



Project Summary

Derivation of Site-Specific Water Quality Criteria for Cadmium and the St. Louis River Basin, Duluth, Minnesota

R. L. Spehar and A. R. Carlson

Several freshwater aquatic species were exposed to cadmium in site and laboratory water to evaluate an "organism testing" protocol proposed by the U.S. Environmental Protection Agency for deriving site-specific, water quality criteria. The procedures of recalculation, indicator species, and resident species were used in this protocol to modify the national maximum 30-day average cadmium criteria. These procedures were used to account for differences in species sensitivity and in the biological availability and/or toxicity of cadmium due to physical and/or chemical characteristics of the site water.

The site-specific, maximum concentration derived from the recalculation procedure was slightly lower (1.3 as compared to 2.2 $\mu\text{g}/\text{l}$) than the national criterion value. The maximum concentration derived from the indicator species procedure was 7.0 $\mu\text{g}/\text{l}$ and was calculated by using a water effect ratio from tests conducted in both site and laboratory water. Acute tests with several species demonstrated that cadmium was less toxic in site water than in laboratory water. The site-specific, maximum concentration derived from the resident species procedure (from eight species exposed to cadmium in site water) was 1.9 $\mu\text{g}/\text{l}$. The 30-day average concentrations were the same as the maximum concentrations in all procedures where the national acute-chronic ratio was used in the calculation. These concentrations were much lower when the site-specific, acute-chronic ratio was applied.

Acute tests conducted monthly in site water showed that cadmium toxicity varied by more than a factor of three over the year. This indicates the need for considering seasonal changes in physical and chemical characteristics of the site water when deriving criteria to protect aquatic life.

This Project Summary was developed by EPA's Environmental Research Laboratory, Duluth, MN, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

Under the Clean Water Act of 1977 [Sec. 304(a)(1)], the U.S. Environmental Protection Agency (EPA) is required to review and publish criteria for water quality necessary to protect public water supplies and the propagation of shellfish, fish and wildlife. Criteria present scientific data and guidance on the environmental effects of pollutants that can be useful to derive water quality-based regulatory requirements such as effluent limitations, water quality standards or toxic pollutant effluent standards.

National water quality criteria have been derived by applying a set of guidelines to data for certain pollutants designated as toxic under Section 307(a)(1) of the Clean Water Act of 1977, pursuant to an agreement in the case of Natural Resources Defense Council et al. vs. Train, 1976. These guidelines specify that criteria should be based on an array of data from species, both plant and

animal, occupying various trophic levels. Based on these data, criteria can be derived which should adequately protect the type of species necessary to support an aquatic community. Although criteria represent a reasonable estimate of pollutant concentrations consistent with the maintenance of designated uses, each state may appropriately modify these values to reflect local conditions.

Since national criteria may be either underprotective or overprotective, the Office of Research and Development and the Office of Water Regulations and Standards of the EPA are currently developing guidelines for modifying national water quality criteria to local conditions or to site-specific criteria. National criteria are based on information obtained from toxicity and bioconcentration tests conducted in laboratory sources of water. However, toxicological information obtained for laboratory tested aquatic species, however, may not be applicable to species in specific water bodies because: 1) the species at a particular site may be more or less sensitive than those included in the national criteria data base, or 2) the physical and/or chemical characteristics of the water at the site may alter the biological availability and/or toxicity of the material.

The main purpose of this research was to test procedures that might be useful for deriving site-specific water quality criteria. The specific objective of the study was to conduct tests to evaluate an "organism testing" protocol for deriving site-specific criteria utilizing toxicity tests with several species of aquatic organisms in site and laboratory water. The type of tests and/or exercises that were performed in this study were designed to correlate with the site-specific guidelines as they are now proposed. This study was designed to help identify problems that

one might encounter when using the guidelines and to provide an example for a site-specific criteria derivation for a chemical at an actual site.

Tests were conducted with cadmium because this chemical is highly toxic to aquatic organisms, and is commonly found in the environment due to its presence in treated municipal wastes. Its chemistry in water is such that it may be influenced by changes in water quality, which would be a major consideration for modifying the present national criteria.

Overall Assessment

Although all of the above procedures were tested in this study, only one approach would most likely be used in an actual site criteria modification. If species sensitivity was the important factor, the recalculation procedure would be the least costly approach because it would require no testing. When water quality at a site may mitigate the toxicity of a chemical, the indicator species procedure is encouraged. This is especially true for metals like cadmium where biological availability and/or toxicity are significantly affected by variations in water quality characteristics of the site water.

When both species sensitivity and water quality are important considerations for a particular site, the resident species procedure would be the best approach because it is designed to account for differences due to both of these factors. This approach, however, would be the most costly because at least eight acute tests are required to be conducted in site water.

The above procedures were designed for deriving site-specific water quality criteria by allowing substantial flexibility with respect to the methodology used. This should permit regulatory agencies to choose the most efficient means of obtaining the information needed to modify national criteria for each particular site. Site-specific water quality criteria for cadmium and the St. Louis River obtained from the site specific guidelines appear to be logical, taking into account the national cadmium criteria and physical, chemical and biological characteristics of this site water. Using these procedures to derive site-specific, water quality criteria for toxic materials at different sites should provide additional input to the development of effective, site-specific guidelines.

The EPA authors R. L. Spehar and A. R. Carlson are with the Environmental Research Laboratory, Duluth, MN 55804.

The complete report, entitled "Derivation of Site-Specific Water Quality Criteria for Cadmium and the St. Louis River Basin, Duluth, Minnesota," (Order No. PB 84-153 196; Cost: \$10.00, subject to change) will be available only from:

*National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
Telephone: 703-487-4650*

For information contact the authors at:

*Environmental Research Laboratory
U.S. Environmental Protection Agency
6201 Congdon Blvd.
Duluth, MN 55804*

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