

1.0 INTRODUCTION

The Conceptual Model for Mercury in the Guadalupe River Watershed describes our understanding of the biogeochemical processes controlling mercury transport and fate in the watershed. There are sufficient data available to support a strong scientific basis for this TMDL (Total Maximum Daily Loads) including the magnitude and location of sources, numeric targets, linkage from targets to sources, seasonal variations and critical conditions, and the implementation plan and monitoring plan.

The Final Conceptual Model Report completes a series of documents developed in Phase 1 of the TMDL for Mercury in the Guadalupe River Watershed (Tetra Tech, 2003a). The other documents in this series are:

- **Preliminary Problem Statement.** *Technical Memorandum 1.2 Preliminary Problem Statement* (Tetra Tech, 2003b) provides a preliminary description of the processes or factors that are most relevant to controlling mercury in the watershed. The Problem Statement describes the basis for listings of Guadalupe and Calero Reservoirs, Guadalupe River, and Guadalupe and Alamitos Creeks on the Mercury TMDL List.
- **Synoptic Survey.** *Technical Memorandum 2.1.2 Synoptic Survey Plan* (Tetra Tech, 2003c) and *Technical Memorandum 2.2 Synoptic Survey Report* (Tetra Tech, 2003d) describe the preliminary field sampling effort designed to provide an overview of mercury contamination in the watershed. This survey was conducted in July and August 2003, and the results have been incorporated into the development of the conceptual model.
- **Data Collection Plan.** Based on the draft conceptual model, the data collection plan identifies the minimum additional data needed to develop a defensible TMDL and Implementation Plan. *Technical Memorandum 5.2.3 Data Collection Plan* (Tetra Tech, 2004b) identifies data required to reduce uncertainty associated with key aspects of the TMDL, e.g., 1) the relative importance of individual processes to the transport and fate of mercury in the

watershed, 2) estimated magnitudes of mercury loads from different sources, and 3) the effectiveness of alternative control measures.

- **Data Collection Report.** The Data Collection Program was conducted in two parts: Part 1 Wet Season Sampling that was conducted primarily to assess the magnitude of mercury loading to the watershed during the wet season, and Part 2 Dry Season Sampling that was conducted to estimate methylmercury production in reservoirs and to measure bioaccumulation in fish within the watershed. *Technical Memorandum 5.3.2 Data Collection Report* (Tetra Tech, 2005a) presents the results of field and laboratory studies and provides loading estimates based on the most up-to-date information on mercury sources and transport processes in the watershed.

The development of conceptual models was one of the primary recommendations of the National Research Council (NRC) in its assessment of the scientific basis of the TMDL approach to Water Quality Management (NRC, 2001). Conceptual models provide an explicit description of our understanding of the relationships among important environmental variables. The use of conceptual models was recommended to describe the link between environmental stressors (as well as control actions) and environmental responses. The NRC recommendation for building conceptual models was also made with the recognition of the “inevitable limits on our conceptual understanding of these complex natural systems” and with the warning that the science behind water quality management must be utilized with an acknowledgement of uncertainties that exist.

1.1 ROLE OF THE CONCEPTUAL MODEL IN THE DEVELOPMENT OF THE GUADALUPE RIVER WATERSHED MERCURY TMDL

The conceptual model report provides a synthesis of existing information. Mercury sources, loadings, mercury inventories within the system, and tissue levels within biota are summarized. Water quality, physical data, and significant system characteristics are summarized to describe the variables that affect mercury behavior in the watershed. The existing data include historical data that have been collected over the past several decades as well as the results of the Synoptic Survey (Tetra Tech, 2003d) and Data Collection Program (Tetra Tech, 2005a), which provide an up-to-date overview of mercury contamination in the watershed.

The processes affecting mercury behavior in creeks, reservoirs, and river systems in general are identified, and their roles in individual waterbodies within the watershed are described. Emphasis is also placed on the importance of the hydrologic connectivity within the watershed. There are six waterbodies within the watershed that have been affected by past mercury mining (Almaden Reservoir, Calero Reservoir, Guadalupe Reservoir, Alamitos Creek, Guadalupe Creek, and Guadalupe River). It is believed that mercury concerns in these waterbodies can most efficiently be addressed by undertaking a single TMDL project that concurrently considers all mercury sources in the Watershed (RWQCB, 2003a). The Guadalupe River

Watershed Mercury TMDL is also viewed as the primary regulatory vehicle for reducing mercury loads to San Francisco Bay (RWQCB, 2003b).

This report makes extensive use of graphics to communicate the information that has been developed on the extent of mercury in the watershed (sources) and how mercury behaves (i.e., fate, transport, and bioaccumulation). Graphic tools have been prepared for effectively communicating the existing information to a wide audience of interested stakeholders. It is intended that the diagrams presented in this document can be used to facilitate the discussion of important issues and individual elements of the TMDL.

The *Final Conceptual Model Report* builds on a *Draft Conceptual Model Report* (Tetra Tech, 2004a) that summarized the historical data and the results of the Synoptic Survey. A product of the draft report was a series of hypotheses that were used as a guide for the development of the data collection program. With the completion of the Data Collection Program and the evaluation of the results (Tetra Tech, 2005), these hypotheses are revisited. This revision of the conceptual model considers all new data that were collected in the Data Collection Program and evaluates our ability to confirm or refute the original hypotheses. Emphasis is placed on identifying the remaining data gaps, alternative working hypotheses, and the effect of these data gaps on the development of the TMDL. Recommendations are made on how to proceed to reduce the remaining uncertainties.

1.2 GUIDE TO THE CONCEPTUAL MODEL – REPORT ORGANIZATION

In addition to this introduction, the Conceptual Model Report is organized into six chapters:

2.0 Watershed Characterization and Description of Mercury Sources

Much of the information presented in the Conceptual Model assumes a fundamental understanding of the watershed characteristics (topography, geology, meteorology, and hydrology) and historical mercury mining operations in the watershed. The reader familiar with this information may choose to skip this section. However, this section also provides a comparison of the data from mercury mines in the New Almaden Mining District to other mercury and gold mines in California.

3.0 Data Summary

The most recent mercury measurements in the watershed, including the results of the recently completed Data Collection Program (Tetra Tech, 2005a) are summarized in this section.

4.0 Estimated Mercury Loads

Mercury loads are assessed separately for the wet and dry season based on the knowledge that most mercury transport occurs during the wet season, and most methylmercury production occurs in the warm, dry season. Using historical

streamflow data from 1950 to 2001, annual total mercury loads for the Guadalupe River are also estimated.

5.0 Conceptual Model of Mercury Behavior in the Guadalupe River Watershed

The important processes affecting mercury behavior in creeks, reservoirs, and the Guadalupe River are summarized in a series of diagrams. The accompanying descriptions summarize the current understanding of mercury behavior in the watershed. These descriptions are summarized in a series of hypotheses that identify the essential information needed to develop a defensible TMDL and Implementation Plan.

6.0 Summary and Strategy for Developing the Data Collection Plan

The findings of the Conceptual Model Report are summarized, and the use of this information to develop the TMDL is discussed.

7.0 References

The references cited in all chapters of this report are presented at the end of the report in Chapter 7.0.