GUADALUPE RIVER WATERSHED MERCURY TMDL PROJECT AGREEMENT NO. A2643G

TECHNICAL MEMORANDUM 4.1 DRAFT CONCEPTUAL MODEL REPORT

Prepared for Santa Clara Valley Water District 5750 Almaden Expressway San Jose, CA 95118-3614

Prepared by



October 2, 2003

TABLE OF CONTENTS

1.0	Intr	oduction	1-1
	1.1	Role of the Conceptual Model in the Development of the Mercury TMDL.	1-2
	1.2	Guide to the Conceptual Model – Report Organization	1-4
2.0	Wat	tershed Characterizations and Description of Mercury Sources	2-1
	2.1	Watershed Description and System Characteristics	2-1
	2.2	Description of Existing Mercury Data and Other Relevant Data	2-20
	2.2	Wetland Vegetation	2-36
3.0	Sum	nmary of the Synoptic Survey Results – An Initial Step in Conceptual Mode	el
	Dev	elopment	3-1
	3.1	Background Water Chemistry	3-1
	3.2	Elevated Mercury Levels	3-3
	3.3	Mercury Water Chemistry	3-4
	3.4	Almaden Lake	3-5
4.0	Con	ceptual Model of Mercury Behavior in the Guadalupe River Watershed	4-1
	4.1	Overview of Mercury Transport Processes	
	4.2	Overview of Mercury Transformation and Biological Uptake	4-2
	4.3	Mercury Behavior in Guadalupe River Watershed Reservoirs:	
		Knowns and Unknowns	4-6
	4.4	Mercury Behavior in Creeks: Knowns and Unknowns	
	4.5	Mercury Behavior in Guadalupe River: Knowns and Unknowns	
	4.6	Mercury Bioaccumulation and Numeric TMDL Targets	
5.0	Preliminary Source and Loading Estimates		5-1
	5.1	Dry Weather Estimates	
	5.2	Wet Weather Estimates	
	5.3	Annual Variability of Mercury Loads at the USGS Gauge Station	- 7
		at St. Johns Stroot San Jose	5.8

	5.4	Uncertainty	5-10
	5.5	Summary of Findings from Load Estimates	5-10
6.0	Sum	nmary and Strategy for Developing the Data Collection Plan	6-1
		Mercury Sources and Loading	
	6.2	Mercury Production, Fate and Transport Process	6-2
	6.3	Bioaccumulation	6-3
	6.4	Data Collection Plans	6-4
7.0	Refe	erences	

LIST OF TABLES

Table 2-1	Reservoir Capacity and Drainage Area of Reservoirs of Guadalupe River System
Table 2-2	Size of Subwatersheds in Guadalupe River Watershed2-7
Table 2-3	Past Sediment Removal Operations in Guadalupe River Watershed 2-13
Table 2-4	Production of Mercury from Major Mines in New Almaden Mining District2-16
Table 2-5	Acreage of Existing Land Uses for the Guadalupe River Watershed2-21
Table 2-6	Comparison of Dry and Wet Weather Water Samples for Mercury2-21
Table 2-7	Mercury Concentrations in Stream Water Samples Draining Almaden Quicksilver County Park2-24
Table 2-8	Existing Data on Mercury Concentrations in Sediment and Bank Soils in Guadalupe River Watershed2-24
Table 2-9	Sampling Locations and Rationale
Table 2-10	Summary of Fish Mercury Measurements from Guadalupe River Watershed2-35
Table 3-1	Mercury Species Concentrations
Table 4-1	Range of Total Mercury Concentrations4-8
Table 4-2	Range of Unfiltered Methylmercury Concentrations4-8

LIST OF FIGURES

Figure 2-1.	General topography of Guadalupe River watershed.	2-2
Figure 2-2.	Major waterbodies and subwatersheds of Guadalupe River system	2-3
Figure 2-3.	Schematic showing major flows in wet season along Guadalupe River system	2-9
Figure 2-4.	Schematic showing major flows during dry season along Guadalupe River system.	2-10
Figure 2-5.	Location of potential erosion site along the tributaries to	
	the Guadalupe River	2-11
Figure 2-6.	Example of sediment erosion and bank undercutting sites	2-12
Figure 2-7.	Map of major mine-related features.	2-15
Figure 2-8.	Location of exposed mine-wastes and seeps along the tributaries to	
	the Guadalupe River	2-17
Figure 2-9.	Example of calcine deposits and other mine wastes in	
	or near creeks	2-18
Figure 2-10	. Wet-weather sampling locations used in 2003 for Almaden Quicksilver County Park by SCPRD	2-22
Figure 2-11.	Schematic diagram of sampling locations. Numbers identify individual sampling stations, see Table 2-9	2-26
Figure 2-12.	.Total mercury in reservoirs a) deep water and b) shallow water	2-28
Figure 2-13	.Methylmercury in reservoirs a) deep water and b) shallow water	2-29

Figure 2-14.	.Total mercury in creek water samples	2-31
Figure 2-15.	.Methylmercury in creek water samples	2-32
Figure 2-16.	Examples of wetland vegetation	2-36
Figure 3-1.	Dissolved oxygen profiles in a) Almaden, b) Guadalupe, c) Calero, and d) Lexington Reservoirs	3-2
Figure 3-2a.	Concentrations of total methylmercury and total mercury in the four reservoir-stream systems	. 3-7
Figure 3-2b.	.Concentrations of dissolved methylmercury and total dissolved mercury in the four reservoir-stream systems.	3-8
Figure 3-2c.	Concentrations of alkalinity and pH in the four reservoir-stream systems	3-9
Figure 3-2d.	.Concentrations of dissolved oxygen and carbon dioxide in the four reservoir-stream systems	3-10
Figure 3-2e.	Concentrations of dissolved organic carbon and sulfate in the four reservoir-stream systems	3-11
Figure 3-2f.	Concentrations of total phosphorous and conductivity in the four reservoir-stream systems	3-12
Figure 3-2g.	. Water temperature and concentration of chloride in the four reservoir-stream systems	3-13
Figure 4-1.	Transport to reservoirs.	. 4-2
Figure 4-2.	Creek/river processes at high flow.	. 4-3
Figure 4-3.	Creek/river processes at low flow.	4- 3
Figure 4-4.	Accelerated weathering of mercury solids	. 4-4
Figure 4-5.	Mercury methylation reducing bacteria.	. 4-5
Figure 4-6.	Uptake of sulfate-methylmercury.	. 4-5
Figure 4-7.	Food chain biomagnification of methylmercury	. 4-6
Figure 4-8.	Hypothesized relationship between sediment mercury and methylmercury concentrations in water	4-1 2
Figure 4-9.	Dissolved methylmercury in creeks downstream of the reservoirs	4-16
Figure 4-10.	Flow and Hg on Guadalupe River downstream of confluence with Los Gatos Creek	4-18
Figure 4-11.	Example relationship between fish size (total length) and mercury concentration in muscle tissue.	4- 22
Figure 5-1	Daily summer loads and concentrations (July 28 - August 1, 2003)	5-4

Figure 5-2	Estimated daily loads and concentrations during a large winter storm	
	(December 15-16, 2002)	5-5
Figure 5-3	Histograms	5-9