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QUALITY CRITERIA FOR WATER

U.S. ENVIRONMENTAL PROTECTION AGENCY
Washington, D.C. 20460

ATTACHMENT 19

CONTENTS

CONTENTS CONT'D

MIXING ZONES

INTRODUCTION:

A mixing zone is an area contiguous to a discharge where receiving water quality may neither meet all quality criteria nor requirements otherwise applicable to the receiving water. It is obvious that any time an effluent is added to a receiving waterway, where the effluent is poorer in quality, there will be a zone of mixing. The mixing zone should be considered as a place where wastes and water mix and not as a place where effluents are treated.

RATIONALE:

Because damage to the aquatic resource can occur when quality standards are violated, the permissible size of a mixing zone is dependent upon the acceptable amount of damage. The permissible size depends in part on the size of the particular receiving water; the larger the water body, the larger the mixing zone may be without violating quality standards in more than a given percentage of the total area or volume of the receiving water. Likewise, the greater number of mixing zones within a reach of river or within a water body, the smaller each must be in order to maintain an appropriate mixing zone to water body ratio. Future industrial and population growths must be considered in designating such areas for wastes admixture.

As a guideline, the quality for life within a mixing zone should be such that the 96-hour LC_{50} for biota significant to the indigenous aquatic community is not exceeded; the mixing zone should be free from effluent substances that will settle to form objectionable deposits, free from effluent-associated materials that float to form unsightly masses, and free from effluent-associated substances that produce objectionable color, odor, or turbidity.

A prime purpose in designating the location, size, and area constraints of a mixing zone is to protect the aquatic life within the receiving waterway. Shallow water areas, generally, are the nursery areas for aquatic ecosystems. Designating offshore mixing areas or providing a larger available volume or area for mixing offshore as a viable alternative to a smaller shoreside area has a lesser potential for adverse biotic effects than a comparable discharge area in shallow water. Offshore, diffusion will tend to occur in all directions and not be constrained by a land barrier. Mixing zones may be less harmful biologically when located deep within the receiving water and, wherever possible, beneath the light-penetration area where photosynthesis occurs and algae and associated protozoa and other organisms provide the extensive base for the aquatic food web.

An axiom of environmental quality is that different areas vary in ecological importance, one from the other. Generally the highest importance, and therefore the greatest protection, must be placed on shallow-water shoreline areas of rivers, lakes and coastal zones and on the nation's wetlands. These are commonly the areas that protect the young and supply the food not only for the animals that live in open waters but also for those animals that depend upon water in some measure for their existence. Likewise, one local aquatic area may have a higher social or ecological value than another, and the higher that value the greater the protection from degradation that is warranted within a waste mixing area.

Mixing zones should be located in such a manner that they do not form a barrier to the migratory routes of aquatic species. On a given reach of a stream or river , it would be good practice to limit the total mixing zone area to one-third of the receiving water width. In the same fashion, the combined

areas of all mixing zones within a lake should not exceed ten percent of the lake surface area. In some cases, this maximum should be reduced depending on lake volume and other local conditions. Within an estuary, the maximal dimension of the mixing area should not exceed 10 percent of the cross-sectional area of the waterway. It is not the objective of this rationale to outline limits for effluents, but to provide the reader with some of the general biological and physical considerations necessary for the establishment of mixing zones.

In essence, the positioning of mixing zones should be accomplished in a manner that will provide the greatest protection to aquatic life and for the various uses of water. Generally, shoreline and surface areas for waste admixture should be discouraged in preference to deep water, offshore designations. The relative social and ecological values of the aquatic life that may inhabit a particular waterway area should be given due consideration in zone definition. (Fetterolf, 1973; NAS, 1974) The designation of particular mixing zones is a task that should follow the biological, physical and chemical appraisal of the receiving waterway.

References cited:

Fetterolf, C.M., Jr., 1973. Mixing zone concepts; Biological Methods for the Assessment of Water Quality, ASTM STP-528, American Society for Testing and Materials, pp. 31-45.

National Academy of Sciences, National Academy of Engineering, 1974. Water Quality Criteria, 1972. U. S. Government Printing Office, Washington, D.C.