8 METHYLMERCURY ALLOCATIONS, TOTAL MERCURY LIMITS & MARGIN OF SAFETY

This chapter presents recommended methylmercury allocations and total mercury limits for methyl and total mercury sources to the Delta. Reductions in aqueous methylmercury are required to reduce methylmercury concentrations in fish. Reductions in total mercury loads are needed to enable aqueous and fish methylmercury reductions and to comply with the USEPA's CTR criterion for human protection and San Francisco Bay Mercury TMDL total mercury allocation for the Central Valley. Section 8.1 describes the proposed load and wasteload allocations for within-Delta and tributary inputs of methylmercury by source category. Section 8.2 describes the proposed total mercury limits and reductions. Sections 8.3 and 8.4 describe the associated margin of safety and inter-annual and seasonal variability.

The methylmercury allocations and total mercury limits described in this chapter reflect the preferred implementation alternative described in Chapter 4 of the Proposed Basin Plan Amendment draft staff report and are designed to address the beneficial use impairment in all subareas of the Delta and San Francisco Bay. However, as described in the draft Basin Plan Amendment report, a number of alternatives are possible. The Central Valley Water Board will consider a variety of allocation strategies and implementation alternatives as part of the basin plan amendment process.

8.1 Methylmercury Load Allocations

A water body's loading capacity (assimilative capacity) represents the maximum rate of loading of a pollutant that the water body can assimilate without violating water quality standards. A TMDL typically represents the sum of all individual allocations of the water body's assimilative capacity and must be less than or equal to the assimilative capacity. Allocations are divided among "wasteload allocations" for point sources and "load allocations" for nonpoint sources. The TMDL is the sum of these components:

Equation 8.1:

$$\text{TMDL} = \text{Background} + \text{Wasteload Allocations} + \text{Load Allocations}$$

A TMDL need not be stated as a daily load (Code of Federal Regulations, Title 40, §130.2[i]). Other measures are allowed if appropriate. The methylmercury allocation scheme proposed below is expressed in terms of average annual concentrations and loads because the adverse effects of mercury occur through long-term bioaccumulation. The allocations are intended to represent annual averages and account for both seasonal and long-term variability.

Methylmercury allocations were made in terms of the existing assimilative capacity of each of the different Delta subareas. A methylmercury TMDL must be developed for each Delta subarea because the sources and percent reductions needed to meet the proposed implementation goal are different in each subarea. The linkage analysis (Chapter 5) described the calculation of an implementation goal for aqueous methylmercury that is linked to the fish tissue methylmercury targets. The recommended implementation goal is an annual average concentration of 0.06 ng/l methylmercury in unfiltered water. This goal describes the assimilative capacity of Delta waters in terms of concentration (Section 5.2). Central Valley Water Board staff anticipates that as the average concentration of methylmercury in each

Delta subarea decreases to the safe aqueous goal, then the targets for fish tissue will be attained. To determine necessary reductions, the existing average aqueous methylmercury levels in each Delta subarea were compared to the methylmercury goal (Table 8.1).

The amount of reduction needed in each subarea is expressed as a percent of the existing concentration. As noted in the linkage analysis, the aqueous methylmercury goal was developed using water data for March to October 2000 because this was the only period for which there was overlap between water data and the lifespan of the fish. Table 8.1 compares the proposed goal to average methylmercury concentrations for March to October 2000 (Scenario A) and for March 2000 to April 2004 (Scenario B). Scenario B is based on a much larger dataset and includes values for all seasons. However, the percent reductions are similar for both scenarios and range from 0 to 80% for the different subareas. Therefore, staff recommends the use of the proposed reductions listed in Scenario B for the calculation of assimilative capacity.

The assimilative capacity of each subarea (Table 8.2) was determined using the proposed reductions listed in Scenario B in Table 8.1 (except for the Central Delta subarea, as discussed in the next paragraph), the sum of existing annual methylmercury inputs from identified sources (Table 8.3,[46] at the end of this section) and the following equation:

<u>Equation 8.2</u>: *(using the Sacramento subarea as an example)*

$$\text{Assimilative Capacity (g/yr)} = \text{Existing MeHg Inputs (g/yr)} - \left[\text{\% Reduction Needed to Meet Proposed Goal} \times \text{Existing MeHg Inputs (g/yr)} \right]$$

$$= 2{,}418 \text{ g/yr} - (44\% * 2{,}418 \text{ g/yr})$$
$$= 1{,}354 \text{ g/yr}$$

Scenarios A and B indicate no reduction is needed for ambient methylmercury in the Central Delta subarea to meet the proposed implementation goal. Because Central Delta water quality is dominated by inflows from upstream Delta subareas that require reductions ranging from 44 to 80%, Central Delta fish tissue and aqueous methylmercury levels are expected to decrease when actions are implemented to reduce up-basin aqueous methylmercury levels. Therefore, staff recommends that no reduction be required for point and nonpoint source methylmercury discharges within the Central Delta subarea. However, staff recommends a policy of no net increase in ambient methylmercury concentrations in the Central Delta subarea to ensure that fish methylmercury concentrations do not increase. This can be achieved by setting the acceptable methylmercury concentrations in Table 8.3 for Central Delta sources at their existing levels. In addition, staff recommends that source discharges with average methylmercury concentrations above the proposed aqueous methylmercury goal of 0.06 ng/l have load allocations set at their existing levels. No load allocations are needed for sources with existing discharge methylmercury concentrations at or below the implementation goal because they act as dilution. However, the loads for such discharges are listed in brackets in Table 8.3 to enable the calculation of the percent allocations required for other sources to meet the implementation goal in ambient waters given current conditions.

[46] "Existing annual MeHg loads" in Table 8.3 represent the loads estimated for WY2000-2003, a relatively dry period. Actual loads from MS4 discharges and nonpoint sources are expected to fluctuate with water volume and other environmental factors. Load estimates will be re-evaluated in subsequent phases of the TMDL as more data become available.

Table 8.1: Aqueous Methylmercury Reductions Needed to Meet the Proposed Methylmercury Goal of 0.06 ng/l. (a)

	Delta Subarea						
	Central Delta	Marsh Creek	Mokelumne River	Sacramento River	San Joaquin River	West Delta	Yolo Bypass
A. Scenario Based on March to October 2000 Aqueous MeHg Data (b)							
Average Aqueous MeHg Concentration (ng/l)	0.055	0.224	0.140	0.120	0.147	0.087	0.305
Percent Reduction Needed to Meet the Proposed MeHg Goal	0%	73%	57%	50%	59%	31%	80%
B. Scenario Based on March 2000 to April 2004 Aqueous MeHg Data (b)							
Average Annual Aqueous MeHg Concentration (ng/l)	0.060	0.224	0.166	0.108	0.160	0.083	0.273
Percent Reduction Needed to Meet the Proposed MeHg Goal	0%	73%	64%	44%	63%	28%	78%

(a) The amount of reduction needed in each subarea is expressed as a percent of the existing methylmercury concentration. For example, the percent reduction needed for the Marsh Creek subarea Scenario A is calculated by: (0.244 - 0.06) / 0.244 = 73%. The average March to October 2000 methylmercury concentration for the Central Delta is below the proposed implementation goal of 0.06 ng/l. As a result, Scenario A calculations for the Central Delta result in negative numbers: A(1): (0.055 - 0.06)/0.055 = -9%. No reduction is needed under Scenario A or B for Central Delta ambient methylmercury.

(b) Average concentrations are based on unfiltered MeHg concentration data collected at the following locations: Delta Mendota Canal and State Water Project (Central Delta); Marsh Creek at Highway 4; Mokelumne River near I-5; Sacramento River at Freeport, RM44 and Greene's Landing; San Joaquin River near Vernalis; outflow to San Francisco Bay measured at X2, usually near Mallard Island (West Delta); and Prospect Slough near Toe Drain (Yolo Bypass). The values for the Central Delta, Mokelumne River, Sacramento River, San Joaquin and West Delta subareas are described in Section 5.1 and Table 5.1 in Chapter 5 and are based on monthly average concentrations so that the average concentrations for each study period are not influenced by the unequal number of samples collected in each month. The Yolo Bypass average concentrations also are based on monthly average concentrations. The sampling frequency on Marsh Creek was inadequate to develop averages for each study period, much less to pool data by month; therefore, the average of all available concentration data was used in both scenarios. The Yolo Bypass and Marsh Creek data are described in Chapter 6, Section 6.2.1 and Table 6.3. It was assumed that the sampling locations are representative of the subareas in which they occur.

Table 8.2: Assimilative Capacity Calculations for Each Delta Subarea.

Delta Subarea	**Existing Average Annual MeHg Conc.** (a) (ng/l)	**% Reduction Needed to Achieve Proposed Goal of 0.06 ng/l** (a)	**Existing Annual MeHg Load from Identified Sources** (b) (g/yr)	**Assimilative Capacity** (g/yr)
Central Delta	0.060	0%	524	524
Marsh Creek	0.224	78%	6.6	1.4
Mokelumne River	0.166	69%	123	38
Sacramento River	0.108	49%	2,414	1,221
San Joaquin River	0.160	68%	478	155
West Delta	0.083	0%	320	320
Yolo Bypass [North & South]	0.273	83%	1,068	181

(a) No percent reductions are proposed for the Central and West Delta subareas because their fish tissue and aqueous methylmercury levels either currently achieve or are expected to achieve safe levels when actions are implemented to reduce up-basin aqueous methylmercury levels. Proposed reductions for other subareas are from Table 8.1 Scenario B.

(b) "Existing annual MeHg loads" represent the sum of all identified inputs to each subarea (Chapter 6 and Table 8.3).

The subareas on the eastern boundary of the Delta require substantial reductions in fish and aqueous methylmercury levels. In contrast, ambient methylmercury concentrations in the West Delta subarea approach the proposed aqueous methylmercury goal of 0.06 ng/l, resulting in the need for only modest reductions in methylmercury sources. The primary within-subarea source of methylmercury in the West

Delta subarea is sediment flux from open channel habitats (Table 8.3), for which there is no responsible party yet identified. In addition, it is expected that, should the proposed reductions take place in sources to the upstream Delta subareas, the proposed aqueous goal will be met in the West Delta subarea. (For example, the Sacramento subarea – the largest source of water to the West Delta subarea – requires a source reduction of 44%.) Therefore, staff recommends that no reduction be required for point and nonpoint source methylmercury discharges within the West Delta subarea. However, staff recommends a policy of no net increase in ambient methylmercury concentrations in the West Delta subarea to ensure that fish methylmercury concentrations do not increase. This can be achieved by using the same allocation strategy described in the previous paragraph for Central Delta methylmercury sources.

Staff recommends that atmospheric deposition and sediment flux from open water habitats be considered background sources in all Delta subareas and assigned no net increase in methylmercury concentration or loading. Discharges from urban areas outside of MS4 service areas comprise less than 4% of all urban acreage and associated urban methylmercury loading to the Delta, and a fraction of a percent of total mercury loading to the Delta; as a result, they will be assigned allocations in 2014 and are considered capped for calculation of Delta-wide allocations.[47] In addition, staff recommends that source discharges with average methylmercury concentrations below the proposed aqueous methylmercury goal of 0.06 ng/l be considered dilution and assigned no net increase in methylmercury concentration. The acceptable methylmercury concentrations in Table 8.3 for such sources were set at their existing levels. No load allocations are needed for sources with existing discharge methylmercury concentrations at or below the implementation goal because they act as dilution. However, the loads for such discharges are listed in brackets in Table 8.3 to enable the calculation of percent allocations required for other sources to meet the implementation goal in ambient waters given current conditions.

The following equation was used to determine the percent allocations needed for the remaining sources to achieve the assimilative capacity in each Delta subarea:

Equation 8.3: (using the Sacramento subarea as an example)

Percent Allocations for Other Sources Developed Using Average Annual Methylmercury Loads:

$$= \frac{\text{Assim. Cap.} - (\text{Atm. Dep.} + \text{Open Water Sed. Flux} + \text{Nonpoint Urban} + \text{Sources w/ Ave. MeHg Conc.} \leq 0.06\text{ ng/l})}{(\text{Sum of All Sources}) - (\text{Atm. Dep.} + \text{Open Water Sed. Flux} + \text{Nonpoint Urban} + \text{Sources w/ Ave. MeHg Conc.} \leq 0.06\text{ ng/l})}$$

$$= \frac{1{,}354\text{ g/yr} - (1.5\text{ g/yr} + 118\text{ g/yr} + 0.64\text{ g/yr} + 0.40\text{ g/yr})}{2{,}418\text{ g/yr} - (1.5\text{ g/yr} + 118\text{ g/yr} + 0.64\text{ g/yr} + 0.40\text{ g/yr})}$$ *[West Sacramento WWTP average discharge is ≤0.06 ng/l.]*

= 53.7%

The percent allocations were applied to every point and nonpoint source discharge load and concentration – except those with concentrations capped at existing levels – within each subarea to calculate acceptable methylmercury concentrations and loads (Table 8.3) using the following equations:

[47] As described in Chapter 4 of the Proposed Basin Plan Amendment Draft Staff Report, if such urban communities expand significantly, or are found to be significant contributors of methylmercury or other pollutants, they will be designated Phase II MS4 dischargers and required to develop and implement mercury control plans like those proposed for existing Phase II dischargers.

Equation 8.4a: (using SRCSD SRWWTP effluent concentration as an example)

$$\text{Acceptable MeHg Concentration} = \text{\% Allocation} * \text{Average SRCSD SRWWTP Effluent Conc.}$$
$$= 53.7\% * 0.727 \text{ ng/l}$$
$$= 0.390 \text{ ng/l}$$

Equation 8.4b: (using SRCSD SRWWTP effluent load as an example)

$$\text{Acceptable MeHg Load} = \text{\% Allocation} * \text{Annual SRCSD SRWWTP Load}$$
$$= 53.7\% * 157 \text{ g/yr}$$
$$= 84 \text{ g/yr}$$

Sometimes the use of Equation 8.4a resulted in a value less than 0.06 ng/l. Staff recommends that no source discharge be required to reduce its discharge methylmercury concentrations to less than 0.06 ng/l during the first phase of the implementation program. Therefore, if use of Equation 8.4a resulted in a value less than 0.06 ng/l for a particular source discharge, the acceptable methylmercury concentration (Table 8.3) was set at 0.06 ng/l and the allocation percent and equivalent load were calculated by the following equations:

Equation 8.5a: (using the City of Tracy WWTP in the San Joaquin subarea as an example)

$$\text{\% Allocation} = \text{Proposed Implementation Goal} \div \text{Existing Average MeHg Conc.}$$
$$= 0.06 \text{ ng/l} \div 0.146 \text{ ng/l}$$
$$= 41.1\%$$

Equation 8.5b:

$$\text{Equivalent MeHg Load} = \text{\% Allocation} * \text{Existing Annual MeHg Load}$$
$$= 41.1\% * 1.9 \text{ g/yr}$$
$$= 0.8 \text{ g/yr}$$

No load allocations are needed for sources with allocated discharge methylmercury concentrations of 0.06 ng/l or less because they will act as dilution if their allocations are maintained. However, the loads for such discharges are listed in brackets in Table 8.3 and included in Equation 8.3 (in the "Sources w/ Ave. MeHg Conc. ≤0.06 ng/l" component) to enable the calculation of percent allocations required for other sources to meet the implementation goal in ambient waters. The ultimate purpose of this iterative set of calculations is to ensure that the sum of all methylmercury inputs to each Delta subarea does not exceed the assimilative capacity so that the proposed implementation goal for ambient water can be achieved in each subarea.

Limited methylmercury concentration data exist for specific NPDES-permitted MS4s and nonpoint sources (e.g., agricultural and sediment flux) in each Delta subarea. Allocations for MS4s and nonpoint sources will be updated as additional results become available.

Tributary inputs account for about half of the methylmercury loading to the Delta (Figure 6.11). Methylmercury load reductions from tributary inputs will be needed to achieve the numeric targets in the Delta. Substantial aqueous methylmercury data are available for some of these inputs – enough to assign load allocations for the tributary inputs. The tributary allocations are treated as load allocations because there is insufficient information to assign load allocations to specific nonpoint sources (e.g., wetland and agricultural inputs) within the tributary watersheds at this time. Several of the tributary watersheds contain 303(d) listed waterways; future TMDLs are planned for these watersheds. Site-specific point and nonpoint source load reductions will be assigned as basin plan amendments are developed for each of these. However, there are several tributary watersheds that discharge to Delta subareas that require substantial mercury reductions (e.g., Mokelumne River and Ulatis Creek), for which no TMDLs are planned because none of waterways in these watersheds are currently 303(d) listed. Staff recommends that these watersheds be evaluated as part of Phase II of the proposed implementation plan (see Chapter 4 in the Proposed Basin Plan Amendment draft staff report).

There are several NPDES-permitted facilities and MS4s just outside the legal Delta boundary in the Delta's tributary watersheds. There is a need for a methylmercury control program that can consistently address permittees within and adjacent to the Delta. For this reason, staff evaluated upstream permittees. The alternatives analysis in Chapter 4 of the Proposed Basin Plan Amendment draft staff report identified a scope of 30 miles upstream of the Delta as the preferred option because: (a) 30 miles represents approximately 1-day travel time by water (sources within this distance may directly contribute to the Delta); and (b) it encompasses the MS4 service areas that have discharge points adjacent to or within the Delta. Appendix G provides potential methylmercury allocations for point sources (NPDES permitted facilities and MS4s) within 30 miles of the legal Delta boundary organized by tributary. The allocations are based on the percent reductions required for each tributary input to achieve the aqueous methylmercury implementation goal in each Delta subarea. Appendix G also provides a list of the point sources upstream of the 30-mile radius and downstream of major dams. The Central Valley Water Board will evaluate several alternatives to ultimately determine the scope of the Delta methylmercury control program.

As described in Chapter 4 of the Proposed Basin Plan Amendment draft staff report, staff recommends that responsibility parties for point and nonpoint methylmercury discharges conduct collaborative source characterization and control studies during the next six or so years. To the extent the efforts to develop methylmercury controls are effective, and/or further scientific information has been collected, the Central Valley Water Board may consider amendments to the Basin Plan to update the methylmercury allocations and implementation plan after the studies are completed.

About thirty percent of the methylmercury in the Delta is produced locally in sediment (Figure 6.11). Methylmercury production is a positive linear function of the inorganic mercury content of sediment (Chapter 3). This TMDL requires a 110-kg/yr reduction in total mercury from upstream watersheds with mercury sediment concentrations greater than 0.2 mg/kg and large mercury loads (next section). This represents about a 26% decrease in the 20-year average annual loading from the Sacramento Basin (Table 8.4) and should eventually result in a similar proportional decrease in sediment mercury concentrations. Inorganic mercury load reductions elsewhere have resulted in decreases in fish tissue methylmercury concentrations (Table 3.1). It is expected that similar reductions in fish tissue concentration also will occur in the Delta once the mercury content of its sediment decreases.

Proposed total mercury load reductions are described in Section 8.2, after Tables 8a through 8g.

Table 8.3a: Allocations for Methylmercury Sources to the Central Delta Subarea (a)

MeHg Sources	Tributary or Permittee	Permit #	Existing Average Annual MeHg Conc. (ng/l)	Existing Average Annual MeHg Load (g/yr)	Percent Allocation	Acceptable MeHg Conc. (g/yr)	Acceptable MeHg Load (g/yr)
BACKGROUND							
Atmospheric Deposition			*Not applicable.*	3.2	100%	*Not applicable.*	3.2
Sediment Flux	Open Water Habitats		*Not applicable.*	301	100%	*Not applicable.*	301
LOAD ALLOCATIONS							
Agricultural Drainage			0.352	37	100%	0.352	37
Sediment Flux	Wetland Habitats		*Not applicable.*	135	100%	*Not applicable.*	135
Tributary Inputs	Calaveras River		0.144	25	100%	0.144	25
	Bear/Mosher Creeks		0.310	11	100%	0.310	11
Urban (nps) (b)			0.241	0.13	100%	0.241	0.13
WASTELOAD ALLOCATIONS (c)							
MS4	City of Lodi	CAS000004	0.241	0.053	100%	0.241	0.053
	County of Contra Costa	CAS083313	0.241	0.75	100%	0.241	0.75
	County of San Joaquin	CAS000004	0.241	0.57	100%	0.241	0.57
	Port of Stockton MS4	CAS084077	0.241	0.39	100%	0.241	0.39
	Stockton Area MS4	CAS083470	0.241	3.6	100%	0.241	3.6
Facilities	Discovery Bay WWTP	CA0078590	0.199	0.42	100%	0.199	0.42
	City of Lodi White Slough WWTP	CA0079243	0.131	0.72	100%	0.131	0.72
	San Joaquin Co DPW CSA 31-Flag City WWTP	CA0082848	0.085	0.007	100%	0.085	0.007
CENTRAL DELTA SUBAREA TOTAL:			**0.060**	**519**	**100%**	**0.060**	**519**

(a) Existing concentrations were rounded to three decimal places, and existing loads were rounded to two significant digits, before calculating acceptable concentrations and loads. Acceptable concentrations are provided to three decimal places for ease of verifying calculations. However, staff recommends that they be rounded to two decimal places to evaluate compliance.

(b) Urban areas not encompassed by a MS4 service area were grouped into the “nonpoint source” (nps) category, which is considered a load allocation rather than a wasteload allocation.

(c) Permittees with NPDES No. CAS000004 are covered under the General Permit for the discharge of storm water from small MS4s (WQ Order No. 2003-0005-DWQ) adopted by the State Board to provide permit coverage for smaller municipalities (serving less than 100,000 people).

Table 8.3b: Allocations for Methylmercury Sources to the Marsh Creek Subarea (a)

MeHg Sources	Tributary or Permittee	Permit #	Existing Average Annual MeHg Conc. (ng/l)	Existing Average Annual MeHg Load (g/yr)	Percent Allocation	Acceptable MeHg Conc. (g/yr)	Acceptable MeHg Load (g/yr) (b)
BACKGROUND							
Atmospheric Deposition			*Not applicable.*	0.00049	100%	*Not applicable.*	0.00049
Sediment Flux	Open Water Habitats		*Not applicable.*	0.033	100%	*Not applicable.*	0.033
LOAD ALLOCATIONS							
Agricultural Drainage			0.352	2.2	25.5%	0.090	0.56
Sediment Flux	Wetland Habitats		*Not applicable.*	0.40	25.5%	*Not applicable.*	0.10
Tributary Inputs	Marsh Creek		0.255	1.9	25.5%	0.065	0.48
WASTELOAD ALLOCATIONS							
MS4	County of Contra Costa	CAS083313	0.241	1.2	25.5%	0.061	[0.31]
Facilities	City of Brentwood WWTP	CA0082660	0.020	0.085	100%	0.020	[0.085]
MARSH CREEK SUBAREA TOTAL:			**0.224**	**5.8**	**27%**	**0.060**	**1.6**

(d) Existing concentrations were rounded to three decimal places, and existing loads were rounded to two significant digits, before calculating acceptable concentrations and loads. Acceptable concentrations are provided to three decimal places for ease of verifying calculations. However, staff recommends that they be rounded to two decimal places to evaluate compliance.

(e) No load allocations are needed for sources with existing (e.g., City of Brentwood WWTP) or allocated (e.g., Contra Costa MS4) discharge methylmercury concentrations at or below the implementation goal because the discharges act as dilution. However, the loads for such discharges are listed in brackets ("[ ]") in this table to enable the calculation of the percent allocations required for other sources to ultimately meet the implementation goal in ambient waters given current conditions. "Percent allocations" listed for these sources may be greater than for other sources because staff recommends that sources with existing average concentrations less the implementation goal maintain their existing concentration, and that no source discharge be required to reduce its discharge methylmercury concentrations to less than 0.06 ng/l during the first phase of the implementation program.

Table 8.3c: Allocations for Methylmercury Sources to the Mokelumne/Cosumnes Rivers Subarea (a)

MeHg Sources	Tributary or Permittee	Permit # (a)	Existing Average Annual MeHg Conc. (ng/l)	Existing Average Annual MeHg Load (g/yr)	Percent Allocation	Acceptable MeHg Conc. (g/yr)	Acceptable MeHg Load (g/yr)
BACKGROUND							
Atmospheric Deposition			*Not applicable.*	0.024	100%	*Not applicable.*	0.024
Sediment Flux	Open Water Habitats		*Not applicable.*	1.1	100%	*Not applicable.*	1.1
LOAD ALLOCATIONS							
Agricultural Drainage			0.352	1.6	35.4%	0.125	0.57
Sediment Flux	Wetland Habitats		*Not applicable.*	12	35.4%	*Not applicable.*	4.2
Tributary Inputs	Mokelumne River		0.166	108	35.4%	0.059	38
Urban (nps)			0.241	0.018	35.4%	0.085	0.0064
WASTELOAD ALLOCATIONS							
MS4	County of San Joaquin	CAS000004	0.241	0.051	35.4%	0.085	0.018
MOKELUMNE/COSUMNES RIVERS SUBAREA TOTAL:			**0.166**	**123**	**36%**	**0.060**	**44**

(a) Existing concentrations were rounded to three decimal places, and existing loads were rounded to two significant digits, before calculating acceptable concentrations and loads. Acceptable concentrations are provided to three decimal places for ease of verifying calculations. However, staff recommends that they be rounded to two decimal places to evaluate compliance.

Table 8.3d: Allocations for Methylmercury Sources to the Sacramento River Subarea (a)

MeHg Sources	Tributary or Permittee	Permit #	Existing Average Annual MeHg Conc. (ng/l)	Existing Average Annual MeHg Load (g/yr)	Percent Allocation	Acceptable MeHg Conc. (g/yr)	Acceptable MeHg Load (g/yr) (b)
BACKGROUND							
Atmospheric Deposition			*Not applicable.*	1.5	100%	*Not applicable.*	1.50
Sediment Flux	Open Water Habitats		*Not applicable.*	118	100%	*Not applicable.*	118
LOAD ALLOCATIONS							
Agricultural Drainage			0.352	36	53.7%	0.189	19
Sediment Flux	Wetland Habitats		*Not applicable.*	66	53.7%	*Not applicable.*	35
Tributary Inputs	Sacramento River		0.103	2,026	53.7%	0.055	1,088
	Morrison Creek		0.102	8.1	53.7%	0.055	4.3
Urban (nonpoint source)			0.241	0.64	53.7%	0.129	0.34
WASTELOAD ALLOCATIONS							
MS4	City of West Sacramento	CAS000004	0.241	0.62	53.7%	0.129	0.33
	County of San Joaquin	CAS000004	0.241	0.19	53.7%	0.129	0.10
	County of Solano	CAS000004	0.241	0.074	53.7%	0.129	0.040
	County of Yolo	CAS000004	0.241	0.073	53.7%	0.129	0.039
	Sacramento Area MS4	CAS082597	0.241	3.0	53.7%	0.129	1.6
Facilities	City of Rio Vista WWTP	CA0079588	0.164	0.11	53.7%	0.088	0.06
	City of Rio Vista Trilogy WWTP	CA0083771	tbd	tbd	tbd	tbd	tbd
	Sacramento Regional CSD Walnut Grove WWTP	CA0078794	1.689	0.19	53.7%	0.907	0.10
	Sacramento Regional CSD Combined WWTP (c)	CA0079111	0.241	0.43	53.7%	0.129	0.23
	Sacramento Regional CSD Sacramento River WWTP	CA0077682	0.727	157	53.7%	0.390	84
	City of West Sacramento WWTP	CA0079171	0.051	0.40	100%	0.051	[0.40]
SACRAMENTO RIVER SUBAREA TOTAL:			**0.108**	**2,418**	**56%**	**0.060**	**1,354**

(a) Existing concentrations were rounded to three decimal places, and existing loads were rounded to two significant digits, before calculating acceptable concentrations and loads. Acceptable concentrations are provided to three decimal places for ease of verifying calculations. However, staff recommends that they be rounded to two decimal places to evaluate compliance.

(b) No load allocations are needed for sources with existing average discharge methylmercury concentrations at or below the implementation goal (e.g., City of West Sacramento WWTP) because the discharges act as dilution. However, the loads for such discharges are listed in brackets ("[ ]") in this table to enable the calculation of the percent allocations required for other sources to ultimately meet the implementation goal in ambient waters given current conditions. "Percent allocations" listed for these sources may be greater than for other sources because staff recommends that sources with existing average concentrations less the implementation goal maintain their existing concentration during the first phase of the implementation program.

(c) Because the City of Sacramento Combined Sewer System (CSS) discharges predominantly urban storm runoff with some domestic and industrial wastewater, and no methylmercury data are available for CSS discharges, the wet weather methylmercury concentration (0.24 ng/l) used to calculate storm runoff loads in Section 6.2.5 was used to develop a preliminary load estimate for the CSS. The CSS effluent methylmercury load will be re-calculated using data provided by 13267 monitoring reports once they are submitted.

Table 8.3e: Allocations for Methylmercury Sources to the San Joaquin River Subarea (a)

MeHg Sources	Tributary or Permittee	Permit #	Existing Average Annual MeHg Conc. (ng/l)	Existing Average Annual MeHg Load (g/yr)	Percent Allocation	Acceptable MeHg Conc. (g/yr)	Acceptable MeHg Load (g/yr) (b)
BACKGROUND							
Atmospheric Deposition			*Not applicable.*	0.41	100%	*Not applicable.*	0.41
Sediment Flux	Open Water Habitats		*Not applicable.*	20	100%	*Not applicable.*	20
LOAD ALLOCATIONS							
Agricultural Drainage			0.352	23	17.8%	0.063	4.1
Sediment Flux	Wetland Habitats		*Not applicable.*	18	17.8%	*Not applicable.*	3
Tributary Inputs	San Joaquin River		0.160	356	37.5%	0.060	134
	French Camp Slough		0.142	11	42.3%	0.060	4.6
Urban (nps)			0.241	0.0022	24.9%	0.060	[0.00055]
WASTELOAD ALLOCATIONS							
MS4	City of Lathrop	CAS000004	0.241	0.27	24.9%	0.060	[0.07]
	City of Tracy	CAS000004	0.241	1.8	24.9%	0.060	[0.45]
	County of San Joaquin	CAS000004	0.241	2.6	24.9%	0.060	[0.65]
	Port of Stockton MS4	CAS084077	0.241	0.0096	24.9%	0.060	[0.0024]
	Stockton Area MS4	CAS083470	0.241	0.50	24.9%	0.060	[0.12]
Facilities	Manteca Aggregate Sand Plant	CA0082783	0.032	0.40	98.4%	0.032	[0.39]
	Deuel Vocational Inst. WWTP	CA0078093	0.020	0.013	100.0%	0.020	[0.013]
	City of Manteca WWTP	CA0081558	0.216	1.4	27.8%	0.060	[0.39]
	Mountain House CSD WWTP	CA0084271			*To be determined.*		
	City of Stockton WWTP	CA0079138	0.936	36	17.8%	0.167	6.4
	City of Tracy WWTP	CA0079154	0.146	1.9	41.1%	0.060	[0.8]
SAN JOAQUIN RIVER SUBAREA TOTAL:			**0.160**	**473**	**37%**	**0.060**	**175**

(d) Existing concentrations were rounded to three decimal places, and existing loads were rounded to two significant digits, before calculating acceptable concentrations and loads. Acceptable concentrations are provided to three decimal places for ease of verifying calculations. However, staff recommends that they be rounded to two decimal places to evaluate compliance.

(e) No load allocations are needed for sources with existing (e.g., Deuel Vocational Institute WWTP) or allocated (e.g., City of Manteca WWTP) discharge methylmercury concentrations at or below the implementation goal because the discharges act as dilution. However, the loads for such discharges are listed in brackets (“[ ]”) in this table to enable the calculation of the percent allocations required for other sources to ultimately meet the implementation goal in ambient waters given current conditions. “Percent allocations” listed for these sources may be greater than for other sources because staff recommends that sources with existing average concentrations less the implementation goal maintain their existing concentration, and that no source discharge be required to reduce its discharge methylmercury concentrations to less than 0.06 ng/l during the first phase of the implementation program.

Table 8.3f: Allocations for Methylmercury Sources to the West Delta Subarea (a, b)

MeHg Sources	Tributary or Permittee	Permit #	Existing Average Annual MeHg Conc. (ng/l)	Existing Average Annual MeHg Load (g/yr)	Percent Allocation	Acceptable MeHg Conc. (g/yr)	Acceptable MeHg Load (g/yr)
BACKGROUND							
Atmospheric Deposition			*Not applicable.*	2.3	100%	*Not applicable.*	2.3
Sediment Flux	Open Water Habitats		*Not applicable.*	190	100%	*Not applicable.*	190
LOAD ALLOCATIONS							
Agricultural Drainage			0.352	4.1	100%	0.352	4.1
Sediment Flux	Wetland Habitats		*Not applicable.*	121	100%	*Not applicable.*	121
Urban (nps)			0.241	0.024	100%	0.241	0.024
WASTELOAD ALLOCATIONS							
MS4	County of Contra Costa	CAS083313	0.241	3.3	100%	0.241	3.3
WEST DELTA SUBAREA TOTAL:			**0.083** (a)	**128**	**100%**	**0.060** (a)	**128**

(a) Ambient methylmercury concentrations in the West Delta subarea approach the proposed aqueous methylmercury goal of 0.06 ng/l, resulting in the need for only modest reductions (28%) in methylmercury sources. The primary source of methylmercury in the West Delta subarea is sediment flux from open channel habitats, for which there is no responsible party yet identified. In addition, it is expected that, should the proposed reductions take place in sources to the upstream Delta subareas, the proposed aqueous goal will be met in the West Delta subarea. For example, the Sacramento subarea – the largest source of water to the West Delta subarea – requires a source reduction of 44%. Therefore, this TMDL proposes no net increase in methylmercury loading to the West Delta.

(b) Existing concentrations were rounded to three decimal places, and existing loads were rounded to two significant digits, before calculating acceptable concentrations and loads. Acceptable concentrations are provided to three decimal places for ease of verifying calculations. However, staff recommends that they be rounded to two decimal places to evaluate compliance.

Table 8.3g: Allocations for Methylmercury Sources to the Yolo Bypass Subarea (a)

MeHg Sources	Tributary or Permittee	Permit #	Existing Average Annual MeHg Conc. (ng/l)	Existing Average Annual MeHg Load (g/yr)	Percent Allocation	Acceptable MeHg Conc. (g/yr)	Acceptable MeHg Load (g/yr) (b)
BACKGROUND							
Atmospheric Deposition			*Not applicable.*	1.1	100%	*Not applicable.*	1.1
Sediment Flux	Open Water Habitats		*Not applicable.*	86	100%	*Not applicable.*	86
LOAD ALLOCATIONS							
Agricultural Drainage			0.352	19	17.0%	0.060	3.2
Sediment Flux	Wetland Habitats		*Not applicable.*	415	14.9%	*Not applicable.*	62
Tributary Inputs	Prospect Slough		0.424	537	14.9%	0.063	80
	Ulatis Creek (a)		0.240	8.9	25.0%	0.060	2.2
WASTELOAD ALLOCATIONS							
MS4	County of Solano	CAS000004	0.241	0.085	24.9%	0.060	0.021
	County of Yolo	CAS000004	0.241	0.12	24.9%	0.060	0.030
	City of West Sacramento	CAS000004	0.241	1.1	24.9%	0.060	0.27
YOLO BYPASS [North & South] SUBAREA TOTAL:			**0.273**	**1,068**	**22%**	**0.060**	**235**

(a) Existing concentrations were rounded to three decimal places, and existing loads were rounded to two significant digits, before calculating acceptable concentrations and loads. Acceptable concentrations are provided to three decimal places for ease of verifying calculations. However, staff recommends that they be rounded to two decimal places to evaluate compliance.

(b) No load allocations are needed for sources with allocated average discharge methylmercury concentrations at or below the implementation goal (e.g., City of West Sacramento) because the discharges act as dilution. However, the loads for such discharges are listed in brackets ("[ ]") in this table to enable the calculation of the percent allocations required for other sources to ultimately meet the implementation goal in ambient waters given current conditions. "Percent allocations" listed for these sources may be greater than for other sources because staff recommends that no source discharge be required to reduce its discharge methylmercury concentrations to less than 0.06 ng/l during the first phase of the implementation program.

8.2 Total Mercury Limits

Total mercury limits were developed for three reasons: (1) to maintain compliance with the USEPA's criterion of 50 ng/l for total mercury in the water column; (2) to prevent increases in total mercury discharges from causing increases in aqueous and fish methylmercury in the Delta, thereby worsening the impairment; and (3) to meet the San Francisco Bay TMDL allocation to the Central Valley. The TMDL for San Francisco Bay assigned the Central Valley a five-year average total mercury load allocation of 330 kg/yr or a decrease of 110 kg/yr (Section 2.4.2.3). A reduction of 110 kg/yr represents about a 28% decrease in the 20-year average annual loading[48] from Delta tributaries (Table 7.1). As described in Chapter 4 of the Proposed Basin Plan Amendment draft staff report, staff recommends that the 110 kg total mercury reduction be met by reductions in total mercury entering the Delta from the Sacramento Basin (Table 8.4). The reductions should occur in the Cache Creek, Feather River, American River and Putah Creek watersheds because these watersheds export the largest volume of highly contaminated sediment (Tables 7.5 and 7.17). Staff recommends that the proposed total mercury reductions for the Sacramento Basin tributaries be based on WY1984-2003 average annual loads. This 20-year period includes a mix of wet and dry years that is statistically similar to what has occurred in the Sacramento Basin over the last 100 years. The proposed reductions will enable Delta waters to maintain compliance with the CTR criterion of 50 ng/l (Section 7.4).

The Cache Creek Settling Basin is a 3,600-acre structure located at the base of the Cache Creek watershed.[49] The U.S. Army Corp of Engineers initially constructed the Settling Basin in 1937 to contain sediment and maintain the flood capacity of the Yolo Bypass. The CCSB was modified in 1993 to increase its sediment trapping efficiency. However, no provision was made for removing the additional trapped material. Most of the mercury in Cache Creek is transported on sediment. Therefore, an increase in sediment trapping also results in deposition and retention of mercury. The CCSB currently traps about 50% of the sediment and mercury transported by Cache Creek (Foe and Croyle, 1998; CDM, 2004; Cooke *et al.*, 2004). The rest is exported to the Delta through the Yolo Bypass. On average, the basin receives about 250 kg/yr from the Cache Creek watershed and discharges about 125 kg/yr to the Yolo Bypass. The sediment/mercury trapping efficiency of the Settling Basin is expected to decrease as the Basin fills and may reach zero in about 40 years unless a maintenance program is instituted to periodically remove material (CDM, 2004). A non-operational Settling Basin would result in a mercury discharge to the Yolo Bypass and Delta of about 250 kg/yr, an addition of 125 kg/yr mercury loading (Table 7.6b in the TMDL Report).

Staff recommends that total mercury loading from the Cache Creek Settling Basin be reduced by 72 kg/yr, resulting in an acceptable load to the Yolo Bypass and Delta of 53 kg/yr. This reduction is approximately 65% of the 110-kg/yr reduction required by the San Francisco Bay mercury TMDL. Two sets of actions are considered in the Proposed Basin Plan Amendment draft staff report (Chapter 4) for the Cache Creek Settling Basin to ensure that mercury loads to the Delta decrease. First, mercury loads entering the Basin from the Cache Creek watershed could be reduced. The Basin Plan Amendment for control of mercury in Cache Creek was adopted by the Central Valley Water Board in October 2005. Implementation actions described in the Basin Plan Amendment report would reduce mercury loads entering the Cache Creek Settling Basin by about 60 kg/year (Cooke and Morris, 2005), from 250 to

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[48] Year-to-year loads are expected to fluctuate with water volume and other environmental factors.

[49] The Cache Creek Settling Basin is owned by local private landowners and the California Department of Water Resources.

Table 8.4: Total Mercury Load Limits for Sacramento Basin Tributaries

Tributary	Existing Annual TotHg Load [WY1984-2003] (a) (kg/yr)	TotHg Load Limit (b)	Acceptable TotHg Load (kg/yr)
Cache Creek	125	42%	53
American River	14	63%	66
Feather River	77		
Putah Creek	13		
TOTAL:	**229**	**48%**	**119**

(a) Existing annual TotHg loads represent the average annual loads estimated for WY1984-2003. This 20-year period includes a mix of wet and dry years that is statistically similar to what has occurred in the Sacramento Basin over the last 100 years. Annual loads are expected to fluctuate with water volume and other factors, but the limit as a percentage of a given load will not change as a function of these factors.

(b) These limits equate to a reduction of 110 kg/yr. Additional TotHg reductions may be recommended for the Delta's tributary watersheds in future phases of the Delta and tributary mercury control programs to address fish impairment in the Delta and/or upstream tributaries.

190 kg/yr. Approximately 25 kg of the 60 kg/year reduction in the Cache Creek watershed may come from instituting control programs at all major mercury mines in the watershed.[50] The remainder of the reduction will be achieved by control of erosion in mercury-enriched areas and by remediation/removal of contaminated floodplain sediment in the Cache Creek canyon and in Bear Creek. However, most the total mercury load now leaving the CCSB appears to originate from erosion of mercury contaminated sediment in the active flood plain downstream of the mines. Studies are required by the Cache Creek mercury control program to evaluate in-stream sediment control options. It is unclear whether environmentally acceptable, cost effective control programs can be developed to significantly curtail the movement of this material. As result, a second set of actions could focus on decreasing the mercury load leaving the CCSB. A program should be instituted to (a) periodically excavate the material presently accumulating in the basin, and (b) make additional modifications to the Basin to increase trapping efficiency. Initial modeling results indicate that Basin operation and design could be modified to remove up to an additional 55 kg/yr (CDM, 2004, Table 4-3, Alternative 5 - Excavate and Raise Weir Early), improving the trapping efficiency of the CCSB from 50% to 72%. Decreasing mercury inputs to the CCSB to 190 kg/yr through the watershed control program and increasing the trapping efficiency of the CCSB to 72% results in an export to the Yolo Bypass of 53 kg/yr, which represents a decrease of 72 kg/yr from current loading. Additional studies are underway to evaluate improvement options and costs.

The remaining 38 kg/yr reduction required to achieve a 110 kg/yr reduction in Central Valley total mercury loading is assigned to the sum of the mercury loads (104 kg/yr, Table 8.4) leaving the Feather River, American River and Putah Creek watersheds. This results in a reduction of 37% and an acceptable load of 64 kg/yr leaving these three watersheds. Monitoring is underway to identify sources of methyl and total mercury in these and the other Sacramento Basin tributary watersheds. Specific limits for the Feather River, American River and Putah Creek watersheds are not defined in Table 8.4 to allow for greater flexibility in developing future implementation strategies. However, the sum of the load reductions for these basins and Cache Creek Settling Basin must equal 110 kg/yr. Each of these watersheds contains waterways already identified on the CWQA Section 303(d) List as impaired by

[50] The mines are located in Harley Gulch, Sulfur and Bear Creeks and Clear Lake.

mercury. Hence, each will be the focus of future watershed-specific TMDL programs. Actual load reductions for each watershed will be specified in its TMDL report.

A 110 kg reduction in total mercury from the Sacramento Basin is a reasonable goal for the first phase of the Delta mercury control program. For example, Feather River and Cache Creek Settling Basin outflows have average methylmercury concentrations of 0.098 and 0.558 ng/l, respectively (see Appendix N for a summary of available methylmercury concentration data). If Feather River and Cache Creek Settling Basin outflows needed to meet the proposed implementation goal for the Delta of 0.06 ng/l to enable achievement of the aqueous methylmercury goal in the Sacramento River and Yolo Bypass inputs to the Delta, they would require methylmercury load reductions of 39% and 89%, respectively. If the proposed source characterization and control studies find no means to reduce aqueous methylmercury by methods other than total mercury reduction, than the total mercury exports from the Feather River (77 kg/yr) and CCSB (125 kg) may require reductions of a similar magnitude. A 39% reduction of Feather River watershed total mercury outflows is about 30 kg/yr, and an 89% reduction of CCSB exports is about 110 kg/yr, totaling about 140 kg/yr.

Anticipated population growth and regional hydrologic changes that may result from global climate changes could result in increases in total mercury loading. As described in Sections 2.2.1 and 8.4.3.1, rapid growth is occurring in urban areas in and surrounding the Delta. There are numerous NPDES-permitted facilities and MS4s that discharge mercury to the Delta and its tributary watersheds. These discharges are expected to increase with increased population growth. In addition, changes to reservoir and flood control operations could result in changes in mercury loading to the Delta. As described in Chapter 4 of the Proposed Basin Plan Amendment draft staff report, staff recommends that total mercury loading to the Delta not increase as a result of new or expanded projects, and that any increase in total mercury loading be mitigated or in compliance with an offset program.

There is a need for a mercury control program that is consistent in addressing NPDES permits within and adjacent to the Delta. For example, applying different regulations to a given MS4 service area split by the legal Delta boundary would be ineffective and difficult to implement. Therefore, it may be more efficient to implement controls on both within-Delta and upstream sources as part of the Delta implementation plan, to the extent justified by available information. The alternatives analysis in Chapter 4 of the Proposed Basin Plan Amendment draft staff report identified a scope that includes NPDES permits downstream of major dams[51] as the preferred option because: (a) dams on the major tributaries act as constraints on water volumes and total mercury loading from the upper watersheds; and (b) total mercury discharges in the tributaries are expected to eventually be transported to the Delta.

Power, heating/cooling and aquaculture facilities, which account for about 50% of the volume discharged by facilities to the Delta source region, do not appear to add measurable amounts of total mercury to the water that they withdraw from Delta waterways (see Section 7.1.2 and Appendix G). This consideration will be re-evaluated as additional information becomes available. In addition, facilities that discharge greater than 1 mgd account for about 97% of the volume discharged by facilities to the Delta source region. Therefore, total mercury limits do not apply to power, heating/cooling and aquaculture facilities

[51] Major reservoirs and lakes in the Sacramento Basin include Shasta, Whiskeytown, Oroville, Englebright, Camp Far West, Folsom/Natoma, and Black Butte, Indian Valley, Clear Lake and Lake Berryessa. Major reservoirs and lakes in the San Joaquin Basin include Camanche, New Hogan, New Melones/Tulloch, Don Pedro, McClure, Burns, Owens, Eastman, Hensley, Millerton and Marsh Creek.

or to facilities that discharge less than 1 mgd. Staff recommends that the annual load of total mercury from all NPDES facilities that discharge greater than 1 mgd in the Delta and its tributary watersheds downstream of major dams be capped at their 2008 loading rate; a mercury offset program is anticipated for Central Valley Water Board consideration in 2009.

Staff recommends that the annual load of total mercury from all MS4 service areas in the Delta and its tributary watersheds downstream of major dams be capped at their 2014 loading rate, a delayed cap to allow adequate time to conduct total mercury characterization and control studies.

Tables 8.5 and 8.6 list the permitted facilities and MS4s within the Delta and its tributary watersheds downstream of major dams for which the total mercury limits would apply. The Central Valley Water Board will evaluate several alternatives to ultimately determine the scope of the Delta mercury control program.

8.3 Margin of Safety

Implicit and explicit margins of safety are included in the aqueous methylmercury goal for the Delta. In addition, while not a direct margin of safety, the implementation plan (Chapter 4 in the Proposed Basin Plan Amendment draft staff report) calls for updated fish advisories in the Delta and an expanded outreach program to educate humans fishing in the Delta.

The proposed aqueous methylmercury goal of 0.06 ng/l (Chapter 5) incorporates an explicit margin of safety of approximately 10%. The linkage analysis (Section 5.2) predicted a safe level of 0.066 ng/l for average aqueous methylmercury, from which 0.006 was subtracted to provide a margin of safety.

In addition, there is an implicit margin of safety for wildlife species that consume Delta fish. As outlined in the previous paragraph, the aqueous methylmercury goal corresponds to 0.24 mg/kg mercury in large TL4 fish, which was calculated for the protection of humans consuming about one meal per week. As shown in Table 4.9 (Chapter 4), the wildlife targets for smaller and lower trophic level fish correspond to large TL4 fish mercury levels that range from 0.30 mg/kg (for Western grebe) to 1.12 mg/kg (for Western snowy plover). These values correspond to 350-mm largemouth bass mercury levels of 0.31 and 1.34 mg/kg. When entered into the regression equation for largemouth bass and unfiltered average aqueous methylmercury (Figure 5.2[A]), these values translate to aqueous methylmercury concentrations of 0.08 ng/l and 0.19 ng/l, allowing a margin of safety of 25% or more, depending on the wildlife species.

Table 8.5: NPDES Permitted Facilities in the Delta and its Tributary Watersheds Downstream of Major Dams for Which 2008 Total Mercury Load Limits Are Recommended

Facility (NPDES No.)	**Facility (NPDES No.)**
Facilities within the Delta	
Brentwood WWTP (CA0082660) Discovery Bay WWTP (CA0078590) Lodi White Slough WWTP (CA0079243) Manteca Aggregate Sand Plant (CA0082783) Manteca WWTP (CA0081558) Mountain House CSD WWTP (CA0084271)	Sacramento Combined WWTP (CA0079111) SRCSD Sacramento River WWTP (CA0077682) Stockton WWTP (CA0079138) Tracy WWTP (CA0079154) West Sacramento WWTP (CA0079171)
Facilities in the Tributary Watersheds Downstream of Major Dams	
Aerojet Interim Groundwater Treatment Plant (CA0083861) Anderson WPCP (CA0077704) Atwater WWTF (CA0079197) Auburn WWTP (CA0077712) Boeing Company Interim Treatment System (CA0084891) Chico Regional WWTF (CA0079081) Corning Industries/ Domestic WWTF (CA0004995) Davis WTP (CA0079049) Defense Logistics Agency Sharpe Groundwater Cleanup (CA0081931) El Dorado Irrigation District Deer Creek WWTP (CA0078662) El Dorado Irrigation District El Dorado Hills WWTP (CA0078671) Galt WWTP (CA0081434) General Electric Co. GWCS (CA0081833) Hershey Chocolate USA, Oakdale (CA0004146) J.F. Shea Co Fawndale Rock and Asphalt (CA0083097) Lincoln WWTP (CA0084476) Linda Co Water Dist WPCP (CA0079651)	Live Oak (CA0079022) Merced WWTF (CA0079219) Modesto WQCF (CA0079103) Olivehurst PUD WWTP (CA0077836) Oroville WWTP (CA0079235) Pactiv Molded Pulp Mill (CA0004821) Placer Co. SMD #1 WWTP (CA0079316) Proctor & Gamble Co. WWTP (CA0004316) Red Bluff WWRP (CA0078891) Redding Clear Creek WWTP (CA0079731) Redding Stillwater WWTP (CA0082589) Roseville Dry Creek WTP (CA0079502) Roseville Pleasant Grove WTP (CA0084573) Turlock WWTP (CA0078948) University of California, Davis WTP (CA0077895) U.S. Air Force McClellan Air Force Base Groundwater Extraction & Treatment System (CA0081850) Vacaville Easterly Sewage Plant (CA0077691) Woodland WWTP (CA0077950) Yuba City WW Reclamation Plant (CA0079260)

Table 8.6: MS4s in the Delta and its Tributary Watersheds Downstream of Major Dams for Which 2014 Total Mercury Load Limits Are Recommended (a)

MS4 (NPDES No.)	Phase	MS4 (NPDES No.)	Phase
MS4s within the Delta			
Contra Costa (County of) (CAS083313)	I	San Joaquin (County of) (CAS000004)	II
Lathrop (City of) (CAS000004)	I	Solano (County of) (CAS000004)	II
Lodi (City of) (CAS000004)	II	Stockton Area MS4 (CAS083470)	I
Port of Stockton MS4 (CAS084077)	I	Tracy (City of) (CAS000004)	II
Rio Vista (City of) (CAS000004)	II	West Sacramento (City of) (CAS000004)	II
Sacramento Area MS4 (CAS082597)	I	Yolo (County of) (CAS000004)	II
MS4s in the Tributary Watersheds Downstream of Major Dams			
Butte (County of) (CAS000004)	II	Ripon (City of) (CAS000004)	II
Ceres (City of) (CAS000004)	II	Riverbank (City of) (CAS000004)	II
Chico (City of) (CAS000004)	II	Rocklin (City of) (CAS000004)	II
Contra Costa (County of) (CAS083313)	I	Roseville (City of) (CAS000004)	II
Dixon (City of) (CAS000004)	II	Sacramento Area MS4 (CAS082597)	I
Hughson (City of) (CAS000004)	II	San Joaquin (County of) (CAS000004)	II
Lathrop (City of) (CAS000004)	II	Solano (County of) (CAS000004)	II
Lincoln (City of) (CAS000004)	II	Stanislaus (County of) (CAS000004)	II
Lodi (City of) (CAS000004)	II	Stockton Area MS4 (CAS083470)	I
Loomis (City of) (CAS000004)	II	Sutter (County of) (CAS000004)	II
Manteca (City of) (CAS000004)	II	Tracy (City of) (CAS000004)	II
Marysville (City of) (CAS000004)	II	Turlock (City of) (CAS000004)	II
Modesto (City of) (CAS083526)	I	Vacaville (City of) (CAS000004)	II
Oakdale (City of) (CAS000004)	II	West Sacramento (City of) (CAS000004)	II
Patterson (City of) (CAS000004)	II	Yolo (County of) (CAS000004)	II
Port of Stockton MS4 (CAS084077)	I	Yuba City (City of) (CAS000004)	II

(a) Including Caltrans Statewide permit #CAS000003.

8.4 Seasonal & Inter-annual Variability

8.4.1 Variability in Aqueous Methyl and Total Mercury

Mercury loads in Delta tributary inputs fluctuate because of seasonal and inter-annual variation. Winter precipitation increases the sediment and total mercury loads entering the Delta through erosion and resuspension of sediment. Most of the total mercury coming from tributaries and direct surface runoff enters the Delta during high flow events. In contrast, methylmercury production is typically higher during the summer months. In addition, greater mercury loads enter the Delta during wet water years.

Seasonal and inter-annual variability in methylmercury loads were accounted for in the source analysis and methylmercury load allocations by evaluating annual average loads for Delta sources and losses for WY2000 to 2003, a relatively dry period that encompasses the available concentration data for the major Delta inputs and exports. Twenty-year average, annual loads of total mercury were estimated for tributary loads based on flow and precipitation records for WY1984-2003. This 20-year period includes a mix of wet and dry years that is statistically similar to what has occurred in the Sacramento Basin over the last 100 years. However, insufficient data were available to estimate 20-year average annual loads for methylmercury sources. Methylmercury allocations and total mercury limits will be re-evaluated as additional information becomes available. Future monitoring programs will accommodate long-term inter-annual variability by evaluating whether sources are meeting allocations on a multi-year basis.

8.4.2 Variability in Biota Mercury

Seasonal and inter-annual variation also occurs in biota. Slotton and others (2003) found that Delta species exhibited both seasonal and inter-annual variability in mercury body burden. Corbicula (clams) had higher mercury concentrations in the spring while inland silversides (representative forage fish species) were higher in fall. In addition, silverside bioaccumulation was greater in 1998 than in 1999 and 2000 at many locations in the Delta. Davis and others (2002) measured higher mercury concentrations in similar sized largemouth bass in 1999 than in 2000. The researchers noted that the winter of 1997 was very wet and speculated that the high flows may have introduced significant quantities of "new" mercury that was methylated and incorporated into forage fish in 1998. Predacious fish like largemouth bass, which feed upon silversides, took an additional year to reflect the higher methylmercury concentrations.

Seasonal and inter-annual variability in large fish was accounted for in the numeric targets and linkage analysis by using data collected over multiple years. Future monitoring will accommodate seasonal and inter-annual variability by sampling large fish about every five years.

8.4.3 Regional and Global Change

Several ongoing regional and global changes may affect methyl and total mercury loading in the Delta. This section identifies several of these.

8.4.3.1 Population Growth

The Delta and its tributary Sacramento and San Joaquin watersheds are experiencing substantial population growth. Populations in both basins increased by about 18% between 1990 and 2000 (AFT, 2004; CDOF, 2004). This resulted in the conversion of about 55,000 acres of agricultural land to urban uses (AFT, 2004). Four of the five fastest growing cities in the Sacramento Valley are located within about one day's travel time (about 20 to 30 miles by water) of the Delta. The California Department of Finance predicts that populations in the Delta and immediately adjoining counties will increase 130 to 200% by 2050 (CDOF, 2004).

Urbanization increases both volume and discharge velocity of runoff because of the increase in impervious surfaces. In addition, urbanization tends to increase pollutant loading because impervious surfaces neither absorb water nor remove pollutants, and urban development tends to create new anthropogenic mercury pollution sources. As Chapter 7 indicates, urban runoff in the Sacramento, Stockton and Tracy areas has higher total mercury concentrations than ambient river concentrations. However, little is known about how the conversion of agricultural land to urban uses affects methylmercury concentration. Chapter 4 in the Proposed Basin Plan Amendment draft staff report reviews possible implementation strategies to address the methylmercury allocations and total mercury limits for urban areas in the Delta region.

8.4.3.2 Restoration of Wetlands

Research conducted in the Delta and elsewhere has found that wetlands are efficient sites for methylmercury production. The Record of Decision for the CALFED Bay-Delta Program commits it to restore about 40,000 acres of seasonal and permanent wetlands in the Delta during the next 30 years (CALFED Bay-Delta Program, 2000c). Methylmercury production estimates from experimental marshes and open water habitat in the Delta suggest that this amount of new wetland may result in about a 50% increase in methylmercury loading from sediment during low flow periods (Heim *et al.*, 2004). Mass balance calculations indicated that sediment flux during this time may account for approximately 1,149 g/year of MeHg (Table 6.2 and 6.4 and Figure 6.11), or about 23% of the total methylmercury budget for the Delta (4,922 g/yr; Table 6.2). A 50% increase in methylmercury from sediment would increase overall Delta loading by about 12%. The linkage relationship suggests that a 12% increase in aqueous methylmercury loads could result in up to a 20% increase in mercury concentrations in standard 350-mm largemouth bass (Figure 5.3). Chapter 4 in the Proposed Basin Plan Amendment draft staff report provides a description of staff's suggested Central Valley Water Board policy for new wetland creation.

8.4.3.3 Decreasing Sediment Loads

The sediment load in the Sacramento River decreased by about 50% between 1957 and 2001 (Wright & Schoellhamer, 2004). The decrease is believed to be caused by the trapping of sediment in reservoirs, a decrease in erodable material from hydraulic mining, changes in land use, and construction of levees (Wright & Schoellhamer, 2004; James, 2004). Mercury loads are likely to have also decreased during the same time period as much of the inorganic mercury is transported on sediment particles. It is not known what the magnitude of the decrease in mercury loading has been and whether it will continue in the future. The decrease in sediment loading suggests that the relative proportion of erodable material from upstream watersheds may also be changing. The present 20-year volume-weighted average mercury to TSS ratio of sediment entering the Delta is approximately 0.18 mg/kg. This value may change depending on the new sources of sediment. The mercury content of surficial sediment is important, as it is one of the major factors controlling methylmercury production. Methylmercury production in Delta sediment now accounts for about 30% of the methylmercury in the Delta (Figure 6.11). It is not clear how this proportion may change in the future.

8.4.3.4 Climate Change

Recent studies indicate that global warming may disrupt traditional weather and run-off patterns and increase the frequency and severity of summer droughts and springtime flooding (Brekke *et al.*, 2004; Knowles and Cayan, 2002; Miller *et al.*, 2003; Service, 2004; Stewart *et al.*, 2004). Trends over the last 50 years indicate that more precipitation in the Sierra Nevada Mountains is occurring as rain, and that snow is melting earlier in the spring, resulting in a reduced snow pack and less water in reservoirs in the summer and fall. Climate models suggest that these trends may become more pronounced with continued warming. The net result may have unpredictable consequences on ecological processes in the Delta including the synthesis and bioaccumulation of methylmercury. The source analyses, linkage analysis, methylmercury allocations and total mercury limits described in this TMDL are based on present climate. Staff will re-evaluate linkage relationships associated with changing environmental conditions as more information becomes available in the future.

Key points and options to consider are summarized on the following two pages.

Key Points

- Methylmercury allocations are divided among "wasteload allocations" for point sources and "load allocations" for nonpoint sources. The TMDL is the sum of these components. The allocation strategies described in this report are an initial proposal to address the beneficial use impairment in all subareas of the Delta. Total mercury limits were developed to maintain compliance with the USEPA's CTR for total mercury in the water column and to achieve the San Francisco Bay mercury control program's total mercury allocation for the Central Valley.

Methylmercury:

- Methylmercury allocations were made in terms of the existing assimilative capacity of the different Delta subareas. The recommended goal for ambient water is an average annual concentration of 0.06 ng/l methylmercury in unfiltered water (Chapter 5). This goal describes the assimilative capacity of Delta waters in terms of concentration and encompasses a margin of safety of approximately 10%. Central Valley Water Board staff anticipates that as the average concentration of methylmercury in each Delta subarea decreases to the safe aqueous goal, the targets for fish tissue will be attained.
- To determine necessary reductions, the existing average aqueous methylmercury levels in ambient water in the Delta subareas were compared to the methylmercury goal. The amount of reduction needed in each subarea is expressed as a percent of the existing concentration. Percent reductions required to meet the goal ranged from 0% in the Central Delta subarea to more than 70% in the Yolo Bypass and Mokelumne River subareas.
- Central Valley Water Board staff recommends that sources with existing or allocated average methylmercury concentrations at or below 0.06 ng/l be considered dilution and assigned no net increase in methylmercury concentration.

Total Mercury:

- Central Valley Water Board staff recommends that the 110 kg total mercury reduction allocated by the San Francisco Bay mercury control program to the Central Valley be met by reductions in total mercury entering the Delta from the Cache Creek, Feather River, American River and Putah Creek watersheds in the Sacramento Basin. These watersheds have both relatively large mercury loadings and high mercury to TSS ratios, which makes them likely candidates for load reduction programs. All other tributary watershed and within-Delta point sources were assigned no net increase in total mercury loading. Additional reductions may be recommended in future phases of the Delta mercury implementation program to meet the proposed methylmercury goal for ambient Delta waters.

Options to Consider

- The methylmercury allocations described in this chapter reflect the preferred implementation alternative described in Chapter 4 of the Proposed Basin Plan Amendment draft staff report and are designed to address the beneficial use impairment in all subareas of the Delta. However, as described in the draft Basin Plan Amendment report, a number of alternatives are possible. The Central Valley Water Board will consider a variety of allocation strategies and implementation alternatives as part of the Basin Plan amendment process.
- Likewise, a variety of total mercury reduction strategies are possible. A total mercury load reduction strategy was developed to comply with the San Francisco Bay mercury TMDL allocation for to the Central Valley and the USEPA's criterion for human health protection, and to help enable methylmercury reductions in Delta water and fish. Staff applied the San Francisco Bay TMDL's allocated reduction of 110 kg total mercury reduction to loads from the Cache Creek, Feather River, American River and Putah Creek watersheds because these watersheds export the largest volume of highly contaminated sediment while within-Delta sources comprise only a couple percent of total mercury inputs. An alternate strategy could be to apply equal percent reductions to all within-Delta and tributary source loads.
- Most sources of total mercury in the Delta and its tributary watersheds are not expected to increase in the future, except for sources related to population growth: industrial and municipal wastewater treatment plant and MS4 discharges. The strategy recommended in this report assigns total mercury limits to the NPDES facilities and MS4 service areas in the tributary watersheds downstream of major dams. Another approach could be to assign limits to those discharges in watersheds with TMDLs planned when TMDL development takes place, and to assign limits during Phase II of the proposed implementation plan (see Chapter 4 of the Proposed Basin Plan Amendment draft staff report) to those watersheds with no TMDLs currently planned. The Central Valley Water Board will consider a variety of strategies as part of the final Basin Plan amendment process.