A CRITIQUE OF NEW WATER QUALITY CRITERIA IN GEORGIA: POLICY AND ECOLOGICAL IMPLICATIONS

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Abstract. The objective of the paper is to examine recent changes in the Georgia Rules for Water Quality Control. The State of Georgia changed surface water metals criteria from a total recoverable standard to a dissolved standard. These standards were changed to reflect the biologically available fraction of metals in surface waters. These changes have far reaching effects on NPDES permits, TMDL calculations, and sediment contamination and may have negative impacts on Georgia surface waters.

INTRODUCTION

Metal contamination of streams throughout the US poses a threat to water quality, ecosystem and human health. Therefore, trace metals are strictly regulated to protect water quality. The US Environmental Protection Agency (US EPA) sets minimum water quality standards as guidelines for state standards (Federal Clean Water Act). These guidelines are then used to develop state standards and permit limits by state agencies. In 1993, the US EPA promulgated a change in the method for metals criteria in surface waters. This change allowed for states to change their standards from total recoverable metals criteria to the dissolved fraction of metals. In Nov. 1998, Georgia made these changes to the Georgia Rules for Water Quality Control (Chapter 391-3-6)(Table 1). In addition the state added acute and chronic criteria as shown in Table 1. The objective of this paper to examine the purpose for making these alterations to metals criteria and to explore the potential impacts of these changes on Georgia's surface waters

CRITERIA CHANGED

Trace metal regulations in Georgia were previously based upon a total recoverable standard. Total recoverable metals are measured by digesting a water sample before analysis. The digestion process solubilizes metals that are sorbed to particles in the water sample such as organic matter and clays. After digestion the sample is analyzed for metal concentrations. The new standards are based upon the total dissolved metals in a water sample. These are the metals that are not sorbed to particles and can be obtained through analysis of the sample before digestion. Therefore the dissolved metals in a sample are a fraction of the total metals. The new dissolved criteria use identical metal concentrations as before (Table 1), yet the new standards are only the dissolved fraction.

Table 1. Freshwater criteria for metals before and after recent changes in the Georgia Rules for Water Quality Control. New limits are given as acute and chronic criteria.

Contaminant	Previous Total Recoverable Limit (μg/L)	New Dissolved Limits (μg/L)	
		Acute	Chronic
Arsenic	50	50	50
Cadmium	0.7	1.7	0.62
Chromium VI	11	16	11
Copper	6.5	8.8	6.2
Lead	1.3	30	1.2
Mercury	0.012	-	0.012
Nickel	88	790	88
Selenium	5.0	-	5.0
Zinc	60	64	58

BIOAVAILABILITY

The obvious question that arises from these changes to metals criteria is how effective will these criteria be in protecting aquatic organisms? The answer lies in determining if the dissolved fraction, which is regulated under the new changes, is the sole portion affecting aquatic life. The US EPA initially changed the national guidelines to better reflect the bioavailability of metals in surface waters. The bioavailable fraction of a contaminant is the fraction that is in a form that may adversely affect the organisms in the system (Rand 1995).

The bioavailability of metals in natural systems is difficult to measure. Numerous studies have attempted to determine the multiple effects of metals in stream systems and determine what fractions of metals are bioavailable (van Hattum et al 1991, Cain et al. 1992, Dukerschein et al. 1992, Axtmann et al. 1997).

POLICY IMPLICATIONS

There are three major effects of these changes in metals regulations. The first is that permits for discharging metals into surface waters are calculated through the use of metals criteria. Permit limits are determined by calculating the amount (concentration) of discharge from the facility that will result in the receiving body maintaining the criteria limit. The recently adopted criteria will result in larger NPDES permit limits for metals.

A second effect of these changes is the number of streams that are meeting their designated use. A designated use for metals is not met if the predicted concentration of metals in surface water violate the water quality criteria. The recent change in Georgia's criteria may result in an increase number of streams meeting their designated use. Streams that change designated use status are then removed from the list of streams that require total maximum daily load calculations. A number of streams that previously did not meet their designated use but under new criteria do, may actually be protected. However, this would be difficult to ascertain given the type of data collected for designated use status assessment.

Metal contamination in Georgia surface waters is a major reason that streams do not meet their designated uses. In the Chattahoochee River metal contamination (e.g. lead, copper, cadmium, zinc) is the second most commonly listed reason for streams not meeting designated uses. In the Tallapoosa, Coosa, and Oconee river basins 30, 30, and 20 % of the streams, respectively, are not meeting designated uses due to metal contamination. The recent changes in Georgia criteria may place these streams within the concentration range appropriate for their designated uses and alleviate the need for TMDL calculations. However the streams have not actually improved in any way.

The final effect that these changes have is in the actual amount of metals entering Georgia surface waters. Currently sediment quality is threatened by contamination due to metals (US EPA 1997). As stated above, metals readily bind to inorganic and organic particles. Inorganic particles become in-stream sediments, which may subsequently have higher metal concentrations under the new criteria. Recently the EPA designated four of Georgia's major watersheds as areas of probable concern (to human and ecological health) due to high levels of trace metal contamination in the sediments (EPA 1997). The new criteria are likely to result in greater sediment contamination.

ECOLOGICAL IMPLICATIONS

Dissolved metals that enter a natural water body can sorb to particulate matter, however many factors may affect the sorption kinetics of metals which makes predictions about sorption difficult (Rand 1995). When metals are bound to particles, either organic or inorganic, their bioavailability may be altered. Sorption to particles may have a buffering effect (Lyman 1995) or may simply alter the route of exposure to organisms. Trophic and sediment exposure to metals sorbed to particles also have been shown to affect aquatic organisms (Smock, 1983, Luoma 1991, Axtmann 1997, Luoma 1997). Studies have shown that organisms may be exposed or accumulating metals in waters that have low levels of dissolved metals (Kiffney and Clements 1993). Problems arise when extrapolating from lab experiments to the field. Determining which concentrations of metals are bioavailable in Georgia surface waters will be crucial for adequate protection of ecosystems.

In large rivers in Georgia, organic particles are an important food resource for aquatic communities (e.g. more than 60% of the food web can be supported by this resource Rosi 1997). Increased metal contamination of organic particles may cause metals to enter food webs and contribute to fish contamination. The USGS NAWQA program has documented high concentrations of trace metals in Corbicula (Asiatic clam) in the Appalachicola Chattahoochee Flint basin. In addition higher trophic levels may also be exposed, e.g. fishes, reptiles, and birds in Georgia.

In addition to exposure to metals sorbed to organic particles, metals sorbed to inorganics may also be important. In a recent report to Congress, the US EPA (1997) recommended that reducing the rate of sediment contamination should be a goal of state and federal agencies. In order to accomplish this the EPA recommends putting more stringent regulations on the discharge of contaminants such as metals.

Less stringent criteria may result in increases in permitted discharges of metals, which will affect multiple streams in Georgia. If the EPA is correct in assuming that metals sorbed to particles are not bioavailable, there should be no net increase in contamination of aquatic organisms. However, given the problems of sediment contamination and exposure through feeding on organic particles these new criteria may not be adequately protective.

The question of the bioavailability of metals in surface waters remains poorly understood (Luoma et al. 1991, Kiffney and Clements 1993, Axtmann et al. 1997), yet regulations need to be set. The EPA has continued to perform a balancing act between protection of aquatic systems and over regulation, which is commend-able. The recent change in metals criteria may be adequate to protect aquatic life or may not. However in an era of uncertainty and a Federal Clean Water Act that set zero discharge of contaminants as an ultimate goal, allowing less stringent criteria for metals without requiring subsequent assessment of the impact of these changes on metal concentrations in sediments and biota is questionable.

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