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M E M O R A N D U M
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To: Files
From: Bill Yake *BY*
Subject: Metro Work on Un-ionized Ammonia and Potential Fish Kills in the
Duwamish River

After reviewing METRO's memorandum ("Ammonia Toxicity to Fish") distributed to the Water Quality Review Board on December 12, 1980 under a cover letter by Jeff Bauman, I spoke by phone with Gunar Sreibers, the author of the memo. I forwarded to Gunar my concerns regarding the logic used in the memo and we discussed, in a general way, their intent in generating and distributing this analysis.

Gunar was not aware of EPA's need for a justification to fund upgrades in excess of conventional secondary treatment. This document evidentially, then, was written for review board consumption and not as a justification document. The specific concerns regarding the memo's logic are listed below. If the METRO memorandum serves as the basis for a formal justification to EPA, these concerns should be addressed.

1. The effect of salt water dilution on ammonia concentrations in the dredged waterway is not considered. The analysis is based primarily on surface water data from the 16th Avenue station; however conductivity or salinity data from this station were not reviewed and total ammonia concentrations were assumed to be the same as in the river. A review of our data from this station indicates that surface waters at this location contain about 3 to 60% salt water with a mean of about 20% salt water. Gunar mentioned that Dr. Welch's work indicates that algal blooms occur in the fresh water layer when conditions favor stratification. This may minimize the necessity to spend a great deal of effort accounting for salt water dilution.
2. The spatial distribution of un-ionized ammonia "cloud" versus the spatial distributions of fish in the dredged waterway is another, more difficult problem. METRO's present analysis is based almost exclusively on surface water analyses at the 16th Avenue bridge. Although Dr. Welch's 1979 work in the waterway did not encounter significant blooms, therefore high pH's, therefore high un-ionized ammonia levels, it should provide data on the distribution of total ammonia, fresh or weakly diluted fresh water, and temperature. If indeed algal blooms are limited to the (essentially) fresh water layer, assumptions of elevated pH's (see number 3) could be applied to this three-dimensional space to define the potential distribution of the un-ionized ammonia "cloud" and predict concentrations in the "cloud". The spatial (and temporal) distribution of fish is another difficult problem. METRO (in general) and Gunar (in specific) have contacted the State Department of Fisheries (Mary Lou Mills) and have been told that Fisheries is "looking into" the question and will "make a strong stand" on getting the effluent out of the river. Gunar also mentioned that the Muckleshoot Indians are concerned and will surely support effluent removal.

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3. The temporal distribution (that is, the likely frequency of high un-ionized ammonia concentrations) is a third issue which the memorandum does not address. Gunar indicated that 16 "occurrences" of pH values ≥ 8.5 have been documented from 16th Avenue surface data. These data represent the 1966-1977 time period. Six of these occurrences are linked to D.O. data which show the classic diurnal curves associated with algae blooms. A compilation of this supporting data in any later, formal document would be very valuable. The four-hour exposure time also was said to be based on these monitoring data, as elevated pH's evidently were rather short-lived during any one day, but would recur daily during the course of a bloom.
4. The source of the toxicity curves is not addressed in the memorandum, but is evidently based on work done by Jim Buckley. Art Johnson has reviewed the toxicity curves and they appear to be realistic. Again, any formal document to EPA should reference these backup data.
5. The cost figures for potential fish kills do not account for egg loss or second generation loss. Gunar indicated that, at least now, excess Coho are available for quick restocking, but that Chinook are not. This increased cost should be included if an attempt is made to quantify losses. This quantification may, however, be very difficult because of the necessity of estimating the number of fish exposed to any un-ionized ammonia "cloud".

Summary

Although the METRO memo is a valuable step in accessing potential problems associated with un-ionized ammonia toxicity to salmon, any formal document should be provided with supporting information discussed above. In addition, it would probably be valuable to look closely at the river above the dredged waterway -- particularly in the location of the outfall where "triple-dosing" occurs and the lack of vertical stratification does not allow fish to swim below the affected areas.

BY:cp

**cc: Bob McCormick
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