# CHAPTER 1.0 INTRODUCTION

The Central Valley, comprising the Sacramento and San Joaquin River watersheds, is a vital source of drinking water in California. Many Central Valley communities rely on water from the Sacramento and San Joaquin rivers or their tributaries. The Sacramento-San Joaquin Delta (hereafter referred to as the Delta) provides source water to more than 23 million people in the Southern California, Central Coast, and San Francisco Bay regions (CALFED Water Quality Program Plan, 2000). The tributaries of the Sacramento and San Joaquin rivers that originate in the Sierra Nevada Mountains generally have high quality water; however, as the tributaries flow into lower elevations, they are affected by urban, industrial, and agricultural land uses, natural processes, and a highly managed water supply system.

The Central Valley Drinking Water Policy Workgroup (CVDWPWG) is working with the Central Valley Regional Water Quality Control Board (Regional Board) to conduct the technical studies needed to develop a policy that will ensure reasonable protection to drinking water supplies in the Central Valley. The policy is initially focused on five categories of constituents: organic carbon, nutrients, salinity, bromide, and pathogens and indicator organisms. This conceptual model report is focused on nutrients. Typically, the elements nitrogen and phosphorus are referred to as nutrients for photosynthesis, although depending on the context, other elements may also be included (such as silicon and other trace elements). For the purpose of this report, when we refer to nutrients, we refer only to nitrogen and phosphorus.

Nutrients are vital to the functioning of aquatic ecosystems, and, in their absence, there can be no aquatic life. Aquatic systems, depending on location and type, can have a range of natural background nutrient levels, and it is difficult to define generally applicable standards for “acceptable” nutrient levels. It is generally understood, however, that elevation of nutrients above natural levels, can result in adverse impacts that are caused by increased productivity and discussed in more detail in the following chapter.

Nutrient levels in water bodies are important for drinking water supply for several reasons. The presence of nutrients in aquatic systems promotes primary productivity (through increased algal and macrophyte growth) which adds to the levels of dissolved and total organic carbon in water. Organic carbon in source waters is a constituent of drinking water concern, primarily due to the formation of carcinogenic byproducts during disinfection at water treatment facilities (discussed in greater detail in the organic carbon conceptual model report, prepared as part of this larger study; Tetra Tech, 2006). In addition to being a source of organic carbon, some species of algae are associated with compounds, such as geosmin and 2-methylisoborneol (MIB) that produce objectionable odors and tastes. Species of cyanobacteria (blue-green algae), produce toxins that may be harmful to humans. Recent algal blooms in the Delta have produced measurable levels of microcystin, the most common toxin produced by cyanobacteria. There are not currently any drinking water standards for these algae, but cyanobacteria, other freshwater algae, and their toxins are on EPA's Drinking Water Contaminant Candidate List (CCL) for consideration of regulation adoption.[1] The presence of algae in source waters may also decrease filtration efficiency by causing clogging of pores. Finally, the presence of nitrate and nitrite, components of total nitrogen, can exceed current drinking water standards (10 mg/l nitrate as nitrogen and 1 mg/l nitrite as nitrogen) in some of the waste streams that are discharged to surface waters. Although the toxicity associated with nitrate and nitrite is an important concern, it should be noted that these are very high concentrations for nitrogen in general, and many ecosystem-related impacts may occur at much lower nitrogen levels (1 to 10 mg/l) than the toxicity impacts.

This report presents a conceptual model of nitrogen and phosphorus, summarizing current knowledge of the sources, transformation processes, and transport of these elements in the waters of the Central Valley and Delta. The conceptual model is intended to form the basis for identifying data needed to better understand the sources of nutrients, the relationship between drinking water concerns and ecosystem concerns, and the ability to control nutrients in the Delta and its watersheds. Changes that may impact nutrient levels in the waters of the Central Valley include increases in developed land, population, and concomitant increases in wastewater and urban runoff discharges.

The contents of the chapters that follow are briefly summarized as follows:

- Chapter 2 presents a summary of the key processes associated with nutrient cycling in terrestrial and aquatic systems, and the relationship to organic matter production.

- Chapter 3 summarizes the information on nutrient-related parameters in the database developed by the Central Valley Drinking Water Policy Workgroup. Spatial and temporal trends in concentration data are presented. This database

[1] Because of its toxicity to humans, there is a World Health Organization provisional guideline for microcystin of 1 μg/l in drinking water (Hoeger et al., 2005). Current water treatment processes remove some fraction of this toxin from drinking water supplies.

is the primary source of information for the development of this conceptual model. Additional sources of data used for this assessment are also identified.

- Using the data summarized in Chapter 3, Chapter 4 provides an estimate of the flows and nitrogen and phosphorus loads transported from the tributaries to the Delta in wet and dry years. Sources of nutrients from key non-point and point sources are estimated on a unit basis (e.g., per unit area or per unit population) to compare stream loads to watershed inputs.

- Chapter 5 presents an overview of nutrient concentrations and sources within the Delta boundaries. Loads internal to the Delta are presented along with tributary sources discussed in Chapter 4.

- Chapter 6 identifies recommendations for data collection to better understand the sources and potential impacts of nutrients loads on municipal supplies and highlights the key findings of the analysis presented in this conceptual model.