

A Backgrounder on Mixing Zone Studies and Water Quality Standards

The Santa Rosa Board of Public Utilities (BPU) has authorized several studies to address a variety of specific issues related to Direct and Indirect Discharge options. These studies and activities have been underway since spring 2005 and will continue through at least fall 2006. This work will result in Direct and/or Indirect Discharge options being developed to an equal level of detail with respect to understanding conveyance and discharge facilities requirements, siting considerations and the identification of specific sites where discharge relocation appears feasible. Because mixing zones are an important component of Santa Rosa's discharge relocation effort we are providing the following additional background on the topic.

Meeting Water Quality Standards

In the early 1970s, a growing public awareness and concern for controlling water pollution led to the enactment of the Federal Water Pollution Control Act. In 1977, this law was amended and became commonly known as the Clean Water Act. The Act establishes the basic structure for regulating discharges of pollutants into the waters of the United States and gives the Environmental Protection Agency (EPA) authority to implement pollution control programs such as setting wastewater standards for industry. The Clean Water Act also sets water quality standards for all contaminants in surface waters and requires that every state develop and adopt their own standards to protect, maintain and improve the quality of the nation's surface waters.

In California, the State Water Resources Control Board (SWRCB), under direction of the EPA, sets standards needed to protect the beneficial uses of surface water, such as swimming, public water supply, and the propagation and growth of aquatic life in this state. The SWRCB administers water quality through nine Regional Water Quality Control Boards. Each region's control board has the authority to set standards specific to the environmental needs of their area as long as those standards meet or exceed those set by SWRCB and the EPA. In Sonoma and several other northern California counties, the North Coast Regional Water Quality Control Board (NCRWQCB) is the governing body for water quality issues.

Santa Rosa's Wastewater Challenge

The Santa Rosa Subregional Water Reclamation System currently recycles about 80 percent of its treated water through the Geysers Recharge Project and urban and agricultural irrigation activities in central Sonoma County. Though a plan to recycle even more is being developed, some water must be discharged because it is produced in winter, when irrigation is unnecessary.

In 2000, additional regulations, called the California Toxics Rule (CTR), were imposed for discharge of 126 constituents of concern. The Subregional System can comply with the new regulations for all but about seven of these constituents and is working to comply with those seven by using a combination of source control, treatment changes, and mixing zones to reduce their concentration in the water that must be discharged.

The use of mixing zones in the Russian River is of great interest to dischargers and the NCRWQCB. The Subregional System and other regional dischargers support NCRWQCB efforts toward adopting a mixing zone policy because it will protect the environment and provide a cost-effective compliance solution for their ratepayers. However, the expense of studies and

staff shortages have impeded NCRWQCB efforts to complete their findings and still meet the timelines of dischargers in the region. Therefore, regional dischargers must base their mixing zone studies on the criteria and guidelines as set by SWRCB and EPA to meet water quality standards under the same conditions that were used to establish the standards.

Mixing Zone Studies

A mixing zone is a limited area where a natural body of water receives and dilutes highly treated wastewater. The intent of mixing zones is to prevent any harmful impact of a discharged effluent on the aquatic environment and its designated uses, such as drinking, fishing or swimming. In theory, the regulatory mixing zone allows for efficient natural pollutant assimilation. In practice mixing zones can be used as long as the integrity of a water body is not impaired.

California has used mixing zones for decades. The EPA issued its first guidance document on mixing zones in 1968, and reaffirmed their use in its 1993 Water Quality Standards Handbook. Several regional water boards incorporated mixing zone policies into their Basin Plans years ago, including the Central Valley Regional Water Quality Control Board and the San Francisco Bay Regional Water Quality Control Board.

Mixing zone studies are used to evaluate the effectiveness of the mixing of effluent and surface receiving water under a variety of conditions to ensure compliance with water quality standards. Mixing zone studies can involve direct measurements of tracer chemicals or dyes in the receiving water to develop a three dimensional picture of the mixing or mixing zones. Computer models can simulate hydrodynamic conditions and are particularly useful because they can model proposed outfalls before they are constructed and can be used as a tool to help design better outfall structures. Computer modeling also has the advantage of simulating critical low flow receiving water conditions combined with high discharge flows, which rarely occur and hence are difficult to measure directly.

"Acute toxicity" means a stimulus severe enough to rapidly induce a response. In toxicity tests, a response is normally observed in 96 hours or less. Acute effects are often measured in terms of mortality or other debilitating effects. To ensure the results are protective, mixing zone studies typically model compliance with acute water quality standards under the worst-case conditions, when receiving water flows are lowest and effluent flows are highest.

"Chronic toxicity" means a stimulus that lingers or continues for a long period of time, often one-tenth the life span or more. A chronic effect can be mortality, reduced growth, reproductive impairment, harmful changes in behavior, and other non-lethal effects. When modeling chronic toxicity, mixing zone sizes are larger and are based on the seven-day average of the lowest dilution expected every 10 years. Effluent flows are typically based on the daily average rather than maximum peak flow.

Human health criteria are developed under Section 304(a) of the Clean Water Act. EPA guidance for establishing water quality criteria to protect human health includes systematic procedures for evaluating cancer risk, noncancer health effects, human exposure, and bioaccumulation potential in fish. These standards are generally based on long-term exposures over many years. Hence, when modeling mixing zones to assess compliance with human health standards averages are used for both the receiving water and effluent flows.

By carefully matching the size of the mixing zone, the duration of exposure, and the effluent flows, mixing studies provide a conservative means of demonstrating that water quality standards are met under the same conditions that were used to establish the standards.

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