet during treatment. Northern pike, a predaceous fish, were illegally introduced into the reservoir and were believed to threaten fisheries resources in Lake Davis, downstream watersheds, and watersheds throughout California.

The CFT Legumine™ formulation contains approximately 5% rotenone, 10% methyl pyrrolidone (MP), 60% diethylene glycol ethyl ether (DEGEE), 17% Fennedefo 99 (Fennedefo), and 3% other compounds (Table 1). The lethality of CFT Legumine™ was tested in the laboratory using rainbow trout. The 24-hour LC_{50} value for rainbow trout averaged 126 µg/L CFT Legumine™ and 6.4 µg/L rotenone (Table 1). Northern pike (24-hour LC_{50} = 2.2 µg/L) are more sensitive than rainbow trout (24-hour LC_{50} = 3.4 µg/L) to rotenone (from Noxfish®; Marking and Bills 1976) making the latter excellent sentinels for the former.

Hatchery-reared rainbow trout were placed in cages at all ten lake permanent monitoring sites, plus an additional four shallow water sites, to evaluate the effectiveness of the treatment. Cages were placed at three depths, except in the shallow sites where they were placed at two depths. Three trout were placed in each cage prior to the initial lake piscicide application. Rainbow trout were also used to monitor the effectiveness of all stream treatments (Lehr 2008).

A total of 16,830 gallons of CFT Legumine™ was applied to the 41,800 acre-foot reservoir yielding a treatment rate of 1.24 mg/L CFT Legumine™ (Stephens and Lehr 2008). The rotenone concentration at this treatment rate was expected to be 63 µg/L. A total of 165.10 gallons was applied to the tributaries using both backpack sprayers and drip stations. The tributaries to Lake Davis were treated at rate of 1 to 2 mg/L CFT Legumine™ (51 to 102 µg/L rotenone).

Table 1. Chemical and toxicity analyses of CFT Legumine™ lots used in Lake Davis (CDFG 2007b).

Lot Number	Rotenone (mg/L)	Rotenolone (mg/L)	Methyl Pyrrolidone (mg/L)	Diethylene Glycol Ethyl Ether (mg/L)	Fennedefo 99 (mg/L)	Rainbow Trout 24-h LC50 (mg/L as rotenone)
54257	58,900	7,630	98,200	603,000	181,000	0.0098
54271	51,600	4,350	100,000	611,000	179,000	0.0083
54272	51,200	6,190	96,000	582,000	165,000	0.0048
54821	48,700	9,770	98,900	596,000	163,000	0.0089
54297	50,400	7,340	81,400	634,000	173,000	0.0047
54307	50,900	7,640	108,000	638,000	158,000	0.0047
54311	46,400	7,320	104,000	610,000	180,000	0.0042
Average	**51,000**	**7,200**	**98,000**	**610,000**	**170,000**	**0.006**

A chemical monitoring program was implemented as described in Lake Davis Northern Pike Eradication Project 2007 Water Quality Monitoring Plan (Borucki 2007). The program included sampling of the surface water in Lake Davis and tributaries to Lake Davis, and sediment in Lake

Davis. The California Department of Public Health Sanitation and Radiation Laboratory (DPH) served as the primary analytical laboratory. The CDFG Water Pollution Control Laboratory (WPCL), North Coast Laboratory (NCL), and Lawrence Livermore National Laboratory (LLNL) analyzed a subset of samples for quality assurance purposes. CDFG analyzed 15% of all water samples and all sediment samples. NCL analyzed splits of the last set of water samples taken for volatile organic compound (VOC) and semi-volatile organic compound (semi-VOC) analysis. LLNL analyzed splits of the last set of water and sediment samples taken for rotenone, rotenolone, MP, DEGEE, and Fennedefo.

Monitoring began in September 2007 and continued until all formulation constituents degraded to non-detectable levels in Lake Davis (Table 2).

Constituents Monitored

In the reservoir, samples of water and sediment were collected for analyses of rotenone and rotenolone, VOCs, semi-VOCs, MP, DEGEE, and Fennedefo. Samples of water were also collected for biochemical oxygen demand, alkalinity, hardness, and TOC. Temperature and dissolved oxygen were measured in the field. Rotenone and rotenolone concentrations were measured in water samples taken from the tributaries within hours after treatment to measure peak concentrations (operational monitoring).

METHODS

Sampling

Water

Water samples from the lake were generally collected using a 4.2 L-Kemmerer bottle. Before taking each sample, the Kemmerer bottle was triple rinsed at the sampling depth. Surface samples were taken either with the Kemmerer bottle or by submerging the bottle directly a few inches below the surface. Care was taken to exclude air space in the bottles and caps. Samples were stored on ice while being transported to the appropriate laboratory. Samples were accompanied by lab-specific, chain-of-custody forms documenting the sequence of transfer from collection to chemical analysis.

Samples for rotenone and rotenolone analysis and DGEE, MP, and Fennedefo were collected in chemically clean 250-ml amber glass bottles (two per site). Samples for 524.2 (VOC method used by DPH) or 8260 (VOC method used by CDFG) analysis were collected in duplicate in chemically clean 40-ml vials with septa caps containing acid preservative. Each sample for 8270 (semi-VOCs) analysis was collected in chemically clean 1-L amber glass bottles. Samples for water quality were collected in 1-L high density polyethylene bottles. All glass bottles and vials had teflon-lined caps.

Sediment:

Sediment samples were collected in chemically clean 500-ml glass jars. All glass jars had teflon-lined lids. Samples were collected by dipping the jar directly into the sediment and filling the rest of the jar with overlying water. At least 100 ml of sediment was collected per sample in shallow areas adjacent to water sampling sites. Samples were stored on ice while being transported to the appropriate laboratory. Samples were accompanied by chain-of-custody forms documenting the sequence of transfer from collection to chemical analysis.

Schedule

Water samples were collected at ten sites within the reservoir (Figure 1). At Sites 1, 3, 5, 7, and 9, samples were collected close to the bottom of the reservoir, mid-depth, and a few inches below the surface of the reservoir. At Sites 2, 4, 6, 8, and 10, samples were collected close to the bottom of the reservoir and a few inches below the surface of the reservoir only because of the shallower depth. Sediment samples were collected at Sites 2, 4, 6, 8, and 10 (Table 2).

Water samples in the tributaries were collected right below the surface (Figure 1). Water samples were collected from tributaries to Lake Davis within two hours of the tributary treatments during September 10 through 13 and September 24 through 26, 2007.

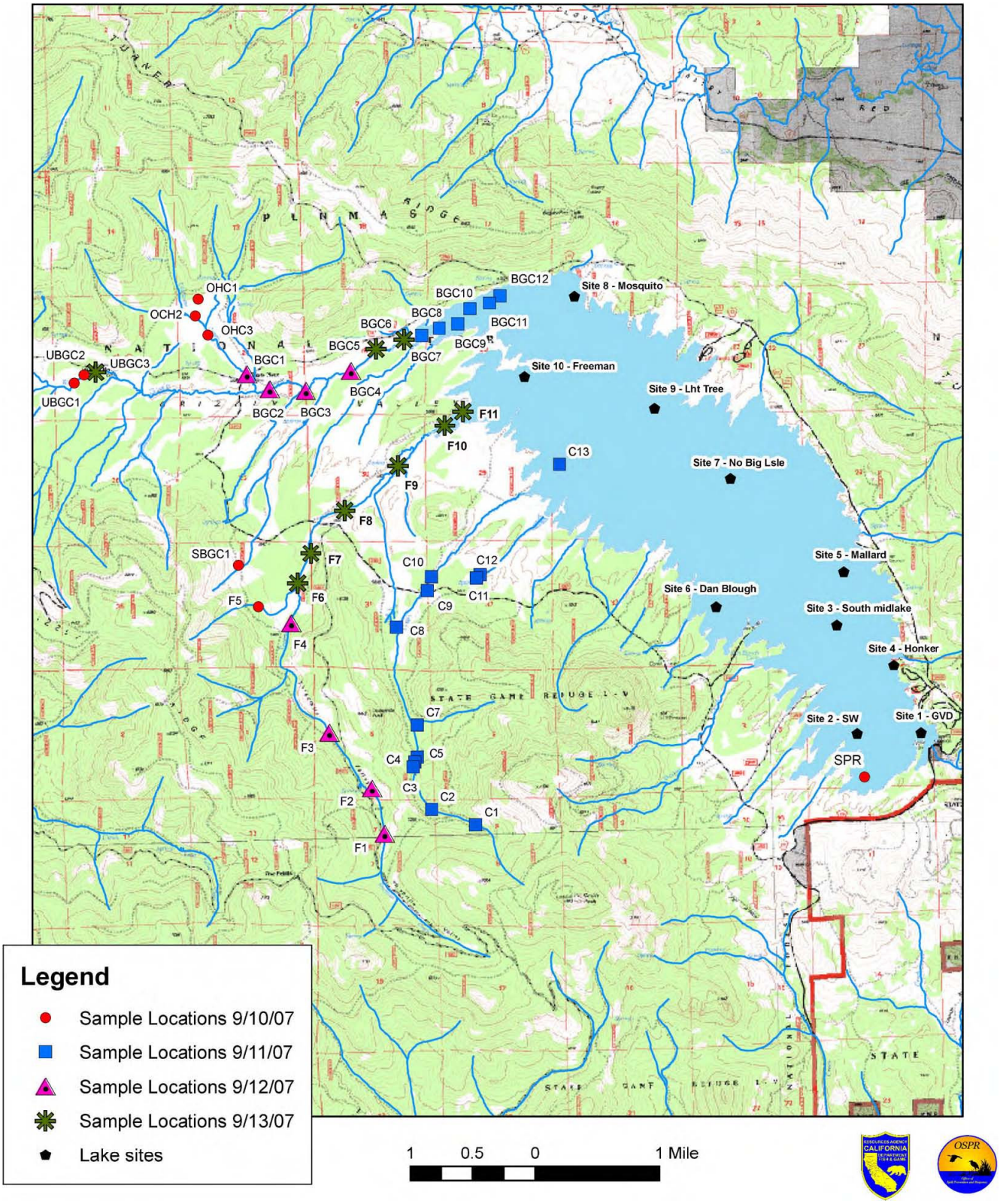

Figure 1. Map of Sampling Sites on Lake Davis and the Upper Tributaries.

Table 2. Dates and number of sites sampled at Lake Davis for water and sediment

Date	Water Sites	Sediment Sites	Analytical Lab(s)
9/3/07	10	5	DPH (water), CDFG (QA water, sediment)
9/28/07	10 (rotenone only)	0	CDFG (water)
10/1/07	10	5	DPH (water), CDFG (QA water, sediment)
10/8/07	10	0	DPH (water), CDFG (QA water)
10/15/07	10	5	DPH (water), CDFG (QA water, sediment)
10/22/07	10	0	DPH (water), CDFG (QA water)
10/29/07	10	5	CDFG (water and sediment)
11/5/07	10	0	DPH (water), CDFG (QA water), NCL (water)
11/26/07	10	5	DPH (water), CDFG (QA water, sediment)
12/4/07	10	5	DPH (water), CDFG (QA water, sediment)
12/17/07	2	1	DPH (water), CDFG (QA water, sediment)
1/14/08	10	5	DPH (water), CDFG (QA water, sediment)
1/15/08	10	5	DPH (water), CDFG (QA water, sediment)
1/22/08	10	5	DPH (water), CDFG (QA water, sediment), LLNL (water)
2/2/08	1	5	CDFG (water, sediment), LLNL (sediment)
2/28/08	0	2	CDFG (sediment)
2/29/08	0	2	CDFG (sediment)
3/26/08	0	2	CDFG (sediment)
4/7/08	0	2	CDFG (sediment)
4/11/08	0	2	CDFG (sediment), LLNL (sediment)

Analyses

Water:

Rotenone analysis was performed by DPH with direct injection liquid chromatography/mass spectrophotometry LC/MS (CDFG WPCL 2007, Appendix A). CDFG used direct injection LC/MS or LC/MS/MS for rotenone. VOCs and semi-VOCs in water were measured by DPH using EPA method 524.2 (USEPA 1995) and CDFG used EPA method 8260 and 8270, respectively. MP, DEGEE, and Fennedefo were analyzed by DPH and CDFG using LC/MS. Reporting limits for the individual analytes varied (Table 3). For calculations of statistics, values below the reporting limit were assigned the value of one-half the reporting limit.

Water quality parameters BOD, alkalinity, hardness, TOC, and conductivity were measured using standard methods (American Public Health Association 1998).

Table 3. Reporting limits for analytes in water.

Lab	Analyte	Method	Reporting Limit
DPH, CDFG	Rotenone	LC/MS, LC/MS/MS	2 µg/L
DPH, CDFG	Rotenolone	LC/MS, LC/MS/MS	2 µg/L
DPH	1,3,5-Trimethylbenzene	EPA 524.2	0.5µg/L
DPH	sec-Butylbenzene	EPA 524.2	0.5µg/L
DPH	n-Butylbenzene	EPA 524.2	0.5µg/L
DPH	p-Isopropyltoluene	EPA 524.2	0.5µg/L
DPH	Naphthalene	EPA 524.2	0.5µg/L
DPH	Toluene	EPA 524.2	0.5µg/L
DPH	m/p-Xylene	EPA 524.2	0.5µg/L
DPH	o-Xylene	EPA 524.2	0.5µg/L
DPH	Isopropylbenzene	EPA 524.2	0.5µg/L
DPH	n-Propylbenzene	EPA 524.2	0.5µg/L
DPH	1,2,4-Trimethylbenzene	EPA 524.2	0.5µg/L
DPH	Trichloroethylene	EPA 524.2	0.5µg/L
DPH	2-Methylnaphthalene	EPA 524.2	0.5µg/L
DPH	Naphthalene	EPA 524.2	0.5µg/L
DPH	n-Methyl-2-pyrrolidone	LC/TOF	5 µg/L
DPH	Diethylene glycol ethyl ether	LC/TOF	5 µg/L
DPH	Fennedefo-99	LC/TOF	50 µg/L
CDFG	1,3,5-Trimethylbenzene	EPA 8260	0.1µg/L
CDFG	sec-Butylbenzene	EPA 8260	0.3µg/L
CDFG	n-Butylbenzene	EPA 8260	0.3µg/L
CDFG	p-Isopropyltoluene	EPA 8260	0.3µg/L
CDFG	Naphthalene	EPA 8260	0.4µg/L
CDFG	Toluene	EPA 8260	0.2µg/L
CDFG	m/p-Xylene	EPA 8260	0.3µg/L
CDFG	o-Xylene	EPA 8260	0.3µg/L
CDFG	Isopropylbenzene	EPA 8260	0.1µg/L
CDFG	n-Propylbenzene	EPA 8260	0.2µg/L
CDFG	1,2,4-Trimethylbenzene	EPA 8260	0.2µg/L
CDFG	Trichloroethylene	EPA 8260	0.3µg/L
CDFG	2-Methylnaphthalene	EPA 8270	5µg/L
CDFG	n-Methyl-2-pyrrolidone	LC/MS	5µg/L
CDFG	Diethylene glycol ethyl ether	LC/MS	5µg/L
CDFG	Fennedefo-99	LC/MS	50 µg/L

Sediment:

Sediment samples were analyzed for rotenone and rotenolone, VOCs, semi-VOCs, MP, DEGEE, and Fennedefo by CDFG. Rotenone, rotenolone, MP, DEGEE, and Fennedefo were analyzed by direct injection LC/MS or LC/MS/MS (CDFG WPCL 2007, Appendix A). VOCs and semi-VOCs were analyzed using USEPA 8260 and USEPA 8270, respectively. Reporting limits for individual analytes varied (Table 4). For calculations of statistics, values below the reporting limit were assigned the value of one-half of the reporting limit.

Table 4. Reporting limits for analytes in sediment.

Lab	Analyte	Method	Reporting Limit (dry weight)
CDFG	Rotenone	Dawson et al. 1983	10 ng/g
CDFG	Rotenolone	Dawson et al. 1983	10 ng/g
CDFG	1,3,5-Trimethylbenzene	EPA 8260	10 ng/g
CDFG	sec-Butylbenzene	EPA 8260	30 ng/g
CDFG	n-Butylbenzene	EPA 8260	30 ng/g
CDFG	p-Isopropyltoluene	EPA 8260	30 ng/g
CDFG	Naphthalene	EPA 8260	40 ng/g
CDFG	Toluene	EPA 8260	20 ng/g
CDFG	m/p-Xylene	EPA 8260	30 ng/g
CDFG	o-Xylene	EPA 8260	30 ng/g
CDFG	Isopropylbenzene	EPA 8260	10 ng/g
CDFG	n-Propylbenzene	EPA 8260	20 ng/g
CDFG	1,2,4-Trimethylbenzene	EPA 8260	20 ng/g
CDFG	Trichloroethylene	EPA 8260	30 ng/g
CDFG	2-Methylnaphthalene	EPA 8270	500 ng/g
CDFG	Naphthalene	EPA 8270	500 ng/g
CDFG	n-Methyl-2-pyrrolidone	EPA 8015b	5 ng/g
CDFG	Diethylene glycol ethyl ether	EPA 8015b	5 ng/g
CDFG	Fennedefo	EPA 8015b	50 ng/g

Quality Assurance/Quality Control

Accuracy

Laboratory accuracy was determined using samples enriched with target or surrogate compounds (matrix spikes) for the parameters being monitored. Accuracy (Relative Percent Error [RPE]) was calculated as follows:

Acc = [(Da-D)/D] x 100, where
Acc = percent accuracy
Da = Analysis value of quality assurance sample
D = Accepted value of quality assurance sample

RPE values of less than 70 or greater than 130% were considered unacceptable and corresponding analytical results may be considered questionable.

Precision

Intralaboratory and interlaboratory precision were determined using duplicate samples which were analyzed separately. Precision (Relative Percent Difference [RPD]) was calculated using the equation:

RPD = (D1-D2)/[(D1+D2)/2] x 100, where

D1 = First sample results
D2 = Second sample results

A control limit of 15% for samples greater than 20 times the reporting limit was used. For concentrations greater than 5 and less than 20 times the reporting, a control limit of 20% was permitted. If precision fell outside the control limits, data associated with the duplicate samples may be considered questionable.

Travel Blanks

Samples of organic-free water (travel blanks) were transported to and from the sampling site and analyzed with samples to monitor for potential cross-contamination during sampling and shipping.

RESULTS

Bioassay: All trout used for bioassay in the lake and streams were killed due to the piscicide application (Lehr 2008).

Quality Analysis/Quality Control

Water:

Rotenone: CDFG analyzed split samples for approximately 15% of rotenone samples analyzed by DPH. Interlaboratory precision was calculated for all samples in which the values were at least five times the reporting limit. A control limit of 15 percent for sample values greater than 20 times the Reporting Limit is considered acceptable. For concentrations greater than 5 times and less than 20 times the Reporting Limit, a control limit of 20 percent is considered acceptable.

CDFG took the initial set of water samples from Lake Davis on September 27, 2007; no interlaboratory QA/QC was performed. For samples taken on October 1 and after, QA/QC analyses for interlaboratory variability were performed by CDFG on the analyses done by DPH. On October 8, DPH found over twice the rotenone that CDFG found and was traced to a bad (weak) rotenone standard that DPH was using. DPH results were consistently higher on October 15 samples as well, but average RPD was 15 (Table 5; Appendix B).

Table 5. Percent of QA/QC samples (numbers of samples in parentheses) that had unacceptable interlaboratory variability for analyses of rotenone and rotenolone.

	Rotenone			Rotenolone		
Date	RPD (%)	Mean DPH	Mean CDFG	RPD (%)	Mean DPH	Mean CDFG
10/1/08	50 (1/2)	38	30.4	100 (2/2)	18.5	12.6
10/8/08	100 (21/21)	18.6	7.8	17 (4/24)	40.5	43.7
10/15/08	88 (7/8)	7.4	6.4	35 (8/23)	33.7	28.2
10/22/08		2.2	2.6	16 (4/25)	23.4	21.8

DPH analyzed split samples for rotenone for two sites per sampling episode. These splits were taken from the same Kemmerer bottle at each site. The intralaboratory precision, as measured by RPD, was

consistently in the acceptable range for rotenone and in the acceptable range for all but one sample for rotenolone (Appendix C).

To determine accuracy, DPH analyzed surrogate spikes for 31 samples for each sampling date. Monolinuron was used as a surrogate for rotenone and rotenolone. A RPD in the 70 to 130% range is considered acceptable. Accuracy generally fell within the acceptable range (DPH records).

Methyl pyrrolidone: CDFG analyzed split samples for approximately 15% of samples analyzed by DPH. There were six samples for which RPD values could be calculated. All six were outside the acceptable range (above 20%). RPD values ranged from 23 to 43% (Appendix D). Samples corresponding with QA/QC samples with unacceptable RPD values are designated with bold font (Appendix J).

DPH analyzed splits for MP for two sites per sampling episode. These splits were taken from the same Kemmerer bottle at each site. The intralaboratory precision, as measured by RPD, was consistently in the acceptable range (Appendix E).

To determine accuracy, DPH analyzed surrogate spike samples for each sampling date. 5-Methyl 2-pyrrolidone was used as a surrogate for MP. A RPD in the 70 to 130% range is considered acceptable. Accuracy consistently fell within the acceptable range (DPH records).

Diethylene glycol ethyl ether: CDFG analyzed split samples for approximately 15% of DEGEE samples analyzed by DPH. A total of 28 RPD values could be calculated, and 6 fell outside the acceptable range (Appendix D). Samples corresponding with QA/QC samples with unacceptable RPD values are designated with bold font (Appendix J).

DPH analyzed splits for MP for two sites per sampling episode. These splits were taken from the same Kemmerer bottle at each site. The intralaboratory precision, as measured by RPD, was consistently acceptable (Appendix E).

To determine accuracy, DPH analyzed surrogate spike samples for each sampling date. Diethylene glycol methyl ether was used as a surrogate for MP. A RPD in the 70 to 130% range is considered acceptable. Accuracy consistently fell within the acceptable range (DPH records).

Fennedefo 99: CDFG analyzed split samples for approximately 15% of Fennedefo samples analyzed by DPH. Two RPD values were outside the acceptability range (Appendix D).

DPH analyzed splits for Fennedefo for two sites per sampling episode. These splits were taken from the same Kemmerer bottle at each site. The intralaboratory precision, as measured by RPD, was consistently in the acceptable range (Appendix E).

To determine accuracy, DPH analyzed spike samples for each sampling date. An RPD value in the 70 to 130% range is considered acceptable. Accuracy generally fell within the acceptable range (DPH records).

524.2: DPH analyzed splits for 524.2 for two sites per sampling episode. These splits were taken from the same Kemmerer bottle at each site. 524.2 analysis detected no constituent at either of these sites.

To determine accuracy, DPH analyzed spike samples for each sample on each sampling date. Samples were spiked with surrogates 1,2-dichlorobenzene-d4 and 4-bromofluorobenzene. An RPD value in the 70 to 130% range is considered acceptable. Accuracy consistently fell within the acceptable range (DPH records).

Sediment:

Rotenone: To determine intralaboratory precision, samples were split in the laboratory and spiked with a known quantity of surrogate. Relative percent difference of the two samples was calculated (Appendix F). All values were within the acceptable range.

To determine accuracy, matrix spikes were prepared for each batch of samples. Relative Percent Difference (RPD) between the spiked amount and recovered amount was calculated. An RPD value in the 70 to 130% range is considered acceptable. RPD values outside the acceptable range were tagged and corresponding results may be regarded as questionable (Appendix F). RPD values rotenone for spikes corresponding with samples taken on September 3 and January 14, 15, and 22 fell outside the acceptable range. RPD values for rotenolone for a subset of spike samples corresponding with samples taken on October 1 and 15 and December 4 fell outside the acceptable range.

Methyl pyrrolidone: To determine intralaboratory precision, samples were split in the laboratory and spiked with a known quantity of surrogate. Relative percent difference of the two samples was calculated. All values were in the acceptable range (Appendix G).

To determine accuracy, matrix spikes were prepared for each batch of samples. Relative Percent Difference (RPD) between the spiked amount and recovered amount was calculated. An RPD value in the 70 to 130% range is considered acceptable. All values were in the acceptable range (Appendix G).

Diethylene glycol ethyl ether: To determine intralaboratory precision, samples were split in the laboratory and spiked with a known quantity of surrogate. Relative percent difference of the two samples was calculated. One value was outside of the acceptable range. However, another set of duplicates was run for this set of samples, and was found to be acceptable (Appendix G).

To determine accuracy, matrix spikes were prepared for each batch of samples. Relative Percent Difference (RPD) between the spiked amount and recovered amount was calculated. An RPD value in the 70 to 130% range is considered acceptable. One value was outside the acceptable range for the set of samples collected on September 2, and October 1, 15, and 29. However, the duplicate was within the acceptable range (Appendix G).

Fennedefo 99: To determine intralaboratory precision, samples were split in the laboratory and spiked with a known quantity of surrogate. Relative percent difference of the two samples was calculated. All values were in the acceptable range (Appendix G).

To determine accuracy, matrix spikes were prepared for each batch of samples. Relative Percent Difference (RPD) between the spiked amount and recovered amount was calculated. An RPD value in the 70 to 130% range is considered acceptable. All but one value were in the acceptable range (Appendix G).

Analyses

Water:

Rotenone and Rotenolone - Rotenone analysis was performed by DPH and CDFG using LC/MS and LC/MS/MS. The average concentrations of rotenone and rotenolone in Lake Davis immediately after treatment were 58 and 16 µg/L, respectively (Appendix H). The highest concentration of rotenone was found at Site 8, which was located in Mosquito Slough in the northeast part of the reservoir (Figure 2). All water sites were below reporting limit for rotenone starting on October 29, thirty-two days after treatment. Rotenone had a half-life in Lake Davis of approximately 5.6 days. All water sites were below reporting limit for rotenolone starting on November 20, fifty-four days after treatment.

Rotenone and rotenolone concentrations were monitored in the tributaries within two hours of treatment (Appendix I). It is likely that the samples having extremely high concentrations or no detectable concentrations of rotenone and rotenolone were the result of collecting the water samples too early before adequate mixing had occurred. For the first tributary treatment, rotenone and rotenolone concentrations were highest in the Big Grizzly Creek drainage. Concentrations of rotenone and rotenolone in Big Grizzly Creek were as high as 2,462 µg/L and 3,950 µg/L, respectively. Rotenone and rotenolone concentrations in Freeman Creek were as high as 293 µg/L and 203 µg/L, respectively. In Cow Creek, concentrations were as high as 105 µg/L and 56.4 µg/L, respectively.

Immediately prior to the second tributary treatment, Big Grizzly Creek was sampled to determine the concentrations of rotenone and rotenolone persisting from the first treatment. These concentrations averaged 19.5 µg/L for rotenone and 59.8 µg/L for rotenolone. Samples were again collected within two hours of the treatment from Big Grizzly Creek, Freeman Creek, and Cow Creek. Sampling times were better coordinated during the second treatment to account for mixing and there were fewer extreme measurements. In Big Grizzly Creek, concentrations of rotenone ranged from 11 to 344 µg/L and concentrations of rotenolone ranged from 5.8 to 304 µg/L. In Freeman creek, concentrations of rotenone ranged from 59 to 291 µg/L and concentrations of rotenolone ranged from 9.8 to 130 µg/L. In Cow Creek, concentrations of rotenone ranged from 14 to 1420 µg/L and concentrations of rotenolone ranged from 4.5 to 83.1 µg/L.

Methyl pyrrolidone - MP analysis was performed by DPH using EPA method 524.2. The average concentration of MP in Lake Davis during the week following treatment was 156 µg/L (Appendix J); the expected mean concentration based on dilution of CFT Legumine in Lake Davis was 121 µg/L. The highest concentration of MP was found at Site 10, which was located in Freeman Cove in the northwest part of the reservoir (Figure 3). The first day in which no MP was detected in Lake Davis was November 5, thirty-nine days after treatment.

Diethylene glycol ethyl ether - DEGEE analysis was performed by DPH using EPA method 524.2. The average concentration of DEGEE in the reservoir during the week following treatment was 779 µg/L (Appendix J); the expected mean concentration based on dilution of CFT Legumine in Lake Davis was 756 µg/L. The highest concentration of DEGEE was found at Site 10 (Figure 4). The first day in which no DEGEE was detected in any of the 25 water sites in the reservoir was December 4, sixty-eight days after treatment.

Fennedefo 99 - Fennedefo analysis was performed by DPH using LC/TOF. The average concentration of Fennedefo in the reservoir during the week following treatment was 228 µg/L (Figure 5); the expected mean concentration based on dilution of CFT Legumine in Lake Davis was 211 µg/L. The highest concentration of Fennedefo was found at Site 10. The first day in which no Fennedefo was detected in any of the 25 water sites in the reservoir was January 14, one hundred nine days after treatment (Appendix J). However, it is possible that Fennedefo was non-detectable before then, as the last complete set of samples had been taken on December 4, 2007.

Volatile Organic Compounds and Semi-Volatile Organic Compounds - VOC and semi-VOC analyses were performed by DPH using EPA method 524.2. Seven of the twenty-five water sites in Lake Davis sampled on October 1 contained methylene chloride concentrations in the range of 0.503 to 0.648 µg/L (Appendix K). No methylene chloride or any other analyte was found by DPH using EPA method 524.2 in any sample taken subsequently. Three samples collected from Lake Davis on October 1 were analyzed by CDFG for QA purposes. VOC and semi-VOC analyses were performed using EPA methods 8260 and 8270. Each of these samples contained toluene, m/p xylene, 1,2,4-trimethylbenzene, and naphthalene (Appendix K), all constituents of gasoline. All water samples collected during subsequent sampling contained no detectable levels of analytes in 8260 and 8270 analyses.

Water quality – Water quality parameters were measured before and after the treatment (Appendix L). Total organic carbon (TOC) measurements appear slightly elevated after treatment, reflecting a greater amount of decomposing organic matter. The biological oxygen demand (BOD) of water samples taken four months after the treatment was lower than BOD values taken prior to the treatment in 1997 (Siepmann and Finlayson 1999). The temperature in Lake Davis decreased until freezing in mid-December (Table 6).

Table 6. Water temperature in Lake Davis in 2007 (DFG and DWR data).

Date	Average temperature (^{o}C)
Sept. 5, 2007	19.8
Sept. 18, 2007	17.2
Oct. 8, 2007	9.9
Oct. 22, 2007	8.7
Nov. 6, 2007	9.1
Nov. 26, 2007	5.2
Dec. 4, 2007	3.6

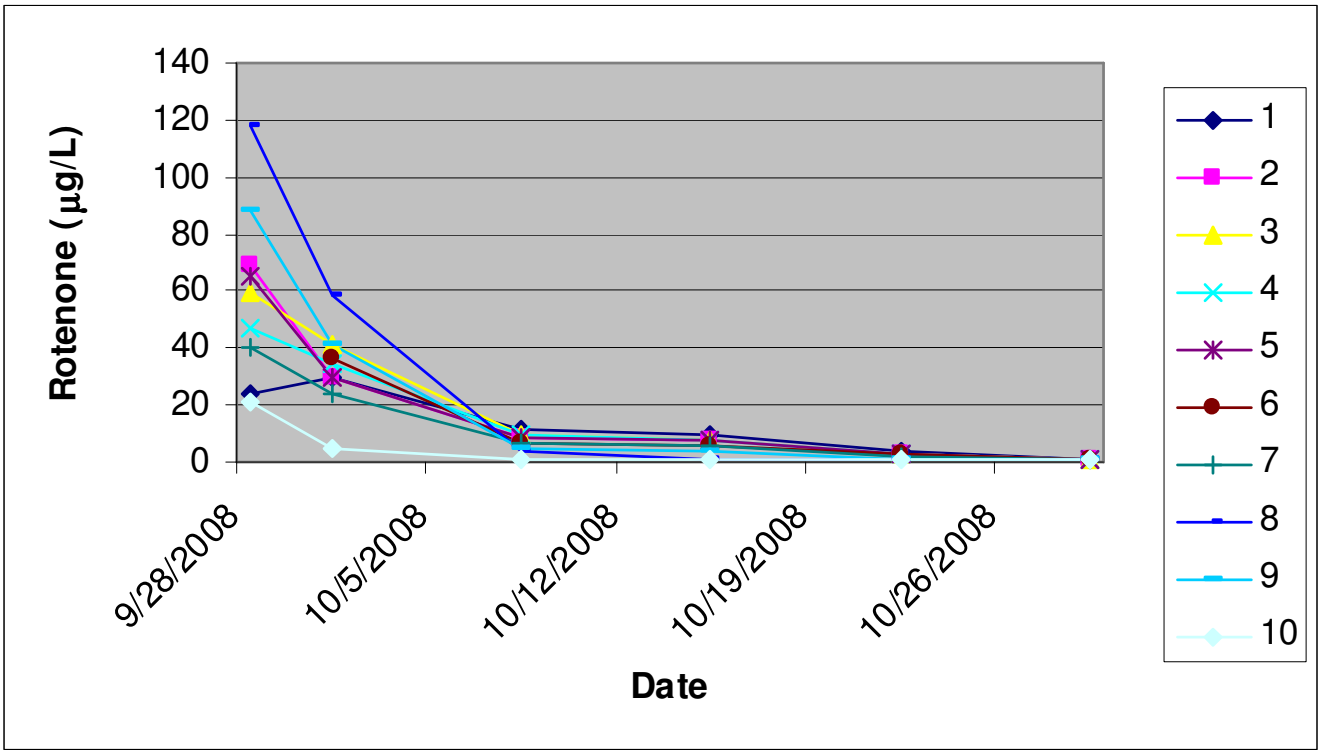

Figure 2. Rotenone concentrations in water in Lake Davis by site.

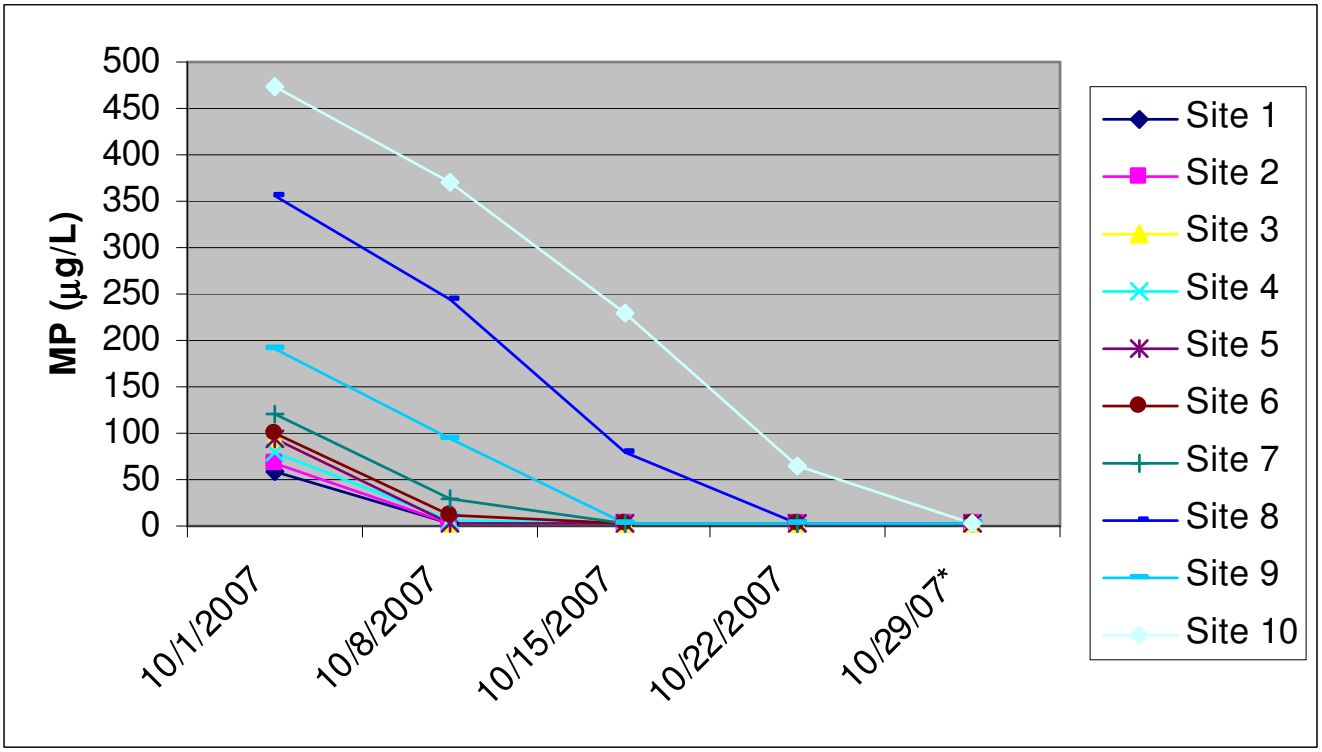

Figure 3. Methyl pyrrolidone (MP) concentrations in water in Lake Davis by site.

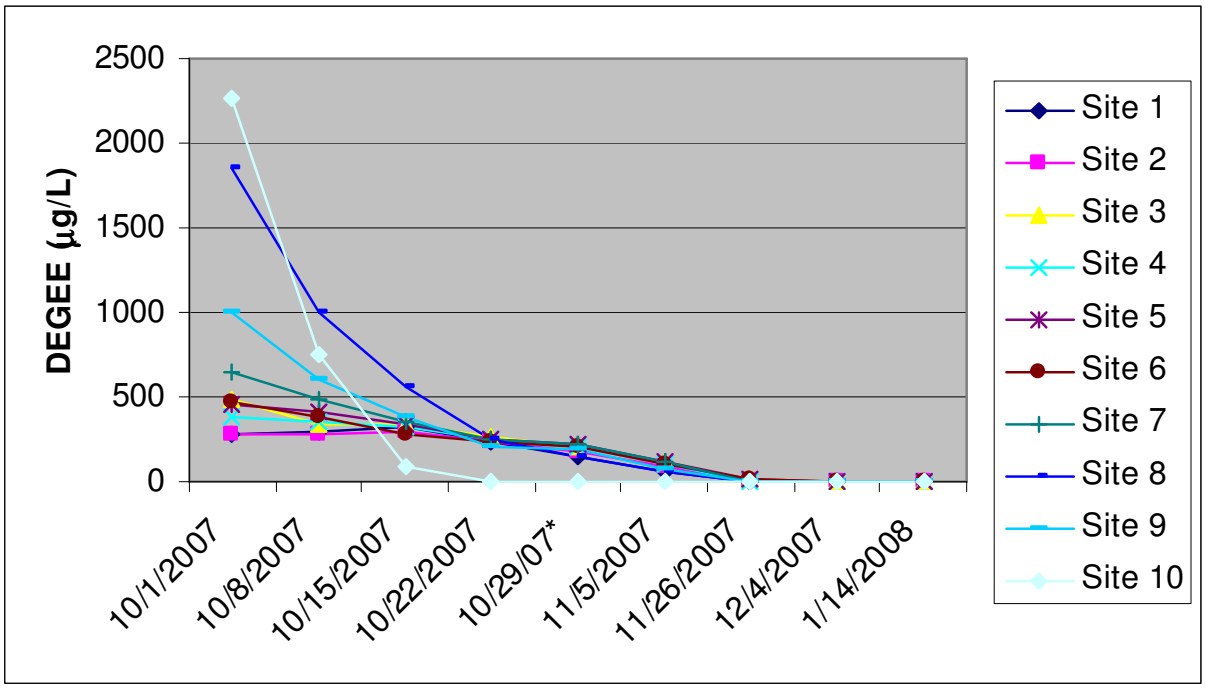

Figure 4. Diethylene glycol ethyl ether (DGEE) concentrations in water in Lake Davis by site.

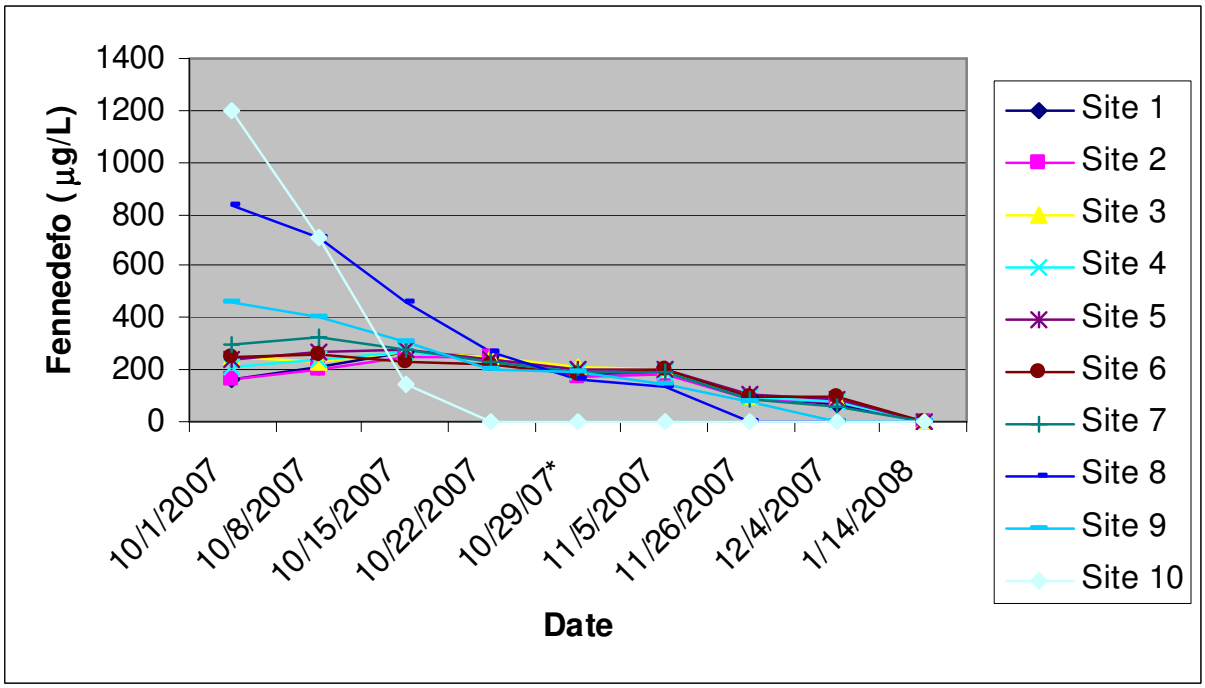

Figure 5. Fennedefo concentrations in water in Lake Davis by site.

Sediment:

CDFG analyzed sediment in Lake Davis for rotenone and rotenolone using LCMS (Appendix N). Concentrations of rotenone and rotenolone in sediment averaged 271.6 and 213.4 ng/g, respectively in Lake Davis during the week following treatment. The first date in which all samples had no rotenone above the reporting limits were taken on March 27.

CDFG analyzed sediment in Lake Davis for MP using LCMS. Concentrations as high as 742 ng/g were detected (Appendix O). No MP was detected in any sediment sample from any of the five sites starting on November 26, 2007.

CDFG analyzed sediment in Lake Davis for DEGEE using LCMS. DEGEE was detected in sediment only in samples taken on October 15, 2007. Concentrations on that date ranged from <5 ng/g to 75.7 ng/g (Appendix O).

CDFG analyzed sediment in Lake Davis for Fennedefo using LCMS. Concentrations as high as 367 ng/g were detected (Appendix O). No Fennedefo was detected in any sediment sample from any of the five sites starting on January 14, 2008.

CDFG analyzed sediment in Lake Davis for VOCs using USEPA 8260 and for semi-VOCs using USEPA 8270. Samples collected on October 1, October 15, and November 5 were analyzed for VOCs and semi-VOCs and none were detected (Appendix P).

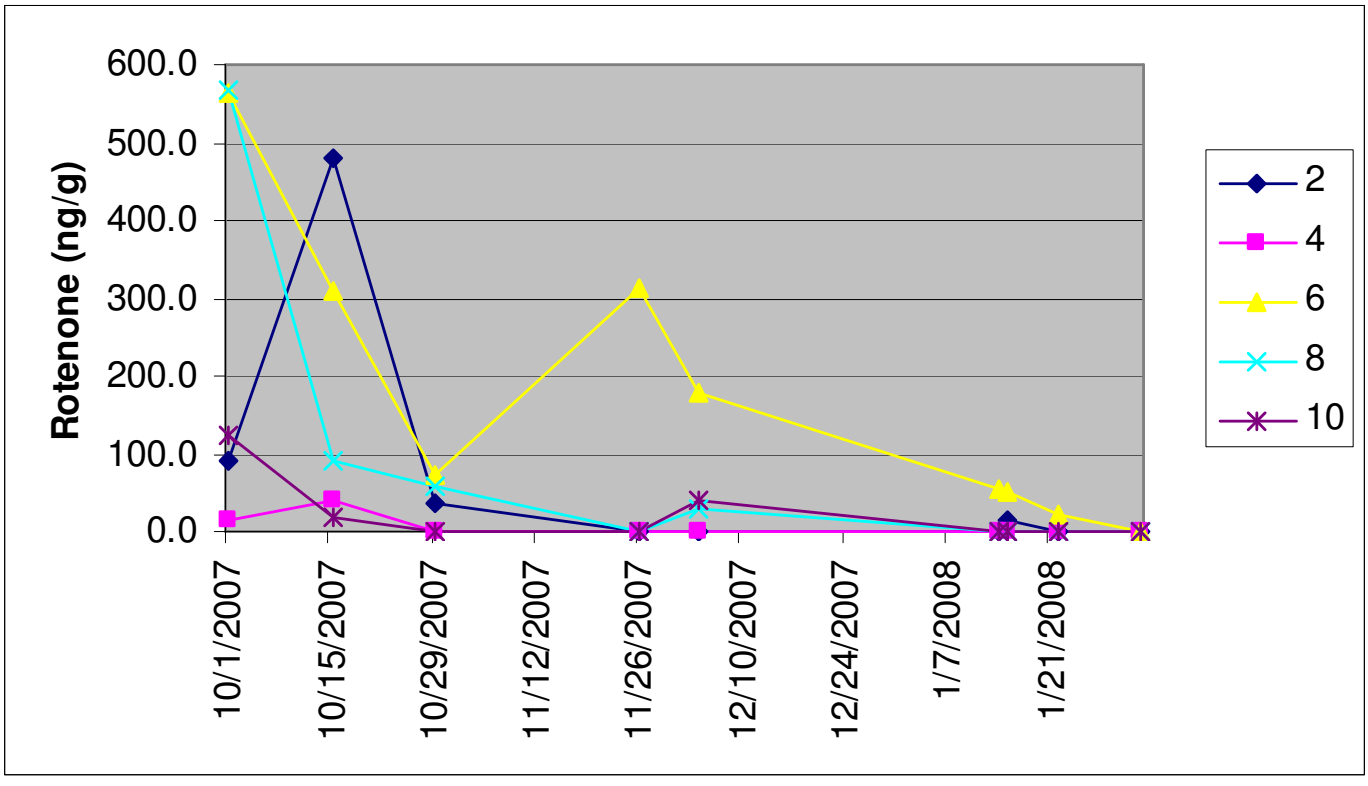

Figure 6. Rotenone concentrations (dry weight) in sediment in Lake Davis by site.

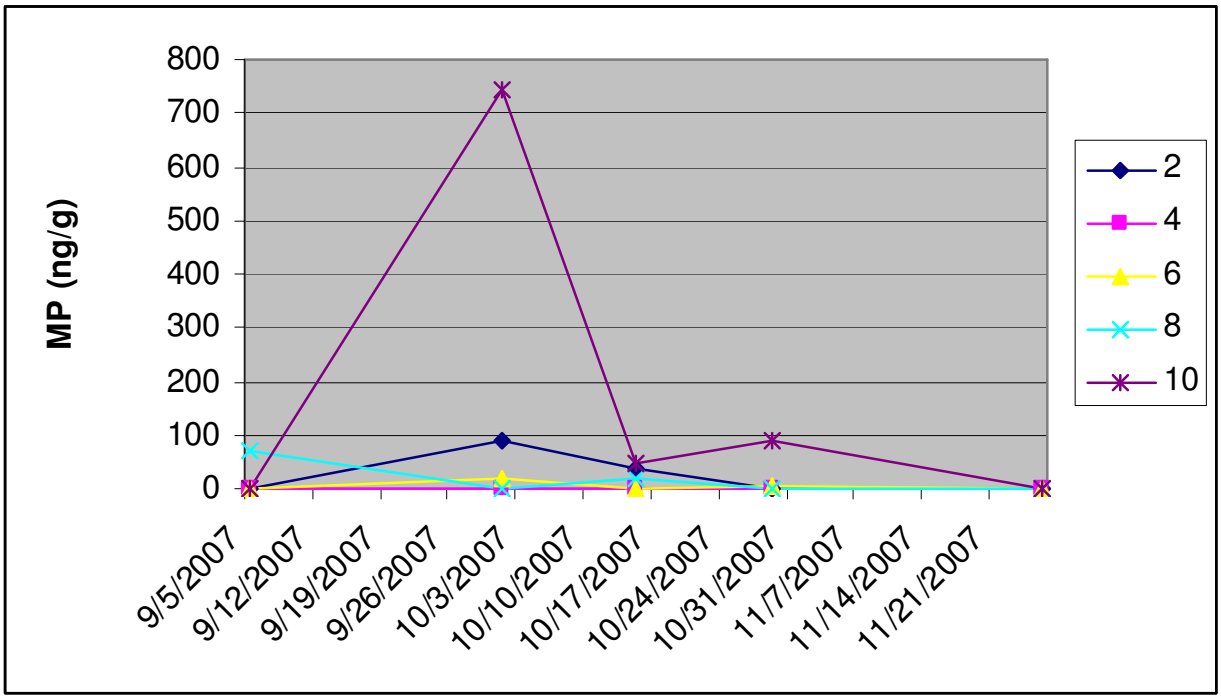

Figure 7. Methyl pyrrolidone (MP) concentrations (dry weight) in sediment in Lake Davis by site.

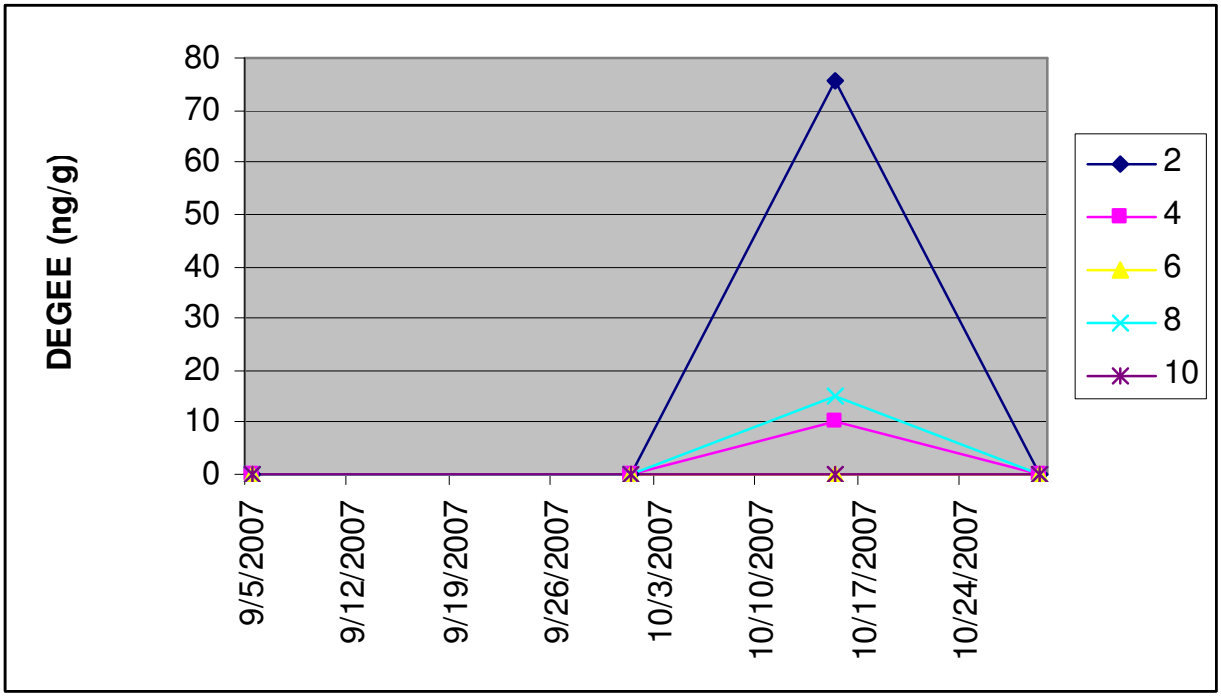

Figure 8. Diethylene Glycol Ethyl Ether (DEGEE) concentrations (dry weight) in sediment in Lake Davis by site.

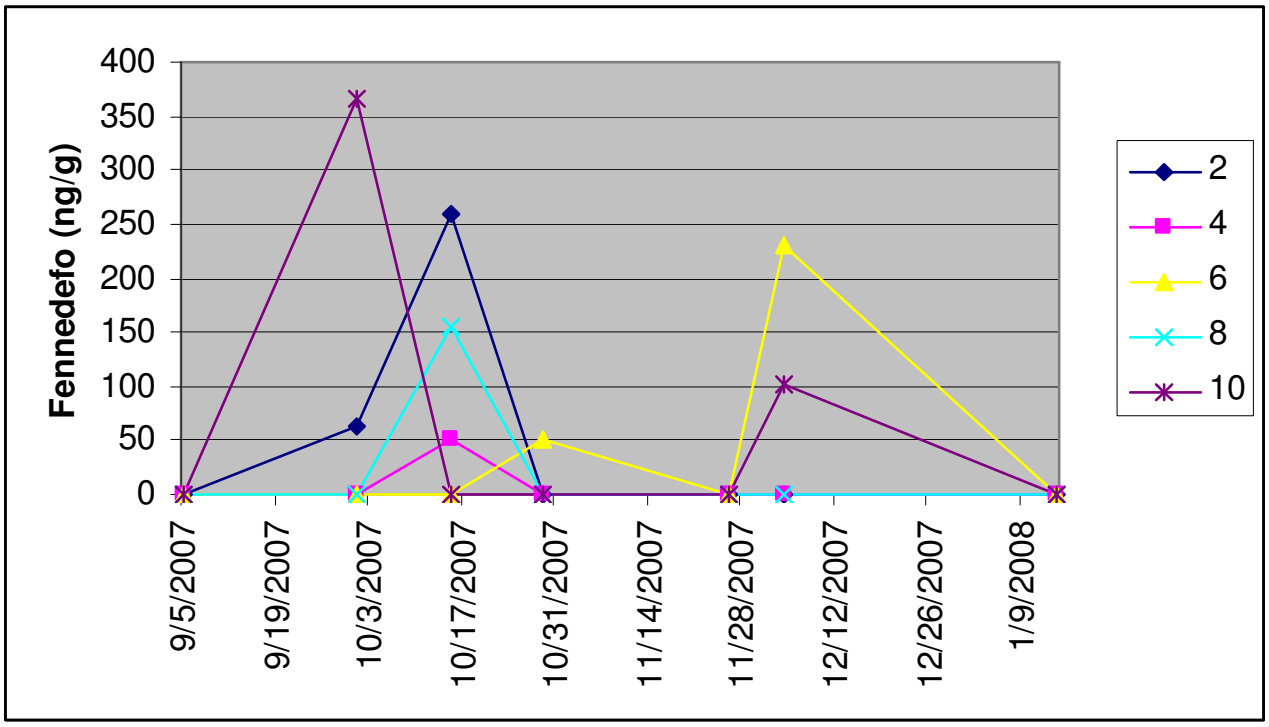

Figure 9. Fennedefo 99 concentrations (dry weight) in sediment in Lake Davis by site.

DISCUSSION

Rotenone concentrations in Lake Davis were sufficient to eliminate northern pike. Rotenone concentrations in water averaged 58 µg/L in the reservoir, close to the predicted concentration of 63 µg/L. The 24-h LC_{50} for rotenone to rainbow trout, less sensitive than northern pike, for CFT Legumine™ was 6 µg/L rotenone. The lowest concentration of rotenone found in Lake Davis immediately after treatment was 20.1 ug/L at Site 10; this was three times the lethal level. All of the rainbow trout in live cars distributed as various depths and locations in Lake Davis died following treatment.

The half-life of rotenone in water, based on DFG data, was approximately 5.6 days, as compared to 7.7 days during in the 1997 treatment. The longer half-life in 1997 was probably due to the colder water temperature at the time of treatment (Table 7). The water temperature was almost 4°C colder in 1997 than in 2007 at the time of treatment. In addition, the day length in Portola is 11.9 hours on September 24th (the day of the 2007 treatment) compared to 10.9 hours on October 15th (the day of the 1997 treatment). The breakdown of rotenone is both by hydrolysis and photolysis (CDFG 1994). Rotenolone, the major metabolite of rotenone, degraded quickly in Lake Davis about one to two weeks behind rotenone, which similarly occurred during the 1997 treatment. The half-life for rotenone in California lakes varies from between 0.6 to 7 days, inversely related to temperature (Finlayson et al. 2001).. Analytical results for rotenone in water varied considerably between the two laboratories. However, there was agreement that rotenone was not detectable in the reservoir by the end of October 2007.

Table 7. Comparison of water temperatures in Lake Davis in 1997 and 2007 (DFG and DWR data).

Date	Average temperature (°C)	Date	Average temperature(°C)
Sept. 19, 1997	19.0	Sept. 5, 2007	19.8
Oct. 8, 1997	**13.5[1]**	**Sept. 18, 2007**	**17.2[1]**
Oct. 22, 1997	11.7	Oct. 8, 2007	9.9
Nov. 5, 1997	10.1	Oct. 22, 2007	8.7
Nov. 20, 1997	6.6	Nov. 6, 2007	9.1
		Nov. 26, 2007	5.2
		Dec. 4, 2007	3.6

[1]Average temperature in reservoir one week prior to treatment.

Concentrations in tributaries to Lake Davis were also sufficient to eliminate northern pike. Measured rotenone concentrations, in conjunction with mortality of live car fish, indicate that the tributary treatments were successful. Only one wild fish (rainbow trout) was found dead during the second tributary treatment, indicating the near success of the first tributary treatment in killing all fish. This trout was found in an isolated spring high in the drainage on Freeman Creek and upstream of any northern pike. This is the only fish killed as a result of the second stream treatment and because of the locations and circumstances surrounding the location (difficult spring to treat), additional stream treatments were determined not to be needed.

Lake Davis represented the first major rotenone treatment in California where CFT Legumine™ was used. MP degraded relatively rapidly (within a month) and DEGEE was more persistent in water

(within two months). The most persistent constituent of the CFT Legumine™ formulation in water was Fennedefo. Fennedefo persisted in water for up to 3 ½ months. However, the actual persistence of Fennedefo may be up to a month less as there were no complete sampling sessions during the last month. In the 1997 treatment, the most persistent chemical in water was piperonyl butoxide which persisted for 9 months.

The most persistent constituent of the CFT Legumine™ in sediment was rotenone. Rotenone persisted in sediment for up to six months. In the 1997 treatment, rotenone persisted in sediment for less than two months. However, the reporting limit for rotenone in sediment was decreased from 30 ng/g in 1997 to 10 ng/g in 2007. Less degradation of rotenone and rotenolone occurs in sediment while the reservoir is frozen. MP degraded from sediment within 2 months and DEGEE was found in sediment only during the October 15th sampling episode. Fennedefo degraded from sediment within four months.

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APPENDICES

Appendix A. Water Pollution Control Laboratory Analytical Methods

Determination of Rotenone, Rotenolone, Methyl Pyrrolidone, Diethylene Glycol Monoethyl Ether and Fennedefo 99 In Lake Davis Water by Direct Injection using LC/MS and LC/MS/MS

1.0 Scope and Application

1. 1.1 This method describes the sample preparation and quantitative analysis of trace level rotenone and rotenolone pesticides and other ingredients (methyl pyrrolidone, diethylene glycol monoethyl ether and Fennedefo 99 (a mix of polyethylene glycols)) of CFT Legumine™ in lake water using direct injection in a high performance liquid chromatography quadrapole mass spectrometer system (HPLC-MSD) coupled to a diode array UV-Vis detector (DAD) or high performance liquid chromatography with positive ion electrospray–tandem triple quadrupole (QQQ) mass spectrometry (LC/MS/MS) in multiple reaction monitoring (MRM) mode.
2. 1.2 The method detection limits and reporting limits for each analyte are listed in Table 1. The actual MDL may differ from those listed, depending upon the nature of interferences in the sample matrix. Validation of the target analytes produced average recoveries ranging from 79 to 116 percent and standard deviation ≤ 10 percent (Tables 5 and 6).

Table 1. Pesticides analyzed, their Minimum Detection Limits (MDL) and Reporting Limits (RL) in water samples.

Target Analytes	MDL (µg/L)	RL (µg/L)
Rotenone (R)	1.00	2.00
Rotenolone (R')	1.00	2.00
Methyl pyrrolidone (MP)	2.00	5.00
Diethylene glycol monoethyl ether (DEGEE)	2.00	5.00
Fennedefo 99		
Tetraethylene glycol	20.0	50.0
Pentaethylene glycol	20.0	50.0
Hexaethylene glycol	20.0	50.0
Heptaethylene glycol	20.0	50.0
Octaethylene glycol	20.0	50.0
Nonaethylene glycol	20.0	50.0
Decaethylene glycol	20.0	50.0

.2.0 Summary of Method

1. 2.1 A method was developed and validated by Water Pollution Control Laboratory chemists where a measured volume of water sample (containing ten percent methanol) is

vortexed, filtered and analyzed by liquid chromatography using conditions which permit the separation and measurement of the target analytes in the samples by MS or MS/MS detection. Surrogate and internal standards are added for QA/QC purposes.
2. 2.2 Interferences in analyses may be encountered in very dirty samples and cleanup may be needed to aid in the elimination or reduction of these interferences.
2. **3.0 Interferences**

3.1 Solvents, reagents, glassware, and other sample processing hardware may cause LC artifacts and/or elevated baselines, resulting in the misinterpretation of chromatograms. All materials should be demonstrated to be free from interferences under the conditions of the analysis by running method blanks initially and with each sample lot. Specific selection of reagents and purification of solvents by distillation in all-glass systems are required. High-purity distilled-in-glass solvents are commercially available.

An effective way of cleaning laboratory glassware is by rinsing with polar and non-polar solvents before use. The cleaning procedure used must be tested by analyzing procedural blanks prior to analyzing samples.

1. 3.2 Matrix interferences may be caused by contaminants that are co-extracted from the sample. The extent of matrix interferences will vary considerably from source to source. Solid phase extraction (SPE) can be used to overcome many of these interferences, but unique samples may require additional cleanup approaches to achieve the MDL listed in Table 1.
2. 3.3 SPE Clean Up Procedure Pre-filtered water samples (200 mL) were extracted with J.T.Baker™ C18, 6 mL, 500 mg solid phase cartridges (Milford, MA) mounted on a Resprep™ vacuum manifold, (Restek Corp., Bellefonte, PA).The cartridges were first pre-conditioned with 10 mL methanol followed by 10 mL water. The samples were loaded through the cartridges at a rate of 5 mL/min, not to exceed 20 psi. The cartridges were then dried for 5 minutes with vacuum and finally, eluded with 2 mL methanol, vortexed and filtered through 0.45 µm filters.

4.0 Apparatus and Laboratory Supplies

1. 4.1 Culture tubes. 16 x 100 mm with PTFE lined screw cap.
2. 4.2 Gelman Acrodisc® CR PTFE syringe filter, 0.45 µm pore size, 13 mm diameter.

3. 4.3 Autosampler vials, borosilicate glass, 2 mL with PTFE-lined screw cap.
□.4.4 Analytical systems
1. 4.4.1.1 High performance liquid chromatograph-mass spectrometer (HPLCMS). Analysis was performed using an Agilent 1100 series LC-MS quadrupole MS system coupled to an Agilent 1100 series LC system consisting of a binary pump, diode array UV-Vis detector

(DAD), autosampler, thermostated column compartment and vacuum degasser. The DAD was used to assist with method development, confirmation and troubleshooting. The MS was operated with atmospheric pressure electrospray ionization (API-ES) source in positive ion mode. Section 9 describes the acquisition and analysis procedures while Tables 2A, 3 and 4 lists the operating parameters.

2. 4.4.1.2 High performance liquid chromatograph-tandem mass spectrometer (HPLC-MS-MS). Analysis was performed using an Agilent 6410 triple quadrupole MS/MS system coupled to an Agilent 1200 series LC system consisting of a binary pump, autosampler and thermostated column compartment. The MS was operated with atmospheric pressure electrospray ionization (API-ES) source in positive ion mode. Section 9 describes the acquisition and analysis procedures while Table 2B lists the operating parameters.

3. 4.4.2 Data System. Agilent, to collect and record LC data, generates reports, computes and records response factors for multi-level calibrations. Data system should be capable of calibrating a method using a minimum of 5 concentrations of analytical standards and calculating in external or internal standard mode.

Table 2A Operating parameters for Agilent 1100 LC/MSD for the analysis of rotenone and rotenolone, Method 1A (M1A).

Chromatographic Conditions

. • Column: Agilent ZORBAX Eclipse XDB-C8 column, 4.6 mm x 150 mm x 5 µm (or equivalent)

. • Mobile phase A: water (0.1% formic acid)

. • Mobile phase B: acetonitrile (0.1% formic acid)

□.• Pump parameters: Time (min) Mobile Phase (%B)

1. 0.0 25.0
2. 5.0 25.0
3. 8.0 75.0
4. 18.0 75.0
5. 20.0 25.0

. • Flow rate: 0.50 ml/min

. • Run time: 20 minutes

. • Column temperature: 40ºC

. • Injection volume: 60 µL

□.• Diode array detector (DAD): Signal, Bw (nm) Reference, Bw (nm) 254 16 360 8 295 8 360 8

□.MS Conditions: API-ES in positive ion mode

. • Drying gas flow: 12 L/min

. • Drying gas temperature: 320ºC

. • Nebulizer gas pressure: 40 psig

. • Capillary voltage: 3000

. • Fragmentor voltage: 70, 110

. • Selected ion monitoring (SIM): 393, 395

. • Scan: m/z 50-1000

. • Threshold: 150 counts

. • Gain: 3
. • Step size: 0.25 amu
. • Peak width: 0.1 min
. • Time filter: enabled

Table 2B Operating parameters for Agilent 1100 LC/MS/MS for the analysis of rotenone and rotenolone, Method 1B (M1B).

Chromatographic Conditions
. • Column: Agilent ZORBAX Eclipse XDB-C8 column, 4.6 mm x 150 mm x 5 µm (or equivalent)
. • Mobile phase A: 25% water (0.1% formic acid)
. • Mobile phase B: 75% acetonitrile (0.1% formic acid)
. • Pump parameters: isocratic
. • Flow rate: 0.50 ml/min
. • Run time: 6.5 minutes
. • Column temperature: 38ºC
• Injection volume: 20 µL
MS Conditions: API-ES in positive ion mode
. • Drying gas flow: 12 L/min
. • Drying gas temperature: 320ºC
. • Nebulizer gas pressure: 40 psig
. • Capillary voltage: 4000
. • Selected ion monitoring (SIM):

Target Analyte	Scan Type	Precursor Ion	Product Ions	Fragment (V)	Collision Energy (V)
Rotenone	MRM	395.3	213.1, 203	120	37
Rotenolone	MRM	393.1	365.1, 335.1	120	37

Table 3 Operating parameters for Agilent 1100 LC-MSD for the analysis of methyl pyrrolidone and diethylene glycol monoethyl ether, Method 2 (M2).

Chromatographic Conditions
. • Column: Waters ATLANTIS dC18 column, 2.1mm x 100mm x 3µm (or equivalent)
. • Mobile phase A: water (0.1% formic acid)
. • Mobile phase B: acetonitrile (0.1% formic acid)
• Diode array detector (DAD): Signal, Bw (nm) Reference, Bw (nm) 254 16 360 8 295 8 360 8
MS Conditions: API-ES in positive ion mode
. • Drying gas flow: 12 L/min

. • Drying gas temperature: 320ºC
. • Nebulizer gas pressure: 40 psig
. • Capillary voltage: 3000
. • Fragmentor voltage: 70, 110
. • Selected ion monitoring (SIM):
. • Scan: m/z 50-1000
. • Threshold: 150 counts
. • Gain: 3
. • Step size: 0.25 amu
. • Peak width: 0.1 min
. • Time filter: enabled

- Pump parameters: Time (min) Mobile Phase (%B)
  0.0 2.5
  5.0 2.5
  10.0 10.0
  10.5 2.5
  11.0 2.5

- Flow rate: 0.190 ml/min Run
- time: 11 minutes
- Column temperature: 38ºC
- Injection volume: 20 µL

Target Analyte	$[M + H]_+$	$[M + Na]_+$
MP	100	122
DEGEE	135	157

Table 4 Operating parameters for Agilent 1100 LC-MSD for the analysis of Fennedefo 99 compounds, Method 3 (M3).

Chromatographic Conditions
. • Column: Agilent ZORBAX Eclipse XDB-C8 column, 4.6 mm x 150 mm x 5 µm (or equivalent)
. • Mobile phase A: water (0.1% formic acid)
. • Mobile phase B: acetonitrile (0.1% formic acid)
□.• Pump parameters: Time (min) Mobile Phase (%B)
1. 0.0 12.0
2. 5.0 12.0
3. 10.0 80.0
4. 18.0 80.0
5. 20.0 12.0

6. 22.0 12.0
. • Flow rate: 0.50 ml/min
. • Run time: 22 minutes
. • Column temperature: 40ºC
. • Injection volume: 80 µL
□.• Diode array detector (DAD): Signal, Bw (nm) Reference, Bw (nm) 254 16 360 8 295 8 360 8
□.MS Conditions: API-ES in positive ion mode
. • Drying gas flow: 12 L/min
. • Drying gas temperature: 320ºC
. • Nebulizer gas pressure: 40 psig
. • Capillary voltage: 3000
. • Fragmentor voltage: 90
. • Selected ion monitoring (SIM):
. • Scan: m/z 150-500
. • Threshold: 150 counts
. • Gain: 4
. • Step size: 0.15 amu
. • Peak width: 0.1 min
. • Time filter: enabled

Target Analyte	$[M + H]_+$	$[M + Na]_+$	$[M + NH_4]_+$
Tetraethylene glycol	195.2	217.3	212.2
Pentaethylene glycol	239.3	261.2	256.2
Hexaethylene glycol	283.3	305.2	300.3
Heptaethylene glycol	327.5	349.5	344.5
Octaethylene glycol	371.5	393.5, 437.5	388.5, 432.5
Nonaethylene glycol	371.5, 415.5	393.5, 437.5	388.5, 432.5
Decaethylene glycol	459.5	481.5	467.50

5.0 Reagents, materials, gases and standards

1. 5.1 Reagent water is defined as water in which an interferent is not observed at the method detection limit of each parameter of interest. Deionized (DI) water was used for method validation and as method blank.
2. 5.2 Acetonitrile, formic acid, HPLC water, methanol. Pesticide residue quality

or equivalent.

1. 5.3 Liquid Nitrogen. 230 psi or higher.

2. 5.4 Stock standards. Individual stock standards (100 µg/ml) were purchased as certified solutions. Rotenone (CAS# 83-79-4) from Chem Service, P/N: F2382, 1-methyl-2-pyrrolidone (CAS# 872-50-4) from Sigma-Aldrich, P/N: 27,045-8 and diethylene glycol monoethyl ether (CAS# 111-90-0) also from Sigma-Aldrich, P/N: 537616.
3. 5.5 Internal standards. Tentative internal standards are N-methyl-2-pyrrolidinone-d9 (CAS# 185964-60-7) from Cambridge Isotopes, P/N: DLM-1988-97-1, and monolinuron-2 (CAS# 1746-81-2) from Sigma-Aldrich, P/N: 45590.
4. 5.6 Surrogates. Tentative surrogates are diethylene glycol monomethyl ether kit from AccuStandard, P/N: PS-160C-SET and 5-methyl-2-pyrrolidinone (CAS# 108-27-0) from Sigma-Aldrich, P/N: M79700.

.6.0 Sample Collection, Preservation, and Storage
1. 6.1 Samples are collected in amber bottles and iced or refrigerated at 4 ℃ from time of collection until extraction.
2. 6.2 All samples must be processed within 5-7 days of collection.

.7.0 Sample Preparation
1. 7.1 Remove water samples from refrigerator to acclimate at room temperature. Ten percent of methanol is added to a measured aliquot of sample (9:1, v/v) and vortex.
2. 7.2 Add surrogate and vortex a second time. For laboratory control spikes (LCS/LCSD) and matrix spikes (MS/MSD) fortifiy sample with target compounds at 5-10 times the reporting limit and vortex again. Let sample rest after vortexing for 5 minutes.
3. 7.2 Filter sample using 0.45 µm Gelman filter into pre-labeled 2 mL vial.
4. 7.3 Add 10 uL internal standard. Cap and vortex. Sample is now ready for LC/MS or LC/MS/MS analysis.

8.0 Cleanup Procedure

8.1 Cleanup of dirty samples may be necessary due to interferences in the analysis of baseline or co-elution with target analytes of the sample. Dilution or SPE cartridges may be used to overcome the problem.

.9.0 Analytical Procedure

.9.1 The samples are analyzed on an Agilent 1100 LC-MS and/or 1200 LC/MS/MS. Operating conditions are found in Tables 2A, 2B, 3 and 4. The analysis requires three analytical methods: Method 1(M1A or M1B) is for the analysis of R and R', Method 2 (M2) is for the analysis of MP and DEGEE. Method 3 (M3) is for the analysis of Fennedefo 99 polyethylene glycols.

.10.0 Quantitation
1. 10.1 Quantitation procedure for Rotenone (R), MP and DEGEE: Standard calibration using a 5-7 point curve (linear). Acceptable correlation coefficient ($r^2 > 0.995$), RSD < 15%.
2. 10.2 Quantitation procedure for Rotenolone (R'): Commercially available standards for Rotenolone do not exist. The WPCL has 2 Rotenolone standards available: several milligrams of Rotenolone synthesized at U.C. Berkeley in the 1980s and a degraded Rotenone standard that was purchased in 1997 that has almost completely degraded to Rotenolone.

The procedure used by the WPCL to quantify Rotenolone involves using the degraded Rotenone standard which when analyzed results in chromatographic peaks for both Rotenone and Rotenolone. The original concentration of Rotenone is used to calculate Rotenolone using the following formula:

Total Area = Area (Rotenone Peak) + Area (Rotenolone Peak)
Area (Rotenolone)/ Total Area = Decimal Fraction (Rotenolone)
Rotenolone Conc. in Std. = Decimal Fraction (R') x Original Std. Conc.

This quantitation procedure has been validated using the Rotenolone standard synthesized at U.C. Berkeley.

10.3 Quantitation procedure for Fennedefo 99: Commercially available certified standards for Fennedefo 99 do not exist. It was obtained directly from the manufacturer and a standard was prepared in methanol. A calibration curve of Fennedefo 99 was then prepared in methanol:water (10:90). Fennedefo 99 is a formulation which includes polyethylene glycols. Tetra-, penta-, hexa-, hepta-, octa-, nona- and decaethylene glycol are quantified individually and the total of these is reported as the total amount in the sample.

11.0 Method Validation

11.1 Method validation was done on Lake Davis water at four levels; nine replicates at reporting limit, eight replicates at mid-level and three replicates at high level using standards and CFT Legumine™. See tables 5 and 6.

Table 5.

Fortified Lake Davis Water with Rotenone (R), Rotenolone (R'), Diethylene glycol monoethyl ether (DEGEE), 1-Methyl-2-Pyrrolidinone (MP) and Fennedefo 99

Level 1 -20ppb **R = 2ppb R' = 4ppb DEGEE = 20ppb MP = 20ppb**									
Compound % Recovery	**LCS-1**	**LCS-2**	**LCS-3**	**LCS-4**	**LCS-5**	**LCS-6**	**LCS-7**	**LCS-8**	**LCS-9**
R	96.8	80.0	81.8	80.0	69.3	86.7	91.0	90.6	81.7
R'	98.2	99.1	91.1	104	106	131	93.8	88.5	97.1
DEGEE	92.3	89.0	89.4	91.3	87.6	91.4	86.2	88.6	87.3
MP	95.4	92.4	93.1	93.2	91.8	91.5	90.9	95.8	96.3
Level 2 -100ppb **R = 10ppb R' = 20ppb DEGEE = 100ppb MP = 100ppb**									
Compound % Recovery	**LCS-1**	**LCS-2**	**LCS-3**						
R	76.9	83.1	79.2						
R'	98.2	96.3	99.3						
DEGEE	94.2	95.1	93.8						
MP	96.4	97.1	94.1						
Level 3 -500ppb **R = 50ppb R' = 100ppb DEGEE = 500ppb MP = 500ppb Fennedefo 99 = 500ppb**									
Compound % Recovery	**LCS-1**	**LCS-2**	**LCS-3**	**LCS-4**	**LCS-5**	**LCS-6**	**LCS-7**	**LCS-8**	**LCS-9**
R	89.1	80.4	86.6	95.3	91.8				
R'	102	99.7	110	106	109				
DEGEE	103	99.1	100	101	98.0				
MP	98.6	98.7	97.4	103	103				
Fennedefo 99	101	102	99.4	103	103	99.2	105	102	101
Level 4 - 1000ppb **R = 100ppb R' = 200ppb DEGEE = 1000ppb MP = 1000ppb**									
Compound % Recovery	**LCS-1**	**LCS-2**	**LCS-3**						
R	78.2	77.4	81.5						
R'	104	96.4	104						
DEGEE	98.2	97.9	97.4						
MP	103	100	101						

Table 6.

Fortified Lake Davis Water with CFT Legumine

Level 1 -50ppb R = 2.5ppb R' = 0.25ppb DEGEE = 25ppb MP = 5ppb									
Compound % Recovery	**LCS-1**	**LCS-2**	**LCS-3**						
R	85.4	87.8	91.0						
R'	NA	NA	NA						
DEGEE	99.7	100	99.1						
MP	100	96.1	101						
Level 2 -100ppb R = 5ppb R' = 0.5ppb DEGEE = 50ppb MP = 10ppb									
Compound % Recovery	**LCS-1**	**LCS-2**	**LCS-3**						
R	80.1	79.5	80.2						
R'	NA	NA	NA						
DEGEE	91.4	91.5	90.0						
MP	95.8	96.2	95.4						
Level 3 -200ppb R = 10ppb R' = 1ppb DEGEE = 100ppb MP = 20ppb									
Compound % Recovery	**LCS-1**	**LCS-2**	**LCS-3**						
R	90.9	83.4	88.9						
R'	NA	NA	NA						
DEGEE	96.7	96.5	97.9						
MP	111	101	106						
Level 4 -500ppb R = 25ppb R' = 2.5ppb DEGEE = 250ppb MP = 50ppb									
Compound % Recovery	**LCS-1**	**LCS-2**	**LCS-3**						
R	108	86.4	94.1						
R'	NA	NA	NA						
DEGEE	81.4	80.5	82.4						
MP	122	106	120						

Level 5 - 1000ppb R = 50ppb R' = 5ppb DEGEE = 500ppb MP = 100ppb									
Compound % Recovery	**LCS-1**	**LCS-2**	**LCS-3**						
R	92.7	88.5	83.9						
R'	NA	NA	NA						
DEGEE	104	102	102						
MP	102	101	102						

SOP Section Approval: Date: _____ SOP Final Approval: Date: _____ SOP QA Officer Approval: Date: _____

Appendix B. Interlaboratory comparison for rotenone in water (analysis by DPH and CDFG).

		DPH	CDFG		DPH	CDFG	
Date	**Sites**	**Rotenone**	**Rotenone**	**RPD**	**Rotenolone**	**Rotenolone**	**RPD**
9/5/2007							
P2489	**4-surface**	< 2	< 2		< 2	< 2	
10/1/2007							
P2498	**3-surface**	40	31.90	**23**	21	14.10	**39**
	4-surface	36	30.00	18	16	11.20	**35**
10/8/2007							
P2499	**1-bottom**	21.0	12.4	**52**	18.2	22.8	**-23**
	1-mid	21.6	11.2	**64**	19.7	22.0	-11
	1-surface	22.4	10.8	**70**	21.5	21.6	0
	2-bottom	9.9	9.08		11.8	23.3	**-65**
	2-surface	18.4	7.88	**80**	20.3	22.3	-9
	3-bottom	20.3	9.05	**76**	22.0	23.5	-7
	3-mid	20.3	9.88	**69**	22.5	23.4	-4
	3-surface	21.0	9.56	**75**	21.7	23.1	-6
	4-bottom	22.0	10.1	**74**	24.0	26.0	-8
	4-surface	22.3	9.13	**84**	21.8	22.1	-2
	5-bottom	19.2	8.01	**82**	35.2	42.1	**-18**
	5-mid	24.1	9.26	**89**	26.1	24.4	7
	5-surface	22.5	8.12	**94**	24.3	22.8	6
	6-bottom	< 2	6.55		< 2	28.7	
	6-surface	17.6	6.22	**96**	27.6	28.6	-3
	7-bottom	18.5	5.24	**112**	41.9	49.9	-17
	7-mid	20.2	7.16	**95**	29.1	33.3	-13
	7-surface	19.6	7.03	**95**	28.4	29.1	-2
	8-bottom	12.0	3.86	**103**	74.5	93.5	**-23**
	8-surface	12.8	3.67	**111**	78.4	92.0	-16
	9-bottom	11.4	3.07	**115**	57.3	62.5	-9
	9-mid	15.3	5.28	**98**	40.7	42.2	-4
	9-surface	16.1	6.44	**86**	36.9	41.3	-11
	10-bottom	< 2	< 2		133	147	-10
	10-surface	< 2	< 2		136	124	9
	lake average	18.6	7.8	83.0	40.5	43.7	-10

Appendix B(cont.). Interlaboratory comparison for rotenone in water (DPH and CDFG).

		DPH	CDFG		DPH	CDFG	
	Sites	**Rotenone**	**Rotenone**	**RPD**	**Rotenolone**	**Rotenolone**	**RPD**
10/15/2007							
P2501	**1-bottom**	10.1	9.07	11	23.1	21.2	9
	1-mid	14.4	9.86	**37**	26.0	21.9	17
	1-surface	2.42	9.38		6.58	19.1	
	2-bottom	10.9	7.95	**31**	27.6	20.7	**29**
	2-surface	11.6	8.12	**35**	29.4	22.0	**29**
	3-bottom	11.1	7.24	**42**	25.0	21.0	17
	3-mid	11.6	8.43	**32**	26.4	20.3	**26**
	3-surface	9.55	8.18		25.1	21.4	16
	4-bottom	11.5	8.20	**34**	28.9	22.0	**27**
	4-surface	11.0	7.66	**36**	28.8	22.0	**27**
	5-bottom	9.1	7.37		28.5	22.9	**22**
	5-mid	9.4	6.94		27.0	22.2	**20**
	5-surface	<2	7.32		5.95	22.9	
	6-bottom	6.06	6.07		24.8	22.4	10
	6-surface	7.57	5.63		26.6	22.5	17
	7-bottom	5.38	5.15		26.0	26.6	-2
	7-mid	8.12	6.10		30.3	25.2	18
	7-surface	6.71	6.01		23.6	23.0	3
	8-bottom	2.07	1.75*		64.6	48.4	**29**
	8-surface	<2	1.75*		52.9	49.2	7
	9-bottom	3.86	3.21		33.8	29.6	13
	9-mid	3.89	3.61		36.8	31.8	15
	9-surface	3.79	3.40		35.0	31.5	11
	10-bottom	<2	< 2		59.8	59.7	0
	10-surface	<2	< 2		66.1	56.6	15
	lake average	7.4	6.4	15	33.7	28.2	18

Appendix B (cont.). Interlaboratory comparison for rotenone in water (DPH and CDFG).

		DPH	CDFG		DPH	CDFG	
	Sites	**Rotenone**	**Rotenone**	**RPD**	**Rotenolone**	**Rotenolone**	**RPD**
10/22/2007	**1-bottom**	2.92	4.10		16.2	18.4	-13
P2505	**1-mid**	3.63	3.43		18.0	17.8	1
	1-surface	3.19	3.24		17.4	17.7	-2
	2-bottom	3.34	3.42		17.5	17.8	-2
	2-surface	4.22	3.07		23.1	17.6	**27**
	3-bottom	3.23	3.12		20.7	18.7	10
	3-mid	2.85	3.02		18.6	18.4	1
	3-surface	2.86	3.00		19.5	19.4	1
	4-bottom	2.92	3.04		18.5	18.2	1
	4-surface	<2	2.98		12.7	18.4	**-36**
	5-bottom	3.06	3.07		22.7	20.1	12
	5-mid	3.31	2.78		28.8	19.6	**38**
	5-surface	3.05	2.62		25.2	19.6	**25**
	6-bottom	2.69	2.93		19.5	18.3	7
	6-surface	2.77	3.00		18.8	18.4	2
	7-bottom	<2	**1.87**		24.5	22.3	9
	7-mid	<2	2.28		21.5	20.3	6
	7-surface	2.06	2.27		23.6	21.1	11
	8-bottom	<2	<2		35.6	30.6	15
	8-surface	<2	<2		30.6	29.8	3
	9-bottom	<2	**1.52**		24.1	23.0	5
	9-mid	<2	**1.67**		24.5	22.7	8
	9-surface	<2	**1.70**		24.9	22.1	12
	10-bottom	<2	<2		39.0	37.4	4
	10-surface	<2	<2		38.7	37.8	2
		2.2	2.6		23.4	21.8	6

Appendix B (cont.). Interlaboratory comparison for rotenone in water (DPH and CDFG).

		DPH	CDFG		DPH	CDFG	
	Sites	Rotenone	Rotenone	RPD	Rotenolone	Rotenolone	RPD
11/5/2007	1-bottom	<2	<2		<2	<2	
	2-bottom	<2	<2		<2	<2	
	10-bottom	<2	<2		<2	<2	

11/26/07	1-bottom	<2	<2		<2	<2	
	2-bottom	<2	<2		<2	<2	
	4-bottom	<2	<2		<2	<2	
	10-bottom	<2	<2		<2	<2	
12/04/07	2-bottom	<2	<2		<2	<2	
	4-bottom	<2	<2		<2	<2	
	10-bottom	<2	<2		<2	<2	
12/17/2007	4-surface	<2	<2		<2	<2	

Appendix C. Intralaboratory Precision: DPH Rotenone Analysis

		Primary			Split					
Date	**Site**	**Sample ID**	**Rotenone**	**Rotenolone**	**Sample ID**	**Rotenone**	**Rotenolone**	**RPD: Rotenone**	**RPD: Rotenolone**	
10/1/2007	**3-surface**	-8	40.1	20.7	-26	36.6	23.3	9	12	
	4-surface	-10	36.2	16.3	-27	37.9	16.9	5	4	
10/8/2007	**5-surface**	-13	22.5	24.3	-26	21	26.5	7	9	
	6-surface	-15	17.6	27.6	-27	20.6	29.7	16	7	
10/15/2007	**7-surface**	-18	6.71	23.6	-26	8.73	30.2		**25**	
	8-surface	-20	<2	52.9	-27	<2	45.3		15	
10/22/2007	**9-surface**	-23	<2	24.8	-26	<2	22.7		9	
	10-surface	-25	<2	38.7	-27	<2	38.4		1	

Appendix D. Interlaboratory Comparison: MP, DEGEE, Fennedefo in water in Lake Davis

		MP			DEGEE			Fennedefo		
		CDFG	DPH	RPD	CDFG	DPH	RPD	CDFG	DPH	RPD
10/01/07	3-surface	128	97	**28**	587	489	18	418	252	**50**
	4-surface	111	88	**23**	528	431	20	344	226	
10/08/07	2-surface	NA	<5		NA	343		NA	198	
	3-surface	5.81	<5		545	338	**47**	280	227	
	4-surface	4.80*	<5		500	322	**43**	244	219	
	10-bottom	542	373	**37**	720	749	-4	699	712	-2
10/15/07	1-bottom	<5	<5		356	324	9	280	268	4
	2-surface	<5	<5		336	294	13	252	251	0
	3-surface	<5	<5		357	336	6	284	265	7
	4-bottom	<5	<5		ND	331		284	275	3
	5-surface	<5	<5		381	345	10	288	279	3
	6-bottom	<5	<5		321	282	13	249	231	
	7-mic	<5	<5		407	357	13	295	273	8
	8-bottom	119	77.1	**43**	676	554	20	490	461	6
	9-surface	7.78	5.28		447	391	13	322	305	5
	10-bottom	313	232	**30**	142	97	**38**	163	149	
10/22/07	1-surface	<5	<5		245	242	1	200	247	
	2-surface	<5	<5		257	227	12	203	246	
	4-bottom	<5	<5		276	245	12	205	240	
	4-surface	<5	<5		262	258	2	226	246	
	5-bottom	<5	<5		276	257	7	214	246	
	6-surface	<5	<5		254	233	9	203	222	
	7-bottom	<5	<5		255	237	7	189	222	
	8-surface	<5	<5		289	254	13	255	275	-8
	9-bottom	<5	<5		231	208	10	177	202	
	10-surface	91.6	62.7	**37**	2.38	3		<50	<50	
11/05/07	1-bottom	<5	<5		62	79	**-24**	243	190	
	2-bottom	<5	<5		82	98	-18	222	168	
	4-bottom	<5	<5		100	123	**-21**	253	190	**28**
	10-bottom	<5	<5		<5	<5		<50	<50	

Appendix D. (cont.) Interlaboratory Comparison: MP, DEGEE, Fennedefo in water in Lake Davis

		MP			DEGEE			Fennedefo		
		CDFG	DPH	RPD	CDFG	DPH	RPD	CDFG	DPH	RPD
11/26/07	1-bottom	<5	<5		<5	<5		88.6	96	
	2-bottom	<5	<5		<5	5.1		84.9	90	
	4-bottom	<5	<5		6.58	5.9		98	94	
	10-bottom	<5	<5		<5	<5		<50	<50	
12/03/07	2-bottom	<5			<5			139	77	
	4-bottom	<5			<5			136	84	
	10-bottom	<5			<5			<50	90	

Appendix E. Intralaboratory Precision for MP, DEGEE, and Fennedefo (DPH)

		Primary				Split				RPD:	RPD:	RPD:
Date	Site	Sample ID	MP	DEGEE	Fennedefo	Sample ID	MP	DEGEE	Fennedefo	MP	DEGEE	Fennedefo
10/1/07	3-surface	-8	96.8	489	265	-26	96.9	497	265	0	2	0
	4-surface	-10	87.5	431	238	-27	86.9	422	235	1	2	1
10/8/07	5-surface	-13	<5	344	230	-26	<5	340	233		1	1
	6-surface	-15	12.6	388	260	-27	11.4	389	266		0	1
10/15/07	7-surface	-18	<5	357	277	-26	<5	353	276		1	0
	8-surface	-20	79.7	568	469	-27	78.6	564	458	1	1	2
10/22/07	9-surface	-23	<5	194	208	-26	<5	210	206		8	
	10-surface	-25	62.7	<5	<50	-27	69.7	<5	<50			
11/26/07	3-surface	-8	<5	9.1	96.1	-26	<5	9.16	102			
	4-surface	-10	<5	6.51	105	-27	<5	6.78	107			

Appendix F. Rotenone in Sediment in Lake Davis: Precision and Accuracy (CDFG)

	Rotenone			Rotenolone		
	Spike	Duplicate		Spike	Duplicate	
Date	Recovery	Recovery	RPD	Recovery	Recovery	RPD
9/3/2007-LCS	67.7	64.1	5.46	**69.5**	**61.8**	11.73
9/3/2007-MS	85.2	86.2	-1.17	**67.9**	**69.6**	-2.47
10/1/-15/2007 LCS1	**62.2**	**62.8**	-0.96	89.8	90.1	-0.33
10/1/-15/2007 LCS2	76.2	75.7	0.66	95.3	110	-14.32
10/29/2007-LCS	75.8	83	-9.07	77.8	74.5	4.33
11/26/2007-LCS	105	98.7	6.19	89.8	82.8	8.11
12/4/2007-LCS1	74.3	**62.3**	17.57	97.4	83.1	15.84
12/4/2007-LCS2	93.4	114	-19.86	75.5	82.4	-8.74
1/14,15,22/2008-MS	90.1	98.7	-9.11	**58.4**	70.2	-18.35
2/2/2008-MS	112	115	-2.64	99.6	90.3	9.79

Appendix G. Sediment Precision and Accuracy: MP, DEGEE, and Fennedefo

	MP			**DEGEE**			**Fennedefo**		
	Spike	Duplicate		Spike	Duplicate		Spike	Duplicate	
	Recovery	Recovery	RPD	Recovery	Recovery	RPD	Recovery	Recovery	RPD
9/3, 10/1, 10/15, 10/29	85	78.8	7.57	72.5	**68.8**	5.24	109	109	0.00
11/26/2007	107	105	1.89	96.8	96.5	0.31	70.4	75	-6.33
12/4/2007 Set 1	80.1	83.8	-4.51	79.5	75.5	5.16	84.6	81	4.35
12/4/2007 Set 2	105	97.8	7.10	89.5	91.2	-1.88	96.2	81.9	16.06
12/4/2007 Set 3	103	104	-0.97	101	102	-0.99	94	104	-10.10
1/14, 1/15, 1/22 Set 1	90.8	92.6	-1.96	95.6	97.8	-2.28	75.1	**68.5**	9.19
1/14, 1/15, 1/22 Set 2	70.2	72.5	-3.22	97.7	78.8	**21.42**	95.6	107	-11.25

Appendix H. Rotenone concentrations (µg/L) in water in Lake Davis (analysis by DPH).

Site	9/4/07		9/27/2007[1]		10/1/2007		10/8/2007		10/15/2007	
	rotenone	rotenolone	rotenone	rotenolone	rotenone	rotenolone	rotenone	rotenolone	rotenone	rotenolone
1-bottom	<2	<2	21.3	2.5	33.4[2]	11.6	**21.0**	**18.2**	10.1	23.1
1-mid	<2	<2	25.1	3.52	31.4	11.5	**21.6**	19.7	**14.4**	26.0
1-surface	<2	<2	26.3	3.61	25.1	11.1	**22.4**	21.5	2.42	6.58
2-bottom	<2	<2	74.8	16.4	29.2	13.5	9.9	**11.8**	**10.9**	**27.6**
2-surface	<2	<2	62.6	15	29.9	14.8	**18.4**	20.3	**11.6**	**29.4**
3-bottom	<2	<2	64.1	9.59	47.9	24.0	**20.3**	22.0	**11.1**	25.0
3-mid	<2	<2	55	8.81	36.9	20.1	**20.3**	22.5	**11.6**	**26.4**
3-surface	<2	<2	60.4	9.74	**40.1**	**20.7**	**21.0**	21.7	9.55	25.1
4-bottom	<2	<2	26	3.03	32.2	13.0	**22.0**	24.0	**11.5**	**28.9**
4-surface	<2	<2	67.4	9.01	36.2	**16.3**	**22.3**	21.8	**11.0**	**28.8**
5-bottom	<2	<2	62.2	9.43	31.5	17.5	**19.2**	**35.2**	9.1	**28.5**
5-mid	<2	<2	73.9	12.1	36.7	17.9	**24.1**	26.1	9.4	**27.0**
5-surface	<2	<2	60.2	10	22.2*	17*	**22.5**	24.3	<2	5.95
6-bottom	<2	<2	NA	NA	34.5	20.7	< 2	< 2	6.06	24.8
6-surface	<2	<2	NA	NA	37.6	20.6	**17.6**	27.6	7.57	26.6
7-bottom	<2	<2	41.1	7.64	35.3	28.7	**18.5**	41.9	5.38	26.0
7-mid	<2	<2	39.4	8.01	34.8	24.8	**20.2**	29.1	8.12	30.3
7-surface	<2	<2	41.2	8.04	<2	<2	**19.6**	28.4	6.71	23.6
8-bottom	<2	<2	148	55.1	56.6	85.9	**12.0**	**74.5**	2.07	**64.6**
8-surface	<2	<2	88.6	19.6	59.5	85.8	**12.8**	78.4	<2	52.9
9-bottom	<2	<2	87.2	19.7	33.6	55.1	**11.4**	57.3	3.86	33.8
9-mid	<2	<2	88.6	19.6	41.2	52.9	**15.3**	40.7	3.89	36.8
9-surface	<2	<2	88.4	20.7	49.5	54.2	**16.1**	36.9	3.79	35.0
10-bottom	<2	<2	17.4	42.3	5.2	176.0	< 2	133	<2	59.8
10-surface	<2	<2	24.4	60.6	4.1	171.0	< 2	136	<2	66.1
lake average	<2	<2	58	16	35	42	19	41	7	32

[1]CDFG results
[2]Corresponding QA/QC results were outside of acceptable range.

Appendix H (cont.). Rotenone concentrations (µg/L) in water in Lake Davis (DPH).

Site	10/22/2007		10/29/07[1]		11/5/2007		11/26/2007		12/4/2007	
	rotenone	rotenolone	rotenone	rotenolone	rotenone	rotenolone	rotenone	rotenolone	rotenone	rotenolone
1-bottom	2.92	16.2	<2	<2	< 2	< 2	<2	<2	<2	<2
1-mid	3.63	18.0	<2	<2	< 2	< 2	<2	<2	<2	<2
1-surface	3.19	17.4	<2	<2	< 2	< 2	<2	<2	<2	<2
2-bottom	3.34	17.5	<2	<2	< 2	< 2	<2	<2	<2	<2
2-surface	4.22	**23.1**[2]	<2	<2	< 2	< 2	<2	<2	<2	<2
3-bottom	3.23	20.7	<2	<2	< 2	< 2	<2	<2	<2	<2
3-mid	2.85	18.6	<2	<2	< 2	< 2	<2	<2	<2	<2
3-surface	2.86	19.5	<2	<2	< 2	< 2	<2	<2	<2	<2
4-bottom	2.92	18.5	<2	<2	< 2	< 2	<2	<2	<2	<2
4-surface	<2	**12.7**	<2	<2	< 2	< 2	<2	<2	<2	<2
5-bottom	3.06	22.7	<2	<2	< 2	< 2	<2	<2	<2	<2
5-mid	3.31	**28.8**	<2	<2	< 2	< 2	<2	<2	<2	<2
5-surface	3.04	**25.2**	<2	<2	< 2	< 2	<2	<2	<2	<2
6-bottom	2.69	19.5	<2	2.58	< 2	< 2	<2	<2	<2	<2
6-surface	2.77	18.8	<2	2.28	< 2	< 2	<2	<2	<2	<2
7-bottom	<2	24.4	<2	6.43	< 2	< 2	<2	<2	<2	<2
7-mid	<2	21.5	<2	5.18	< 2	< 2	<2	<2	<2	<2
7-surface	2.06	23.6	<2	3.13	< 2	< 2	<2	<2	<2	<2
8-bottom	<2	35.6	<2	23.9	< 2	< 2	<2	<2	<2	<2
8-surface	<2	30.6	<2	23.0	< 2	29.8	<2	<2	<2	<2
9-bottom	<2	24.1	<2	13.1	< 2	< 2	<2	<2	<2	<2
9-mid	<2	24.5	<2	13.4	< 2	< 2	<2	<2	<2	<2
9-surface	<2	24.8	<2	13.1	< 2	< 2	<2	<2	<2	<2
10-bottom	<2	39.0	<2	21.6	< 2	< 2	<2	<2	<2	<2
10-surface	<2	38.7	<2	21.3	< 2	< 2	<2	<2	<2	<2
lake average	2	23	<2	6	<2	2	<2	<2	<2	<2

[1]CDFG results
[2]Corresponding QA/QC results were outside of acceptable range.

Appendix H (cont.). Rotenone concentrations (µg/L) in water in Lake Davis (DPH).

Site	12/17/2007		1/14/2008	
	rotenone	rotenolone	rotenone	rotenolone
1-bottom	<2	<2	<2	<2
1-mid	<2	<2	<2	<2
1-surface	<2	<2	<2	<2
2-bottom			<2	<2
2-surface			<2	<2
3-bottom			<2	<2
3-mid			<2	<2
3-surface			<2	<2
4-bottom	<2	<2	<2	<2
4-surface	<2	<2	<2	<2
5-bottom			<2	<2
5-mid			<2	<2
5-surface			<2	<2
6-bottom			<2	<2
6-surface			<2	<2
7-bottom			<2	<2
7-mid			<2	<2
7-surface			<2	<2
8-bottom			<2	<2
8-surface			<2	<2
9-bottom			<2	<2
9-mid			<2	<2
9-surface			<2	<2
10-bottom			<2	<2
10-surface			<2	<2
lake average			<2	<2

Appendix I. Rotenone and rotenolone concentrations in water from tributaries to Lake Davis (analysis by CDFG).

FIRST TRIB TREATMENT				
		Rotenone	Rotenolone	
Drainage	Site	(µg/L)	(µg/L)	Date
BGC	OHC1	ND	ND	September 10, 2007
	OHC2	4.72	1.3	September 10, 2007
	OHC3	1*	1*	September 10, 2007
	UBGC1	2462	3950	September 10, 2007
	UBGC2	5.21	4.38	September 10, 2007
	UBGC3	1470	2520	September 13, 2007
	BGC1	24.9	15.9	September 12, 2007
	BGC2	155	245	September 12, 2007
	BGC3	345	282	September 12, 2007
	BGC4	862	1890	September 12, 2007
	BGC5	49.4	122	September 11, 2007
	BGC5	118	214	September 13, 2007
	BGC6	180	538	September 11, 2007
	BGC6	63.3	79.3	September 13, 2007
	BGC7	123	252	September 11, 2007
	BGC8	189	302	September 11, 2007
	BGC9	825	1080	September 11, 2007
	BGC10	352	531	September 11, 2007
	BGC11	94.4	48.8	September 11, 2007
	BGC12	2004	2791	September 11, 2007
	SBGC1	132	68.1	September 10, 2007
Freeman	F1	44.8	134	September 12, 2007
	F2	ND	ND	September 12, 2007
	F3	23.6	11.8	September 12, 2007
	F4	32.1	34.9	September 12, 2007
	F5	293	203	September 10, 2007
	F6	68.9	140	September 13, 2007
	F7	130	245	September 13, 2007
	F8	57.5	149	September 13, 2007
	F9	35.7	77.7	September 13, 2007
	F10	28.4	44.8	September 13, 2007
	F11	38	68.3	September 13, 2007

Appendix I (cont). Rotenone and rotenolone concentrations in water from tributaries to Lake Davis (analysis by CDFG).

		Rotenone	Rotenolone	
Drainage	**Site**	**(µg/L)**	**(µg/L)**	**Date**
Cow	C10	79.7	35.6	September 11, 2007
	C13	ND	ND	September 11, 2007
	C12	25.3	21.1	September 11, 2007
	C9	20.8	5.54	September 11, 2007
	C11	22.3	18.6	September 11, 2007
	C5	8.67	3.78	September 11, 2007
	C6	105	45.8	September 11, 2007
	C7	93.2	56.4	September 11, 2007
	C8	ND	ND	September 11, 2007
Unnamed	SPR	2.32	6.62	September 10, 2007
SECOND TRIB TREATMENT				
BGC -	BGC12	**7.67**	**79.1**	Sept. 25, 2007
pre-	BGC11	**12.7**	**90.4**	Sept. 25, 2007
treatment	BGC	**28.8**	**103**	Sept. 25, 2007
	BGC6	**24.8**	**59.3**	Sept. 25, 2007
	BGC9	**31.2**	**122**	Sept. 25, 2007
	BGC6	**21.2**	**31.8**	Sept. 25, 2007
	BGC6	**24.4**	**43.2**	Sept. 25, 2007
	BGC5	**19.1**	**29.0**	Sept. 25, 2007
	BGC4	**11.2**	**19.3**	Sept. 25, 2007
	BGC5	**14.0**	**20.4**	Sept. 25, 2007
BGC-	OHC2	**36.1**	**19.4**	Sept. 24, 2007
post	OHC2	**36.1**	**16.6**	Sept. 24, 2007
treatment	OHC1	**11.0**	**5.78**	Sept. 24, 2007
	BGC12	**104**	**103**	Sept. 25, 2007
	BGC11	**99.6**	**168**	Sept. 25, 2007
	BGC10	**79.6**	**132**	Sept. 25, 2007
	BGC9	**67.9**	**116**	Sept. 25, 2007
	BGC6	**73.6**	**73.0**	Sept. 25, 2007
	BGC6	**237**	**69.0**	Sept. 25, 2007
	BGC6	**76.6**	**59.7**	Sept. 25, 2007
	BGC5	**126**	**41.6**	Sept. 25, 2007
	BGC5	**151**	**42.2**	Sept. 25, 2007
	BGC4	**344**	**89.6**	Sept. 25, 2007

Appendix I (cont). Rotenone and rotenolone concentrations in water from tributaries to Lake Davis (analysis by CDFG).

		Rotenone	Rotenolone	
Drainage	**Site**	**(µg/L)**	**(µg/L)**	**Date**
BGC	BGC	**253**	**58.3**	Sept. 26, 2007
	BGC	**26**	**12.3**	Sept. 26, 2007
	BGC	**78**	**262.0**	Sept. 26, 2007
	BGC	**19**	**6.2**	Sept. 26, 2007
	BGC	**121**	**40.0**	Sept. 26, 2007
	BGC	**128**	**52.1**	Sept. 26, 2007
	BGC	**156**	**304.0**	Sept. 26, 2007
Freeman	Freeman	**288**	**130.0**	Sept. 26, 2007
	Freeman	**291**	**30.3**	Sept. 26, 2007
	Freeman	**66**	**15.1**	Sept. 26, 2007
	Freeman	**260**	**30.8**	Sept. 26, 2007
	Freeman	**59**	**9.8**	Sept. 26, 2007
Cow	Cow	**58**	**16.9**	Sept. 25, 2007
	Cow	**14**	**4.5**	Sept. 25, 2007
	Cow	**296**	**83.1**	Sept. 25, 2007
	Cow	**97**	**18.8**	Sept. 25, 2007
	Cow	**83**	**27.3**	Sept. 25, 2007
	Cow	**1420**	**52.9**	Sept. 25, 2007
	Cow	**262**	**82.9**	Sept. 25, 2007

Appendix J. Methyl pyrrolidone (MP), Diethylene glycol ethyl ether (DEGEE), and Fennedefo concentrations (µg/L) in water in Lake Davis (analysis by DPH).

10/1/2007				10/8/2007			10/15/2007			10/22/2007		
Site	**MP**	**DEGEE**	**Fennedefo**	**MP**	**DEGEE**	**Fennedefo**	**MP**	**DEGEE**	**Fennedefo**	**MP**	**DEGEE**	**Fennedefo**
1-bottom	61	291	172[3]	<5	305	217	<5	324	268	<5	241	251
1-mid	59	282	171	<5	300	214	<5	329	269	<5	242	247
1-surface	56	265	147	<5	296	212	<5	318	263	<5	221	248
2-bottom	67	280	166	<5	280	196	<5	292	250	<5	235	247
2-surface	66	289	166	<5	283	198	<5	294	251	<5	227	246
3-bottom	93	480	248	<5	343	233	<5	330	273	<5	247	246
3-mid	95	493	252	<5	**340**	234	<5	331	269	<5	255	254
3-surface	**97**	489	252	<5	338	227	<5	336	265	<5	273	250
4-bottom	72	337	189	8.61	396	259	<5	331	275	<5	245	240
4-surface	**88**	431	226	<5	**322**	219	<5	322	270	<5	258	246
5-bottom	97	474	248	40.3	551	349	<5	350	277	<5	257	246
5-mid	92	452	240	<5	356	240	<5	345	279	<5	251	241
5-surface	NA[1]	NA	NA	<5	344	230	<5	334	267	<5	256	238
6-bottom	99	471	245	11.4	382	260	<5	282	231	<5	225	221
6-surface	100	475	255	12.6	389	261	<5	274	228	<5	233	222
7-bottom	131	692	323	58.6	568	383	<5	345	284	<5	237	222
7-mid	115	615	288	20.4	451	301	<5	357	273	<5	249	228
7-surface	114	625	286	13.2	423	284	<5	343	277	<5	251	235
8-bottom	359	1850	830[2]	246	1010	711	**77.1**	554	460	<5	245	255
8-surface	350	1860	840[2]	243	999	701	79.7	568	469	<5	254	275
9-bottom	207	1060	490[2]	150	677	472	<5	388	304	<5	208	202
9-mid	188	983	450[2]	73.4	589	381	5.28	391	305	<5	204	197
9-surface	182	975	450[2]	57.7	547	361	5.33	380	299	<5	194	208
10-bottom	437	2060	1200[2]	**370**	742	699	**232**	**96.9**	149	64.9	<5	<50
10-surface	511	2460	1200[2]	373	749	712	225	91.6	143	**62.7**	<5	<50
Lake average	156	779	228	68	479	342	27	332	276	7	221	221

[1]Sample not analyzed.
[2]Estimate. Value exceeded the upper calibration range.
[3]Corresponding QA/QC results were outside of acceptable range.

Appendix J (cont.). Methyl pyrrolidone (MP), Diethylene glycol ethyl ether (DEGEE), and Fennedefo concentrations (µg/L) in water in Lake Davis (DPH).

	10/29/07*			11/5/2007			11/26/2007			12/4/2007		
Site	**MP**	**DEGEE**	**Fennedefo**	**MP**	**DEGEE**	**Fennedefo**	**MP**	**DEGEE**	**Fennedefo**	**MP**	**DEGEE**	**Fennedefo**
1-bottom	<5	151	183	< 5	**62**[1]	190	< 5	< 5	96	< 5	< 5	69
1-mid				< 5	45	185	< 5	< 5	91	< 5	< 5	65
1-surface				< 5	53	198	< 5	< 5	94	< 5	< 5	73
2-bottom	<5	176	176	< 5	82	168	< 5	5.1	90	< 5	< 5	77
2-surface				< 5	89	197	< 5	5.2	87	< 5	< 5	74
3-bottom				< 5	120	203	< 5	9.1	102	< 5	< 5	81
3-mid				< 5	123	199	< 5	8.5	94	< 5	< 5	85
3-surface	<5	211	207	< 5	120	208	< 5	9.1	96	< 5	< 5	83
4-bottom				< 5	**100**	**190**	< 5	5.9	94	< 5	< 5	84
4-surface	<5	200	196	< 5	99	197	< 5	6.5	105	< 5	< 5	72
5-bottom				< 5	123	200	< 5	8.4	103	< 5	< 5	80
5-mid	<5	217	199	< 5	123	200	< 5	8.5	103	< 5	< 5	84
5-surface				< 5	117	196	< 5	9.8	105	< 5	< 5	98
6-bottom	<5	209	183	< 5	104	186	< 5	9.0	93	< 5	< 5	90
6-surface				< 5	109	220	< 5	9.6	105	< 5	< 5	93
7-bottom				< 5	128	216	< 5	5.1	73	< 5	< 5	51
7-mid	<5	214	193	< 5	112	192	< 5	6.7	82	< 5	< 5	67
7-surface				< 5	94	170	< 5	10	111	< 5	< 5	51
8-bottom	<5	143	164	< 5	57	133	< 5	< 5	<50	< 5	< 5	<50
8-surface				< 5	60	135	< 5	< 5	<50	< 5	< 5	<50
9-bottom				< 5	49	98	< 5	5.8	72	< 5	< 5	<50
9-mid				< 5	89	161	< 5	5.7	73	< 5	< 5	<50
9-surface	<5	194	188	< 5	94	166	< 5	6.4	71	< 5	< 5	<50
10-bottom	<5	<5	<50	< 5	< 5	<50	< 5	< 5	<50	< 5	< 5	<50
10-surface				< 5	< 5	<50	< 5	< 5	<50	< 5	< 5	<50
Lake average	<5	172		<5	86	170	<5	6	82	<5	<5	62

[1]Corresponding QA/QC results were outside of acceptable range.

Appendix J (cont.) Methyl pyrrolidone (MP), Diethylene glycol ethyl ether (DEGEE), and Fennedefo concentrations (µg/L) in water in Lake Davis (DPH).

	12/17/2007			1/14/2008		
Site	**MP**	**DEGEE**	**Fennedefo**	**MP**	**DEGEE**	**Fennedefo**
1-bottom	< 5	< 5	<50	< 5	< 5	<50
1-mid	< 5	< 5	<50	< 5	< 5	<50
1-surface	< 5	< 5	<50	< 5	< 5	<50
2-bottom				< 5	< 5	<50
2-surface				< 5	< 5	<50
3-bottom				< 5	< 5	<50
3-mid				< 5	< 5	<50
3-surface				< 5	< 5	<50
4-bottom	< 5	< 5	<50	< 5	< 5	<50
4-surface	< 5	< 5	<50	< 5	< 5	<50
5-bottom				< 5	< 5	<50
5-mid				< 5	< 5	<50
5-surface				< 5	< 5	<50
6-bottom				< 5	< 5	<50
6-surface				< 5	< 5	<50
7-bottom				< 5	< 5	<50
7-mid				< 5	< 5	<50
7-surface				< 5	< 5	<50
8-bottom				< 5	< 5	<50
8-surface				< 5	< 5	<50
9-bottom				< 5	< 5	<50
9-mid				< 5	< 5	<50
9-surface				< 5	< 5	<50
10-bottom				< 5	< 5	<50
10-surface				< 5	< 5	<50
Lake average				< 5	< 5	<50

Appendix K. VOC and Semi-VOC concentrations (µg/L) detected in water in Lake Davis (analysis by DPH).

Site	Date	n-Butyl-benzene	sec-Butyl-benzene	Isopropyl-benzene	4-Isopropyl-toluene	Methylene Chloride	1-Methyl-naphthalene	2-Methyl-naphthalene	Naphthalene	n-Propyl-benzene	Toluene	Trichloroethylene	1,2,4-Trimethyl-benzene	1,3,5-Trimethyl-benzene	m-,p-Xylenes	o-Xylene
1-bottom	10/1/07	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
1-mid		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
1-surface		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
2-bottom		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
2-surface		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
3-bottom		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
3-mid		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
3-surface		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
4-bottom		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
4-surface		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
5-bottom		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
5-mid		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
5-surface		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
6-bottom		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
6-surface		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
7-bottom		< RL	< RL	< RL	< RL	0.540	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
7-mid		< RL	< RL	< RL	< RL	0.563	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
7-surface		< RL	< RL	< RL	< RL	0.503	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
8-bottom		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
8-surface		< RL	< RL	< RL	< RL	0.534	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
9-bottom		< RL	< RL	< RL	< RL	0.603	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
9-mid		< RL	< RL	< RL	< RL	0.631	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
9-surface		< RL	< RL	< RL	< RL	0.648	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
10-bottom		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
10-surface		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL

Appendix K. (cont.) VOC and Semi-VOC concentrations (µg/L) detected in water in Lake Davis in 2007 by DPH.

Site	Date	n-Butyl-benzene	sec-Butyl-benzene	Isopropyl-benzene	4-Isopropyl-toluene	Methylene Chloride	1-Methyl-naphthalene	2-Methyl-naphthalene	Naphthalene	n-Propyl-benzene	Toluene	Trichloroethylene	1,2,4-Trimethyl-benzene	1,3,5-Trimethyl-benzene	m-,p-Xylenes	o-Xylene
1-bottom	10/8/07	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
1-mid		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
1-surface		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
2-bottom		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
2-surface		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
3-bottom		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
3-mid		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
3-surface		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
4-bottom		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
4-surface		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
5-bottom		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
5-mid		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
5-surface		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
6-bottom		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
6-surface		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
7-bottom		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
7-mid		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
7-surface		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
8-bottom		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
8-surface		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
9-bottom		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
9-mid		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
9-surface		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
10-bottom		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
10-surface		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL

Appendix K. (cont.) VOC and Semi-VOC concentrations (µg/L) detected in water in Lake Davis in 2007 by DPH.

Site	Date	n-Butyl-benzene	sec-Butyl-benzene	Isopropyl-benzene	4-Isopropyl-toluene	Methylene Chloride	1-Methyl-naphthalene	2-Methyl-naphthalene	Naphthalene	n-Propyl-benzene	Toluene	Trichloroethylene	1,2,4-Trimethyl-benzene	1,3,5-Trimethyl-benzene	m-,p-Xylenes	o-Xylene
1-bottom	10/15/07	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
1-mid		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
1-surface		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
2-bottom		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
2-surface		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
3-bottom		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
3-mid		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
3-surface		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
4-bottom		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
4-surface		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
5-bottom		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
5-mid		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
5-surface		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
6-bottom		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
6-surface		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
7-bottom		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
7-mid		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
7-surface		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
8-bottom		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
8-surface		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
9-bottom		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
9-mid		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
9-surface		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
10-bottom		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
10-surface		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL

Appendix K. (cont.) VOC and Semi-VOC concentrations (µg/L) detected in water in Lake Davis in 2007 by DPH.

Site	Date	n-Butyl-benzene	sec-Butyl-benzene	Isopropyl-benzene	4-Isopropyl-toluene	Methylene Chloride	1-Methyl-naphthalene	2-Methyl-naphthalene	Naphthalene	n-Propyl-benzene	Toluene	Trichloroethylene	1,2,4-Trimethyl-benzene	1,3,5-Trimethyl-benzene	m-,p-Xylenes	o-Xylene
1-bottom	11/5/07	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
1-mid		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
1-surface		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
2-bottom		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
2-surface		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
3-bottom		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
3-mid		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
3-surface		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
4-bottom		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
4-surface		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
5-bottom		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
5-mid		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
5-surface		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
6-bottom		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
6-surface		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
7-bottom		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
7-mid		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
7-surface		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
8-bottom		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
8-surface		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
9-bottom		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
9-mid		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
9-surface		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
10-bottom		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL
10-surface		< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL	< RL

Appendix L. VOC and Semi-VOCs (µg/L) in water in Lake Davis (analysis by CDFG).

10/1/2007	Site	Toulene	Xylene-m/p	Trimethylbenzene1,2,4	Naphthalene
	3-surface	0.15	0.08	0.24	0.11
	4-surface	0.13	0.07	0.06	0.11
	5-surface	0.15	0.08	0.06	0.11
10/8/2007	3-surface	ND	ND	ND	ND
	4-surface	ND	ND	ND	ND
	10-surface	ND	ND	ND	ND
10/15/2007	2-surface	ND	ND	ND	ND
	4-surface	ND	ND	ND	ND
	6-surface	ND	ND	ND	ND
	8-surface	ND	ND	ND	ND
	10-surface	ND	ND	ND	ND

Scanned for but never found

8270:

Phenol
Bis(2-chloroethyl) ether
2-Chlorophenol
1,3-Dichlorobenzene
1,4-Dichlorobenzene
1,2-Dichlorobenzene
Bis (2-chloisoropyl) ether
2-Methylphenol
N-Nitrosodi-n-propylamine
Hexachloroethane
4-Methylphenol
Nitrobenzene
Isophorone
2-Nitrophenol
2,4-Dimethylphenol
Bis(2-chloroethoxy)methane
2,4-Dichlorophenol
1,2,4-Trichlorobenzene
Naphthalene
4-Chloroaniline
Hexachlorobutadiene
4-Chloro-3-methylphenol
2-Methylnaphthalene
Hexachlorocyclopentadiene
2,4,6-Trichlorophenol
2,4,5-Trichlorophenol
2-Chloronaphthalene
2-Nitroaniline
2,6-Dinitrotoulene
Dimethyl phthalate
Acenaphthylene
3-Nitroaniline
Acenaphthene
2,4-Dinitrophenol
2,4-Dinitrotoulene
Dibenzofuran
4-Nitrophenol
Diethyl phthalate
Fluorene
4-Chlorophenyl phenyl ether
4,6-Dinitro-2-methylphenol
Carbazole
4-Bromophenyl phenyl ether
Hexachlorobenzene
Pentachlorophenol
4-Nitroalinine
Phenanthrene
Anthracene
Di-n-butyl phthalate
Fluoranthene
Pyrene
Butyl benzyl phthalate
Benz(a)anthracene
Chrysene
Bis(2-ethylhexyl)phthalate
Di-n-octyl phthalate
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Benzo(a)pyrene
Indeno(1,2,3-cd)pyrene
Dibenz(a,h)anthracene
Benzo(g,h,i)perylene

8260:

Dichloroethylene, 1,1-
MTBE
Dichloroethylene, trans 1,2-
Dichloroethane, 1,1-
Dichloropropane, 2,2-
Dichloroethylene, cis 1,2-
Bromochloromethane
Chloroform
Trichloroethane, 1,1,1-
Carbon tetrachloride
Dichloropropene, 1,1-
Benzene
Dichloroethane, 1,2-
Trichloroethylene
Dichloropropane, 1,2-
Dibromomethane
Bromodichloromethane
Trichloroethane, 1,1,2-
Tetrachloroethylene
Dichloropropane, 1,3-
Dibromochloromethane
Dibromoethane, 1,2-
Chlorobenzene
Ethylbenzene
Xylene-o
Tetrachloroethane, 1,1,1,2-
Bromoform
Isopropylbenzene
Bromobenzene
Propylbenzene, n-
Trichloropropane, 1,2,3-
Tetrachloroethane, 1,1,2,2-
Chlorotoulene, 2-
Trimethylbenzene 1,3,5-
Chlorotoulene, 4-
Butylbenzene, tert
Butylbenzene, sec-
Dichlorobenzene, 1,3-
Isopropyltoulene, p-
Dichlorobenzene, 1,4-
Butylbenzen, n-
Dichlorobenzene, 1,2
Dibromo-3-Chloropropane, 1,2-(DBCP)
Trichlorobenzene, 1,2,4-
Hexachlorobutadiene
Trichlorobenzene, 1,2,3-

Appendix M. Water Quality in Lake Davis (analysis by CDFG).

Date	Site	TOC (mg/L)	Hardness (mg/L as CaCO3)	Alkalinity mg/L as CaCO3	BOD (mg/L)	pH	conductivity (µmhos/com)
9/3/2007	1-1	4.3	34.4	41.4			
	1-3	4.5	33	42.2			
	5-1	4.3	35.4	46.7			
	5-3	4.7	33.5	42.9			
	9-3	4.9	32.7	42.1			
1/22/2008	3-3	5.1					
	6-2	5.9			2.16	8	97
2/2/2008	4-2		40.1	53			

Appendix N. Rotenone and rotenolone concentrations (ng/g) in sediment in Lake Davis (analysis by CDFG).

	9/5/2007		10/1/2007		10/15/2007		10/29/2007		11/26/2007		12/4/2007	
Sites	Rotenone	Rotenolone	Rotenone	Rotenolone	Rotenone	Rotenolone	Rotenone	Rotenolone	Rotenone	Rotenolone	Rotenone	Rotenolone
2	<10	**<10**	92.5	30.2	481	158	37.2	25.9	<10	<10	<10	<10
4	<10	**<10**	13.5	<10	39.7	15.1	<10	<10	<10	<10	<10	<10
6	<10	**<10**	562	213	308	152	73.2	53.9	311	58.9	177	54.1
8	<10	**<10**	568	179	91.9	187	56.6	8.03	<10	11.0	28.5	12.9
10	<10	**<10**	122	640	16.5	114	<10	31.6	<10	<10	41.8	194
average	<10	<10	271.6	213.4	187.4	125.2	35.4	24.9	66.2	17.0	51.5	54.2

	1/14/2008		1/15/2008		1/22/2008		2/2/2008	
Sites	Rotenone	Rotenolone	Rotenone	Rotenolone	Rotenone	Rotenolone	Rotenone	Rotenolone
2	<10	<10	13.9	<10	<10	<10	<10	<10
4	<10	<10	<10	<10	<10	<10	<10	<10
6	53.9	26.2	52.0	<10	22.5	<10	<10	<10
8	<10	<10	<10	<10	<10	<10	<10	<10
10	<10	<10	<10	<10	<10	<10	<10	<10
average	14.8	<10	16.2	<10	<10	<10	<10	<10

Appendix O. MP, DEGEE, and Fennedefo concentrations (ng/g) in sediment in Lake Davis (analysis by CDFG).

	9/5/2007			10/1/2007			10/15/2007			10/29/2007		
Sites	MP	DEGEE	Fennedefo	MP	DEGEE	Fennedefo	MP	DEGEE	Fennedefo	MP	DEGEE	Fennedefo
2	<5	**<5**[1]	<5	88.5	**ND**	64.1	39.7	**75.7**	260.0	ND	**ND**	ND
4	<5	**<5**	<5	ND	**ND**	ND	ND	**10.2**	50.7	ND	**ND**	ND
6	<5	**<5**	<5	20.5	**ND**	ND	ND	**ND**	ND	6.7	**ND**	50.0
8	72.9	**<5**	<5	ND	**ND**	ND	16.5	**14.8**	156.0	ND	**ND**	ND
10	<5	**<5**	<5	742	**ND**	367.0	48.2	**ND**	ND	90.6	**ND**	ND
average	16.6	<5	<5	171.2	<5	87.7	21.9	21.1	94.3	22.5	<5	30.0
	11/26/2007			12/4/2007			1/14/2008			1/15/2008		
Sites	MP	DEGEE	Fennedefo	MP	DEGEE	Fennedefo	MP	DEGEE	Fennedefo	MP	DEGEE	Fennedefo
2	ND	ND	ND	ND	ND	ND	ND	**ND**	ND	ND	**ND**	ND
4	ND	ND	ND	ND	ND	ND	ND	**ND**	ND	ND	**ND**	ND
6	ND	ND	ND	ND	ND	231.0	ND	**ND**	ND	ND	**ND**	ND
8	ND	ND	ND	ND	ND	ND	ND	**ND**	ND	ND	**ND**	ND
10	ND	ND	ND	ND	ND	103.0	ND	**ND**	ND	ND	**ND**	ND
	<5	<5	<50	<5	<5	81.8	<5	<5	<50	<5	<5	<50
	1/22/2008			2/2/2008								
Sites	MP	DEGEE	Fennedefo	Fennedefo								
2	ND	**ND**	ND	ND								
4	ND	**ND**	ND	ND								
6	ND	**ND**	ND	ND								
8	ND	**ND**	ND	ND								
10	ND	**ND**	ND	ND								

[1]Corresponding QA/QC results were outside of acceptable range.

Appendix P. VOC and Semi-VOC analyzed for but not detected in sediment in Lake Davis (analysis by CDFG).

8270:

Phenol
Bis(2-chloroethyl) ether
2-Chlorophenol
1,3-Dichlorobenzene
1,4-Dichlorobenzene
1,2-Dichlorobenzene
Bis (2-chloisoropyl) ether
2-Methylphenol
N-Nitrosodi-n-propylamine
Hexachloroethane
4-Methylphenol
Nitrobenzene
Isophorone
2-Nitrophenol
2,4-Dimethylphenol
Bis(2-chloroethoxy)methane
2,4-Dichlorophenol
1,2,4-Trichlorobenzene
Naphthalene
4-Chloroaniline
Hexachlorobutadiene
4-Chloro-3-methylphenol
2-Methylnaphthalene
Hexachlorocyclopentadiene
2,4,6-Trichlorophenol
2,4,5-Trichlorophenol
2-Chloronaphthalene
2-Nitroaniline
2,6-Dinitrotoulene
Dimethyl phthalate
Acenaphthylene
3-Nitroaniline
Acenaphthene
2,4-Dinitrophenol
2,4-Dinitrotoulene
Dibenzofuran
4-Nitrophenol
Diethyl phthalate
Fluorene
4-Chlorophenyl phenyl ether
4,6-Dinitro-2-methylphenol
Carbazole
4-Bromophenyl phenyl ether
Hexachlorobenzene
Pentachlorophenol
4-Nitroalinine
Phenanthrene
Anthracene
Di-n-butyl phthalate
Fluoranthene
Pyrene
Butyl benzyl phthalate
Benz(a)anthracene
Chrysene
Bis(2-ethylhexyl)phthalate
Di-n-octyl phthalate
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Benzo(a)pyrene
Indeno(1,2,3-cd)pyrene
Dibenz(a,h)anthracene
Benzo(g,h,i)perylene

8260:

Dichloroethylene, 1,1-
MTBE
Dichloroethylene, trans 1,2-
Dichloroethane, 1,1-
Dichloropropane, 2,2-
Dichloroethylene, cis 1,2-
Bromochloromethane
Chloroform
Trichloroethane, 1,1,1-
Carbon tetrachloride
Dichloropropene, 1,1-
Benzene
Dichloroethane, 1,2-
Trichloroethylene
Dichloropropane, 1,2-
Dibromomethane
Bromodichloromethane
Trichloroethane, 1,1,2-
Tetrachloroethylene
Dichloropropane, 1,3-
Dibromochloromethane
Dibromoethane, 1,2-
Chlorobenzene
Ethylbenzene
Xylene-o
Tetrachloroethane, 1,1,1,2-
Bromoform
Isopropylbenzene
Bromobenzene
Propylbenzene, n-
Trichloropropane, 1,2,3-
Tetrachloroethane, 1,1,2,2-
Chlorotoulene, 2-
Trimethylbenzene 1,3,5-
Chlorotoulene, 4-
Butylbenzene, tert
Butylbenzene, sec-
Dichlorobenzene, 1,3-
Isopropyltoulene, p-
Dichlorobenzene, 1,4-
Butylbenzen, n-
Dichlorobenzene, 1,2
Dibromo-3-Chloropropane, 1,2-(DBCP)
Trichlorobenzene, 1,2,4-
Hexachlorobutadiene
Trichlorobenzene, 1,2,3-
Toulene
Xylene-m/p
Trimethylbenzene-1,2,4
Naphthalene