ABSTRACT

QUANTIFICATION OF BACKGROUND SOURCES OF PHOSPHORUS IN THE TUALATIN RIVER BASIN, OREGON: IMPLICATIONS FOR THE TMDL PROCESS

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Development of Total Maximum Daily Loads (TMDLs) is driven most effectively by scientific research and data collection. Because TMDLs often must be established before all critical data are available, setting TMDLs is ideally a dynamic process that allows for refinement and adjustment as new data and scientific understandings become available. The Tualatin River is an example where a phased approach to TMDLs helped produce a final phosphorus (P) TMDL that is more realistic and scientifically defensible.

The Tualatin River drains a 1,840-km^2 basin west of Portland, Oregon. The basin supports a population of 450,000 people and a wide range of urban, agricultural, and forest activities. In the 1980s, P-related water-quality problems were identified in the Tualatin River, particularly during periods of base flow (May through October). Sluggish flows and high P concentrations from many sources promoted algal blooms in the lower reaches, periodically exceeding 50 ug/L (micrograms per liter) chlorophyll-*a*. Algal blooms created aesthetic problems and contributed to wide fluctuations of dissolved oxygen (4 to 20 mg/L) and pH (6.8 to 9.5), making the Tualatin River water-quality limited relative to Oregon standards. The Oregon Department of Environmental Quality (ODEQ) established a P TMDL in 1988 for the Tualatin Basin, the first in the nation.

In response to a court decree, ODEQ was required to rapidly establish the TMDL before adequate data could be collected, and before they could reliably estimate the river's response to planned point-source reductions (four wastewater treatment plants) that swamped all other nonpoint sources of P combined. The preliminary TMDL established target P concentrations ranging from 45 to 70 ug/L for tributaries and the river during base flow periods, anticipating that nonpoint-source controls could achieve these targets. Data collected subsequent to the preliminary TMDL, however, show that while point- source controls met their targets and greatly reduced P concentrations in the river, TMDL concentration targets for the tributaries and river were unattainable. Higher-than-expected background P concentrations in shallow ground water (averaging 150 ug/L) account for similarly high base-flow concentrations in tributaries, springs, and seeps entering the river. (Tualatin valley soils are derived from relatively P-rich Missoula Flood deposits, accounting for high ground-water concentrations.) Even higher background P concentrations (up to 2,500 ug/L) were measured in deeper, regional ground water that flows through organic-rich (highly reducing) lacustrine deposits buried by the flood deposits. The P concentration of regional ground water discharging directly to the river averages 1,650 ug/L, based on samples from 11 wells driven into the riverbed that have upward flow. Mass-balance calculations show that direct ground water discharge to the Tualatin River accounts for 30 to 35 percent of the P load during base flow periods, which contributed to making the original TMDL concentration targets unattainable. Based on these measurements of background P concentrations

in ground water, and recognizing the influence of ground water on base-flow P concentrations in tributaries and the river, ODEQ raised the TMDL concentration targets in 2001 to more accurately reflect what might be attainable through nonpoint-source controls.