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Balancing Conservation and Development in Maryland's Coastal Zone: A Program Evaluation

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BALANCING CONSERVATION AND DEVELOPMENT IN MARYLAND'S COASTAL ZONE: A PROGRAM EVALUATION

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Abstract

An evaluation of a federal regulatory program administered by the Baltimore District Corps of Engineers (COE), governing certain development activities in Maryland's coastal zone, was conducted to (1) identify cumulative development and wetland impact outcomes that occurred over a 5-year (1981-1985) period; and (2) assess a component of the decision-making process that resulted in these outcomes. This study focuses specifically on program coordination between the COE and the National Marine Fisheries Service (NMFS) to evaluate how the process has been affected by (1) programmatic changes resultant of the Reagan Administration's regulatory reform; and (2) societal demands as indicated by changes in coastal development. Evaluative results not only help to identify district/regional-level program deficiencies, but also to emphasize changes necessary to improve federal agency policies.

Effectiveness of interagency coordination between the COE and NMFS in the public interest review was contingent upon the extent to which NMFS recommendations ("conservation efforts") were accepted by the COE. Conservation effort values were based on (1) ranked wetland habitats; (2) the magnitude of habitat impact; and (3) areal extent of habitat NMFS desired to conserve.

Coordination effectiveness between the COE and NMFS in the public interest review was not significantly affected by decreasing mean annual permit processing time that occurred over the 5-year period. NMFS' conservation efforts were adversely affected by (1) reform measures shifting the "burden of proof" to the resource agencies; and (2) the declining quality of interagency joint-permit processing. Manpower limitations and subjective value judgements made by NMFS staff were

other probable indirect influential factors. Measures to improve the effectiveness of interagency coordination and to better approximate a balanced public interest review are discussed.

Outcome evaluation identified similar development patterns among Maryland's four coastal regions. Regions were comprised of coastal counties experiencing both nodal and diffuse development. Counties were often characterized by specific types of development. Private marinas, especially "dockominiums" and wildlife enhancement impoundments are two development activities significantly increasing in Maryland.

Projects authorized by the Baltimore District COE resulted in the loss of 913.1 acres of vegetated and non-vegetated coastal wetlands, alteration of 1280.8 acres of estuarine subtidal habitats, and a gain of 687.9 new wetland acres. Estuarine irregularly flooded emergent and palustrine forested wetlands sustained the greatest habitat losses. Significant percentages of wetland losses were attributed to a limited number of large major impacts.

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I dedicate this work to Mom and Dad

and

to all others who share a keen sense

for our environment.

Table of Contents

List of Tables

Page

Page

List of Figures

Chapter I
Introduction

The coastal zone is a precious resource in great demand. Much of the nation's population is concentrated along the coast where the shore provides an ideal place to live, work, and play. Undeveloped coastal areas are becoming increasingly more valuable, both economically and aesthetically, as fewer shorelands available for development remain.[1] Other resources such as valuable oil and gas and hard mineral deposits are extracted from the coastal zone. Favorable sites to construct energy-producing facilities, aquaculture operations, coal and oil terminals, and shipping ports as well as locales to dispose of sewage, construction, and dredge wastes are often located along the coast. Additionally, many historic, archaeological, and cultural values are often located along the coast. The nation's shoreline, a mecca of finite resources, is truly under siege.

The nation also benefits from the ecological significance of the coastal zone. The coast provides attractive habitats for many fish and wildlife species. Estuaries and coastal waters serve as valuable spawning, nursery, and feeding sites for many commercial and recreational fishery resources. Coastal wetlands function as nutrient sources or sinks, produce detritus supporting marine ecosystems, reduce flooding impacts and erosion problems, absorb or transform pollutants, and provide refuges for waterfowl and other wildlife including endangered species. Barrier islands and other coastal systems serve as buffers to protect the mainland from hazardous storm surges. Each physical and life component of the ocean basin or basins and watersheds

or drainages entering these basins interacts with others thus contributing to a complex ecosystem.

Although the socioeconomic and environmental values of the coastal zone are realized by our society, the competitive realities of attaining each of these benefits are also apparent. Man has attempted to strike a balance between conservation and economic development of coastal resources by implementing innovative mechanisms to manage the coast. Laws enacted attempt to govern and permit rational coastal development, while simultaneously protecting the environment in the public interest.[2] In turn, these public policies are translated into operational programs empowering designated agencies to regulate coastal development or planning.

Decision outcomes of coastal programs are influenced by a system of governmental checks and balances via a myriad of public agencies sharing decision-making responsibilities. Although regulating powers are most often delegated to a single governmental entity in each particular coastal program, the agency must first communicate, coordinate, or consult with other participant agencies in the program (in addition to addressing issues raised by the individual or organized interests) prior to making a final management decision.[3] Through this interagency (and intraagency) process, coordinated efforts are expected to achieve a better approximation of the public interest in the decision outcome.

Society must question the effectiveness of coastal management programs to ensure the most broadly representative decisions are reached. One presumes that a program, guided by comprehensive public policies and regulated by an efficient governmental agency, will be effective (excluding political influence) in generating decisions most

conducive to the needs of society. However, program effectiveness is limited to the extent outcomes are based upon interagency coordination and cooperation. Coordination is complicated by a broad range of agency missions encompassed in the realm of coastal management.[4] Numbers of participant agencies, responsibilities of each agency, and the diversity and conflict among agency missions are primary factors constraining program outcomes. Hence, are cooperative interagency objectives attained in coastal management programs? More importantly, are coastal programs effective in achieving their intended goals?

All coastal programs are likely inhibited to some extent by problems associated with conflicting interagency goals. A means to improve effectiveness (or efficiency) of a program can be achieved through evaluative methods. One solution is for each agency involved in a particular program to sustain a self-evaluating capacity that leads to improving its role in the program.[5] In turn, self-evaluations should lead not only to improvements in agency participation but also to more advantageous changes in the overall program.

"Evaluation" by definition is the act or result of appraising, judging, rating, or interpreting the worth, quality, significance, or condition of something.[6] Evaluation, in the context of this discussion, centers on explanation, assessment, and prediction of public programs based on empirical evidence and analysis. The purpose of evaluation research is to measure the effects of a program against the goals it was intended to accomplish as a means of improving subsequent program decisions and implementing alternative policies. Program goals and objectives must first be identified prior to measuring program outcomes (i.e., the results of outputs) and governing processes. Thus, process

evaluation is concerned with the extent to which a program is implemented according to stated guidelines, whereas outcome (or impact) evaluation is concerned with the extent to which a program causes change. Then, conclusions can be drawn on the effectiveness or efficiency of a particular program, thereby providing results which may lead to program improvements.[8]

Evaluations in the past have primarily addressed social programs.[9] Although these studies have been conducted in many diverse social fields, all have been generated with one primary intent - the purpose for which it is done. Thus, in evaluation research, one begins with the program (the independent variable) and then assesses how the program affects intended goals.[10] Evaluations are generated to address questions posed by decision-makers and to determine whether implemented policies are providing the most effective results for society.

Evaluations of state, regional and local coastal management programs were initiated in the mid-1970's identifying coastal issues, development impacts, and the decision-making processes that influenced these outcomes. West Coast programs implemented in the early 1970's were subject to initial evaluation efforts. One or more of the six regional commissions established by the 1972 California Coastal Act were assessed in case studies to determine whether and how program goals were achieved.[11-15] An early evaluation was also conducted on the state regulatory program established by Washington's Shoreline Management Act.[16] Although various resource-use goals (e.g., land-use, public access, environmental protection) were evaluated through several methodologies in these studies, results were valuable in identifying

decision-making processes that were effective (or ineffective) in attaining policy goals.

Several authors suggest the need for program evaluations and postulate not only what coastal programs should be evaluated,[17] but also ways in which programs could be assessed.[18,19] Others emphasize the need for more extensive evaluations which link resource outcomes with organizational processes, so that remedial actions can be taken to alleviate programmatic deficiencies.[20]

More recent coastal program evaluations have incorporated some of these initiatives. Results of two separate studies of Rhode Island's Coastal Resources Management Council (CRMC) indicate that decisions made by the regulatory agency were based upon a case-by-case mitigation process, rather than a comprehensive approach utilizing specifically defined criteria to achieve state objectives.[21] One study conclusion rationalizes that CRMC could improve decision making effectiveness to protect valuable coastal resources including tidal wetlands through alternative mechanisms.[22] An evaluation of a Canadian Great Lakes shore policy restricting development in hazard-prone areas concludes that the program was ineffective and inefficient in controlling development.[23] Violations of regulatory procedures and lengthy delays in the decision making process were two common occurrences identified by the study. The authors provide several recommendations to improve the permitting program. Additionally, an empirical study of California's Coastal Zone Conservation Act concludes that policy goals were achieved, as the legislation had a positive effect on increasing regional beach-use.[24]

In addition to these program evaluations, the Coastal Zone Management Act requires federal studies of state management

programs.[25] Section 312 of the Act outlines responsibilities of the Office of Coastal Resource Management (OCRM) for ongoing evaluations to assure that the states implement their coastal plan, measure the success or failure of the program, and provide measures for ongoing program accountability. Critics have identified numerous problems associated with OCRM evaluations which attempt to classify state program success or failure via effort, compliance, and performance.[26,27]

Few published studies have assessed federal environmental regulatory programs except those evaluations conducted by the U.S. General Accounting Office (GAO).[28] Often, GAO studies are conducted by professionals unfamiliar with programs being evaluated, and consequently, findings seldom link programmatic outcomes with specific decision making processes. Internal federal agency program assessments are submitted to Congress for agency accountability and appropriations, but frequently generate only generic recommendations justifying agency stability or expansion, rather than identifying programmatic dysfunctions. Thus, internal agency assessments are partial evaluative sources that should be carefully interpreted.

This study focuses on the federal regulatory program administered by the Corps of Engineers (COE) governing certain development activities in and adjacent to waters of the U.S. Three principal mandates[29] authorize the COE to permit or prohibit coastal development activities, whereas agency regulations[30] address substantive programmatic procedures. Central to the program's decision making process is a public interest review requiring careful weighing of all those factors relevant to a particular proposal.[31] Hence, program decisions are attained through the consideration and balancing of socioeconomic and

environmental factors best approximating the public interest. The overall goal of the program, therefore, is implicit in this balancing process.

As part of the program's review process, the COE is required to consult with federal and state agencies responsible for the conservation of fish and wildlife resources,[32] and is mandated[33] to equally consider (in relation to all socioeconomic factors) these resources in reaching a permit decision. The National Marine Fisheries Service (NMFS), the federal agency responsible for the conservation and management of living marine resources and their habitats and protection of certain endangered species, contributes consultative efforts in the review process in order to fulfill these agency goals.[34] The advisory role contributed by NMFS and the coordinated efforts achieved between the agency and the COE in the review process is the principal program action evaluated in this study.

The purpose of this study is two-tiered. The first is to identify and evaluate program outcomes (development and associated habitat impacts) within a spatial and temporal context and relate those outcomes to the program process. The second objective is to evaluate how the coordination process between NMFS and the COE has been affected by (1) programmatic changes resultant of the Reagan Administration's regulatory reform; and (2) societal demands as indicated by changes in coastal development. Study results will identify causal relationships between program outcomes and the coordination process between NMFS and the COE.

Two principal programmatic changes relative to this thesis have occurred via regulatory reform. In 1981, the Reagan Administration directed federal regulatory agencies to increase cost-effectiveness of

their programs.[35] Soon after, the COE initiated mechanisms to decrease the average time needed to process a permit and to reduce overall regulatory burden within the program. The second programmatic change occurred in 1984 when the COE released final amended regulations governing the permit program. The most substantive regulatory revision implemented by the COE was to shift the "burden of proof" from the applicant to the resource agencies (i.e., NMFS and other federal and state entities) participating in the public interest review.[36] Thus, new regulations require the advisory agencies, rather than the applicant, to provide scientific documentation supporting their position on a particular development proposal.

Taking into consideration these reforms in the COE's regulatory program, it is hypothesized that the success of NMFS' advisory role in the public review process has diminished over time as a result of altered interagency coordination and program reforms. Testing of this hypothesis will be limited spatially and temporally to a 5-year (1981-1985) study of NMFS' consultative efforts in the Baltimore District COE's program addressing projects sited in Maryland's coastal zone.

A second hypothesis of this study tests whether distinct trends and rates in project development and coastal impacts have occurred in coastal Maryland over the 5-year period. Hypothesis testing will be limited to total numbers of projects proposed annually in Maryland's coastal counties and regions over the 5-year period. Results will identify all causal relationships between program outcome and process and how changes in coastal development patterns may affect the effectiveness of the coordination process.

Chapter II
Program Overview

The Corps of Engineers 10/404 Regulatory Program

The two principal federal statutes regulating wetlands alteration and influencing coastal development are the Rivers and Harbors Act (RHA)[1] and the Clean Water Act (CWA).[2] Under Section 10 of the RHA and Section 404 of the CWA, the Corps of Engineers (COE) is delegated authority by the Secretary of the Army to regulate certain coastal development activities.[3] Each mandate regulates certain activities according to spatial limits, although the statutes generally act in concert to regulate the use and alteration of coastal habitats.

Section 10 of the RHA prohibits the unauthorized alteration or obstruction of any navigable water of the United States. The construction of any structure in or over any navigable water, excavation of materials, or the accomplishment of any work affecting the course, location, condition, or capacity of such waters is forbidden unless the work has been authorized by the District Engineer acting through the Secretary of the Army.[4] Section 10 jurisdiction is limited to those waters that have been defined as "navigable".[5] Prior to 1968, the COE was authorized to consider only potential impacts that could affect navigation. After 1968, permit criteria were expanded to also include values typically supporting coastal habitat protection (e.g., conservation, fish and wildlife, antidegradation) and others generally favoring development (e.g., water supply, energy needs, interstate commerce).

Although wetlands protection is not a stated goal of the RHA, regulation under Section 10 serves to protect coastal habitats against

some development activities that are not under jurisdiction of Section 404 of the CWA. In addition, Section 10 does not exempt any activities from coverage, whereas Section 404 may. Hence, Sections 10 and 404 act in a complementary manner to regulate coastal development activities.

Section 404 is the principal statuatory force controlling wetlands alteration. Prior to 1975, Section 404 governed dredging and fill activities occurring only in "navigable waters" as part of the CWA's overall purpose to improve water quality. In 1975, a landmark judicial decision expanded the COE's 404 authority to include all "waters of the United States" and resulted in the protection of more wetlands habitat after 1977.[6]

At present, the 404 program covers nearly all activities resulting in dredged and fill material discharges into these waters and wetlands, although some specified exemptions remain.[7] Other activities involving excavation, drainage, clearing, and flooding of wetlands are not explicitly covered by Section 404 and may or not be covered by Section 10.

The Permit System

Sections 10 and 404 activities require permits issued by the Secretary of the Army acting through the District Engineer. Individuals seeking to conduct such activities must apply for and obtain a permit from the regulatory branch of the local COE district office.[8]

The Baltimore District, similar to other COE districts, issues four types of permits.[9] Standard individual permits are issued for both Sections 10 and 404 projects requiring a case-by-case evaluation of the proposed discharge(s)[10] and/or specific structure(s) or work.[11] In most instances, an individual permit is required for proposed activities,

unless the District Engineer determines that the activity will not have a "significant" individual or cumulative impact on environmental values and will encounter no appreciable public opposition. Individual permits processed by the Baltimore District are the primary component evaluated in this study.

Letters of permission (LOPs) are required for certain activities subject to Section 10 but are determined by the District Engineer to have no significant environmental impact.[12] Hence, LOPs may be utilized for minor projects. In the Baltimore District, LOPs are typically issued for small private pier construction requiring no wetlands fill. Since projects qualifying for a LOP within the Baltimore District are reviewed by the resource agencies in the regulatory process, the permits are included in this study in addition to standard individual permits.

The two remaining permit types are general permits. General permits are required for certain Sections 10 and 404 maintenance activities and result in only "minimal" individual and cumulative environmental impacts.[13] The COE issues two types of general permits. Regional general permits (GPs) are issued by either the Division or District Engineer. The authority issuing the permit may further append specific conditions to a GP to best protect the public interest.[14] The Baltimore District has been issuing 3 types of GPs since 1981.[15]

The second type of general permit, the nationwide, authorizes a category of activities throughout the nation and allows work to take place, while reducing needless delays and paperwork that may occur during individual permit processing. However, the Division Engineer is delegated discretionary power to override nationwide coverage and require an individual or regional permit.[16] In most instances,

nationwide permits result in minimal adverse environmental impact. Minor bank stabilization projects that result in no wetlands fill represent a significant percentage of the nationwide permits issued by the Baltimore District. General permits are excluded from this thesis as resource agencies are excluded from reviewing and commenting on projects qualifying for these permits.

Process Review and the Role of the Resource Agencies

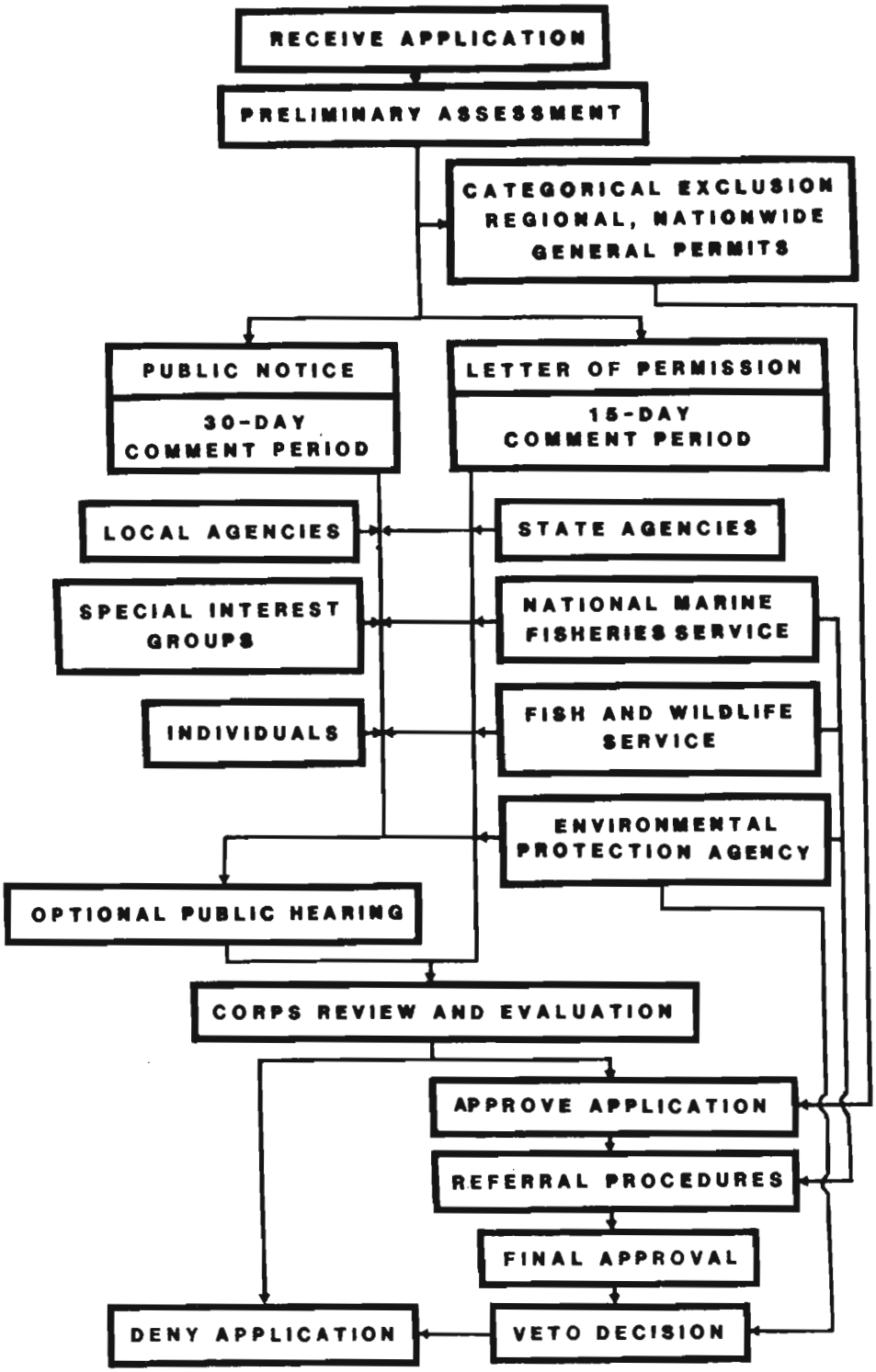
Congress passed the CWA with the intent to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters."[17] The COE, however, views its primary function in carrying out the statute as protecting water quality, while protecting wetlands are a secondary concern. To accomplish its responsibilities, the COE evaluates permit applications via a public interest review (Figure 1).

The three principal criteria that the COE uses to evaluate Section 10 and 404 projects include (1) the extent of public and private need for the proposed work; (2) the use of alternatives to achieve the objectives of the work; and (3) the extent of the beneficial and detrimental effects that the work may have on public and private uses. Hence, the public interest review, in sum, involves a general balancing of the benefits and detriments of a proposed activity with consideration given not only to environmental preservation, but also, to requirements favoring development.[18]

In addition to public interest review regulations, the COE must also adhere to guidelines implemented by the Environmental Protection Agency (EPA).[19] Known as the 404(b)(1) guidelines, these directives are the primary basis for the COE's evaluation of the effects of dredged and

FIGURE 1

THE CORPS REGULATORY PROCESS



fill materials discharged to the aquatic ecosystem. No discharge is to be permitted if there are practicable alternatives that would have less adverse impact on the aquatic ecosystem.[20] Further, the guidelines establish a presumption that practicable, less-damaging alternatives do exist for non-water dependent activities proposed in special aquatic sites including wetlands.[21] In sum, the guidelines are binding on the COE, although interpretation of the guidelines, from a legal perspective, remains speculative.[22]

To address environmental concerns in the public review process, the COE has formal consultation procedures with the federal and state resource agencies. Under the Fish and Wildlife Coordination Act (FWCA),[23] the National Marine Fisheries Service (NMFS) and the Fish and Wildlife Service (FWS) provide an advisory role in the review process. Further, the COE is required to give full consideration to recommendations provided by the resource agencies in the evaluation of a project.[24] Conservation of fish and wildlife resources is to be given "equal consideration" in the COE's evaluation and may serve as the basis for modifying, conditioning, or denying a permit.

Each resource agency plays an equal and integral role in the review process, while divergent responsibilities contribute to a complementary agency review in the regulatory process.

The NMFS has primary responsibility for the conservation, management, and development of living marine resources and for the protection of certain marine mammals and endangered species under numerous federal laws.[25] To carry out these mandates, the NMFS also serves to protect the habitats and biological communities sustaining living marine resources. NMFS' concerns are embodied in the Habitat

Conservation Policy,[26] while the agency's consultative role in the review process is carried out through regional offices.[27]

Although the NMFS has no formal guidelines identifying the criteria used to review permit applications, agency personnel base their comments on three principal elements. The NMFS considers whether (1) a project is water-dependent; (2) the proposal is the most feasible alternative minimizing adverse impacts to aquatic resources; and (3) the project is in the public interest. Additionally, the NMFS reviews Sections 10 and 404 activities by adhering to more specific criteria defined by informal agency guidelines.[28]

The FWS reviews permit applications and provides comments according to formal agency guidelines. In 1981, the FWS adopted a mitigation policy that established guidelines for reviewing project proposals and providing recommendations to minimize impacts to fish and wildlife resources.[29] The guidelines establish review criteria, so that resource losses are immediately rectified, reduced, or eliminated over time. Those losses which the FWS cannot prevent are to be compensated by like replacement, so that the total loss of habitat values is eliminated.[30]

In addition to promulgating the 404(b)(1) guidelines, the EPA, similar to NMFS and FWS, reviews Sections 10 and 404 projects to ensure that environmental impacts are minimized. The EPA also provides standard procedural conditions for Section 404 projects permitted by the COE. Most importantly, the agency has been delegated powers to veto or alter 404 permits issued by the COE that violate the 404(b)(1) guidelines.[31] These powers to override a COE decision thereby provides EPA with the most substantive powers of any of the federal resource agencies involved in the permit program.

State resource agencies also provide impetus to the review process. In Maryland, the Water Resources Administration (WRA) reviews and comments on activities requiring Sections 10 and 404 permits issued by the Baltimore District COE. The WRA issues coinciding permits for activities occurring in "private" wetlands, while the State Board of Public Works issues licenses for activities taking place in "state" wetlands.[32]

In addition, any activity that may result in a discharge to navigable waters requires water quality certification by the Department of Health and Mental Hygiene.[33] Proposed activities must also be consistent with the state's coastal management program, and therefore, a positive determination is requisite by the Coastal Resources Division of the state's Department of Natural Resources.[34] Lastly, the Maryland Port Administration of the Department of Transportation issues construction permits for all port-related activities in state waters, generally located within the Port of Baltimore. The WRA, however is the principal state body influencing decisions in the COE regulatory process.

Upon receipt of a request for a permit application, the COE determines whether the proposed project qualifies for either an individual, LOP, or general permit. Activities qualifying for an individual permit require public review. A public notice (PN) is prepared containing information on the nature and magnitude of each proposed activity necessary to evaluate the probable impact to the public interest.[35] Copies of the PN are forwarded by the COE to each federal and state resource agency and distributed to local agencies and

the public for review and comment. A comment period of not less than 30 days is provided for activities requiring a standard individual permit.

The Baltimore District COE does not provide a PN for activities qualifying for a LOP, GP, or nationwide permit. Resource agencies are consulted for project review of activities requiring a LOP, and are provided a 15-day comment period.

Joint agency procedures have been established to improve coordination and expedite the decision making process, while still protecting the applicant's right to a full public interest review.[36] Procedures include early pre-application meetings, joint site inspections, and joint permit processing.[37] Formal meetings and other joint procedures are attended by COE, NMFS, FWS, EPA and state agency personnel, and in some cases, the applicant or designated representative. Agency concerns are aired at the meetings, while each agency still retains its right to respond to a proposal, regardless of the positions of the other agencies present. The Baltimore District COE initiated joint processing procedures in 1975.[38]

Federal resource agency authority in the Section 404 regulatory program is strengthened by formal Memoranda of Agreements (MOAs) between the COE and the agency.[39] The MOAs are procedural guidelines for each agency, and provide a referral mechanism for higher-level review of interagency disagreements that cannot be resolved at lower-levels of authority. In the past, permit applications could only be elevated on the grounds of procedural questions, or issues considered to be of "national significance."[40] Current MOAs establish local environmental or fish and wildlife concerns as valid grounds to implement elevation procedures.[41]

Chapter III
Study Area: Maryland's Coastal Zone

Physiographic and Ecological Description

The Coastal Plain covering approximately half of Maryland's area is a distinct physiographic region distinguished by its geologic structures and sequential physical surface processes. The province extends from below sea level on the continental shelf westward to the Piedmont region. The boundary between the Coastal Plain and Piedmont Plateau passes through Washington, D.C. and Baltimore City, progresses northeastward intersecting Cecil county. The Coastal Plain's 5000 square mile (mi^2) area is dominated by an extensive, partially submerged, undulating flat surface consisting primarily of recently deposited marine sediments.[1] Seaward-dipping beds of unconsolidated clay, sand, and gravel, the result of erosive processes acting upon the Appalachian highlands, were deposited over millions of years.

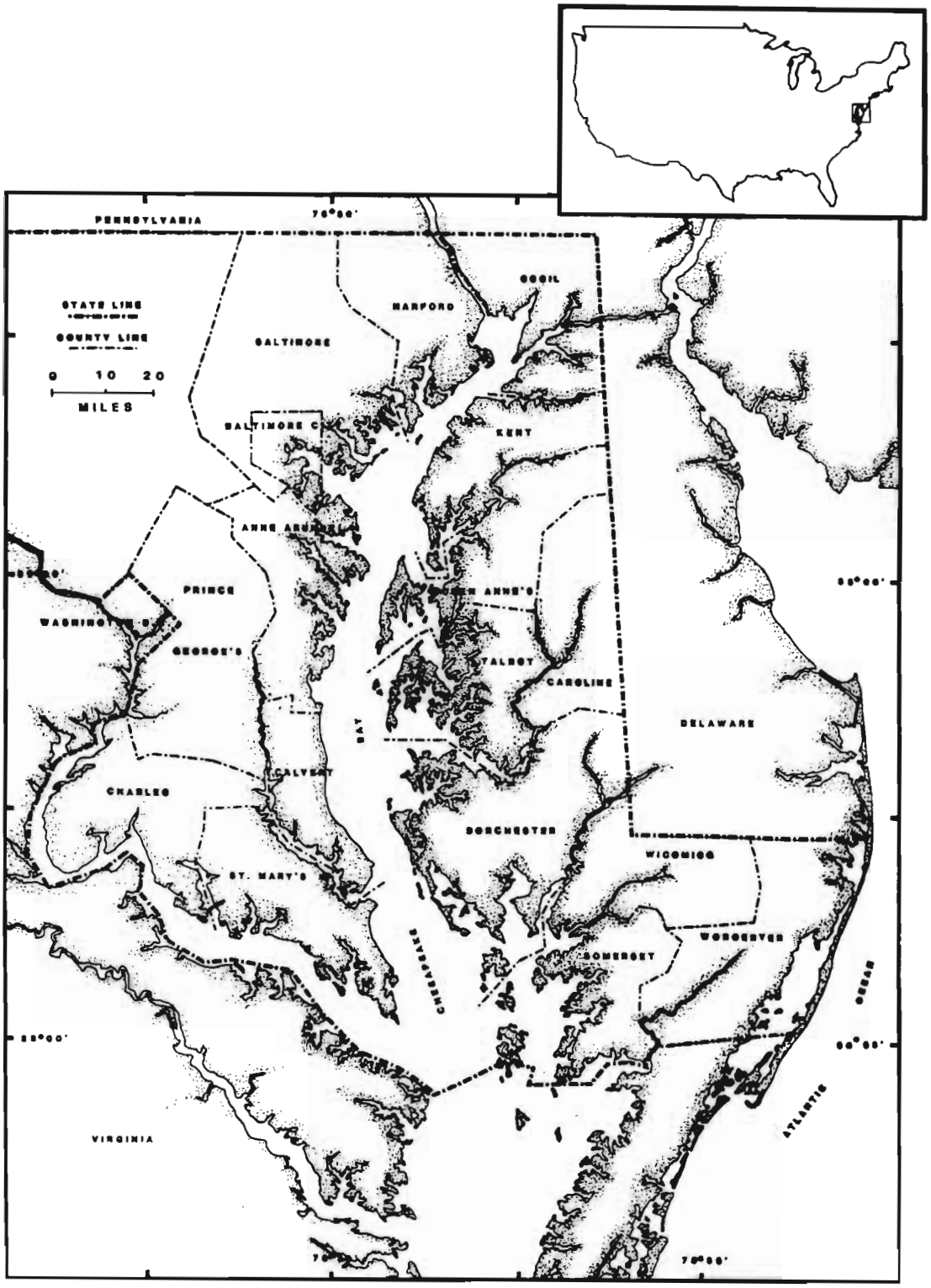
Chesapeake Bay, a drowned river valley, divides the Coastal Plain into the Eastern and Western Shores (Figure 2). The Eastern Shore is a low-lying area traversed by a complex drainage network with deeply indented bays and estuaries. Much of the land is at or near sea level with a maximum shoreline elevation of 60 feet (ft).

The Western shore is characterized by small ridge topography and several large rivers including the Potomac, Patuxent, Patapsco, and Gunpowder which transect the land prior to entering the Bay. Land elevations range from sea level to a maximum elevation (above mean sea level) of 270 ft along the Bay's edge.

Maryland's coastline bordering the Atlantic Ocean is characterized by a barrier island system. Fenwick and Assateague Islands, running in

FIGURE 2

STUDY AREA: MARYLAND'S COASTAL ZONE,
DELIMITED BY POLITICAL BOUNDARIES.



a north to south direction, are separated from the mainland by tidal lagoons - Assawoman and Sinepuxent Bays. The 31 miles (mi) of long, narrow, and fragile islands are dominated by longshore currents influencing the net southerly-directed littoral drift along the nearshore zone.

Most of Maryland's coastal zone borders Chesapeake Bay, one of the world's largest estuaries. The Bay is approximately 180 mi in length extending from the mouth of the Susquehanna River in the north to its Atlantic Ocean entrance at Cape Charles-Cape Henry (Virginia) in the south. The Bay's shoreline measures greater than 8100 mi; approximately 4000 mi of the shoreline is located in Maryland. The Chesapeake Bay ranges in width from 5 to 31 mi, covers a 4400 mi^2 surface area, and has average and maximum depths of 28 and 175 ft, respectively.[2]

Several large rivers dominate the Bay's ecology. The Susquehanna River, draining a 27,510 mi^2 area, contributes approximately half of the total freshwater inflow to the Bay.[3] The Potomac, James, Rappahannock, York, and Patuxent Rivers also contribute significant percentages of the total inflow volume (Table 1). Smaller tributaries, entering the Bay via Eastern and Western Shore drainages, contribute the remaining 6 and 2.5 percent, respectively. The entire Chesapeake Bay drainage basin measures 64,000 mi^2.

The tidal range is small, typically between 1 and 2 ft. Tidal currents range from less than 0.5 knots to more than 2 knots. Waves are generally less than 3 ft in height except during periods of extremely high winds. Salinities range from 33 parts per thousand (ppt) at the Bay's mouth to near 0 ppt where the Susquehanna River enters the Chesapeake. In addition, estuarine mixing, influenced by river inflow

TABLE 1
CHESAPEAKE BAY DRAINAGE CHARACTERISTICS*.

RIVER BASIN	DRAINAGE AREA (mi^2)	PERCENT TOTAL DRAINAGE	AVERAGE FRESHWATER INFLOW (cfs)[a]	PERCENT TOTAL FLOW
SUSQUEHANNA	27,510	43.0	39,240	51.0
POTOMAC	14,217	22.0	13,770	18.0
RAPPAHANNOCK	2,885	5.0	2,940	4.0
YORK	2,857	4.0	2,660	3.0
JAMES	10,187	16.0	10,940	14.0
PATUXENT	875	1.5	884	1.5
EASTERN SHORE	4,061	6.0	4,697	6.0
UPPER WESTERN SHORE	1,568	2.5	1,758	2.5

*Adapted from U.S. Army Corps of Engineers, 1984.
[a]cubic feet per second

and climatic factors, contributes to localized and seasonal changes in salinity, dissolved oxygen, nutrients, toxics, pathogens, and water temperature that ultimately affect biological productivity of the Bay.

Coastal Resources and Values

Man benefits from a multitude of resources and their uses in Maryland's coastal zone. Commercial and recreational fishing, hunting, recreational boating, residential and urban development, energy production, and waterborne commerce are some of the socio-economic activities associated with the coast. Maryland's coastal zone represents an aesthetically valuable resource which paradoxically, also serves as a waste disposal site. In addition, many fish and wildlife species live in, or migrate to and from, Maryland's many coastal habitats.

Fisheries Resources

Chesapeake Bay has been characterized as an "immense protein factory" because of the estuary's high biological productivity.[4] More than 2700 living species inhabit the ecosystem, each dependent upon one or more of the Bay's habitats.

Many of the Bay's living resources support important commercial and recreational fisheries generating significant economic revenues to the state. The Eastern Shore, in particular, is largely dependent upon Bay fisheries. "Watermen" or commercial fishermen who typically enter more than one fishery throughout the year are the most renowned participants in the industry. These individuals represent not only an important sector of the seafood industry, but also typify one of the important

cultural groups in Maryland.[5] In 1978, there were 17,504 licensed watermen in the state.

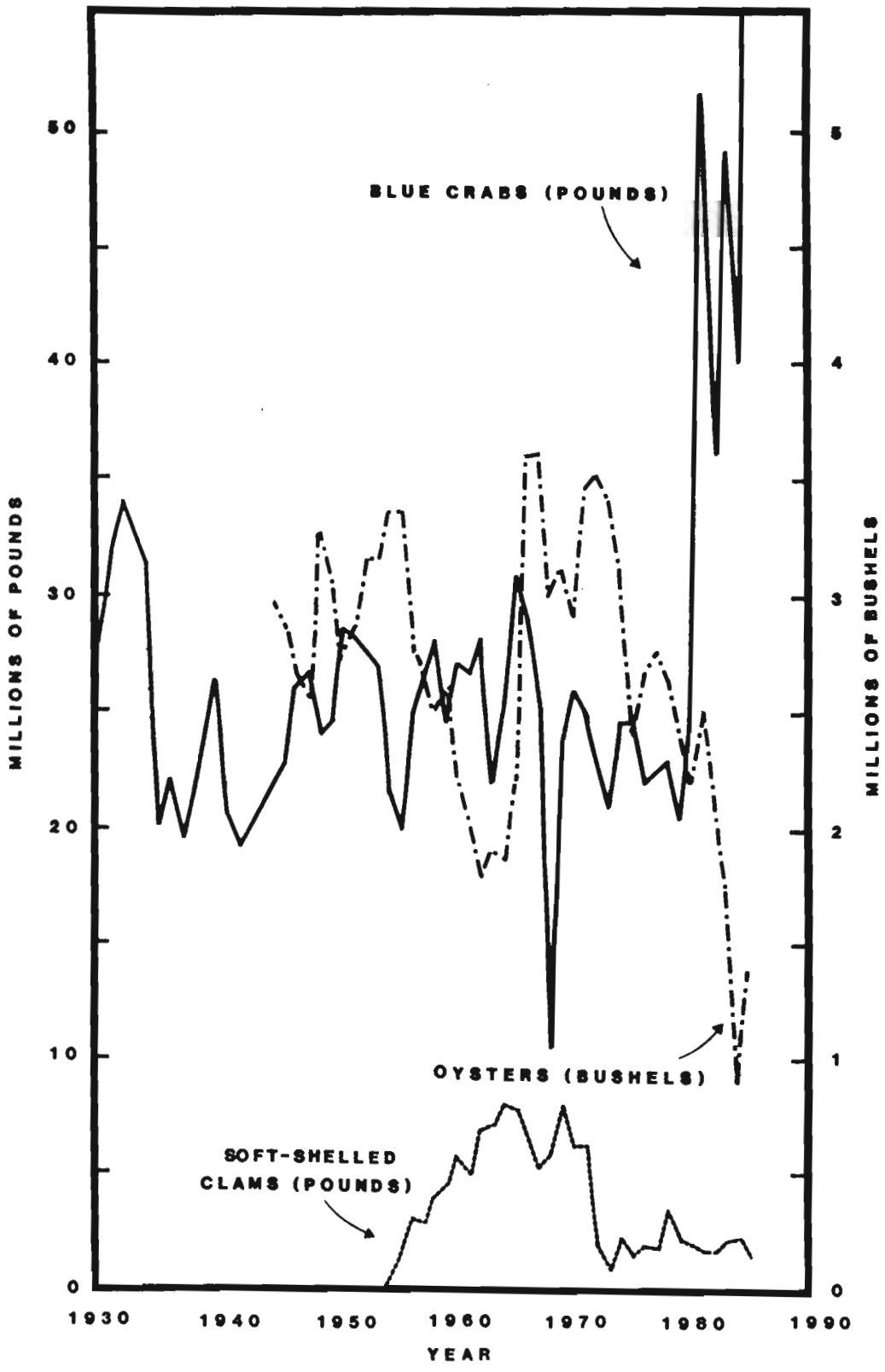
In 1983, there were 143 fish processing (70) and wholesale (73) plants in Maryland, employing 2556 permanent and an additional 846 seasonal workers. Fish landings totaled 90 million pounds with an estimated value of more than $45 million.[6] These values included resources captured in the Atlantic Ocean and landed at Ocean City. Between 1981 and 1984, Ocean City ranked 27th and 37th nationally in commercial landings by weight and catch value, respectively.

Shellfishing remains the principal commercial Bay fishery. The oyster has been the highest value species harvested in the Bay, although the Maryland (and Virginia) stocks have been in serious decline during the last several years due to several factors including: overharvesting, pollution, hypoxia, predator abundance, and disease.[7] Maryland's commercial oyster landings (1930-1985) are shown in Figure 3.

Between 4000 and 5000 watermen currently harvest oysters in Maryland.[8] The oyster fishery supports a seasonal industry, beginning in late fall and lasting through the winter. Total landings in 1984 reached 900,000 bushels and had an ex-vessel price equalling $13.6 million. Dockside value of Maryland's oyster harvest was approximately 17 percent of the total value of oysters harvested nationally in 1984. Most of Maryland's oysters are harvested and landed in lower Eastern Shore (Talbot, Dorchester, and Somerset) counties.

Between late spring and early fall, Maryland watermen harvest blue crabs, the Bay's other major shellfish resource.[9] Crabs are commercially harvested with trotlines and wire-mesh traps ("pots").[10]

FIGURE 3
MARYLAND'S COMMERCIAL SHELLFISH LANDINGS, 1930-1985.



Scraping dredges are sometimes utilized during the winter months in the lower Bay (primarily in Virginia waters).

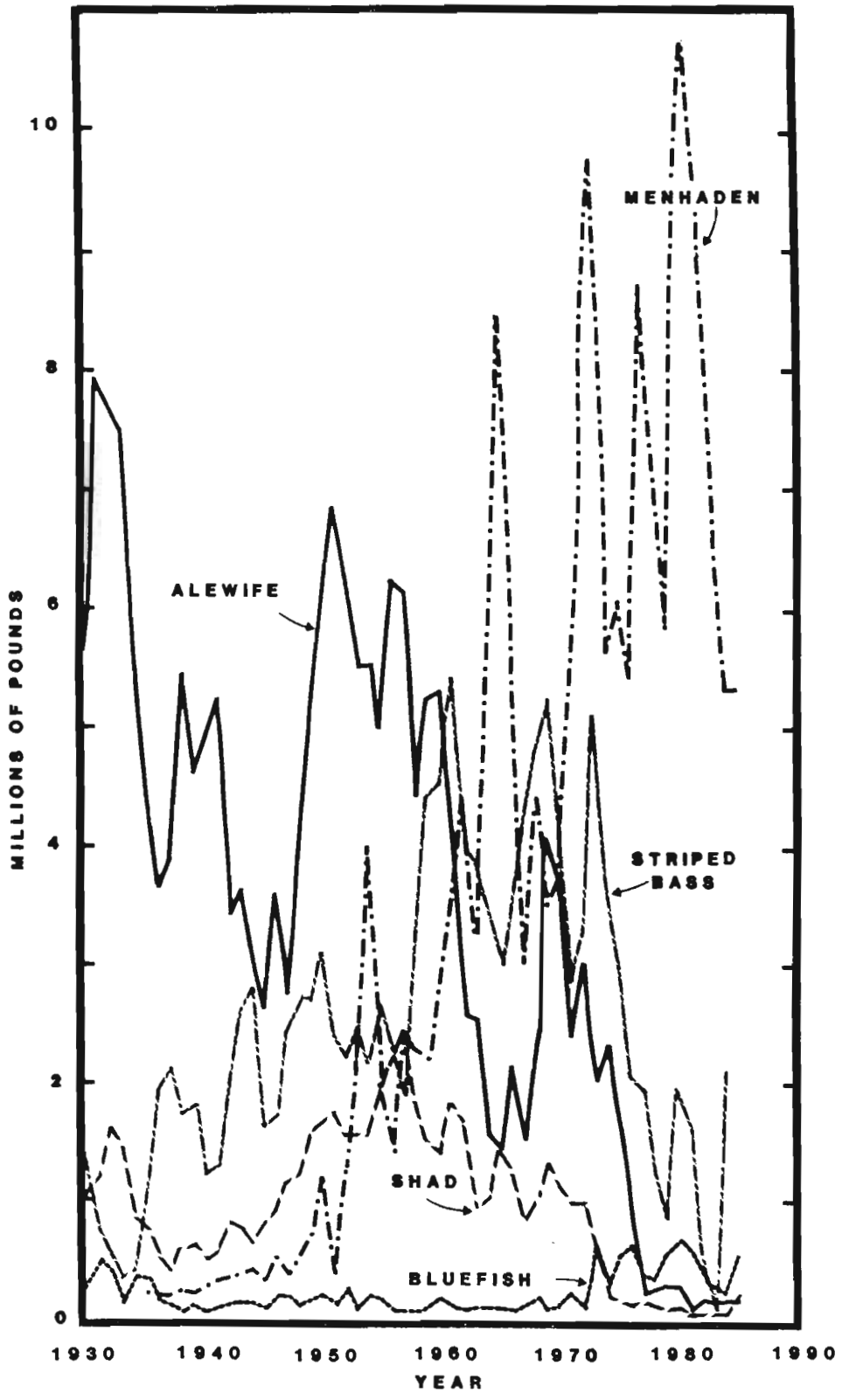
Maryland's annual blue crab landings have fluctuated around 25 million pounds since 1930 (Figure 3). During the last several years, Maryland landings have reached record levels (e.g., over 55 million pounds in 1985), and in 1984, the dockside value of blue crab landings ($22 million) exceeded the value of Maryland's oyster landings ($14 million) for the first time.[11] Maryland landings equalled 22 percent (in weight) and 40 percent (in value) of the total U.S. blue crab landings in 1984.

Chesapeake Bay also sustains a soft-shell clam fishery located primarily in the upper and central eastern Bay. Watermen use boats geared with conveyor systems to harvest clams that are typically located in silty-sand bottom sediments and water depths of 10 to 20 ft. Annual Bay landings have never exceeded 7 million pounds although the Bay harvest contributes a major portion of the total U.S. landings.

The striped bass is the Bay's prominent finfish species. In fact, its been estimated that nearly 90 percent of the East Coast population originates from Chesapeake Bay spawning waters.[12] In 1973, the Maryland commercial catch reached 5 million pounds, although the harvest has precipitously plummeted (Figure 4). Overfishing, pollution, and the loss or degradation of habitat are the primary causes identified as being responsible for the decline.[13]

A moratorium on striped bass harvest began January 1, 1985 after intense controversy over the closure.[14] However, drastic measures were necessary to curtail decimated stocks. Prior to the closure, the striped bass fishery had reached levels so low that it resulted in an

FIGURE 4
MARYLAND'S COMMERCIAL FISH LANDINGS, 1930-1985.



estimated loss of 7,500 jobs and $220 million in lost revenues to the East Coast.[15]

Chesapeake Bay supports several other commercial fisheries. Menhaden and bluefish, for example, are presently harvested by both Maryland and Virginia watermen, and the annual harvests of these species have been increasing during the last several years. Other species like the striped bass have not fared as well (Figure 4). Anadromous species including shad, alewife, and blueback herring, once supporting large commercial gill-, stake-, and trapnet fisheries, are now largely absent in the Bay. In 1980, the shad fishery was closed after landings reached a low of 20,000 pounds, a value significantly less than the million pounds plus attained a decade earlier. Landings of other Bay species (estuarine-dependent) continue to be below average. Of particular concern, it has been noted that catches of Bay-spawning species, especially the anadromous fishes (e.g., striped bass, shad) have declined, while landings of off-shore spawners (e.g., menhaden, bluefish) have increased. Changes to the habitat and overfishing are two principal causes hypothesized to be responsible for the changes in fish stocks, although direct linkages between the environment and fish populations remain uncertain.[16]

Maryland's commercial Atlantic coast fisheries are differentiated from the Bay harvest, although they make up a significant part of the state's fishing industry. At least 36 commercial vessels were based at West Ocean City in 1983, the majority of which were engaged in dredging for deepwater ocean quahogs and surf clams. Trawling fisheries for groundfish and fixed gear fisheries harvesting lobster, red crab, and black sea bass also exist.[17] A seasonal swordfish longline fishery is

carried out by a few local boats which are joined by transient boats from the Gulf of Mexico.[18] In 1981, Ocean City swordfish landings were in excess of 300,000 pounds.

Ocean quahogs and surf clams comprise most of Maryland's total ocean harvest. Between 1981 and 1984, total annual ocean fisheries harvest averaged 22.9 million pounds and had an estimated dockside value of $10.2 million.[19]

Chesapeake Bay and the Atlantic Coast also support important recreational fisheries. In 1980, there were 598,000 fishermen in Maryland, of whom 71 percent spent 4.6 million angler days fishing in Maryland's coastal waters.[20]

Key species sought in the recreational fisheries include weakfish, bluefish, summer flounder, spot, striped bass and white perch. In 1985, Maryland's recreational harvest exceeded 7.5 million fish of which bluefish (34 percent), spot (13 percent), and white perch (13 percent) were the most frequently captured species.[21] Shellfish are also recreationally harvested by many individuals. It is estimated that blue crabs are sought by as many people as are finfish, and the recreational quantity captured may equal Maryland's commercial harvest.[22]

Data are lacking which identify total economic benefits attributable to the recreational fisheries. Rents generated by these fisheries are significant. For example, fishermen spent an average $23 per trip to catch striped bass in 1979. Over 900,000 trips were made, generating more than $21 million in revenues to the state.[23] Maryland also established an angling license system for Chesapeake Bay and tidal tributaries in 1985. Approximately $1.2 million was realized from the 170,000 licenses sold during the initial 9-month period.[24]

Coastal Wetlands

Approximately 215,000 wetland acres are located along Maryland's coast (Table 2). Estuarine and palustrine wetlands are the predominant groups in the Chesapeake Bay, while estuarine wetlands predominate along Maryland's coastline (i.e., Fenwick and Assateague Islands located in Worcester county) bordering the Atlantic Ocean.[25] Estuarine emergent, irregularly-flooded species including, inter alia, saltmeadow cordgrass (Spartina patens), saltgrass (Distichlis spicata), needlerush (Juncus roemerianus), and bulrushes (Scirpus spp.) dominate (61 percent of the total) Maryland's coastal wetlands. Estuarine emergent, regularly-flooded wetlands dominated by saltmarsh cordgrass (Spartina alterniflora) and palustrine emergent wetlands populated with species including arrow-arum (Peltandra virginica), broad-leaved arrowhead (Sagittaria latifolia), pickerelweed (Pontederia cordata), spatterdock (Nuphar advena) and cattail (Typha spp.) represent other major wetland types. Regularly-flooded estuarine emergents and palustrine emergents comprise 16 and 12 percent of Maryland's total coastal wetlands, respectively.

Most of the coastal wetlands are located in Maryland's Eastern Shore. Eighty-one percent of the state's coastal wetlands are located in the 4 lower Eastern Shore counties: Dorchester (40 percent); Somerset (25 percent); Worcester (10 percent) and Wicomico (6 percent). Western Shore coastal counties contain approximately 11 percent of the vegetated wetland total. Palustrine emergent and estuarine emergent, irregularly-flooded wetlands comprise 49 and 36 percent of the Western Shore's total coastal wetlands, respectively.

TABLE 2

WETLAND HABITATS (IN ACRES) IN MARYLAND'S 16 COASTAL COUNTIES*.

	SHRUB SWAMP	WOODED SWAMP	FRESH MARSH	BRACKISH HIGH MARSH	BRACKISH LOW MARSH	SALINE HIGH MARSH	SALINE LOW MARSH	OPEN WATER	MUDFLAT/ SANDFLAT	TOTAL WETLANDS
ANNE ARUNDEL	151	17	609	1140	380	0	0	55	57	2409
BALTIMORE	16	3	1885	168	31	0	0	10	108	2221
CALVERT	24	0	428	1879	331	0	0	16	17	2695
CAROLINE	5	871	1690	766	35	0	0	22	3	3392
CECIL	281	77	1988	0	0	0	0	0	5[b]	2351
CHARLES	173	14	1047	2511	320	0	0	16	0	4081
DORCHESTER	906	6533	3075	60423	12280	0	0	2271	308	85796
HARFORD	73	177	6035	154	0[a]	0	0	37	88	6564
KENT	354	83	1230	1883	398	0	0	140	93	4181
PRINCE GEORGE'S	303	80	1915	603	8	0	0	0	0	2909
QUEEN ANNE'S	4	7	286	3021	104	0	0	134	128	3684
SOMERSET	68	1259	484	42077	6901	0	0	1829	137	52755
ST. MARY'S	59	15	20	2420	653	0	0	189	60	3416
TALBOT	32	188	1545	2675	341	0	0	131	57	4969
WICOMICO	110	1475	2429	6279	3271	0	0	68	97	13729
WORCESTER	41	5995	951	523	26	4205	9544	638	639	22562
TOTAL	2600	16798	25563	126569	25079	4205	9544	5556	1797	215111

*Adapted from McCormick, J. and H. Somes, Jr., 1982.

[a] Brackish low marsh habitat was present but was not measured by the method of estimation.
[b] Value comprised of sandflat habitat. Mudflat habitat was present but was not measured by the method of estimation.

Wetlands provide goods and services to man that arise from both ecosystem structure and function. Values potentially derived from wetland ecosystems include direct harvest of marketable products such as fin- and shellfish and the contribution of wetlands to recreation and other aesthetic values.[26] Wetland functions stem from "life support" services provided by interaction between ecosystem components. Erosion control, waste assimilation, and wildlife habitat are some of the functions provided by wetlands.

Wetland habitats sustain many commercially and recreationally important fin- and shellfish species, both directly and indirectly. Net primary production by wetland plants is high, and the bulk of the plant material dies, decomposes, and is often subsequently transported to estuarine waters.[27] There, the detritus may be directly consumed[28] or indirectly passed onto fishery resources via the food web.[29]

Wetlands and shallow estuarine waters serve as important spawning, nursery, and feeding habitats for many fishery resources.[30] More than 69 percent of the U.S commercially important fish species are estuarine-dependent.[31] Empirical studies have been conducted to evaluate wetland and estuarine habitats relevant to fishery resource production.[32] These resources provide large economic benefits to the nation.[33] Although the direct contribution of wetlands to fisheries-derived revenues is difficult to ascertain, it is assumed that the benefits generated by the fisheries are, at minimum, an indirect result of wetlands and coastal habitat productivity.

Wetlands also provide essential wildlife habitats. Wildife species utilizing wetland and adjacent riparian habitats include, inter alia, bob-white quail, pheasant, eastern cottontail, woodcock, and white-

tailed deer.[34] Waterfowl, wading birds, and shorebirds heavily utilize wetlands, particularly those located in the Chesapeake Bay.[35] Many of these wetland-associated wildlife species generate significant economic rents through hunting and other aesthetic pleasure (e.g., bird-watching).[36]

Erosion control is another function served by wetlands. Wetland and submerged aquatic plants trap sediments, maintain channels by directing currents, and dissipate wave energies that influence coastal erosion processes.[37]

Wetlands also have the ability to store and convey floodwater. Runoff entering wetlands is retained, thereby reducing floodpeaks and the frequency of flooding and delaying crest of floods in downstream areas. River velocity may further be slowed, so that erosive forces are ameliorated. The value of wetlands to floodpeak reduction is typically dependent on area of the wetland, location downstream, magnitude of flooding, and the degree of enroachment on the wetland. Some wetlands save millions of dollars annually in flood loss prevention.[38]

Waste assimilation is a wetland function that may improve water quality. Plants retain suspended material, excess nutrients, toxic chemicals and pathogens from the water flowing over and through them. The potential of a wetland to intercept and retain nutrients, however, is largely dependent upon the wetland's hydrological characteristics, wetland and plant type, and the amount of peat and organic material in the soil.[39] All wetlands have the ability to intercept nutrients and contaminants from agricultural and urban runoff and act as sinks for these pollutants. However, freshwater tidal wetlands which comprise a significant percentage of Chesapeake Bay's wetland acreage may be less

effective pollutant removers than other wetland types because of their near complete material breakdown during autumn, winter, and early spring.

Finally, wetlands have intrinsic values to many people. Besides the fishing, hunting, canoeing, and wildlife observation, wetlands provide other visual-cultural values to society.[40]

Recreation

Maryland's extensive coastline bordering the Chesapeake Bay and Atlantic Ocean offers abundant recreational opportunities. In accordance with the complexities of the Bay ecosystem, with its many unique and diverse life forms, the region is dominated by a favorably mild climate conducive to outdoor recreation.

The coastal zone provides an attractive setting for boating, sailing, swimming, camping, and picnicking activities. Bays and estuaries are ideal places for fishing and crabbing while artificial structures such as piers and jetties enhance these recreational activities. Wetlands rovide areas for hunting, birdwatching and nature walking.

Twenty state parks and forests, open to the public, are located in Maryland's coastal zone.[41] These recreational areas feature large woodland preserves, historical and archeological sites, sandy beaches, boat launching facilities, and fossil-bearing cliffs that attract thousands of visitors each year.

The federal government also maintains nature preserves in Maryland's coastal zone. Assateague Island National Seashore, incorporating 16 of Maryland's 31 miles of coastline bordering the Atlantic Ocean, is a unique barrier island ecosystem unlike Maryland's

other 4000 shoreline miles.[42] Large wetlands tracts such as the Blackwater National Wildlife Refuge also provide many public recreational benefits.

Boating is a major activity in Maryland, with more than 142,000 registered boats cruising Chesapeake Bay and other state waters.[43] Whether small fishing vessels, large powered crafts, or luxious yachts, these boats support a major industry in Maryland's coastal zone. In addition, boating contributes to and enhances secondary recreational activities.

The developed Maryland coastline also provides recreational areas. Ocean City, located on Fenwick Island, extends 15 mi along the Atlantic coast. The resort area is characterized by rows of mobile homes, high-rise condominium units, restaurants, and hotels fronting the fragile and unstable sandy shoreline. Although only a fraction of the area is open to public recreation, these avenues provide access to the 15 mi of beaches that sometimes draw more than 200,000 visitors during a summer weekend.[44]

Hence, whether it is the excitement of Ocean City, the excellent sailing waters of the Chesapeake Bay, or the solitude of large natural preserves, the Maryland coast is a recreational mecca.

Demographic Characteristics

The population of Maryland exceeded 4.2 million in 1980, a 7.5 percent increase from the 3.9 million people residing in Maryland in 1970.[45] In 1980, approximately 73 percent of the population was situated in Maryland's 16 coastal counties and Baltimore City (Table 3). The largest population increase between 1970 and 1980

TABLE 3

POPULATION OF MARYLAND'S COASTAL COUNTIES AND BALTIMORE CITY, 1960-1980*.

	1960 POPULATION (in 1000s)	1970 POPULATION (in 1000s)	1960-1970 PERCENT CHANGE	1980 POPULATION (in 1000s)	1970-1980 PERCENT CHANGE
ANNE ARUNDEL	206.6	297.5	44.0	370.7	24.7
BALTIMORE	492.4	621.0	26.1	655.6	5.6
BALTIMORE CITY	939.0	905.7	-3.5	786.7	-13.1
CALVERT	15.8	20.6	30.7	34.6	67.5
CAROLINE	19.4	19.7	1.6	23.1	17.0
CECIL	48.8	53.2	10.1	60.4	13.4
CHARLES	32.5	47.6	46.4	72.7	52.6
DORCHESTER	29.6	29.4	-0.9	30.6	4.1
HARFORD	76.7	115.3	50.4	145.9	26.5
KENT	15.4	16.1	4.3	16.6	3.4
PRINCE GEORGE'S	357.3	660.5	84.8	665.0	0.7
QUEEN ANNE'S	16.5	18.4	11.2	25.5	38.5
ST. MARY'S	38.9	47.3	21.8	59.8	26.4
SOMERSET	19.6	18.9	-3.6	19.1	1.4
TALBOT	21.5	23.6	9.8	25.6	8.1
WICOMICO	49.0	54.2	10.6	64.5	19.0
WORCESTER	23.7	24.4	3.0	30.8	26.4
MARYLAND COASTAL TOTAL	2402.4	2973.4	23.7	3087.2	3.8

*From U.S. Department of Commerce, 1973, 1982.

occurred in the Tri-County Region (Calvert, Charles, and St. Mary's Counties) and Queen Anne's and Worcester Counties, while the Baltimore City population declined by 13 percent. All other coastal counties experienced increased but slower growth between 1970 and 1980.

Baltimore City and Washington, D.C. are the principal metropolitan centers influencing much of Maryland's coastal development. The dense urban corridor between the two cities comprises part of the megalopolis dominating much of the East Coast.[46] Baltimore's population density in 1980 was approximately 9700 people per square mile (p/mi^2).

Coastal counties characterized by high population densities include Prince George's (1365 p/mi^2), Baltimore (1097 p/mi^2), Anne Arundel (886 p/mi^2), and Harford (326 p/mi^2) Counties which are situated along the Bay's central and upper Western Shore. Eastern Shore counties generally have lower (less than 170 p/mi^2) population densities than the more urbanized Western Shore counties. Smaller towns (less than 2500 people) prevail on the Eastern Shore.[47]

Residential housing coincides largely with the major Western Shore urban areas. In 1980, approximately 19.3 percent of Maryland's total housing units were located in Baltimore City. Baltimore, Prince George's, and Anne Arundel Counties are also principal residential coastal development centers. Between 1970 and 1980, the number of new homes increased 68, 61, and 51 percent in Charles, Calvert, and St. Mary's Counties, respectively. Significant growth occurred in Worcester County as housing units increased by 118 percent during the 1970's. Many of these units are condominiums and vacation homes located along Ocean City's resort area. Recreational homes contribute a significant proportional of the total housing units in other counties;

8.8 and 7.6 percent of the housing units in Kent and Cecil counties are vacation homes.[48]

In 1980, 36.5 percent of the Eastern Shore was forest covered, while crop (31.4 percent) and pasture (1.9 percent) lands were less prevalant. Lands comprising the remaining 30.1 percent included wetlands and urban areas.[49] Between 1950 and 1980, Eastern Shore land use has gradually evolved; pasture (-6.3 percent), cropland (-1.8 percent), and forest (-1.2 percent) area has declined, while urban land use has increased (9.3 percent).

The Western Shore experienced a 34.3 percent increase in urban growth between 1950 and 1980. Conversely, there were declines in cropland (-14.2 percent), pasture (-10.0 percent), and forest (-9.2 percent) lands. By 1980, urban land use comprised approximately 47 percent of the Western Shore of Chesapeake Bay.[50]

Eastern Shore agricultural lands are used primarily for vegetable, grain, cattle, and poultry production. Upper Eastern Shore farms produce corn, wheat, and hay; central eastern shore farms produce primarily vegetables and cattle, while poultry and grains are the major products of lower Eastern Shore farms. Tobacco is the principal agricultural crop produced in Maryland's central and lower Western Shore counties.[51]

Industrial and commercial growth contributes to the urban development in Maryland's 16 coastal counties and Baltimore City. Steel making, petroleum refining, production of electrical goods, printing and publishing, and food processing are important industries to the Maryland economy. Baltimore is dominated by metal, engineering, and food product industries. The Eastern Shore maintains significant seafood and

agriculture-related product industries, particularly in Dorchester and Wicomico counties.[52]

Baltimore is a major U.S. seaport located on the Patapsco River. In 1982, waterborne commerce via the port ranked (nationally) fourth in export and seventh in import tonnage valued at $8.5 and $5.6 billion, respectively.[53] Shipping of raw materials for sugar refining, manufacturing of commercial fertilizer, and steel making has been the major trade through the Baltimore port.

Man's Role in Environmental Change

Many factors influence environmental change. Natural variables such as climate, hydrology or biological interactions cause changes in coastal habitats and the organisms which inhabit them. Conversely, anthropogenic variables may be principal elements contributing to changes in the environment. Man's impacts may increase natural variability or may introduce non-natural stresses including excess nutrients, pathogens, and toxics that adversely affect coastal organisms. Coastal structures may alter physical processes such as estuarine mixing or littoral drift. Man also destroys estuarine and marine habitats by dredging, filling, draining, ditching, and impounding within these coastal areas. Changes in environmental quality, often the result of many minor, seemingly insignificant development activities, are not readily identified until these activities are assessed cumulatively.

In 1975, Congress passed legislation establishing the Chesapeake Bay Program and initiating a major research effort to identify environmental changes in the Bay (including both Maryland and Virginia

waters) resulting from man's influence.[54] The Environmental Protection Agency (EPA) released its findings in 1983, identifying trends in water and sediment quality and the Bay's living resources. Several major changes were documented: shifts in fisheries landings; an increased number of algal blooms in the upper Bay (Maryland waters); a decline in abundance of submerged aquatic vegetation throughout the Bay; nutrient enrichment in the Bay; high concentrations of toxic metals and compounds present in bottom sediments and the water column; and an increase of anoxic or hypoxic waters in the Bay's main stem.[55]

Although the EPA program identified a decline in the Bay's valued resources and a paralleled increase in nutrients and toxicants throughout the Bay, no definitive link between the two was established. It was concluded that other factors including physical alterations to the Bay attributed to development activities, and over-fishing and climatic trends exacerbated ecological stresses influencing the abundance of many of the Bay's living resources.[56] Therefore, it is essential to identify and evaluate specific development activities affecting the Bay's resources.

Numerous development activities alter Maryland's Bay and Atlantic coastlines. Coastal erosion and inundation is a major problem in Maryland. Between 1845 and 1942, Maryland lost approximtely 25,000 upland acres to erosive forces. Erosion rates in some Maryland counties (e.g., Dorchester, Talbot) exceed 1.5 ft per year.[57] To combat erosion, both structural and non-structural devices are placed in and along high-energy coastlines.[58] Construction of these structures often results in the loss of inter- and subtidal habitats and vegetated wetlands. Conversely, the structures may prevent the loss of valuable uplands and

wetlands if properly constructed. Improperly placed structures typically intensify erosion forces and needlessly destroy additional coastal habitats and upland property.

Maryland's coastal erosion problems will always prevail. Of particular concern, sea level rise exacerbates shoreline erosion.[59] Hence, many structures provide only short-term solutions to long-term erosion problems.

Waterborne commerce requires the dredging of channels and ports to adequately maintain economical depths. New and maintenance dredging activities alter Maryland's coastal waters.[60] Presently, there are 81 federal and 70 state navigational projects located in Maryland waters. Dredging of these channels results in the alteration of thousands of acres of subtidal lands and the need for adequate upland and open-water disposal sites.[61]

Smaller commercial marinas and private recreational boat basins also require frequent dredging. Although these projects are of much smaller magnitude than the larger federal projects, they too generate large volumes of spoil materials and affect subtidal lands and coastal waters by suspending sediments; altering tidal exchange, mixing, and circulation; or releasing toxic substances into the water column.[62]

Docks, piers, and other construction projects often associated with dredging activities also generate physical alterations of the Maryland coast. Solid structures result in filling and the direct loss of nearshore zones. Open-pile structures often traverse vegetated wetlands and gradually eliminate these habitats by blocking out sunlight essential to the wetlands flora. Piers, docks, and wharves may also inhibit basin circulation and flushing.

Water quality degradation is a secondary impact associated with port, marina, and small boat basin projects. Boats and vessels release toxic metals, hydrocarbons, and pathogens to the water column and bottom sediments. The problem is often exacerbated by improperly placed structures and methods which decrease flushing and tidal circulation, thereby concentrating toxicants in nearshore environments.[63]

Dams and impoundments are built for water supply, recreation, flood and erosion control, and wildlife enhancement. In Maryland, earthen dikes are often constructed in conjunction with tide gates in coastal wetland and transitional habitats. Weirs and tide gates impound upstream waters, while restricting the influx of higher saline waters. Typically, significant vegetation changes occur in response to wetlands inundation and restriction of the normal tidal prism.[64]

Agricultural detention ponds and waterfowl ponds and impoundments are the principal man-made water bodies located in Maryland's coastal counties. Farm ponds are constructed according to recommendations provided by state and federal soil conservation agencies to reduce topsoil erosion and minimize cropland impacts.

State programs have been established to create, restore, and enhance waterfowl habitats. To fulfill state objectives, impoundments are created to increase waterfowl production and enhance hunting opportunities, a major recreational activity in Maryland.[65] In addition, a tax incentive program was established in 1981 encouraging land-owners to enter into 10-year license agreements on approved projects.[66] These projects create new open-water and wetlands habitats at the expense of other upland and coastal wetland areas.

To reduce mosquito problems, marsh management practices are implemented in coastal areas such as the expansive salt marshes of Maryland's lower Eastern Shore. Ditching techniques increase fish habitat and access of fish to mosquito-breeding areas, where they can prey on mosquito larvae. These practices convert marsh areas to shallow-water habitats, although these activities may further influence vegetative patterns by inhibiting tidal exchange.[67]

Transportation structures contribute to coastal development. Causeways and bridges result in the filling and dredging of wetlands and may eliminate or reduce tidal exchange. Culverts and channelization techniques are utilized to control and divert freshwater flows to estuaries and may, in fact, adversely affect downstream coastal habitats.

Other activities associated with industrial, commercial, and residential development, silviculture and agriculture practices, and energy production also affect the coastal environment. As the coastal population continues to soar, so will many of these activities. These developments are not restricted solely to the coast; impacts upstream also effect changes in coastal environments. In 1983, over 12.7 million people lived in the Chesapeake Bay region, including all Maryland coastal counties. This regional population is expected to grow to 14.9 million by 2000.[68] Consequently, development pressures will continue to drive environmental changes, requiring man to develop innovative management strategies to conserve his valued coastal resources while simultaneously permitting further development.

Management of Maryland's Coast

Congress passed the Coastal Zone Management Act (CZMA) in 1972, a much needed plan for the use of the nation's coastal resources.[69] The CZMA was not only the national policy to manage the coastal zone, but it was also the first major national land use planning policy.

Land use planning, encompassing coastal zone management, is an inherent state function and states have traditionally delegated this authority to local governments. Local governments have responded by implementing zoning and subdivision ordinances and special codes and regulations to control development. The CZMA reflects an attempt to achieve state-federal cooperation while maintaining the existing balance between local, state, and federal governments. To accomplish the national goals, the Act was passed to encourage and assist states in developing and implementing management programs to conserve and rationally use the nation's valuable coastal resources.[70]

Responding to the federal policy, Maryland initiated work on its coastal program in 1975, and the plan was approved by the federal Office of Coastal Zone Management in 1978.[71] The Maryland plan delimits the state's coastal zone[72] and provides an organizational framework which is based on applicable state and local planning and regulatory programs forming a consistent and enforceable policy.[73] Thus, the coastal management plan incorporates existing state and local laws and programs to form a comprehensive state policy and meet the goals and objectives of the federal CZMA.

Several principal objectives are established by Maryland's program. To address complex coastal issues the plan seeks: increased coordination of study and managment efforts by state agencies; reduced

agency conflict and effort in permit programs; a mechanism for public involvement contributing to coastal decisions; and information needed to implement existing programs more effectively.[74] Hence, the accomplishment of each of these objectives is prerequisite to an effective state program and partnership among citizens, local governments, and the agencies.

Eight state departments and agencies either manage or review standards for local implementation.[75] Planning and regulatory activities include impact evaluation and siting of power plants, sewage treatment plants, port facilities, marinas, highways, and coal and oil storage terminals. State agencies also promulgate standards and guidelines for sediment erosion control, stormwater management, designation and management of historic districts and scenic rivers, and watershed management.

The executive branch, comprised of the six executive departments and two independent agencies, is organized into secretariats. In turn, each department may consist of several administrations, divisions, or bureaus which are responsible to one secretary.[76] These secretaries are responsible to the Governor who settles interagency conflicts, clarifies duties of departments, and creates interdepartmental task forces[77] that may influence coastal management decisions.

The Department of Natural Resources (DNR) is the lead agency designated to receive and administer federal (CZMA) funds.[78] Additionally, the DNR is steward of the state's coastal waters, fish and wildlife, forest, minerals, and recreational resources.

The Coastal Resources Division (CRD), a part of the Tidewater Administration of the DNR, provides staff for coordinating Maryland's coastal plan. The DNR and CRD maintain interaction and cooperation with other state departments through Memoranda of Understanding (MOU). These formal agreements are the mechanisms permitting the CRD to work cooperatively with various state agencies to fulfill the goals of the Maryland coastal management plan. MOUs provide specificity and detail to obligations incurred by each agency.[79] Lastly, the CRD conducts project evaluations to determine whether a development is consistent with state policies, and reviews existing programs and procedures dealing with coastal resources and their activities.[80]

The Maryland coastal plan also requires that all federal actions affecting coastal resources and uses be consistent with state policies.[81] Included in these actions are programs and activities conducted or supported by federal agencies.[82] Conversely, in order for the state of Maryland to receive federal administrative grants for its coastal program, all federal agencies and other government entities must be given the opportunity to fully participate the development of relevant coastal programs.[83]

Local governments provide key roles in management of the Maryland coast. The Maryland coastal plan identifies six principal components including local management structure, technical expertise, financial assistance, program evaluation involvement, participation in state-wide coastal studies, and involvement in state coastal policy-making.[84] Each of Maryland's 17 coastal jurisdictions (16 counties and Baltimore City) has a lead agency, designated by its elected officials, responsible for the coastal program in that jurisdiction. Thus, the designated agency

is the direct link between the local government and all state agencies with coastal responsibilities.

Local jurisdictions also provide technical expertise in coastal matters. Those local governments lacking technical assistance may be provided professional staff via federal (CZMA) funding. Technical support serves as a means to evaluate projects and review programs; review, analyze, and draft management plans for state critical area recommendations; and identify and document coastal problems requiring funding.

Problems identified by local jurisdictions may receive federal grants. Projects most likely funded are those which have been identified by several or more local governments as inhibiting effective management of coastal resources.

Designated lead agencies of each local government may request project evaluations for those problems adversely affecting local coastal resources. Projects identified by local governments may then be evaluated by the CRD.

Local governments also play a role in setting research and study priorities at the state level by participating in steering committees and selecting contractors to address specific issues.

County and city representatives comprise a forum which identifies local concerns relative to statewide actions, ensure that other coastal plan participants recognize and consider local management issues, and ensure that evolving programs at the local level are compatible with other program participants.[85]

Local governments enhance coastal management programs through additional organizational mechanisms. Regional planning and management

are the principal cooperative efforts. The Regional Planning Council, Tri-County Council, and the Maryland-National Capital Park and Planning Commission are such management bodies influencing coastal management decisions.[86] These bodies do not have legislative powers, so plan implementation generally requires local government and agency cooperation.

Public participation is a primary means of influencing coastal management decisions.[87] In 1976, the DNR created a 60-member committee comprised of individuals representing local governments, interest groups, and the public.[88] The Coastal Resources Advisory Committee (CRAC) also has members representing regional entities and private industry. Non-voting technical support is provided by representatives of federal and state agencies and academic institutions.

CRAC has a legislative-style organizational structure, and task-force subcommittees are established to address specific coastal issues. These task forces review and comment on technical matters and recommend policy positions to the Executive Subcommittee for consideration by CRAC.[89] Specific task force positions are subsequently reviewed and voted upon by the full committee and final recommendations are forwarded to the DNR and other state bodies.

CRAC's organizational structure is devised in such a way that it permits specific, frequently localized problems to be addressed by the forum. Hence, the diverse group of entities representing CRAC [90] provide a mechanism necessary to effectively manage Maryland's coastal resources. Conversely, the diverse and fragmented structure of CRAC may also lead to confusion and irresolution of important and often highly controversial coastal issues.

In 1983, Maryland governor Harry Hughes together with the governors of Virginia and Pennsylvania, the mayor of Washington, D.C., and the Administrator of the Environmental Protection Agency signed the Chesapeake Bay Agreement to address and initiate mechanisms to reverse the decline of the Bay's water quality and many of its coastal resources.[91] Hughes established a number of key "Bay Initiatives" in 1984, one of which was the Critical Areas Act.[92] The Act addresses land use and the effects of development on coastal habitats and water quality, and is the state's first comprehensive policy controlling local land-use planning.[93] Hence, the law is a major step forward in setting limitations on coastal development to preserve and protect the Bay.

The Act establishes a 25-member Critical Areas Commission (CAC), a "super zoning board", that is charged with developing criteria to protect the Bay's water quality and coastal habitats. The law also delimits a "critical" 1000-ft strip of land bordering the Bay and its tributaries and wetlands that are subject to resource protection and development limitations. Consequently, local jurisdictions are required to use criteria developed by the CAC in developing land use plans for those lands within the critical area.

Three principal goals are sought through implementation of the law: minimize adverse impacts on water quality; conserve fish, wildlife, and plant habitats; and establish comprehensive land-use policies for the critical area, taking into consideration that human activities in the area can create adverse environmental impacts.[94] Thus, the primary purpose is to restrict growth in undeveloped areas and permit

development, incorporating best management practices, in locations most suitable for growth.

Local governments are mandated to categorize their lands within the critical area into one of three types depending on the extent of present development. "Intensively developed areas" are those lands predominated by residential, commercial, and industrial development. These areas typically have one or more of the following: at least four housing units per acre; public sewage and water systems; or concentrated urban land uses.[95] "Limited development areas" have moderate development features: housing density ranging from one dwelling per 5 acres up to four dwellings per acre; public sewage and water systems; or areas not dominated by agriculture, wetlands, forest, barren land, surface water, or open space.[96] "Resource conservation areas" are lands dominated by agriculture, wetland, forest, barren land, surface water, or open space, or have less than one dwelling unit per 5 acres.[97]

Once each local government classifies its lands within the 1000-ft critical zone, specific criteria act as the guide to future development. Stormwater management and sediment control, in addition to other best management practices, are required for activities occurring in intensely developed areas. Forest and agriculture development and road construction are restricted in the limited development areas and soil, water, and forest management plans are required for these designated zones. Local governments must limit development in conservation areas to no more than one dwelling unit per 20 acres.

The Critical Areas Act is a major precedent limiting future growth and economic development within Maryland's coastal zone. Prior to the approval of the Act's final regulations by Maryland's General Assembly,

several local governments, particularly the Eastern Shore counties dominated by undeveloped areas, would not uphold the guidelines.[98] Further, the interim regulations resulted in a "land rush" for undeveloped waterfront property in many of the coastal counties.[99] Subdivision growth was so intensive in one county, a moratorium was implemented to end the massive land grab.[100] However, the final critical area regulations were adopted in early 1986.[101]

The Critical Areas Act presents an innovative means to manage Maryland's coastal zone by permitting limited development while simultaneously attempting to protect valuable coastal resources. The law will undoubtedly change the area's economy. However, it is apparent and officially accepted that the mandate's regulations provide essential guidelines leading to a greater balance between development and resource conservation within Maryland's coastal zone.

Chapter IV
Methodology

Program evaluation was achieved through analyses of permit applications (i.e., public notices) processed by the Baltimore District Corps of Engineers (COE). Included in the data set were proposed activities requiring Section 10 and/or Section 404 standard individual permits or letters of permission with the initial notification date between January 1, 1981 and December 31, 1985. All permit applications identifying project proposals located within Maryland's 16 coastal counties and Baltimore City limits and in or adjacent to waters of Chesapeake Bay or the Atlantic Ocean were included in the analysis. Other applications subject to the Baltimore District's jurisdiction including activities proposed in Delaware, New York, Pennsylvania, Virginia, the District of Columbia and non-coastal Maryland counties were not included in the analysis. Additionally, federal navigational dredging authorized by the Baltimore District COE and all projects addressed by an Environmental Impact Statement were not included in the analysis.

It was assumed that those individual permit applications processed by the COE and forwarded to the National Marine Fisheries Service (NMFS) field office in Oxford, Maryland comprised the total number of activities proposed within Maryland's coastal zone between 1981 and 1985. Other activities qualifying for regional or nationwide general permits were excluded from analysis because those projects are not reviewed in the permit process. NMFS does not comment on those projects qualifying for either regional or nationwide general permits, nor does the agency receive information on the permitted projects. Additionally,

the Baltimore District COE maintains minimal information on those projects qualifying for general permits. Thus, lack of general permit records prevented further data analysis in this study.

Outcome Evaluation

Application data were categorized according to project purpose, type, location (region and county), permit application notification date (differentiated according to calendar year), and the legal mandate(s) to which the project was subject. Permit applications often identified several project purposes. In those cases, the project was categorized according to the assumed primary purpose stated in each public notice. Some proposals, however, identified a dual purpose of both shoreline stabilization and private recreation. Consequently, these dual-purpose proposals were classified into a separate category.

All proposed structures and physical alterations were identified and recorded as areal (ft^2) measurements when possible.

Bulkhead, revetment (riprap), breakwater, and groin construction were principal proposals identified for shoreline stabilization purposes. Non-structural (vegetative) shoreline erosion control projects were included in the shoreline stabilization category.

Permit applications for pier, dock, boathouse, and travel lift construction or mooring and pile placement were those activities most frequently proposed for private (individual homeowners) recreational purposes. Dredging of private boat slips was also included in the private recreational category.

Projects providing public recreational benefits generally included boat mooring facilities, access ramps, and dredging to maintain or

improve boating access. State, federal, and municipal landings, parks, and nature centers were classified as public recreational projects.

Marina-related activities were differentiated from other private and public recreational proposals if the project represented a profit-making venture or an exclusive multiple user facility. Included in marina-related projects were piers, docks, moorings, piles, travel lifts, and dredge and fill activities associated with public commercial marinas, yacht clubs, condominium-boat slip complexes (dockominiums), and private community (associations) marinas.

Projects proposed for commercial (excluding marina projects) purposes included commercial fishing operations, condominium developments, crab-holding facilities, and bait shop structures. Applications for industrial growth were differentiated from commercial proposals. Activities associated with coal and oil terminals and other waterborne commerce were classified primarily as industrial projects.

Activities proposed principally for public service or utility purposes were most frequently telephone cables, stormwater outfalls, sewage pipelines, and power plant structures. Transportation-related activities including bridge and road construction and causeway and culvert placement were classified as a separate category from other public service proposals.

Activities proposed for fish and wildlife enhancement purposes were typically impoundment structures or dredging and excavating of wetland and upland habitats. Impounding and ditching activities to create waterfowl, fish, and other wildlife habitats were included in this category. Artificial reef proposals and fish enhancement structures were also included in this category.

Additionally, wetlands ditching and other activities associated with mosquito control were aggregated with the fish and wildlife enhancement projects because the habitat losses or alterations resulting from these activities were similar. Specific physical alterations resulting from mosquito control activities were infrequently identified in public notices. Rather, most of these projects were vast areas proposed for open marsh water management (OMWM) and achieved through the creation of a series of parallel or radial ditches in irregularly flooded estuarine wetlands. Those proposals containing information on both the OMWM area and specific areal extent of ditching were used to attain a calculated mean fractional value comparing areal ditching versus the specified management area. Hence, projects with plans lacking requisite information were assumed to have eliminated .0125 wetland acres for each acre influenced by OMWM.

Infrequently proposed activities were aggregated into a final "other" projects category. Activities associated with naval operations, archaeological exploration, private sewage containment structures (i.e., bermed infiltration ponds), and agricultural practices comprised most of these projects.

NMFS data files and the Baltimore District COE's permit records were accessed to obtain permitted project data. Permitted activities were reviewed for modification of the original proposal identified in each public notice. All permitted development activities were assumed to have been or will be constructed, and conform to the specifications stipulated in each permit.

Coastal development patterns, trends, and rates were identified using time-series data. Non-parametric statistical analyses were

utilized when feasible to identify significant (95 percent confidence level) developmental changes in Maryland's coastal zone. County data were also aggregated into regional data sets, so that significant differences or associations could be identified. Aggregated county data were categorized into four recognized regions: (1) the Tri-County Region (Calvert, Charles, and St. Mary's counties); (2) the Baltimore-Washington, D.C. Metropolitan Region (Anne Arundel, Baltimore, Harford, and Prince George's counties and Baltimore City); (3) the Upper Eastern Shore (Caroline, Cecil, Kent, Queen Anne's, and Talbot counties); and (4) the Lower Eastern Shore (Dorchester, Somerset, Wicomico, and Worcester counties). Prince George's county, generally considered a Washington, D.C. Metropolitan government, is Maryland's only coastal county within this region. Additionally, the county has a relatively limited shoreline (48 mi) in comparison to Maryland's other coastal counties, thereby geographically constraining shoreline development. Because of this and also due to its close proximity and land use patterns similar to the Baltimore Metropolitan Region, Prince George's County data were aggregated with data from the other three counties and Baltimore City.

Physical coastal habitat alterations resulting from permitted development were maintained as areal (ft^2) data. Habitats lost (i.e., areas dredged, filled, or impounded), altered (i.e., subtidal dredging), or gained (i.e., converted or enhanced habitats or compensatory projects to mitigate and offset habitat losses) due to project construction were estimated using information supplied in public notices, permit conditions and drawings, and state (Water Resources Administration) wetlands reports. Additional data on coastal habitats affected by

permitted development were obtained through personal communication with agency personnel and from field and joint-processing records maintained by the NMFS. In some cases where data were lacking, U.S. Fish and Wildlife Service (FWS) National Wetlands Inventory maps (1:24,000 scale) were obtained to estimate habitat types present and to identify those habitats likely lost, altered, or converted by each permitted activity.

All habitats subject to alteration by proposed and permitted activities were identified according to the FWS classification system.[1] Habitats were classified as specifically as possible based on pertinent site information (e.g., periodicity of tidal flooding, salinity regimes) available.

This study does not take into account habitats lost or altered as a result of indirect secondary effects associated with permitted activities, nor does it identify habitat changes influenced by natural processes including ecological succession, erosional forces, and sea level rise. It should be noted, however, that coastal habitat changes resulting from secondary impacts and natural processes are frequently equal to or greater in magnitude than those primary impacts attributed to the projects identified in this thesis.

Process Evaluation

Application, agency response, and permit data were analyzed to evaluate the regulatory process outcome. Recommendations and project modifications contributed by NMFS as an advisory agency in the regulatory process were obtained from interagency memoranda (i.e., agency position letters) located in NMFS record files, and from joint-processing forms and informal, transcribed interagency correspondence

located in COE permit files. Recommendations provided by NMFS to the COE were summarized as annual (calendar year) data and categorized according to the measure and extent desired by NMFS to conserve resources and habitats that would likely be affected by project construction. Specific project recommendations were recorded and categorized; NMFS recommendations ranged from denial of major controversial projects to requesting time-of-year restrictions on dredging activities.

To adequately evaluate the consultative role contributed by NMFS and assess the outcome of specific recommendations in the regulatory program, agency recommendations were categorized according to the habitats and areal size affected and the magnitude of impact. Thus, empirical values were derived for each specific recommendation through a three-tiered approach. Numeric values based on ecological functions and values were needed to compare and differentiate estuarine and palustrine habitats affected by project construction. Therefore, habitats that were or could have been affected by activities included in this study were ranked empirically, based on the best available scientific literature documenting the ecological functional values of these habitats.[2] Specific functional values of each habitat type were obtained from the results of quantitative studies and assessed in this thesis (Appendix 5). Both vegetated and non-vegetated habitats are identified by relative integers values indicating the sum ecological value for each habitat (Table 4). These values are not necessarily supported by the NMFS nor are they provided as an interpretation of the agency's specific coastal habitat concerns. Rather, this habitat valuation system contributes to the methodology presented here to

TABLE 4

HABITAT VALUES APPLIED IN THE CATEGORIZATION OF NMFS PROCESS REVIEW RECOMMENDATIONS.

HABITAT TYPE	HABITAT VALUE
ESTUARINE REGULARLY FLOODED PERSISTENT EMERGENT (*Spartina alterniflora* dominant)	10
PALUSTRINE/ESTUARINE PERSISTENT AND NON-PERSISTENT EMERGENT (narrow- and broad-leaved tidal fresh and brackish species)	10
ESTUARINE SUBTIDAL OYSTER REEF	10
ESTUARINE SUBTIDAL WITH SUBMERGED AQUATIC VEGETATION	10
ESTUARINE IRREGULARLY FLOODED PERSISTENT EMERGENT (*S. patens* dominant)	3
PALUSTRINE AND ESTUARINE FORESTED/SCRUB-SHRUB	3
ESTUARINE INTERTIDAL UNCONSOLIDATED FLAT (Mudflat/Sandflat)	2
ESTUARINE SUBTIDAL UNCONSOLIDATED BOTTOM/OPEN WATER	1
PALUSTRINE/ESTUARINE PERSISTENT EMERGENT (*Phragmites* spp. dominant)	1
RIPARIAN HABITAT AND FACULTATIVE WETLAND SPECIES (e.g., *Cyperus*, *Rhus*, *Iris*, *Impatiens* spp.)	1

TABLE 5

IMPACT VALUES APPLIED IN THE CATEGORIZATION OF NMFS PROCESS REVIEW RECOMMENDATIONS.

TYPE OF IMPACT	IMPACT VALUE
IMMEDIATE, TOTAL, AND IRREVERSIBLE LOSS BY FILLING, DREDGING, OR IMPOUNDING	5
PERMANENT, PRACTICALLY IRREVERSIBLE ADVERSE CHANGE TO THE HYDROLOGIC AND/OR TIDAL REGIME	4
PRACTICALLY IRREVERSIBLE IMPACT CAPABLE OF LONG-TERM RECOVERY	3
CHRONIC, LOW-LEVEL LOSS	2
TEMPORARY IMPACT WITH SHORT-TERM RECOVERY	1

compare and rank specific recommendations and evaluate NMFS' advisory role in the regulatory program.

The ranking of wetlands and other habitats is a controversial subject among individuals involved with the conservation, regulation, and development of these resources. Conservationists believe that by placing a value on a specific habitat type, it permits developers to "buy" permits through compensation for lost habitats or to trade off one habitat tract for another of equal size and value. It should be noted that that the habitat valuation methodology presented in this thesis is not an attempt to facilitate specific site evaluations. More appropriate valuation systems such as the Adamus method[3] have been developed for project assessment. These methodologies were considered for this study, although the large number of NMFS recommendations evaluated made this task infeasible within the limited timeframe. Consequently, integer values were applied to achieve one of the objectives of this thesis - to evaluate an interagency process.

The severity and permanence of a project's impact on the habitat and resources were also considered in the evaluation of NMFS' advisory role in the permit program. Consequently, relative impact values were assigned to specific activities according to the magnitude of impact.[4] Highest values were assigned to direct irreversible habitat losses resulting from dredging, filling, and impounding (Table 5). Low-level, chronic losses (e.g., gradual loss of emergent vegetation due to open-pile pier construction) and short-term temporary impacts (e.g., dredging of subtidal unconsolidated bottom) were assigned lower impact values. All acute and chronic physical impacts were identified, when possible, to derive a project's impact value.

Finally, the areal extent of habitat(s) that the NMFS conserved or attempted to protect from loss or alteration by providing a recommendation in the permit program was identified and recorded (value in acres). This value was then used as a multiplier in association with the habitat and impact values to derive a "conservation" value identifying NMFS' efforts to eliminate or minimize a project's adverse environmental impacts. For example, if NMFS recommended denial of a proposal to fill (impact value equals 5) 0.4 acres (area of impact value equals 0.4) of Spartina alterniflora wetlands (habitat value equals 10), the conservation value or effort would equal 20.0. Conservation values were identified as "minor", "intermediate", or "major"; values less than 1.0 were termed minor, while numbers between 1.0 and 5.0 were considered intermediate. Major conservation values were all those numbers greater than 5.0. Additional NMFS recommendations not eliminating or reducing a demonstrative physical habitat alteration (e.g., time-of-year restriction on subtidal dredging) were classified as minor conservation measures.

Acceptance of a NMFS recommendation by the Baltimore District COE was recorded only if the outcome occurred. Modification of a specific project activity was classified as "accepted" if the recommendation was either: (1) stated in the permit conditions; or (2) depicted by the project plans or drawings. All other NMFS recommendations provided during application review were classified as unacceptable to the COE, unless data were lacking to make an definitive determination.

Recommendation data were compiled and evaluated to identify changes or trends in the regulatory process. Non-parametric statistical analyses were utilized to identify significant (95 percent confidence

level) changes, trends, or problematic issues that have occurred over the 5-year period.

This study identifies only those recommendations contributed by the NMFS and forwarded to the COE. Input provided by other federal and state resource agencies, interest groups, and private individuals was acknowledged as an influencial factor in the review process, although decision outcomes affected by these entities were not evaluated. An assumption was made that some project proposals were modified according to decisions made by the COE, regardless of input provided by the NMFS. However, all recommendations contributed by NMFS were assumed to be an influential factor in the categorized "accepted" outcomes.

Chapter V
Results

A total 2481 public notices processed by the Baltimore District Corps of Engineers (COE) were reviewed for analysis. Of the total projects proposed in Maryland's coastal zone over the 5-year period, 1934 proposals required standard individual permits, whereas letters of permission (LOPs) fulfilled permit requirements for the remaining 547 projects. Fifty-nine percent of all proposals required joint Section 10 and 404 standard permits, while an additional 956 projects (39 percent) qualified for Section 10 permit authorization. Section 404 permits were requisite for construction of the remaining 62 projects (2 percent).

A continuous increase in annual proposal number occurred in Maryland's coastal zone from 1982 through 1985, although activities proposed in 1981 exceeded the number of proposals in either 1982 or 1983 (Table 6). Numbers of LOPs fluctuated, peaking at 160 in 1985. Overall, an average 496 projects requiring public interest review were proposed annually in Maryland's coastal zone over the 5-year period.

Additionally, the Baltimore District COE received many requests for permission to construct projects in or adjacent to navigable waters that qualified for either nationwide or regional general permits. Although these projects were not subject to public interest review, and therefore, were not assessed in this study, the proposals are indicative of the coastal development that has occurred in Maryland over the 5-year period. The number of projects constructed via general permit issuance by the Baltimore District COE are shown in Table 6. Values identified are the total numbers of general nationwide and regional permits issued annually (calendar year) by the Baltimore District.[1] These values

TABLE 6

TOTAL NUMBER OF PERMIT APPLICATIONS FOR PROJECTS PROPOSED IN MARYLAND'S COASTAL ZONE, 1981-1985.

PERMIT TYPE	1981	1982	1983	1984	1985	5-YEAR TOTAL
STANDARD AND INDIVIDUAL PERMITS	407	276	337	441	473	1934
LETTERS OF PERMISSION	99	70	126	92	160	547
TOTAL NUMBER OF PERMIT APPLICATIONS REVIEWED IN THIS STUDY	506	346	463	533	633	2481
NATIONWIDE PERMITS[a]	203	292	293	503	541	1832
REGIONAL PERMITS[a]	975	572	571	815	709	3642
BALTIMORE DISTRICT PERMIT TOTAL[b]	1684	1210	1327	1851	1883	7955

[a]Values are total numbers of projects occurring within Baltimore District jurisdiction including all Maryland coastal and non-coastal counties, the District of Columbia, Pennsylvania, New York, Delaware, and Virginia.

[b]Totals do not include individual permits and letters of permission applied for in non-coastal Maryland counties, the District of Columbia, Pennsylvania, New York, Delaware, and Virginia.

include all projects constructed in Maryland's coastal zone and all additional activities within the Baltimore District's purview and sited in Pennsylvania, New York, the District of Columbia, and Maryland's non-coastal counties.

Outcome Evaluation

Coastal Development

Regional permit application number was greatest in the Baltimore-Washington, D.C. Metropolitan area (847) over the 5-year period, primarily because of the large number (567) of projects proposed in Anne Arundel County. Of all counties, Baltimore ranked eighth in total project number (153) and comprised approximately 6.2 percent of all projects proposed in Maryland's coastal zone between 1981 and 1985 (Table 7). Fewer activities were proposed in Baltimore City, although the total (63) was greater than the project total for either Harford (54) or Prince George's (10) Counties. Baltimore City and Harford and Prince George's Counties respectively ranked 12th, 14th, and 17th in total project numbers.

The Upper Eastern Shore Region had the second largest permit application number (704) of all 4 Maryland regions. Approximately 12.9 percent of the total projects proposed in Maryland were located in Talbot County, the local jurisdiction ranked second in permit application number (320) over the 5-year period. Fewer activities were proposed in Queen Anne's (178), Kent (115), Cecil (76) and Caroline (15) Counties which respectively ranked fourth, ninth, 11th, and 16th in total project numbers.

TABLE 7

ANNUAL AND 5-YEAR TOTAL NUMBER OF PERMIT APPLICATIONS IN MARYLAND'S COASTAL COUNTIES AND BALTIMORE CITY, 1981-1985. VALUES IN PARENTHESES ARE A PERCENT OF THE ANNUAL NUMBER AND 5-YEAR TOTAL.

	YEAR					
	1981	1982	1983	1984	1985	TOTAL
ANNE ARUNDEL	111(21.9)	72(20.8)	96(20.7)	124(23.1)	164(26.0)	567(22.8)
BALTIMORE	43(8.5)	24(6.9)	20(4.3)	29(5.4)	37(5.9)	153(6.2)
BALTIMORE CITY	13(2.6)	4(1.2)	18(3.9)	15(2.8)	13(2.1)	63(2.5)
CALVERT	28(5.5)	22(6.4)	30(6.5)	36(6.7)	50(7.9)	166(6.7)
CAROLINE	3(0.1)	1(0.3)	6(1.3)	3(0.6)	2(0.3)	15(0.6)
CECIL	13(2.6)	8(2.3)	16(3.5)	23(4.3)	16(2.5)	76(3.1)
CHARLES	11(2.2)	2(0.6)	7(1.5)	6(1.1)	11(1.7)	37(1.5)
DORCHESTER	37(7.3)	20(5.8)	36(7.8)	27(5.0)	39(6.2)	159(6.4)
HARFORD	8(1.6)	11(3.2)	12(2.6)	10(1.9)	13(2.1)	54(2.2)
KENT	15(3.0)	20(5.8)	20(4.3)	35(6.5)	25(4.0)	115(4.6)
PRINCE GEORGE'S	5(1.0)	0(0.0)	2(0.4)	0(0.0)	3(0.5)	10(0.4)
QUEEN ANNE'S	40(7.9)	28(8.1)	38(8.2)	32(6.0)	40(6.3)	178(7.2)
ST. MARY'S	30(5.9)	30(8.7)	33(7.1)	48(9.0)	35(5.5)	176(7.1)
SOMERSET	19(3.8)	8(2.3)	14(3.0)	27(5.0)	36(5.7)	104(4.2)
TALBOT	66(13.0)	38(11.0)	70(15.1)	58(10.8)	88(13.9)	320(12.9)
WICOMICO	13(2.6)	8(2.3)	8(1.7)	10(1.9)	22(3.5)	61(2.5)
WORCESTER	51(10.1)	50(14.5)	37(8.0)	50(9.3)	39(6.2)	227(9.1)
MARYLAND TOTAL	506	346	463	533	633	2481

Lower Eastern Shore permit applications totaled 551 between 1981 and 1985, comprising approximately 22 percent of the Maryland total. Worcester county had the largest application number (227) in the region, many of which were projects proposed in Ocean City along the Atlantic coast or Assawoman and Sinepuxent Bays. Fewer Lower Eastern Shore proposals were located in Dorchester (159), Somerset (104), and Wicomico (61) Counties. Worcester County ranked third in total project number, while Dorchester, Somerset, and Wicomico Counties ranked seventh, 10th, and 13th, respectively.

Tri-County Region proposals accounted for the lowest permit application number (379) of all 4 regions. St. Mary's County (ranked fifth) proposals totaled 176 or approximately 7.1 percent of the 5-year Maryland total. Calvert and Charles County (ranked sixth and 15th, respectively) proposals contributed 6.7 and 1.5 percent of the total Maryland project number, respectively.

Number of projects proposed annually within the counties were not significantly different over the 5-year period. No counties experienced a continuous increase in project number, although 4 counties (Anne Arundel, Calvert, Somerset, and Wicomico) exhibited either static or increasing project numbers between 1982 and 1985. St. Mary's and Kent Counties experienced a continuous rise in application number from 1981 through 1984, although total project numbers decreased in these counties in 1985. Thus, approximately one-third of Maryland's 17 jurisdictions experienced continuously increasing permit application numbers over 4 of the 5 years studied.

Annual project numbers increased in all regions between 1982 and 1985 (Table 8). Similarly, all 4 regions experienced more projects in

TABLE 8

ANNUAL NUMBER OF PERMIT APPLICATIONS FOR EACH OF MARYLAND'S COASTAL REGIONS, 1981-1985.

REGION	1981	1982	1983	1984	1985	5-YEAR TOTAL
UPPER EASTERN SHORE	137	95	150	152	171	704
LOWER EASTERN SHORE	120	86	95	115	136	551
BALTIMORE-WASHINGTON, D.C. METROPOLITAN	180	111	148	179	229	847
TRI-COUNTY	69	54	70	90	96	379
TOTAL	506	346	463	533	633	2481

1981 than in 1982, indicating that fluctuations in permit application numbers were more likely a result of changes in the regulatory program or a reflection of the state or national economy than a consequence of local economic conditions or planning restrictions. Annual permit application numbers in the 4 Maryland coastal regions were not statistically different (X^2=9.87, d.f.=12, P>.50) among regions over the 5-year period indicating that each of the 4 coastal regions have experienced similar development patterns. Thus, regions are characterized by areas of light development counterbalanced by areas of intense coastal development.

A development index for Maryland's 16 coastal counties and Baltimore City was created using total application numbers and county shoreline lengths. An assumption was made that Maryland's 5-year coastal development occurred as a spatially non-random (even) distribution. County shoreline lengths, identified as a percent of the total Maryland coastline, were utilized to extrapolate expected hypothetical county project numbers from the total number of Maryland projects (2481) proposed. Hence, the actual proposed project number (APN) for each county was compared to the expected county project number (EPN) to obtain each ratio value and coastal development index (Table 9). It should be noted that the development index does not take into account preexisting coastal development that would limit the extent of development identified in this study. The index does not take into account proposals covered by nationwide or regional permits.

Largest ratios were obtained for two of the five Baltimore-Washington, D.C. Metropolitan Regional governments; Baltimore City had the highest index value (3.5) followed by Anne Arundel County (3.0).

TABLE 9

DISTRIBUTION (IN NUMBERS) OF PROPOSED PROJECTS IN MARYLAND'S COASTAL COUNTIES AND COMPARISON TO HYPOTHETICAL EVEN DISTRIBUTION.

COUNTY	SHORELINE LENGTH (MILES)[a]	SHORELINE LENGTH AS PERCENT OF STATE TOTAL	EXPECTED PROJECT NUMBER (EPN)	ACTUAL PROPOSED PROJECT NUMBER (APN)	APN/EPN RATIO
ANNE ARUNDEL	362	7.7	190	567	3.0
BALTIMORE	179	3.8	94	153	1.5
BALTIMORE CITY	34	0.7	18	63	3.5
CALVERT	161	3.4	84	166	2.0
CAROLINE	158	3.3	83	15	0.2
CECIL	219	4.6	115	76	0.7
CHARLES	162	3.4	85	37	0.4
DORCHESTER	642	13.6	337	159	0.5
HARFORD	200	4.2	105	54	0.5
KENT	268	5.8	141	115	0.8
PRINCE GEORGE'S	48	1.0	25	10	0.4
QUEEN ANNE'S	335	7.1	176	178	1.0
ST. MARY'S	324	6.9	170	176	1.0
SOMERSET	600	12.7	315	104	0.3
TALBOT	527	11.1	276	320	1.2
WICOMICO	158	3.3	83	61	0.7
WORCESTER	351	7.4	184	227	1.2
TOTAL	4728	100.0	2481	2481	

[a]Extrapolated from Eberhart, 1980.

Calvert (2.0), Baltimore (1.5), Talbot (1.2), and Worcester (1.2) Counties also had high index values, whereas Caroline (0.2), Somerset (0.3), Charles (0.4) and Prince George's (0.4) Counties had the lowest indices. Results indicate that Dorchester and Harford Counties have experienced similar coastal growth over the 5-year period, as have Queen Anne's and St. Mary's and Talbot and Worcester Counties.

To determine whether the indices varied significantly among regions, the Kruskal-Wallis test was used in carrying out a non-parametric one-way analysis of variance. The Kruskal-Wallis test can be used when there are three or more sample groups, and the sample sizes vary from three upwards.[2] The test assists in deciding whether the groups could have been drawn from a common population.

Data are first ranked over all observations regardless of their groups. Ranks are then summed within each group in obtaining group rank values. These rank values are then included within the Kruskal-Wallis equation to compute the H-statistic. The H-statistic has an approximate chi-square distribution.

Ratios were ranked and counties were grouped according to Maryland coastal regions to determine whether variations in application number ratios could be explained in terms of differences in regional development pressures. Values for each of the 16 coastal counties and Baltimore City grouped into assigned regions could not be explained ($H=1.58$, $d.f.=3$, $P > .30$) by differences between the 4 coastal regions. Thus, all regions are comprised of some counties experiencing lower density development which are counterbalanced by other counties or local jurisdictions exhibiting more intense coastal growth.

Shoreline Stabilization Projects

Shoreline stabilization activities accounted for 29.2 percent of all projects proposed in Maryland over the 5-year period (Table 10). The number of erosion control projects, as percentages of the annual coastwide total varied little from year to year, ranging from a low of 27.4 percent in 1985 to a high 31.5 percent in 1982. In 1982, permit applications for shoreline stabilization projects totalled 109, increasing to 174 in 1985. Shoreline stabilization proposals in 1981 (144) exceeded the number of erosion control structures proposed in either 1982 or 1983, but were fewer in number than either the 1984 or 1985 totals.

Additionally, 8.2 percent of the total permit applications received by the COE over the 5-year were proposed for both shoreline stabilization and private recreational activities. Annual number of the dual-purpose projects fluctuated from 51 in 1981 to 44 in 1985 and accounted for a low 7.0 percent of the 1985 project proposals and a high 10.1 percent of all permit applications received in 1981.

The largest number of shoreline stabilization projects (as a total of both the single and dual-purpose proposals) proposed over the 5-year period were located in the Upper Eastern Shore Region (Table 11). Erosion control structures (291) accounted for 41.3 percent of all Upper Eastern Shore projects, 159 (63.3 percent) of which were sited in Talbot County (Table 12A). Another 77 (26.5 percent) shoreline stabilization projects were sited in Queen Anne's County, while Kent (28), Cecil (24), and Caroline (3) Counties comprised, respectively, 9.6, 8.2, and 1.0 percent of the Region's 5-year total erosion control project number.

TABLE 10

PROJECT PURPOSE AS A PERCENT OF THE TOTAL ANNUAL NUMBER OF PERMIT APPLICATIONS IN MARYLAND'S COASTAL ZONE, 1981-1985.

	YEAR					
	1981	1982	1983	1984	1985	TOTAL
SHORELINE STABILIZATION	28.5	31.5	29.8	29.9	27.4	29.2
SHORELINE STABILIZATION AND PRIVATE RECREATIONAL	10.1	8.4	8.6	7.5	7.0	8.2
PRIVATE RECREATIONAL	30.0	34.1	32.0	32.8	37.5	33.5
COMMERCIAL	6.1	7.8	9.1	6.9	6.2	7.3
MARINA-RELATED	7.3	8.4	6.0	6.2	8.1	7.1
PUBLIC RECREATIONAL	5.1	2.0	5.0	4.5	3.6	3.9
PUBLIC UTILITY/SERVICE	4.0	3.2	1.9	2.6	4.0	3.3
FISH & WILDLIFE ENHANCEMENT AND MOSQUITO CONTROL	1.6	1.2	1.9	5.2	3.5	2.9
TRANSPORTATION-RELATED	3.2	1.2	3.0	2.8	1.6	2.4
INDUSTRIAL	2.8	1.7	2.2	0.8	0.7	1.6
OTHER	1.3	0.5	0.5	0.8	0.4	0.6
	100.0	100.0	100.0	100.0	100.0	100.0

TABLE 11

NUMBER OF PROJECTS PROPOSED IN MARYLAND'S COASTAL REGIONS AS A PERCENT OF THE STATE TOTAL, 1981-1985. APPLICATIONS ARE CATEGORIZED ACCORDING TO PROJECT PURPOSE.

PURPOSE	BALTIMORE-WASHINGTON, D.C. METROPOLITAN	TRI-COUNTY	UPPER EASTERN SHORE	LOWER EASTERN SHORE	MARYLAND TOTAL
SHORELINE STABILIZATION	172 (23.7)	156 (21.5)	251 (34.6)	146 (20.1)	725 (100.0)
SHORELINE STABILIZATION AND PRIVATE RECREATIONAL	66 (32.5)	32 (15.8)	40 (19.7)	65 (32.0)	203 (100.0)
PRIVATE RECREATIONAL	365 (43.9)	130 (15.6)	215 (25.9)	121 (14.6)	831 (100.0)
COMMERCIAL	56 (31.1)	8 (4.4)	32 (17.8)	84 (46.7)	180 (100.0)
MARINA-RELATED	78 (44.1)	20 (11.3)	60 (33.9)	19 (10.7)	177 (100.0)
PUBLIC RECREATIONAL	25 (25.8)	11 (11.3)	39 (40.2)	22 (22.7)	97 (100.0)
PUBLIC UTILITY/SERVICE	32 (39.5)	8 (9.9)	17 (21.0)	24 (29.6)	81 (100.0)
FISH & WILDLIFE ENHANCEMENT AND MOSQUITO CONTROL	2 (2.8)	4 (5.6)	32 (45.1)	33 (46.5)	71 (100.0)
TRANSPORTATION-RELATED	23 (38.3)	3 (5.0)	8 (13.3)	26 (43.3)	60 (100.0)
INDUSTRIAL	28 (70.0)	5 (12.5)	2 (5.0)	5 (12.5)	40 (100.0)
OTHER	0 (0.0)	2 (15.4)	5 (38.5)	6 (46.2)	13 (100.0)
TOTAL	847 (34.1)	379 (15.3)	704 (28.4)	551 (22.2)	2481 (100.0)

TABLE 12A

NUMBER AND PERCENTAGE OF PROJECTS PROPOSED IN MARYLAND'S COASTAL COUNTIES, 1981-1985.
PROJECTS ARE CATEGORIZED ACCORDING TO PROJECT PURPOSE.

	UPPER EASTERN SHORE REGION					
PURPOSE	CAROLINE	CECIL	KENT	QUEEN ANNE'S	TALBOT	REGIONAL TOTAL
SHORELINE STABILIZATION	2 (13.3)	17 (22.4)	25 (21.7)	60 (33.7)	146 (45.6)	251 (35.7)
SHORELINE STABILIZATION AND PRIVATE RECREATIONAL	0 (0.0)	7 (9.2)	3 (2.6)	17 (9.6)	13 (4.1)	40 (5.7)
PRIVATE RECREATIONAL	1 (6.7)	24 (31.6)	30 (26.1)	54 (30.3)	106 (33.1)	215 (30.5)
COMMERCIAL	0 (0.0)	4 (5.3)	7 (6.1)	12 (6.7)	9 (2.8)	32 (4.5)
MARINA-RELATED	1 (6.7)	9 (11.8)	30 (26.1)	11 (6.2)	9 (2.8)	60 (8.5)
PUBLIC RECREATIONAL	5 (33.3)	9 (11.8)	5 (4.3)	12 (6.7)	12 (3.8)	39 (5.5)
PUBLIC UTILITY/SERVICE	2 (13.3)	4 (5.3)	2 (1.7)	1 (0.6)	8 (2.5)	17 (2.4)
FISH & WILDLIFE ENHANCEMENT AND MOSQUITO CONTROL	2 (13.3)	1 (1.3)	11 (9.6)	3 (1.7)	15 (4.7)	32 (4.5)
TRANSPORTATION-RELATED	0 (0.0)	1 (1.3)	0 (0.0)	5 (2.8)	2 (0.6)	8 (1.1)
INDUSTRIAL	0 (0.0)	0 (0.0)	1 (0.9)	1 (0.6)	0 (0.0)	2 (0.3)
OTHER	2 (13.3)	0 (0.0)	1 (0.9)	2 (1.1)	0 (0.0)	5 (0.7)
TOTAL	15 (100.0)	76 (100.0)	115 (100.00)	178 (100.0)	320 (100.00)	704 (100.0)

TABLE 12B

NUMBER AND PERCENTAGE OF PROJECTS PROPOSED IN MARYLAND'S COASTAL COUNTIES, 1981-1985.
PROJECTS ARE CATEGORIZED ACCORDING TO PROJECT PURPOSE.

BALTIMORE-WASHINGTON, D.C. METROPOLITAN REGION

PURPOSE	ANNE ARUNDEL	BALTIMORE	BALTIMORE CITY	HARFORD	PRINCE GEORGE'S	REGIONAL TOTAL
SHORELINE STABILIZATION	129 (22.8)	28 (18.3)	9 (14.3)	4 (7.4)	2 (20.0)	172 (20.3)
SHORELINE STABILIZATION AND PRIVATE RECREATIONAL	60 (10.6)	5 (3.3)	0 (0.0)	1 (1.9)	0 (0.0)	66 (7.8)
PRIVATE RECREATIONAL	258 (45.5)	74 (48.4)	4 (6.3)	28 (51.9)	1 (10.0)	365 (13.1)
COMMERCIAL	35 (6.2)	6 (3.9)	11 (17.5)	3 (5.6)	1 (10.0)	56 (6.6)
MARINA-RELATED	49 (8.6)	11 (7.2)	9 (14.3)	9 (16.7)	0 (0.0)	78 (9.2)
PUBLIC RECREATIONAL	6 (1.0)	4 (2.6)	5 (7.9)	8 (14.8)	2 (20.0)	25 (3.0)
PUBLIC UTILITY/SERVICE	18 (3.2)	8 (5.2)	5 (7.9)	0 (0.0)	1 (10.0)	32 (3.8)
FISH & WILDLIFE ENHANCEMENT AND MOSQUITO CONTROL	1 (0.2)	1 (0.1)	0 (0.0)	0 (0.0)	0 (0.0)	2 (0.2)
TRANSPORTATION-RELATED	9 (1.6)	6 (3.9)	4 (6.3)	1 (1.9)	3 (30.0)	23 (2.7)
INDUSTRIAL	2 (0.4)	10 (6.5)	16 (25.4)	0 (0.0)	0 (0.0)	28 (3.3)
OTHER	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
TOTAL	567 (100.0)	153 (100.0)	63 (100.0)	54 (100.0)	10 (100.0)	847 (100.0)

TABLE 12C

NUMBER AND PERCENTAGE OF PROJECTS PROPOSED IN MARYLAND'S COASTAL COUNTIES, 1981-1985.
PROJECTS ARE CATEGORIZED ACCORDING TO PROJECT PURPOSE.

	LOWER EASTERN SHORE REGION				
PURPOSE	DORCHESTER	SOMERSET	WICOMICO	WORCESTER	REGIONAL TOTAL
SHORELINE STABILIZATION	44 (27.7)	26 (25.0)	22 (36.1)	54 (23.8)	146 (26.5)
SHORELINE STABILIZATION AND PRIVATE RECREATIONAL	8 (5.0)	6 (5.8)	6 (9.8)	45 (19.8)	65 (11.8)
PRIVATE RECREATIONAL	39 (24.5)	11 (10.6)	17 (27.9)	54 (23.8)	121 (22.0)
COMMERCIAL	11 (6.9)	22 (21.2)	4 (6.6)	47 (20.7)	84 (15.2)
MARINA-RELATED	4 (2.5)	4 (3.8)	3 (4.9)	8 (3.5)	19 (3.4)
PUBLIC RECREATIONAL	5 (3.1)	11 (10.6)	2 (3.3)	4 (1.8)	22 (4.0)
PUBLIC UTILITY/SERVICE	3 (1.9)	12 (11.5)	2 (3.3)	7 (3.1)	24 (4.4)
FISH & WILDLIFE ENHANCEMENT AND MOSQUITO CONTROL	23 (14.5)	2 (1.9)	1 (1.6)	7 (3.1)	33 (6.0)
TRANSPORTATION-RELATED	18 (11.3)	6 (5.8)	1 (1.6)	1 (0.4)	26 (4.7)
INDUSTRIAL	0 (0.0)	2 (1.9)	3 (4.9)	0 (0.0)	5 (0.9)
OTHER	4 (2.5)	2 (1.9)	0 (0.0)	0 (0.0)	6 (1.1)
TOTAL	159 (100.0)	104 (100.0)	61 (100.0)	227 (100.0)	551 (100.0)

TABLE 12D

NUMBER AND PERCENTAGE OF PROJECTS PROPOSED IN MARYLAND'S COASTAL COUNTIES, 1981-1985.
PROJECTS ARE CATEGORIZED ACCORDING TO PROJECT PURPOSE.

	TRI-COUNTY REGION			
PURPOSE	CALVERT	CHARLES	ST. MARY'S	REGIONAL TOTAL
SHORELINE STABILIZATION	60 (36.1)	19 (51.4)	77 (43.8)	156 (41.2)
SHORELINE STABILIZATION AND PRIVATE RECREATIONAL	21 (12.7)	3 (8.1)	8 (4.5)	32 (8.4)
PRIVATE RECREATIONAL	61 (36.7)	8 (21.6)	61 (34.7)	130 (34.3)
COMMERCIAL	4 (2.4)	0 (0.0)	4 (2.7)	8 (2.1)
MARINA-RELATED	12 (7.2)	2 (5.4)	6 (3.4)	20 (5.3)
PUBLIC RECREATIONAL	3 (1.8)	1 (2.7)	7 (4.0)	11 (2.9)
PUBLIC UTILITY/SERVICE	4 (2.4)	1 (2.7)	3 (1.7)	8 (2.1)
FISH & WILDLIFE ENHANCEMENT AND MOSQUITO CONTROL	1 (0.6)	1 (2.7)	2 (1.1)	4 (1.2)
TRANSPORTATION-RELATED	0 (0.0)	1 (2.7)	2 (1.1)	3 (1.0)
INDUSTRIAL	0 (0.0)	0 (0.0)	5 (2.8)	5 (1.3)
OTHER	0 (0.0)	1 (2.7)	1 (0.6)	2 (0.5)
TOTAL	166 (100.0)	37 (100.0)	176 (100.0)	379 (100.0)

The Baltimore-Washington, D.C. Metropolitan Region ranked second in number of shoreline stabilization proposals over the 5-year period. Between 1981 and 1985, 238 projects were proposed, 189 (79.4 percent) of which were proposed by Anne Arundel County property owners (Table 12B). An additional 33 projects (13.9 percent) were sited in Baltimore County, while fewer erosion control projects were located in Baltimore City (9), Harford (5), and Prince George's (2) Counties.

Approximately 46.9 percent (99) of Lower Eastern Shore shoreline stabilization projects (211) were proposed by Worcester County property owners (Table 12C). Fewer projects were proposed for Dorchester (52), Somerset (32), and Wicomico (28) Counties.

The Tri-County Region had the fewest (188) shoreline stabilization projects, although construction of erosion control structures was the primary activity for 49.6 percent of the Tri-County projects, representing the largest percentage of erosion control proposals for any of the 4 regions (Table 12D). Eighty-five (45.2 percent) of the total 188 Tri-County shoreline stabilization projects were located in St. Mary's County; an additional 81 (43.1 percent) and 22 (11.7 percent) of the projects were sited in Calvert and Charles Counties, respectively.

Bulkhead and revetment construction accounted for over 75 miles (mi) of the Maryland coastline stabilized over the 5-year period (Figure 5). An average 6.5 mi of bulkhead and 8.6 mi of riprap structures were constructed annually. Annual numbers of bulkhead and revetment structures constructed in Maryland did not differ significantly over the 5-year period ($X^2=8.12$, d.f.=4, $P>.05$), although numbers of bulkhead and revetment projects in each of the 4 coastal regions were statistically different ($X^2=64.52$, d.f.=3, $P<.001$) (Table 13). The largest number of

FIGURE 5

MARYLAND SHORELINE LENGTH STABILIZED BY PERMITTED STRUCTURES, 1981-1985.

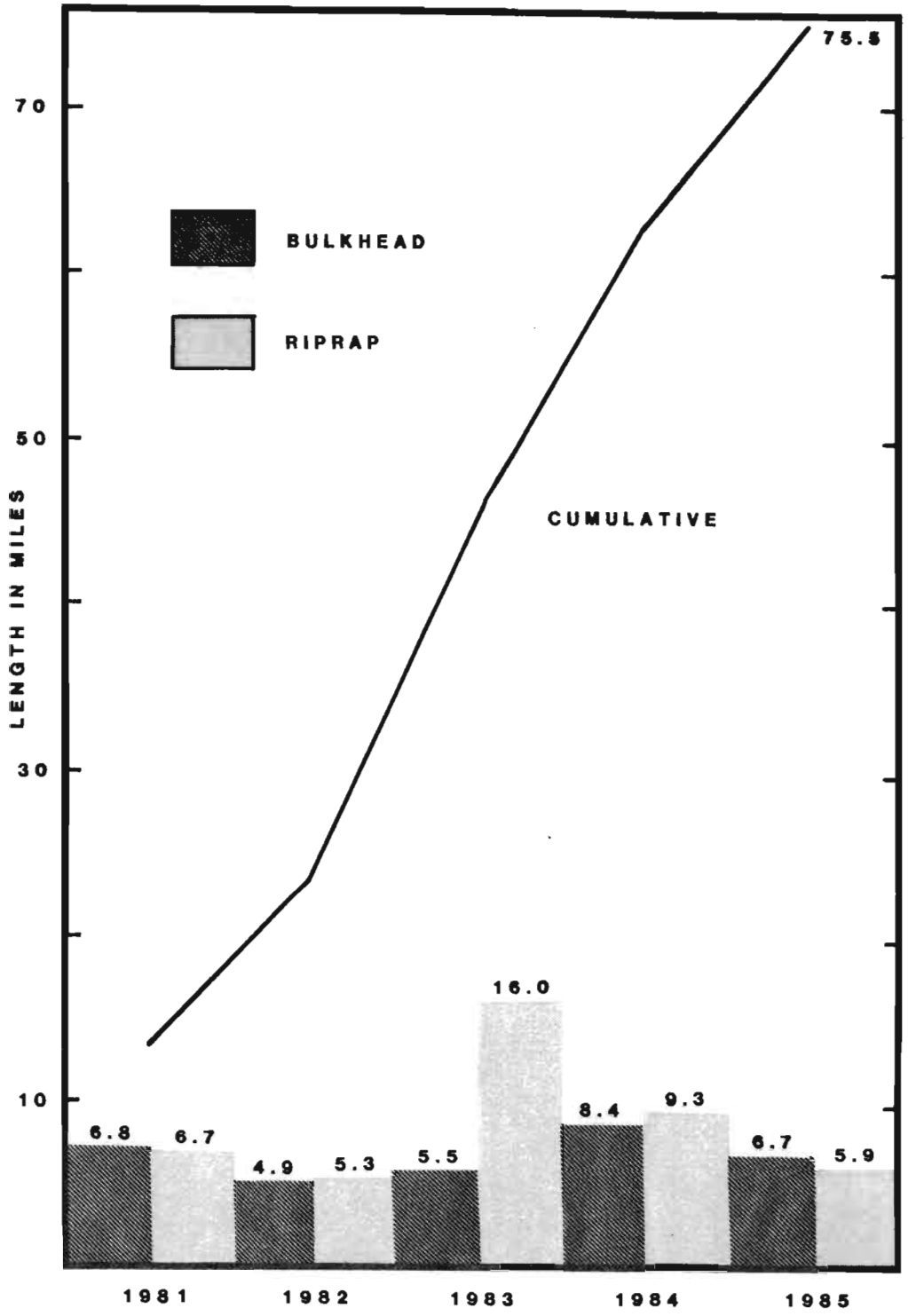


TABLE 13

SHORELINE STABILIZATION PROJECTS PERMITTED IN MARYLAND'S COASTAL ZONE, 1981-1985.

COUNTY	BULKHEAD			REVETMENT			COMBINED TOTAL		
	NUMBER OF PROJECTS <200 FT	>200 FT	SHORELINE LENGTH STABILIZED (MILES)	NUMBER OF PROJECTS <200 FT	>200 FT	SHORELINE LENGTH STABILIZED (MILES)	NUMBER OF PROJECTS <200 FT	>200 FT	SHORELINE LENGTH STABILIZED (MILES)
ANNE ARUNDEL	111	52	6.4	20	20	3.1	131	72	9.5
BALTIMORE	28	10	2.0	1	6	1.8	29	16	3.8
BALTIMORE CITY	4	5	0.5	2	3	0.3	6	8	0.8
CALVERT	47	26	2.6	1	5	0.5	48	31	3.1
CAROLINE	0	1	0.1	0	2	0.2	0	3	0.3
CECIL	8	5	0.5	3	7	2.0	11	12	2.5
CHARLES	9	4	0.6	2	1	0.1	11	5	0.7
DORCHESTER	30	20	2.1	10	16	2.4	40	36	4.5
HARFORD	2	7	1.5	2	6	1.7	4	13	3.2
KENT	8	4	0.4	4	8	1.0	12	12	1.4
PRINCE GEORGE'S	1	1	0.2	1	3	11.1	2	4	11.3
QUEEN ANNE'S	19	31	3.2	11	13	2.4	30	44	5.7
ST. MARY'S	18	20	1.8	7	21	5.0	25	41	6.8
SOMERSET	21	13	1.0	6	7	0.6	27	30	1.6
TALBOT	23	34	4.1	26	50	9.5	49	84	13.6
WICOMICO	14	11	1.2	1	2	0.5	15	13	1.7
WORCESTER	74	22	4.2	5	5	0.9	79	27	5.1
TOTAL	417	266	32.3	102	175	43.2	519	441	75.5

bulkheads (221) was constructed in the Baltimore-Washington, D.C. Metropolitan Region, while fewer were erected in the Lower Eastern Shore (205), Upper Eastern (133), and Tri-County (124) Regions. Approximately 45 percent (124) of the 277 revetment structures built in Maryland was located in the Upper Eastern Shore, whereas Baltimore-Washington, D.C. Metropolitan (64), Lower Eastern Shore (52), and Tri-County (37) Regional coastlines were stabilized by fewer revetment structures.

The largest number of bulkheads (163) was constructed in Anne Arundel County, while Worcester (96) and Calvert (73) Counties ranked second and third, respectively, in numbers constructed. Fewer bulkheads were located in Talbot (57), Dorchester (50), and Queen Anne's (50) Counties; less than 40 bulkhead projects were sited in each of the remaining 11 local jurisdictions.

Talbot County accounted for the largest number (76) of revetment structures built between 1981 and 1985. Anne Arundel County ranked second with 40 riprap projects, while St. Mary's (28), Dorchester (26), and Queen Anne's (24) Counties ranked third, fourth, and fifth, respectively. Shorelines in each of the other 12 jurisdictions were stabilized by fewer than 20 revetment structures subject to Section 10/404 jurisdiction.

Talbot County ranked first as the county with the longest (13.6 mi) shoreline length stabilized, of which 9.5 mi of revetment and 4.1 mi of bulkhead structures were constructed. A single local public works department project accounted for approximately 98 percent of the 11.3 mi of shoreline stabilized in Prince George's County (ranked second), while 6.4 mi of bulkhead and 3.1 mi of revetment structures were built in Anne Arundel County (ranked third). Over the 5-year period, less than 7 mi

of shoreline were stabilized in each of the remaining 14 coastal counties.

Although the number of bulkheads constructed along Maryland's coastline between 1981 and 1985 was approximately 2.5 times the number of riprap structures built, revetment projects were, on an average, of greater length than bulkhead structures. An a priori length value of 200 ft, representing an assumed "average" shoreline property, was chosen to test significant differences. The calculated mean length value ($\bar{X}$=415 ft) of all bulkheads and revetments identified in the study was not used in the statistical analysis because several exceptionally large projects would have skewed the results. Thus, the results would not have accurately identified statistically significant differences reflecting differences in regional development types.

Difference in numbers of "small" (less than 200 ft in length) versus "large" (200 ft and longer) revetment and bulkhead structures were statistically significant (X^2=47.05, d.f.=1, P<.001). Approximately 61 percent (417) of the 683 bulkheads constructred were less than 200 ft in length, while 175 (63.2 percent) of the 277 revetment structures built were 200 ft or greater in length.

Regional shoreline stabilization projects (both bulkhead and revetment structures) were also categorized into the two size (small and large) classifications. Structural size was significantly different (X^2=33.77, d.f.=3, P<.001). A greater number of large projects (155) than expected (118), was constructed in the Upper Eastern Shore Region, whereas more structures (172) less than 200 ft in length were constructed in the Baltimore-Washington, D.C. Metropolitan Region. There were also fewer large bulkhead and revetment structures (96) in

the Lower Eastern Shore than expected (118), although the number of large projects (74) expected to have been constructed in the Tri-County Region nearly equalled the actual number (77) built.

Overall, the greatest number of shoreline stabilization projects and also the largest bulkhead and revetment structures were built in the Upper Eastern Shore Region, most of which were located in Talbot County. Fewer and smaller bulkhead and riprap structures were constructed in the Baltimore-Washington, D.C. Metropolitan Region, of which approximately 80 percent were sited in Anne Arundel County. Lower Eastern Shore bulkheads and revetments were typically smaller and fewer in number in comparison to the other 2 coastal regions; approximately half of the Region's erosional control structures were located in Worcester County. The Tri-County Region had the fewest shoreline stabilization projects of all 4 regions, although erosion control proposals accounted for half of all projects located in the Region.

Private Recreational Projects

Projects proposed for private recreational purposes accounted for approximately one-third of all public notices analyzed (Table 10). Private recreational activities associated with shoreline stabilization activities comprised an additional 8.2 percent (203) of all projects proposed between 1981 and 1985. Thus, pier, dock, and boathouse construction, travel lift and pile emplacement, and dredging of privately-owned (non-commercial or industrial) boat basins (slips) accounted for 41.7 percent of all projects proposed over the 5-year period. Numbers of projects cited for private recreational purposes, as percentages of total annual project numbers ranged from a low 40.1 percent in 1981 to a high 44.5 percent in 1985.

Approximately 44 percent of all private recreational activities in Maryland were located in the Baltimore-Washington, D.C. Metropolitan Region (Table 11). An additional 66 of the Regional projects proposed for both private recreation and shoreline stabilization, combined with the 365 private individual proposals, accounted for 41.7 percent of Maryland's coastal zone projects subject to Section 10/404 jurisdiction over the 5-year period. Fewer private recreational proposals were sited in the Upper Eastern Shore (255), Lower Eastern Shore (186), and Tri-County (162) Regions.

Number of private recreational proposals in Anne Arundel County (318) was the largest value for any of Maryland's 17 local jurisdictions and accounted for 56.1 percent of all projects proposed in the county (Table 12). Additionally, these projects comprised 73.8 percent of the private recreational activities located in the Baltimore-Washington, D.C. Region. Fewer private recreational proposals in Baltimore (79), Harford (29), and Prince George's (1) Counties and Baltimore City (4) accounted for the other 26.2 percent of private recreational projects in the Region.

Talbot ranked second as the county with the greatest number of private recreational projects (119) proposed over the 5-year period, accounting for 46.7 percent of all private recreational activities located in the Upper Eastern Shore Region. Queen Anne's (71), Kent (33), Cecil (31), and Caroline (1) Counties ranked sixth, ninth, 10th, and 16th, respectively, in private recreational project number.

Approximately 53 percent of the Lower Eastern Shore's private recreational project total (186) were sited in Worcester County (99). Additionally, these projects accounted for 43.6 percent of the county's

5-year project number total. The Lower Eastern Shore's 87 remaining projects were located in Dorchester (47), Wicomico (23), and Somerset (17) Counties.

Eighty-two projects sited in Calvert County accounted for half of the private recreational activities proposed in the Tri-County Region over the 5-year period. Another 42.6 percent (69) of the Region's proposals were located in St. Mary's County; the remaining 6.8 percent (11) were sited in Charles County. Of Maryland's 17 coastal jurisdictions, Calvert, St. Mary's, and Charles Counties ranked fourth, seventh, and 14th in private recreational project number, respectively.

Commercial Development

A total 180 projects or 7.3 percent of the public notices analyzed were proposed for commercial purposes (Table 10). Annual commercial project numbers ranged from 28 (7.8 percent) in 1982 to 42 (9.1 percent) in 1983.

Approximately 47 percent (84) of all commercial proposals were located in the Lower Eastern Shore Region (Table 11). An additional 56 (31.1 percent) of the projects were sited in the Baltimore-Washington, D.C. Metropolitan Region, while the remaining 40 (22.2 percent) commercial projects were located in the Upper Eastern Shore (32) and Tri-County (8) Regions.

Eighty-four commercial projects accounted for 15.2 percent of all 551 Lower Eastern Shore projects (Table 12). More than half (47) of the commercial proposals were located in Worcester County; condominium and restaurant developments along the Atlantic coast in Ocean City accounted for 83.0 and 8.5 percent of the commercial projects, respectively.

An additional 22 (26.2 percent) Lower Eastern Shore commercial

proposals were located in Somerset County and attributed to commercial fishing operations. Proposals included activities generating new port facilities and expansions of crab shedding operations.

Dorchester (11) and Wicomico (4) Counties accounted for 17.9 percent of the Lower Eastern Shore's commercial projects. Condominium developments (8) and commercial fishing operations (3) accounted for the Dorchester County projects, while Wicomico County proposals generated 4 fishery or trade-related port facilities.

Nearly one-third of all projects proposed in Maryland for commercial purposes were located in the Baltimore-Washington, D.C. Metropolitan Region. Approximately 62.5 percent of these projects (35) were sited in Anne Arundel County, comprising 6.2 percent of all projects proposed in the county over the 5-year period. Fewer Baltimore-Washington, D.C. Metropolitan Region commercial proposals were located in Baltimore City (11) and Baltimore (6), Harford (3), and Prince George's (1) counties.

Thirty-two (17.8 percent) of Maryland's 180 commercial projects were located in the Upper Eastern Shore Region. These projects comprised 4.5 percent of all the Region's (704) proposals (Table 12). Queen Anne's County (12) accounted for more than one-third of the Upper Eastern Shore's commercial projects, while the remaining 20 projects were sited in Talbot (9), Kent (7), and Cecil (4) Counties. No commercial development, subject to Section 10/404 jurisdiction, was proposed for Caroline County.

Only 8 commercial proposals were identified in the Tri-County Region, representing 4.4 percent of all commercial activities. Four commercial developments were proposed in each Calvert and St. Mary's

Counties, comprising 2.4 and 2.7 percent of each county's total project number, respectively. Commercial activities accounted for only 2.1 percent of the projects proposed in the Tri-County Region between 1981 and 1985.

Marina Development

Approximately 7.1 percent (177) of all Maryland projects were proposed for marina-related activities (Table 10). Public commercial marinas were differentiated from private community (associations) marinas, yacht clubs, and combination condominium-boat slip proposals. All proposals to construct new boat slips and expansions, create additional recreational boating facilities or structures, and dredge new or existing boat basins were classified as marina-related activities.

Over the 5-year period, permitted projects generated 169 new or expanded public (94) and private (75) boating facilities (Table 14). The largest combined number of facilities (47) was located in Anne Arundel County and was comprised of 27 private and 20 public commercial facilities. These projects generated an additional 1496 private (873) and public (623) boat slips in the county.

Worcester County ranked second in marina project number with 25 permitted facilities. Eighty-four percent of these projects (21) were private marina developments creating an additional 1461 boat slips, whereas 4 public boating facilities generated 270 additional slips to Worcester County's total slip number.

Sixteen marinas were sited in Kent County, of which 87.5 percent were public facilities. Public marina projects generated 425 of the county's 450 new boat slips.

TABLE 14

NUMBER OF PERMITTED MARINA FACILITIES AND BOAT SLIPS IN MARYLAND'S COASTAL COUNTIES AND BALTIMORE CITY, 1981-1985.

	PUBLIC COMMERCIAL		CONDOMINIUM, PRIVATE COMMUNITY, AND YACHT CLUBS		COMBINED TOTAL	
	BOAT FACILITIES	BOAT SLIPS	BOAT FACILITIES	BOAT SLIPS	BOAT FACILITIES	BOAT SLIPS
ANNE ARUNDEL	20	623	27	873	47	1496
BALTIMORE	4	198	3	66	7	264
BALTIMORE CITY	7	905	3	275	10	1180
CALVERT	6	228	1	10	7	238
CAROLINE	1	16	0	0	1	16
CECIL	5	67	2	24	7	91
CHARLES	1	250	0	0	1	250
DORCHESTER	3	116	6	172	9	288
HARFORD	3	90	2	202	5	292
KENT	14	425	2	25	16	450
PRINCE GEORGE'S	0	0	0	0	0	0
QUEEN ANNE'S	6	384	4	296	10	680
ST. MARY'S	7	93	0	0	7	93
SOMERSET	4	65	0	0	4	65
TALBOT	7	117	3	52	10	169
WICOMICO	2	86	1	32	3	118
WORCESTER	4	270	21	1461	25	1731
TOTAL	94	3933	75	3488	169	7421

No more than 10 marina projects were located in each of Maryland's 13 remaining coastal counties. Seven of Baltimore City's 10 marina developments were public facilities. These projects, together with the 3 private marinas generated 1180 new boat slips in the city.

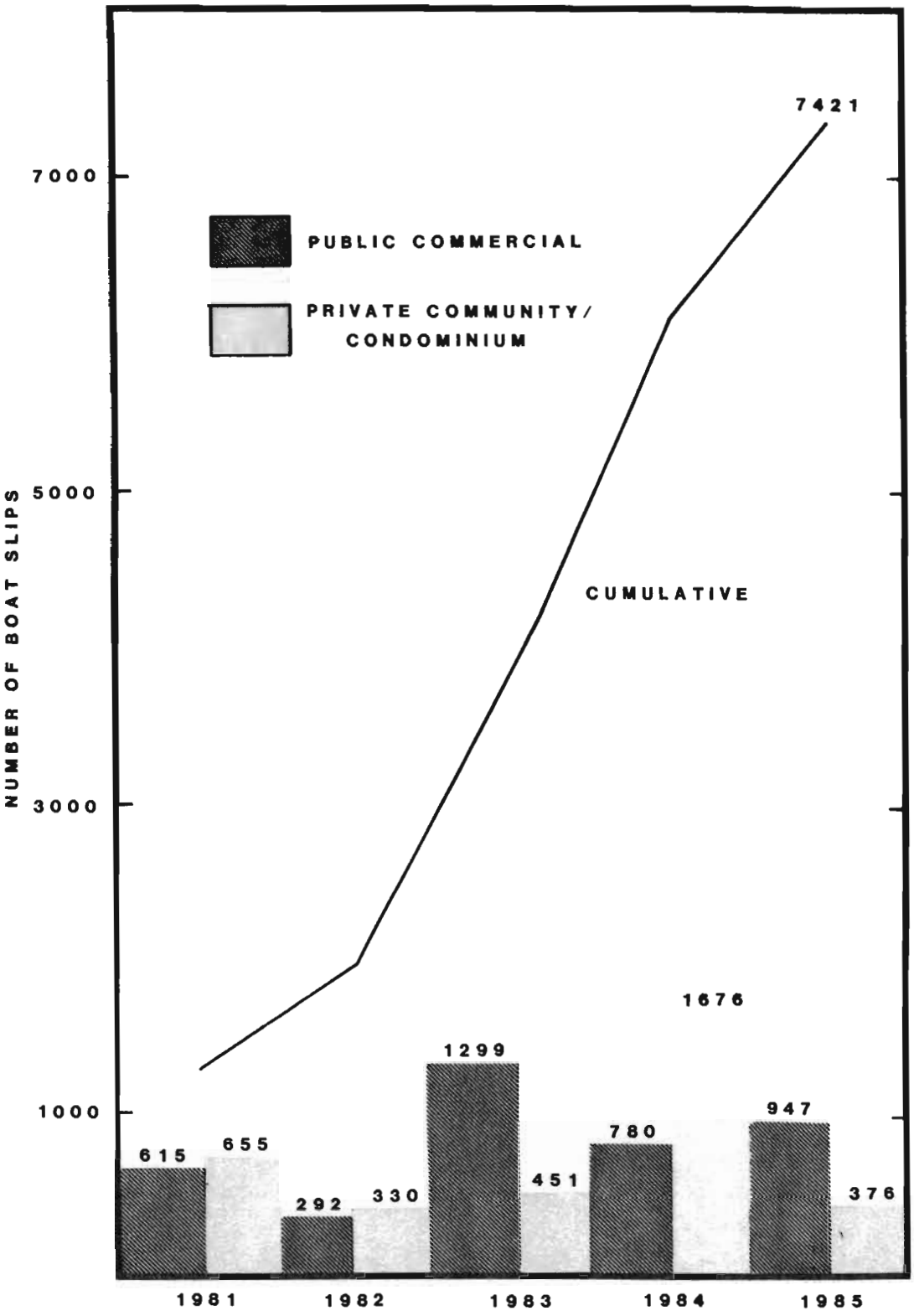
Ten facilities in each Queen Anne's and Talbot Counties created, respectively, 680 and 169 new boat slips in Maryland's coastal zone. More public (6) than private (4) facilities were constructed in Queen Anne's County, although average boat slip number for private (74) county marinas was greater than mean boat slip number for public (64) marina developments. Similarly, there were more public (7) than private (3) marina developments in Talbot County; these marina types averaged 16 and 17 boat slips per development, respectively.

Numbers of public commercial and private marinas aggregated according to Maryland's 4 coastal regions exhibited distinct regional patterns. Public marinas (14) comprised nearly all of the Tri-County Region's 15 marina developments. Similarly, three-quarters of the marina developments (33) in the Upper Eastern Shore Region were public facilities. The Baltimore-Washington, D.C. Metropolitan Region, however, experienced a near equal number of both public (34) and private (35) marina developments over the 5-year period. Private marina developments (28), attributed primarily to condominium-boat slip complexes located in Worcester County, dominated the Lower Eastern Shore's 41 marina facilities. Differences between public and private facilities in each of Maryland's 4 coastal regions were statistically significant ($X^2=25.92$, d.f.=3, $P<.001$).

Maryland's 169 permitted projects generated an additional 7421 public (3933) and private (3488) marina boat slips (Figure 6). Annual

FIGURE 6

MARINA DEVELOPMENT IN MARYLAND'S COASTAL ZONE, 1981-1985.



slip number for both public and private developments fluctuated greatly over the 5-year period. For example, 21 private marina projects permitted in 1984 generated 1676 additional slips, a significant increase in number of private boat slips permitted in each of the 3 previous years. These significant deviations were attributed to permittance of several large individual marina proposals dominating annual total slip numbers.

Annual numbers of public versus private marina developments were not statistically different (X^2=8.04, d.f.=4, P>.05) over the 5-year period (Table 15). However, numbers of private marinas, particularly condominium-boat slip complexes, significantly increased and surpassed numbers of public facilities permitted in both 1984 and 1985. Thus, condominium-boat slip developments representing economically favorable and aesthetically pleasing coastal recreational housing, will likely continue to increase in number, thereby posing potentially significant implications to future Maryland coastal development rates and trends in addition to public access to the coast.

Data on new marinas versus expansions over the 5-year period support this hypothesis (Table 16). Less than one-quarter of all public commercial marinas permitted over the 5-year period were new facilities. Conversely, nearly three-quarters of the private marina developments were new projects, rather than existing facility expansions. Differences between numbers of new versus expanded public and private marina developments over the 5-year period were statistically significant (X^2=40.14, d.f.=3, P<.001). Hence, results not only indicate that alternative concepts are being utilized in marine

TABLE 15

NUMBER OF PERMITTED MARINA DEVELOPMENTS
IN MARYLAND'S COASTAL ZONE, 1981-1985.

	PUBLIC COMMERCIAL	CONDOMINIUM, PRIVATE COMMUNITY AND YACHT CLUBS	TOTAL
1981	17	16	33
1982	16	12	28
1983	24	7	31
1984	20	21	41
1985	17	19	36
TOTAL	94	75	169

TABLE 16

TYPE OF PERMITTED MARINA DEVELOPMENTS
IN MARYLAND'S COASTAL ZONE, 1981-1985.

	NEW	EXPANSION	TOTAL
PUBLIC COMMERCIAL	23	71	94
CONDOMINIUM, PRIVATE COMMUNITY, AND YACHT CLUBS	55	20	75
TOTAL	78	91	169

recreational boating, but more importantly, coastal zone development in Maryland is evolving to accommodate the changing needs of society.

Public Recreational Projects

Approximately 3.9 percent (97) of projects proposed in Maryland over the 5-year period were for public recreational purposes (Table 10). Annual recreational project numbers ranged from 7 in 1982 to 28 in 1985 and accounted for no more than 5.1 percent of the projects proposed in any single year.

The largest percentage (40.2 percent) of all public recreational proposals were located in the Upper Eastern Shore Region and represented 5.5 percent of all projects proposed in the Region during the 5-year period (Table 11). One-quarter of all public recreational projects were sited in the Baltimore-Washington, D.C. Metroplitan Region, while fewer projects were proposed in either the Lower Eastern Shore (22) or Tri-County (11) Regions.

Of all public recreational projects proposed in the Upper Eastern Shore Region, most were located in Queen Anne's (12) and Talbot (12) Counties. These projects accounted for only 3.8 percent of all Talbot County proposals, whereas public recreational activities represented 6.7 percent of all Queen Anne's County projects. Fewer Upper Eastern Shore projects were sited in Cecil (9), Caroline (5), and Kent (5) Counties.

One-third of Baltimore-Washington, D.C. Metropolitan Region public recreational projects (25) were found in Harford County (18) and equalled 14.8 percent of all activities proposed in the county. An additional 6 public recreational proposals for were located in Anne Arundel County; fewer projects were sited in Baltimore City (5) and Baltimore (4) and Prince George's (2) Counties.

Public recreational proposals in Somerset County comprised one-half of all Lower Eastern Shore Region public recreational projects and accounted for more than 10 percent of the County's projects. Five projects were sited in Dorchester County, while the remaining 6 regional public recreational projects were located in Worcester (4) and Wicomico (2) Counties.

Approximately 64 percent of all Tri-County Region public recreational projects were proposed in St. Mary's County. Four remaining projects proposed for public recreation were located in Calvert (3) and Charles (1) Counties.

Public Utility/Service Projects

Activities associated with public utilities or services accounted for no more than 4 percent of the annual project number proposed each year between 1981 and 1985 (Table 10). Cable and pipeline emplacement across navigable waterways and/or through wetlands were activities most frequently categorized as a public service. Overall, approximately 3.3 percent of all projects proposed over the 5-year period involved a public service activity.

Thirty-two public service projects were proposed in the Baltimore-Washington, D.C. Metropolitan Region, whereas the Lower Eastern Shore accounted for 24 (29.9 percent) of these projects (Table 11). Fewer public utility proposals were located in the Upper Eastern Shore (17) and Tri-County (8) Regions.

Most Baltimore-Washington, D.C. Metropolitan Region public service projects were proposed in Anne Arundel County (Table 12). The Region's 14 remaining projects were sited in Baltimore (8) and Prince George's (1) Counties and Baltimore City (5).

Half of Lower Eastern Shore public service activities were proposed in Somerset County (12), while fewer of these projects were sited in Worcester (7), Dorchester (3), and Wicomico (2) Counties.

Talbot County accounted for 47 percent of the Upper Eastern Shore public service activities. An additional 4 projects were located in Cecil County, while fewer public utility projects were found in Caroline (2), Kent (2), and Queen Anne's (1) Counties.

Eight public service projects were proposed in the Tri-County Region, of which half were sited in Calvert County. The Region's 4 remaining projects were attributed to St. Mary's (3) and Charles (1) County proposals.

Fish and Wildlife Enhancement and Mosquito Control Activities

Less than 3 percent of all Maryland coastal projects subject to Section 10/404 permit authorization were proposed for either fish and wildlife enhancement or mosquito control purposes. The largest number (28) of fish and wildlife enhancement projects were proposed in 1984 and accounted for 5.2 percent of all projects proposed that year (Table 10). An additional 22 enhancement projects were proposed in 1985, although no more than 8 projects were proposed in 1981, 1982, or 1983. Thus, an average 7 fish and wildlife enhancement projects were proposed annually between 1981 and 1983, whereas an average annual 25 proposals or 3.5 times as many projects occurred in 1984 and 1985.

Although fish and wildlife enhancement and mosquito ditching activities accounted for only a small fraction of all Maryland projects proposed over the 5-year period, these activities were often large, affecting significant coastal areas. For example, areas proposed for open marsh water management (OMWM) to control mosquito populations

generally averaged several hundred acres in size. Many waterfowl impoundments and associated dams typically affect several acres or more. Thus, these enhancement projects alter large areas of the Maryland coastal zone when the activities are assessed cumulatively.

More than 90 percent of all fish and wildlife enhancement proposals were located on Maryland's Eastern Shore. Eastern Shore projects were distributed in near equal numbers in each Lower (33) and Upper (32) Eastern Shore Regions (Table 11). Fewer enhancement and mosquito control activities were located in either the Tri-County (4) or Baltimore-Washington, D.C. Metropolitan (2) Regions.

Twenty-three of the 33 Lower Eastern Shore projects were sited in Dorchester County (Table 12). Over the 5-year period, 6 mosquito ditching OMWM projects affecting 14,310 acres were permitted. Additionally, 15 waterfowl impoundments and 2 artificial reef projects were permitted.

Almost half of all Upper Eastern Shore enhancement projects were sited in Talbot County, of which 13 projects were proposed for waterfowl habitat enhancement. Fourteen additional wildlife enhancement proposals were permitted in the Upper Eastern Shore including waterfowl impoundments and ponds in Kent (8), Queen Anne's (3), Caroline (2), and Cecil (1) Counties.

Other Lower Eastern Shore fish and wildlife enhancement projects were sited in Worcester (7), Somerset (2) and Wicomico (1) Counties. Waterfowl impoundments (6) and one 67-acre OMWM project comprised all Worcester County activities; a 410-acre mosquito ditching project was permitted in Wicomico County, while 2 enhancement proposals were permitted in Somerset County.

Permits were issued for 2 OMWM projects located in the Tri-County Region; 45 and 40-acre wetland tracts were managed in St. Mary's and Calvert Counties, respectively. Additionally, one artifical reef proposal was permitted in Charles County.

Only 2 projects proposed for fish and wildlife enhancement purposes were located in the Baltimore-Washington, D.C. Metropolitan Region. An artificial reef for fish utilization was proposed and permitted in Anne Arundel County coastal waters; the second project involved dredging of an approximate 2784-acre subtidal area located in Baltimore County coastal waters. This proposal was categorized as an enhancement project as it generated fossil shell material, suitable for oyster cultch (propagation), for use in the State's management of the Chesapeake Bay shellfish resource.

Transportation-Related Projects

Approximately 2.4 percent of all projects analyzed were proposed for transportation-related purposes including road construction, expansion, and repair; bridge construction and renovation; and all additional ancillary activities associated with these projects. In 1981, 16 bridge and causeway projects were proposed, representing the largest annual number of transportation-related projects identified over the 5-year period. Fifteen road construction projects were proposed in 1984, 14 in 1983, 10 in 1985, and 5 in 1982. Transportation-related projects comprised no more than 3.2 percent of the projects proposed annually in Maryland (Table 10).

Approximately 43.3 percent of Maryland's transportation-related projects were located in the Lower Eastern Shore Region (Table 11). Eighteen (69.2 percent) of the 26 projects were sited in Dorchester

County; fewer bridge and highway proposals were located in Somerset (6), Wicomico (1), and Worcester (1) Counties (Table 12).

Baltimore-Washington, D.C. Metropolitan Region transportation-related projects were most often sited in Anne Arundel (9) County. One-quarter of the region's bridge and roadway projects were located in Baltimore County, while the remaining 8 projects were proposed in Baltimore City (4) and Prince George's (3) and Harford (1) Counties.

A total 8 bridge and causeway activities were proposed in the Upper Eastern Shore, comprising 1.1 percent of all projects proposed in the region over the 5-year period. Five of these projects were sited in Queen Anne's County in addition to the 3 projects located in Talbot (2) and Cecil (1) Counties.

One percent of all Tri-County Region projects were proposed for transportation-related activities. Two highway proposals were located in St. Mary's County in addition to the single road project identified in Charles County.

Industrial Development

All dredge and fill activities and structures associated with ports and waterborne commerce, coal and oil terminals, sand and gravel operations, and ship repair facilities were classified as industrial development. Forty coastal Maryland projects subject to Section 10/404 authorization over the 5-year period were proposed for industrial purposes. Industrial projects as percentages of the total annual project numbers comprised a maximum 2.8 percent (15) of all projects proposed in 1981 and declined to 0.7 percent (6) of all proposals identified in 1985 (Table 10). Industrial projects equalled 1.6 percent of all projects proposed over the 5-year period.

Seventy percent of all industrial activities were located in the Baltimore-Washington, D.C. Metropolitan Region (Table 11). Baltimore City accounted for 16 (57.1 percent) of these projects, while 10 (35.7 percent) and 2 (7.1 percent) industrial projects were located in Baltimore and Anne Arundel Counties, respectively.

St. Mary's County accounted for all 5 industrial proposals located in the Tri-County Region; five projects in Wicomico (3) and Somerset (2) Counties comprised all industrial activities in the Lower Eastern Shore. One project in Kent and one in Queen Anne's County accounted for the only industrial proposals of the Upper Eastern Shore.

Other Projects

Thirteen miscellaneous activities associated with agricultural practices, naval operations, archaeological explorations and private sewage containment structures were identified, representing 0.6 percent of all projects proposed over the 5-year period. Six of these projects were sited in the Lower Eastern Shore, of which 4 were in Dorchester and 2 were in Somerset Counties. Caroline (2), Queen Anne's (2), and Kent (1) Counties accounted for 5 miscellaneous projects located in the Upper Eastern Shore, while St. Mary's and Charles Counties accounted for 2 miscellaneous proposals in the Tri-County Region.

Changes in Coastal Habitats

A total 2359 permitted projects were assessed to identify cumulative changes in Maryland's coastal wetlands that have resulted from Section 10/404 activities issued by the COE over the 5-year period. All dredging, filling, and impounding of both vegetated and non-vegetated intertidal wetland habitats were classified as immediate

irreversible losses. Subtidal habitats were either lost as a result of filling activities or altered by channel or basin dredging. Additional coastal habitats were generated via (1) enhancement projects; (2) compensatory activities required to offset wetlands eliminated by other permitted development; and (3) projects converting one habitat to an alternative wetland type.

Habitat Losses

Maryland projects authorized by the Baltimore District COE resulted in the loss of 913.1 coastal wetland acres between 1981 and 1985 (Table 17). Approximately 90 percent of all habitats eliminated were vegetated coastal wetlands; estuarine, irregularly flooded emergent habitats (i.e., high marsh) predominated by saltmeadow hay (Spartina patens) and salt grass (Distichlis spicata) comprised most (674.7 acres) of these vegetated wetland losses. Additionally, 56.9 acres of palustrine forested and scrub-shrub wetlands (i.e., bottomland hardwoods) vegetated with species including, red maple (Acer rubrum), alder (Alnus spp.), and willow (Salix spp.) species were lost to Maryland coastal development. Loss of combined tidal freshwater and oligohaline (i.e., salinities between 0.5 and 5.0 parts per thousand), narrow-leaved persistent emergent marshes (i.e., Typha spp. and Spartina cynosuroides dominated wetlands) totaled 36.3 acres, while more than 32 acres of combined tidal (27.3 aces) and non-tidal (5.4 acres) Phragmites dominated wetlands were also destroyed over the 5-year period. Although losses of palustrine and estuarine broad-leaved emergent wetlands (dominant species including Peltandra virginica and Pontedaria cordata) and regularly flooded estuarine (Spartina alterniflora) wetlands were less than other vegetated habitat types, the elimination of these habitats represents

TABLE 17

CHANGES (IN ACRES) IN MARYLAND COASTAL HABITATS RESULTING FROM PROJECTS AUTHORIZED BY THE BALTIMORE CORPS DISTRICT, 1981-1985.

HABITAT TYPE	LOSS	ALTERATION	GAIN
VEGETATED			
ESTUARINE REGULARLY FLOODED PERSISTENT EMERGENT (*Spartina alterniflora* dominant)	8.3	[a]	44.3
ESTUARINE IRREGULARLY FLOODED PERSISTENT EMERGENT (*S. patens* dominant)	674.7	[a]	13.7
PALUSTRINE/ESTUARINE BROAD-LEAVED NON-PERSISTENT EMERGENT (*Peltandra*, *Sagittaria*, *Pontederia* spp. dominant)	9.4	[a]	7.5
PALUSTRINE/ESTUARINE NARROW-LEAVED PERSISTENT EMERGENT (*Typha* spp., *S. cynosuroides* dominant)	36.3	[a]	12.6
PALUSTRINE/ESTUARINE PERSISTENT EMERGENT (*Phragmites australis* dominant)	27.3	[a]	[a]
PALUSTRINE NON-TIDAL PERSISTENT EMERGENT (*Phragmites australis* dominant)	5.4	[a]	[a]
PALUSTRINE AND ESTUARINE FORESTED/SHRUB (*Acer rubrum*, *Iva*, *Alnus* spp., dominant)	56.9	[a]	29.2
SUBTOTALS	818.3	[a]	107.3
NON-VEGETATED			
ESTUARINE INTERTIDAL UNCONSOLIDATED SHORE (Mudflat/Sandflat)	61.4	[a]	[a]
ESTUARINE SUBTIDAL UNCONSOLIDATED BOTTOM/OPEN-WATER	33.4	1280.8	633.6
PALUSTRINE TIDAL OPEN-WATER	[a]	[a]	18.4
PALUSTRINE AND LACUSTRINE NON-TIDAL OPEN-WATER	[a]	[a]	117.9
SUBTOTALS	94.8	1280.8	769.9
TOTALS	913.1	1280.8	877.2

[a]Habitat loss, alteration, or gain may have resulted from project permittance and construction under regulatory program jurisdiction, but could not be measured.

the loss of important functions and values that wetlands contribute to the ecosystem and man. Permitted development accounted for losses of 9.4 acres of palustrine/estuarine broad-leaved emergent and 8.3 acres of regularly flooded estuarine wetlands.

Dredging, filling, and impounding activities between 1981 and 1985 also accounted for the destruction of 61.4 acres of Maryland's estuarine intertidal mud- and sandflats. Approximately 33.4 acres of subtidal habitat and open water were also lost to fill projects.

Of Maryland's total coastal habitat losses over the 5-year period, 75 percent (685.5 acres) of the wetlands eliminated were in Dorchester County (Table 18). Irregularly flooded estuarine marshes (650.4 acres) were habitats most frequently lost to development, although 22.4 acres of the county's palustrine forested and scrub-shrub wetlands were also developed. Losses of high marsh and bottomland hardwoods in Dorchester County were respectively, 96.4 and 39.4 percent of the state's total losses for these two habitat types.

Talbot ranked second among Maryland's coastal counties in total habitat losses (69.5 acres). Losses of cattail/big cordgrass communities (21.4 acres) and common reed habitats (22.4 acres) accounted for 30.8 and 32.2 percent of the county's total wetland losses, respectively. Talbot County intertidal flats (10.4 acres), bottomland hardwoods (4.8 acres), high marshes (4.8 acres), and non-tidal common reed wetlands (4.0 acres) also incurred significant losses.

Subtidal (27.7 acres) and intertidal (16.0 acres) habitats accounted for nearly all wetlands lost (43.9 acres) in Baltimore County, ranked third among all counties in habitats eliminated. The 29.7 wetland acres lost in Kent County (ranked fourth) were largely

TABLE 18

COASTAL COUNTY HABITATS LOST (IN ACRES) AS A RESULT OF PROJECTS AUTHORIZED BY THE BALTIMORE CORPS DISTRICT, 1981-1985.

	HABITATS[a]									
COUNTY	(A) E2EM5N	(B) E2EM5P	(C) PEM4	(D) PEM5+E2EM5	(E) PEM5+E2EM5	(F) PEM5	(G) PFO1+PSS	(H) E1UB/OW	(I) E2FL	TOTAL
ANNE ARUNDEL	<0.1	0.4		0.7			4.8	0.2	17.0	23.1
BALTIMORE	0.1				0.1			27.7	16.0	43.9
BALTIMORE CITY								2.1	0.5	2.6
CALVERT	<0.1	0.5						0.8	1.8	3.1
CAROLINE		0.1	<0.1	0.3					0.1	0.5
CECIL	<0.1			0.2	3.5			0.9	2.2	6.8
CHARLES		0.8		<0.1					0.5	1.3
DORCHESTER	1.6	650.4	4.0	3.2		0.9	22.4	<0.1	3.0	685.5
HARFORD		0.2					0.5	<0.1	1.2	1.9
KENT	0.1		4.3	4.9	0.4	0.2	18.8	0.3	0.7	29.7
PRINCE GEORGE'S			<0.1				3.0	<0.1	0.4	3.5
QUEEN ANNE'S	0.7	1.9		0.5	0.5		0.7	0.1	1.9	6.3
SOMERSET	1.2	3.0		0.2				0.2	1.0	5.6
ST. MARY'S	0.1	0.6		0.1			0.1	0.4	2.5	3.8
TALBOT	0.2	4.8	1.0	21.4	22.9	4.0	4.8	<0.1	10.4	69.5
WICOMICO	0.2	5.7						0.1	0.6	6.6
WORCESTER	4.1	6.3	—	4.8	—	0.3	1.8	0.7	1.5	19.5
TOTAL	8.3	674.7	9.4	36.3	27.3	5.4	56.9	33.4	61.4	913.1

[a]Habitats identified according to the USFWS classification system (Cowardin et al., 1979).
(A) Estuarine, regularly flooded, persistent emergent (*Spartina alterniflora* dominant).
(B) Estuarine, irregularly flooded, persistent emergent (*S. patens*, *Distichlis spicata* dominant).
(C) Palustrine, broad-leaved, non-persistent emergent (*Peltandra*, *Sagittaria* spp. dominant).
(D) Palustrine and estuarine, narrow-leaved, persistent emergent (*Typha* spp., *S. cynosuroides* dominant).
(E) Palustrine and estuarine, narrow-leaved, persistent emergent (*Phragmites australis* dominant).
(F) Palustrine, non-tidal, narrow-leaved, persistent emergent (*Phragmites australis* dominant).
(G) Palustrine, forested, broad-leaved, deciduous and scrub-shrub (*Acer rubrum* dominant).
(H) Estuarine, subtidal, unconsolidated bottom/open water.
(I) Estuarine, intertidal, unconsolidated sand or mudflat.

palustrine forested and scrub-shrub (18.8 acres), estuarine/palustrine narrow-leaved emergent (4.9 acres) and palustrine broad-leaved emergent (4.3 acres) wetlands, while intertidal flats (17.0 acres) and bottomland hardwoods (4.8 acres) comprised most of Anne Arundel County's (ranked fifth) 23.1 wetland acres lost to coastal development.

The 4.1 acres of low salt marsh eliminated in Worcester County (ranked sixth) accounted for 21 percent of the county's wetlands losses and nearly half of all regularly flooded emergent wetlands lost in Maryland over the 5-year period. One-third of Worcester County's habitat losses were attributed to developments in irregularly flood salt marshes (6.3 acres), while losses of palustrine/estuarine narrow-leaved emergent (4.8 acres), palustrine forested and scrub-shrub (1.8 acres), and estuarine intertidal flat (1.5 acres) habitats accounted for 41.5 percent of the county's wetland losses.

None of the remaining 10 coastal counties nor Baltimore City lost more than 7 acres of combined tidal and non-tidal vegetated and non-vegetated habitats during the 5-year study period. Phragmites dominated tidal wetlands comprised more than half of Cecil County's (ranked seventh) habitat losses, whereas 86.4 percent of Wicomico County's (ranked eighth) lost habitats were irregularly flooded salt marshes. Losses of several habitat types mutually contributed to Queen Anne's County (ranked ninth) wetlands losses (6.3 acres); more than half of 10th ranked Somerset County's losses (5.6 acres) were associated with high salt marsh habitats.

Western Shore counties experienced fewer wetland losses, and impacts were typically associated with non-vegetated coastal habitats. St. Mary's, Prince George's, Calvert, Baltimore City, Harford, and

Charles Counties ranked 11th through 16th, respectively, in coastal habitats lost over the 5-year period. Minimal wetlands losses (0.5 acres) were identified in Caroline County.

Overall, vegetated wetland losses were most significant on the Eastern Shore, especially in Dorchester County. Vegetated wetland losses were cumulatively less severe in Talbot, Kent, and Worcester Counties, although these developments were significant in comparison to losses in other coastal counties. Most significant vegetated wetland losses were associated with Maryland's estuarine irregularly flooded emergent and palustrine forested and scrub-shrub habitats. Significant losses of estuarine, regularly flooded emergent and palustrine/estuarine narrow-leaved emergent wetlands were identified in Worcester and Talbot Counties, respectively.

Habitat losses in Western Shore coastal counties were primarily dredging and filling of both estuarine, non-vegetated inter- and subtidal wetlands. Largest habitat losses were located in the Baltimore-Washington, D.C. Metropolitan Region, particularly in Baltimore and Anne Arundel Counties. Tri-County Region wetland losses, primarily attributed to filling of non-vegetated intertidal habitats, were minimal in comparison to wetland losses in other Regions. Most significant vegetated wetland losses on the Western Shore were associated with palustrine forested and scrub-shrub habitats.

Approximately 83 percent of all coastal habitat losses resulted from fish and wildlife enhancement and mosquito control activities of which, 656.1 acres were estuarine irregularly flooded emergent wetlands (Table 19). Construction of a 440-acre state-managed waterfowl impoundment[3] in Dorchester County and 189.3 acres of state-wide mosquito

TABLE 19

MARYLAND'S COASTAL HABITATS LOST (IN ACRES) AS A RESULT OF ACTIVITIES PERMITTED BY THE BALTIMORE CORPS DISTRICT, 1981-1985. ACTIVITIES ARE CATEGORIZED ACCORDING TO PROJECT PURPOSE.

	HABITATS[a]									
PURPOSE	(A) E2EM5N	(B) E2EM5P	(C) PEM4	(D) PEM5+E2EM5	(E) PEM5+E2EM5	(F) PEM5	(G) PFO1+PSS	(H) E1UB/OW	(I) E2FL	TOTAL
SHORELINE STABILIZATION	0.3	0.2		<0.1	0.1			3.2	24.6	28.4
PRIVATE RECREATIONAL		0.7	<0.1					<0.1	0.6	1.3
COMMERCIAL	4.0	6.0		4.8		0.3		<0.1	7.2	22.3
MARINA-RELATED	0.4	3.8		0.2			0.9		1.3	6.6
PUBLIC RECREATIONAL	<0.1	0.2		0.2				0.5	1.2	2.1
PUBLIC UTILITY/SERVICE		0.8							0.1	0.9
FISH & WILDLIFE ENHANCEMENT AND MOSQUITO CONTROL	1.0	656.1	5.3	29.9	26.9	5.2	26.9		9.3	760.6
TRANSPORTATION-RELATED	2.5	6.5	4.0	1.1	0.3		29.1	19.6	16.0	79.1
INDUSTRIAL								10.0	0.8	10.8
OTHER	0.1	0.4	—	—	—	—	—	0.1	0.3	0.9
TOTAL	8.3	674.7	9.4	36.3	27.3	5.5	56.9	33.4	61.4	913.1

[a]Habitats identified according to the USFWS classification system (Cowardin et al., 1979).
(A) Estuarine, regularly flooded, persistent emergent (Spartina alterniflora dominant).
(B) Estuarine, irregularly flooded, persistent emergent (S. patens, Distichlis spicata dominant).
(C) Palustrine, broad-leaved, non-persistent emergent (Peltandra, Sagittaria spp. dominant).
(D) Palustrine and estuarine, narrow-leaved, persistent emergent (Typha spp., S. cynosuroides dominant).
(E) Palustrine and estuarine, narrow-leaved, persistent emergent (Phragmites australis dominant).
(F) Palustrine, non-tidal, narrow-leaved, persistent emergent (Phragmites australis dominant).
(G) Palustrine, forested, broad-leaved, deciduous and scrub-shrub (Acer rubrum dominant).
(H) Estuarine, subtidal, unconsolidated bottom/open water.
(I) Estuarine, intertidal, unconsolidated sand or mudflat.

ditching projects accounted for more than 95 percent of all high salt marsh habitats eliminated by permitted activities in Maryland over the 5-year period.

Eastern Shore waterfowl impoundments and ponds comprised nearly all of the wildlife enhancement projects constructed. Water control structures and water bodies generated for wildlife enhancement resulted in loss of 62.0 acres of palustrine and estuarine narrow-leaved emergent (Typha spp., Spartina cynosuroides and Phragmites australis dominant) wetlands and 26.9 acres of palustrine forested and scrub-shrub habitats. Palustrine broad-leaved emergent (5.3 acres), estuarine intertidal flat (9.3 acres), and estuarine regularly flooded emergent (1.0 acres) wetlands were also eliminated by fish and wildlife enhancement activities.

Causeway and bridge construction, renovation, and realignment accounted for 79.1 coastal wetland acres lost in Maryland between 1981 and 1985. Bottomland hardwoods comprised 36.8 percent of these habitats, while 19.1 and 16.0 acres of non-vegetated subtidal and intertidal habitats were eliminated by transportation-related activities, respectively. Additionally, dredge and fill operations associated with transportation development accounted for losses of irregularly flooded estuarine emergents (6.5 acres); palustrine non-persistent, broad-leaved emergents (4.0 acres); regularly flooded estuarine emergents (2.5 acres); palustrine and estuarine, narrow-leaved persistent emergents (1.1 acres); and palustrine and estuarine Phragmites-dominated (0.3 acres) wetlands.

Nearly 25 acres of intertidal mud and sandflats and 3.2 acres of subtidal habitats were filled for shoreline stabilization purposes.

Cumulative impacts resulting from erosion control projects were significantly less for Maryland's other coastal wetlands; net loss was less than 1.0 acres for all other habitats combined.

Commercial developments destroyed 22.3 acres of Maryland wetlands, one-third (7.2 acres) of which were non-vegetated intertidal habitats. Twenty-seven percent of the commercially-related habitat losses were to S. patens-dominated (6.0 acres) habitats, whereas Typha- (4.8 acres) and S. alterniflora-dominated (4.0 acres) wetlands respectively accounted for 21.5 and 17.9 percent of Maryland's coastal wetlands lost to commercial development. The 4.0 acres of regularly flooded emergent wetlands eliminated by commercial activities represented almost half of all S. alterniflora wetlands destroyed by permitted activities over the 5-year period. Cumulative impacts, resulting from commercial development, were less significant for Maryland's other coastal wetland types.

Habitat losses attributed to other permitted coastal activities were significantly less; dredging and filling for industrial purposes destroyed 10.0 acres of subtidal habitat and 0.8 acres intertidal mudflat. Each of the remaining project groups accounted for no more than 6.6 acres of wetlands lost in coastal Maryland over the 5-year period. These purpose-related activities, ranked according to decreasing cumulative losses, were marina-related (sixth), public recreational (seventh), private recreational (eighth), and public service/utility and other (ninth) permitted projects identified.

Habitat Alterations

All permitted dredging of estuarine subtidal habitats was classified as an alteration of open water habitats. Additional wetland

types may have been altered during project construction, although these impacts could not have been assessed without site visits. Thus, only permitted dredging of subtidal habitats were included as an alteration; Congressionally-approved federal navigation projects were not assessed.

More than 1280 acres of subtidal habitats were dredged over the 5-year period. Significantly larger subtidal habitats areas were altered by permitted state-contracted shell dredging operations that were not included in this assessment.[4] Of the 1280.8 subtidal acres identified, 854.9 acres (66.7 percent) were previously dredged subtidal lands, while 425.9 acres (33.3 percent) were previously unaltered subtidal habitats (Table 20). Baltimore County ranked first among all 17 Maryland jurisdictions in largest area dredged (500.5 acres) and accounted for 39 percent of the Maryland total. Anne Arundel County and Baltimore City dredging accounted for an additional 26.8 and 9.1 percent of the state total, respectively. Dredging in the 14 remaining jurisdictions comprised only one-quarter of Maryland's permitted dredging activities between 1981 and 1985.

New versus maintenance dredging were contrasted to identify (1) counties experiencing new coastal development; and (2) habitat impacts of greater (i.e., previously unaltered areas) concern (Table 20). Dredging in 2 counties was comprised entirely of new dredging; 41.2 and 1.9 acres of new dredging occurred in Harford and Wicomico Counties, respectively. Worcester (.87), Queen Anne's (.85), Talbot (.79), and Caroline Counties (.79) also experienced primarily new dredging activities. Conversely, habitats dredged in Baltimore City (.17) and Anne Arundel (.19) and Baltimore (.23) Counties were mostly previously altered habitats.

TABLE 20

ESTUARINE SUBTIDAL UNCONSOLIDATED BOTTOM HABITATS ALTERED (IN ACRES) BY PERMITTED DREDGING ACTIVITIES, 1981-1985.

	DREDGING			
COUNTY	NEW (N)	MAINTENANCE	COMBINED (C)	N/C VALUE
ANNE ARUNDEL	65.0	278.2	343.2	0.19
BALTIMORE	115.2	385.3	500.5	0.23
BALTIMORE CITY	19.3	96.9	116.2	0.17
CALVERT	2.2	5.3	7.5	0.29
CAROLINE	12.9	3.5	16.4	0.79
CECIL	4.3	7.7	11.9	0.36
CHARLES	5.2	9.0	14.2	0.37
DORCHESTER	16.9	10.9	27.8	0.61
HARFORD	41.2	0.0	41.2	1.00
KENT	12.6	6.3	18.9	0.67
PRINCE GEORGE'S	0.0	0.0	0.0	0.00
QUEEN ANNE'S	26.4	4.6	31.0	0.85
SOMERSET	10.6	10.3	20.9	0.51
ST. MARY'S	9.7	22.1	31.8	0.31
TALBOT	17.7	4.8	22.5	0.79
WICOMICO	1.9	0.0	1.9	1.00
WORCESTER	64.9	10.0	74.9	0.87
TOTAL	425.9	854.9	1280.8	0.33

Overall, dredging in Western Shore jurisdictions was primarily maintenance, whereas new alterations exemplified most of the dredging on the Eastern Shore. Harford and Cecil Counties were exceptions to this general principle. New alterations dominated Lower Eastern Shore counties; greater maintenance dredging was indicative of Upper Eastern Shore counties. Worcester, Harford, and Queen Anne's Counties were identified as jurisdictions experiencing the most significant new coastal development, based on magnitude of dredging and higher proportion of new alterations.

Although industrial-related activities comprised only a minor percentage of all projects proposed in Maryland over the 5-year period, the projects accounted for two-thirds of all subtidal habitat alterations (Table 21). Another 10 percent of Maryland's dredged subtidal lands were altered by marina-related activities, three-quarters of which were affected by new alterations. Dredging of private boat slips and basins (93.0 acres) accounted for 7.3 percent of the state total. Dredging associated with commerical (73.8 acres), public recreational (60.6 acres), public service (33.0 acres), transportation-related (12.6 acres), and other (12.8 acres) developments contributed to the cumulative alteration of Maryland's estuarine subtidal habitats.

In summary, industrial dredging activities altered primarily (85.5 percent) previously dredged habitats; public recreational (52.4 percent) and transportation-related activities were also characterized by greater maintenance than new dredging activities. Public service, commercial, and private recreational projects were predominated by new dredging alterations.

TABLE 21

MARYLAND'S ESTUARINE SUBTIDAL UNCONSOLIDATED BOTTOM HABITATS ALTERED (IN ACRES) BY PERMITTED DREDGING, 1981-1985. ACTIVITIES ARE CATEGORIZED ACCORDING TO PROJECT PURPOSE.

	DREDGING		
PURPOSE	NEW	MAINTENANCE	COMBINED
PRIVATE RECREATIONAL	64.2	28.8	93.0
PUBLIC RECREATIONAL	28.7	31.9	60.6
COMMERCIAL	61.0	12.8	73.8
INDUSTRIAL	124.3	731.0	855.3
PUBLIC SERVICE	32.3	0.7	33.0
MARINA-RELATED	105.7	34.0	139.7
TRANSPORTATION-RELATED	6.1	6.5	12.6
OTHER	3.6	9.2	12.8
TOTAL	425.9	854.9	1280.8

Habitats Gains

Coastal projects permitted by the Baltimore District COE also contributed to the creation or conversion of wetland habitats. Between 1981 and 1985, approximately 877.2 Maryland wetland and deepwater habitat acres were generated via habitat conversion or upland excavation (Table 17). Estuarine open-water habitats comprised 72.2 percent of all new subtidal habitats identified; these habitats were produced via (1) vegetated wetlands impounding (410.0 acres); (2) mosquito ditching (189.3 acres); (3) uplands excavation (26.8 acres); and (4) dredging of intertidal habitats (7.5 acres). Additionally, wetland and upland impoundments generated 117.9 acres of non-tidal palustrine and lacustrine open water habitats and 18.4 acres of tidal palustrine open-water habitats. Overall, non-vegetated open water habitats accounted for 87.7 percent of all new habitats created in Maryland over the 5-year period.

Approximately 107.3 acres of vegetated wetlands were also generated by permitted activities. Compensatory mitigation for unavoidable losses accounted for 96.6 percent (103.6 acres) of all vegetated wetlands created, while 3.4 percent (3.7 acres) were generated by non-structural shoreline stabilization practices.

Regularly flooded estuarine emergent (S. alterniflora dominant) wetlands comprised 41.3 percent (44.3 acres) of all vegetated habitats created via the permit process. Approximtely 2.7 acres of the low salt marsh created resulted from shoreline stabilization activities; 41.6 acres were produced as compensation for other wetland losses.

Habitat gains resulting from the permit process were less significant for other vegetated wetland types. Compensation for

unavoidable project losses accounted for the creation of 29.2 acres of palustrine forested and scrub-shrub wetlands (Acer rubrum, Alnus spp. dominant), 12.7 acres of irregularly flooded estuarine emergents (S. patens dominant), 12.6 acres of palustrine/estuarine narrow-leaved emergents (Typha spp., S. cynosuroides dominant), and 7.5 acres of palustrine/estuarine broad-leaved emergents (Peltandra, Sagittaria, Pontederia spp. dominant). Vegetative shoreline stabilization activities also accounted for 1.0 acres of high salt marsh generated in Maryland's coastal zone over the 5-year period.

Process Evaluation

Ninety-five percent of all projects requiring Section 10/404 authorization over the 5-year period were permitted by the Baltimore District COE (Table 22). Percentage of projects issued annually ranged from a low 93.1 percent in 1982 to a high 99.2 percent in 1981. Of 122 proposals not permitted, 94 were withdrawn, 27 were denied, and 1 was still pending. Projects withdrawn accounted for 3.8 percent of all activities proposed and 77.0 percent of all non-permitted projects; only 1.1 percent of all projects were denied by the COE and comprised 22.1 percent of the non-permitted activities. Largest number (30) of withdrawals occurred in 1984, whereas most project denials (9) occurred in 1983.

Mean annual permit processing time progressively decreased over the 5-year period. An average 112 days were required to process a permit in 1981, whereas the COE processed Section 10/404 permits, on an average, within 53 days in 1984. Mean annual processing time decreased continuously between 1981 and 1984, only to increase slightly in 1985. The most significant change occurred between 1981 and 1982; average

TABLE 22

PROCESS EVALUATION SUMMARY

	YEAR					
	1981	1982	1983	1984	1985	TOTAL
PROJECTS PROPOSED IN MARYLAND'S COASTAL ZONE	506	346	463	533	633	2481
APPLICATIONS WITHDRAWN	3	19	18	30	24	94
APPLICATIONS DENIED	1	5	9	6	6	27
APPLICATIONS PENDING	0	0	0	0	1	1
AFTER-THE-FACT APPLICATIONS (PROJECTS CONSTRUCTED WITHOUT PERMITTANCE)	5	4	10	14	9	42
INDIVIDUAL PERMITS ISSUED	502	322	436	497	602	2359
PERCENTAGE OF APPLICATIONS PERMITTED	99.2	93.1	94.2	93.2	95.1	95.1
MEAN PERMIT PROCESSING TIME (DAYS)	112	80	58	53	64	74

processing time in 1982 was one month shorter in duration than the period of time necessary to process a permit in 1981. Results reflect programmatic changes resulting from the Reagan Administration's regulatory relief efforts.

Between 1981 and 1985, the National Marine Fisheries Service (NMFS) recommended modification or denial of 301 (12.1 percent) projects proposed; the agency did not object to 2109 (85.0 percent) proposals submitted (Table 23). Seventy-one additional projects (2.9 percent) were not addressed by NMFS because (1) the agency lacked manpower to adequately assess the projects; or (2) the projects would not have affected resources (i.e., fisheries-related) within the agency's purview.

Number of NMFS recommendations as percentages of annual project totals fluctuated over the 5-year period. In 1981, one-fifth of all proposals generated NMFS recommendations, while the agency recommended modification or denial of only 5.6 pecent of all projects proposed in 1983. Annual numbers of recommendations versus no objections over the 5-year period were statistically significant (X^2=62.70, d.f.=4, P<.001). This difference was partially explained by the annual numbers of projects not assessed by NMFS because of manpower constraints. However, annual combined numbers of NMFS recommended and no-actioned projects versus numbers of non-controversial (no objection) projects between 1981 and 1985 were also significantly different (X^2=35.76, d.f.=4, P<.001). NMFS provided more recommendations (than expected) in 1981, whereas fewer comments (than expected) were forwarded to the COE in either 1983 or 1984. Numbers of recommendations provided in 1982 and

TABLE 23

NATIONAL MARINE FISHERIES SERVICE RECOMMENDATIONS PROVIDED TO THE BALTIMORE CORPS DISTRICT IN THE REGULATORY PROCESS, 1981-1985.

	YEAR					
	1981	1982	1983	1984	1985	TOTAL
NUMBER OF RECOMMENDATIONS PROVIDED	104	49	26	37	85	301
PERCENTAGE OF PUBLIC NOTICES PROVIDED WITH RECOMMENDATIONS	20.6	14.2	5.6	6.9	13.4	12.1
RECOMMENDATION OUTCOME						
ACCEPT	93	41	25	34	58	251
REJECT	3	4	1	0	25	33
UNKNOWN	8	4	0	3	2	17
PERCENTAGE OF RECOMMENDATIONS ACCEPTED BY THE CORPS	89.4	83.7	96.2	91.9	68.2	83.4
NUMBER OF "NO OBJECTIONS"	397	294	420	460	538	2109
NUMBER OF ADDITIONAL PROJECTS NOT ASSESSED BY NMFS DUE TO MANPOWER CONSTRAINTS	0	2	8	29	9	48
PROJECTS NOT WITHIN NMFS' PURVIEW	5	1	9	7	1	23

1985 were nearly equal to what was expected. Thus, the NMFS review process exhibited inconsistent outcomes during the 5-year study period.

More than 80 percent of all NMFS recommendations were accepted by the Baltimore District COE between 1981 and 1985. Approximately 11.0 percent of NMFS' recommendations were not accepted, while the outcome of 17 recommendations (5.6 percent) could not be determined. Twenty-five (75.6 percent) of the 33 non-acceptable recommendations occurred 1985, whereas no more than 4 rejections were identified in each of the other 4 years. Annual numbers of accepted versus rejected NMFS recommendations were statistically significant (X^2=41.07, d.f.=4, P<.001). A slightly greater number (than expected) of NMFS recommendations were accepted by the COE in all years except 1985, when significantly more rejections occurred. Thus, results may reflect new policies implemented by the Baltimore District COE in 1985, consistent with revisions in the agency's national regulatory procedures.

NMFS recommendations were grouped into conservation values according to the methodology applied in this thesis (p. 57). Three-quarters of all NMFS recommendations generated were categorized as minor conservation values (Table 24). Of these, 83.4 percent were accepted by the COE. Forty recommendations were categorized as intermediate of which, 85.0 percent were accepted by the COE. Major NMFS conservation values were accepted in 81.6 percent of the 38 cases identified. Numbers of (5-year total) accepted versus rejected minor, intermediate, and major recommendations did not differ significantly (X^2=1.46, d.f.=2, P>.30), indicating that the COE accepted near equal percentages of categorized recommendations regardless of the extent of NMFS' conservation efforts. However, it is important to note that 4 of the 5

TABLE 24

NUMBER OF
NATIONAL MARINE FISHERIES SERVICE RECOMMENDATIONS BY CATEGORY
AND OUTCOME IN THE REGULATORY PROCESS, 1981-1985.

YEAR	OUTCOME	MINOR	INTERMEDIATE	MAJOR
1981	ACCEPT	75	11	7
	REJECT	3	0	0
	UNKNOWN	6	1	1
	TOTAL	84	12	8
1982	ACCEPT	34	6	1
	REJECT	4	0	0
	UNKNOWN	4	0	0
	TOTAL	42	6	1
1983	ACCEPT	11	6	8
	REJECT	0	0	1
	UNKNOWN	0	0	0
	TOTAL	11	6	9
1984	ACCEPT	19	6	9
	REJECT	0	0	0
	UNKNOWN	1	1	1
	TOTAL	20	7	10
1985	ACCEPT	47	5	6
	REJECT	19	2	4
	UNKNOWN	0	2	0
	TOTAL	66	9	10
5-YEAR TOTAL	ACCEPT	186	34	31
	REJECT	26	2	5
	UNKNOWN	11	4	2
	TOTAL	223	40	38

major and the 2 intermediate recommendations rejected over the 5-year period occurred in 1985, likely resultant of changes in the COE's regulatory program.

Annual numbers of minor, intermediate, and major NMFS recommendations over the 5-year period were statistically significant (X^2=32.18, d.f.=8, P<.001). In 1981 and 1982, greater numbers (than expected) of minor but fewer intermediate and major recommendations were identified, while more (than expected) intermediate and major recommendations occurred in 1983 and 1984. Numbers of categorized 1985 recommendations were similar to numbers expected. Thus, results, based on NMFS' conservation efforts identified, indicate that: (1) there has not been a continuous increase in numbers of more environmentally damaging proposals between 1981 and 1985; (2) NMFS personnel commented on fewer (than expected) minor projects in 1983 and 1984; or (3) there was greater interagency coordination during pre-application processes in 1981, 1982, and 1983 that could not be identified by this study.

Habitats conserved as a result of the COE's acceptance of NMFS recommendations are identified in Table 25. Approximately 45 acres of both vegetated and non-vegetated coastal habitats were protected from elimination (24.6 acres) or alteration (20.5 acres) by permitted activities. More than 8 acres of estuarine subtidal habitats containing submerged aquatic beds[5] were conserved through acceptance of NMFS recommendations. Estuarine regularly (3.3 acres) and irregularly (2.4 acres) flooded emergent, palustrine non-persistent emergent (0.1 acres), palustrine/estuarine narrow-leaved persistent (0.8 acres of Typha spp. and 0.2 acres of Phragmites australis dominant) emergent, and palustrine forested/scrub-shrub (0.2 acres) wetlands were also preserved via NMFS'

TABLE 25

MARYLAND COASTAL HABITATS CONSERVED (IN ACRES) AS A RESULT OF NMFS RECOMMENDATIONS ACCEPTED BY THE BALTIMORE CORPS DISTRICT IN THE REGULATORY PROGRAM, 1981-1985.

HABITAT TYPE	PREVENTED LOSS	PREVENTED ALTERATION
VEGETATED		
ESTUARINE REGULARLY FLOODED PERSISTENT EMERGENT (*Spartina alterniflora* dominant)	3.3	[a]
ESTUARINE IRREGULARLY FLOODED PERSISTENT EMERGENT (*S. patens*, *Distichlis spicata* dominant)	2.4	[a]
PALUSTRINE BROAD-LEAVED NON-PERSISTENT EMERGENT (*Peltandra*, *Sagittaria* spp. dominant)	0.1	[a]
PALUSTRINE/ESTUARINE NARROW-LEAVED PERSISTENT EMERGENT (*Typha* spp. *S. cynosuroides* dominant)	0.8	[a]
PALUSTRINE/ESTUARINE PERSISTENT EMERGENT (*Phragmites australis* dominant)	0.2	[a]
PALUSTRINE FORESTED/SHRUB (*Acer rubrum*, dominant)	0.2	[a]
ESTUARINE OPEN-WATER WITH SUBMERGED AQUATIC VEGETATION (*Vallisneria*, *Myriophyllum*, *Potamogeton* spp. dominant)	8.3	[a]
SUBTOTALS	15.3	[a]
NON-VEGETATED		
ESTUARINE INTERTIDAL UNCONSOLIDATED SHORE (Mudflat/Sandflat)	8.9	[a]
ESTUARINE SUBTIDAL UNCONSOLIDATED BOTTOM/ OPEN-WATER	0.4	20.5
SUBTOTALS	9.3	20.5
TOTALS	24.6	20.5

[a]Additional habitat alteration may have been prevented but could not be measured.

actions. More than 30 acres of combined non-vegetated intertidal (8.9 acres) and subtidal (20.9 acres) estuarine habitats were conserved through acceptance of NMFS recommendations in the COE's review process.

The loss of 913 acres and alteration (dredging) of 1280 acres of Maryland's coastal habitats between 1981 and 1985 resulted, in part, from the COE's non-acceptance of 31 NMFS recommendations. Approximately 23.6 acres of estuarine subtidal habitats were either dredged (23.5 acres) or filled (0.1 acres) by permitted activities contrary to NMFS' conservation efforts (Table 26). Estuarine intertidal flats experienced the most significant losses (7.5 acres) of all habitat types eliminated as a result of NMFS recommendations not accepted by the COE. Loss of vegetated wetlands was less severe; unacceptable NMFS recommendations resulted in the loss of 3.2 acres of palustrine/estuarine persistent (1.4 acres of Typha spp. and 1.1 acres of Phragmites australis dominated) and estuarine regularly (0.3 acres) and irregularly (0.4 acres) flooded emergent wetlands.

TABLE 26

MARYLAND COASTAL HABITATS LOST OR ALTERED (IN ACRES) AS A RESULT OF NMFS RECOMMENDATIONS NOT ACCEPTED BY THE BALTIMORE CORPS DISTRICT IN THE REGULATORY PROGRAM, 1981-1985.

HABITAT TYPE	LOSS	ALTERATION
VEGETATED		
ESTUARINE REGULARLY FLOODED PERSISTENT EMERGENT (Spartina alterniflora dominant)	0.3	[a]
ESTUARINE IRREGULARLY FLOODED PERSISTENT EMERGENT (S. patens) dominant)	0.4	[a]
PALUSTRINE/ESTUARINE NARROW-LEAVED PERSISTENT EMERGENT (Typha spp. dominant)	1.4	[a]
PALUSTRINE/ESTUARINE PERSISTENT EMERGENT (Phragmites australis dominant)	1.1	[a]
SUBTOTALS	3.2	[a]
NON-VEGETATED		
ESTUARINE INTERTIDAL UNCONSOLIDATED SHORE (Mudflat/ Sandflat)	7.5	[a]
ESTUARINE SUBTIDAL UNCONSOLIDATED BOTTOM/OPEN-WATER	0.1	23.5
SUBTOTALS	7.6	23.5
TOTALS	10.8	23.5

[a]Habitat alteration may have resulted from project construction but could not be measured.

Chapter VI
Discussion

Outcome Evaluation

Coastal Development

Results indicated that Maryland's 4 coastal regions were experiencing similar development patterns but differing development types. Development patterns were similar in that regions were dominated by counties and local municipalities experiencing either intense or low-density development. Large numbers of activities proposed in some of the coastal counties offset limited numbers of activities proposed in other counties comprising each region. Hence, two spatial development patterns were apparent — nodal and spread development.

"Nodal" or "nucleated" development involves the use of relatively little coastline, but at an extremely high density of use.[1] The high-density use characteristics of nodal development produce spillover effects , where the development activities spatially dominate other adjacent development types. Conversely, "spread" or "diffuse" development is characterized by low-density use more uniformly distributed parallel to the coast. This development pattern gives rise to few high-density use problems, although effectively restricts access to the shoreline by reserving it for those who control the coastal land. Results of this thesis and of an earlier study[2] verify the occurrence of these two distinct development patterns in Maryland's coastal zone. It is important to note, however, that as Maryland's population continues to increase and standards of living grow, there will be an even greater demand for shoreline use, particularly for housing and recreation. Increasing numbers of high-density recreational

housing, marinas, resort complexes, and "dockominiums" will occur through subdivision of spread-type development areas. The result will likely be a series of "nucleated settlements" superimposed upon spread development coastal land use.[3]

Population centers and growth rates help in identifying coastal counties experiencing either nodal or dispersed development. Large urban centers exist in Baltimore City and Anne Arundel, Baltimore, and Prince George's Counties, although only Anne Arundel County's population continues to grow at a significant rate (Table 3). Harford, Calvert, Charles, Queen Anne's, St. Mary's, and Worcester Counties are characterized by smaller but rapidly increasing populations. Thus, the nodal centers located within the Baltimore-Washington Metropolitan Region (Baltimore City and suburbs, Washington, D.C., Annapolis) are producing a spillover effect into those Western Shore coastal counties (Calvert, Charles, Harford, St. Mary's) previously dominated by spread development. Nucleated settlements have been established on Maryland's Eastern Shore and serve as either bedroom communities (Queen Anne's County) or high-density recreational centers (Ocean City) for the Metropolitan Region population.

This study helps in identifying Maryland's nodal or spread development areas. The APN/EPN ratio identified for each of Maryland's 17 coastal counties (Table 9) indicates where coastal changes are likely influenced more by nodal than spread development. All counties with values greater than 1.0 have experienced, to some degree, project clustering over the 5-year period; counties with values less than 1.0 may or may not have been experiencing project clustering. These ratios are limited in applicability to development pattern identification by

two factors. First, the results only identify development subject to the COE's regulatory authority. Second, results are based on the assumption that no more than one proposal was associated with a specific project. Thus, APN/EPN ratios are more beneficial in comparing coastal county development rates rather than in defining actual spatial development patterns.

Distinct spatial relationships were identified by this study. Commercial developments were most frequently located in either the Lower Eastern Shore or Baltimore-Washington, D.C. Regions, while industrial-related activities were most often proposed in the Baltimore-Washington Metropolitan Region (Table 11). High-density recreational use centered in Ocean City contributed a major proportion of the Lower Eastern Shore's commercial development, although commercial fishing operations in Somerset County were also significant components. The Baltimore-Washington, D.C. Region's commercial developments (primarily high-density recreational and residential use) were largely centered in Anne Arundel County.

New marinas and expansions were most frequently sited either in the Baltimore-Washington, D.C. Metropolitan or Upper Eastern Shore Regions. Many of the marina facilities were located in Anne Arundel County in the vicinity of Annapolis or in Kent County at or near Rock Hall Harbor. Private marinas, primarily condominium-boat slip complexes ("dockominiums"), were proposed most frequently in Worcester County in or near Ocean City.

Significant increase in numbers of private marina facilities occurred over the 5-year period (Table 15). Dockominiums flourished not only in Worcester, but also in Dorchester County, in vicinity of the

City of Cambridge waterfront.[4] Private community (associations) marinas also increased significantly over the 5-year period, especially in vicinity of Annapolis (Anne Arundel County).

Public commercial marina developments were primarily sited in high-density ports located in Anne Arundel (Annapolis), Kent (Rock Hall Harbor), St. Mary's (Solomons Island), Talbot (Oxford-St. Michaels), and Queen Anne's (Kent Island) Counties and Baltimore City, generating mostly existing facility expansions. These marina developments aided in meeting the growing demand for boat storage and public access to Maryland's coastal waterways. In 1970, approximately 27,500 public commercial marina boat slips existed in Maryland[5] and increased approximately 65 percent to 42,600 by 1980.[6] State estimates project that an additional 10,460 slips will be needed by 1990.[7] Thus, the 3933 public commercial boat slips constructed between 1981 and 1985 is equivalent to a 10 percent increase in number of slips that were available in 1980 and 38 percent of the projected demand needed by 1990. If the number of private marina slips is added to the number of public marina slips identified in this study, statewide slip number has increased more than 17 percent since 1980, and represents 71 percent of the projected slip demand needed in Maryland by 1990. However, the number of slips constructed represents 71 percent of the projected 1990 statewide demand and will not fulfill the projected regional demands. Thus, both private and public commercial development will continue, although rates will be greater in some regions than in others, depending upon peak regional demand.

Fish and wildlife enhancement and mosquito control activities occurred primarily on Maryland's Eastern Shore. Many of these projects

were waterfowl enhancement structures (ponds or impoundments) located in Dorchester, Talbot, and Kent Counties. Annual numbers of waterfowl habitat enhancement projects after 1983 were more than three times the number proposed annually between 1981 and 1983, coinciding with the development of both government and private-sponsored waterfowl enhancement programs.[8] Mosquito control activities were few in number but represented large areal perturbations in undeveloped lower county, coastal wetland areas. Although both mosquito ditching and wildlife enhancement activities comprised only 2.9 percent of all projects proposed, these developments generated the largest areal changes in Maryland's vegetated coastal habitats over the 5-year period. Because of their increasing numbers and the extensive habitat changes associated with them, wildlife enhancement activities were more often subject to major modification or denial by NMFS in the review process. Wildlife enhancement proposals will likely continue to be activities of primary NMFS concern in the review process.

Transportation-related development comprised only 2.4 percent of all activities proposed over the 5-year period but ranked second among all project types in causing the largest areal wetland impacts. Bridge and highway developments occurred most frequently in the Lower Eastern Shore and Baltimore-Washington, D.C. Metropolitan Regions. These operations were most often associated with state or county projects in Dorchester and Anne Arundel Counties. Route expansions and bridge replacements in rural Lower Eastern Shore Counties were often extensive, typically generating significant cumulative alterations of irregularly flooded estuarine emergent wetlands. Projects in Anne Arundel County and other Baltimore-Washington, D.C. Regional counties often involved

bridge replacements on major state routes. Impacts were generally spatially restricted to waterway or wetland crossings and associated with palustrine habitats.

Bridge and highway operations were either associated with Maryland's State Highway Administration (MD SHA) or with county public works departments. Projects were long-term, often taking several years or more to complete from the initial proposal period. All wetland losses resulting from MD SHA projects were replaced through in-kind, on-site compensation. Mitigation plans were designed by MD SHA personnel but subject to revisions requested by any or all of the federal or state resource agencies involved in the review process. Hence, compensation for these non-water dependent, public interest activities served to offset some of Maryland's wetland losses. Conversely, wetland losses attributed to county public works projects were generally not offset by compensation because the activities were carried out in economically-depressed wetlands-dominated areas. Consequently, a shortage of municipal funds and a lack of available uplands requisite for mitigation sites, prevented offsetting of all transportation-related impacts.

Shoreline stabilization activities, located primarily in Talbot, Anne Arundel, and Worcester Counties, accounted for approximately one-third of all projects proposed over the 5-year period. Stabilization projects built in Talbot and other Upper Eastern Shore Counties were significantly larger than those structures constructed in Anne Arundel and Worcester Counties, reflecting greater spatial than nodal development and higher per capita incomes dominating the Upper Eastern Shore Region. Conversely, smaller stabilization structures in Anne

Arundel and Worcester Counties were indicative of high-density nodal development.

Approximately 42 percent of all proposals were for private recreational purposes. Private recreational projects were concentrated in Anne Arundel County, although significant development also occurred in Talbot, Worcester, and Calvert Counties. These projects, primarily pier and boathouse construction, were indicative of areas experiencing higher-density nodal development. Although private recreational activities were great in number, they resulted in minimal adverse habitat impacts. In fact, private recreational development ranked eighth among all project types in generating the largest cumulative habitat losses. Thus, many of these activities required minimal modification and coordination in the review process.

Public recreational development, primarily located in Harford, Queen Anne's, and Talbot Counties, comprised only 4 percent of all projects proposed over the 5-year period. Similarly, numbers of public service and utility projects equalled 4 percent of the total project number. Public service and infrastructure development, including cable and pipeline emplacement, were proposed most frequently in high-density use areas in Anne Arundel, Somerset, Baltimore, and Worcester Counties. These developments, combined with all miscellaneous project proposals, generally resulted in minimal but cumulative habitat impacts.

Habitat Impacts

Distinct trends in or rates of habitat loss attributed to federally permitted activities could not identified by this thesis. Rather, results indicated that mean annual habitat losses were dominated by relatively few projects generating large areal perturbations. Although

many small wetland losses were produced via project permittance, these impacts often generated cumulative losses less than or near equal to those impacts contributed by several major individual activities. For example, nearly two-thirds of all irregularly flooded estuarine emergent wetlands lost over the 5-year period were attributed to the construction of a single waterfowl enhancement impoundment. Similarly, development associated with a single state highway project resulted in the destruction of one-third of all estuarine/palustrine forested wetland losses identified in study area over the 5-year period. Neither increasing nor decreasing annual wetland loss rates were identified, as these anomalous activities dominated cumulative wetland perturbations. However, these results reflect only the trend occurring over the 5-year period and do not necessarily represent long-term trends in habitat loss.

Distinct regional habitat losses and alterations over the 5-year period were evident. Of the 913.1 acres cumulatively lost in Maryland, 717.1 (78.5 percent) acres were lost in the Lower Eastern Shore, whereas 112.8 acres (12.4 percent) were eliminated in the Upper Eastern Shore Region. Impacts sustained on the Western Shore were less severe. Seventy-five wetland acres (8.2 percent) were lost in the Baltimore-Washington, D.C. Metropolitan Region, while only 8.2 acres (0.9 percent) were eliminated in the Tri-County Region. Conversely, cumulative estuarine subtidal habitat alterations were highly correlated with Western Shore dredging activities. Approximately 78 percent of all subtidal dredging occurred in the Baltimore-Washington, D.C. Region, of which 76 percent was maintenance activities. Tri-County Regional dredging, largely (68 percent) maintenance activities, accounted for 4.2

percent of all Maryland dredging. New dredging dominated both Lower (75 percent) and Upper (73 percent) Eastern Shore alterations. Of Maryland's 1280.8 subtidal habitat acres dredged, 9.8 and 7.9 percent respectively occurred in the Lower and Upper Eastern Shore Regions.

Cumulative vegetated wetland losses were attributed largely to fish and wildlife enhancement and mosquito control activities. It should be noted, however, that gross habitat losses, attributed to these activities, were not necessarily equivalent to the resultant net losses. Wetlands filling (e.g., berm construction) and dredging (e.g., pond or ditch excavation) initially eliminated site habitats, although these sites were likely revegetated by previously existing or alternative wetland species. Emergent wetland species, for example, generally revegetate berm structures, while submerged aquatic vegetation often flourishes in impounded or excavated open-water habitats. Additionally, wildlife enhancement impoundments are frequently managed by seasonally manipulating water levels to enhance wetland plant growth. Thus, cumulative wetland losses attributed to wildlife enhancement projects are not only offset to some degree by gains in estuarine or palustrine open water habitats but also by other ecological changes (i.e., revegetation) not identified in this study.

Some habitat losses were also offset through in-kind or out-of-kind wetlands compensation identified as habitat gains (Table 17) in this thesis. For example, the 29.1 acres of palustrine forested and scrub-shrub habitat losses attributed to transportation-related development were offset by in-kind compensatory measures developed by MD SHA, the COE, and federal and state resource agencies involved in the review process. Similarly, creation of regularly flooded estuarine emergent

wetlands to compensate (in-kind and out-of-kind) for wetland losses, attributed to other development types, contributed to a net gain of 36.0 acres of Spartina alterniflora wetlands in Maryland. Although benefits gained from artificially created habitats were most likely less than the values obtained from those wetlands foregone, they represented trade-offs made in the review process, permitting projects in the public interest while simultaneously minimizing habitat losses.

The 45.1 wetland acres conserved by the COE's acceptance of NMFS' recommendations (Table 25) are an indication of coordination effectiveness achieved between the two agencies in the review process. These conserved habitats help in identifying partial benefits achieved through a balanced public interest review. Conversely, the 34.3 habitat acres lost (10.8 acres) or altered (23.5 acres) by COE permitted activities to which NMFS was opposed are an indication of the degree to which interagency coordination could have been improved. Although these lost or altered wetlands are only a small fraction of the total habitats affected via the COE's permit program, they represent additional cumulative losses to an ever-dwindling national resource.

Wetlands of the United States have been lost at an alarming rate. Between the mid-1950's and mid-1970's, approximately 11 million acres of estuarine, palustrine, and riverine wetlands were lost.[9] Estuarine wetland losses totaled 18,000 acres annually. Tidal wetland losses during this time period were greatest in Louisiana, Florida, and Texas and were attributed primarily to coastal submergence.[10] Along the Gulf of Mexico, coastal development has also contributed both directly and indirectly to destruction of the nation's estuarine wetlands. Development activities have been, the principal source of coastal

wetlands perturbation in many areas of the United States.[11]

Numerous ecological functions that wetlands perform and the benefits they provide to society attest to why these resources should be conserved. Reducing wetland losses and alterations via coastal subsidence and sea level rise will be improbable. Conserving wetlands can be accomplished through federal, state, and regional regulatory programs, but more stringent policies must be implemented if society favors greater resource protection.

COE District Engineers are required to consider probable cumulative wetland changes in their permit application reviews,[12] although incremental adverse coastal impacts accrued over both time and location are seldom identified in project evaluation. District Engineers have difficulty denying a project based on cumulative impacts alone, particularly when the proposal is in an area where similar projects have already been approved. Although the notion that cumulative wetlands loss adversely affects ecosystem productivity is superficially accepted, it has not been invoked as a determining decision-making factor. The result has been a tyranny of small independent decisions contributing to cumulative wetland losses.[13]

For example, no one intended to destroy approximately 50 percent of Connecticut's coastal marshes over the last 50 years, but through hundreds of independent decisions to develop hundreds of small coastal land tracts, 15,000 wetland acres were lost.[14] Similarly, projects subject to the COE permit process contribute to the loss of the nation's dwindling wetland resources. Nationwide, the COE receives an average 11,000 individual permit applications per year. Additionally, an estimated 90,000 general permits are issued annually.[15] In 1981, COE

districts (excluding Alaska) processed permits for projects that, if constructed as proposed, would have resulted in conversion of approximately 100,000 wetland acres. Through the review process, total proposed wetlands conversion was reduced by one-half.[16] Although it may be argued that the COE regulatory program effectively reduced wetlands destruction by 50 percent in 1981, it can also be contested that the program failed to protect the additional 50,000 wetland acres lost or altered via the many independent and incremental decision outcomes. Hence, a joint effort by the COE and federal resource agencies should be initiated to devise procedural mechanisms addressing consequences of cumulative wetland losses.

Multiple human threats have been attributed to wetlands loss and degradation, many of which are not subject to COE permit authority. Alternatively, some states have strong wetlands programs that not only complement the federal program but also effectively regulate other development activities not under the COE's purview. Other state programs exempt certain activities such as agricultural and silvicultural practices, mosquito control, public utility projects, and local government actions from permitting requirements.[17] Many of these activities (e.g., channelization and draining) serve as the initial step in eventual conversion of wetlands to agricultural and urban lands.[18] Generally, estuarine wetlands are subject to greater federal and state regulation than are palustrine wetlands. Problems remain, however, in identifying and eliminating adverse coastal wetland impacts because of legal gaps plaguing both federal and state programs. Thus, states must strengthen existing coastal regulations, thereby comprehensively fulfilling a national policy to permit development while simultaneously

avoiding adverse individual and cumulative wetland impacts. States should adopt policies that not only prioritize wetlands according to their functional values, but also enforce a no net loss of habitat functions in wetlands regulation.

State regulation of Maryland's coastal wetlands provides less stringent development control than does the federal program, although issuance of a COE permit does not necessarily assure state approval.[19] Primary consideration is given to all lands lying below mean high water (state wetlands). Private wetlands, the lands shoreward of mean high water subject to periodic flooding and supporting aquatic growth, are regulated less stringently.[20] Maryland's Wetlands Act also provides exemptions and allows landowners to gain access to navigable waters and to reclaim certain lands lost through erosion.[21] Consequently, deemphasized state regulation of irregularly or periodically flooded wetlands has governed the degree of federal regulation required in Maryland. Regularly flooded wetlands are regulated by complementary state and federal programs, although COE positions have been influenced by politically or economically-oriented state decisions.

Prior to the passage of the Wetlands Act in 1970, Maryland's wetlands incurred significant losses to development. More than 23,000 acres were lost between 1942 and 1967 either by man's activities or through natural succession and erosion.[22] Estimated coastal vegetated wetland losses attributed to man were 293 acres per year.[23] Greatest coastal wetland losses were associated with tidal freshwater marsh, salt meadow, and regularly flooded salt marsh habitats that resulted from residential, industrial, and marina development and dredging and spoil disposal. Additionally, extensive wooded swamp habitats, comprised

largely of non-tidal wetlands, were drained for agriculture in many of Maryland's coastal counties. During the 26-year period, coastal wetland losses attributed to urban development were greatest in Worcester, Queen Anne's, Talbot, and Wicomico Counties.[24]

Wetlands conversion has been significantly reduced in Maryland since 1970. Between 1973 and 1977, an average 25.3 acres of vegetated state and private wetlands were lost annually to state permitted dredge and fill activities. Mean annual vegetated wetlands loss decreased to 13.6 acres between 1978 and 1982, and declined to 12.6 acres between 1983 and 1985.[25] The significant decline in vegetated wetlands loss after 1977 likely resulted from combined improvements in the state program and implementation of federal program revisions.

Cumulative loss of Maryland's coastal wetland and open water habitats resulting from state permitted dredge and fill activities equalled 608.7 acres between 1973 and 1985.[26] Filling of estuarine subtidal and open-water habitats accounted for 376.8 acres (61.9 percent) of all wetlands lost during this period, whereas 231.9 vegetated wetland acres were eliminated by permitted fill (127.5 acres) and dredge (104.4 acres) activities. Alteration of subtidal habitats totaled 2683.7 acres. Mean annual habitat loss and alteration over the 13-year period were 47 and 206 acres, respectively. Overall, data indicate that the rate of vegetated coastal wetlands lost prior to implementation of Maryland's regulatory program was more than sixteen times the loss rate that has occurred since initial state regulation.

Process Evaluation

Annual percentages of NMFS recommendations rejected by the Baltimore District COE were not related to a decreasing mean annual

permit processing time. However, results were limited by the lack of information on 17 recommendation outcomes. Additionally, 48 projects which NMFS was unable to adequately review and provide comment on inhibited a more precise evaluation. These 65 projects in which NMFS provided or may have contributed recommendations could have affected the results of this study. Thus, the conclusion that NMFS-COE interagency coordination was not affected by a declining mean annual permit processing time is based only upon partial results.

Differences in percentages of NMFS recommendations accepted annually by the COE varied little between 1981 and 1984. In 1985, significantly fewer recommendations were accepted. Based on statistical analysis (p. 116), the regulatory revisions implemented in 1984 appeared to adversely affect NMFS' abilities to influence decision outcomes. However, this conclusion is limited by two factors. First, the projects not adequately assessed by NMFS (particularly prior to October, 1984) could have resulted in additional unacceptable NMFS recommendations, thereby affecting evaluation results. The second factor is related to NMFS personnel changes. In early 1985, Section 10/404 project review and assessment responsibilities were delegated within NMFS' Maryland field office. Addition of a staff biologist resulted in more extensive review of COE permits in 1985. Consequently, more stringent project reviews and variability in individual subjective value judgements must be considered as possible factors affecting the number and/or rigidity of NMFS recommendations generated in 1985. Annual evaluations of project review data should continue, so as to determine whether recommendation outcomes were independent of subjective staff decisions.

Staff limitations rather than agency policy changes appears to be a

primary factor contributing to fluctuations in percentages of proposals for which NMFS recommended one or more activities be modified or denied. For example, recommendations were provided for more than 20 percent of all projects proposed in 1981, while only 6 percent of all 1983 projects generated NMFS comments. This hypothesis is supported by the fact that there was an increase in numbers of projects inadequately reviewed between 1981 and 1984 (Table 23).

Manpower constraints within the NMFS field office are attributed to numerous responsibilities in which staff personnel actively carry out agency missions. NMFS staff responsible for providing an advisory role in the Baltimore District COE permit program also oversee all other marine recreational and commercial fishery-related habitat concerns in Maryland, Virginia, Delaware, the District of Columbia, Pennsylvania, and New York. Numerous responsibilities often prohibit agency personnel from providing adequate review and comment, thus limiting the effectiveness of the NMFS' advisory role not only in the COE permit program but also in other areas of purview.[27]

Fluctuations in the proportion of NMFS recommendations were also attributed to the number of projects withdrawn. These proposals were either withdrawn voluntarily by the applicant for various reasons or were logistically withdrawn by the COE due to the projects' inherent adverse environmental impacts.[28] If these projects had been subject to process review, NMFS would have recommended modification or denial of many, if not all of these proposals.[29] Thus, many environmentally adverse projects requiring extensive or irreconcilable modification were eliminated early in the permit program, thereby reducing costly administrative reviews.

Results indicated significant annual differences in the numbers of minor, intermediate, and major recommendations generated by NMFS. Minor recommendations were greater in number (than expected) in 1981 and 1982, whereas significantly more intermediate and major recommendations were submitted to the COE in 1983 and 1984. Fewer minor recommendations in 1983 and 1984 were attributed to manpower limitations; fewer intermediate and major recommendations were generated in 1982 because of the larger percentage of projects withdrawn from process review. In 1981, NMFS adequately reviewed all proposals, with fewer projects withdrawn or denied. Also, fewer proposals required intermediate or major recommendations. These results may reflect economic conditions unfavorable to project construction in 1981, although this hypothesis remains unsubstantiated by the large number of proposals that were identified in 1981. More likely, results were indicative of more effective interagency coordination within the review process.

NMFS recommended denial of 19 projects proposed over the 5-year period, of which 13 (68.4 percent) requests were accepted. In other projects, NMFS recommended that the loss or alteration of coastal habitats be eliminated or minimized. Of 302 specific recommendations generated by NMFS, 162 requested the reduction (119) or elimination (43) of habitat fill, while 63 measures were either to reduce (41) or eliminate (22) dredging of wetlands.[30] Twenty-three recommendations were either to eliminate (5) or modify (18) proposed structures. Special permit conditions were requested for inclusion in 36 projects, while compensation for wetland losses was recommended in 18 cases.

NMFS recommendations most frequently found unacceptable to the COE included elimination of non-water dependent structures, reduced

dredging, and compensatory measures. Approximately 19 percent of all recommended dredging modifications were rejected, while all recommendations to delete non-water dependent structures were found unacceptable to the COE. Twenty-two percent of all recommended compensatory measures were rejected; fill modification (7.4 percent), alternative structure (5.5 percent), and special permit condition (2.8 percent) recommendations were rejected less frequently by the COE.

NMFS recommendations are based upon non-definitive internal guidelines rather than a formal directive similar to the Fish and Wildlife Service's Mitigation Policy which directs agency positions in the process review.[31] NMFS is guided by a Habitat Conservation Policy, although the policy provides minimal substantive guidance for field-level decisionmaking.[32] According to agency documention, comprehensive assessment criteria have not been developed because each project has unique characteristics, and therefore, final recommendations are based upon site-specific conditions.[33] Three principal factors are considered in agency comments: water-dependency, project alternatives, and the public interest. NMFS guidelines also direct agency personnel to consider other resources, long-term economic benefits to the community, establishment of public water access for recreational opportunities, and factors influencing public health as elements defining the public interest. Thus, agency directives encourage NMFS field personnel to maintain a broad and flexible perspective as project assessors in the review process.

Because each project was unique, evaluating whether NMFS had maintained project assessment consistency over the 5-year period was an arduous task. In most cases, agency personnel generated consistent

recommendations in analogous project scenarios. Recommended denial of non-water dependent activities occurred in nearly all cases.[34] Several exceptions were identified where NMFS accepted permittance for non-water dependent activities, provided the applicant agreed to requisite compensation for all wetland losses.[35] NMFS' decisions were based upon stipulation that the projects should only be permitted if applicants provided greater than equal compensation for all habitat losses. Although these decisions may have actually resulted in a net gain of ecological benefits, they may have also set a precedent contrary to NMFS' water dependency and public interest guidelines. It may be argued that these decisions were a consequence of negotiation - to conserve at least some habitat values, rather than to lose all in an irreconcilable situation. Conversely, it may also be contended that by permitting non-water dependent, private interest activities through compensatory measures, persuasive and persistent developers were able to "buy" a permit, or perhaps more appropriately, oblige vulnerable resource managers to "sell" them the project.

In many cases, NMFS recommended project modifications to ameliorate environmental impacts. One must consider whether these recommendations provided reasonable and practicable alternatives allowing project permittance. NMFS recommendations frequently identified alternatives to reduce the magnitude of habitat loss or alteration due to dredging, filling, or impounding. In most cases, alternatives were identified, although recommendations sometimes added economic costs to the project. In nearly all cases, no justification was provided by either NMFS or the COE as to what constituted an economically practicable alternative. Most often, the extent to which the project was in the

public interest determined its economic practicability. However, by incorporating NMFS recommendations into the proposal, the COE was able to permit projects that were not contrary to the public interest.

Prior to 1985, nearly all NMFS recommendations were accepted by the COE. Seven of the 8 recommendations found unacceptable between 1981 and 1984 were minor conservation efforts generated by NMFS; only one major recommendation was rejected during this time period.[36] Significantly more NMFS recommendations, especially intermediate and major conservation efforts, were rejected by the COE in 1985. Major and intermediate actions involved the impounding of wetlands,[37] dredging of an oyster bar,[38] and compensatory measures to offset vegetated wetland losses.[39] NMFS also recommended revised bulkhead alignments, reduced dredging, deletion of non-water dependent structures, and compensatory measures as minor conservation measures.

Increase in numbers of NMFS recommendations rejected by the COE in 1985 reflects not only COE programmatic changes responsive to regulatory reform, but also changes in NMFS' advisory role in the program. Prior to 1985, NMFS' concerns were more likely to be resolved early in the review process. Often projects were discussed on an ad hoc basis during pre-application or joint-agency evaluations. Primary NMFS concerns were addressed and frequently resolved during coordination meetings, eliminating the need for NMFS to provide formal recommendations (i.e., permanent records). Hence, study results may not accurately depict past interagency coordination efforts.

Interagency coordination effectiveness has been affected by the declining quality of monthly joint-processing meetings. NMFS staff involved in the Baltimore District program claim that interagency

coordination procedures have been declining since 1983.[40] Previously, COE project managers, required to conduct site visits and obtain adequate project data, presented information at joint-evaluations sufficient for NMFS and other resource agencies to establish all concerns. With implementation of regulatory reform, the COE has responded by not only attempting to decrease the average time required to process a permit, but also by indirectly altering coordination mechanisms that increase administrative efforts. Both the quality and quantity of information supplied to the review agencies has declined. Consequently, inadequate project information has severely limited the effectiveness of the review process, and has limited NMFS' success in contributing to a balanced process review.

Factors Influencing Program Effectiveness

Results of this study indicated that regulatory reform has altered the effectiveness of a balanced public interest review. Effective balancing was defined as the degree of coordinated efforts attained between NMFS' Northeast Region and the Baltimore District COE. Advisory roles contributed by other (e.g., FWS, EPA) agencies and the effectiveness of their efforts in the Baltimore District program were not evaluated. Additionally, the COE's national policy (i.e., regulations) provides procedural flexibility for District Engineers to implement district programs. Thus, evaluative results of the Baltimore District's program in Maryland may not necessarily reflect the degree of interagency effectiveness of other COE district programs. However, some key factors influencing the effectiveness of the Baltimore District program are inherent in all district programs, and likely, in other environmental policy programs. While development of measures to improve

some of these factors will be improbable, changes in programmatic, administrative, and policy components could enhance the review process to better approximate the public interest.

Scientific Uncertainty

Coastal wetlands are complex ecosystems. Physical and biochemical components dictate whether a species will be present or absent from a particular ecological community. Vascular plants are sources of energy to the wetland community, and the loss or alteration of these autotrophs may eliminate or stress higher trophic level organisms dependent upon these primary producers. Minor coastal developments generating seemingly insignificant environmental impacts may, in fact, cause major shifts in food web interactions. Alteration of a single physical, chemical, or biological parameter may have little effect on a particular species or coastal community, although major ecological impacts can result when multiple conditional changes interact synergistically. Because ecological interactions are so complex, identification of cause-and-effect relationships is difficult, and the uncertainties endure. Hence, project evaluation is an arduous task, leaving many unresolved problems for decisionmakers.

How much are nature's services worth?[41] Wetlands provide numerous benefits to society, although many of these values cannot be quantified. Attempts to economically valuate intangible wetland functions have been made.[42] However, critics point out that by placing economic values on wetland functions, these ecosystems become even more vulnerable to development as the realized benefits attributable to development often outweigh those associated with intangible and intrinsic wetland values. Also, some non-economic assessment procedures

have focused on evaluating standing stocks of nature or a limited number of species, rather than addressing total energy flows.[43] More recent evaluating methodologies have been developed to address ecological functions that better approximate the benefits to society.[44] However, these procedures are frequently time-consuming tasks requiring experienced wetland ecologists to conduct site assessments. Consequently, comprehensive site evaluations conducted by federal agencies are infeasible because of the thousands of projects proposed annually that require modifications. A further problem of all methodologies, no matter how comprehensive, is that results are based upon finite circumstances and subjective perceptions. Perhaps, other evaluation criteria that should be used to a greater extent for wetlands regulatory purposes include the scarcity of habitat types, estuarine habitat diversity and carrying capacity, degree of degradation from past development, and the cumulative losses from a particular watershed or geographical region.

Of all factors inhibiting a balanced approach in the COE's regulatory program, the lack of known causal relationships is one of the most influential components affecting the decision making process. Since 1984, programmatic changes have placed substantive burden on NMFS and other resource agencies to scientifically document agency positions. In many cases, technical information is available identifying the value of ecological components (i.e., those subject to loss or perturbation) in situ. Less evident is the role which these ecological components play in providing benefits, in toto, to society. Hence, "the burden of proof" clause places an almost insurmountable burden on the resource agencies to prove that a project is, beyond

reason of a doubt, contrary to the public interest. Balancing conservation and development, therefore, is a consequence of what the COE interprets as adequate documentation. One questions the validity of this process, as it requires COE professionals, who often lack the technical expertise necessary in interpreting scientific results, to make programmatic decisions affecting our society.

Purpose of interagency coordination is to develop feasible measures permitting coastal development, while simultaneously minimizing environmental impacts. Through the mitigation process, project proposals are reviewed by advisory agencies and often revised by the COE to avoid these impacts.[45] Projects within the public interest but resulting in unavoidable losses generally are acceptable only through compensation for all detrimental physical impacts. Typically, compensation is achieved by creating on-site artificial habitats proportionate in size and relative value to those wetlands lost, although similar off-site measures including mitigation banks are also permitted.[46]

Because it is difficult to valuate wetlands functions, it is also a troublesome task in reaching agreement on what is adequate and practicable compensation. Mitigation projects involving the creation of out-of-kind habitat types are particularly problemmatic. Attempts are made to replace, in-kind, the habitats lost, although alternative wetlands are often created in out-of-kind measures when the ecological value of the habitat lost is not a primary concern.[47] Not only are trade-offs provided in these instances, but assumptions are made that artifically created wetlands will survive, flourish, and be at least of equal functional value to the natural habitats foregone. Many

compensatory projects have been successful,[48] although other mitigation sites have been plagued with problems.[49] Thus, further research is necessary not only to identify successful methods ensuring equal compensation for all unavoidable losses,[50] but also to determine whether a development should be allowed at all.

Public Versus Private Rights

Environmental laws and regulations serve to protect our natural resources as a public trust,[51] while simultaneously addressing the needs of the individual. In wetlands regulation, decisions must be made whether to permit a landowner to develop entitled property to some degree of his or her satisfaction, or to deny that right in order to preserve public rights in the privately held land. Regulatory agencies, delegated police powers, make these public policy decisions. Most often regulatory decisions are final, setting precedent over similar subsequent actions. Other times, decisions reached by regulatory entities, such as the COE are contested and challenged through judicial intervention. Thus, conflict between the rights of the individual and those of society are sometimes resolved through litigation.

Wetlands regulation must be exercised within the limits of constitutionality. Consequently, regulatory legislation has been challenged on grounds that either: (1) the statute itself is unconstitutional; or (2) the application of the law achieves an unconstitutional result.[52] Because of overriding constitutional presumption attached to a statute, nearly all claims of legislative unconstitutionality have been struck down. Decisions have been based on whether (1) the interests of the public require such regulation;[53] (2) the regulation is excessive for effectuating its own purpose;[54] (3) the

regulation acts in arbitrary, capricious, or discriminary manner;[55] or (4) the regulation is unduly oppressive to the individual.[56]

Assertions that a wetlands law or regulation produces an unconstitutional result often focuses on whether the "taking" clause of the Fifth Amendment has been violated. The Constitution states:

> "No person shall...be deprived of...property without due process of law; nor shall private property be taken for public use without just compensation."

Thus, the taking issue represents a conflict between a landowner's right to use personal property as he or she desires and the government's duty to exercise police powers in protecting natural resources in the public interest. Most cases involving wetlands takings have addressed whether it is reasonable to prevent activity harmful to the public by excluding development or limiting use of private property. Other cases have addressed the power of eminent domain that takes private property because it is beneficial to the public.[57] Federal, state, and local regulatory decisions have been challenged in the courts in determining whether police powers have been legally applied.

Many of the earlier cases addressed state or local restrictions, often ruling that a taking had occurred because permit denial prevented any "reasonable" or "practical" use of the property. Rulings in Bartlett v Zoning Comm'n[58] and Dooley v. Town Plan & Zoning Comm'n[59] confirmed that zoning ordinances had overrestricted floodplain development and prevented practical and economical use of private property. In State v. Johnson, the court concluded that denial of a permit to fill a coastal marsh tract would have, in effect, disproportionately deprived the landowner reasonable use of his property.[60] A Massachusetts town by-law protecting wetlands resulted in

a taking decision ruled in MacGibbon v. Board of Appeals of Duxbury, where the court concluded that permit denial, in effect, rendered private land of "no practical use."[61] Although recreation and salt hay harvesting were permitted zoned land uses, the court in MacGibbon found these uses to be lacking in practicality. Thus, many earlier courts concluded that wetlands served few or no practical or productive uses unless development or modifications occurred.

Decisions upholding regulations protecting wetlands in the public interest were often based upon potential harm that could have resulted from development. In Turnpike Realty Company, Inc. v. Town of Dedham, the court ruled that floodplain development restrictions prevented potential flood hazards but permitted the landowner some beneficial use of his property.[62] A no taking decision was also reached in Sibson v. State, where the plaintiff proposed to fill four acres of salt marsh.[63] The court concluded that: (1) the permit decision was a valid use of police powers by preventing public harm; (2) the landowner had not been deprived of current uses of the marsh; and (3) permit denial had not depreciated the value of the land because its value as property that could not have been developed was nominal both before and after permit denial.[64] In Sibson, depreciated property value was assumed to have occurred with the state legislation's enactment rather than because of permit denial. Consequently, the court's decision deprived the landowner of compensation for any value depreciation, regardless of the claim. Lastly, a case involving a Wisconsin county ordinance regulating lakeshore land use to maintain water quality and public navigability rights resolved a taking issue. In Just v. Marinette, the court concluded that the ordinance was not to secure a public benefit, but to

prevent activity harmful to the public.[65] However, the courts reasoning was, in effect, contrary to the statutory objectives, as the ordinance was to protect wetlands in order to ameliorate water quality problems - an obvious public health benefit. The Supreme Court, however, rejected the landowner's claim that potential development was an essential private right.

In a recent takings case, the Supreme Court noted that previous takings decisions were based on "ad hoc factual inquires" rather than on a "set formula."[66] Two primary factors directed these inquiries: (1) whether the regulation advances legitimate governmental interests; and (2) whether the property owner has no alternative, economically viable use of his property.[67] In Penn Central Transportation Co. v. New York City, the court also identified the reasonable expectation of a property right in land subject to regulation as an important factor influencing a takings decision.

Few recent wetlands cases have ruled that a governmental action has resulted in violation of the Fifth Amendment. In Smithwick v. Alexander, the COE's denial of a dredge and fill permit was not an unconstitutional taking of property because the landowner had alternative uses for his land including natural, undisturbed uses.[68] Similarly, in Jentgen v. United States, the court concluded that a reasonable market value for the unaltered property, alone, constituted a viable alternative use.[69] Further, the court held, that because a permit was necessary for the contemplated activities at the time the landowner acquired the property, the plaintiff must have been aware that standards and conditions governing permit issuance could change. Therefore, he had only expectation that the permit would be issued. In

Deltona Corp. v. United States, denial of COE permits to dredge and fill 2887 acres of Florida mangrove swamp did not constitute a taking of property because the landowner was not able to demonstrate the absence of an alternative use for his land.[70] Therefore, burden of proof was placed on the landowner to demonstrate no alternatives were available, rather than on the government in identifying the existence of such a use. Also, other court decisions confirm that regulation, within limits, is "a burden borne to secure the advantage of living and doing business in a civilized community."[71]

Takings resulting from COE regulation have been ruled. In Kaiser Aetna v. United States, the government sought to require public access to a private pond by dredging a connecting channel to navigable waters.[72] Prior to the taking decision, the courts had supported the government's preemptive powers under the navigable servitude to override any private property claims.[73] However, the court concluded that the navigable servitude was part of the government's Commerce Clause power to regulate, rather than preeminent government interest. The fact that the pond had not previously been connected to navigable waters, and that the public access requirement was an invasion of property were principal factors influencing the decision.

In 1902 Atlantic Ltd. v. Hudson, the COE's denial of a dredge and fill permit for a developer planning to fill a man-made, tidally influenced 11-acre borrow pit for use as an industrial park constituted a taking because denial rendered the wetlands commercially worthless and precluded any reasonable use of the pit.[74] In this case, the court concluded, with minimal factual evidence, that there were no alternative uses for the site, and erred in interpreting previous judicial decisions

based on the concept of navigability.[75] The takings ruling was based primarily on findings that: (1) the COE had placed too much emphasis on a single (non-water dependency) decision making factor; (2) the project would not have resulted in a net loss of vegetated wetlands; (3) no private citizen or organization had objected to the project; (4) the wetland losses lacked "ecological significance"; and (5) the site had not previously been subject to COE regulatory authority.

Most recently, a Federal Circuit Court decision vacated an earlier claims court decision holding that the COE's denial of a Section 404 permit had deprived a mining company of all reasonable economic uses of its land.[76] The court, in Florida Rock Industries, Inc. v. United States, based its decision on an earlier judicial case[77] where the impact of permit denial did not have a "sufficiently severe" effect on the landowner's ability to put the property to productive use. Criteria of "particular significance" that were applied as determinant factors included: (1) the economic impact of the regulation on the claimant; (2) the extent to which the regulation interferred with distinct investment-backed expectations; and (3) the character of the government action.[78] In particular, the Circuit Court concluded that denial of the highest and best land use did not render the property economically useless. The court determined that the claims court erred in assessing the severity of economic impact by considering only those practicable, immediate land use values, and not other, possible future property values. However, the court maintained that in the permit denial situation, the private interest, relative to the balancing of both public and private interests, would be much more deserving of compensation for any loss that actually occurred.[79]

In summary, irreconcilable public versus private rights conflicts arising from wetlands regulation have been settled through judicial intervention. Permit denial has not constituted a taking of property in most judicial decisions. Courts have resolved the takings issue by determining whether permit denial renders a property useless relative to all (immediate and future) reasonable and practicable economic and natural considerations, and whether the decision will ameliorate impacts harmful to the public. Further, private landowners claiming a taking of property must prove that no alternative landuses were available, and must demonstrate that a distinct financially-based expectation of the property right existed. A taking may be held if: (1) the activity is an invasion of private property; (2) the defense rests upon only limited decisionmaking factors; (3) no public opposition to the activity is demonstrated; and (4) the property site was previously non-navigable. Rulings may be influenced by site-specific conditions such as those encountered in the 1902 Atlantic decision. These court decisions raise policy-relevant issues that should be addressed by all agencies involved in the regulatory program.

Limitations of Purview

Federal regulation has been reasonably successful in protecting the nation's coastal wetlands from development. However, coastal wetlands subject to COE regulation can be destroyed by excavating, draining, flooding, clearing, or shading without the need for a permit as long as the activities do not involve discharge of either dredge or fill material. While dredge or fill materials cannot be placed on wetlands subject to Section 404, wetlands can be drained or excavated for agricultural, silvicultural and urban uses.[80] Similarly, wetlands can

be impounded for creation of irrigation or wildlife enhancement ponds. Structures such as tide gates can be placed in tidal wetlands and non-navigable waters without a 404 permit, while impoundments can also be constructed by permitting non-fill structures. In fact, "normal" farming, silviculture, and ranching activities and certain temporary and maintenance operations are exempted specifically by the Clean Water Act (CWA) from COE regulation.[81] Consequently, program objectives in protecting wetlands are significantly inhibited by statutory limitations.

Legislative changes must be made if the regulatory program is to effectively restrict wetlands destruction. These changes will require Congress to amend the CWA to include those activities not presently subject to permit regulation. More importantly, the values and functions of wetlands must be addressed through CWA revisions to provide the substantive basis for the COE to regulate wetlands. Options other than improved federal wetlands protection are available through greater state action - a responsibility that will unlikely be assumed.

A second principal program limitation arises from issuance of certain development under nationwide or regional general permits that are restricted from resource agency review. Some nationwide permits, for example, exempt areas rather than activities from COE regulation.[82] Issuance of nationwide permits require that specified criteria be achieved, and are subject to discretionary District Engineers' authority[83] and regional conditioning. However, because these activities are not subject to normal public interest review nor are they adequately monitored for permit compliance, it may be contended that nationwide permits limit the effectiveness of the

program in protecting wetlands. Similarly, regional general permits are exempt from normal public interest review and are rarely monitored to ensure best management practices are implemented. Because of the large numbers of general permit activities issued annually and their exemption from the mitigation process, significant but unquantified adverse cumulative impacts likely occur. Increased monitoring of these projects should be conducted to determine the extent of both compliance and cumulative effects.

Mission-Oriented Agencies

The system of checks and balances established within our pluralistic government is exemplified by a myriad of fragmented agencies, each created to fulfill an intended mission. Governmental decentralization influences a multitude of public policies guided by multiple goals, and the success of achieving any one goal often inhibits the chance of attaining another. The productivity of an agency in attaining its goals is often directly dependent on the productive capacity of another agency. Agencies that have given missions must rely on other agencies for information, research, cooperation, financing, or personnel in achieving their goals. Thus, the success of any one agency policy is inevitably dependent upon the performance or function of some other agency.[84]

Agency personnel are comprised of individuals trained in professions directly relevant to the agency's mission, and in general, have a stronger commitment to the principal objectives of their programs than to other secondary goals added on through interagency programs. Consequently, agency staff often possess a myoptic perspective in public interest decision making processes. Loyalty to the agency is

maintained, regardless of other relevant, interrelated social factors, thereby limiting interagency cooperation and program success.

Many federal agencies have responsibilities affecting the conservation and development of coastal wetlands. These agencies are guided by opposing federal policies. Some policies encourage wetlands alteration by providing incentives to convert them to agricultural lands,[85] while others serve purposes to control or manage wetlands through acquisition,[86] leasing, or regulation. In the COE's regulatory program, NMFS, the Fish and Wildlife Service (FWS), and the Environmental Protection Agency (EPA) are guided by policies that recognize the importance of wetland functions and values. Consequently, these resource agencies often maintain stronger commitment to environmental considerations than to socioeconomic values. Conversely, the COE is guided by a policy encouraging a balancing of all environmental and socioeconomic factors, and is required to serve in a mediative capacity in addressing self-interests. However, because the COE works closely with private self-interests, the agency is often perceived as encouraging rather than regulating development and fulfilling the mediative capacity. This problem is exacerbated by the fact that the COE is guided by a policy that not only places the burden of proof on the environmental entities but also requires that all environmental detriments be substantiated within a restricted time frame conducive to addressing private interests.

It has been suggested that regulatory burden associated with the COE's process review program could be eliminated or at least reduced by consolidation of the public interest review into a "super" agency.[87] By transferring all public interest functions to a single entity, perhaps

decision uncertainty and social costs could be diminished through implementation of quantitative limits and standards and more stringent regulatory control. However, it is obvious that a balanced pluralistic review process is a more effective means of ensuring that developers internalize the costs of their projects, rather than imposing costs (externalities) to our society.[88]

Regional-Level Procedural Deficiencies

Regional or district-level informational transfer among all agencies involved in the COE's regulatory program is a key component necessary in achieving a balanced public interest review. Decisions should be based on all relevant technical and socioeconomic information and scientific rationale supporting agency concerns. Procedural mechanisms including pre-application consultation, joint-permit processing, and joint-site evaluations serve to enhance interagency communication, verify all agency concerns, and often resolve conflicting issues. However, increasing numbers of permit applications combined with decreased individual permit-processing time have acted in concert to reduce interagency coordination and program effectiveness.

Alternative procedural mechanisms are available via systematic review or planning, although the COE and other federal agencies have been reluctant to implement these procedures. For example, COE District Engineers may undertake reviews of particular wetland areas to assess the cumulative effect of activities in these areas.[89] Some districts have conducted wetland reviews particularly in areas where large numbers of permit applications and development pressures prevail. Reviews have been conducted for at least six estuaries on the West Coast, one area in Alaska, and in the Atlantic City, New Jersey area.[90] As part of these

projects, complete inventories and mapping of land use and cover, fish and wildlife habitats, and physical, cultural, and aesthetic characteristics were prepared and evaluated. Results were used to establish designated areas where wetlands would or would not be stringently protected. Consequently, some development has been either prohibited altogether, stringently regulated for specific activities, or restricted to certain wetlands exhibiting predetermined functional values. The need for agencies to conduct time-consuming site visits has been reduced, while pre-application procedures have been improved by eliminating controversial (and frequently unacceptable) proposals.

Special Area Management Plans (SAMPs) are also interagency collaborative planning mechanisms beneficial to resolving coastal policy conflicts. Under the Coastal Zone Management Act, preparation of SAMP's are encouraged to provide for increased specificity in protecting significant natural resources, reasonable coastal-dependent economic growth, and improved predictability in governmental decision making.[91] These plans are not intended to circumvent statuatory responsibilities of regulatory agencies, but rather to serve as a means of advance resolution of public interest conflicts.[92] Thus, SAMPs serve to complement or enhance COE regulatory programs by prohibiting certain development activities from ever reaching process review.

The Grays Harbor Estuary Management Plan is the most notable SAMP implemented to date.[93] Objectives of the plan are to establish guidelines that offer some assurance that activities permitted through the plan would have general acceptance from all federal and state agencies involved. Consequently, the plan is viewed as an attempt to create a regional shoreline management control that will provide

consistency and predictability for both development and conservation interests. Further, local jurisdictions will be discouraged from pursuing individual coastal management plans that serve to fragment comprehensive regional planning. Federal agencies including the COE and NMFS should encourage and provide assistance to appropriate state entities in preparing SAMPs for coastal areas experiencing intense growth and development that threaten particular resources of concern.

Advanced Wetlands Analysis (AWA) is a third mechanism to improve interagency procedural coordination by identifying specific regional wetlands values before permits are sought. Objectives of resource agency AWA are to provide permit applicants and state and local planners with an early indication of the degree of suitability of specific wetlands for various regulated development activities.[94] Additionally, the AWA process permits a more systematic regional identification of wetlands and their functions, enhancing predictability in the regulatory program. These procedures are most suitable in undeveloped regions characterized by near uniform physiography, predominated by few wetland type classifications, and providing favorable conditions (e.g., aesthetically-pleasing waterfront property) for intense future development.

Remote sensing and limited wetland reconnaissance survey techniques employed in AWA require substantial agency resources initially but result in favorable long-term wetlands conservation. Regulatory and resource agency staff workloads could be reduced by the need for fewer project site visits and by the enhancement of the mitigation process. Interagency conflicts could be reduced while still maintaining goals to protect wetlands and their functions. In-kind compensatory mitigation

could be more easily resolved for all unavoidable impacts resulting from water-dependent proposals in the public interest because wetland value and upland site information is available in advance. Thus, advanced and comprehensive regional wetlands analysis is a valuable decision-making procedure available to resource agencies. Such techniques are particularly useful during times when agency budgets and staff are limited.

Inadequate Agency Policies

The Corps of Engineers

District Engineers, delegated authority to regulate certain coastal development activities via a public interest review, must conform to the COE's formal regulations and EPA's 404(b)(1) guidelines[95] in reaching their decisions. No formal standards exist, however, to guide the 38 semiautonomous district offices in actual COE program implementation. District office interpretation leads to significant national procedural inconsistencies, thereby resulting in varying degrees of effectiveness in interagency coordination.[96] Hence, both adverse cumulative impacts and the rates of coastal wetland losses, and the ability to protect coastal resources through federal regulation, differ significantly, nationwide.

The 404(b)(1) guidelines contain a presumptive clause which states:

> "dredged and fill material should not be discharged into the aquatic ecosystem, unless it can be demonstrated that such a discharge will not have an adverse impact either individually or cumulatively or in combination with known and/or probable impacts of other activities affecting the ecosystem of concern."[97]

Hence, there is an implicit presumption that District Engineers must not

permit a discharge of dredged or fill materials unless it can be proven that wetlands will not be adversely affected. This presumptive conditioning seems directly converse to the COE's revised regulations promulgated during regulatory reform that place the burden of proof on NMFS, EPA, and the FWS to substantiate all adverse impacts contrary to the public interest. Obviously, the degree of proven evidence necessary for permit denial (or modification) depends largely on the whims of District Engineers. Unless highly probable impacts of significant magnitude exist, resource agencies will likely fail. Perhaps resource agencies would achieve greater success if their rationale were based more upon contradictory rationale and evidence supported amongst the semiautonomous, disparate COE district offices.

Compliance with the (b)(1) guidelines requires that the COE not permit a dredge or fill discharge if practicable alternatives exist.[98] An alternative is considered practicable if it is capable of being done after taking into consideration cost, existing technology, and logistics in light of the overall project purpose.[99] Further, there is an explicit guideline presumption that practicable alternatives do exist for non-water dependent activities, unless clearly demonstrated otherwise.[100] Lastly, the COE must determine whether all potential short- and long-term,[101] secondary,[102] and cumulative effects[103] of discharge materials on the aquatic ecosystem,[104] wetlands,[105] and water-related human uses[106] comply with the guidelines.

Broad interpretation of a "practicable alternative" should be maintained by District Engineers. However, the most cost-effective alternative desired by the applicant is often not the most practicable, least environmentally-damaging preferred alternative. Consequently,

decisions must be made whether the costs accrued by the property owner through the mitigation process are reasonable or whether externalities should be borne by society. If a District Engineer adopts a strict position that the least environmentally damaging alternative is the most practicable alternative, this interpretation should act to deter other property owners and developers from applying for activities generating significant adverse effects. Conversely, weak interpretation of practical alternatives would likely lead to net wetland losses.

Although both the (b)(1) guidelines and COE regulations contain a water dependency test, the COE maintains that the water dependency factor, standing alone, is not intended to be a single determination of whether a permit is issued.[107] This interpretation appears contrary to the guidelines, although the COE will permit non-water dependent activities, provided overall public interest benefits and compliance of guidelines are achieved.[108]

Many COE districts have misconstrued the presumptive practicable alternatives clause of the guidelines. "Alternatives" have been narrowly defined as only those actions that can accomplish the applicant's stated objectives; "practicable" has been defined as an economic rate of return more or less commensurate with which the applicant expects to attain from his proposed use.[109] Thus, a practical alternative can be so narrowly defined that no alternatives exist which do not affect wetlands. In cases like this, the review process becomes confined to discussion of the applicant's original objectives and the compensatory measures to mitigate for all resultant wetland losses.[110] Consequently, interpretation of "practicable alternatives", in effect,

results in converting non-water dependent proposals into de facto water dependent uses.[111]

The COE interpretation of the (b)(1) guidelines may have serious implications to the public interest review. Court decisions have ruled that the COE may consider "beneficial" impacts of an unforseeable mitigation process in deciding whether a dredged or fill discharge may have significant adverse impacts.[112] Thus, legal decisions may support the COE's guideline interpretation. However, the practical alternatives test would be significantly weakened if compensatory mitigation is allowed to be considered for fulfillment of a non-water dependent activity. Hence, the COE's current interpretation of the (b)(1) guidelines could seriously jepordize EPA's powers in exercising the 404 program.

National Marine Fisheries Service

Traditionally, NMFS has not based its public interest review decision making on a formal mitigation policy. Delimitations of agency purview, stringent project standards, wetland valuations, and impact prioritization have not been formally established. Rather, internal guidelines have been maintained in providing flexibility to NMFS' decision making abilities.[113] Several advantages to the agency's "no policy is the best policy" position are apparent.

First, flexibility in agency decision making demonstrates a favorable willingness to cooperate in project review. Success in the mitigation process is most frequently achieved through some degree of compromise between both conservation and development interests. Second, flexibility permits alternative agency solutions in addressing unique project activities, special cases, or the changing needs of society.

For example, redirection of national energy policies could dictate how future development will proceed, thereby requiring NMFS and other governmental entities to adjust their consultative review programs. Lastly, agency guidance can be revised as technological advancements occur. As additional scientific information is gained on the values of wetlands, and causal relationships between ecological processes and fishery resource production are identified, these discoveries may further structure agency positions.

Conversely, it is contended that the effectiveness of interagency coordination in the review process is inhibited by the lack of a NMFS mitigation policy or assessment standards. Policies serve as valuable mechanisms in achieving consistency, predictability, and accountability. Through policy implementation, consistent field-level decisions are maintained, thereby generating predictable agency positions in the public interest review that are desirable to other interacting governmental entities. Predictability would not only reduce overall interagency conflict, but also deter permit applicants and developers from even applying for permits to carry out certain development activities. Further, a mitigation policy or formal guidelines would also prevent field-level staff from entering into precarious situations with developers who attempt to "buy" permits by offering compensation for conspicuous private interest, non-water dependent activities. Lastly, a policy provides stability and accountability which are essential in maintaining a defense when or if legal issues occur.

Adoption of a mitigation policy by NMFS would strengthen the agency's role in the review process. A NMFS policy or guidelines should

address practical alternatives relative to water-dependency, impact avoidance, and compensation components. These policy concepts should be based on or consistent with those components expressed in the 404(b)(1) guidelines and the National Environmental Policy Act. Although a mitigation policy could, in effect, reduce decision making flexibility, it should prohibit agency misrepresentation in the public interest review.

Chapter VII
Summary and Conclusions

Federal powers to regulate certain development activities affecting waters of the U.S. are delegated amongst 38 semiautonomous district offices of the Corps of Engineers (COE). Laws and regulations require programmatic decisions, either permitting or denying certain development, to be based on a careful balancing of all relevant socioeconomic and environmental factors. A public interest review in which other federal and state agencies, municipal governments, private interest groups, and individuals are given the opportunity to comment on or recommend changes to development proposals is the principal process influencing balanced program outcomes.

An evaluation of the program administered by the Baltimore District COE governing certain development activities in Maryland's coastal zone was conducted to (1) identify cumulative development and wetland impact outcomes occurring over a 5-year (1981-1985) period; and (2) assess a component of the decision-making process that resulted in these outcomes. Interagency coordination between the COE and the National Marine Fisheries Service (NMFS) was the process component evaluated in this study. Process evaluation specifically identified how interagency coordination was affected by (1) programmatic changes resulting from regulatory reform; and (2) changes in numbers or the types of coastal development.

Evaluative results indicated similar development patterns among Maryland's 4 coastal regions. Regions were comprised of counties dominated by either nodal (high-density landuse) or spread (low-density) development. Population centers of the Baltimore-Washington, D.C.

Region dictated nodal development in Baltimore City and Anne Arundel, Baltimore, and Prince George's Counties and produced a spillover effect into other Western Shore (Calvert, Charles, Harford, and St. Mary's) coastal counties previously experiencing spread development. Nucleated settlements in the Upper (e.g., Kent Island in Queen Anne's County) and Lower (e.g., Ocean City in Worcester County) Eastern Shore Regions generated higher-density development and larger project numbers than other Eastern Shore coastal areas predominated by spread development pattern.

Distinct development types were spatially identified by this thesis. Commercial, industrial, marina-related, fish and wildlife enhancement, and transportation-related projects were more prevalant in some coastal counties than others. Similarly, habitat type losses were associated with specific development types. Eastern Shore activities accounted for a major proportion of the 5-year cumulative wetland loss, while estuarine subtidal habitat alterations were primarily resultant of Western Shore projects. Significant percentages of habitat losses and alterations were attributed to a limited number of large projects.

Effectiveness of interagency coordination in the Baltimore District's public interest review was contingent upon the extent to which NMFS recommendations were accepted by the COE. NMFS recommendations were categorized into three distinct groups based on (1) ranked wetland habitats; (2) the magnitude of habitat impact; and (3) areal extent of habitat NMFS desired to conserve.

Over the 5-year period, NMFS recommended modification or denial of 12.1 percent of all proposals submitted, of which the COE accepted 83.4 percent of these recommendations. NMFS' conservation efforts were not

adversely affected by decreasing mean annual permit processing time. Interagency coordination effectiveness was adversely affected by regulatory changes in 1984 and the declining quality of joint-permit processing. NMFS manpower limitations and individual subjective value judgements were minor contributory factors affecting the public interest review.

Chapter I
Notes and References

1. The prediction that more than 200 million people will live within 50 miles of the U.S. coast by the year 2000 is startling. However, some current economic statistics are even more eye-opening. See: Sleeper, P.B. 1986. "Bay State Coast Feels Pressures of Popularity." Boston Globe. Aug. 10, 1986.

   According to the article, one must pay a high price to live along the Massachusetts coast. For example, coastal land in 1986 costs an average $13,500 per acre, whereas inland property costs an average $2650 an acre. At Roves Wharf on Boston's Inner Harbor, the least expensive new condominiums cost $675,000, a high price to pay to live on the waterfront.

2. Multiple federal mandates have been implemented to govern rational conservation and development of the coastal zone. Some of the more substantive laws include:

   (1) Coastal Zone Management Act (16 U.S.C. Sec. 1451 et seq.).
   (2) Clean Water Act (33 U.S.C. Sec. 466 et seq.).
   (3) National Environmental Policy Act (42 U.S.C. Sec. 4321 et seq.).
   (4) Fish and Wildlife Coordination Act (16 U.S.C. Sec. 661-666c).
   (5) National Flood Insurance Act (42 U.S.C. Sec. 4001 et seq.).
   (6) Rivers and Harbors Act (33 U.S.C. Sec. 401 et seq.).
   (7) Endangered Species Act (16 U.S.C. Sec. 1531 et seq.).
   (8) Executive Order No. 11988 Floodplain Management.
   (9) Executive Order No. 11990 Protection of Wetlands.

3. Molner, J.J. and D.L. Rogers. 1982. "Inter-organizational Coordination in Environmental Management: Process, Strategy, and Objective." In: Environmental Policy Implementation. D.E. Mann (ed.). pp. 95-108. Massachusetts: Lexington Books.

   Of course, outcomes of some programs affecting the coastal environment are predetermined by rigid statuatory standards set by regulatory agencies or may be preempted by overriding organizational powers. See: Andrews, R.N. 1981. "Values Analysis in Environmental Policy." In: Environmental Policy Formulation. D.E. Mann (ed.). pp. 137-147. Massachusetts: Lexington Books.

4. Ibid. p. 99.

5. Wildavsky, A. 1972. "The Self-Evaluating Organization." Public Admin. Rev. 32:509-520.

6. Webster's Unabridged Dictionary. 1981.

7. Weiss, C.H. 1972. Evaluative Research. Methods of Assessing Program Effectiveness. New Jersey: Prentice-Hall. 160 pp.

8. It is acknowledged that evaluation is only one input out of many for decision-makers. One must also take into account other factors including public receptivity, administrative acceptability, costs, and manpower. Most often decisions are reached through negotiation and accommodation through politics.

9. For a brief overview of the evaluative research paradigm, see: Rossi, P.H. and H.E. Freeman. 1982. Evaluation: A Systematic Approach. 2nd Edition. California: Sage Pubs. 351 pp. (See pages 21-27).

10. Connolly, W.E. 1969. "The Challenge to Pluralist Theory." In: The Bias of Pluralism. W.E. Connolly (ed.). New York: Atherton; p.3. (As cited in D. Nachmias (ed.). 1980. The Practice of Policy Evaluation. New York: St. Martins; p.7).

11. Healy, R.G. 1974. "Saving California's Coast: The Coastal Zone Initiative and Its Aftermath." Coastal Zone Manag. Jour. 1(4):365-394.

    The author analyzes state permit data to identify impacts resultant of the implementation of the Coastal Act on beach access, environmental protection, agriculture, coastal growth, and energy facilities development.

12. Swanson, G. 1975. "Coastal Zone Management from an Administration Perspective: A Case Study of San Francisco Bay Conservation and Development Commission." Coastal Zone Manag. Jour. 2(2):81-102.

    Swanson's evaluation identifies decision-making processes that were effective in achieving the Commission's objectives to (1) prevent land fills; (2) increase public access; and (3) improve shoreline quality.

13. Rosentraub, M.S. and R. Warren. 1976. "Information Utilization and Self-Evaluating Capacities for Coastal Zone Management Agencies." Coastal Zone Manag. Jour. 2(3):193-222.

    The authors reason that individual agencies should initiate self-evaluative procedures determining whether public-policy goals are attained. Permit data (1973-1974) obtained from California's South Coast Commission are analyzed to identify anomalies in the decision making process. Results indicate that more detailed and consistent permit information should be gathered for further assessment.

14. Sabatier, P. 1977. "State Review of Local Land Use Decisions: The California Coastal Commissions." Coastal Zone Manag. Jour. 3(3):255-291.

Sabatier investigates decisions appealed to the State's Coastal Commission to identify: (1) types of coastal development that occurred; (2) major issues that emerged; and (3) decisions reached by the 6 commissions on various types of development.

15. Warren, R., L.F. Wechsler, and M.R. Rosentraub. 1977. "Local-Regional Interaction in the Development of Coastal Land Use Policies: A Case Study of a Metropolitan Area." Coastal Zone Manag. Jour. 3(4):331-356.

The authors, utilizing time-series permit data, conclude that development trends were not significantly altered by passage of California's Coastal Act.

16. McCrea, M. and J.H. Feldmann. 1977. "Interim Assessment of Washington State Shoreline Management." Coastal Zone Manag. Jour. 3(2):119-150.

This study focuses on the permit system implemented through Washington's Shoreline Management Act to identify (1) how permits were issued and appealed; (2) whether policy goals were attained through administrative action; and (3) coastal resources affected by the legislation.

17. Hoole, F.W. and R.L. Friedheim. 1978. "Evaluation Research and Marine and Coastal Policies." Mar. Technol. Soc. Jour. 12(4):13-17.

18. Hennessey, T.M. 1979. "Theory and Coastal Zone Management." High Tide. Coastal Zone Manag. Jour. 5(4):259-262.

In addition to evaluation research, the author also identifies implementation analysis and public choice theory as valuable techniques to assess and improve coastal management programs, rather than attempting to resolve problems simply through experiences in process.

19. Lowry, Jr., G.K. 1980. "Policy-Relevant Assessment of Coastal Management Programs." Coastal Zone Manag. Jour. 8(3):226-255.

The article outlines five general approaches to evaluative research applicable to coastal management programs including: (1) program logic; (2) compliance; (3) process; (4) goal achievement; and (5) impact assessment.

20. Englander, E., J. Feldmann; and M. Hershmann. 1977. "Coastal Zone Problems: A Basis for Evaluation." Coastal Zone Manag. Jour. 3(3):217-236.

21. Amato, R.J. and L.R. Whitaker. 1979. "Rhode Island Coastal Community Land Use Review: A Study of Resoures Allocation in the Coastal Community" In: The Coastal Society's Fifth Annual Conference Proceedings. Newport, Rhode Island. Nov. 7-9, 1979. pp. 130-152.

22. Gold, J. 1978. "Administration of Wetland Resources in Rhode Island: An Evaluation of Management Effectiveness." Master's Thesis. Dept. of Marine Affairs. Univ. of Rhode Island. 122 pp.

23. Jessen, S., J.C. Day, and J.G. Nelson. 1983. "Assessing Land-Use Regulations in Coastal Wetlands: The Case of the Long Point Area, Lake Erie, Ontario. Coastal Zone Manag. Jour. 11(1/2):91-115.

24. Bowen, R.E., F.W. Hoole, and S.H. Anderson. 1980. "Evaluating the Impact of Coastal Zone Activities: An Illustration of the Evaluation Research Approach." Coastal Zone Manag. Jour. 7(1):25-46.

25. 16 U.S.C. Sec. 1451 et seq. (1980).
Lowry, Jr., G.K. and N.H. Okamura. 1980. "Evaluation and Intergovernmental Relations in CZM". In: Coastal Zone '80 Proceedings. Vol. I. B.L. Edge (ed.). pp. 429-443.

27. Travis, W. 1980. "Coastal Program Evaluation from a State Perspective or Can an Amoeba Find True Happiness Under a Microscope?" In: Coastal Zone '80 Proceedings. Vol. I. B.L. Edge (ed.). pp. 451-469.

28. Two previous GAO evaluations assessed the Coastal Zone Management Program. See: GAO. 1976. "The Coastal Zone Management Program- An Uncertain Future: Department of Commerce and Other Federal Agencies." Dec. 10, 1976. GED-76-107; and GAO. 1980. "Report to Congress. Problems Continue in the Federal Management of the Coastal Zone Management Program." June 25, 1980. CED-80-103.

Two additional GAO studies assessed regulatory programs administered by the Corps of Engineers. Results identify interagency conflict and overlapping jurisdiction as major programmatic issues. See: Comptroller General of the United States. 1980. "Managerial Changes Needed to Speed Up Processing Permits for Dredging Projects." CED-80-71. June 9, 1980; GAO. 1981. "Federal Water Resource Agencies Should Assess Less Costly Ways to Comply with Regulations." Feb. 17, 1981. CED-81-36.

Reforms in the federal budget process; growing concern over the size, scope, and complexity of the federal government; and rising dissatisfaction with governmental inefficiency and ineffectiveness have led to increased federal program oversight and accountability. For an inside perspective on federal program evaluation, see: U.S. General Accounting Office. 1979. "Status and Issues: Federal Program Evaluation." In: Program Evaluation in the Public Sector. A.C. Hyde and J.M. Shafritz (eds.). New York: Praeger Pubs. 380 pp.

29. (1) Rivers and Harbors Act (33 U.S.C. Sec. 403).
(2) Clean Water Act (33 U.S.C. Sec. 1344).

(3) Marine Protection, Research and Sanctuaries Act (33 U.S.C. Sec. 1413).

Other legislative mandates authorize the COE to issue permits. Refer to the COE regulations. 33 C.F.R. Secs. 320.2 (a)-(g) and 320.3 (a)-(n).

30. 47 Federal Register 31794 (1982). The reader is advised to consult amended regulations of October 5, 1984. 49 Federal Register 29478.

For a summary of the most recent COE program changes consult: National Wetlands Newsletter Nov.-Dec., 1984.

31. 33 C.F.R. 320.4 (a).

All factors which may be relevant to the proposal must be considered including the cumulative effects thereof: conservation, economics, aesthetics, general environmental concerns, wetlands, cultural values, fish and wildlife values, flood hazards, flood plain values, land use, navigation, shore erosion and accretion, recreation, water supply, and conservation, water quality, energy needs, safety, food and fiber production, mineral needs and in general, the needs and welfare of the people.

32. 33 C.F.R. 320.4 (c).

33. Under the Fish and Wildlife Coordination Act (FWCA) (16 U.S.C. Secs. 661-666c), regulatory agencies are required to give equal consideration to fish and wildlife resources in making their decision. 33 C.F.R. 320.3 (e).

34. Delegated responsibilities were provided to NMFS through Reorganization Plan No. 4 in 1970. 35 Federal Register 15627.

NMFS responsibilities are consistent with several legislative mandates besides the FWCA. See, for example:

Magnuson Fishery Conservation and Management Act (16 U.S.C. Sec. 1801 et seq.).

Marine Mammal Protection Act (16 U.S.C. Sec. 1361 et seq.).

Endangered Species Act (16 U.S.C. Sec. 1531 et seq.).

35. Results of the Presidential Task Force study on regulatory relief were released on May 7, 1982. For a review of the affects of reform on the COE's program, see: Advisory Commission on Intergovernmental Relations. 1984. Regulatory Federalism: Policy, Process, Impact and Reform. A Commission Report. A-95. Washington, D.C. See also: Feaver, D.B. 1981.

"Army Seeks to Rule Out 'Permit Escalation'." The Washington Post. Nov. 5, 1981.

36. The "burden of proof" clause created significant changes in the public interest review. See: 33 C.F.R. Sec. 320.4 (a). Prior to the 1984 revisions, the review clause stated that, "no permit will be granted unless its issuance is found to be in the public interst." New regulations stipulate, "a permit will be granted unless its issuance is found to be contrary to the public interest."

Chapter II
Notes and References

1. 33 U.S.C. Sec. 401 (1976 and Supp. V., 1981).

2. 33 U.S.C. Sec. 1344 (Supp. V, 1981).

   The Clean Water Act of 1977, P.L. 95-217 amended the Federal Water Pollution Control Act Amendments of 1972, P.L. 92-500.

3. 33 C.F.R. Sec. 322 App. B (1982).

4. 33 U.S.C. Sec. 403 (1976).

5. 33 C.F.R. Sec. 329.4 (1982).

   The definition of "navigable" has evolved as a result of several landmark legal decisions. In The Daniel Ball case (77 U.S. 557 (1870)), the Court limited Congress' powers to those waterways that might carry foreign or interstate commerce. Subsequent litigation narrowed the definition of "navigability" based on criteria other than the commerce clause.

   Navigable waters of the United States are presently defined as "those waters that are subject to the ebb and flow of the tide and/or are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce." 33 C.F.R. Sec. 329.4 (1982).

   For a detailed review of federal wetlands law and the delimitation of Sections 10 and 404 jurisdiction, see: Want, W.L. 1984. "Federal Wetlands Law: The Cases and the Problems". 8 Harv. Envtl. Law Rev. 1-54; or Hildreth, R.G. and R.W. Johnson. 1983. Ocean and Coastal Law. Prentice-Hall, New Jersey.

6. Natural Resources Defense Council, Inc. v. Callaway 392 F. Supp. 685 (D.D.C., 1975).

   "Waters of the United States" are presently defined as all traditionally navigable waters; interstate waters, including wetlands which do or could contribute to interstate commerce; all impoundments; tributaries of all U.S. waters; and wetlands adjacent to all such waters.

   Wetlands, as defined by the COE, have the three following attributes: (1) the land supports mainly hydrophytes at least periodically; (2) the substrate is at least periodically inundated; and (3) the soils exhibit hydric or anaerobic conditions. This multiparameter definition is modified in the regulations (33 C.F.R. 323.2(c) (1982)).

7. 33 U.S.C. 1344. Sec. 404(f)(1)(A)-(F) (1982).

Exemptions to 404 jurisdiction include normal farming, silviculture, and ranching activities such as plowing, seeding, or cultivating; maintenance of emergency reconstruction structures and farm irrigation systems; construction of temporary sedimentation basins; maintenance of farm roads and best management practices; and activities under authority of an approved State program under Section 208(b)(4) of the CWA. Congressionally approved projects involving an EIS are also exempt (33 U.S.C. Sec. 1344, Sec. 404(r)).

8. There are 11 Divisions and 39 Corps Districts throughout the United States, including the Baltimore District incorporated into this study.

The Baltimore District has authority over all 10/404 activities occurring in Maryland and Pennsylvania and New York counties located within the Susquehanna River drainage.

Appendix 1 provides a schematic representation of the Baltimore Corps Districts' Operations Division. All other Divisions of the District were deleted from the diagram.

9. 33 C.F.R. Sec. 320.1(c) (1982).

10. 33 C.F.R. Sec. 323.2(m) 1982).

11. 33 C.F.R. Sec. 322.2(e) (1982).

12. 33 C.F.R. Sec. 325.2(e)(1) (1982).

13. 33 C.F.R. Sec. 322.2(f)(1) (1982).

For a discussion of a methodology to establish criteria for general permitting coastal structures, see: Holton, J.W. 1980. "General Permits: Method of Criteria Development." In: Coastal Zone '80 Proceedings. Vol. II. pp. 1026-1044. B.L. Edge (ed.).

14. 33 C.F.R. Sec. 325.2(e)(2) (1982).

15. Baltimore District GPs include:

GP-2 Small pier construction and/or mooring placement.
GP-3 Bulkhead replacement.
GP-6 Riprap for shore protection with minimal channelward encroachment.

16. 33 C.F.R. Sec. 330.1 (1982).

17. 33 U.S.C. Sec. 1344 (Supp. V, 1981).

18. 33 C.F.R. Sec. 320.4(a) (1982).

All factors that may be relevant to the proposal must be considered including conservation, economics, aesthetics,

environmental concerns, wetlands, cultural values, fish and wildlife resources, flood hazards, flood plain values, land use, navigation, erosion, recreation, water supply and conservation, energy needs, safety, food and fiber production, mineral needs, and the welfare of the people.

19. 33 U.S.C. Sec. 1344 (Supp. V, 1981).

20. 40 C.F.R. Sec. 230.1(c) (1982).

An alternative is practicable if it is available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall purposes.

21. 40 C.F.R. 230.10(a)(3) (1982).

22. In National Wildlife Federation v. Marsh (14 E.L.R. 20262 (D.D.C., 1984)), the Court ruled that the Guidelines were binding on the COE, although the decision did not resolve the issue of Guideline interpretation.

The COE's interpretation of the 404(b)(1) Guidelines was a major concern of the environmental agencies in a recent proposal in South Attleboro, Massachusetts, where a developer, Pyramid Companies, proposed to construct a shopping mall on a 50-acre wetlands site. The resource agencies recommended denial of the non-water dependent project because there were less environmentally damaging alternatives. The COE claimed that since the developer's plan to enhance existing wetlands and create new wetlands would fully compensate for all adverse environmental impacts, there was no practicable alternative site, and therefore, the project complied with the Guidelines.

For a discussion of the project, see: Eggert, T. 1985. "Out with the Old, in with the New: The Corps' Controversial Interpretation of the 404(b)(1) Guidelines." National Wetlands Newsletter pp. 2-4. Sept.-Oct., 1985; or Shabecoff, P. "Critics Say Protection of Wetlands is Endangered." New York Times, May 10, 1986.

23. 16 U.S.C. Sec. 661 (1982).

24. 33 C.F.R. Sec. 320.4(c) (1982).

25. In addition to the FWCA, the NMFS has delegated responsibilities under the National Environmental Policy Act, the Magnuson Fishery Conservation and Management Act (MFCMA), the Endangered Species Act, the Marine Mammal Protection Act and other federal statutes.

26. 48 Federal Register 53142-53147.

For further discussion of the Conservation Policy, see: Gordon, W.G. 1984. "The National Marine Fisheries Service Habitat Conservation Policy." Fisheries 9(3):2,26; or Sullivan, C. 1984. "The National Marine Fisheries Service Habitat Conservation

Policy. An Interview with William Gordon." Fisheries 9(3):3-5. For a review of habitat concerns addressed through the MFCMA, see: Warner, L.S. 1983: "Conservation Aspects of the Fishery Conservation and Management Act and the Protection of Critical Marine Habitat." Nat. Res. Jour. 23:97-130.

27. Internal reorganization has delegated habitat protection responsibilities to various administrative divisions. The Habitat Conservation Branch (HCB) in the Management Division assumed responsibilities in 1984. The Northeast Region's HCB interacts with the Baltimore District COE in the review process. For a schematic representation of the NMFS and Northeast Region organizational structure, see Appendices 2A and 2B.

28. Regional office personnel base comments on guidelines that have been developed to address regionally-specific project proposals.

29. 46 Federal Register 7644.

30. 46 Federal Register 7658. Sec. V.B. Resources Category 2C Guideline.

31. The Administrator of EPA has the authority under Section 404(c) to deny or restrict the use of any area as a disposal site, if he determines, after notice and opportunity for public hearings, that the discharge will have an unacceptable adverse effect on municipal water supplies, shellfish beds, and fishery, wildlife, or recreational areas.

    EPA most recently executed its discretionary powers by denying the issuance of a COE permit to construct a shopping mall and destroy 50 wetland acres in Massachusetts. Supra note 22. See also: Horton, T. 1986. "Sweedens Swamp: EPA Comes Back from the Dead." Baltimore Sun July 27, 1986.

32. Private wetlands are defined as those lands extending shoreward from the mean high water line which are subject to periodic flooding and support aquatic growth. State wetlands are all lands lying below the mean high water line as defined by the Maryland Wetlands Law (Natural Resources Code Article, 9-101 et seq.)

    Under Section 404(g)(1) of the CWA, a state may take over the COE's 404 permit program by submitting a proposed program to the Administrator of the EPA. In turn, the EPA approves a state program if it fulfills specific criteria according to 40 C.F.R. Sec. 233 (1984).

    To date, only Michigan has assumed responsibility for the 404 permit program.

33. Certification is authorized by the Health-Environmental Article 9-313 et.seq. (Water Quality Certification 10.50.01.03A).

34. See Chapter III, Infra note 68.

35. 33 C.F.R. Sec. 325.3(a)(1)-(15) (1982).

36. 33 C.F.R. Sec. 325.2(e)(3) (1982).

37. For a discussion of interagency coordination procedures, see: Rees, M.R. 1980. "A Practical Intergovernmental Coordination Program." In: Coastal Zone '80 Proceedings. Vol. III, pp. 1984-1993. B.L. Edge (ed.).

38. See: LeGath, J.S. and R.L. Lippson. 1980. "Interagency Permit Review. Lessons of Experience." In: Coastal Zone '80 Proceedings. Vol. III. pp. 1638-1644. B.L. Edge (ed.).

39. MOAs are periodically updated when one or more of the federal agencies requests that formal procedures be revised. New MOAs were signed between the COE and the NMFS (25 March, 1986), the FWS (31 December, 1985), and the EPA (12 January, 1986). For a short review of the most recent FWS-COE MOA, see: Coastal Zone Management 12(1):7. January, 1986.

    MOAs are required by law, according to 33 U.S.C. 1344 (1982). (Section 404(q)).

40. The MOA between the Secretary of Commerce (NMFS) and the Secretary of Army (COE), dated 2 July, 1982.

41. For a review of the most recent Senate oversight hearings on Section 404(q) procedures, see: National Wetlands Newsletter, pp. 8-10. July-August, 1985.

Chapter III
Notes and References

1. DiLisio, J.E. 1983. Maryland: A Geography. Colorado: Westview Press.

2. U.S. Army. Corps of Engineers. 1973. Chesapeake Bay. Existing Conditions Report.

   Approximately two-thirds of the Bay's depth is 18 feet or less.

3. U.S. Army. Corps of Engineers. 1984. Chesapeake Bay Study.

4. McCloskey, W. 1985. "Along the Chesapeake. Heaven and Earth Agree." Oceans 3:3-13.

5. Many articles have been written depicting the watermen's lifestyle. For example, see: Simpson, C. 1986. "Chesapeake Shaft Tongers - Backbone of the Bay's Oyster Industry." National Fisherman Yearbook 1986. pp. 46-48; Valliant, J. 1986." Tightened Fisheries Thinned Out Ranks of Chesapeake Watermen." National Fisherman Yearbook 1986. pp. 91-92; Lade, H.J. and B.J. McCay. 1982." Work on the Water, Work the Land: The Waterman-Farmer." In: Communicating Coastal Information. Proceedings of 8th Annual Coastal Society Conference. pp. 343-352.

6. U.S. Department of Commerce. 1985. Fisheries of the United States, 1984. Current Fishery Statistics No. 8360.

   Landings recorded in round (live) weight for all species except molluscs which are reported in meat weight.

7. Salinity plays an important role in limiting oyster distribution in the Bay, as well as oyster disease (i.e., MSX and Dermocystidium sp.) and predation (i.e., oyster drills). The Chesapeake Bay Region has experienced drought conditions during the last several years, thereby increasing Bay salinities and higher oyster mortality.

8. Department of Natural Resources. 1985. "Preliminary Review. Current Status of Maryland's Oyster Resources."

9. An excellent review of the life history of the blue crab and the Bay fishery can be found in: Warner, W. 1976. Beautiful Swimmers: Watermen, Crabs, and the Chesapeake Bay.

10. Bundy, M.M. and J.B. Williams (eds.). 1978. Maryland's Chesapeake Bay Commercial Fisheries.

11. Horton, T. 1986. "The Blue Crab is Now the Royalty of Chesapeake Fisheries; Long Live the King?" Baltimore Sun, June 29, 1986.

12. U.S. Fish and Wildlife Service. 1984. "Striped Bass Fact Sheet."

For a description of Maryland's commercial striped bass fishery, see: Koo, T.S. 1970. "The Striped Bass Fishery in the Atlantic States." Chesapeake Sci. 11(2):73-93.

13. Phillips, A. 1983. "A Decade of Decline for the Rockfish." The Washington Post, February 16, 1983; Horton, T. 1983. "900,000 Amateurs Say That's Too Much." The Baltimore Sun, February 11, 1983.

Decreased pH and increased mobilization of aluminium in surface waters is now believed to be a major factor influencing larval mortality. See: Hall, Jr., L.W., A.E. Pinkney, L.O. Horseman, and S.E. Finger 1985. "Mortality of Striped Bass Larvae in Relation to Contaminants and Water Quality in a Chesapeake Bay Tributary." Trans. Amer. Fish. Soc. 114:861-868.

14. The moratorium not only received strong opposition from the watermen but also generated turmoil within the state's fishery management body. See: Russell, D. 1984. "Fisheries Management on the Chesapeake. From Fiasco to a Future After All." The Amicus Jour. 6(1):20-25.

15. Norton, V., T. Smith, and I. Strand (eds.). 1984. Stripers. The Economic Value of the Atlantic Coast Commercial and Recreational Striped Bass Fisheries. Maryland Sea Grant Publication No. MDU-T-84-001.

16. Rothschild, B.J., P.W. Jones, and J.S. Wilson. 1981. "Trends in Chesapeake Bay Fisheries." In: Trans. 46th N. Amer. Wildlife Nat. Res. Conf. Sabol, K. (ed.) pp. 284-298.

17. Economics Research Associates. 1984. "Assessment of a Proposed Major Seafood Industrial Park in Worcester County, Maryland." Final Report.

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19. Supra note 6.

20. U.S. Department of Interior and Department of Commerce. 1980. National Survey of Fishing, Hunting, and Wildlife - Associated Recreation.

21. U.S. Department of Commerce. 1986. Marine Recreational Fishery Statistics Survey, Atlantic and Gulf Coasts, 1985. Current Fishery Statistics. No. 8327.

22. U.S. Army. Corps of Engineers. 1977. Chesapeake Bay. Future Conditions Report.

23. Supra note 15.

24. Chesapeake Bay Sport Fishing License Dividends. Sport. Fish. Inst. Bull. No. 374. May, 1986.

25. Wetlands are classified according to the system developed by the FWS. See: Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of Wetlands and Deepwater Habitats of the United States. USFWS, Washington, D.C. FWS/OBS-79/31.

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27. de la Cruz, A.A. 1973. "The Role of Tidal Marshes in the Productivity of Coastal Waters." Assoc. Southeast. Biol. Bull. 20(4):147-156.

28. Lewis, V.P. and D.S. Peeters. 1984." Menhaden - A Single Step from Vascular Plant to Fishery Harvest." J. Exp. Mar. Biol. Ecol. 84:95-100.

29. Crow, J.H. and K.B. Macdonald. 1978. "Wetlands Values: Secondary Production." In: Wetland Functions and Values: The State of Our Understanding. Greeson, P.E., J.R. Clark, and J.E. Clark (eds.). pp. 146-161. Amer. Water Res. Assoc.

30. Weinstein, M.P. and H.A. Brooks. 1983. "Comparative Ecology of Nekton Residing in a Tidal Creek and Adjacent Seagrass Meadow: Community Composition and Structure." Mar. Ecol. Prog. Ser. 12:15-27; Orth, R.J., and K.L. Heck. 1980. "Structural Components of Eelgrass (Zostera marina) Meadows in the Lower Chesapeake Bay - Fishes." Estuaries 3(4):278-288.

31. McHugh, J.J. 1976. "Estuarine Fisheries: Are They Doomed?" In: Estuarine Processes. Volume I. Wiley, M. (ed.). pp. 15-27.

32. Gosselink, J.G., E.P. Odum, and R.M. Pope. 1974. The Value of the Tidal Marsh. Louisiana State University Sea Grant Pub. No. LSU-T1-74-001; Batie, S.S. and J.R. Wilson. 1979. Economic Values Attributable to Virginia's Coastal Wetlands as Inputs in Oyster Production. Res. Bull. 150. Dept. of Agricultural Economics. Virginia Polytechnic Institute and State University; Lynne, G.D., P.D. Conroy, and F.J. Prochaska. 1981. "Economic Valuation of Marsh Areas for Marine Production Processes." J. Environ. Econ. Manag. 8:175-186; Bertelsen, M.K. and L.A. Shabman. 1979. "The Use of Development Value Estimates for Coastal Wetland Permit Decisions." Land Econ. 55:213-222; Farber, S. and R. Costanza. 1987. "The Economic Value of Wetlands Systems." J. Environ. Manag. 24:41-51.

33. In 1984, for example, U.S. commercial landings of estuarine-dependent shrimp, menhaden, and blue crabs were valued at $488, $117, and $56 million, respectively; Supra note 6. Recreation fishermen captured 388 million fish from the Atlantic and Gulf

Coasts in 1985 representing additional undetermined but significant rents. Supra note 21.

34. Gill, J.W. 1985. "Wetland Habitat Values to Upland Wildlife." In: Wetlands of the Chesapeake Proceedings. Burke, D.M., H.A. Groman, T.R. Henderson, J.A. Kusler, and E.J. Meyers (eds.). pp 96-104.

35. Stotts, V.D. 1985. "Values and Function of Chesapeake Wetlands for Waterfowl." In: Wetlands of the Chesapeake Proceedings. Burke, D.M., H.A. Groman, T.R. Henderson, J.A. Kusler, and E.J. Meyers (eds.). pp. 129-142.

36. Hunting, for example, is a principal recreational activity in Maryland. In 1980, there were 198,000 licensed hunters in the state. Thirty-seven percent were migratory bird (i.e. ducks and geese) hunters who spent 700,000 days in search of their quarry. From: U.S. Department of Interior and Department of Commerce. 1982. 1980 National Survey of Fishing, Hunting, and Wildlife - Associated Recreation.

37. Allen, H.H. 1978. "Role of Wetland Plants in Erosion Control of Riparian Shorelines." In: Wetland Functions and Values: The State of Our Understanding. Greeson, P.E., J.R. Clark, and J.E. Clark (eds.). pp. 403-414. Amer. Water Res. Assoc.

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39. Odum, W.E. 1985." The Role of Non-Tidal and Tidal Freshwater Marshes in Reducing Nutrient Inputs to Chesapeake Bay." In: Wetlands of the Chesapeake Proceedings. Burke, D.M., H.A. Groman, T.R. Henderson, J.A. Kusler and E.J. Meyers (eds.). pp. 76-83.

40. Smardon, R.C. 1979. "Visual-Cultural Values of Wetlands." In: Wetland Functions and Values: The State of Our Understanding. Greeson, P.E., J.R. Clark, and J.E. Clark (eds.). pp. 535-544. Amer. Water Res. Assoc.

41. Maryland Forest and Park Service. "Maryland's State Forests and Parks." Brochure.

These 20 recreational areas are located within the Coastal Plain. Twenty-four additional parks and forests are located elsewhere in Maryland.

In addition to the state preserves, the Nature Conservancy's Maryland Chapter has acquired almost 9,000 acres of wetlands and associated buffer in the Chesapeake Bay watershed. These preserves support environmental education centers and walk areas attracting hundreds of visitors every year.

The Maryland Department of State Planning, in association with the Department of Natural Resources, is responsible for developing and

maintaining 5-year state recreational plans. Maryland's first recreational plan was published in 1973. The latest plan contains a set of 19 recommendations to guide state agency programs. For example, Policy 11 directs agencies to promote the preservation of fish and wildlife habitats to secure recreational benefits for this and future generations. See: Maryland Department of State Planning. 1983. Maryland Recreation and Open Space Plan. Report V: Strategy and Summary. Pub. No. 83-18.

Recommendations adopted in the 5-year plans are implemented as specific actions carried out the following year. See: Department of State Planning. 1985. Maryland Recreation and Open Space Plan: 1986-1987 Action Program.

42. Higgins, E.A., R.D. Rappleye, and R.G. Brown. 1971. The Flora and Ecology of Assateague Island. University of Maryland. Agric. Exper. Stat. Bull. A-172.

43. Graefe, A.R. 1984. "An Assessment of Factors Affecting the Demand for and Economic Impacts of Marina-Based Boating in Maryland." R/SU-1.

44. Supra note 1.

45. U.S. Department of Commerce. 1982. 1980 Census of Population. Vol. I. General Population Characteristics. Part 22. Maryland.

46. Gottmann, J. 1961. Megalopolis: The Urbanized Northeastern Seaboard of the U.S. New York: 20th Century Fund.

47. Supra note 45.

48. U.S. Department of Commerce. 1980. 1980 Census of Housing. Final Report HC80-1-A22, Maryland.

49. Environmental Protection Agency. 1983. Chesapeake Bay: A Framework for Action. Appendix B.

50. Ibid.

51. Thompson, D. (ed.). 1977. Atlas of Maryland. College Park, Maryland: University of Maryland.

52. Maryland Department of Economic and Community Development. 1979. "Statistical Abstract, 1979."

53. Maryland Department of Transportation. 1982. Foreign Commerce Statistical Report. Maryland Port Administration.

54. The 94th Congress established the Chesapeake Bay Program October 17, 1975 (P.L. 94-116) which directed the Environmental Protection Agency to conduct a 5-year Bay study.

55. Environmental Protection Agency. 1983. Chesapeake Bay Program: Findings and Recommendations.
Additional literature concerning the Bay's water quality and decline of living resources is available. For example, see: "Troubled Waters. Nutrients and Toxics: Twin Threats for the Chesapeake." Maryland Sea Grant Pub. 7(1):1-16, 1985. or, R.L. Lippson and A.J. Lippson. 1983." The Condition of Chesapeake Bay. An Assessment of Its Present State and Its Future." In: ICES Cooperative Research Report. No. 118. Pearce, J.B. (ed.). pp. 58-80.

Toxic metals and compounds and nutrients are released to the Bay via, industrial effluents, municipal discharges, and agricultural run-off. See: Churchville, V. 1986. "The Poisoning of Chesapeake Bay." Washington Post, June 1, 1986.

56. The results did not identify a "single bullet" responsible for the decline in the Bay's resources. Rather, the outcome enlightened the public, generated greater concern for the Bay and its resources, and provided solutions to reverse some of the problems.

57. U.S. Army. Corps of Engineers. 1985. "Chesapeake Bay Shoreline Erosion Study. Progress Report No. 2."

58. Structural devices include bulkheads, seawalls, revetments, groins, and breakwaters. Bulkheads and seawalls constructed of wood, cement, aluminum, or tires hold or prevent sliding of bank soils and protect shore areas from wave action. Revetments (riprap) consist of multiple layers of various-sized stone or other materials placed along a slope to absorb wave energy. Groins are structures placed perpendicular to the shore and extend into the water. The structures interact with littoral drift to trap shifting sands on the updrift side of the groin. Breakwaters are structures placed offshore to intercept and dissipate incoming waves, forming a low-energy shadow zone on their landward side. Breakwaters are constructed of various materials placed parallel to the shore and may be either fixed or floating.

Non-structural activities include placement of marsh plants to stabilize a shoreline. Sand may be placed in eroded areas and subsequently seeded or planted with plugs (rooted plants) of species such as Spartina alterniflora or S. patens.

59. Zabawa, C.F., R.T. Kerhin, and S. Bayley. 1981. "Effects of Erosion Control Structures Along A Portion of the Northern Chesapeake Bay shoreline." Environ. Geol. 3:201-211.

"Where Will the Beaches Be in 25 Years?" Maryland Environ. 1(1):4,6.

60. U.S. Army. Corps of Engineers. 1985. "Chesapeake Bay Shoreline Erosion Study. Draft Reconnaissance Report."

Environmental Impact Statements are prepared for all federal and federally-funded projects, including navigational channels.

61. The Corps of Engineers has responsibilities over federal navigation projects. Often, these projects are massive undertakings. The Baltimore Harbor and Channels project will increase the depth of 53 miles of Chesapeake Bay channels to 50 ft. The $242 million project will generate more than 52 million cubic yards of disposal materials.

See: Power, G., K.H. Edgecombe, and W.J. Bellows. 1981. The Real Beneficiaries of Federal Dredging. A Legal, Political and Economic Assessment of the Fifty-Foot Channel for the Port of Baltimore. Maryland Sea Grant Pub. UM-SG-TS-81-10.

62. Johnston, Jr., S.A. 1981. "Estuarine Dredge and Fill Activities: A Review of Impacts." Environ. Manag. 5(5):427-440.

63. Nixon, S.A., C.A. Oviatt, and S.C. Northby. 1973. Ecology of Small Boat Marinas. Marine Technical Report 5. University of Rhode Island, Narragansett, Rhode Island.

64. Roman, C.T., W.A. Niering, and R.S. Warren. 1984. "Salt Marsh Vegetation Change in Response to Tidal Restriction." Environ. Manag. 8(2):141-150; "Weirs: Pros and Cons." Aquanotes 14(3):5-8. Louisiana State University Sea Grant.

65. Maryland Forest, Park, and Wildlife Service. 1980. "Maryland Wildlife Management. A Comprehensive Plan for the 80's."

66. Maryland Ann. Code Art. 10-308. 1(e)(3).

67. Talbot, C.W., K.W. Able, J.K. Shisler. 1986. Fish Species Composition in New Jersey Salt Marshes: Effects of Marsh Alterations for Mosquito Control. Trans. Amer. Fish. Soc. 115:269-278.

68. Supra note 55.

69. 16 U.S.C. Sec. 1451(1983). P.L. 96-464 (1980).

Coastal states are encouraged to establish coastal plans through a dual incentive. The Secretary of Commerce, acting through the Office of Coastal Zone Management (OCZM) within the National Oceanic and Atmospheric Administration (NOAA), provides grants to states to develop and implement management programs. 16 U.S.C. Secs. 1455(a)(1)-(2). States must fulfill requirements to be eligible to receive federal monies. 16 U.S.C. 1455 Secs. (d)(2)(A)-(E).

"Consistency" is the second principal incentive for states to develop plans. Section 307 requires federal and state governments to coordinate and cooperate on coastal development activities. Hence, federal activities must be consistent with federally-

approved state coastal management programs. 16 U.S.C. Sec. 1457(C)(1).

70. 16 U.S.C. Sec. 1453(2).

Programs are to give full consideration to ecological, cultural, historic and aesthetic values as well as economic needs.

Natural resources including, inter alia, wetlands, fish and wildlife and their habitat, estuaries, and barrier islands are to be protected by a state plan. 16 U.S.C. Sec. 1453(2)(A). For an overview of federal coastal zone management, see: Natural Resources Defense Council. 1976. Who's Minding the Shore? A Citizen's Guide to Coastal Management. Office of Coastal Zone Management, Wash., D.C. 51 pp.

71. Office of Coastal Zone Management and Department of Natural Resources. 1978. State of Maryland Coastal Management Program and Final Environmental Impact Statement. 464 pp. (hereafter cited as the MCZMP).

72. The Maryland plan affects an area including the 3-mile territorial sea bordering the 31-mile Atlantic coastline; Chesapeake Bay; and the Potomac River, up to the District of Columbia. Sixteen counties and the City of Baltimore are thus affected by the plan. A special "Area of Focus" is identified and includes all coastal waters, bays, estuaries, and wetlands along Chesapeake Bay and the Atlantic coast to the mean high tide and upland areas within the 100-year floodplain. MCZMP p. 11.

73. The plan identifies relevant state authorities affecting the "Area of Focus":

Water Pollution Control Laws
Wetlands Act
State Boat Act
Fisheries Laws
Atlantic Coast Beach Erosion Control District Act
Flood Control and Watershed Management Act of 1976

Additionally, an Executive Order requires state agencies to use these authorities to implement the coastal program. Other authorities also apply to the "Area of Focus" and to areas outside this zone but within jurisdiction of the 16 coastal counties and Baltimore City. MCZMP. pp. 11-14.

74. Jacobik, G. 1981. "A Citizen's Guide. Maryland's Coastal Zone Management Program." p. 6.

75. The Departments are: Natural Resources, State Planning, Economic and Community Development, Health and Mental Hygiene, Agriculture, and Transportation. Maryland's Board of Public Works and the Public Service Commission, independent state agencies, also

contribute key roles in management of Maryland's coast. MCZMP, pp. 40-57.

76. MCZMP, p. 40.

77. Md. Ann. Code, Art. 41-15c(1971).
78. Natural Resources Art. 1-103(c)(1974).

79. MCZMP, p. 14.

80. MCZMP, pp. 14,15.

The Plan has 43 general objectives and 9 policies pursuant to Maryland's Environmental Policy Act applicable to all state agencies. Agency procedure must also adhere to several additional laws, rules regulations, and policies. MCZMP, pp. 83-88.

81. Federal consistency acts an incentive for states to develop coastal plans under Sec. 307(c)(1) of the CZMA. Supra note 68.

The Maryland Plan identifies federally conducted or supported programs and activities. MCZMP, pp. 339-364.

82. The Corps of Engineers 10/404 program discussed in this thesis is one federal program subject to consistency review. MCZMP, pp. 351-352.

83. 16 U.S.C. Sec. 306(c)(1) (1982).

84. MCZMP, pp. 308-311.

85. Ibid.

86. The Regional Planning Council is comprised of Baltimore City and Anne Arundel, Baltimore, and Harford County representatives. Tri-County Council members include representatives from St. Mary's, Charles, and Calvert Counties. Prince George's County participates in the Maryland-National Capital Park and Planning Commission; Eastern Shore counties maintain membership on the Delmarva Advisory Council.

87. The CZMA encourages the participation and cooperation of the public as well as government entities. 16 U.S.C. Sec. 1453(4) (1982). OCZM regulations suggest citizens' advisory committees as an additional means of eliciting public participation. 15 C.F.R. Sec. 920.32(c)(2).

88. MCZMP, pp. 368, 369.

89. Maryland Department of Natural Resources. 1980. "By-Laws for the Maryland Coastal Resources Advisory Committee." Appendix B identifies CRAC task forces, 1979-1981.

90. CRAC membership exhibits great diversity. For a listing of both voting and non-voting members, see: "A Citizen's Guide." Supra note 73. p. 19; or MCZMP, pp. 59, 60.

91. The Agreement resulted from findings identified by EPA's 7-year, $27 million study to evaluate the status of the bay, identify problematic causes, and recommend solutions. Supra note 55. See also: Franklin, B.A. 1983. "Chesapeake Bay Study Citing Pollution Threats." New York Times. Sept. 27, 1983. p. A-24.

Maryland has also joined with other states to manage Chesapeake Bay and its resources through interstate institutions including, inter alia, the Chesapeake Bay Commission and the Chesapeake Research Consortium. For an overview of the institutional framework see: Johnston, M.R. 1982. "An Interstate Coordination Network for Chesapeake Bay." In: Communicating Coastal Information. Procs. 8th Ann. Conf. Coast. Soc. Lynch, M.P. (ed.) pp. 379-385.

92. Md. Nat. Res. Ann. Code Art. 8-1808(d) (1985).

93. Powers, A. 1986. "Protecting the Chesapeake Bay: Maryland's Critical Area Program." Environment 28(4):5,44-45. See also: Marriot, Jr., R.W., A. Van Arsdale, and E.A. Bober. 1985. "The Development of Local Intermin Review Procedures for the Protection of Chesapeake Bay." Nat. Wetl. Newslet. pp. 16-17. Sept.-Oct., 1985.

94. Supra note 91.

95. Ibid. Sec. 14.15.02.03 A-B.

96. Ibid. Sec. 14.15.02.04 A.

97. Ibid. Sec. 14.15.02.05 A.

98. Wicomico, Somerset, and Dorchester county planning officials initially refused to follow the guidelines. See: Horton, T. 1985. "Counties to Defy Bay Plan." Baltimore Sun Dec. 15, 1985.

The Eastern Shore counties were particularly opposed to the regulations because these areas contain most of the critical areas zone and undeveloped lands, and consequently, are favorable areas for development. For example, approximately 30 percent of Dorchester county lands are located within the critical area. Maryland Department of State Planning. 1985. "Chesapeake Bay Critical Area: 1981 Land Use."

99. Goldberg, E. and M. Corddry. 1985. "Rules Spur Eastern Shore 'Land Rush'." Baltimore Sun Nov. 3, 1985.

100. Subdivisions in Talbot county tripled during the interim period. Consequently, the county placed a moratorium on additional

requests. Kirby, W. 1985. "County Passes Moratorium." Talbot Banner. Oct. 2, 1985.

101. The regulations were approved by both Maryland's Senate (42-4) and House of Delegates (102-19) in February, 1986.

Chapter IV
Notes and References

1. Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of Wetlands and Deepwater Habitats of the United States. U.S. Fish and Wildlife Service. FWS/OBS-79/31. 103 pp.

2. Complex methodologies have been devised to determine functional values of specific wetlands habitats. See: U.S. Fish and Wildlife Service. 1980. "Habitat as a Basis for Environmental Assessment." Department of Interior. Washington, D.C. 101 ESM; Adamus, P.R., and L.T. Stockwell. 1983. "A Method for Wetland Functional Assessment." Prepared for the Federal Highway Administration. Rept. No. FHWA-IP-82-83; Larson, J.S. 1981. "Wetland Value Assessment: State of the Art." National Wetlands Newsletter 3:4-8.

3. The Adamus method is a complex, indepth methodology which (1) specifically uses the USFWS wetland classification system; (2) addresses all recognized wetland functions and wetland types; and (3) provides specific guidance for estimating impact magnitude. This methodology was initially developed specifically for assessing impacts resulting from highway projects, although the technique has gained acceptance and is now used in numerous project type assessments.

4. Ranking impacts to wetland habitats has been previously established. See: Nelson, R.W. and E.C. Weller. 1984. "A Better Rationale for Wetland Management." Environ. Manag. 8(4):295-308; Nelson, R.W. and W.J. Logan. 1984. "Policy on Wetland Impact Mitigation" Environ. Internl. 10:9-19.

   Impact ranking explained in these articles has been incorporated into this thesis, although inverse ranking values are utilized. However, concepts and procedures identified by Nelson and Weller (1984) and Nelson and Logan (1984) are maintained, regardless of these modifications.

Chapter V
Notes and References

1. Data supplied by the Baltimore District's Regulatory Functions Branch, Aug. 28, 1986.

2. Norcliffe, G.B. 1982. Inferential Statistics for Geographers. An Introduction. 2nd Ed. Hutchinson, London. 263 pp.

3. Maryland Forest, Parks and Wildlife Service proposed (PN 84-0748) and was permitted to construct a 440-acre waterfowl and mosquito control impoundment in Greens Island Marsh at Elliotts Island. An 18,500 ft berm has been refurbished, thereby seasonally inundating irregularly flooded emergent (species including, inter alia, Spartina patens, Distichlis spicata, Scirpus robustus, Juncus roemarianus, Typha angustifolia) wetlands. State-managed waterfowl impoundments of similar size have been constructed in other Dorchester County locations. It should be noted that many of these large impoundments were originally constructed prior to implementation of the COE's 404 regulatory program and are currently being reconditioned in attempts to enhance populations of several migratory waterfowl species.

4. A permit (PN 82-0223) to dredge fossil oyster shell for shellfish propagation was issued by the COE to the State's Tidewater Administration in 1982. Approximately 2784 acres of oyster shell in Baltimore County were subject to extraction by a state-contracted dredging company (Langenfelder, Inc.). Although permit conditions delimit the dredge area, this expansive site has and will remain largely unaltered according to company officials (J. Matter, personal communication). Thus, physical impacts from the permitted project were omitted from this assessment as it would have unjustifiably skewed the data.

   Oyster shell dredging operations in Baltimore County waters has occurred since 1960. Nearly 50 million bushels of shell were dredged during the first decade of activities. For an overview, see: Sieling, F. 1970. "Brief History of Shell Dredging in Maryland". Commercial Fisheries News 3(1):1.

5. Findings of EPA's 5-year Chesapeake Bay study identified submerged aquatic vegetation (SAV) as an important Bay resource in serious decline and linked plant decline as a factor adversely affecting fisheries resources. See: Orth, R.J. and K.A. Moore. 1981. "Submerged Aquatic Vegetation of the Chesapeake Bay: Past, Present, and Future". Trans. N. Amer. Wildl. Nat. Res. 46:271-283.

Chapter VI
Notes and References

1. Harrison, P. 1975. "Spatial Aspects of the Pressure for Shoreline Development: The Example of Puget Sound." Coastal Zone Manag. Jour. 2(2):125-148.

2. Queen, W.H. 1979. "Existing Modifications, Current Alteration Activity, and Future Development of the Chesapeake Bay Shore Zone." In: Physical Alterations of Coastal Shorelines: An Analysis of Chesapeake Bay Shore Zone Development and Regulations. W.H., Queen (ed.). Chesapeake Research Consortium Pub. No. 64. pp. 51-59.

3. Supra note 1 at p. 135.

4. Dockominiums and other commercially-related developments will likely be principal components in the expansion of the Port of Cambridge. See: Corddry, M. 1985. "Cambridge Plans A New Luxury Look." Baltimore Sun. Sept. 4, 1985.

5. Roy Mann Associates, Inc. 1976. Recreational Boating on the Tidal Waters of Maryland. A Management Planning Study. Prepared for the Energy and Coastal Zone Administration. 177 pp. + appendices.

6. Maryland Department of State Planning. 1983. "Maryland Recreation and Open Space Plan." Report III: Facility and Acreage Requirements.

7. Id.

8. State (Department of Forests, Parks, and Wildlife) and federal (Soil Conservation Service) tax incentive programs are available to property owners if they apply conservation measures, such as waterfowl enhancement and sediment control ponds, to their land. The Chesapeake Wildlife Heritage, a non-profit organization, also encourages alteration of property for waterfowl enhancement purposes.

9. Tiner, Jr., R.W. 1984. "Wetlands of the United States: Current Status and Recent Trends." U.S. Fish and Wildlife Service, Washington, D.C. 59 pp.

   Net loss was 9 million acres as 2 million habitat acres were also generated.

10. Sea level rise is only one factor contributing to coastal submergence and wetlands loss. Dams impounding rivers inhibit sediment fluxes to downstream marshes that require an accumulating substrate on which to grow and to maintain an isostacy with rising sea level. Hydrocarbon extraction from oil and gas reservoirs

leads to displaced sedimentary beds and sinking coastal topography.

11. Zinn, J.A. and C. Copeland. 1982. "Wetland Management." Report to the Senate Committee on Environment and Public Works. Serial No. 97-11. Library of Congress, Washington, D.C. 149 pp.

12. 33 C.F.R. 320.4(b)(3) (1982).

13. Odum, W.E. 1982. "Environmental Degradation and the Tyranny of Small Decisions." BioScience 32(9):728-729.

14. Niering, W.A. 1982. Statement before the House Committee on Merchant Marine and Fisheries. August 10, 1982.

15. Office of Technology Assessment. 1984. "Wetlands: Their Use and Regulation." Washington, D.C. OTA-O-206. 208 pp.

16. Ibid. p. 141.

17. Kusler, J. 1978. "Strengthening State Wetland Regulations." U.S. Fish and Wildlife Service, Washington, D.C.

18. Center for Governmental Responsibility. 1982. "Wetlands Loss in South Florida and the Implementation of Section 404 of the Clean Water Act." University of Florida College of Law.

19. For example, a project permitted by the COE must not impair water quality and must be approved via state water quality certification issued by the Department of Health and Mental Hygiene. The project must also gain coastal zone consistency certification.

20. The State Board of Public Works issues licenses for activities in State wetlands; work in private wetlands requires a permit or notification from the Department of Natural Resources.

21. Md. Natural Resources Article, Sec. 9-101 et seq.

22. Metzgar, R.G. 1973. "Wetlands in Maryland." Dept. of State Planning Pub. No. 157.

23. According to a letter (dated July 27, 1979) forwarded to NMFS by W.S. Sipple, former Chief of Maryland's Wetlands Permit Division, approximately 750 acres of coastal wetlnds were lost annually during this period. It's assumed this value takes into account tidally influenced palustrine forested/scrub-shrub habitats identified as "wooded swamp."

"Coastal wetlands" included wooded swamp, tidal freshwater swamp, salt meadow, and regularly and irregularly flooded salt marsh habitats. Wetlands were classified according to: Shaw, S.P. and C.G. Fredine. 1956. "Wetlands of the United States." U.S. Fish and Wildlife Service, Washington, D.C. Circular 39.

24. Supra note 22. p. IX-3.

25. Water Resources Administration annual wetland report summaries, 1973-1985.

See also: Cassell, H.M. 1977. "Maryland's Wetland Program: A Managerial View-From the Inside." In: National Wetland Protection Symposium. June 6-8, 1977. Reston, Virginia. Montanari, J.H. and J.A. Kusler (eds.). FWS/OBS-78/97. pp. 57-61.

26. Ibid.

State records do not identify habitats lost or altered by permitted impoundment activities.

27. For an overview of NMFS' habitat conservation efforts, see: National Marine Fisheries Service. 1986. "The Habitat Conservation Program of the National Marine Fisheries Service for Fiscal Years 1984 and 1985." Office of Protected Species and Habitat Conservation, NMFS. Washington, D.C. 56 pp.

28. For example, Maryland Port Administration (85-0911) proposed to fill 2.8 acres of inter- and subtidal non-vegetated habitat for parking and loading facilities on the Patapsco River (non-water dependent purpose). Similarly, Worcester County Sanitation Commission (83-0102) proposed to fill 8.4 acres of shallow water and vegetated wetlands for a sewage treatment plant site (non-water dependent purpose).

29. Of the 94 proposals withdrawn over the 5-year period, NMFS would have recommended that at least 19 of the proposals be either modified or denied based on NMFS record files.

30. More than one recommendation was provided for some projects. The 302 recommendations were specific modifications identified in projects with resolved (accept or reject) outcomes.

31. 46 Federal Register 7644 (1981).

32. 48 Federal Register 53142 (1983).

Implementation Strategy No. 8 identifies the agency's objectives to become actively involved early in the decisionmaking process to further reduce conflicts. Mitigation (assumed to mean compensation) measures are identified as being required for essential public interest projects where practical alternatives are unavailable. No other substantive wording directing specific field-level decisionmaking is found in the policy.

33. NMFS, Northeast Region. "General Response to Water-Related Projects Requiring Federal Permits." Undated manuscript. p. B-217.

Identified are projects that NMFS generally encourages, has no objection to, discourages, or recommends permit denial.

Several variations of NMFS' guidelines were identified. All were consistent in their legal and procedural definitions and identified proposals in which the agency would have had no objection, modifications, or denial recommendations.

34. Five projects proposed for non-water dependent structures (i.e., restaurants, houses, and pools on pilings) were found unacceptable to NMFS. All 5 proposals (81-0885, 81-0222, 82-0077, 82-0096, 85-1333) were permitted by the COE.

35. In one permit application, Ocean City Golf and Yacht Club (83-0625) proposed to fill approximately 0.25 acres of S. alterniflora marsh for a golf course and compensate for losses by creating approximately 4.0 acres of artificial wetlands habitat.

In 1981, Marly Neck Patapsco Company (81-0074) proposed to fill approximately 7 wetland acres for a coal storage and unloading facility. NMFS, the COE and other resource agencies reduced fill impacts and generated an appropriate mitigation plan.

Atlantic Wharf Corporation (84-0097) proposed to fill approximately 3.0 acres of open-water habitat for cargo space. NMFS recommended that "an alternative analysis be conducted, and if the project was found to be water-dependent, mitigation would be required." The project was subsequently withdrawn.

36. Recommended modifications were to reduce the magnitude of habitat loss resulting from 2 shoreline stabilization (81-0149, 82-0229) projects. NMFS recommended permit denial of 4 non-water dependent structures (81-0885, 81-0222, 82-0077, 82-0096) and recommended upland rather than open-water disposal for a dredging project (82-0292) permitted for the U.S. Army. The only major conservation effort rejected was identified as an after-the-fact project (Long Cove Marina 83-0220) in which NMFS recommended restoration of lost salt marsh habitat. In this project, the COE accepted all other recommendations provided by NMFS including compensatory mitigation. The outcomes of 2 additional intermediate and 2 major recommendations could not be determined.

37. Waterfowl impoundments were projects of interagency disagreement. One project (85-0557) proposed to impound 8 acres of estuarine inter- and subtidal habitats and 2 acres of Phragmites dominated wetlands. Another project (85-0974) proposed to create 2-10 acre impounds in Typha and Hibiscus dominated wetlands for waterfowl enhancement purposes. In both cases, NMFS recommended that impounding of wetlands be denied because reasonable alternatives were available for constructing the impoundments or achieving project objectives.

38. The applicant (Zamoiski, 85-0691) proposed to dredge 0.3 acres of subtidal and oyster reef habitat for the purpose of improving

mooring facilities. NMFS recommended that the COE deny the dredging, and proposed less environmentally-damaging alternatives.

39. Maryland DNR (85-1355) proposed to dredge both vegetated and non-vegetated wetlands for the creation of public access facilities to an estuarine sanctuary. NMFS recommended that the plan be modified to compensate for all wetland losses. It should be noted that NMFS did not object to an earlier, but identical proposal for this project.

40. T. Goodger, personal communication.

41. Westman, W.E. 1977. "How Much Are Nature's Services Worth?" Science 197:960-964.

42. Supra note 32. Chapter III.

43. Habitat Evaluation Procedures (HEP) developed by the FWS are a habitat-based approach for assessing environmental impacts measured in habitat units. The habitat unit is a ratio measurement of existing to optimum habitat quality, with optimum habitat quality defined as that which is capable of producing the carrying capacity for that species. HEP has no economic relevance. See: USFWS. 1980. "Habitat Evaluation Procedures." Ecological Services Manual 100 ESM.

44. For a review of methodologies used in assessing wetlands, See: Lonard, R.D., 1981, E.J. Clairain, R.T. Huffman, J.W. Hardy, L.D. Brown, P.E. Ballard, and J.W. Watts. "Analysis of Methodologies Used for the Assessment of Wetlands Values." U.S. Army. WES, Vicksburg, Mississippi.

Status of current evaluation approaches can be found in: Kusler, J.A. and P. Riexinger. (eds.). 1985. "Proceedings of the National Wetland Assessment Symposium." Assoc. of State Wetland Managers. Tech. Rept. 1. 331 pp.

The Adamus method is the most commonly-accepted approach at present. See: Adamus, P.R. and L.T. Stockwell. 1983. "A Method for Wetland Functional Assessment." Draft Report. Prepared for the U.S. Dept. of Transportation, Washington, D.C.

45. The concept of "mitigation" has multiple definitions. The National Environmental Policy Act provides five relevant definitions which include: (a) avoiding the impact altogether by not taking a certain action or parts of an action; (b) minimizing impacts by limiting the degree or magnitude of the action and its implementation; (c) rectifying the impact by repairing, rehabilitating, or restoring the affected environment; (d) reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; and (e) compensating for the impact by replacing or providing substitute resources or environments. 40 C.F.R. Sec. 1508.20(a)-(e). For a review of the mitigation process see: Heagerty, D.C. 1983.

"Mitigation. A Workable Tool For Coastal Development." In: Coastal Zone '83 Proceedings. pp. 1052-1069.

46. Soileau, D.M., J.D. Brown, and D.W. Fruge. 1985. "Mitigation Banking: A Mechanism for Compensating Unavoidable Fish and Wildlife Habitat Losses." Trans. N. Amer. and Natur. Resour. Conf. 50: 465-474. See also: Zagata, M.D. 1985. "Mitigation by 'Banking' Credits: A Louisiana Pilot Project." Trans. N. Amer. Wildl. and Natur. Resour. Conf. 50:475-484.

47. Gatton, R.D. 1983. "The Question of Mitigation." In: Coastal Zone '83 Proceedings. pp. 1105-1119.

48. Artificially created habitats have proven successful in some instances, although one must define the term "success." See: Zada, A. and M. Whaley. 1983. "Mitigation Measures Management Plan for Coastal Zones." In: Coastal Zone '83 Proceedings. pp. 1070-1081; Thorhaug, A. 1985. "Large-Scale Seagrass Restoration in a Damaged Estuary." Mar. Pollut. Bull. 16(2):55-62; Faber, P. 1983. "Marsh Restoration with Natural Revegetation: A Case Study in San Francisco." In: Coastal Zone '83 Proceedings. pp. 729-734.

49. Several compensatory mitigation projects in San Francisco Bay have been plagued by problems. See: Race, M.S. "Critique of Present Wetlands Mitigation Policies in the United States Based on an Analysis of Past Restoration Projects in San Francisco Bay." Environ. Manag. 9(1):71-82.

Only proven mitigation measures should be used in compensatory projects and should be maintained over the life of the development project. Monitoring should be conditioned into all permits involving compensation. See: Savage, N. 1986. "The Mitigation Predicament." Environ. Manag. 10(3):319-320.

50. On October 25, 1985, NMFS and the COE signed a cooperative agreement to study the practicality of a national program to restore previously degraded fishery habitats and to create new habitats as compensatory measures. For an overview, see: Gordon, W.G. 1986. "NMFS and Army Corps of Engineers Restore Fisheries Habitats: A Cooperative Venture." Fisheries 11(5):2-7; Pellicciotto, T. 1986. "Pilot Study of Restoration and Creation of Fisheries Habitats." In: Environmental Effects of Dredging. U.S. Corps of Engineers. WES. Vol. D-86-3. July, 1986. p. 5.

51. Sax, J. 1970. "The Public Trust Doctrine in Natural Resource Law: Effective Judicial Intervention." 68 Mich. L. Rev. 471-566.

52. Martin, K. 19777. "The Wetlands Controversy. A Coastal Concern Washes Inland." 52 Notre Dame Lawyer 1015-1034. (Hereafter cited as Martin).

53. United States v. Caroline Prod. Co., 304 U.S. 144. (1938).

54. Orono-Veazie Water District v. Penobscot City Water Co.,

348 A. 2d. 249 (Me., 1975). In Martin, p. 1024.

55. Shoreline Associates v. Marsh, 19 ERC 1128.

56. Goldblatt v. Town of Hempstead, 369 U.S. 590. In Martin, p. 1024.

57. Vartelas v. Water Resources Comm., 153 A. 2d. 822. (Conn., 1959); Commissioner of Natural Resources v. S. Volpe & Co., Inc., 206 N.E. 2d. 666. (Mass., 1965).

58. 282 A. 2d. 907. (Conn., 1971).

59. 197 A. 2d. 770. (Conn., 1964).

60. 265 A. 2d. 711 (Me., 1970).

61. 310 N.E. 2d. 487 (Mass., 1976).

62. 284 N.E. 2d. 891. (Mass., 1972).

63. 336 A. 2d. 239. (N.H., 1975).

64. Id.

65. 201 N.W. 2d. 761. (Wisn., 1970).

66. Penn Central Transportation Co. v. New York City. 438 U.S. 104. (1978).

67. Want, W. 1984. "1902 Atlantic Ltd. v. Hudson: A Case for Concern." National Wetlands Newsletter 6(3):14-17.

68. 17 ERC 2126-2131. No. 78-83-CIV-7 (1983).

69. 657 F. 2d. 1210. 16 ERC 1474 (1981).

70. 657 F. 2d. 1184. 18 ERC 1009 (1982).

71. Andrus v. Allard, 444 U.S. 51 (1979).

72. 444 U.S. 164 (1979).

73. Zabel v. Tabb, 430 F. 2d. 199 (Fla., 1970).

74. 574 F. Supp. 1381 (Va., 1983). 19 ERC 1926.

75. In Zabel v. Tabb, the Circuit Court held that the COE could consider ecological as well as navigational factors when determining whether to issue a Section 10 permit.

In United States v. Sexton Cove Estates, Inc. (526 F. 2d. 1293 (1976)), the Fifth Circuit Court found that jurisdiction over man-made, land-locked, canals directly connected to navigable waters requires a permit for certain development activities. The case

concerned an underground tidal connection, rather than a direct surface connection as in 1902 Atlantic.

76. Nos. 85-2588, 85-2609 (Fed Cir, 1986). 22 ERC 1943.

77. United States v. Riverside Bayview Homes, Inc., 729 F. 2d. 391 (6th. Cir) (Mich., 1984) cert. granted. No. 84-701 (U.S., 1985).

In Riverside, the Sixth Circuit Court based its takings decision on the extent of interference with the property, similar to the decision reached in Kaiser Aetna.

The U.S. Supreme Court overturned the Riverside decision on December 4, 1985. See: Supreme Court Upholds U.S. On Protecting Wetland Areas." New York Times. Dec. 5, 1985.

78. Connolly v. Pension Benefit Guaranty Corp. 54 U.S.L.W. 4208 (Feb., 1986). As cited in: Meyers, E. 1986. "Murky Waters: Florida Rock Revisited" National Wetlands Newsletter. July-Aug., 1986. pp. 17-19.

79. Ibid. p. 19.

80. Center for Governmental Responsibility. 1982. "Wetlands Loss in South Florida and the Implementation of Section 404 of the Clean Water Act." Contract Study by the University of Florida College of Law for the Office of Technology Assessment.

81. 33 U.S.C. Sec. 1344. (Sec. 404(f)(1)).

82. 33 C.F.R. Sec. 330.5(a)(1)-(26) (1986).

83. 33 C.F.R. Sec. 330.8 (1986).

84. Mann, D.E. (ed.). 1982. Environmental Policy Implementation. Massachusetts: Lexington Books. p. 1.

85. The U.S. Department of Agriculture sponsors income tax provisions, and to a limited extent, cost-sharing and technical-assistance programs that reduce costs and risks associated with conversion.

86. Wetlands are acquired through (1) funds obtained through sale of migratory bird hunting and conservation stamps; (2) the Wetlands Loan Act; (3) the Land and Water Conservation Fund Act; and (4) the Water Bank Program.

87. Parish, G.E. and J.M. Morgan. 1982. "History, Practice and Emerging Problems of Wetlands Regulation: Reconsidering Section 404 of the Clean Water Act." Land and Water Rev. 17(1):43-84.

88. Blumm, M.C. 1983. "Wetlands Preservation, Fish and Wildlife Protection, and 404 Regulation: A Response." Land and Water Rev. 18(2):469-489.

89. 33 C.F.R. 320.4(b)(3) (1986).
Harbor characterizations also serve as interagency coordination mechanisms guiding the COE's regulatory authority. See: New England Interagency Technical Group on Ocean Disposal of Dredged Material and Sewage Sludge. "Harbor Characterization Guidelines: A Standardized Review Process for New England Dredging Projects." In press.

90. Office of Technology Assessment. 1984. Wetlands. Their Use and Regulation. Washington, D.C. OTA-0-206. 208pp.

91. CZMA. Sec. 303(3).

92. U.S. Senate Committee on Commerce, Science, and Transportation. 1982. Report No. 96-783. p. 6.

93. Carol, D.S. and D.J. Brower. 1983. "Legal Considerations for Special Area Management." In: Coastal Zone '83 Proceedings. pp. 2073-2085.

In Maryland, the Baltimore Harbor Environmental Enhancement Plan was prepared as a Special Area Management Plan to address the continuing need for economic development of scarce and within the harbor, and the associated loss of aquatic habitat. The SAMP acts as a mitigation plan for all harbor habitat losses associated with Baltimore City development. See: Regional Planning Council. 1982. The Baltimore Harbor Environmental Enhancement Plan.

94. Coastal Zone Management. Aug. 15, 1986. pp. 2-3.

EPA has initiated AWA efforts on Chincoteague Island, Virginia, a largely undeveloped Eastern Shore area experiencing rapid urban growth and generating potential implications to wetlands protection. See: Jensen, P. 1986. "Chincoteague Island Residents at Odds with EPA Over Wetlands Preservation." Baltimore Sun. Oct. 5, 1986.

95. 40 C.F.R. 230.2(a)(1) (1985).

96. For example, a study of seven COE Districts in the Southeastern United States identified varying rates of acceptance of NMFS recommendations over a 5-year period. Rates varied from a low 20 percent acceptance by the Jacksonville District to a high 89 percent by the Savannah District. See: Mager, Jr., A. 1986. "Treatment of National Marine Fisheries Service Recommendtions by the Corps of Engineers in the Southeast Region of the United States from 1981 through 1985." Manuscript. 9 pp.

97. 40 C.F.R. 230.1(c) (1985).

98. 40 C.F.R. 230.10(a) (1985).

99. 40 C.F.R. 230.10(a)(2) (1985).

100. 40 C.F.R. 230.10(a)(3) (1985).

101. 40 C.F.R. 230.11 (1985).

40 C.F.R. 230.11(h) (1985).

Fluctuating water levels in an impoundment and downstream of a dam, and leachate and runoff from a sanitary landfill are examples of secondary effects.

103. 40 C.F.R. 230.11(g) (1985).

104. 40 C.F.R. 230.20-230.25 (1985).

105. 40 C.F.R. 230.41 (1985).

106. 40 C.F.R. 230.50-230.54 (1985).

107. This interpretation is consistent with the 1902 Atlantic Ltd. v. Hudson decision. (574 F. Supp. 1381 (E.D., Va., 1983)).

108. Regulatory Guidance Letter No. 84-9, DAEN-CWO-N. July 26, 1984.

109. Tripp, J.B. 1985. "Legal Implications of Various Assessment Methodologies: Assessing Wetland Functions and the Taking Issue." In: National Wetlands Assessment Symposium Proceedings. J.A. Kusler and P. Riexinger (eds.). June 17-20, 1985. Portland, Me. pp. 280-285.

Supra note 22. Chapter II.

110. The Attleboro project, in which the COE permitted Pyramid Companies to fill approximately 32 acres of bottomland hardwood swamp to construct a shopping mall and parking lots, serves as a prime example. Although the applicant had an alternative, less environmentally-damaging site available, the COE ignored this consideration. Rather, the permit was issued with a mitigation plan to comply with the guidelines. However, EPA overturned the decision with their 404(c) ruling.

111. Supra note 109. p. 282.

112. State of Louisiana v. Lee. 758 F.2d. 1081. (5th Cir., 1985).

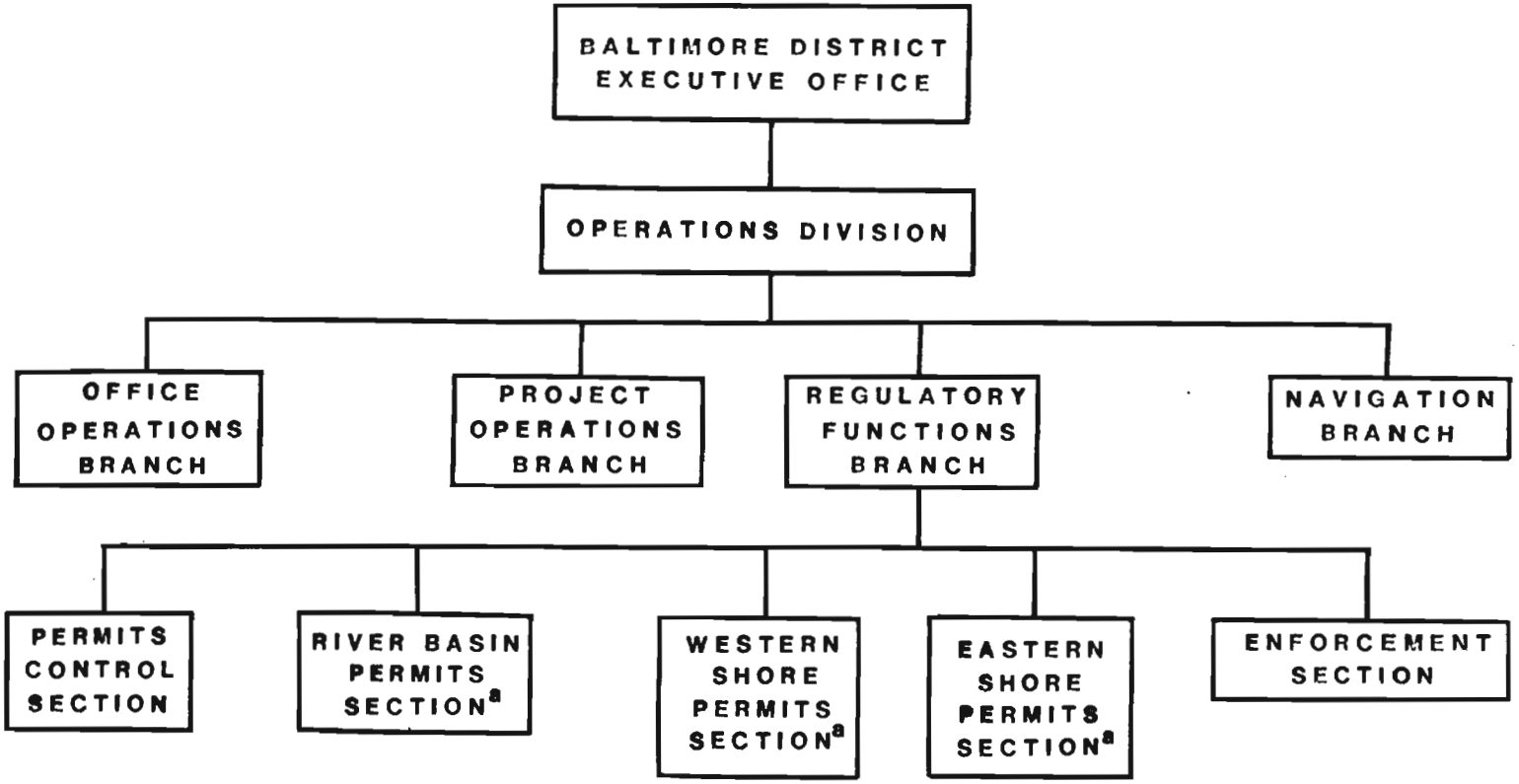
113. NMFS has produced several brief documents to guide staff decisions contributing to the public interest review. The most detailed guidance generated thus far has been implemented by NMFS' Southeast Region. Both general and project-specific guidelines are considered. Relevant considerations include the:

(1) extent of precedent setting and potential cumulative impacts;
(2) direct and indirect effects to fishery resources;

(3) avoidance of impacts through project modification;
(4) extent of alternative sites to reduce unavoidable impacts;
(5) degree of project's water-dependency; and
(6) extent to which mitigation is possible to offset unavoidable habitat losses associated with a water-dependent project clearly in the public interest.

APPENDIX 1

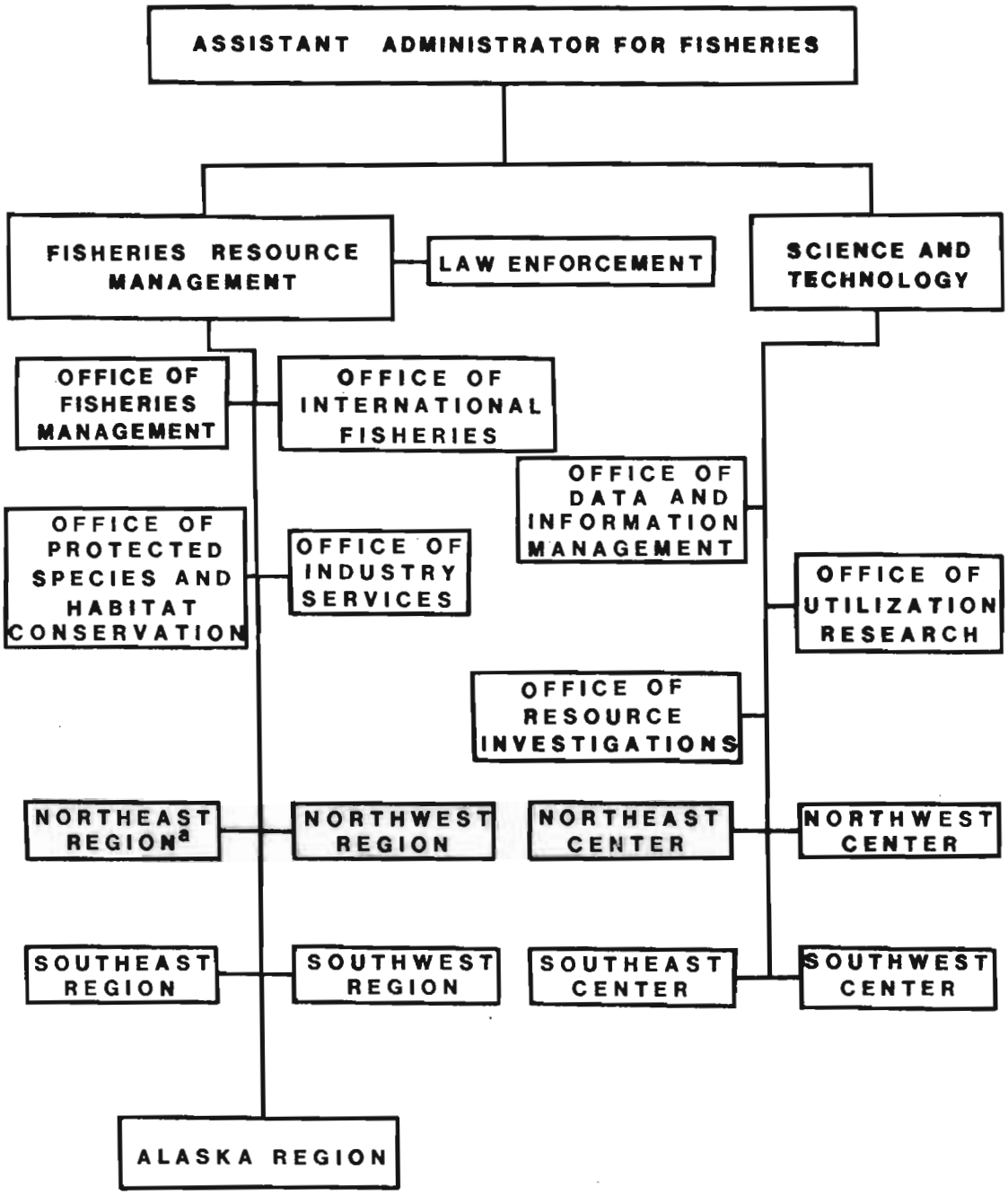
ORGANIZATIONAL STRUCTURE OF THE BALTIMORE CORPS DISTRICT'S OPERATIONS DIVISION



[a]DENOTES SECTIONS INCLUDED IN STUDY

APPENDIX 2A

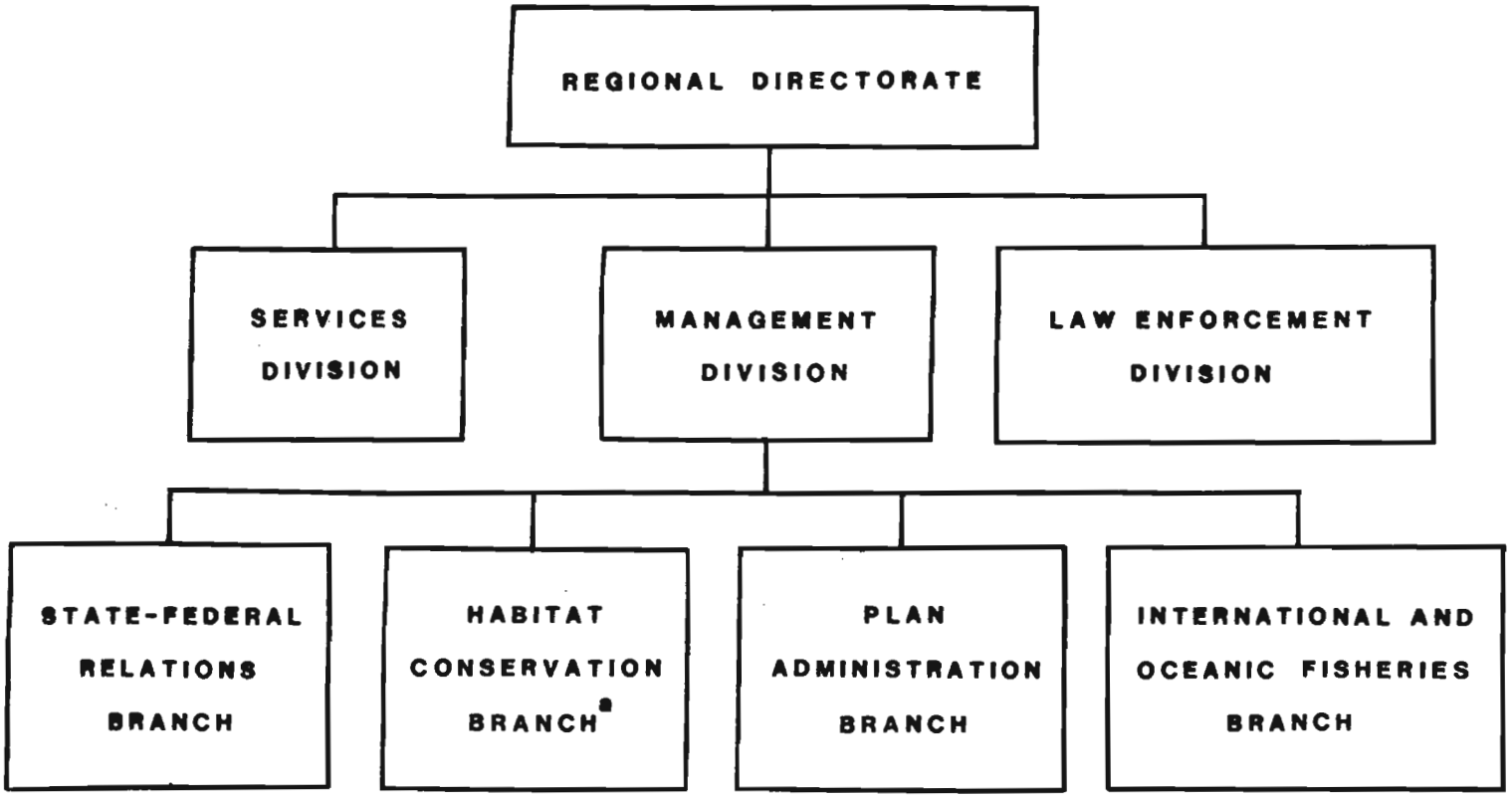
ORGANIZATIONAL STRUCTURE OF THE NATIONAL MARINE FISHERIES SERVICE



[a]DENOTES REGION EVALUATED IN STUDY

APPENDIX 2B

ORGANIZATIONAL STRUCTURE OF THE NATIONAL MARINE FISHERIES SERVICE
NORTHEAST REGION



*DENOTES BRANCH (OXFORD, MARYLAND FIELD OFFICE) EVALUATED IN STUDY

APPENDIX 3

LIST OF REFERENCED ACRONYMS

AWA	Advanced Wetlands Analysis
CAC	Critical Areas Commission
CFR	Code of Federal Regulations
COE	Corps of Engineers
CRAC	Coastal Resources Advisory Committee
CRD	Coastal Resources Division
CRMC	Coastal Resources Management Council
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
DNR	Department of Natural Resources
EPA	Environmental Protection Agency
ERC	Environmental Reporter Cases
FWCA	Fish and Wildlife Coordination Act
FWS	Fish and Wildlife Service
GAO	General Accounting Office
GP	General Permit
LOP	Letter of Permission
MCZMP	Maryland Coastal Zone Management Plan
MD SHA	Maryland State Highway Administration
MOA	Memorandum of Agreement
MOU	Memoranda of Understanding
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
OCRM	Office of Coastal Resource Management
OMWM	Open Marsh Water Management
PN	Public Notice
RHA	Rivers and Harbors Act
SAMP	Special Area Management Plan
USC	United States Code
WRA	Water Resources Administration

APPENDIX 4

LIST OF UNIT ABBREVIATIONS

cfs	cubic feet per second
ft	feet
ft^2	square feet
mi	mile
mi^2	square mile
p/mi^2	people per square mile
ppt	parts per thousand

APPENDIX 5

HABITAT FUNCTION AND VALUE REFERENCES

HABITAT VALUE OR FUNCTION	HABITATS[a] E2EM5N	PEM1+E2EM1 + PEM2+E2EM2	E1RF2	E1AB	E2EM5P	PFO+PSS + EFO+ESS	E2FL	E1UB	PEM5 + E2EM5	RIPARIAN HABITAT
HIGH PRIMARY PRODUCTION	18,21,29,30, 33,40,49,50, 52,53,56,69	18,33,57,63, 75	3	17,18, 21,33, 70	35,40	23	61,77	21,29 33,56	50	
FISH AND SHELLFISH HABITAT	11,26,52,53, 62,69,71,73	57	3	15,17, 38,70	6,54,67, 68,74		15,61, 77	26,73		
WILDLIFE HABITAT	5,8,10,12, 52,66,69	5,8,10,12,28, 44,45,57,66	3	47,70	5,8,10, 54	5,28,45	5,8,10, 46,61, 66,67	5,8,10		16
POLLUTION ABATEMENT	9,27,34, 37,72	9,14,27,43, 57,64,65			54		7			16,19,32
NUTRIENT CYCLING	2,9,20, 22,37,41, 42,53,69	9,51,57, 64,65	3	4,70	2,13,39	23	61,77			16,32,48 59,76
DETRITAL SOURCE	24,36,42, 49,50,53, 55,60,62	31,57	3	70	30				50	
EROSION CONTROL	1,25,53,69	1,25,57		70						
FLOOD CONTROL	53	57,58				58				16

[a] All habitats except "riparian habitat" identified according to the USFWS classification system (Cowardin et al., 1979).
E2EM5N = Estuarine regularly flooded persistent emergent (Spartina alterniflora dominant).
PEM1+E2EM1+PEM2+E2EM2 = Palustrine and estuarine persistent and non-persistent emergent (species including Peltandra, Pontederia, Sagittaria, Typha).
E1RF2 = Estuarine subtidal oyster reef.
E1AB = Estuarine subtidal aquatic bed (species including Ruppia, Vallisneria, Myriophyllum, Potamogeton, Hydrilla).
E2EM5P = Estuarine irregularly flooded persistent emergent (S. patens dominant).
PFO+PSS+EFO+ESS = Palustrine and estuarine forested and scrub-shrub (species including Acer, Iva, Alnus, Pinus).
E2F1 = Estuarine intertidal unconsolidated flat (includes both mud- and sandflat).
E1UB = Estuarine subtidal unconsolidated bottom/open water.
PEM5+E2EM5 = Palustrine and estuarine persistent emergent (Phragmites australis dominant).
Riparian habitat = transitional wetlands dominated by facultative wetland plant species (species including Cyperus, Impatiens, Rhus, Iris,).

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