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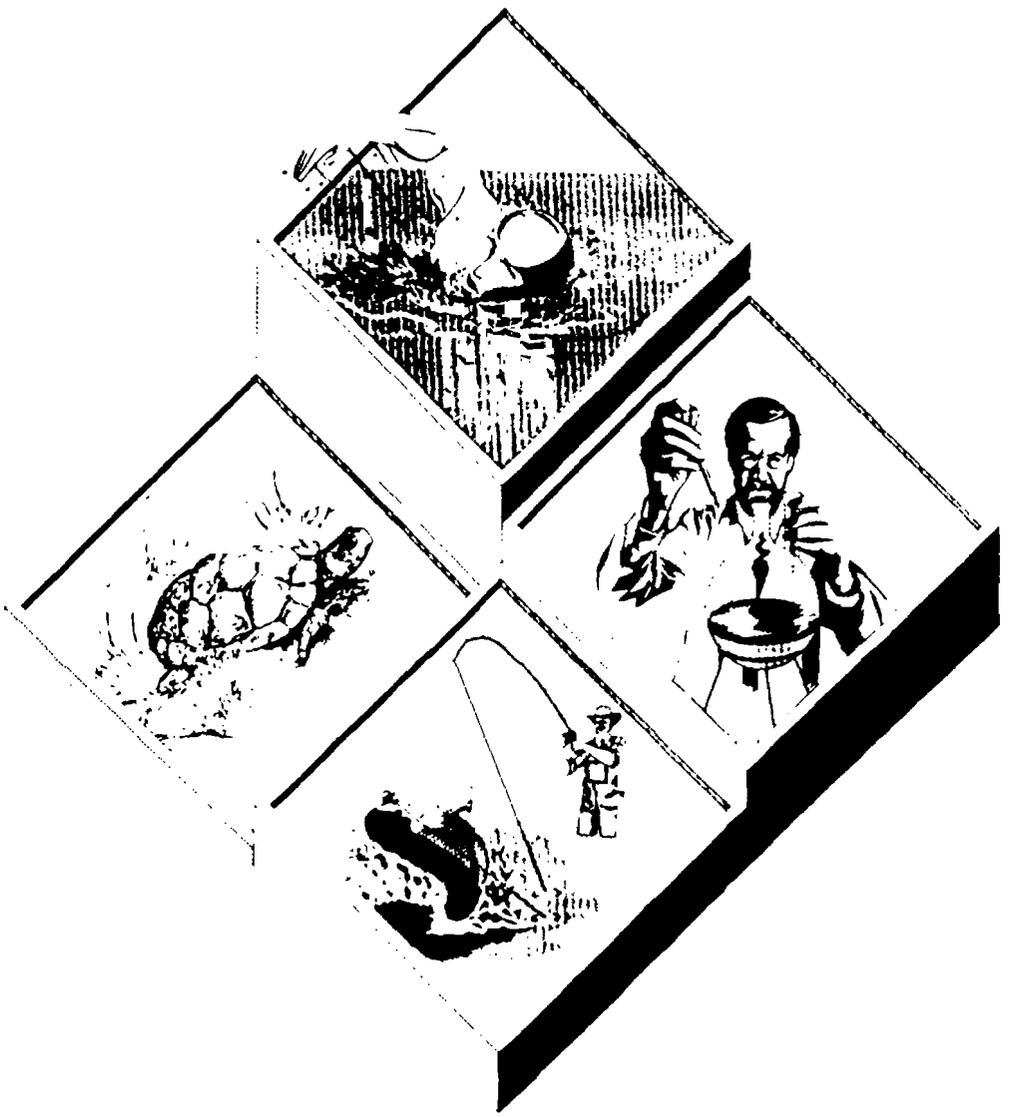
Water Quality Standards Handbook:

Second Edition



"... to restore and maintain the chemical, physical, and biological integrity of the Nation's waters."

Section 101(a) of the Clean Water Act

Contains Update #1
August 1994

ATTACHMENT 20

WATER QUALITY STANDARDS

HANDBOOK

SECOND EDITION

Water Quality Standards Branch
Office of Science and Technology
U.S. Environmental Protection Agency
Washington, DC 20460

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GENERAL POLICIES

(40 CFR 131.13)

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CHAPTER 5
GENERAL POLICIES

States may, at their discretion, adopt certain policies in their standards affecting the application and implementation of standards. For example, policies concerning mixing zones, water quality standards variances, and critical flows for water quality-based permit limits may be adopted. Although these are areas of State discretion, EPA retains authority to review and approve or disapprove such policies (see 40 CFR 131.13).

5.1 Mixing Zones

It is not always necessary to meet all water quality criteria within the discharge pipe to protect the integrity of the water body as a whole. Sometimes it is appropriate to allow for ambient concentrations above the criteria in small areas near outfalls. These areas are called mixing zones. Whether to establish a mixing zone policy is a matter of State discretion, but any State policy allowing for mixing zones must be consistent with the Clean Water Act and is subject to approval of the Regional Administrator.

A series of guidance documents issued by EPA and its predecessor agencies have addressed the concept of a mixing zone as a limited area or volume of water where initial dilution of a discharge takes place. Mixing zones have been applied in the water quality standards program since its inception. The present water quality standards regulation allows States' to adopt mixing zones as a matter of States discretion. Guidance on defining mixing zones previously has been provided in several EPA documents, including FWPCA (1968); NAS/NAE (1972); USEPA (1976); and USEPA (1983a).

EPA's current mixing zone guidance, contained in this Handbook and the *Technical Support Document for Water Quality-based Toxics Control* (USEPA, 1991a), evolved from and supersedes these sources.

Allowable mixing zone characteristics should be established to ensure that:

- mixing zones do not impair the integrity of the water body as a whole,
- there is no lethality to organisms passing through the mixing zone (see section 5.1.2, this Handbook); and
- there are no significant health risks, considering likely pathways of exposure (see section 5.1.3, this Handbook).

EPA recommends that mixing zone characteristics be defined on a case-by-case basis after it has been determined that the assimilative capacity of the receiving system can safely accommodate the discharge. This assessment should take into consideration the physical, chemical, and biological characteristics of the discharge and the receiving system; the life history and behavior of organisms in the receiving system; and the desired uses of the waters. Mixing zones should not be permitted where they may endanger critical areas (e.g., drinking water supplies, recreational areas, breeding grounds, areas with sensitive biota).

EPA has developed a holistic approach to determine whether a mixing zone is tolerable (Brungs, 1986). The method considers all the impacts to the water body and all the impacts that the drop in water quality will have on the surrounding ecosystem and water body uses. It is a multistep data collection and analysis

procedure that is particularly sensitive to overlapping mixing zones. This method includes the identification of all upstream and downstream water bodies and the ecological and cultural data pertaining to them; the collection of data on all present and future discharges to the water body; the assessment of relative environmental value and level of protection needed for the water body; and, finally, the allocation of environmental impact for a discharge applicant. Because of the difficulty in collecting the data necessary for this procedure and the general lack of agreement concerning relative values, this method will be difficult to implement in full. However, the method does serve as a guide on how to proceed in allocating a mixing zone.

Mixing zone allowances will increase the mass loadings of the pollutant to the water body and decrease treatment requirements. They adversely impact immobile species, such as benthic communities, in the immediate vicinity of the outfall. Because of these and other factors, mixing zones must be applied carefully, so as not to impede progress toward the Clean Water Act goals of maintaining and improving water quality. EPA recommendations for allowances for mixing zones, and appropriate cautions about their use, are contained in this section.

MIXING ZONES

A limited area or volume of water where initial dilution of a discharge takes place and where numeric water quality criteria can be exceeded but acutely toxic conditions are prevented.

The *Technical Support Document for Water Quality-based Toxics Control* (USEPA, 1991a, sections 2.2, 4.3, 4.4) discusses mixing zone analyses for situations in which the discharge does not mix completely with the receiving water within a short distance. Included are discussions of outfall designs that maximize initial dilution in the mixing zone, critical design periods for mixing zone analyses, and methods to analyze and model nearfield and farfield mixing.

5.1.1 State Mixing Zone Methodologies

EPA recommends that States have a definitive statement in their standards on whether or not mixing zones are allowed. Where mixing zones provisions are part of the State standards, the State should describe the procedures for defining mixing zones. Since these areas of impact, if disproportionally large, could potentially adversely impact the productivity of the water body and have unanticipated ecological consequences, they should be carefully evaluated and appropriately limited in size. As our understanding of pollutant impacts on ecological systems evolves, cases could be identified where no mixing zone is appropriate.

State water quality standards should describe the State's methodology for determining the location, size, shape, outfall design, and in-zone quality of mixing zones. The methodology should be sufficiently precise to support regulatory actions, issuance of permits, and determination of BMPs for nonpoint sources. EPA recommends the following:

- **Location**

Biologically important areas are to be identified and protected. Where necessary to preserve a zone of passage for migrating fish or other organisms in a water course, the standards should specifically identify the portions of the waters to be kept free from mixing zones.

Where a mixing zone is allowed, water quality standards are met at the edge of that regulatory

mixing zone during design flow conditions and generally provide:

- a continuous zone of passage that meets water quality criteria for free-swimming and drifting organisms; and
- prevention of impairment of critical resource areas.

Individual State mixing zone dimensions are designed to limit the impact of a mixing zone on the water body. Furthermore, EPA's review of State waste load allocations (WLAs) should evaluate whether assumptions of complete or incomplete mixing are appropriate based on available data.

In river systems, reservoirs, lakes, estuaries, and coastal waters, zones of passage are defined as continuous water routes of such volume, area, and quality as to allow passage of free-swimming and drifting organisms so that no significant effects are produced on their populations. Transport of a variety of organisms in river water and by tidal movements in estuaries is biologically important for a number of reasons:

- food is carried to the sessile filter feeders and other nonmotile organisms;
- spatial distribution of organisms and reinforcement of weakened populations are enhanced; and
- embryos and larvae of some fish species develop while drifting.

Anadromous and catadromous species must be able to reach suitable spawning areas. Their young (and in some cases the adults) must be assured a return route to their growing and living areas. Many species make migrations for spawning and other purposes. Barriers or blocks that prevent or interfere with these types of essential transport and movement can be created by water with inadequate chemical or physical quality.

Size

Various methods and techniques for defining the surface area and volume of mixing zones for various types of waters have been formulated. Methods that result in quantitative measures sufficient for permit actions and that protect designated uses of a water body as a whole are acceptable. The area or volume of an individual zone or group of zones must be limited to an area or volume as small as practicable that will not interfere with the designated uses or with the established community of aquatic life in the segment for which the uses are designated.

To ensure that mixing zones do not impair the integrity of the water body, it should be determined that the mixing zone will not cause lethality to passing organisms and that, considering likely pathways of exposure, no significant human health risks exist. One means to achieve these objectives is to limit the size of the area affected by the mixing zones.

In the general case, where a State has both acute and chronic aquatic life criteria, as well as human health criteria, independently established mixing zone specifications may apply to each of the three types of criteria. For application of two-number aquatic life criteria, there may be up to two types of mixing zones (see Figure 5-1). In the zone immediately surrounding the outfall, neither the acute nor the chronic criteria are met. The acute criteria are met at the edge of this zone. In the next mixing zone, the acute, but not the chronic, criteria are met. The chronic criteria are met at the edge of the second mixing zone. The acute mixing zone may be sized to prevent lethality to passing organisms, the chronic mixing zone sized to protect the ecology of the water body as a whole, and the health criteria mixing zone sized to prevent significant human risks. For any particular pollutant from any