Potential Impact of Pesticides (Insecticides & Herbicides) on Low DO in the SJR DWSC and South Delta[1]

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It has been found that dissolved oxygen (DO) concentrations below the water quality objective (WQO) for the San Joaquin River (SJR) Deep Water Ship Channel (DWSC) are caused in part by the growth of algae in the SJR DWSC watershed. As discussed by Lee and Jones-Lee (2003), these algae, upon entering the DWSC, die due to limited light penetration, and become a source of oxygen demand that leads to DO WQO violations. Jassby (pers. comm., 2000) and Lee and Jones-Lee (2000) have suggested that insecticides such as diazinon and chlorpyrifos could affect algal populations in the San Joaquin River through being toxic to zooplankton, and thereby reducing zooplankton grazing, leading to a greater pulse of algae entering the DWSC than would occur without the pesticide toxicity to zooplankton. This situation, in turn, could adversely impact dissolved oxygen depletion in the SJR Deep Water Ship Channel in the critical reach between Channel Point and Turner Cut.

CVRWQCB studies (Larsen, 2001; Larsen and Connor, 2002) have found that the growth of the alga *Selenastrum* in the standard US EPA toxicity test (Lewis, et al., 1994) is inhibited in some water samples taken from the Central Valley. This is an indication of algal toxicity that could be affecting phytoplankton populations in the SJR upstream of the DWSC and within the DWSC. Further, Miller, et al. (2002, 2003), through toxicity identification evaluation (TIE) procedures, determined that a commonly used herbicide within the Central Valley (diuron) occurs in ambient waters at concentrations that are toxic to algae. They also found a number of unidentified algal toxicants in Central Valley waters that are likely herbicides. These herbicides can affect algal populations that in turn can affect DO depletion in the DWSC through reducing the magnitude of the algal related oxygen demand load added to the DWSC. Lee and Jones-Lee (2003) have reported that during the summers of 2000 and 2001 there was about an eight-fold increase in algal concentrations and BOD in the San Joaquin River from above where the Merced River enters the SJR to Mossdale. Pulses of herbicides added to the SJR or one of its upstream tributaries (Mud Slough, Salt Slough and the SJR upstream of Lander Avenue watershed), as well as directly to the SJR in tailwater discharges, could potentially cause sufficient algal toxicity to reduce the magnitude of algal growth in the DWSC between the primary upstream sources in the Mud and Salt Slough and SJR at Lander Avenue watersheds and Mossdale. This, in turn, would lead to a lower algal associated oxygen demand entering the DWSC.

[1] Reference as Lee, G. F., "Potential Impact of Pesticides (Insecticides & Herbicides) on Low DO in the SJR DWSC and South Delta," Report of G. Fred Lee & Associates, El Macero, CA (2003).

Lee and Jones-Lee (2000, 2003) have discussed that the algal related oxygen demand load to the DWSC is variable, with short-term pulses of greater or less algae, and the associated BOD. Further, they point out that the DWSC at times has crashes in the DO concentrations (pulses of lower than normal DO). The variability in oxygen demand load and the pulses could be related to the impacts of insecticides and herbicides discharged to the SJR DWSC watershed on the algal populations. Lee and Jones-Lee recommend that special studies be conducted to determine the causes of the algal load variability and, especially, the DO crashes, since these crashes could be become the extreme conditions that must be controlled through aeration, oxygen demand source control, and increased SJR flow through the DWSC. Because the DO water quality objective is a low value at any time and location, the crash low DO must be controlled. As a result, there is need to evaluate the potential for toxic pulses of insecticides and herbicides to cause toxicity that impacts DO depletion in the DWSC as part of the Phase I TMDL.

Issues that Need to be Considered in Developing Study Components

The Phase I TMDL study program should evaluate the potential for pesticides and herbicides to affect the low-DO problem in the DWSC. In addition to investigating the impacts of pesticides on the low-DO problem in the DWSC, there is need for studies to determine if pesticides (insecticides and herbicides) affect the low-DO problem that occurs in the South Delta in Old River near the Tracy Blvd bridge. As discussed by Lee and Morgan (2003) and Lee and Jones-Lee (2003), some of the channels in the South Delta have severe DO depletion problems. On August 5, 2003, a large fish kill of threadfin shad occurred in Old River near the Tracy Wildlife Association facilities that was related to low DO and possibly pesticide toxicity to fish or algae.

Pesticide and Toxicity Monitoring

The SJR DWSC and at selected locations in the SJR upstream of the DWSC should be monitored for pesticide toxicity to fathead minnow larvae, *Ceriodaphnia*, and the alga *Selenastrum*, every week during the period June 1 through December 31. If toxicity is found, then TIE studies need to be conducted to determine the cause of the toxicity. If toxic pulses are found, then examination should be made to see if there is a change in the DO levels in the DWSC associated with these pulses. Diazinon and chlorpyrifos should also be monitored in the samples that are tested for toxicity. For toxic samples, a dilution series, with and without piperonyl butoxide (PBO) added, should be conducted to determine the level of toxicity and whether the toxicity is impacted by PBO.

A similar program should be conducted by sampling the waters in the South Delta Old River at the Tracy Wildlife Association facility, where samples are taken at the Association's pier.

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