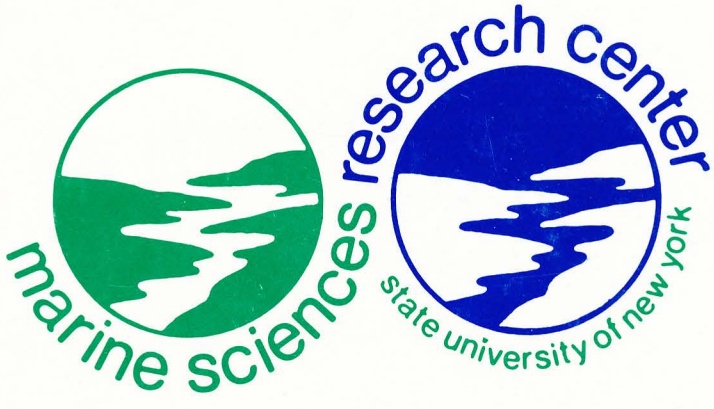
ZONING

A RATIONAL APPROACH TO ESTUARINE REHABILITATION AND MANAGEMENT

by J. R. SCHUBEL



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J. R. Schubel
J. R. Schubel, Director

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INTRODUCTION

This is an essay--an interpretative literary composition dealing with its subject from a personal point of view. It is an essay on a new approach to estuarine management by an oceanographer who has almost no management experience, but who has spent his professional career studying estuarine processes and problems, who has repeatedly attempted to translate the findings of his research into a form usable by managers and planners, and who has been chronically frustrated by the fact that little of his work, or that of his colleagues, has ever been incorporated into environmental management.

USES AND ABUSES OF THE ESTUARINE ENVIRONMENT

It is in the estuary where man has his most intimate contact with the marine environment and his greatest impact on it. The population density of estuarine areas is approximately twice that of the remainder of the country (1), and these areas serve as the sites of heavy concentrations of industry. Approximately 40% of all manufacturing plants in the country are in coastal counties, a large percentage of which are in estuarine areas. Man uses estuaries as a transient receiver for his industrial, municipal, and human wastes. He also utilizes them for their extractable resources, both mineral and biological; for shipping and transportation; as a source of industrial-process water; as a source of cooling water for factories and power plants; and for military activities. And he uses estuaries for recreation--for re-creation. The great value of estuaries lies in this multiplicity of uses, but herein also lies their vulnerability.

All of these uses are probably "legitimate." Few, if any, of them are inherently prohibitive, and most, perhaps all need not ever be seriously restrictive below some threshold level of activity. But the demands that the various activities make on the estuarine zone are sometimes in conflict. The conflict arises mainly between those activities, primarily fisheries and recreation, that require the maintenance of certain water quality "standards," and other activities for which water "quality," as we generally define it, is relatively unimportant; activities which in fact usually lead to a degradation of existing water "quality." There is also a conflict between military and civilian uses that results from the setting aside of large areas of some estuaries for ordnance testing and training. Examples are the use of the upper Potomac by the Dahlgren Proving Ground (U. S. Navy) and portions of upper Chesapeake Bay including the Bush River estuary and Romney Creek by the Aberdeen Proving Ground (U. S. Army). Schubel (2) estimated that in 17% of the Chesapeake Bay estuarine system civilian activities are restricted by military regulations. This is nearly twice the cumulative area of shellfish bars closed because of "pollution."

Estuaries do have a capacity to assimilate some wastes whether heat, sewage, or dredged spoil, without suffering persistent ecological damage. They can support certain levels of shipping and transportation without a significant loss of commercial and recreational fish landings. Some minerals can be extracted from the estuarine zone without smothering shellfish beds. And, the biological resources of estuaries can be harvested to certain levels without affecting future yields. Estuaries can serve all of these uses and still remain aesthetically pleasing environments for man's re-creation. But an estuary's capacity to support these varied activities is finite. The ability of an estuary to tolerate each "environmental

insult" before suffering significant and persistent ecological damage or aesthetic degradation varies not only from estuary to estuary, but also from segment to segment within a given estuary as well. And within any segment of an estuary it varies temporally.

It is apparent that in many estuaries, or at least segments of them, we have exceeded this capacity. It is also apparent, as Gross (3) points out in his paper, that despite the very large expenditures for pollution abatement over the past several decades "the few available long-term data on water quality show little evidence of significant improvement in estuarine water quality in the United States." The ineffectiveness of our efforts is attributable to a variety of factors. Among the more important are our failures to develop regional plans for the management of estuarine systems, and to implement management strategies that have a sound scientific basis. It is not surprising to scientists that the millions of dollars spent on waste treatment in the District of Columbia have had little effect on the water quality of the upper Potomac.

Decisive environmental action does not await a more detailed understanding of estuaries as Holden (4) suggested was the case for Chesapeake Bay. There are certainly many unanswered scientific questions; there always will be. But many of the important features of the prevailing biological, chemical, geological, and physical processes that characterize important estuarine systems are known and understood. Scientific predictions can be made. In many respects scientific information has developed at a faster rate than management's ability to utilize it. Managers and planners rarely have the scientific expertise required for the formulation of plans for effective environmental management, and scientists have been derelict in translating the results of their investigations into a form readily usable by managers and planners. As a result planners have been disillusioned with academicians and have turned to consultants for guidance. The typical planning documents that have resulted are of little value. They form a seemingly endless series of studies outlining the studies that need to be done, but they are of little consequence in affecting solutions.

For a significant improvement in the effectiveness of the management of estuaries and in their condition, a new approach to estuarine management and pollution abatement is required. At a time of fiscal exigencies when we are all being asked to assess the effectiveness of our programs and our personnel, Federal, state, and county environmental protection agencies would be well advised to do the same. Continuation of present policies, or even acceleration of these policies, will result, in many estuaries, in little improvement of water quality as generally measured, and will place undue restrictions on estuarine usage. Uniform, invariant regulations and standards whether they are for temperature, bacteria, nutrients, dredged spoil, or turbidity are environmentally naive. The only justification for their enactment is that it simplifies enforcement. A uniform speed limit of 40 km/hr is as irrational as one of 175 km/hr is irresponsible. Uniform estuarine regulations have proven to be ineffective, and are wasteful of natural resources--resources that should be used and used responsibly. The philosophy of those "environmental crusaders," bureaucrats, and politicians who espouse cessation as the solution to all of man's environmental problems is not viable. People live. They eat, they defecate, they procreate, and yes, they also need to re-create. They engage in these activities even during election years. This is not to imply that we

should not insist on reasonable levels of waste treatment, on carefully supervised methods of dredging and spoil disposal, on controlled mining, on properly managed fisheries, and on reasonable thermal standards. We should. We should insist on more.

ZONING--A RATIONAL ALTERNATIVE

Estuarine systems should be zoned; zoned into a number of segments in which different water "quality" standards and criteria are applied which are consistent with the natural prevailing processes and with the most important uses of each estuarine segment. To date, formal zonation of estuaries has been restricted largely to that associated with military activities, and major shipping channels. Man zones his terrestrial environment into residential and industrial areas, and sets aside portions of it as parks and forests for recreation. He identifies other segments of it for the disposal of his waste products. He does not make it an official policy to spread his garbage and trash uniformly over the landscape. He neither demands nor expects all parts of his terrestrial environment to be of equal "quality." Should he expect to be able to swim and harvest seafood in every part of every estuary? I think not. Segments of some estuaries should be designated as spoil disposal areas, as receiving waters for municipal and industrial wastes, as sinks for the heated effluents from power plants, as spawning and nursery areas, as military testing areas, and as fishing and recreational areas. Still others should be preserved, or at least conserved in a "wild" state. These designations would not necessarily be mutually exclusive; there would be considerable overlap. In addition, some zones might even receive seasonal designations. The identification of a finfish spawning area certainly would not preclude its use as a recreational area for man; indeed many of the activities would probably be similar. But one should not build a large power plant with a once-through cooling system that would use a large fraction of the available water in an important spawning or nursery area--and a STUDY is not required to establish this. If we accept that the primary reasons for "managing" estuaries are to protect their biological resources and to conserve their recreational and aesthetic values, then certain activities should be restricted more severely in some areas than in others and also during those periods when organisms are most vulnerable; presumably during the egg and larval stages.

In one sense, the zoning of estuaries will be more difficult than zoning the terrestrial environment because of the reactivity and mobility of the medium. However, once the proper uses of a segment have been perceived, implementation should be simpler, since in general, the water and most of the bottom are publicly owned. The objective however, is essentially the same. Zoning is a formal restriction on use and constitutes a police power. The primary purpose of zoning is to manage. But manage for what? . . . for whom? Management must be directed at some goal or goals if it is to be effective. Good managers, like good scientists, must set significant but realistic goals--goals which if attained will produce worthwhile and desired results, and goals which have a reasonably high probability of being attained. Environmental management is an exercise in decision theory, and the stakes are too high to leave to any one, or even several, special-interest groups.

A prerequisite to the establishment of any zoning plan then is the assignment of priorities to the various uses, and this is among the most difficult tasks in any zoning procedure. In terms of

gross monetary return the most "important" uses of the estuarine zone are for military activities, for shipping, and for industry (1). However the monetary values of commercial fisheries and of recreational activities are also very high, although they are much more difficult to assess. And if communication with nature is indeed one of man's ultimate sources of happiness (5), then the recreational and aesthetic value of estuaries cannot be measured in dollars and cents.

The establishment of priorities clearly involves not only scientific inputs, but social and economic inputs as well. The decisions are in large part value judgments, and natural scientists have no peculiar talents for making such decisions. Scientists can neither determine incontestably what uses of an estuary are most "important," nor even which are most desirable. Through science, we can learn to understand estuaries and even to control them in part, but scientists cannot unequivocally and decisively determine the ways in which we should use and control them; neither can politicians, nor "environmentalists," not alone. These decisions must be made by appropriate governmental agencies in response to the needs and desires of the public.

Effective estuarine zoning must not only take into account present and potential uses of a particular segment but must also recognize existing uses of the contiguous coast. For example, one could prohibit point source outfalls in a particular segment by zoning the receiving waters, but such action would have little effect on water "quality" if there were large adjacent non-point sources, from, for example, agricultural runoff, or septic field drainage. In many estuaries, these non-point sources have a much greater impact on water "quality" than do point sources.

Formulation and adoption of a comprehensive zoning plan for estuaries would proceed through the same general steps used for zoning of the land. These include:

I. Determine uses and assign priorities both regionally and for smaller segments.
II. Formulate goals and objectives.
III. Conduct appropriate water surveys:
    - Hydrography
    - Biota
    - Sediments
    - Topography
IV. Prepare the formal zoning plan.
V. Hold public hearings.
VI. Prepare and adopt the zoning plan (ordinance) as a legal document.
VII. Administrate the zoning ordinance.

The zoning ordinance would consist of a series of maps delimiting the various zones and a text. The text would explain the goals and objectives of the zoning system and the rationale behind the designation of the various zones. A detailed discussion of zoning procedures is beyond the scope of this paper; these have been described at some length in a variety of publications (6) and will not be commented upon further.

ZONING FOR DISPOSAL OF DREDGED SPOIL--A CRITICAL NEED

The need for a particular type of zoning is imminent; zoning for disposal of dredged spoil. The rapid sedimentation rates characteristic of estuaries pose a serious immediate threat to one important estuarine activity--shipping--and therefore to the "quality" of many people's lives. Most of the nation's major ports are located in estuaries, and in fiscal terms shipping is the second most

"important" use of estuaries (1). According to the Baltimore Port Authority (7), approximately one-half of all jobs in Maryland are dependent either directly or indirectly on the Port of Baltimore. While this figure may be inflated, it is clear that disruption of the activities of the Port of Baltimore, or of any other major port, would result in serious economic perturbations.

Shipping is an important and legitimate activity. Most shipping channels require periodic dredging even to maintain their project depths. The intensity of the dredging, and the disposal of the dredged materials have created a great deal of concern, discussion, and speculation about the impacts of these activities on the "quality" of the estuarine environment. The magnitude of dredging activity in the United States is staggering. According to Boyd et al. (8), there are currently about 35,000 km of waterways and 1,000 harbors (including the Great Lakes) that must be kept open to support the nation's waterborne commerce. Each year approximately 230,000,000 m^3 of maintenance dredging is carried out. And an additional 61,000,000 m^3 of material is dredged in conjunction with new projects, or to increase the capacity of existing systems.

There have been several recent reviews of the effects of dredging and spoil disposal on the estuarine milieu and biota (9, 10). Shipping channels occupy a very small fraction of the total area of most estuaries and even if these channel areas were totally sacrificed--which is very improbable--it is unlikely that the losses would be biologically significant; and in any event the economic benefits of the channels probably far outweigh any potential "environmental" losses. It is clear that the greatest potential impact of dredging is not from the actual removal of the material, but rather from the disposal of it. Any effects of disposal are clearly a function of the mass and character of the material to be disposed of, the method and time of disposal, and the character--physical, chemical, biological, and geological--of the host environment. Assessment of the probable impacts of disposal depend upon a knowledge of all of these factors.

In an attempt to mitigate the impacts of spoil disposal on the aquatic environment, Federal agencies have established chemical criteria for determining the acceptability of dredged materials for disposal in open waters. At the time of this writing the criteria are being reevaluated. The criteria presently in use were intended to be "environmentally conservative," but they appear to be unduly restrictive with respect to certain designated parameters, and completely disregard a number of other potentially important contaminants including PCB's, pesticides, and others. The criteria do not, in any case, have a sound scientific basis (11, 12).

Criteria governing the disposal of dredged materials should not be based on total concentrations of contaminants, but rather they should be based on the total masses of contaminants in the dredged material that are available for biological uptake; the masses of the reactive fractions. The elutriate test is an attempt to assess the concentration of the available fraction, but the test appears to be of little value in predicting long-term ecological impact. Even with the formulation of "appropriate" criteria and standards for disposal of dredged materials, decisions on dredging and spoil disposal should be based on the biological, chemical, geological, and physical characteristics of the particular estuary. The uniform application of Federal criteria and standards has little merit other than simplicity of enforcement.

Estuary-wide dredging and spoil disposal programs should be developed to ensure that maintenance channel dredging

can be carried out without prolonged delays. The plans should also be flexible enough to provide a mechanism for decision making on requests for other types of dredging permits. Such plans should include the designation of a variety of types of sites (overboard, diked, etc.) for disposal of different types (quantities and "qualities") of dredged materials. Not all dredged material is spoil, and certain types of spoil may have a greater environmental impact if disposed of in aerobic diked areas, than if disposed of by more conventional overboard methods within oxygen-deficient areas of an estuary. The loss of valuable fringing wetland areas through filling must also be controlled. There is little doubt that scientifically defensible regional disposal plans could be developed. Whether such plans would be politically acceptable is quite another matter.

If regional dredging and spoil disposal plans are not developed promptly, the activities of a number of major ports may be significantly affected, resulting in serious economic perturbations. The observation that a number of our major ports are poorly located is to some extent correct but the suggestion that they should be moved is naive at best. Major ports could not be relocated without serious economic upheaval, and the lead time to implement any such proposals would be decades. The growth of some large ports located near the heads of estuaries should, however, probably be controlled. Baltimore may be such a port.

CONCLUSIONS

If a new approach to estuarine management is not adopted there will probably continue to be little evidence of improved water quality even if standards are made more stringent and expenditures for pollution control are increased. And the true value of the estuarine zone will continue to be diminished not only because of loss in water "quality," but also because of increased restrictions and prohibitions on non-recreational and fisheries uses of estuaries. A regional estuarine management plan should be developed for each estuarine system that is based on the prevailing biological, chemical, geological, and physical processes that characterize that system. The management plan should be based upon zonation of the estuary, in a manner which is compatible with the adjacent coast. The development of an effective estuarine zoning plan depends upon the assignment of priorities to the various uses, and a partitioning of these uses among various segments of the system. Zonation does not eliminate the need for good waste treatment and environmental standards and criteria; rather it would replace the present indiscriminate approach which is not technologically, scientifically, or economically sound, with a concept that calls for adjustment of water quality criteria and standards to characteristic processes of the environment and to the uses of the environment that are perceived to be most important.

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