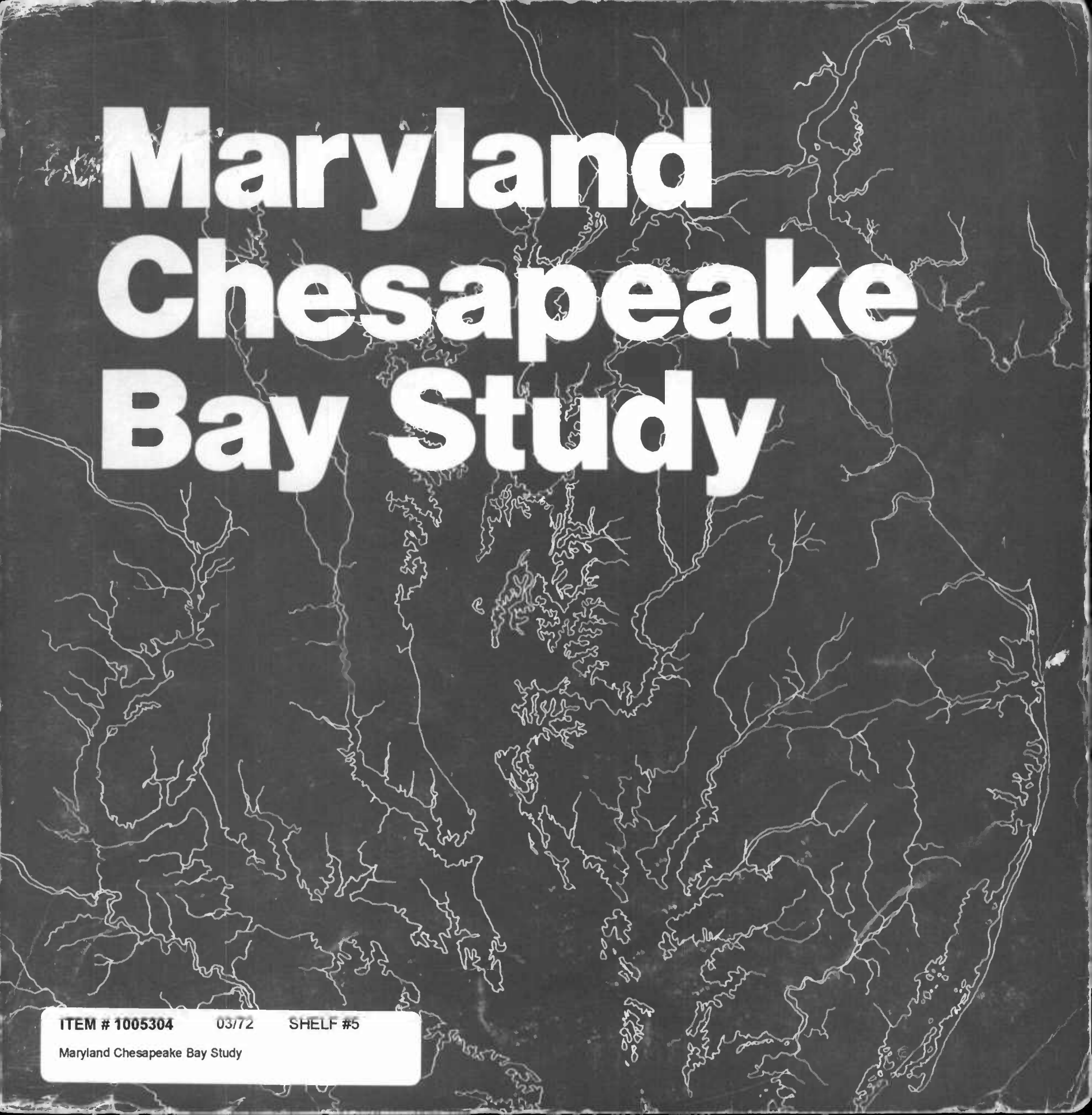
Maryland Chesapeake Bay Study



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Maryland Chesapeake Bay Study

Maryland Chesapeake Bay Study

Wallace
McHarg
Roberts
& Todd

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A Report to the
Maryland Department of State Planning and
The Chesapeake Bay Interagency Planning Committee

Maryland Chesapeake Bay Study

For comments see pp 140, 141, 142, 143, 148

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Comprehensive Planning Assistance Project
No. Md. P–87

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March 20, 1972

Hon. Marvin Mandel
Governor of Maryland
State House
Annapolis, Maryland 21404

Dear Governor Mandel:

The Chesapeake Bay Interagency Planning Committee (CBIPC) was established at your request in 1969 with the expressed purpose of responding to the Statewide concern for the future of Maryland's greatest natural resource - the Chesapeake Bay. The Committee was created to reflect the public concern for the immense economic, environmental, and social values inherent in the Chesapeake Bay. The Bay's natural resources must be studied comprehensively to enable the optimization of land and water-related impacts for the promulgation of policies for balanced use. Only through comprehensive management planning at the State level will Marylanders have continued enjoyment and utilization of the Chesapeake Bay's natural resources.

In 1970 CBIPC enlisted the services of the planning consultant firm of Wallace, McHarg, Roberts, and Todd to study the Maryland portion of the Chesapeake Bay and prepare a comprehensive inventory of the present and anticipated problems plagueing the Bay. Included in the document are recommended goals, policies, and management institutions which would most effectively respond to the Bay problems. This effort was initiated with the aid of a Comprehensive Planning Assistance Program grant by the Federal Department of Housing and Urban Development.

I am pleased to transmit the technical report entitled "Maryland Chesapeake Bay Study" to you, the General Assembly, and citizens of Maryland for reaction. The consultant's findings as reported to the Committee stress the necessary elements in defining a comprehensive Baywide plan and the mechanism for achieving this end. This report does not necessarily reflect a consensus of the Committee, but will be the primary input for further deliberations. Following, under separate cover, will be a "Popularized Summary" which abbreviates the contents of the technical document to afford extensive public distribution. Based upon CBIPC deliberations and statewide reaction, the Committee will shortly be preparing a special report to you recommending the procedures for implementation of the Chesapeake Bay program.

The numerous documents and references utilized are summarized in the "Maryland Chesapeake Bay Study." The document includes the following areas: (1) description of present Bay management systems; (2) problem area definition; (3) identification of goals and objectives; (4) rationalization of information systems; (5) relationship between conservation and utilization objectives; (6) establishment and analysis of alternative institutions for Bay management; (7) establishment of necessary elements of comprehensive Bay plan; and comprises nearly 1,000 pages of text. This endeavor reflects a two-year effort and represents the first comprehensive Maryland Chesapeake Bay inventory of natural resources and economic development problems with suggested mechanisms for management planning.

Sincerely,

Vladimir Wahbe

Vladimir A. Wahbe, Chairman
Secretary, Department of State Planning

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Special Assistance

Specialized support was provided by the following agencies:

Department of State Planning
Department of Natural Resources
State Highway Administration
Maryland Port Administration
Department of Economic and Community Development
Regional Planning Council
Maryland Soil Conservation Service
Johns Hopkins University

Table of Contents

PREFACE i

SUMMARY CONCLUSIONS AND PLAN OF REPORT iii

I. INTRODUCTION: WHAT IS THE BAY? 1
Introduction: What is the Bay? 3
Who Owns the Bay? 9
Viewpoints about the Bay 11

II. PROBLEMS AND GOALS: BY PROBLEM CATEGORY 13
Introduction 15
A. Living Resources of the Bay 25
B. Conservation of Wetlands 40
C. Water Movement 50
D. Shore Erosion and Sedimentation 62
Da. Shore Erosion 64
Db. Sedimentation Problems 73
E. Water Pollution 84
F. Water Supply 106
G. Thermal Waste Discharges 129
H. Marine Transportation Problems 140
I. Water-Related Outdoor Recreation 152
J. Waterfront Industry 163
K. Waterfront Residential Development 178
L. Solid Waste Disposal 187
M. Public Access to and Appearance and Design of Shoreline 197
N. Non-Living Resources - Sand and Gravel 203
O. Information and Information Retrieval 210
P. Synthesis and Planning Problems 215
Q. Public Awareness and Involvement 220
R. Tools for Implementation 225
S. Management Capability 229
T. Fiscal Support 233

III. PROBLEMS AND GOALS: BY PLANNING AREAS 235
A. Relative Importance of Present Problems by Planning Area 238
B. Maryland Chesapeake Bay Problems in the Context of the Bay's Watershed and the North Atlantic Region 250
C. Emerging Issues by Geographic Location and Planning Area 252
D. Population Change, Economic Trends, and Urban Land Absorption Impacts, by Planning Area 255
E. Plans as Goal Statements 266

IV. CURRENT MANAGEMENT AND MANAGEMENT GOALS 277
Introduction 280
A. Federal Bay Management 281
B. Federal-State Bay Management 286
C. State Bay Management 287
D. Intrastate Bay Management 296
E. "Local" Bay Management 297
F. Non-Governmental Bay Management 298
G. Maryland State Mandates as Chesapeake Bay Goal Statements 299

V. CRITERIA AND ORGANIZATIONAL ALTERNATIVES FOR BAY RESOURCE MANAGEMENT 304
A. Is Government Adequately Organized for Bay Resource Management? 306
B. Organizational Alternatives for Bay Resource Management 309

VI. MAJOR ELEMENTS OF A COMPREHENSIVE PLAN FOR THE CHESAPEAKE BAY 317
A. Why Maryland State Government Should Take the Lead in Planning for the Bay 319
B. General Nature of the Comprehensive Plan 320
C. Summary Outline of Major Elements 321
D. Component Plan Description 322
E. Steps for Plan Preparation 328
F. Summary of Elements of a Comprehensive Plan for the Chesapeake Bay 329

VII. WHO SHOULD PREPARE A COMPREHENSIVE PLAN FOR THE CHESAPEAKE BAY? 332
A. Criteria for Bay Planning 334
B. Organizational Alternatives for Comprehensive Plan Preparation 335
C. Formation, Organization and Powers of a Temporary Chesapeake Bay Commission 337
D. Summary of Recommendations 341

APPENDIX A: MANAGEMENT AND PLANNING APPROACHES TO CONFLICT RESOLUTION 344
Introduction 347
A. Day-to-Day Bay Management: Reactive Frameworks 348
B. An Information and Information Retrieval Strategy: Preactive Frameworks 352
C. System Modeling and Planning: Adaptive Frameworks 374
D. Implementation Tools 385

APPENDIX B: BIBLIOGRAPHY AND GRAPHIC REFERENCE 391

PLATE 1: Urban Context, Maryland Chesapeake Bay Study

Preface

In February 1969, Governor Mandel directed the formation of the Chesapeake Bay Interagency Planning Committee (CBIPC) and asked the Secretary of State Planning to prepare a program by which the State could fulfill its "major responsibility for insuring that the threat to one of Maryland's major assets is met on a timely basis and its related resources are planned, developed, and managed in such a way as to meet the needs of present and future generations."

The Chesapeake Bay Interagency Planning Committee and Work Accomplished to Date

The following steps were initiated to fulfill the Governor's directive:

1. Two working committees were assembled:

a. Secretary level committee composed of 10 (now consolidated to 5) State agencies with resource management and general development interests concerning the Bay to serve as the policy and governing board.

b. Staff committee composed of designees of the Secretaries to serve as a technical work group.

2. A Work Program was developed and adopted.

3. Inventory and issue analysis work elements were initiated by the various Departments.

The Role of This Study

In June 1970, Wallace, McHarg, Roberts and Todd were retained to supplement and summarize the work of relevant Department staffs, and to serve as an extension and staff of the CBIPC through a contract with the Department of State Planning. WMRT's work was organized in seven tasks in accord with the general Work Program:

Task 1. Description of the Bay System and of Present State Bay Management Program.

Task 2. Problem and Planning Area Definition.

Task 3. Identification of Goals and Objectives.

Task 4. Rationalization of Information System.

Task 5. Development of Relation Between Conservation of the Bay's Resources and Resource Utilization Objectives.

Task 6. Establishment and Analysis of Implications of Alternate Policies and Programs.

Task 7. Establishment of Necessary Elements of a Comprehensive Plan for the Bay.

Credits for This Report

Many people have contributed to the preparation of this Report, most notably Mr. Robert Tribukait, Mr. Roy Metzgar and Dr. Albert R. Miller of the Maryland Department of State Planning; Mr. John R. Capper of the Maryland Department of Natural Resources; Dr. Robert M. Sparks and Mr. James A. McComas, Jr. of the Maryland Department of Economic and Community Development; and Mr. Henry T. Douglas of the Maryland Port Administration.

Special thanks are due to Mr. Paul R. Farragut of the Maryland Department of Natural Resources for supplying valuable reports and references. Others who contributed by supplying information are Mr. Art Benjamin, Mr. Richard Tucker, Mrs. David Nutter, Mr. W. L. Etzler, and Mr. Edwin L. Thomas of the Maryland Department of State Planning; Mr. T. Wallace Beaulieu of the Maryland State Roads Administration; Miss Martha Kaufman of the Maryland Department of Natural Resources; Mr. Jack Anderson and Mr. Al Katz of the Regional Planning Council, Baltimore, Maryland.

Persons outside of State government who have provided valuable contributions include Dr. L. Eugene Cronin of the University of Maryland, Natural Resources Institute; Dr. Roland F. Beers, Jr. of the Johns Hopkins University Chesapeake Bay Institute; and Mr. Charles Hancock of the Maryland Soil Conservation Service.

Dr. David A. Wallace and James Williams have been in principal charge. Additional staff include Richard Nalbandian, Michael Clarke, Hans-Harald Grote, Carolyn Jones, Felicity Hannay, and Anthwaun Burke. This document was typed by Margaret Dewey and Nancy Chavis.

PLATE 2: Physiographic Context, Maryland Chesapeake Bay Study

Summary Conclusions and Objectives of the Report

The "Maryland Chesapeake Bay Study" is a background document for major State decisions with regard to planning for the Chesapeake Bay. The Bay and special feelings and emotions regarding the Bay have always been a part of the mental make-up of Marylanders. Like other Americans, Marylanders note with dismay the increasing capacity of modern industrial society to degrade the vastest natural resource. In particular, Marylanders are aware of the increasing, often conflicting, demands being made on the waters and shoreline of the Bay. There is thus a widely felt need for a conscious, comprehensive plan for Bay management -- a plan which would spell out State policy regarding current and future use of the Bay, considering both the complete range of demands that will be made on the Bay, and the capacity of the resource to meet the demands. Such a plan would show how continued, and if possible increasing, use of Bay resources can be made; how the uses can provide economic livelihood, personal enjoyment, and necessary urban functions; and how the uses of Bay resources can be made while ensuring the preservation of the Bay's essential and unique qualities.

Summary Conclusions

1. A Comprehensive Bay Plan is Needed

Though in recent years there have been many excellent initiatives in Bay resource management, there is no comprehensive plan expressing coordinated public policy for the use of the Bay. Though a major effort is involved, it is possible to develop such a plan. Further, the time is ripe for the preparation of a comprehensive plan for the Bay - both because the comprehensive plan is needed to provide a coordinating framework for current and future resource planning, and because of increasing public concern for the future of the Bay.

2. Nature of a Comprehensive Plan for the Bay

The plan should be "comprehensive" in several ways:

- the planning area should include the entire Maryland portion of the Chesapeake Bay.
- the plan should be for both Bay waters and related shoreline land.
- the plan should consider the impact of and interrelationship among the broad range of Bay uses and functions.
- the plan should express both conservation and development objectives.
- the plan should include and set in motion processes for its implementation.
- the plan should establish processes for its continual refinement and upgrading.

3. Maryland Should Take The Lead

Maryland State Government should take the lead in developing the comprehensive plan. It should do this with the cooperation of Federal and local agencies. The way should be left open for subsequent integration with planning for the Virginia portion of the Chesapeake Bay and for the Susquehanna and Potomac River Basins (by the Susquehanna and Potomac River Basin Compacts).

4. A Temporary Maryland Chesapeake Bay Commission Should Be Responsible

The responsibility for preparing the comprehensive plan should be given to a special Temporary Commission which would be approved by the General Assembly, accountable to the Governor and visible to the public. The planning period would be three years.

Objectives of the Maryland Chesapeake Bay Study

In order to provide a basis for State decision regarding the preparation of a comprehensive plan for the Bay, the Maryland Chesapeake Bay Study sought to provide three products:

1. Product one is an outline of current and anticipated problems and goals for the Bay. The goals define the problems, and the problems are projected into the future to understand the basic conflicts between resource conservation, resource utilization and resource despoliation.

2. The second product is a review of existing and developing methods for dealing with issues which arise in resource management.

3. Product three is a "plan for a plan" -- a general design for and outline of steps necessary to the preparation of a Comprehensive Plan for the Chesapeake Bay.

This report includes all three products.

Abstract of the Report

The Report begins with a consideration, in Chapter I, of the seemingly simple question, "What is the Bay?" The Bay is variously defined in terms of its functions and characteristics, its physical boundaries, its uses, vested interests in it, viewpoints towards it, and the conventional legal rights to its real estate and resources.

Chapter II is an extensive review of Bay problems and goals. The review relies to a large extent on recent and current work by various agencies (especially State agencies) and little of the material will be new to persons familiar with the Bay. Several aspects of the review should help to set the stage for comprehensive planning for the Bay:

- Twenty Bay management problem categories are identified and each is considered in terms of a consistent discussion format.
- The discussion synthesizes material produced by many governmental and non-governmental agencies.
- The discussion of each problem category attempts to achieve a Bay-wide perspective. The discussion of each problem category begins with an attempt to define the problem in terms of its unique characteristics, its underlying causes, its manifestation at particular locations and times, and its relationship to various groups in society. The second part of the discussion is a "structural speculation" on the future dimensions of the problem, in which forces which would tend to increase or reduce the problem are identified, quantified where possible, and synthesized into a statement of future outlook. The third part of the discussion is a consideration of preliminary goals, objectives, standards and policies as guides for Bay resource management. (The last six of the twenty problem categories discussed in Chapter II focus directly on management; they are only introduced and are considered further in later chapters.)

Chapter II attempts to achieve a Bay-wide perspective on twenty resource management problem categories. Chapter III attempts to retain this perspective -- yet at the same time to recognize the locational variation in the type, mix and intensity of resource management problems, and to do this for a consistent set of Bay planning sub-areas. On the basis of the Chapter II review, Chapter III presents a matrix of the relative significance of existing and emerging resource management problems in counties adjacent to the Bay. A third matrix is developed to place Bay management problems in the perspective of larger geographic contexts. Since the major underlying causes of resource management problems can often be traced to demographic and economic trends and patterns in the several counties, these are presented in Chapter III along with a discussion of their linkages with re-

source management. The demographic and economic data are used at various points in Chapter II as a starting point in describing the future dimensions of resource management problems stemming from liquid and solid waste generation, electricity demands, outdoor recreation demands, etc. One implication of demographic and economic trends which is not considered in Chapter II is land consumption by urban development; preliminary estimates on a county by county basis are presented here. Goals as well as problems have a locational dimension; the concluding section of Chapter III presents several plans as locational expressions of planning goals.

In Chapters IV and V, the focus of the Report shifts from resource management problems to management itself and its dimensions at both policy and staff levels. Chapter IV describes the array of current agency responsibilities and missions relating to Bay resource management. The review considers public agencies from the Federal to the local level as well as certain non-governmental agencies. Special note, however, is made of the mandates of State agencies, which are viewed as preliminary goals for Bay management.

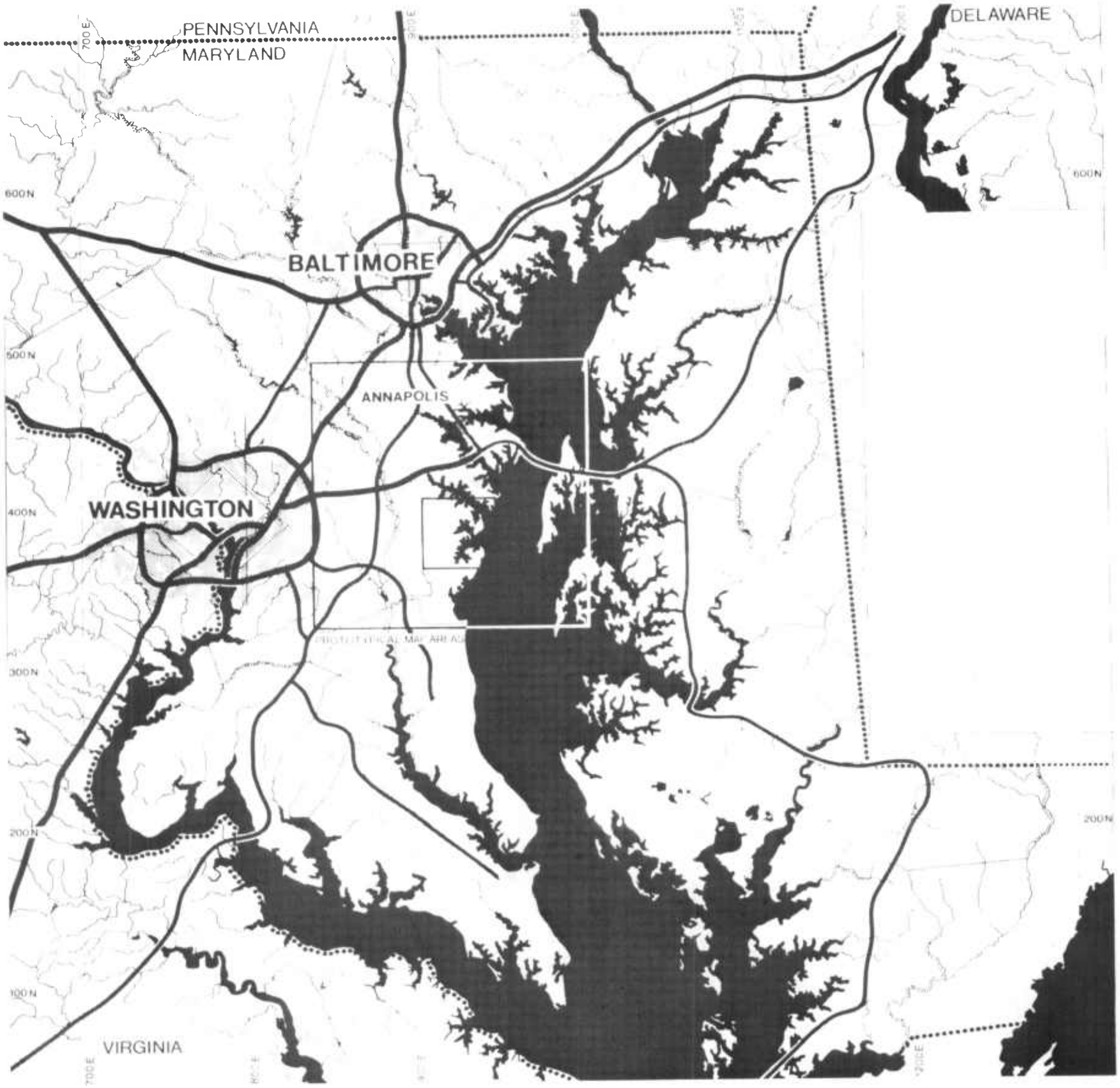
Organizational alternatives for resource management are reviewed in Chapter V. The conclusion, however, is that the recent reorganization of Maryland State Government has satisfactorily established the operational authority and responsibility of various agencies in Bay management. Criteria for integrating long-range planning with day-to-day management and for coordinating management at various governmental levels are discussed and placed in the context of the evolution of thinking on resource management in Maryland in the past decade.

The final two chapters present the planning and management conclusions of the Maryland Chesapeake Bay Study. Chapter VI presents a "plan for a plan". The nature of a Comprehensive Plan for the Chesapeake Bay is described in terms of major planning elements and their sub-components. Steps toward the preparation of the Plan are presented, along with a three year schedule for its preparation.

Based on the Plan description in Chapter VI, Chapter VII addresses the question of how the resources of State Government should be applied to this job. Organizational criteria and alternatives for preparing the plan are presented. Based on these, a Temporary Commission for the preparation of the plan is proposed and its powers, responsibilities and operational procedures are discussed.

In the appendix, the focus shifts from the policy to the staff level of public agencies concerned with resource management. The appendix describes resource planning and management techniques which are either available but not widely applied, under development, or proposed. The techniques have various purposes in application to resource management: to improve agency ability to respond to resource management problems on a day-to-day basis, to anticipate problems so as to be better prepared to resolve them, to communicate the results of professional planning efforts to interested lay persons, to achieve more comprehensive understanding of the dynamics of the Bay system and the interaction of Bay elements and processes.

PLATE 3: Study Area, Maryland Chesapeake Bay Study



I

Introduction: What is the Bay?

I. INTRODUCTION: WHAT IS THE BAY?

INTRODUCTION: WHAT IS THE BAY? 3

Geomorphology 3
Areas and Shoreline 4
Water Movement 5
Shore Erosion and Sedimentation 6
Wildlife 6
Wetlands 6
Water 7
Waterfront Industry 8
Waterfront Residences 8
Recreation 9

WHO OWNS THE BAY? 9

The Public Domain 9
The Private Domain 10
Public Regulation 10

VIEWPOINTS ABOUT THE BAY 11

Introduction: What Is the Bay?

In this chapter, the discussion of Chesapeake Bay management is introduced by a consideration of the question "What is the Bay?" How can the Bay and its resources be defined? Four kinds of answers are outlined in this chapter. First, the Bay is defined in terms of its functions and characteristics. Second, an attempt is made to define the Bay in terms of its boundaries. Third, the Bay can be defined in terms of the conventional legal rights of competing parties to its real estate and resources. Finally, the Bay is defined by its uses, the viewpoints various kinds of people have of it and the vested interests of various groups in it. Following chapters in the report discuss the problems and goals which must be addressed by Bay management, and approaches to improved Bay management.

Plates 1 and 2 place the Maryland Chesapeake Bay Area in its regional urban and physiographic context. The Maryland Bay area is adjacent to the megalopolitan corridor which extends from Boston to Norfolk (Plate 1). Physiographically, the Chesapeake Bay lies in the coastal plain along the Atlantic Seaboard and is part of a drainage basin which includes much of Maryland, Delaware and Pennsylvania as well as portions of New York, Virginia and West Virginia (Plate 2). Plate 3 shows the Maryland Chesapeake Bay Area in greater detail.

How can the Bay and its resources be defined? Four kinds of answers are possible. The Bay can be defined by its functions and characteristics, its boundaries, and in terms of the legal rights to its real estate and resources. Finally, the Bay can be defined by its uses, the viewpoints various kinds of people have of it and the vested interests of various groups in it.

Geomorphology

Land forms are created geologically through erosion and deposition. In this area these processes are generally associated with flowing water, such as rain run-off or ocean waves. All of Maryland's Eastern Shore Counties lie within the Coastal Plain Province which is composed of erodible gravel, sand, silt and clay. The Coastal Plain formations trend northeast - southwest and dip southeastward at less than 1°. The oldest Coastal Plain formations crop out along the western edge of the Coastal Plain along a boundary called the Fall Line. The Piedmont Province, whose rolling hills are underlaid by crystalline rocks, occurs west of the Fall Line. At the Atlantic Ocean, the crystalline rocks are buried beneath over 8,000 feet of unconsolidated sediments; in other words, the Coastal Plain formations form a wedge progressively thickening southeastward. Eastward, the outcropping formations become progressively younger. Cretaceous and Tertiary formations are often covered by a veneer of much younger sediments deposited during the Pleistocene epoch.

Eighteen thousand years ago, or about the same time man came to this continent, a great glacier slowly sliding southward extended over much of the northeast coast above the 40th parallel. It was beginning to thaw and grow thinner; the climate was warming in these regions. But the edge, sparkling in the sun, hung over the head waters of the Susquehanna

River and as it thawed, huge amounts of debris flowed into the river and down to the sea.

The sea was lower then; probably about 400 feet lower than today, and the continent larger, but as the snow and ice that had come originally from the oceans in the form of water vapor returned to it in icy lumps and flowing streams, the sea began to fill and the tides swept up the rivers and splashed over the land, crumbling it away a few feet a century. The shoreline today is some 80 miles west of where it was then and a far different land; there were mammoths on it in prehistoric times; the bones of mammoths, sloths, moose and musk oxen have been dredged far out on what we now call the submarine continental shelf.

During these times, the Susquehanna flowed through what is now Maryland as a non-tidal river in a deep, wide gorge about 100 feet deep and 1,000 feet wide, to the sea. The present wetlands of Dorchester and Somerset were upland areas then, scores of feet above the river level. Streams such as the Wicomico and Choptank which now drain wetlands, were non-tidal rivers and what is now the main shipping channel of the Bay was the ancestral Susquehanna River bed before the sea rose and drowned it.

The Chesapeake Bay is the sea-drowned river system of the Susquehanna River and its tributaries. It was born of flood and is still prone to it -- created from a mix of fresh and salt water and still dependent on it and shaped and re-shaped by erosion that still eats away at the shoreline of the rivers, the coast and the islands.

"The Chesapeake Bay is the largest estuary on the Atlantic Coast of the United States. An estuary has been defined as a semi-enclosed coastal body of water which has a free connection with the open sea and within which sea water is measurably diluted with fresh water derived from land drainage. Estuaries may be grouped according to their geomorphological character, and the Chesapeake Bay falls into a group called coastal plain, or drowned river valley estuaries. According to one system of sub-classification of this group, the Bay, as well as the major tributaries to the Bay, are called partially mixed estuaries. This is because the salinity distribution, while showing an increase with depth, indicating the estuary is not completely mixed vertically, does show a sharp boundary separating an upper, low salinity layer from an intruding wedge-shaped bottom layer of high salinity, which is characteristic of a class of estuaries having small tidal currents, and which are called salt wedge estuaries. The Chesapeake Bay thus represents an intermediate stage in the possible sequence of estuarine types, a stage which is in fact characteristic of the large majority of coastal plain estuaries." (Ref. 3)

Areas and Shoreline

As the sea rose, the Valley and its tributaries filled with sandy river alluvium. Later -- much later, as estuarine conditions developed, sedimentation changed to finer grained silts and clays which were supplemented along the margins of the Bay by redistributed sand eroding from the shoreline; these deposits contain fossil oyster shells and, in some cases, peat derived from near shore tidal marshes. Continued deposition has reduced its depth to a maximum of 95 feet below sea level at Kent Island and 60 feet below sea level at Havre de Grace. Shore erosion has modified the estuary, causing its present shape to differ in detail from the configuration of the submerged river system.

Current data from the U.S. Coast and Geodatic Survey suggest that since 1933, sea level has risen 0.5 feet. However, since 1962, a downward trend has been observed, although it may be only "momentary" in a geologic sense.

If the sea level rise should resume

at the 1933-62 rate, which is about 0.017 feet per year, many acres of Dorchester and Somerset Counties will be under water by year 2000. Residents of Dorchester and Somerset Counties are uncomfortably aware of this process.

Maryland's portion of the tidal Chesapeake Bay system has an area of 2,475 square miles. The Bay proper, excluding all tributaries, has a center line length of 125 miles and covers 1,310 square miles. The tributaries, sounds, bays and creek systems account for 1,165 square miles. River areas tabulated below account for 825 square miles.

Western Shore	Square Miles
Susquehanna River	6
Bush River	12
Gunpowder-Bird River	22
Back River	10
Patapsco River & Creeks	28
Magothy River & Creeks	9
Severn River	17
South River & Creeks	8
Patuxent River & Creeks	48
plus St. Mary's & Wicomico Rivers	304
Wicomico River	17
St. Mary's River	10
TOTAL	491
Eastern Shore	
Elk River & Bohemia River	20
Sassafras River & Creeks	11
Chester River & Creeks	63
Miles River & Creeks	14
Choptank River & Creeks & Trippe Bay	130
Nanticoke River	24
Wicomico River	13
Manokin River	25
Big Annemessex River	10
Pocomoke Sound	24
TOTAL	334

The length of Maryland's Chesapeake Bay shoreline, approximately 3,950 miles, is one of the State's greatest assets. Because tidewater Maryland is experiencing erosion of these shores, there is increased concern over loss of property and the high cost of protective structures.

The center line length of Maryland's Chesapeake Bay is 125 miles, but if one were to traverse the outline of the Bay proper, one would travel 154 miles on the Western Shore and 125 miles along the Eastern shore, a total of 280 miles. The rivers constitute 54 percent of the Bay tidal shoreline. Shoreline of the Bay proper, islands, and other small rivers of the Bay represent 46 percent of the total shoreline length.

Water Movement

Motion and mixing of the water is essential to the Bay's health and vital to the flora, fish and bacteria that live within it, upon it. It provides natural stress, natural bounty. The mixture of salt and fresh water that certain species depend upon in the Bay is in turn dependent upon the movement of the tides, the flow of fresh water and the winds and breezes rippling along the water's surface. Storms aggravate the normal motion and mixing, so do obstructions placed casually or purposefully by man. Both, separately and together, bring about changes in the oxygen content, the salinity mix, and the capability of the water as a waste treatment facility in the immediate area and affect the water quality, the salinity and the usefulness of the whole Bay to a degree related to the size, placement and importance of their occurrence.

Storms we know to be costly. But major obstructions of the free circulation of water or denial of the necessary fresh water inflow to the Bay can also be extremely costly in terms of money, the degradation of the environment, and human health and enjoyment. The needs of fish and wildlife and the demands of the pollu-

tion assimilation function of the Bay are fulfilled by: the oxygen dissolved in the water; the flushing action of tidal and non-tidal water movement; and the variable salinity of the water.

Shore Erosion and Sedimentation

Enormous loads of sediment are carried into the Bay, clogging up shipping channels, mucking up harbors, and destroying marinas. Meanwhile, valuable shoreline, precious topsoil, chunks of wetland, and acres of real estate are lost.

Half of the action is called erosion, the other half sedimentation. But they present one problem; how to control the continuing transformation of earth into silt. The battle is on-going and costly and Maryland must fight on a Bay-wide basis as well as in each estuary and river.

Wildlife

Game and fish were so plentiful in Maryland in early years that oysters were sold by the gallon and terrapins by the dozen. About fifty years ago, the supply began noticeably to dwindle; and it is not simply that the human population is increasing. There are fewer ducks, turtle and oysters to go around; it was an actual decline.

Sportsmen generally have been blamed for these declines in nature's bounty: duck shooters, fishermen and crabbers, as well as oystermen, were for many years held solely responsible, charged with reckless plundering of the Bay's waters and its surrounding meadows and woods. State control, through boards of natural resources, began early in Maryland, but the decline continued until recently. Today, Maryland spends millions of dollars annually protecting the area's wildlife, its fish, fowl, and game. New research suggests that while sportsmen and commercial fishermen -- especially the oystermen -- may often be justly accused of practices deleterious to the game supply; the chief reason for the long-term decline was lack of understanding of the needs of the Bay's creatures in combination with diffused, complex patterns of depredation by all users of Chesapeake Bay, its tributary rivers, and its drainage area.

Simply protecting the wildlife supply is not enough. The wildlife is only a by-product of the ecosystem of the Bay. Man -- sometimes actively, often passively -- adds to the natural stresses and strains of this ecosystem in two major ways. One, in not recognizing that the food he most enjoys is dependent itself on food which he does not respect, he abuses the food web with pollutants and pesticides. Two, not recognizing that as well as being an eater off the food chain, he also contributes to it with his wastes, often overfertilizing it.

Wetlands

Along the borders of the tidal rivers, and along the shallow sea coast where the drowned rivers are invisible, are the wetlands. They are of enormous importance as spawning grounds for fish, as habitats for wildlife, and all but irreplacable as "sponges" in flood control and erosion protection.

Twice daily the tide flushes slowly through these extraordinarily fertile areas; twice a year in spring and fall, the fresh water from the river floods in to mix with the salty sea water and refresh them. Marsh grasses transform carbon dioxide into oxygen, housecleaning the air, water and soil alike for fish, fowl, man and beast. At the same time they provide food and shelter to a great variety of aquatic and aerolife.

Baltimore Harbor's wetlands were destroyed more than a century ago; earlier visitors described this spot where the Patapsco River and Bay meet as teem-

ing with wildlife, echoing with the sound of geese and the song of innumerable birds. The Bay adjusted to this loss of its wetlands, but its capacity to adjust to continued aggregated losses is not unlimited.

Less obvious, less dramatic losses occur daily. Fresh water diversions deprive some wetlands of needed nutrients carried by the water as well as denying the water itself; heavy loads of sediment from city streets, agriculture, deforestation and suburban land development smother others; still others are overfertilized by inadequately treated human sewage; careless industrial, residential or government developers unnecessarily fill, dike or dredge a wetland area.

All parts of the Bay's ecosystem are important to its functioning but because of their oxygen and food producing capabilities, the wetlands play a key role. Because of their vulnerability, their protection is of the utmost importance.

Water

Water quality is different things from different points of view. For drinking, man wants water that is free of color, taste and odor, preferably cool, relatively soft, and free of pathogenic bacteria.

Industry needs water of a different quality. Generally, for manufacturing power plant cooling and steam production, good water quality means an absence of chlorides, iron and manganese, and of dissolved gases. Industry can still find a lot of water that is useful to it, but access to it is often difficult.

The agriculturalist requires still a different quality of water. An absence of chlorides and selenium is important and the presence of minimum concentrations of boron and iron is useful.

Wildlife, finfish, shellfish, plant and mammals require still another kind of water quality, which, with one exception, only can be described as variable. All wildlife needs dissolved oxygen in their water, just as man does, but some like salt water and some fresh, some half and half. Some can take turbulent water and some can't as an environment, and some can drink water with larger amounts of pathogenic bacteria in it than man can and some can't.

Movement is essential to the supply of water; nature ceaselessly recycles it, flushing through the enormous planetary ecosystem of which such ecosystems as the Chesapeake Bay are only microscopic parts. When water moves during the process of recycling by either nature or man or wildlife, its quality changes. As it moves naturally across the surface of the earth as rain or river it collects bacteria and soil particles and interacts with other elements. When it is pumped into plumbing or industrial works, it collects wastes, dirt, and cleansing agents. As the sea tides push it first forward and then back, foreign matter is pushed and pulled into it, such as driftwood, oil, rocks, and soil. Nature pollutes the water even as man does, but nature has her own way of cleansing it too. As water is recycled or tided over, the foreign matter which cannot be liquified is deposited out of the area of movement in the bottom soil or sand, or floated on the surface in the area of greatest movement until it is tossed out. Liquified foreign matter is handled differently; it is recycled with the water and as it mingles with the greater body of water, of which it has become a part, it is diluted. While Maryland is fortunate in having a great body of salt sea and fresh water running through its very heart, the vastness and assimilative capacity of Bay waters can no longer be taken for granted.

Even though there is plenty of rain, many watersheds, many aquifers, and many aquifer recharge areas, there is increasing concern over the provision of water to meet growing urban demands. Steadily, day by day, more water is being

used for more purposes. Technology is a great consumer of water; it uses it to generate power, to make heat and to cool, as well as to wash with and to dilute things with. And the technological way of life is expanding in Maryland as agricultural life declines. The relationships between industrial use and residential use, between water from wells, from water supply systems and run-of-the-river intakes have generally only been estimated, not calculated. Maryland watersheds aren't managed as entities; the minute water flows across a boundary line it belongs to the water system that lies in that county or state -- and whether it gets there via pipe or creek, no one has cared. But there simply is not enough water to go around indefinitely. Maryland has the water management "apparatus", but as demand grows rapidly, major new steps are necessary to protect her water resources.

Waterfront Industry

Many industries have to be near ports and others have to be near the Bay. The first are port related, the second water related. Some in each group are completely dependent upon their proximity to port or Bay, others only partially. Because industry and ecological health are rarely compatible and because Maryland needs both to thrive, priorities must be set to determine what industries may build where and under what conditions.

The problem is further complicated by the fact that land suitable or available for industrial use is getting scarcer by the day.

The significance of the dwindling shoreline is just beginning to be recognized as a public problem. All metropolitan regions in the United States, as well as abroad, face population growth and mounting demands for recreational, industrial, and residential use of their shrinking supply of waterfront land. Industry's increasing dependence upon foreign raw materials, and improved shipping technology emphasize the need for deep-water industrial sites in port regions.

The Baltimore region, where most of the land appropriate for industry is situated, is faced with the prospect of a doubled population by the year 2000. It must enhance the Port and its related industries to support this population; it must also keep the Bay thriving to feed it.

Waterfront Residences

Maryland has a great resource for recreation and vacation communities along the shores of the Bay itself and on the banks of its tidal estuaries. Marylanders, like other Americans, yearn for vacation homes they can get away to easily and maintain simply. Now easier transportation, shorter work weeks and increasing longevity combined with advanced bulding technologies have spurred the growth of planned vacation communities centered on waterfront land some distance from work centers.

Currently, Maryland's Bay residential shorefront is occupied chiefly by holders of large acreage, about a third of which was bought and built upon thirty years ago or more when conditions were quite different and the demand for shore land quite limited. Pressed now by rising property taxes, lack of help, and a decline in agricultural values, these estates can be expected to sell off at least parts of their properties in the near future and may relinquish large tracts. There is also acreage owned by the federal government as military areas that could be developed as residential communities.

The Bay is a great (although vulnerable) resource for waterfront residential development, especially along the Eastern Shore, where large estates may be subdivided up in the near future.

Recreation

When people speak of the recreational value of Chesapeake Bay, they usually are thinking of it as a great sporting ground, a place to shoot duck, fish for bass, sail a small boat, go crabbing. Recreational value today is also economic value at base; supplying the sport, the relaxation and the entertainment to meet the demand of an increasing number of people has become a growth industry. The areas booming in the second half of the twentieth century are not the manufacturing towns and cities, but the resort areas.

Advancing technology created this new industry: the shorter work week due to increasing mechanization, the clumping of holidays due to the greater speed of long distance transportation, the visions (via television) of countless people at ease, the affluence which supports social security for the retired, and the medical research that documents man's needs for play as well as work all have helped make the recreation industry what it is today. And although the felt need is to get away from industry, to escape from technological pressures, usually technology carries the vacationer into nature in the shape of a camper with a trailer and speed boat and shelters him in an air cooled, prefabbed lodging fortified by synthetic material.

Maryland's policy to date has been to encourage outdoor recreational demand but it has done little to facilitate access to the Bay. With regional management and initiative, the Bay is capable of providing greater recreational opportunity for many more Marylanders than it currently does. Recreation on and around the Bay is in general compatible and even supportive of environmental values, provided constraints are put upon overcrowding, litter and waste discharges. This in combination with its growing economic significance, make outdoor recreation a major Bay resource potential.

Who Owns the Bay?

A major portion of Garrett Power's study of "The Chesapeake Bay in Legal Perspective" is devoted to a review of what the law says and does not say regarding the following questions: "Who owns the shoreline and bed of the Bay? What special rights does the law give to private owners of land abutting the Bay? What rights does the law give all private individuals in Bay resources? What are the constitutional and territorial limitations on the regulatory powers of...Maryland and the United States?" (Ref. 2)

In response to changes in viewpoint and uses of the Bay, the law attempts to define the Bay in terms that will be acceptable to contending persons and interests. Thus, the legal approach to definition of the Bay is an evolving rather than a static one and Mr. Power's discussion considers the evolution of the legal definition of the Bay from colonial times. The following paragraphs excerptportions of Power's concluding sections on the public domain, the private domain and public regulatory power in the Bay which have particular relevance to the State of Maryland.

The Public Domain

There is "a neat allocation of the tidewater public domain of the Chesapeake Bay...between...Maryland and the United States." Within its borders, Maryland owns "all inland navigable waters, organic materials which they support, and submerged lands under them." In Maryland, the public domain extends to mean high tide. "The United States ...owns the marginal sea and the land under it to mean low tide, but has granted all land and natural resources back to the states. Paramount to all

of these proprietary interests, however, is the power of the federal government to regulate commerce." However, the United States Supreme Court has recognized "the importance to its people that a State have power to preserve and regulate the exploitation of an important resource." (Ref. 2)

The Private Domain

"Although the Maryland portion of the Chesapeake Bay is nominally said to be owned by the [State] of Maryland..., private uses of Bay resources have been explained as exercises of private rights. Some private rights are said to have devolved upon private individuals as incidents of ownership of submerged land. These are justified by reference to some formal conveyance through which the state transferred its rights into private hands. Most private rights are said to be incident to ownership of land abutting the Bay waters. These are justified either as judicially evolved, or legislatively enacted, riparian rights, and may be effectively delimited by the lack of an effective nuisance remedy to enforce them. Finally, the private right to common fishery may be said to be a natural right. This is justified by reference to the verbal abstractions of archaic rhetoric." (Ref. 2)

Public Regulation

"Demands of the twentieth century have created pressures for more comprehensive regulation of all human conduct. Legal institutions have responded to these pressures on the Chesapeake Bay. Some new regulation has devolved from legislatures and courts, but the bulk of rule-making activity has shifted to the executive branch. Administrative agencies control offshore construction, land use, water use, waste disposal, shipping and the taking of fish and oysters. The role played by legislatures and courts is often limited. Legislatures pass statutes which have the substantive effect of delegating almost unfettered rule-making power to administrative bodies. Courts are presented with cases in a precedural context which presumes the correctness of prior administrative rulings.

"As is to be expected in a federal system, the allocation of regulatory power has been diffusive. Federal agencies have powers which relate, more or less, to the regulation of interstate commerce. Maryland...[has] plenary powers (except to the extent pre-empted by the federal government) but [has] delegated some regulatory activities, including the zoning function, to local governments. The Potomac River Fisheries Compact creates an interstate repository for regulatory power, and the ...federal-interstate (compact for the Susquehanna River Basin and that proposed for the Poto ac River Basin) create the possibility of others.

"Federal and state courts have imposed some limitations on regulatory activity. Most of these limitations have been premised upon provisions of the United States and state constitutions. Although the United States Supreme Court has abdicated the role of a super-legislature passing upon the wisdom of regulation, state courts have continued to review regulation from a due process and equal protection perspective. Most significantly state courts have indicated a solicitude for private land owners and have on occasion required the state to pay compensation if it places onerous restrictions on the use of land." (Ref.2)

Viewpoints about the Bay

Each person or groups view the Bay differently, and from a perspective of personal interest and background. Dr. R. Lamar Green, in his address to the opening session of the Governor's Conference on Chesapeake Bay, posed the seemingly simple question, "What is the Bay?"(Ref.3) His answer was that there are many answers -- as many as there are different uses, vested interests and viewpoints regarding this vast and complex resource. "Our personalities, our backgrounds and our vested interests influence our definition of terms, our interpretation of information and our relation of proposed developments to the public interest. It is appropriate then to seek, not necessarily a common demoninator, but more specifically a mutual understanding of the interrelationships of our vested interests, responsibilities and the viewpoints which reflect our personalities."(Ref.3) Furthermore, according to this approach, new answers will become appropriate as new uses and viewpoints of the Bay resource evolve. Built into this definition of the Bay is the recognition that the definition will change. Dr. Green illustrates his approach to the definition of the Bay by arranging users, vested interests and viewpoints regarding the Bay against corresponding answers to the question "What is the Bay?" (Ref.3)

For the following users, vested interests and viewpoints	the Chesapeake Bay is...
the waterman	a source of shellfish and fin fish
fisheries biologists	the world's largest underwater farm
the recreationist	a place for sports, including boating, hunting, fishing, sailing, water skiing, swimming
sanitary engineers	a waste sink, an environment for disease vectors
power engineers	a heat sink
navigators	a water course
manufacturers	a water supply and waste disposal area
cartographers	22% of the total area of Maryland
the underseas research industry	a laboratory
developers	about 3,000 miles of shoreline
erosion control engineers	1,000 miles of problem shoreline
Tidewater Maryland Citizens	A STATE OF MIND

This list can easily (and indefinitely) be extended:

the conservationist	a preserve for marine and wildlife; an environment for certain aquatic species during critical life stages
the contractor	a source of construction materials (sand and gravel)
the industrial developer	Maryland's key feature for the attraction of heavy "basic" industry to the State
the hydrologist	a complex hydrological system, very different from fresh water systems
the urbanologist	a possible site for the construction of major offshore projects such as airports or residential or industrial developments.

Definition for CBIPC Study

For this Study purpose, the Bay was defined as the estuarine water area and direclty (water) related land within the State of Maryland while arbitrarily restricted, the definition served as a practical solution for the Study.

Footnotes

1. For instance, see the Official Highway Map of Maryland, 1970, prepared by the Maryland State Roads Commission.

2. The "upper reaches of high tide" is a boundary definition employed by the University Consortium to indicate the area of focus for research efforts. (See Ref.4)

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II

Problems and Goals: by Problem Categories

II. PROBLEMS AND GOALS

INTRODUCTION 15

1. Problem Category Definition and Classification 15
1.1 An Approach to Problem Definition 15
1.2 Alternative Approaches to Problem Description 16
1.3 Classification of Problems 16

2. Relating Conservation of the Bay Resource to Resource Utilization Objectives 17

3. Defining Goals and Objectives for Bay Management 18
3.1 The Importance and Usefulness of Bay Management Goals 18
3.2 Approaches to Goal Formulation 19
3.3 A Goal Classification System for the Chesapeake Bay 19
Figure 1: A Five-Level Goal Framework Example 21
3.4 Chesapeake Bay Goal Conflicts and Compatibilities 22
Figure 2: Chesapeake Bay Goal Conflict and Compatibility Matrix 22

Introduction

In this Chapter, twenty general categories (Sections A-T below) are used to describe and dimension problems and goals related to the Chesapeake Bay. The categories include problems and goals primarily associated with ecological, socio-economic or planning and management aspects of the Bay. However, Bay problems and goals are so interrelated and multi-faceted that no category is exclusively ecological or socio-economic; each has important ecological, social, economic, as well as planning and management dimensions. The problems have been identified by State and local agency staff, and by university scientists who have extensive acquaintance with the Bay. This chapter attempts a review of Bay management problems that is comprehensive in both subject matter and geographical scope, and consistent in approach. In each Section A-T below, a problem area is identified and described in a Bay-wide context, its possible future dimensions are examined, and goals and objectives useful in amelioration are posed.

1. Problem Category Definition and Classification

1.1 An Approach to Problem Definition

Any operational (measurable) definition of a problem involves a statement of a present situation measured against some desired state. The measure of the problem is then the gap between the existing and the desired state. In this definition, problems cannot exist without goals, and standards, however unarticulated these may be.

Social problems result when large groups of people sharing similar values (measures of what is important or ought to be) agree on gaps between what is and ought to be. However, while there may be widespread agreement on the statement of a problem, there may be little agreement on what to do about it. This is often because the values that define the problem are only a small portion of each individual's value system and every individual's internal decision process, as well as society's, involves trade-offs between competing values. People tend to apply different weights to specific values in each separate situation -- thus the industrialist may be for conservation of wildlife in his role as a sportsman, but in favor of filling marshes for industrial development. Because of the diverse individual and group value systems involved, and the resulting disagreements on how trade-offs between goals should be made, problems are difficult to define and quantify in ways that lend themselves to wide agreement among parties to their solution.

The dilemma is not just a semantic jungle, but is central to planning and management of the Bay's resources. The way out of the dilemma offered by the concept of planning as a way of problem solving by posing alternative choices (Ref. 1) is to commence with a search for commonly held goals, to place values on these goals, and then to propose those courses of action that most nearly satisfy the goals. Although intellectually rigorous, this method tends to be of limited usefulness when such abstract conceptualizing is put into the "market place" of actual choices. A more effective way out of the dilemma is to offer real choices and find out the net aggregate effect of individual and social goals by the resulting decisions.

To be socially responsible, such a "market place" process must be assured of a political mechanism that is equitable to all parties at interest. Sufficient information on who is affected must also be available. Finally equity is not the only issue. Full knowledge widely under-

stood of the implications of man's acts on the ecosystem becomes an imperative for environmental survival.

The crux of the environmental problem is that we are dealing to a large extent in "externalities". That is to say, the negative effects of actions that satisfy goals held by one group are largely external to that group's value system and are experienced by others, usually removed in time. Part of the evaluation problem is how to get the causes and real effects of environmental change into the same benefit-cost accounting system.

In sum, problems do not exist in abstraction from goals and values of people. On the other hand, people cannot formulate goals and make value trade-offs in abstraction from full information on "what the problem is" and on the consequences of different choices or solutions.

1.2 Alternative Approaches to Problem Description

There are at least two possible approaches to the description of Bay problems and goals. One approach would start with basic causes of socio-economic change and trace their effects to impacts on the Bay resource. This approach would start with population and economic development patterns and trends. There would then be an attempt to predict the future spectrum of development which would relate to the Bay resource directly or indirectly -- and to do this in terms of volume, distribution and density. It would then be necessary, based on an understanding of the Bay resource itself, to predict the impacts of this development on the Bay resource. Finally, it would be necessary to study the array of public policy responses (including land use controls, Bay use regulations, waste disposal and water supply services) and to predict their impacts on the development expected to relate to the Bay or on the impacts of this development on the Bay resource.

Another approach would start with identifiable current Bay management problems for which evidence can be found now, at particular locations, and in relation to particular political and public policy contexts. Having identified the Bay management problem, and classified it for purposes of discussion, the next step would be to describe the environmental effects associated with the problem and to trace the problem area back to its complex of causes, identifying key variables which will determine future dimensions of the problem. The effort to identify environmental effects and causal variables should assist in suggesting policy approaches which have potential to affect the problem as well as goals, objectives and standards that may guide the application of these policies.

The second approach is used to describe Bay management problems (in sub-section #1 of Sections A-T below). The guiding criterion for selecting problem categories is their direct relation to current conservation-development issues in Bay resource management. The focus is on the effects on the Bay resource. Underlying causes of these effects -- relating to population and economic development patterns and trends, and to societal attitudes with regard to resource utilization and preservation trade-offs -- are not considered to be Bay management problems in and of themselves. Population patterns, economic development trends and societal attitudes are the underlying causes of the total array of issues facing State government. Their repercussions do not necessarily impinge on the Bay resource. Therefore, in describing current Bay management problems, underlying causes are treated as a context (see Section III D), so that the discussion can focus more closely on current Bay management problems.

1.3 Classification of Problems

Sections A-T in this Chapter include

problems and goals primarily associated with ecological, socio-economic, or planning and management aspects of the Bay. Obviously the classification system is in many cases somewhat arbitrary, because of the interrelatedness of the problems. For example, commercial fishing has problems related solely to its organization, anachronistic practices and economics, yet is summarized under "primarily ecological factors" as a "living-resource problem" because that problem seems most central. Without the importance of the aquatic resource, there would be no related problems.

The major classification of problem headings is as follows:

Problems Related Principally to Ecological Factors

A. Living Resource Problems
B. Conservation of Wetlands
C. Water Movement
D. Shore Erosion and Sedimentation

It is evident that each of the above is an element of the others, but because of their importance in the ecosystem, they are dealt with separately. "Conservation of Wetlands" is a basic part of the living resource problem but is separated out for consideration because of its special importance. Poor water quality, however, is primarily a function of man's activity within the constraints of nature, and is, therefore, dealt with below.

Problems of Mixed Ecological and Socio-Economic Factors

E. Water Pollution
F. Water Supply

The class of problems is dominated by a mixture of factors with ecological and socio-economic "side effects". As will be seen throughout the discussion, achievement of "solutions" involves complicated "trade-offs" between goals.

Problems Related Primarily to Socio-Economic Factors

G. Thermal Waste Discharge
H. Marine Transportation
I. Water-Related Outdoor Recreation
J. Waterfront Industry
K. Waterfront Residential Development
L. Public Access to and Appearance and Design of the Shoreline
M. Solid Waste Disposal
N. Non-living Natural Resources

Problems of Inadequate Information, Information Retrieval, Synthesis, and Planning

O. Information and Information Retrieval
P. Synthesis and Planning Factors
Q. Public Awareness and Involvement

Problems of Management and Implementation

R. Tools for Implementation
S. Management Capability
T. Fiscal Support

2 Relating Conservation of the Bay Resource to Resource Utilization Objectives

Sub-section 1.2 above outlined two alternative approaches to the description of Bay problems. In order to describe current Bay management problems (Sub-sections "1" in Sections A-T below) it was found convenient to use an approach which focused initially on current conservation-development issues, and which viewed underlying causes as a context for the discussion. In order to examine the dimensions of emerging problems in Bay conservation and development, it is useful to employ the alternative approach outlined in sub-section 1.2 above which focuses initially on the underlying causes of various Bay management problems.

Sub-sections "2" of Sections A-T below are a series of structural speculations on the magnitude, nature, and location of future problems of Bay resource exploitation, utilization, conservation, and preservation.

The factors affecting the future dimension of Bay problems are of three main types:

Changing demands on Bay resources.

These may result from demographic aspects or socio-economic aspects within the Bay region, from events outside the Bay region (e.g. in Delaware Bay or the Virginia portion of the Chesapeake Bay), or from trends which result in greater or lesser demands on the Bay resource (e.g. mining sand and gravel from the Bay bottom because of resistance to such operations in metropolitan areas).

- Changing constraints on Bay resource supply. Resource supply has different appropriate measures for different uses: e.g. "assimilative capacity" for the ability of the Bay to accept certain types of liquid wastes; "acreage" when referring to potential residential land development or wetlands preservation; channel "depth" when the reference is to marine transportation; competitive position when referring to the attractiveness of various economic activities. Resource supply can be depleted not only by resource demands, but also by competing or conflicting uses.

- Alternative policy approaches and costs. These may be a function of changing objectives and standards, changing technology, changes in management approaches, better knowledge about functional interrelationships among Bay entities and processes, better funding sources, etc.

In dimensioning future Bay problems, the various factors identified are categorized according to whether they will tend to increase or reduce the problem(as described in sub-section 1 of Sections A-T). Increases or reductions come in many different terms: usage, monetary costs for meeting objectives; conflicts with other uses -- exacerbated or resolved; undesirable or desirable spillover effects, etc. In the summary section, a judgmental aggregation of all the factors is made in order to yield a dimensioning of future Bay problems.

It is not possible, starting with population and economic development patterns and the potential array of public policy initiatives, to describe in detail the future dimensions of Bay management problems. Available information on projections and trends often does not allow the linkage of underlying socio-economic causes and environmental effects, especially if one aspires to relate these effects to particular aspects of the Bay resource, at particular locations and at particular points in time. Furthermore, the effects of public policy interventions between underlying socio-economic causes and effects on the Bay resource are very difficult to identify and define -- even if it were possible to predict which public policy interventions would be chosen for implementation. As a result, the usefulness of the structured speculations is that they provide a framework for establishing goals, objectives and standards for evolving Bay management. This is the subject of sub-section "3" of Sections A-T, which is introduced below.

3 Defining Goals and Objectives for Bay Management

3.1 The Importance and Usefulness of Bay Management Goals

Increasing interdependence of people, and of the communities and governmental units that comprise the Bay region has made it clear that coordinated planning and management of resources is vital if natural resources are not to be despoliated beyond redemption. What is needed are clearly articulated goals, objectives, standards and policies, from the general to the specific, for resource conservation and utilization to match those usually adopted in traditional socio-economic planning. Such goals then can serve as the framework for plans, for action programs, and for the screening of alternative Bay proposals. A first attempt at a Bay-wide articulation of a goals hierarchy for the 20 Bay management

problem areas is presented in sub-section "3" of Sections A-T in this Chapter. As research, planning and management of the Bay progress and knowledge and understanding of problems and issues increase, it should become possible to define more detailed goals and policies as guides for action.

Part of the problem of goal formulation is that so many people are involved: people who live near the Bay; its present users, many of whom do not live near it, or even in Maryland; plus people who will use it in the future. Not only the State's but the National interest is involved. In fact, since so many people are involved, the method for goal formulation that seems most appropriate is a "pragmatic" one of suggesting a goal hierarchy oriented to the 20 Bay management problem areas. As these goals are articulated into detailed objectives, standards and policies, they can be examined by the "clients" through involvement in the planning process, then weighted and/or modified as appropriate and translated into action programs with necessary "trade-offs". This "pragmatic" method of goal formulation relies on an effective and equitable political and planning mechanism for goal aggregation.

Emphasis here is put on the Bay's natural resources and, therefore, the discussion that follows does not include consideration of human resources or economic resources. In later environmentalplanning efforts, these vital elements of total process of goal formulation must be given adequate expression.

Presently stated goals are preliminary, and it is expected that the goals presented below will be studied, added to, modified, and continuously revised during ensuing planning and management of the Bay's resources.

3.2 Approaches to Goal Formulation

In this Report, three approaches to goal formulation are used:

a. In sub-section 3 of Sections A-T below, a goal hierarchy for each Bay management problem area is attempted. The 20 Bay management problem areas are considered as areas of goal conflict. The description and future dimensions of each problem area are traced back to their relevant goal statements and rephrased as goals, objectives, standards and policies.

b. In Section III E below plans, as publicly or privately expressed, are considered as means towards goals. The combinations of goals which the plans embody (or fail to) can be presumed from the plans. Sample and relevant plans as "goal statements" are examined briefly to illustrate a next and geographic level of goals -- at the operational level and as expressions of how goals are currently integrated, aggregated, and in conflict or consonance.

c. Maryland State legislative mandates for relevant agencies and programs are expressions of public goals and financial commitments to resource conservation and utilization. These express both needs for resource development and utilization and needs for resource conservation. Such legislation and ultimate appropriation, policy, and action is that first level at which values in relation to goals are expressed; that is it demonstrates, albeit crudely, where society puts its money and emphasis. This process puts goals and values into the "market place", and the "net aggregation" that is evolved is the "resultant" of social and economic forces. Legislative mandates of State agencies which have key roles in Bay resource management are summarized in the Appendix of Chapter IV below.

3.3 A Goal Classification System for the Chesapeake Bay

Goals can be classified in hierarchy ascending (or descending) levels of generality. The highest order -- so called "motherhood" goals are at a level on which there is often widespread agreement. Such high level goals are the result of very broad values in society which are in turn

expressions of basic needs.

While "motherhood" goals are so general as not to be immediately useful in terms of guiding planning and management decisions, they serve as an organizing context for lower level goals. Such lower level goals are often called "means", to differentiate them from "ends", a distinction that serves the purpose of tracing their sequential relation. Thus, while one goal is a means to the achievement of a higher goal, it may in turn be an "end" for a lower "means".

The following are operational definitions of the five levels of the goal hierarchy.

a. Super Goals

At the highest goal level, man aspires to achieve a dynamically balanced and compatible relationship with himself, his environment, and natural processes of which he is a part. Much of what he does affects nature around him, often to his cost and long-term peril. The expanding field of ecology focuses on understanding natural processes and the interaction of human activity with them. Ecological planning takes the next step of planning the interaction to minimize negative and maximize positive benefits to man. A new psychology is evolving in which the concept of man as a conquerer of nature is rejected, and instead, he is seen as a fundamental part of nature's "seamless web". His goal is to achieve a best "fit" in a dynamic, self-governing and basically steady state ecosystem that is characterized by complexity, high amenity and productivity. (Ref. 1)

The essential idea is not of "conflict" or "control", but of accommodation and adaptation. A most important realization is that when man "pays attention" and adapts to his environment, he can achieve a more beautiful, creative and rewarding life.

At the highest level of generality, three goals are posited.[1]

Super Goal 1:

Resource Conservation -- Protect the Bay and the natural processes of its ecosystem for the greatest long-term benefit of all forms of life including man.

Super Goal 2:

Resource Utilization -- Utilize the Bay's resources to the highest potential for man with minimum of resource exploitation.

Super Goal 3:

Resource Management -- Create a unified research planning, coordinating and managing capability that can act as a wise steward of the Bay's resources and be truly responsive to the long-term public welfare.

These super goals are abbreviated in this report as (1) Conservation, (2) Utilization, and (3) Management. At this high level most people would agree with all three, although cautious men might say "how much" of each.

Even though the first two are quite obviously interrelated and compatible in many ways, they nevertheless contain inherent incompatibilities and conflicts. Sub-section 3.4 below deals with goal-conflicts as a way of defining problems in operational terms.

The three super goals can be thought of as a conceptual framework for the next four levels: general goals, objectives, standards, and policies. (See Figure 1.) These levels are proposed as a way of putting general statements into progressively specific operational terms. The purpose of doing this is to enable comparison between program and goal achievement and, at the standard and policy levels, the "trade-offs" or levels of goals and objectives that must be given up where goals are in conflict.

b. General Goals

General goals are statements of purpose, or of what ought to be, classified by general problem or aspiration areas. Full employment, decent, safe and sanitary housing in good neighborhoods, and a quality environment are examples. In the present case, the twenty Bay man-

FIGURE 1: A FIVE-LEVEL GOAL FRAMEWORK EXAMPLE

Level of Goal	Definition	Example
Super Goal:	A Super Goal is a highly generalized view of human values about what ought to be.	Protect the Bay and the natural processes of its ecosystem for the greatest long-term benefit of all forms of life including mankind.
General Goal:	A General Goal is a statement of purpose or of what ought to be in relation to a general problem area.	Maximize desirable and minimize undesirable effects of circulation of the Bay's waters.
Objective:	An Objective is all or part of a general goal stated in specific quantitative terms -- i.e., amounts and time -- and related to a course of action.	1.Eliminate negative impact and cost of tidal flooding and movement. 2.Protect necessary development within flood plain areas. 3.Avoid unnecessary development in flood plain areas.
Standard:	A Standard is an acknowledged measure of comparison for qualitative or quantitative value by which goal achievement can be measures.	1.Establish 50-year flood level as basic minimum limit of public responsibility. 2.Adopt a minimum benefit-cost ratio of 1:1 for determining value of flood control public works, benefits to include aesthetic and ecological elements.
Policy:	A Policy is a guiding principle for a course of action which will lead toward goal achievement.	1.Enact legislation which will progressively phase out uses not conforming to above. 2.Adopt land use and shoreline controls that minimize future conflicts.

agement problem areas (Sections A-T) form the basis for organizing general goals for the Chesapeake Bay.

Each goal is worded in such a way as to suggest its maximization regardless of consequences to or desirable and necessary trade-offs with other goals.

It is important to recognize that at this general level, the "clients" of the Chesapeake Bay hold many goals that are unrelated to the Bay (elimination of poverty, national security, etc.), but are very definitely relevant in terms of competition for attention, funds and goal aggregation. For we must be able to see in as specific terms as possible the effect of the achievement of one goal (e.g., waterfront industry) on another (e.g., water quality). Section V A considers a formal "environmental matrix" mechanism for the consideration of these interactions and potential goal conflicts.

One of the most important products of this study and of the subsequent work of the CBIPC is to bring goals for the Chesapeake forcefully into the overall goal "market place" by making the values that the Bay represents publicly recognized in a concrete way.

c. Objectives

An objective is defined as a part (or all) of a general goal stated in specific quantitative terms. Thus a general goal is to protect all wetlands, and an "objective" might be to bring into

state ownership or development control (easements, etc.) all wetlands. (This has now been accomplished.)

d. Standards

Standards are defined as acknowledged qualitative and/or quantitative measures of comparison for determining levels and rates of goal achievement, and the degree to which "what is" differs from "what ought to be". Water quality standards are set in very specific qualitative terms (oxygen content, etc.) in relation to the "objective" of reaching that level by a particular time. Even though standards are more static in concept than objectives, obviously standards, as expressions of values, also are subject to constant technical and social change, both up and down.

e. Policies

Policies are guiding principles for courses of action whose details become specific programs and plans. A state policy regarding wetlands would be: a. to develop criteria for determining the impact of all potential change on wetlands; b. to review all proposals for filling or adjacent land development in relation to the criteria; c. to approve only those proposals which substantially met the criteria and where the benefit-cost ratio exceeded 2:1. It is at the level of operating policies that priorities between goals are established and the "trade-offs" made.

Figure 1 gives an additional example of the goal framework to illustrate the varying level of specificity. A principal function of this approach is to translate general goals into quantitative terms so that methods such as PPBS[2] and Benefit-Cost accounting may be applied to the weighting of otherwise discrete goals.

3.4 Chesapeake Bay Goal Conflicts and Compatibilities

With the increasing tendency for agencies to expand their legislative mandates to include a concern for environmental impact, it is no longer accurate or useful to speak of interagency conflict in the historic sense. Those espousing industrial development do so with the expectation of necessary trade-offs. Conservationists are no longer "preservationists" -- against change per se.

This new climate gives urgency to the development of a more systematic and rigorous approach to goals and objectives than has existed before. More and more agencies at all levels of government are

FIGURE 2: CHESAPEAKE BAY GOAL CONFLICT AND COMPATIBILITY MATRIX

GOALS		A 1 Living Resources	A 2 Wetlands	A 3 Water Movement	A 4 Erosion-Sediment	B 1 Water Quality	B 2 Water Supply	C 1 Thermal Waste	C 2 Marine Transportation	C 3 Water Recreation	C 4 Waterfront Industry	C 5 Waterfront Residential	C 6 Solid Waste	C 7 Public Access	C 8 Non-Living Resources	D 1 Information	D 2 Planning	D 3 Public Awareness	E 1 Implementation	E 2 Management	E 3 Fiscal Support	
Living Resources	A 1	■	●	O	O	X		X	O	O	X	O	X	O	O		O					A 1
Wetlands	A 2	●	■	O	X	X	O	X	O	O	X	O	X	O	X		O					A 2
Water Movement	A 3	O	O	■	X	●	X	X		●		●	O	O	X		O					A 3
Erosion-Sediment	A 4	O	X	X	■	O	O		X	O	O	O		O			O					A 4
Water Quality	B 1	X	X	●	O	■	O	X	X	O	X	X	X	O	X		O					B 1
Water Supply	B 2		O	X	O	O	■	O		O	X	X	O	O			O					B 2
Thermal Waste	C 1	X	X	X		X	O	■		O	●	O		O			O					C 1
Marine Transportation	C 2	O	O		X	X			■	O	●			O			O					C 2
Water Recreation	C 3	O	O	●	O	O	O	O	O	■	X	O	O	●	O		O					C 3
Waterfront Industry	C 4	X	X		O	X	X	●	●	X	■	O		●	●		O					C 4
Waterfront Residential	C 5	O	O	●	O	X	X	O		O	O	■	X	●			O					C 5
Solid Waste	C 6	X	X	O		X	O			O		X	■									C 6
Public Access	C 7	O	O	O	O	O	O	O		●	●	●		■								C 7
Non-Living Resources	C 8	O	X	X		X			O	O	●				■							C 8
Information	D 1															■						D 1
Planning	D 2	O	O	O	O	O		O	O	O	O	O					■					D 2
Public Awareness	D 3																	■				D 3
Implementation	E 1																		■			E 1
Management	E 2																			■		E 2
Fiscal Support	E 3																				■	E 3
		A 1	A 2	A 3	A 4	B 1	B 2	C 1	C 2	C 3	C 4	C 5	C 6	C 7	C 8	D 1	D 2	D 3	E 1	E 2	E 3	

● Mutually Supportive O Minor Conflict

□ Compatible or Neutral X Likely Conflict

becoming multi-purpose in their approaches in response to the interdisciplinary and complex nature of problems faced.

Figure 2 shows the result of a first cut at evaluating the interactions between goals. At this stage, it is simply organized common sense. However, it suggests the direction that next steps should take in the tracing of the relationships between goals. At the level of objectives and policies, the interactions will become much more complex and the results of detailed research and analysis will be necessary to evaluate the degrees of conflict or mutual support.

These interactions can be translated into common units of input and output. Section V C of this Report outlines possible methodologies.

Footnotes

1. These, or variations on the same ideas, are found in most environmental plans and reports. See, for example, References 2 and 3. The North Atlantic Regional Water Resources Study (Ref.3) posits the three overall goals (objectives) as follows: "National Efficiency ...increasing the national income through investment in water resources. Regional Development places emphasis on the fulfillment of regional aspirtation...[and] Environmental Quality emphasizes those benefits that normally are not associated with the market place, such as visual enjoyment, cultural amenities, and wilderness preservation...[and] positive measures to create an improved living environment."

2. A Planning, Programming, Budgeting Systems approach translates inputs of money and personnel into outputs of programs so that different programs may be compared in the same accounting (or budgeting) system by decision makers.

References

1. Ehrlich, Dr. Paul R. and Harriman, Richard L., How to Be a Survivor, A Plan to Save Spaceship Earth, Ballantine Books, New York, 1971, Chapter II.

2. San Francisco Bay Plan, January, 1969, San Francisco Bay Conservation and Development Commission, p. 7.

3. North Atlantic Regional Water Resources Study, Brochure, No. 2, January, 1971, NARWRS Coordinating Committee, p. 3.

II. PROBLEMS AND GOALS

A. LIVING RESOURCES OF THE BAY 25

1. Living Resource Problems 25
1.1 Nature of the Problem 25
Table 1: Principal Kinds of Commercial Fish and Shellfish in Maryland 25
Table 2: Estimated Sportfishing Catches in Maryland 26
1.2 Causes of the Problem 27
1.3 Location of the Problem 30
1.4 Time Characteristics 30
Plate 4: Aquatic Habitats 31
Plate 5: Clam and Oyster Habitats 32
Plate 6: Striped Bass Habitats 33
1.5 Parties Affected 34

2. Future Dimensions of Living Resources Problems 35
2.1 Forces Tending to Increase the Problem 35
2.2 Forces Tending to Reduce the Problem 35
2.3 Summary - Future Outlook 36

3. Living Resources Goals, Objectives, Standards, Policies 36
3.1 Goal 36
3.2 Objectives 36
3.3 Standards 36
3.4 Policies 37

A
Living Resources of the Bay

1 Living Resource Problems

The problem is how to increase living resources commensurate with an ecosystem that is to be maintained in a state of dynamic equilibrium.

1.1 Nature of the Problem

The fish and wildlife of the Chesapeake Bay, its living resources, provide many benefits for the human population of the Bay region. The problem is the maintenance and enhancement of these benefits. The benefits include: a large source of high quality food with an enormous future potential productivity; recreational opportunities for thousands in the form of fishing, hunting, collecting and bird-watching; the concomitant economic gain to the commercial harvestors, processors, and sellers of the fish and shellfish, and to the facilities that service both commercial and recreational users such as boatyards, tackle makers and sellers, marinas, etc.; scientific knowledge about the complex ecology of Bay life and about the biology of individual species, which knowledge will have a direct beneficial feedback in helping to manage the resource; a unique educational resource for the citizens of the region, particularly the young; and the maintenance of a healthy, pleasing, and aesthetic environment.

a. The Amount of the Resource

Of these benefits among the most important, and certainly the easiest to quantify, are those provided by the large commercial fisheries of the Bay. Therefore, we may wish to redefine the problem as being "how to increase the yield of the living resources...to advance the goals of increased food supply and local economic development."(Ref.1) Unfortunately, for a wide variety of reasons this yield has not increased significantly and is constantly threatened.

The landed value of Maryland's commercial fisheries products was just under $17 million in 1967, and the value of Maryland's manufactured fisheries products in the same year was estimated at more than $40 million. About 9,000 fishermen (6,000 of them without other employment) harvested Maryland's seafoods in 1967, and about 6,500 boats were used to harvest and transport the catch. An average of about 4,350 people were employed by 285 wholesale and processing establishments.(Ref.2)

Table 1 lists the ten principal kinds of fish and shellfish landed by Maryland's commercial fisheries, their weights, estimated values, and rankings by both weight and value.

TABLE 1. PRINCIPAL KINDS OF COMMERCIAL FISH AND SHELLFISH IN MARYLAND LANDINGS IN 1967, BY WEIGHT AND ESTIMATED VALUE, AND THEIR RANKINGS

Rank by Wt.	Kind of Fish or Shellfish	Wt. in Millions of lbs.	Estimated Landed Value in Millions of Dollars	Rank by Value
1	Blue Crabs	26.791	2.448	2
2	Oysters	16.568	11.191	1
3	Clams	5.394	1.770	3
4	Menhaden	4.134	0.077	8
5	Striped Bass	4.072	0.665	4
6	Alewives	2.327	0.039	9
7	Swellfish	1.727	0.034	10
8	White Perch	1.199	0.168	5
9	Shad	0.884	0.091	7
10	Flounders	0.619	0.142	6
	Subtotals	63.715	16.625	
	GRAND TOTAL	79.946	16.913	

Source: Ref.3

It seems justifiable to cite the above mentioned manufactured fisheries products value of $40 million as the "real" value of the total catch rather than the landed value, because it more closely approximates a "market value" that would not exist at all without the fisheries resources (i.e., includes "Value Added by Manufacture").

b. The Value of the Resource for Recreation

It is much more difficult to estimate the value of Maryland's sportfishery, but we may attempt some sample calculations. Manning(Ref.2) says "but certainly its contribution to the economy of the State is many times that of the commercial finfisheries. An extensive creel census conducted in 1962 as a joint effort of the Chesapeake Biological Laboratory and the Department of Chesapeake Bay Affairs provides the basis for an estimate that sportfishermen probably catch more than twice as many striped bass as are taken by commercial fishermen." If we assume the sportfishing catch of blue crabs, white perch, shad, flouders to equal the commercial catch; that of clams, alewives and swellfish to be half the commercial catch; and that of striped bass to be double, then we arrive at the estimated sport catches by weight and value given in Table 2. (Sportfishing of oysters and menhaden is considered negligible).

TABLE 2. ESTIMATED SPORTFISHING CATCHES IN MARYLAND BY WEIGHT & VALUE

Kind of Fish or Shellfish	Wt. in Millions of Lbs.	Estimated Landed Value in Millions of Dollars (at Commercial Market Value)
Blue Crabs	26.8	2.45
Clams	2.7	0.9
Striped Bass	8.14	1.330
Alewives	1.16	0.02
Swellfish	0.86	0.017
White Perch	1.2	0.17
Shad	0.88	0.09
Flouders	0.62	0.14
TOTAL	42.36	5.117

In other words, the Bay now produces something on the order of 120 million pounds of fish and shellfish per year, with a total estimated landed value of about $22 million (Tables 1 and 2), and a "processed value" of about $45 million ($40 million being the commercial processed value and $5 million the sport fishing landed value).

If we assume that the resource value for recreation is also threatened not just by the availability of fish but also by the conditions of fishing, that six pounds of fish or shellfish represents a reasonable expected day's catch for a recreational fisherman(Ref.4) and that such a catch is thus equivalent to a user-day, we have 42 million pounds divided by six pounds or over 7 million user-days. If we further assume that a user-day is worth $20 in expenditures on gas, oil, launching fees, boat rentals, bait, tackle, food and beverages, we arrive at a figure of $140 million income from sportfishing aside from the $5 million estimated landed value of the catch itself. Although our sample calculations are rough, they seem to be of the right order of magnitude and we have then a total figure of about $185 million per year from the fisheries resources of the Bay. (The sum of all the major identifiable and quantifiable economic benefits associated with the living resources of Maryland's wetlands was conservatively estimated at $91.1 million annually by the Maryland Department of State Planning.(Ref.5)

c. The Value of the Capital Resource

However, it is of paramount importance to realize that the above figure is not really a "value", but rather represents only the estimated income "made from" the fisheries resource, which would be completely lost if the fisheries were destroyed. The capital needed to produce such an income (at 6% simple interest per year allowing for no capital growth whatsoever) would be about $3 billion. Even if we assume that this represents an income stream of $185 million per year to the year 2000, i.e., for 29 years, and find the discounted present value assuming an average interest rate of 6%, this fisheries value will be only a slightly more modest $2.5 billion. And this doesn't even begin to account for the value of the other living resources, such as birds and other animals, or for the other benefits mentioned above.

In the still more protein-hungry world of the not-too-distant future, perhaps a dollar value for the productivity of

the Bay's fisheries will not be as appropriate a measure of worth as the simple statement of the number of pounds of fish produced. To this end we might now make some speculative sample calculations as to future productivity of a couple of selected Bay fisheries.

1. The Special Case of Oysters

There are 326,000 acres of oyster bars in the Maryland portion of the Bay (Ref.2) However, 28,000 acres are closed because of pollution and only a "small percentage of the (remaining) bars are presently in production." (Ref.6) Therefore, if we assume that only 10% of the remaining 298,000 acres, i.e., 29,800 acres, produced the entire catch of 16,568,000 pounds, we get a productivity of about 550 pounds per acre per year. Now, experiments in South Carolina have produced over "1,800 pounds of oyster meats in a one-acre pond in one year." (Ref.7) Thus, it seems quite reasonable to assume that, with improved methods of both cultivation and harvest, the oyster crop could be boosted to 1,000 pounds per acre per year. Then, if the 28,000 closed acres were reopened by the elimination of pollution, and if only half of the total 326,000 acres were brought into production, this would mean an annual harvest of 163 million pounds of oyster meat, a tenfold increase in production over the 1967 harvest. That this is a reasonable projection is attested by the fact that in 1880 Maryland produced nearly 72 million pounds of oysters, and production did not fall below 20 million pounds until 1929. (Ref.3)

2. The Special Case of Clams

The estimated acreage of important hard clam habitat in the Maryland portion of the Bay is 100,000 acres, and that of the soft clam is about 150,000 acres, for a total of 250,000 acres. (Ref.5) Of this about 39,000 acres, or almost one-sixth, is closed because of pollution. If, using a similar line of reasoning to that used above for oysters, we assume the 39,000 closed acres reopened, half of the total acreage in production, and a yield of only 500 pounds of clams per acre per year, we arrive at a potential commercial harvest of 62.5 million pounds, an almost twelve-fold increase in total production over the 1967 yield.

1.2 Causes of the Problem

Why do the living resources of the Bay present a problem? Will it be difficult to "increase the yield...to increase the food supply and advance local economic development" because the resource is scarce? endangered by over-exploitation or by poor management? Three broad categories of causes may be recognized: (Ref.1)

a. Institutional constraints such as "a mass of restrictive legislation, much of it enacted in the belief that it would solve fishery problems and promote conservation, but which has the general effect of protecting special interest, spreading the catch over more people than are necessary to take it, and generally increasing the cost of catching fish without protecting the capacity of the resource to reproduce itself." (Ref.3) (For an excellent review of institutional constraints see Ref.8, pp.214-222).

b. Insufficient knowledge about the extent and recruitment rate of the various species harvested in the Bay makes it impossible to determine their sustained yield levels; not enough is known about the life cycles of many species, their interdependence, and their sensitivity to both natural environmental changes and man-made influences such as pesticides, thus making their effective management and protection impossible; and little of what is known is picked up and used practically by harvestors or regulators.

c. Environmental conditions, both natural and man-made, destroy fish and shellfish habitats or disrupt their life cycles. Natural hazards include storms, floods, too much or too little salinity, limited nutrient supply, sedimentation, predators and parasites. Man-made impacts include the destruction of habitat by diking and filling of wetlands, dredging and dump-

ing of spoils, diversion of fresh water inflows to the Bay, accelerated sedimentation because of agriculture and urban development, and domestic and industrial pollution of the Bay, particularly of prime shellfish habitats.

These causes may be illustrated better by discussing two of the more important catches of the Bay. Most of the causes discussed below are common to all the fisheries.

d. Problems of Oyster Fisheries: Institutional Constraints

"The reasons for failure to utilize the natural attributes of the Bay for oyster growing are social-political. Traditionally, the man who harvests a crop from the public grounds, usually by backbreaking hand labor, is opposed to private ownership. It is traditional in the Chesapeake, as in almost every fishing area in the United States, to want to divide the harvest among all who would wish to share it. Almost to a man, watermen in the Chesapeake see private ownership as a threat to their livelihood and way of life. They reason that Private leasing of oyster bottom will eventually place control of the industry in the hands of a few large operators."(Ref.3)

Thus, "public policy and fishery laws of the two States (Maryland and Virginia) effectively prevent maximum use of the Bay for growing oysters." (Ref.3) ...The inefficiencies which the Maryland and Virginia laws mandate for the Bay fishery are intentional and pervasive. They include limitations on the length of season, size limits, and type of gear. The seasonal limitations require that gear remain unused for part of the year. The size limitations require that substantial time be spent returning the undersized catch to the waters. The gear limitations require watermen to use archaic harvesting methods. While all of these limitations can be rationalized as conservation measures, because they are codified into law they limit the fishery managers' options in determining how the yield of the fishery can best be sustained.

"The basic discrimination found in the laws of both Maryland and Virginia are limitations which restrict the commercial taking of fish and shellfish to their respective residents. This restriction is modified by the Potomac River Fisheries Compact, which opens the estuarine portions of the Potomac to residents of both Maryland and Virginia. The discrimination is complemented by provisions of the Maryland Code which directly or indirectly prohibit corporations from engaging in commercial fishing.

"Under the Virginia Constitution and the Maryland statutes, natural oyster bars cannot be granted into private ownership...The absence of private rights in natural oyster bars tends to discourage the investment of capital and innovation in the oyster fishery."(Ref.8)

;Insufficient Knowledge

Fluctuations in the population are inadequately understood mainly in the sense that significant corrective and management steps are as yet unavailable. For instance, research is being conducted that is directed toward the development of MSX-resistant strains of seed oysters. The waste-assimilation capacities of the Bay and its tributaries are not known, nor are the incremental effects of departure from whatever the threshold may be.

;Environmental Conditions

"Maryland's tidal waters offer an environment favorable to the growth of oysters perhaps unmatched by any other estuary in the world. No justification can be found, however, for the extravagent claim that our capacity to produce oysters is 'unlimited'. The salinity range of Maryland's portion of Chesapeake Bay is such that we are without the starfish, one of the oyster's most effective predators, and are troubled by boring snails only in waters of the lower Eastern Shore. On the other hand, the oyster parasite Minchinia nelsoni (MSX), and Dermocystidium marinum, a marine fungus that probably kills more oysters in the United States than any other organism, are present in about one-

third of our waters and have caused extensive mortalities. The Upper Bay and the upper reaches of many of the tributaries are waters where salinities occasionally fall below the level necessary for survival of oysters, with resultant mass mortalities. The Bay is occasionally visited by hurricanes, and storms such as Hazel of 1954 cause extensive damage. Throughout all our shellfish-producing waters oysters must compete for space and food with vast numbers of other organisms, and are attacked by several species of predators."(Ref.2)

Heavy sedimentation, caused by floods or by human activities such as farming, logging, or urban development, may smother or abrade bottom-dwelling organisms such as oysters.

Pollution has contaminated and caused the closing of 28,000 acres of oyster bars in the Maryland portion of the Bay. Domestic sewage, chemical and metals processing plant wastes are the most important sources of such contamination. Not only do pathogenic organisms infest the oysters, but heavy metals such as lead, mercury, copper, and zinc may also be concentrated by the oyster. Furthermore, many of the pollutants consume oxygen as they decompose, and oxygen vitally needed by aquatic animals is depleted.

Dredging may be beneficial if it improves tidal flushing of an estuary, but on the other hand, it removes bottom-dwellers such as oysters, increases turbidity, and causes sedimentation.

Diversion and/or consumptive use of fresh water, such as that proposed for water from the Susquehanna or that caused by the deepening of the Chesapeake and Delaware Canal (see section on Water Supply), will cause changes in the ratio of salt to fresh water in large areas of the Bay. A reduction in the freshwater input of the Susquehanna will result in moving the limits of oyster growth farther up the Bay. However, the increased salinity in the lower Bay will also permit the up-Bay movement of the MSX parasite as well. Furthermore, the freshwater flow provides an ever-renewed source of nutrients, which helps to maintain the food supply of the oyster itself, as well as maintaining the foundations of the foodweb of which the oyster is a part.

Usually, one of the most important man-made environmental impacts is the outright destruction of shellfish habitat by diking and filling. However, Maryland is relatively fortunate in this respect, having lost only 1,000 of a total of 376,300 acres of important shoal water habitat in the whole State, including the Atlantic coast.(Ref.1)

e. <u>Problems of Striped Bass Fisheries</u>

<u>Institutional Constraints</u>:

The limitations on length of season, size limits, and type of gear discussed by Power(Ref.8) are particularly pertinent with respect to striped bass. According to McHugh (Ref.3), "occasionally large catches of striped bass are taken in winter with haul seines when the fish are relatively dormant in the deeper parts of the estuary. The sight of large numbers of these valuable fish being landed by commercial fishermen enrages sport fishermen, who see in such catches a threat to their recreation. The overall impact of such catches apparently has not been serious, judging by the present condition of the striped bass resource."

;<u>Environmental Conditions</u>

"The striped bass is anadromous, i.e., it lives most of its life in the sea but runs up river to spawn. It inhabits the Atlantic coast from the St. Lawrence River in Canada to the St. John's River, Florida, major streams of the Gulf of Mexico coast, and has been introduced on the Pacific coast, where it now ranges from the Columbia River to Northern Baja California. The center of distribution on the Atlantic coast is Chesapeake Bay and the North Carolina sounds. It is believed that most of the fish that migrate north to New England each summer were born in the tributaries of the Chesapeake. In their first year or two of life most fish apparently do not move out of the estuary.

Thus the quality of this environment is most important for survival. Striped bass, like most estuarine animals, are sensitive to environmental changes, and success of spawning varies widely from year to year."(Ref.3) Therefore, pollution or other forms of degradation of these estuarine environments may have a particularly harmful impact on the striped bass resource, not only of the Bay, but of the entire North Atlantic coastal zone.

1.3 Location of the Problem

a. Principal Habitats and Zones of Activity

Principal habitats of hardshell and softshell clams, oysters, blue crabs, and spawning areas of striped bass are shown on Plate 4. Also, an excellent series of maps was recently produced by the staff of the Chesapeake Biological Laboratory under the direction of Dr. L. Eugene Cronin. These display recent and reliable information on important habitats of various life-stages of all but two (menhaden and swellfish) of the ten principal kinds of fish and shellfish listed above, as well as many others not in the top ten (e.g.see Plates 5-10).

The location of some of the above-mentioned man-made environmental impacts on these important areas of concentration of living resources may be determined by comparing the above habitat maps to those maps and diagrams listed below:

Pl. 4 Aquatic Habitats(shows areas closed to shellfishing)
Pl.17 Surface Drainage Pattern and Public Surface Water Intakes
Pl.13 Wastewater Discharge
Fig.1 (Sec.II-E) Wastewater Discharge Diag.
Pl.14 Major Sewage Treatment Plants
Pl.15 Water Quality Problems
Pl.16 Public and Private Sources of Pollution
Pl.24 Shoreline Ownership and Major Use

(To determine the location of possible future problem areas, compare the habitat maps with maps such as Pl.30, Selected Major Proposals in Regional Infrastructure; Pl.29, State Development Pattern; Pl.32, Areas Identified for Industrial Development; or Pl.33, Wastewater Collection and Disposal Facilities - Existing to year 2000).

b. A Current Example of a Problem Area Location

Proposed Crisfield Industrial Park

An industrial park has been proposed at Crisfield, Somerset County, to be developed on 1,300 acres of lowland and wetlands that lie between the Big Annemessex and Little Annemessex Rivers. The Department of State Planning has "estimated that approximately 10,000 acres of wetlands would be endangered" (see fuller discussion under Section B. Conservation of Wetlands.) Comparison of maps showing both living resources/aquatic habitats and proposed locations of industrial activity presumably would reveal this as the location of a problem area in accordance with our operational definition as given above.

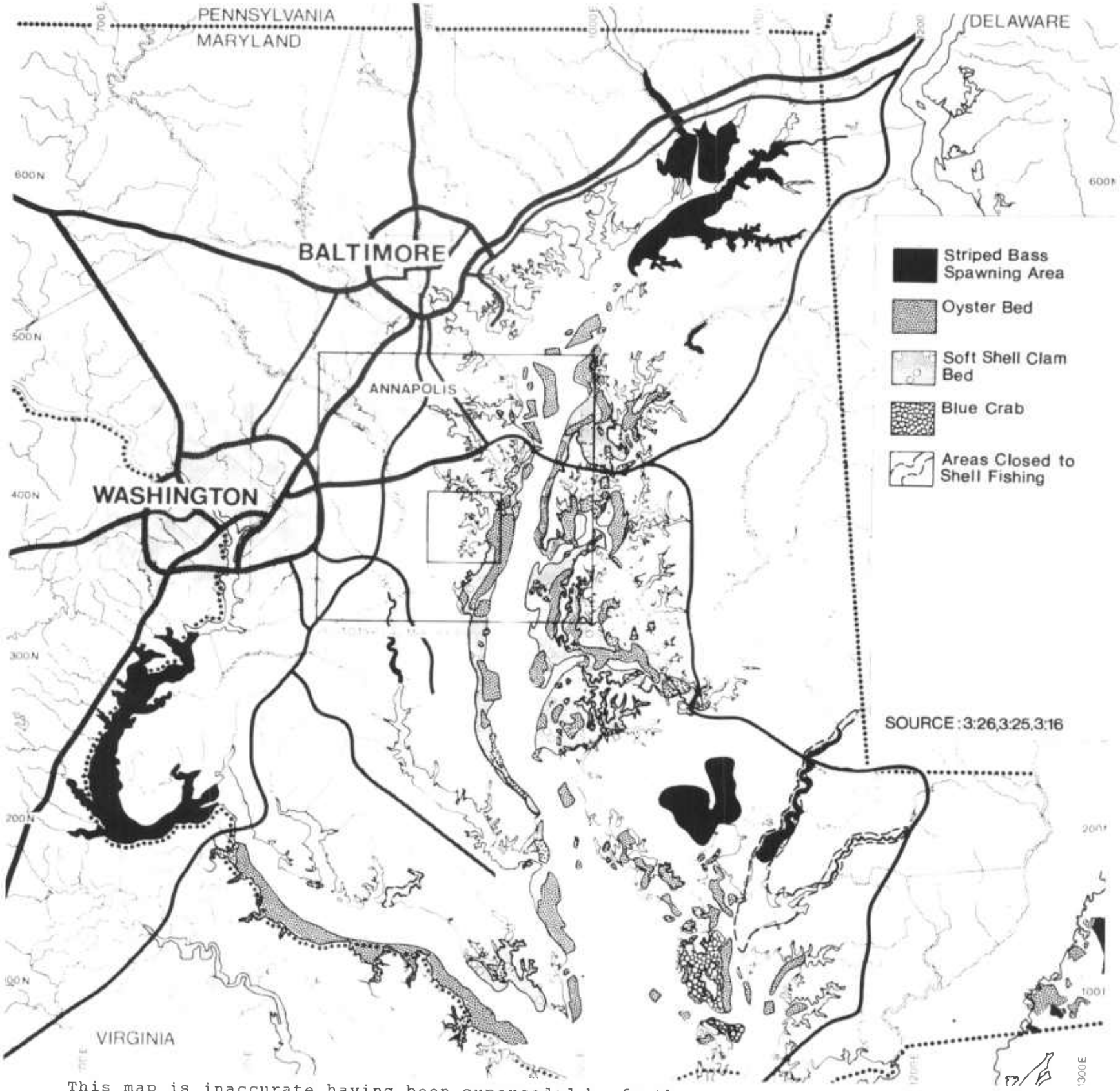
1.4 Time Characteristics

a. Long Term Characteristics of the Problem

"The rapidly expanding world population has a great need for new sources of animal protein, and many are looking to the sea as an important source. This drive is reflected in the increasing effort devoted to the harvesting of fish in recent years. Between 1948 and 1968 the world harvest more than tripled from 18 million to 64 million short tons. (In roughly the same period, 1945-1965, the total weight of Chesapeake bay landings increased from 152,250 to 295,750 short tons, or only slightly less than double). The domestic U.S. market for these products has also experienced a fairly steady increase with a record consumption at 8.7 million tons in 1968. A projection in that year showed a continually growing domestic market reaching some 15 million tons by the year 2000.

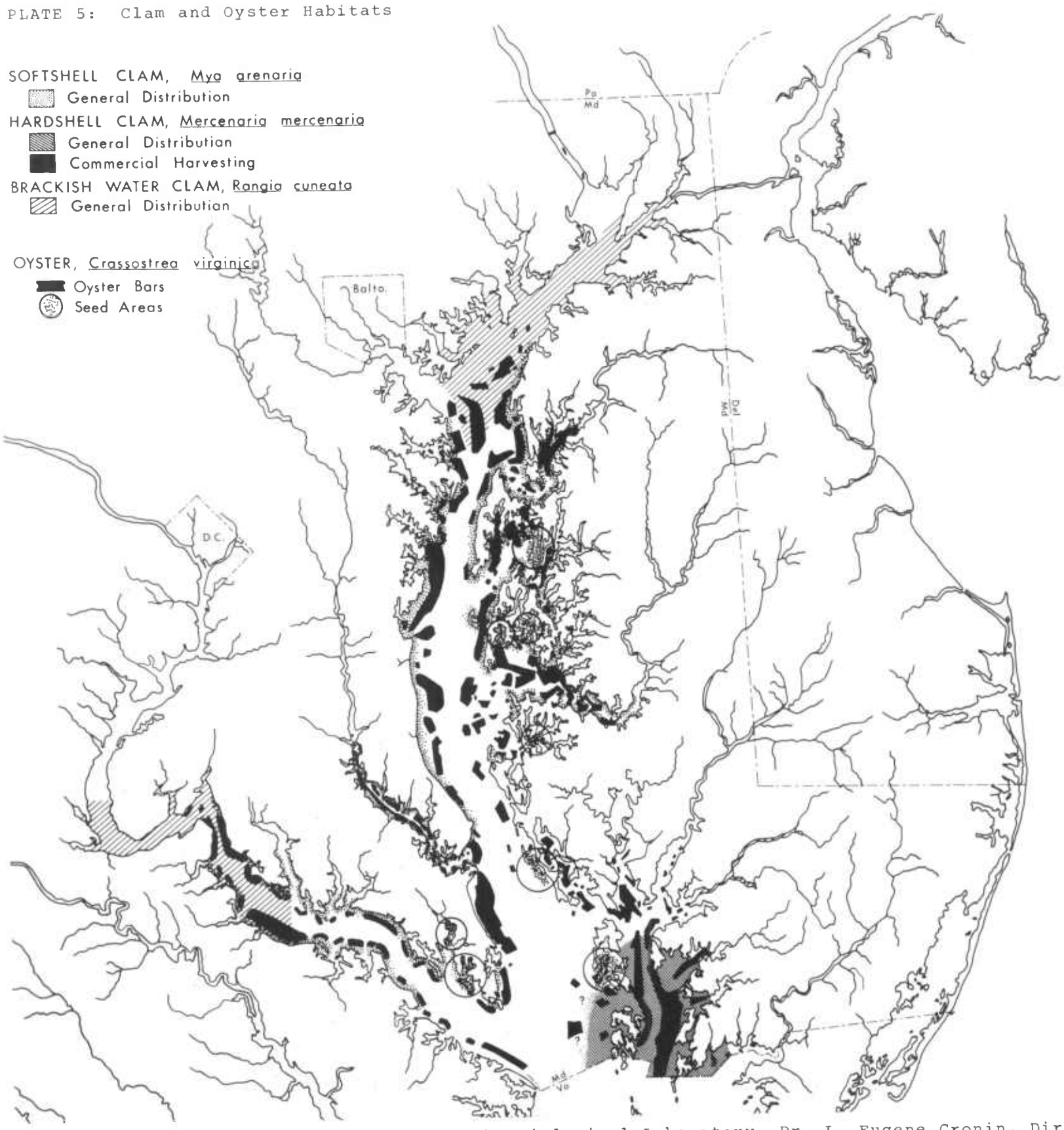
In contrast to this rising demand, the fishing industry in the United States has remained fairly static. The United

PLATE 4: Aquatic Habitats



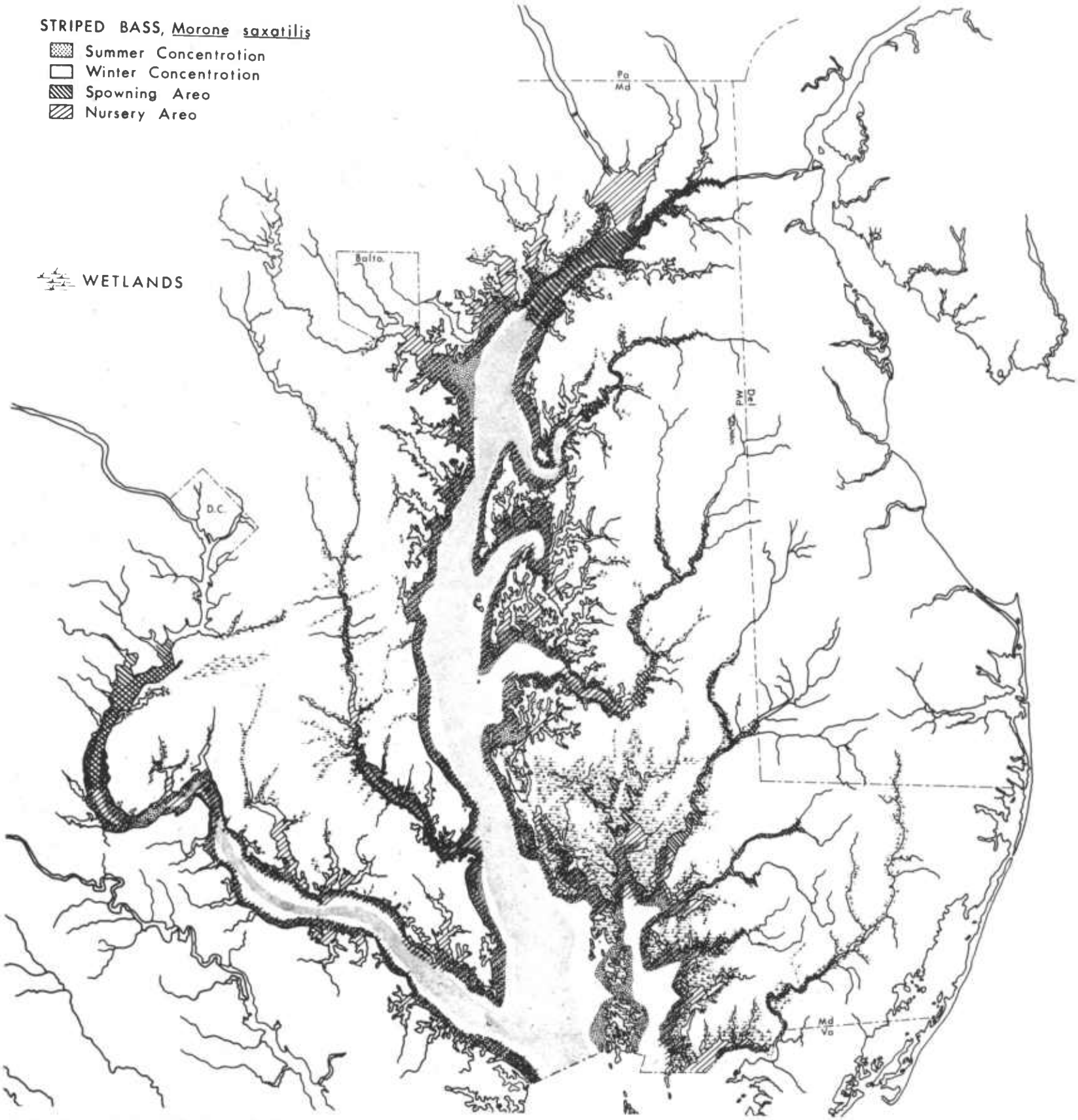
This map is inaccurate having been superceded by further research in many details and is displayed for generalized information only. The two maps following are accurate.

PLATE 5: Clam and Oyster Habitats



Source: University of Maryland, Chesapeake Biological Laboratory, Dr. L. Eugene Cronin, Dir.

PLATE 6: Striped Bass Habitats



Source: University of Maryland, Chesapeake Biological Laboratory, Dr. L. Eugene Cronin, Dir.

States has dropped from second to sixth place among the major fishing countries of the world since 1956. In 1968, it harvested only 3.8% of the world catch. In the 1959-69 period, the domestic catch varied between 2.0 and 2.7 million tons. The difference in domestic market and supply has been filled with an increasing number of imports which in 1968, a record year, totaled 6.6 million tons. Yet, it has been estimated that the known resources adjacent to the United States coast are capable of yielding 22 million tons per year on a sustained basis. These resources are currently being exploited to a great extent by other countries.

This inability of the fishing industry to expand to meet a growing demand in face of, at least in certain areas, extensive resources constitutes the nature of the problem. This phenomenon is even more pronounced in the North Atlantic Region than it is on the national level."(Ref.1)

From the foregoing, it may be seen that the Chesapeake Bay now provides more than one-tenth of the total U.S. catch. Yet there seems no reason to doubt that it could supply many times its present catch, perhaps even as much as the roughly seven-fold increase that would represent 10% of the estimated 22 million ton sustained yield of the U.S. coastal living resources.

Other long term considerations include the continuation of the current growth rate of the commercial fisheries (about $1.5 million per year), trends in capital investment in the industry, and the probable effects on Bay productivity of its gradual environmental degradation.

b. Short-Term Characteristics of the Problem

These comprise mainly of the seasonal aspects of the life cycles of the fisheries species and their influence on the abundance of the resource. For example, at various times of the year adult striped bass or perch are found in the deeper waters of the Bay. Thus, this determines the location in which they are hunted in winter. Also, decisions may be influenced that may have an environmental impact on their winter habitat, such as when to dredge or dump spoils, or location of a deepwater, offshore waste or sewage outfall.

Another example of a short term consideration would be that of how long a temporary environmental trauma might be allowed to exist before serious and irreparable damage to the resource resulted. For example, "it is critical to the upper Bay striped bass ecological needs that a wedge of fresh water remain between the Delaware Bay and the upper Chesapeake Bay (Elk River and the Chesapeake and Delaware Canal) during April and May. Salinity levels should stay below the upper range of 4-6 pp thousand for best survival conditions of eggs and fry during the low flow period (of the Susquehanna River)." (Ref.10) Thus, during a low flow period that lasted too long, it might be necessary to augment the stream flow by releases from upstream reservoirs. The Conowingo Dam is already required to release water whenever large numbers of fish are upstream and dissolved oxygen levels in the water below the dam fall below 5ppm.

1.5 Parties Affected

In addition to the consumer the parties most affected by the living resources problem are those who harvest and process the shellfish and finfish crop, including sportfishers. Others affected are suppliers and servicers of the harvestors, such as boatyards, marinas, tackle manufacturers and retailers. Also concerned are Bay fisheries scientists and managers. (Without the fisheries resource, there would be nothing to study or to manage, and without the scientists or managers, there might ultimately be no resource).

Hunters, bird-watchers, collectors, and just plain Bay-watchers are among those concerned with the other, non-fisheries, living resources of the Bay.

2 Future Dimensions of Living Resources Problems

The problem is how to increase the yield of living resources in order to advance objectives of increasing food supply, developing local economies, and expanding recreational opportunities -- while at the same time maintaining the Bay ecosystem in a desirable state of dynamic equilibrium.

2.1 Forces Tending to Increase the Problem

a. Increasing demands on living resources could result from population increases and concomitant increases in demands for seafood and shellfish, from increases in recreational demands on living resources. While current fish and shellfish takes from the Bay are small in proportion to total production, increased harvesting would increase the need for careful management of the Bay's living resources.

b. One of the greatest forces tending to increase problems of Bay living resources is the impact of man's activities which have the effect of reducing the productive potential of the Bay for aquatic life. These impacts include the destruction of habitat by diking and filling of wetlands, dredging and dumping of spoils, diversion of fresh water inflows into the Bay, accelerated sedimentation because of agriculture and urban development, increasing domestic and industrial pollution. The last category includes oxygen-consuming wastes, chemical and other toxic wastes, thermal waste discharges from electric power generation, and detergents and other wastes that eliminate aquatic habitats through eutrophication. All these threats to the supply of aquatic habitats and their productive potential are likely to increase in the future.

c. The increased use of pesticides and fertilizers in agricultural production will reduce the productive potential of aquatic habitats in rural shoreline areas.

d. Recognition of the potential economic value of Bay living resource production and of partially latent demands for consumptive and recreational use of this production would lead to higher objectives for conservation of aquatic habitats and increased demands on Bay management.

2.2 Forces Tending to Reduce the Problem

a. Institutional constraints on the commercial Bay fisheries could be rationalized or eliminated. Detailed restrictions such as those on length of season, size limits and type of gear could be repealed and the appropriate agency delegated administrative authority to promulgate such regulations. Restrictions on commercial fishing by non-residents and corporations could be repealed and the right to take fish and shellfish regulated by license. The leasing of natural oyster bars could be allowed under the regulation of the above administrative authority. (See Ref.8).

b. Biological and technological research could be continued and expanded in order to give fisheries scientists better understanding of the life cycles, food, temperature, salinity and water quality requirements of valued species, with a view towards better protection and enhancement of the resource.

Research directed toward understanding of the tolerance of various life-stages of important species to pollution and other forms of environmental degradation will help Bay management in resolving conflicts between living resources and other Bay uses. Knowledge about the extent and recruitment rate of the species harvested in the Bay should make it possible to determine their sustained yield levels. More of the knowledge gained through such research could be picked up and used practically by both the harvestors and the regulators of the harvesting.

Technological research could be directed toward finding new ways of increasing the yield of the resource. These

ways may include new methods and new types of gear used to harvest the crop, and also new means of intensive cultivation, particularly of shellfish, which lend themselves well to intensive aquaculture.

c. The main efforts to maintain environmental conditions necessary for the health of the Bay's living resources could be aimed at: conserving important habitats within the Bay, the highest priorities being assigned to spawning and nursery areas, and to the migration routes of anadromous fish at controlling pollution of the Bay; and, at insuring adequate fresh-water inputs to the Bay (particularly from the Susquehanna River).

"Aspects of pollution control particularly beneficial to commercial fishing are (1) the control of human fecal wastes in shellfish areas, (2) the control of toxic materials such as mercury, and (3) the controlled application of "pollutants" for nutrients and habitat improvement. Examples of the latter aspect are the creation of artificial reefs through selective disposal of solid wastes and the inducement of artificial upwellings at points of thermal discharge."(Ref.1)

The effects of dredging and spoils dumping in the Bay could be carefully monitored and such engineering programs could be modified in accordance with the findings of such studies as that of Cronin et al. (Ref. 11)

d. Paradoxically, the demise of commercial fishing in the Bay -- either through the deterioration of the productive potential of Bay aquatic habitats, or through mismanagement of the commercial fishing industry, or through a drastic reduction of demand for consumption of fish and shellfish -- could reduce problems of living resource management by eliminating conflicts with conflicting uses.

2.3 Summary - Future Outlook

Current trends continued indicate gradually decreasing yields of fish and shellfish for commercial and recreational purposes. Contributing to these long-term trends are the depletion of aquatic resources through environmental degradation, possible declines in demand for fish and shellfish associated with public awareness of environmental degradation, and institutional constraints which limit the capacity of commercial and recreational fishing interests from effectively pursuing enlightened objectives with regard to the Bay's living resources.

3 Living Resources: Goals, Objectives, Standards, Policies

3.1 Goal - Maximize the Living Resources

This overall goal can be given somewhat more specifically as follows:

3.2 Objectives

a. Sustained production and use of abundant populations of shellfish, fish, and wildlife through biologically sound management of the environment.

At the level of objectives, "abundant" can be translated into a more specific meaning.

b. Provide commercial and recreational opportunities for consumptive users through controlled harvest of commercial and game species.

c. Provide recreational opportunities for non-consumptive users of fish and wildlife.

The problem and goal statements deal with four major classes of living resources of the Bay: finfish, shellfish, waterfowl, and other aquatic life.

3.3 Standards

(Finfish and Shellfish):

Reference can be made to increasing rates, amounts and locations of production in pounds as well as dollar value. These standards should be related to population growth, and protein requirements as an output from input measured in money and

man/years. The protein productivity of aquatic life is very high; efficiency per unit of energy input and standards for output can be specified.

(Waterfowl):

While the Chesapeake is the most important breeding, nesting, and feeding ground for wildfowl on the Eastern Seaboard, it is only a part of the great flyway, and the standards established must take into account its role. Standards can be related to quantity and type of birds, but obviously such standards must also be related to waterfowl habitat, water quality, general environment, and food production, and these in turn related to standards for other aquatic life in the food chain.

3.4 Policies

Many State and local policies and programs already in operation are aimed at increasing living resources in the Bay. For example, the State program of oyster seeding works in this direction.

Nevertheless, a "systems" or "operations research" approach to the problem would set specific objectives and standards for management of the entire oyster industry, and the benefits of various levels of "living resource" goal achievement could be weighed against program costs, and against achievement of other objectives and goals where in conflict.

While it would be presumptious of this summary study to attempt policy outlines in detail, it is important to point out that existing policies in the area of living resource management should be viewed in context of a goal hierarchy. Using a "systems" approach, their implications can be weighed in monetary terms, against alternate goals and objectives.

An example would be the rationalization of the oyster industry, as though it were under control of a single oyster corporation. Management could be centralized, the market could be controlled, economies of scale would be possible, and the way of life of the oysterman still protected.

The most important policy changes in achieving the goal of maximizing living resources flow from eliminating the present set of statutory controls and adopting administrative controls over the fisheries.

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II. PROBLEMS AND GOALS

B. CONSERVATION OF WETLANDS 40

1. Wetlands Conservation Problems 40
1.1 Nature of the Problem 40
Figure 1: Simplified Bay Ecosystem 41
1.2 Causes of the Problem 41
1.3 Location of the Problem 42
1.4 Time Characteristics 43
Table 1: Extent of Coastal Wetlands in Maryland 43
1.5 Parties Affected 43

2. Future Dimensions of Wetlands Conservation Problems 44
2.1 Forces Tending to Increase the Problem 44
2.2 Forces Tending to Decrease the Problem 44
2.3 Summary - Future Outlook 47

3. Wetlands Conservation Goals, Objectives, Standards, Policies 47
3.1 Goal 47
3.2 Objectives 47
3.3 Standards 47
3.4 Policies 47

B
Conservation of Wetlands

1. Wetlands Conservation Problems

The problem is how to avoid further unnecessary and undesirable destruction or degradation of valuable wetlands, how to evaluate and rank such wetlands, and how to protect and enhance those deemed most valuable or unique, i.e., those considered most worth saving.

1.1 Nature of the Problem

Marshes and other wetlands are extraordinarily fertile, among the most productive natural areas in our environment. The food value of their plants is utilized directly by aquatic animals and birds, and is disseminated through the waters as detritus, or the decomposition products of the plants, thus supporting a vast marine-life nursery. It has been estimated that one kind of marsh plant alone, saltmarsh cordgrass (Spartina alterniflora), has seven times the food value of an equivalent acreage of wheat, to say nothing of the food web that it supports.(Ref.1) Large numbers of birds come to the wetlands to feed directly on the vegetation or on the brackish-water animals that have themselves fed on the plant detritus. Indeed, the Bay is one of the most important wintering areas on the Atlantic Flyway, with about a million ducks and geese wintering here each year.

The natural functions that wetland areas perform are summarized below. (Much of the following is drawn from Ref.2, pp.45-46.)

a. Nutrient Recycling

Organic matter contained in stream runoff from upland areas, or brought in by the tides, is broken down by the microbial population of the wetlands and used as food by plants and other higher life forms. Thus, the foundations of a complex food web, shown greatly simplified in Figure 1, are formed. Many parts of this web are harvested by man, or otherwise used for his benefit. If they are not overloaded with sanitary sewage, or poisoned by toxic industrial wastes or pesticides, the bacteria and zooplankton in the wetlands will cleanse the polluted water by decomposing the organic wastes in a sort of natural tertiary treatment process. Indeed they may even benefit, up to a certain point, from the increased fertilization of the water. (The main worry in such an instance would be the transmission of human pathogens, such as viruses, by shellfish.) Furthermore, marshes have a very high gas-exchange capacity, absorbing oxygen and CO_2 from the air when exposed by the ebb tide, and transferring them to the water when the tide returns. The oxygen is necessary not only for the metabolism of aquatic animals, but also for the decomposition of wastes.

b. Provision of Nursery Areas for Aquatic Animals

The nutrient-rich waters of wetlands support a rapid rate of photosynthesis. Furthermore, the shallow waters of these areas, and the periodic exposure of much of their surface by the withdrawal of the tide, allow for rapid warming by the sun. This combination of a plentiful food supply and moderate temperatures provides an environment favorable to the survival and rapid growth of the larvae and fry of species that are important living resources of the Bay.

c. Wildlife Habitat

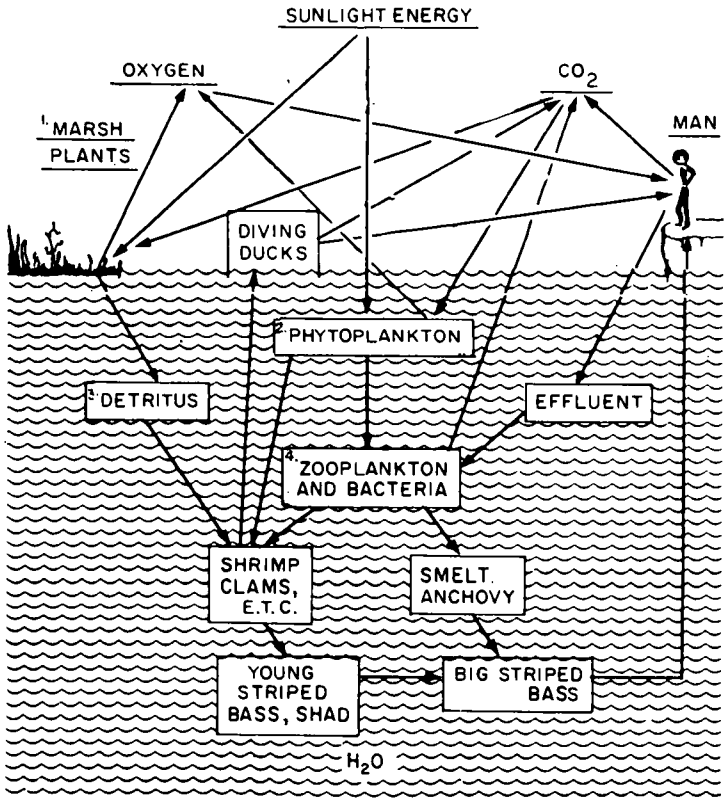
The rich waters of the wetlands attract many species of waterfowl and mammals that are a source of economic benefit and recreational satisfaction to man.

d. Protection of Upland Areas and Shorelines

Wetland areas act as buffers in dissipating the force of storm tides and waves. The boggy substrate and dense vegetation serve to absorb much of the energy of the moving water. Also, these areas can store large additional volumes of water, thereby reducing the potential damage caused by floods. The destruction of wetlands, and of their shore-protection

function, necessitates large public and private expenditures to achieve the same results as are provided free by nature.

FIGURE 1: SIMPLIFIED BAY ECOSYSTEM (Adapted from Ref.1, p.62).



1. Marsh Plants, e.g., cord grass, are the most productive type of organisms in North America, producing 5-10 times as much food and oxygen per acre as highly cultivated crops, such as wheat.

2. Phytoplankton, microscopic plants, with adequate sunlight produce food for minute animals and for filter feeding larger animals, such as mussels, clams and oysters.

3. Detritus, minute organic particles from decomposing organisms.

4. Zooplankton, small animals, e.g., protozoans and marine larvae, which drift with current.

e. Erosion and Sedimentation Control

Related to the above function, absorption of storm, tidal, and current energy by the wetlands helps to prevent shore erosion, which is a serious problem in many parts of the Bay. The physical characteristics mentioned above, namely bog-like bottom and dense vegetation, also serve to trap much of the sediment carried by runoff from these upland areas. Removal of these natural sediment traps would necessitate more dredging of adjacent waterways to maintain channels.

1.2 Causes of the Problem

The main cause of the problem of wetland destruction has been their potential for other uses and a lack of understanding of, and appreciation for, the natural functions they perform. This in turn has led to their gross underevaluation when compared to the possible economic benefits of projects that would damage or destroy them. Even now, when their enormous value is starting to be recognized, the difficulty of putting a price tag on the services they perform presents an obstacle in fighting the economic pressures that threaten them.

With ownerhsip of the Bay shoreline mostly in private hands (about 88% of the Maryland Bay shoreline), and with the present zoning structure, the management of most wetland areas has been left in the hands of local government. Such governments are always faced with the need to increase their tax base so that they can continue to supply the public services demanded by their citizens. In the past, and even now, the destruction of wetlands by diking and filling has often seemed the easiest way to make room for new industry or housing. Finally, local governments have neither the resources nor the overall perspective to stimulate them toward recognizing the value of wetlands, particularly since this value accrues for non-residents.

Also in response to local demand, municipalities have often ditched and drained marshes, and have applied pesticides in order to control mosquitoes. However, these measures have often destroyed the important and desirable biota along with

the mosquitoes, e.g., crab larvae and copepods (tiny crustaceans that form a vital part of the Bay food-web) are extremely susceptible to pesticides. Furthermore, wetlands have been fairly widely used or recommended as dumps for solid waste. A statewise study in 1966 (Ref.3) showed that 14 wetland areas were being used as public or municipal solid waste disposal sites. Not only does this destroy the wetlands outright, but the water pollution ensuing from the leaching of the refuse further degrades water quality in aquifers and frequently in the Bay itself.

The proliferation of small boats presents yet another pressure to fill marshes in order to construct launching ramps and marinas. Yet every bit of marsh filled for such a purpose only decreases the supply of fish available to the launched boat. "Nearly one-half of marina business is tangibly linked to fishing. The fisheries resources supporting this business are in turn dependent on wetlands for part of their life cycles." (Ref.4) Also, each boat further contributes to localized sewage pollution and gas and oil pollution of the water.

Nor is outright destruction the only danger posed for wetlands by local governments. Too often they are regarded as convenient locations for the discharge of untreated municipal and domestic sewage or industrial wastes. Concentration of individual shoreline residences with individual sewage systems (septic tanks) will further overfertilize the waters. Thus, in the past short-sighted (often by political necessity) planning of local or State government has all too often resulted in the destruction or serious degradation of valuable wetlands and of sub-estuaries of the Bay. Residential and industrial development taken together account for slightly over 20% of the 23,777 acres of wetland lost between 1942-44 and 1967-68. (Ref.4)

Dredging of major shipping channels by the U.S. Army Corps of Engineers and of small boat channels by the State, and local governments, and the dumping of spoils generated by this dredging, have all contributed to the destruction of wetlands. Dredging and spoil disposal caused the loss of 1,263 acres (5.3%) of wetlands between 1942-44 and 1967-68. (Ref.4) Further, pollution resulting from shipping, such as oil spills (intentional or unintentional), constitutes an ever-present danger to the health of wetlands.

While the direct and outright destruction by filling, diking, dredging, spoils dumping, and refuse disposal is an obvious threat, as are the effects of pollution, less apparent are the indirect effects of wetland destruction on Bay water qualtiy. Filling of wetlands obviously decreases both the surface area and volume of the Bay, particularly of its sub-estuaries, which -- especially on the western shore -- contain much of its wetland areas. The surface area and volume of a water body help determine its assimilative capacity for wastes. (This is because oxygen in the water is supplied largely by solution from the atmosphere directly across the water-air surface. Therefore, reduction of surface area results in lowered dissolved oxygen levels in the water. Reduction of volume decreases the flushing and dilution efficiencies of the estuaries).

1.3 Location of the Problem

The Maryland Department of Natural Resources is presently mapping State wetlands, as defined by the Maryland Wetlands Act of 1970. In the meantime, the following maps show wetland areas at a very general scale.

Pl.4 Aquatic Habitats

-Shows habitats of important living resource species. Derived largely from Ref. 5.

Plates 5 and 6 in the Wildlife Wetlands and Shellfish Areas of the Atlantic Coastal

Zone.(Ref.5)

-These plates show National Wildlife Refuges and Seashores, State wildlife wetland areas and parks, local and private wetland conservation areas, proposed acquisition areas, and privately owned wetland areas. In addition they show important habitat areas for clams, oysters, and blue crabs.

Comparison of the above maps with maps such as those listed below helps to show wetland areas in the Chesapeake Bay that are threatened by destruction or deterioration.

Plate No.	
22	Manufacturing Employment Centers and Port Dependence by Planning Regions
17	Surface Drainage Pattern and Public Surface Water Intakes
13	Wastewater Discharge
14	Major Sewage Treatment Plants
15	Water Quality Problems
16	Public and Private Sources of Pollution
23	Housing Subdivisions and Developments 1950-1967
24	Shoreline Ownership and Major Use

1.4 Time Characteristics of the Problem

The current public recognition of the problem has helped to slow the destruction of these areas. Maryland House Bill 285, commonly known as the "Maryland Wetlands Act", was passed, signed into law by the Governor on April 22, 1970, and took effect on July 1, 1970. Its purpose is to prevent dredging or filling of State wetlands without a license from the Board of Public Works, and to regulate "dredging, filling, removing or otherwise altering or polluting private wetlands." However, it is hardly likely that outright destruction will be completely halted by such legislative measures, since essential waterfront development will continue through the foreseeable future. A parallel problem is determining which waterfront development is essential. In the meantime, deterioration and therefore ineffectiveness of wetlands caused by urban expansion, e.g., water pollution from sewage and industrial waste, may accelerate as population concentrations increase.

The following tabulation of wetlands shows the extent of wetlands in Maryland by dominant species of wetland plant type. As mentioned above, it is estimated that 23,777 acres were lost to all causes between 1942-44 and 1967-68.(Ref.4) Of this, 20,200 acres are estimated to have been destroyed between 1954 and 1968. (Ref.5)

TABLE 1: EXTENT OF COASTAL WETLANDS IN MARYLAND (Data from 1954 wetland surveys published by U.S. Bureau of Sport Fisheries and Wildlife, as cited in Table 1 of "Wildlife Wetlands and Shellfish Areas of the Atlantic Coastal Zone". (Ref.5)1

Freshwater Species Affected by Tides	70,330 acres
Salt Grass (*Distichlis spicata*) and Cordgrass (*Spartina patens*)	64,790 acres
Needle Rush (*Juncus roemerianus*)	53,050 acres
Saltmarsh Cordgrass (*Spartina alterniflora*)	15,890 acres
1954 TOTAL	204,060 acres

1.5 Parties Affected

The destruction of wetlands ultimately affects many people in the Chesapeake Bay region, because of the loss of the beneficial natural functions, which the wetland areas perform. The net economic benefits accruing to the destruction usually go to the municipalities immediately bordering the wetland, or to whoever (industry, commercial establishment, or individual homeowner) occupies the site. Some benefits will tend to filter back through the local municipality, e.g.,

more public services supported by the increased tax base, or new local jobs. Such benefits will be offset by both local and Bay-wide losses, such as: damage to fisheries resources, thus decreasing the food supply for all and reducing economic gain from commercial and sport fishing; fewer jobs in the fishing industry; closed boatyards and unsuccessful marinas; and deteriorating water quality and the concomitant lessened health and enjoyment of the environment. Thus while the benefits accrue specifically and immediately, the costs are borne widely and over time.

2 Future Dimensions of Wetlands Conservation Problems

The problem is how to avoid further destruction or degradation of wetlands and how to protect and enhance those remaining. Wetlands have major, often unappreciated, functions in nutrient recycling, provision of nursery areas for aquatic animals, wildlife habitats, protection of shorelines and upland areas, and control of sedimentation and erosion. Because of these functions, many of the forces acting to increase the problem of living resources of the Bay (See Section A) also apply to wetlands areas. In this section additional forces pertaining to wetlands will be mentioned.

2.1 Forces Tending to Increase the Problem

An estimated 20,200 acres, or almost 10%, of Maryland's coastal wetlands were destroyed between 1954 and 1968.(Ref.5) The main forces responsible for this destruction are still active and are summarized below.

a. The demand for shoreline residential development, in combination with modern earth-moving techniques which make the filling of wetlands an easy matter, will increase pressures for the destruction of wetlands.

b. The demands of industry for well-located land, in combination with the increasing scarcity of land in metropolitan areas and the need of local governments to increase tax bases, will add to pressures to make new industrial land available by filling wetlands.

c. Increasing constraints on highway routes in urban areas will in some cases encourage the construction of highways through wetlands.

d. Metropolitan land supply problems (especially for "unwanted" uses: airports, heavy industry, highways, etc.) and land price trends will increasingly encourage and make economic the development of new land -- often involving the destruction of wetlands.

e. The magnitude of solid waste disposal problems (See Section L) and the lack of economic alternatives to present methods of solid waste disposal will result in the continuation of present methods, which include the destruction of wetlands.

f. Increase in recreational boating activity will increase pressures for filling of wetlands for marinas and will increase degradation of wetlands by small boat pollution.

g. The increasing amounts and variety of domestic, industrial and agricultural waste water (See Section E) into the Bay constitutes perhaps the major long-run threat of gradual degradation of wetlands.

2.2 Forces Tending to Decrease the Problem

There appear to be many avenues of public action that could be effective in achieving the conservation of wetlands. Some of the more important ones are outlined below.

a. Acquisition

Outright public acquisition of wetlands is the most effective way of preventing their destruction. However, lack of sufficient public funds for their

purchase, coupled with high prices in the areas most threatened by urbanization or industrial activity, has made it difficult to obtain much wetland area in this way. Furthermore, adjacent activity can often degrade their quality and effectiveness, even if they are publicly owned.

There are several possible ways in which to defray the costs of outright acquisition. One possibility might be a cost-sharing program with the federal government. This type of dual level program has already met with some success in New York, where the state and counties have shared costs 75%/25% in purchasing wetlands. Another possibility would be other-than-full-fee purchase, e.g. buying conservation or development easements to the wetlands from private owners.(Ref.6)

b. Tax Relief or Subsidies

Another possibility is the encouragement of the dedication of privately owned areas to public agencies by giving the owners liberal tax incentives. Similar incentives could be extended to people giving land to private conservation foundations. Tax relief or outright subsidies similar to the U.S. Department of Agriculture soil-bank programs could offer an interesting and viable variation on this theme. The cost to the State of such a program would probably be less than acquisition, and the land would stay on the tax rolls.

c. Legislation

Often legislative controls aimed at the conservation of wetlands are primarily concerned with the destruction of them by dredging and filling. However, the Maryland Wetlands Act of 1970 is also concerned with the restriction of activities that would degrade wetlands without actually destroying them. The major provisions of the Act that support the state's policy of preserving wetlands and preventing their despoliation are:

Section 721 - "It shall be unlawful for any person to dredge or fill on State wetlands, except that he has been issued a license to do so by the Board of Public Works."

Section 722 - "The Secretary of Natural Resources...may for the purpose of promoting the public safety, health and welfare, and protecting public and private property, wildlife and marine fisheries, promulgate rules and regulations governing dredging, filling, removing or otherwise altering or polluting private wetlands."

Although examination of the Act and of similar statutes in other states indicates that certain changes may be needed to further strengthen the law, Maryland has taken a significant stride toward conservation of its wetlands by the passage of this legislation.

In view of the expense involved in the acquisition of wetlands, and considering the pattern of ownership in the Bay (1,725 miles of shoreline privately owned, 205 Federally owned, and only 30 miles owned by the public), legislative restrictions on wetlands use are the most likely method of attempting their preservation.

It should be noted that various Maryland State agencies are already engaged in vigorous attempts to implement the provisions of the Wetlands Act.

d. Creation of New Wetlands

1. Natural

"The low elevation of land on the Eastern Shore of Maryland, in combination with rising tides and man-induced land-use changes, is resulting in a gradual encroachment of the tide onto land previously above the mean tide and subsequent conversion of wood, shrub, idle and crop lands to tidal marsh. Conversion to tidal marsh is considerably more prevalent in Somerset and Dorchester Counties, but is believed to be occurring throughout the Eastern Shore where expanses of land less than five feet above tide exist and where sufficient buffering is not present.

"Lower Eastern Shore areas have historically been subjected to tidal

flooding. Old dike and drainage systems exist in what are now tidal marshes.

"No data on actual total losses or conversion rates of 'high' land to tidal marsh exist. However, it is believed that the rate of conversion is higher for acreage in high phases of tidal marsh, wood, shrub and idle land than it is for land actually cropped or settled. One 14,000 acre watershed in Somerset County has a documented crop land loss to conversion between 1938 and 1958 of 684 acres."(Ref.7)

2. Artificial

New marshland can probably be created by very careful and selective placement of uncontaminated dredged spoils materials in shoal water areas in order to raise the bottom to levels at which marsh vegetation can become established. This is the opposite but related process to that outlined above. There higher land is being submerged or worn down to marsh level; here lower levels are built up to it.

e. The greater public understanding and appreciation of the natural functions of wetlands will result in increased pressures for wetlands preservation. The public will come to realize that the wetlands of the Bay must be maintained and enhanced if they are to continue to perform the invaluable natural functions discussed above. Therefore, filling, diking, waste disposal and construction will be allowed only when "essential" and only for clearly demonstrable and overriding public benefits. Wherever withdrawal of wetlands from potential development creates widespread hardship on local levels of government, programs could be designed to ameliorate such effects and to counteract the public loss. In this way, the costs and benefits of conservation can be put into the same "region-wide" accounting system.

However, the public does not have any obligation to reward private land speculation. The overwhelming public interest in the preservation of the Bay both for now and for future generations of Bay citizens should outweigh any purely private profit gained by filling wetlands.

f. Despite the foregoing, some filling or construction in wetlands for purposes that provide demonstrable and substantial public benefits will probably continue to be allowed and indeed can be validated. However, all such proposed fills or construction projects that are considered, whether by public agencies or private developers, should be thoroughly evaluated to determine their possible ecological effects on both the wetland area and the Bay as a whole. If the project is then approved, it could be modified as necessary to minimize the environmental impact. A single agency could be responsible for the approval or denial of all fill, dredging, or construction projects (rather than two or more agencies as now obtains).

It should be noted that the Maryland Department of Natural Resources is now developing criteria for such a process of evaluation of proposed projects for filling or dredging. Procedures will be established for determining impact so that benefit-cost analysis may be applied.

The costs of the review and evaluation of applications for filling, dredging, or construction permits should be borne by the applicants, not by the public. In some cases, costs would be low, but in other, more complex cases, the costs of studying the project's effects could be quite high.

An example of such a complex study is that done by the Chesapeake Bay Institute and the Chesapeake Biological Laboratory in response to the authorized deepening of the Chesapeake and Delaware Canal and its approaches (Ref. 8). The study was funded by the U.S. Army Corps of Engineers, the University of Maryland, the Maryland Department of Chesapeake Bay Affairs, and the U.S. Bureau of Commercial Fisheries. This being a Corps of Engineers project, it is obvious that the U.S. public

will ultimately pay the Corps' share of the costs of both the project and the ecological investigation of it. However, this will still be more equitable than making the citizens of Maryland bear the costs alone, since presumably the Corps project will be in the national, as well as in the regional, interest.

In the case of private developers, the equitability of requiring them to bear the costs of evaluation is much clearer. This would be analogous to the practice of maintaining sliding fee scales for building permit processing by municipal building inspection departments.

The review of all project proposals should include, in addition to ecological impact, the consideration (by appropriate professionals) of: 1) safety of the project design (by engineering geologists, structural and soil engineers, and public health officials); 2) appearance of the design (by design professionals); and 3) the improvement of public access to the Bay.

g. New methods of solid waste and spoil disposal could reduce pressures for the use of wetlands for these purposes.

h. More comprehensive controls on liquid waste generation and discharge would decrease the degradation of wetlands' resources through pollution.

i. New methods of mosquito control could reduce the impact of this activity on the aquatic life of wetlands.

2.3 Summary - Future Outlook

The new wetlands bills greatly increase State control over the destruction of wetlands by dredging and filling. They may be less effective in preventing the degradation of wetlands through pollution, even though Section 722 states that the "Secretary of Natural Resources... may...promulgate rules and regulations governing dredging, filling, removing, or otherwise altering or polluting private wetlands."

3 Wetlands Conservation: Goals, Objectives, Standards, Policies

3.1 Goal: Preserve Biologically and Aesthetically Important Wetlands in a High State of Functional Integrity

This goal is a necessary means to the maximization of the Bay's living resources. It is dealt with separately because of the wetlands'crucial role in the food chain.

3.2 Objectives

a. Establish State ownership control over tidal wetlands. This objective has now been accomplished.

b. Identify wetlands of greatest value to valuable and/or endangered species.

c. Identify wetlands most threatened by pollution as a high priority for special study.

d. Identify wetlands most threatened by erosion as a high priority for special study.

e. Identify wetlands most under pressure for development, dumping, dredging, etc. as a high priority for special study.

3.3 Standards

Standards for wetlands should specify what is meant by "high degree of functional integrity". The functions of wetlands are generally well-known but research such as that being conducted at the Rhode River by the Center for Environmental Studies (Ref. 9) is necessary to set standards for performance of wetlands in relation to their jurisdictions. These functions are (1) nutrient recycling, (2) provision of nursery areas for aquatic animals, (3) wildlife habitat, (4) protection of shoreline and upland areas, and (5) erosion control.

3.4 Policies

Policies regarding wetlands are suggested below as illustrations: (a) develop criteria for determining impact of

all potential change on wetlands; (b) review all proposals for filling or dredging of wetlands or any adjacent land development that may affect the wetlands in relation to criteria: (c) approve only those proposals where the benefit-cost ratio, taking all factors into account, substantially exceeds 1:1, or exceeds it by an agreed-upon amount; and (d) in such cases, new wetlands should be created to make up for losses to development.

The above policies are to a degree currently in operation as part of the responsibility of the Department of Natural Resources in implementing the Maryland Wetlands Bill.

Footnotes

1. More detailed assessments of existing wetlands may be found in Ref. 4.

2. Possible only for large scale cases.

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II. PROBLEMS AND GOALS

C. WATER MOVEMENT 50

1. Water Movement Problems 50
1.1 Nature of the Problem 50
Figure 1: Schematic Flow Pattern and Salinity Distribution in Partially Mixed Estuary 51
1.2 Causes of the Problem 52
Figure 2: Typical Longitudinal Section of the Salinity Distribution in Baltimore Harbor 52
1.3 Location of the Problem 54
Figure 3: Some Combined Climatological Effects 55
1.4 Time Characteristics 56
1.5 Parties Affected 56

2. Future Dimensions of Water Movement Problems 57
2.1 Forces Tending to Increase the Problem 57
2.2 Forces Tending to Reduce the Problem 58
2.3 Summary - Future Outlook 60

3. Water Movement Goals, Objectives, Standards, Policies 60
3.1 Goal 60
3.2 Objectives 60
3.3 Standards 60
3.4 Policies 60

C
Water Movement

1 Water Movement Problems

The problems are how to maintain and enhance the natural functions performed by the circulation of the Bay's waters, and how to minimize the costs of shoreline flooding.

1.1 Nature of the Problem

a. Interference with the Natural Functions Performed by the Movement of Water.

The large-scale movements of water in the Bay and its sub-estuaries are essential to the maintenance of its ecosystem and the desirable physical characteristics and quality of its waters. The movement of the tides and winds and the flow of fresh water into and through the Bay on its way to the sea are of critical importance for the survival of the Bay's valuable living resources, and for the breakdown, dilution, and flushing of pollutants in the Bay and sub-estuaries. Therefore, obstruction of the free circulation of water or denial of the necessary fresh-water inflow to the Bay would be extremely costly, in terms of money, the degradation of the environment, and human health and enjoyment. (See Fig.1, Sec. F a diagram of the Bay's water budget).

The needs of the fish and wildlife and the demands of the pollution assimilation function of the Bay are fulfilled by: 1. the oxygen dissolved in the water; 2. the flushing action of tidal and non-tidal water movement; and 3. the variable salinity of the water.

Oxygen:

Most water carries dissolved oxygen. Fresh water carries as much as 20 to 30 percent more oxygen than salt water. Most marine life including fish need the oxygen in the water to breathe. Oxygen in the water is also an essential element in the decomposition of the millions of gallons of wastes (including raw and treated sewage) that are dumped into the Chesapeake Bay and its sub-estuaries every day.

Decomposing wastes in the Bay, and particularly in its tributary estuaries, already consume considerable amounts of the available oxygen. When the dissolved oxygen is depleted by the decomposition of excessive waste loads, massive kills of fish and other marine life may result.

Flushing:

The Bay and its tributary estuaries dispose of man's wastes by diluting them, decomposing them, and finally by flushing them away. The flushing action is accomplished when the tide, wind, and density-driven currents succeed in exchanging unpolluted, oxygen-carrying water for the polluted, oxygen-depleted water.

The problem in many of the Bay's sub-estuaries is that there is little effective flushing action so that in areas such as the Severn, Magothy, Back and Middle Rivers, the water is not flushed sufficiently to prevent a buildup of pollution.

Salinity:

The waters of the Chesapeake Bay provide a gradual and more or less regular change in salt content from completely sea water at the mouth of the Bay to totally fresh water flowing into the head of the Bay from the Susquehanna River. All forms of life in the environment have adapted to this and the range of salinities is necessary for the survival of the various life-stages of many important fish and shellfish. Just to mention one, the striped bass spawns in fresh water, goes through the fingerling stage in brackish water, and spends its adult life in salt water.

b. Effects of the Bay's Physical Processes on Its Natural Functions.

Pritchard states that "there are three basic processes which produce motion and mixing in an estuary: the

wind, the tide, and the inflow of river water. ...In a tide-dominated estuary [such as the Chesapeake Bay], turbulence associated with the tidal currents results in mixing between the salt and fresh water, which in turn produces the density gradients associated with the non-tidal circulation pattern." (Ref. 1)

However, "the essential characteristics of an estuary result from the passage of river water through the system to the open ocean. It is in the estuary that the fresh water from the land meets the salt water from the sea, where mixing of salt and fresh water occurs, and where dynamic conditions are established which bring about the eventual discharge of the river water to the sea." (Ref. 2)

An important aspect of estuaries is that the system tends to be buffered against fluctuations in the fresh water inflow, i.e., the changes in total salinity are not directly proportional to the changes in the rate of fresh-water inflow. An increase in river flow will push the surface isohalines (lines of equal salinity) downstream, but there will be a compensating increased inflow of salt water from the sea in the bottom layers. This will simply accentuate the two-layered net non-tidal circulation pattern schematically represented in Figure 1. This two-layered estuarine flow pattern, which is characteristic of the Bay and its major tributary estuaries (such as the Potomac and the James Rivers), is discussed in Ref. 3.

"The circulation in estuaries has important implications in the field of pollution study and control. For any estuary in which this problem is significant it is important to be able to calculate the extent to which a pollutant may accumulate in the estuary before a 'steady-state' concentration is reached. Furthermore, the variation in concentration of the pollutant with location in the system must be predictable." (Ref. 2)

The type of circulation prevalent in an estuary has an important bearing on the prediction of pollution patterns. In a moderately stratified estuary such as the Chesapeake Bay, some portion of a pollutant that is lighter than the saltier, denser bottom water will find its way into the bottom layer. This is because of the above-mentioned vertical mixing that carries fresh water downward into that layer. The pollutant will then be broadly distributed by the upriver flow of the bottom layer. Therefore, it is necessary to be able to understand and evaluate the processes that are responsible for the distribution of properties in an estuary, in order to be able to predict pollution in that estuary.

All of the above means that any sub-estuary, or indeed any body of water, has a "capacity" for sewage treatment which, if not exceeded, allows nature to conduct the process at no cost to man.

c. Shoreline Flooding

In addition to the beneficial natural effects of large-scale water

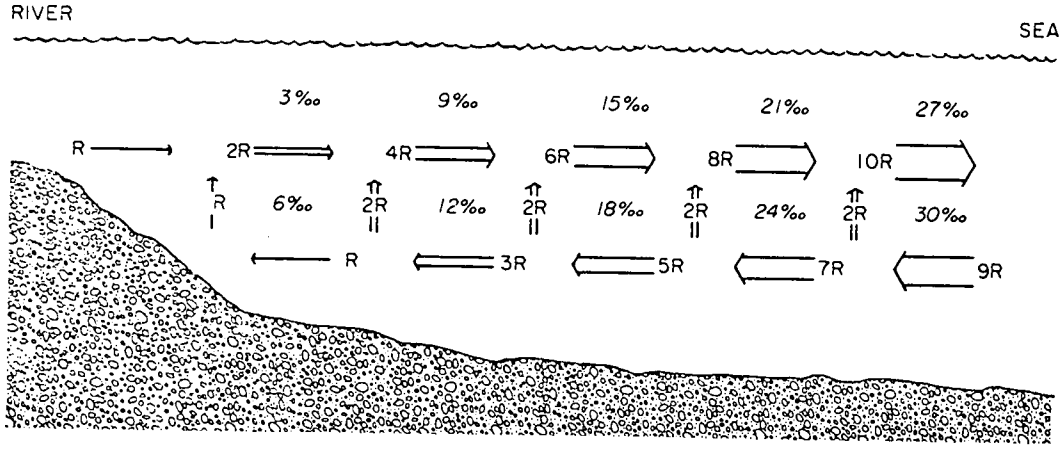


Figure 1:

Schematic flow pattern and salinity distribution (parts per thousand) in a partially mixed estuary. Volume rate of flow is expressed in terms of the volume rate of river flow R. (Reproduced from Figure 17 in Ref. 3)

movements in the Bay, there are significant detrimental effects. Chief among these is the problem of shoreline flooding. As urbanization and recreational use of the Bay shoreline increase, the impact of storms and flooding becomes even more substantial. The U.S. Army Corps of Engineers has estimated damages from recurrence of the "tidal flood of record" for the whole Bay to be 45 million 1970 dollars. (The "tidal flood of record" is simply defined as the worst flood known to have actually hit the impact area under consideration.) (Ref. 4, p.U-150).

1.2 Causes of Water Movement Problems

a. Inadequate Flushing of Tributary Estuaries

Several factors can either cause or aggravate the problem of inadequate flushing of a tributary estuary. Chief among these are: the natural or altered circulation patterns which exist in the estuary; the way in which wastes introduced into an estuary move and are dispersed; and the effects of filling, diking, and sedimentation in a shallow estuary. Diversion of fresh water inflow may aggravate flushing problems, but it is considered separately (see section 1.2.b. below) because of its great relative importance with respect to the Chesapeake Bay and its tributaries.

Circulation Patterns in the Tributary Estuaries:

As Pritchard (Ref.3) points out, the mechanism in Baltimore Harbor that provides for a renewal rate of about 10% of the Harbor's volume per day is a three-layered circulation pattern driven by differences in vertical salinity distributions between the Harbor and the adjacent Bay (see Figure 2). This circulation pattern is due in large measure to the fact that the Harbor has a large navigation channel, which is maintained at essentially the same depth as in the adjacent Bay.

On the other hand, other small tributary estuaries, such as the Magothy and Severn Rivers, are quite shallow and the major factor that controls flushing rates is the variation of the Bay's salinity with time. (Ref.3)

"In [early] spring, when the Bay waters are the lower of the two in salinity, the time required to replace 50% of the volume of the Magothy is only about six days. During late summer and fall...the renewal rate is probably not much greater.

At times (as in early summer) when the salinities within the Magothy approximate those in the upper layers of the Bay, the process of renewal must be that of tidal exchange. The time required to replace 50% of the volume of

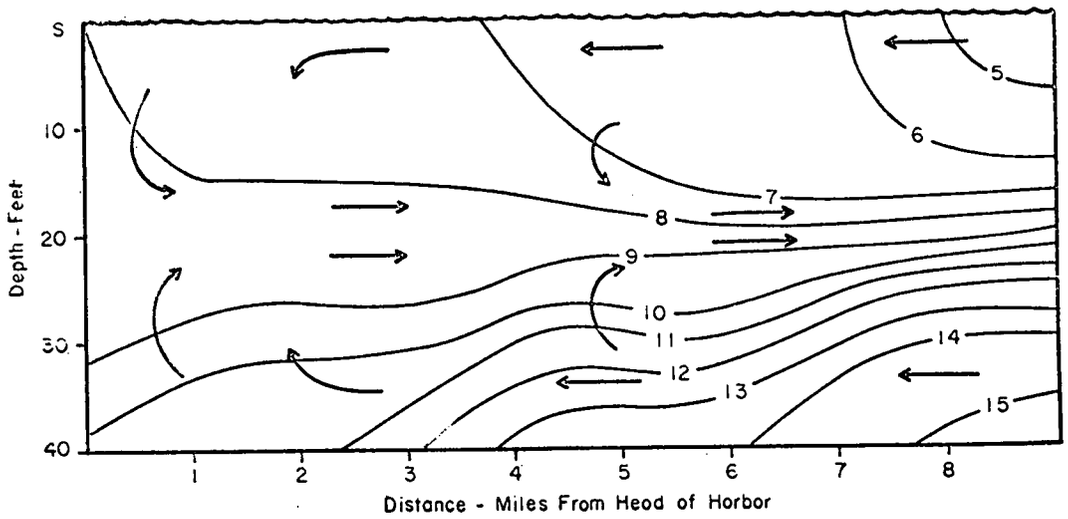


Figure 2:

Typical longitudinal section of the salinity distribution in Baltimore Harbor. The Chesapeake Bay at the mouth of the harbor is at the right end of the figure. The arrows show the net flow pattern. (Reproduced from Figure 19, Ref. 3.)

the Magothy under these circumstances would slightly exceed 30 days." (Ref. 5, p.21.)

Movement and Dispersion of an Introduced Waste in an Estuary:

The degree of concentration of wastes near the point of introduction depends on the initial mixing of the waste; the objective being to attain as high a dilution of the waste as possible during the initial mixing process. After initial dilution, the pollutant patch is transported by the currents in the estuary and spreads both vertically and horizontally by turbulent diffusion. The tide supplies most of the turbulent energy that leads to turbulent diffusion. Irregularities in the shoreline help to deform the pollutant patch. These effects, when combined with the transverse diffusion due to turbulent eddies, lead to an effective longitudinal dispersion of the wastes in the estuary.

Vertical diffusion also helps in the effective longitudinal dispersion of wastes. This is particularly true in a partially mixed estuary (such as the Chesapeake Bay) when a two-layer flow pattern prevails (see Figure 1). Waste introduced into the surface layer, in addition to participating in the oscillatory movement and mixing due to tides is carried initially with the net flow toward the sea. Turbulent diffusion leads not only to horizontal but also to vertical spread of the wastes, and they are, therefore, also added to the deeper layers, where net flow is toward the head of the estuary. The shear in the net circulation pattern produces a deformation of the waste patch and eventually gives rise to an effective longitudinal mixing, when combined with vertical diffusion.

A similar argument holds for the dispersion of wastes initially introduced into the bottom layers of a partially mixed estuary. A small net vertical movement of water increases vertical diffusion, and brings the waste up into the surface layer. Then the shear effect operates on the deformed waste patch to enhance the rate of dispersion. In either case, the wastes are ultimately flushed from the estuary into the sea by the net seaward flow of the estuary.

When waste is introduced as a continuous flow, as from a sewage outfall, it is spread downcurrent in the form of a plume by the prevailing tidal currents. During ebb tide, the plume extends down the estuary, and during flood tide, the plume extends up the estuary. Each reversal of the tidal current results in a folding back of the spreading plume. However, the plume seldom folds exactly back on itself. A widespread field of relatively low concentration develops, upon which is superimposed, on each tide, a relatively narrow new plume of higher concentration. (Ref. 6.)

Filling, Diking, and Sedimentation of Shallow Estuaries:

Filling, diking, and sedimentation aggravate the problem of estuary-flushing in several ways. First, the decreased surface area will mean a roughly proportionate decrease in the amount of oxygen absorbed by the water in the estuary. Second, the decrease in the volume of water in the estuary will lessen its capacity to dilute and, with the decreased dissolved oxygen content of the water, to decompose and assimilate wastes. Third, filling near the mouth of an estuary will constrict its connection with the main estuary or the sea and slow down the exchange or renewal rate of the water in the estuary. Finally, as we have seen above, small shallow tributary estuaries such as the Magothy and Severn Rivers often have very slow flushing rates. This is because only the upper layer of the Bay is able to exchange water with the tributary and also because salinity (and thus density) differences between the Bay and its tributaries are generally slight due to the low fresh water flow into the tributaries. Therefore, if such estuaries are made still shallower by filling or by sedimentation, flushing rates will slow accordingly. Thus, at the very same time that an estuary's waste load is increased by the urbanization and

development of its shoreline, its capacity to assimilate and flush this waste load may be seriously impaired by the filling, diking, and sedimentation engendered by the development.

b. Diversion of Fresh Water Flow

The diversion to other watersheds of fresh water that would normally flow into a particular estuary will most probably have several deleterious effects on water quality in the estuary. First, the dissolved oxygen content of the estuary's water will be decreased because of the denial or reduction of fresh supplies normally carried by the river flow. Second, flushing of the estuary will be slowed directly because of the reduced non-tidal net flow induced by river flow. Also, flushing of tributary estuaries will be indirectly slowed, because the reduced fresh water input will lessen salinity differences between the tributary estuaries and the Bay, thus slowing the density-driven currents. Finally, aquatic life that depends on the traditional salinity of the estuary will probably be harmed by the abrupt change to saltier water. Several examples of important diversions within or out of the Bay watershed are discussed below under "Location of Problem Areas".

c. Causes of Storm-Induced Tidal Flooding

Storms, of hurricane velocity or of extended duration, are the principal causes of flooding in the Bay and its tributary estuaries. According to Pritchard (Ref. 3), "Under certain wind and atmospheric pressure conditions, abnormally high mean water levels can occur in the Bay, with tidal levels as much as 6 feet above normal in the upper Bay, although more typically such meteorological tides are of the order of 3 feet above normal."

However, " (f)unnel shaped estuaries with wide openings and narrow necks are at a particular disadvantage. A large mass of water can easily enter the estuary with great momentum. As the estuary narrows, the only direction this water can move is upward.

When the funnel effect is combined with the quadrant wind effect (i.e., wind direction offshore in one quadrant of cyclonic storm crossing a shoreline, and on-shore in opposite quadrant), with high tide and with (increased) inland runoff in urban areas, conditions become especially severe as depicted in Figure 3. (Ref.4, p.U-145.)

1.3 Location of Problem Areas

a. Tributary Estuaries with Flushing Problems

As we have seen above, estuaries may be subject to flushing problems because of several reasons, important among which are inadequate depth, constriction of the mouth of the tributary, and insufficient fresh water inflow.

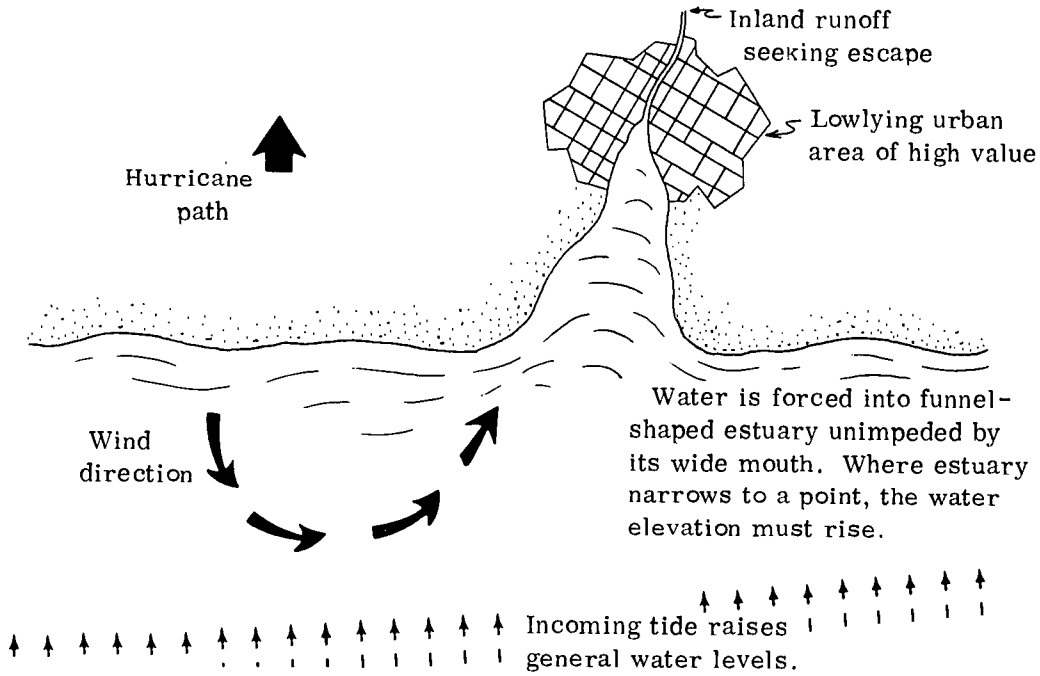
Examples of Bay tributaries with these problems are: the above-mentioned Magothy and Severn Rivers (highly developed shorelines, shallow, low fresh water inflows); Back River (shallow, constricted mouth that further slows exchange, and "fresh" water inflow that consists almost entirely of Baltimore's sewage effluent); and the Bush and Gunpowder Rivers (shallow flushing dominated by salinity fluctuations in Bay proper resulting from varying Susquehanna River flow). As discussed above, flushing of the Patapsco (Baltimore Harbor) is faster than would otherwise be expected, despite its low fresh water inflow, because maintenance of its channel at essentially the same depth as the adjacent Bay permits a three-layered-flow exchange pattern.

b. Diversion of Fresh Water

Large-scale diversions of Patuxent River water to the drainage basins of the Potomac, Patapsco, and Back Rivers have been made and have already affected dissolved oxygen levels and other water quality parameters. Further urbanization and development within the Patuxent watershed will undoubtedly lower water quality in its lower reaches still further at the same time that river flows (and their flushing effects) are being reduced.

Figure 3:

Some Combined Climatological Effects. (Reproduced from Figure U-15, Ref. 4)



Finally, and most importantly of all, large diversions from the Susquehanna River (which provides roughly one-half of the total fresh water inflow to the Bay) to the watersheds of the Potomac and Delaware Rivers have been proposed (the so-called Mason-Dixon Project). Coupled with a greatly increased net outflow of fresh water (the new net outflow will be approximately 30% of the low flow in the Susquehanna) through the Chesapeake and Delaware Canal because of its deepening, these diversions will probably have critical effects on the salinity characteristics, dissolved oxygen contents, flushing rates, and water quality throughout the Bay, but particularly in the Susquehanna Flats at the Bay's head. Much the same effects would be produced by impoundments in the headwaters of the Susquehanna that have been proposed by the Susquehanna River Basin Compact Commission.

c. Tributary Estuaries with Particular Flooding Problems

The tributary estuaries most vulnerable to storm flooding are the south-opening, funnel-shaped ones on the western shore. (See Figure 3 above, and also Figure 2 in Ref. 7, map of "Hurricane Tracks" on east coast of U.S.)

The Severn, South, and Gunpowder Rivers are quite vulnerable to such flooding, but the Patapsco is probably the most susceptible of all. Baltimore's Harbor was flooded in the 1954 hurricane in the manner described above. However, the Chesapeake is not as severely affected as the Atlantic coastal areas, because it is somewhat protected against the northward-travelling hurricanes by Cape Charles and the Delmarva Peninsula and its wetlands absorb much of the energy of the storms.

1.4 Time Characteristics

The time characteristics of the problem of water movement in the Bay and its tributaries have many aspects. There are the short-term aspects of the residence time and dispersion rates of pollutants, which depend in large part on the flushing rates of the water body (the dispersion of wastes depends on diffusion processes as well as on advection, in other words, even without flushing, pollutants will tend to diffuse, or spread out through the water). There are the seasonal variations in salinity, water quality, and renewal rates caused mainly by the seasonal fluctuations in river flow into the Bay, but also by the seasonal differences in climatological factors such as solar heating, precipitation, and evapotranspiration. Storms and storm flooding are worst in winter, but hurricanes usually occur in August and September. Finally, there are the gradual, long-term, accumulative, and more or less permanent changes in water characteristics and flushing rates in the Bay and its tributaries caused by filling and diking, erosion and sedimentation, water pollution, and diversion of river flow.

As was pointed out above (see section 1.2.a.) the volume rate of exchange in Baltimore Harbor (Patapsco River) is "remarkably steady throughout the year" at "approximately 10% of the Harbor volume per day." However, the rate of exchange in, for example, the Magothy is seen to vary from 50% of its volume exchanged in six days in early spring to 50% renewed in more than 30 days in early summer.

Probably the most important single time-varying influence on water characteristics and quality in the Bay is that of the flow of the Susquehanna River. The Susquehanna, with a mean annual flow of about 40,000 cubic feet per second (cfs), contributes over half of the total fresh water inflow to the Bay. Yet the monthly average flow may vary from a low of about 7,000 cfs (in late summer-early fall) to a maximum of 100,000 (in early spring). These seasonal high and low flows are very important to the health and well-being of the Bay ecosystem, which of course includes man. For instance, the spring high flows flush the Bay and its tributaries, and retard the up-Bay advance of salinity-dependent organisms such as oyster parasites and predators. For another example, Back River presently has an extremely low exchange rate with the Bay, and it virtually acts as a sort of large tertiary treatment pond for the sewage effluent dumped into it. But Baltimore will probably divert still more water from the Susquehanna in the future, and a considerable part of this water, after being used, will be discharged into Back River. This could increase Back River's flushing rate, and cause wastes and excessive nutrients to enter the Bay.

1.5 Parties Affected

It is quite obvious that all users of the Bay are ultimately affected by the patterns of water movement within the Bay, and by the effects of these motions on salinity and other water characteristics. Aquatic life is dependent on a wide range of salinities, temperatures, velocities, dissolved oxygen contents, etc., which, as we have seen above, are directly dependent on the water circulation patterns and rates. Thus, the "living resources" of the Bay, and those who exploit or enjoy them, are dependent on "water movement". Similarly, all those who benefit from the natural functions performed from the natural functions performed by wetlands, do so because water movement patterns determine what are in fact wetland areas and further determine the state of well-being of these areas. The assimilation capacities of the Bay and its tributaries for wastes (including heat) are directly related to both large- and small-scale water movements. Thus, all people living in the Bay watershed whose wastes

are discharged, whether treated or untreated, into the Bay are concerned with this function. Again, and in short, shipping, recreational users, all those who use the Bay, are dependent on water movements in the Bay. Indeed, such a statement is almost tautological.

With respect to shoreline flooding of the Bay, the answer to the question "who are the parties affected?" becomes clearer and more specific. Owners and users of shore property suffer the most immediate and greatest damage. Then there may be the water quality damage caused by combined sewer system discharge, the damage to pleasure and commercial boats and marina facilities, and damage to shipping channels by the rapid erosion and sedimentation that accompany floods.

2 Future Dimensions of Water Movement Problems

As stated above, the present problem is to maintain and enhance the natural functions performed by the circulation of the Bay's waters (maintenance of dissolved oxygen levels, flushing of sub-estuaries and varying salinity patterns) and to minimize the impact of shoreline flooding. Many of the physical processes involved in the circulation of the Bay's waters are relatively constant over long periods of time, at least when averaged. These processes are among the important causes of the water movement problem and their cumulative effects will of course increase over time unless the effects are dynamically balanced by appropriate solutions. However, other causes of the problem, particularly those related to the activities of man, will themselves probably increase in magnitude even while their effects are increasing and accumulating. In other words, the problem will be growing, but at an accelerating rate, and solutions will have to be applied in an accelerated fashion to keep the problem in check. For example, without man's activities there would be a fairly constant long-term average rate of sedimentation of the Bay's channels. Thus, to keep the channels at a fairly constant depth, roughly the same volume of material would be dredged each year. But with increased activity in the Bay watershed, the rate of sedimentation will increase year by year, and the amount of dredging will have to increase to keep pace.

2.1 Forces Tending to Increase the Problem at an Accelerating Rate

a. Inadequate Flushing of Sub-Estuaries

Most of the increase in the problem of inadequate flushing of sub-estuaries, with the attendant disbenefits of pollution buildups, ecological and aesthetic degradation, and loss of shoreline property value is caused by the increased activity and intervention in natural processes of man in the watersheds of the estuaries.

Man's activities will probably increase: 1) the alteration of the circulation patterns in the sub-estuaries, leading to speeding up or retardation of flushing rates, by dredging or filling channels, by constricting or widening the mouths of the estuaries, or by building piers, docks, or jetties in harbors; 2) the discharge and buildup of wastes into the estuaries, with consequent depletion of dissolved oxygen and harm to living resources; and 3) filling, diking, and sedimentation because of increased demands for creation of new shoreline for residential, commercial, industrial and recreational uses, and because of the construction activities which accompany the development and which produce vastly increased sediment loads.

b. Diversion of Fresh Water

Man's increasing demands on the fresh water resources of the Bay watershed will further accelerate the growth of the water movement problem. Two outstanding examples are: 1) the Susquehanna, where projected consumptive demands will exceed

minimum monthly low flows by the year 2020, thus endangering the existence of the present Upper Bay ecosystem; and 2) the deepening of the Chesapeake and Delaware Canal, which will undoubtedly sharply increase the net outflow of fresh water from the Upper Bay.

c. Shoreline Flooding

Man himself increases the impacts and costs of shoreline flooding on his works by continuing to build in areas subject to frequent flooding.

2.2 Forces Tending to Reduce the Problem

a. Enhancement of Natural or Altered Circulation Patterns

The exchange or flushing rate of an estuary is a function of its shore and bottom topography, fresh water inflow, tidal and non-tidal currents, wind-driven currents, and salinity gradients. If acceleration of the flushing rate is desirable, as for example in the case of the Magothy or Severn estuaries, potential solutions must be addressed to these factors. In some cases dredging may be called for to deepen channels. As mentioned above, this could allow the deeper, higher salinity layers of the Bay to take part in the exchange process, setting up flow patterns similar to those in Baltimore Harbor, and increasing and stabilizing flushing rates. The dredging would have to be carefully controlled so as to minimize damage to aquatic communities, and environmental conditions carefully monitored to ascertain the effects of the introduction of the higher salinity Bay-bottom waters on the resident aquatic life.

On the other hand, retardation of the flushing rate may be deemed more desirable, as in the case of the Back River "tertiary treatment pond". In such a case, constriction of the tributary's mouth could be maintained, dredging not permitted or at least strictly controlled, and perhaps even the possibility of further constriction of the channel might be in order in extreme cases.

b. Movement, Dispersion, and Assimilation of Introduced Wastes

The distribution over time of a conservative waste introduced in solution or colloidal form into estuarine waters will depend on the manner in which the waste is introduced and on the difference in density between the undiluted waste and the receiving water.

Deep-water outfalls with long diffusers having many ports (in the order of 500 or more) can produce dilutions in the range of 1:300; while single jet discharges in shallow water will provide an initial dilution of only 1:5 to 1:10. The increase in dilution by one or more orders of magnitude through use of a diffuser is highly desirable and is less expensive than building outfalls that are long enough to accomplish the same increase in dilution by natural oceanic dispersion.

In the actual design of an outfall, which will be unique for each site, the engineer can choose the location, depth, and length of the diffuser, and the number and size of its discharge ports. Receiving-water quality objectives have the major effect on the design. Design decisions can be made only in a systems context, taking into account the degree of treatment, outfall and diffuser hydraulics, the various stages of dilution, the decay rate of bacteria and other substances, and the density stratification and current regimes in the receiving-water body. Water quality objectives also have a major effect on the design. In some instances a submerged waste field may be desirable, while in areas such as estuaries it may not be. (Ref.6)

Still, the most obvious and most desirable way of maintaining adequate levels of water quality in the Bay's tributary estuaries with respect to dissolved oxygen will be to reduce the oxygen demand for the

the decomposition of wastes by more effective waste treatment before discharge. Another approach that will probably gain favor would be a treatment of the effect (i.e., treating the "symptom" rather than curing the "disease"). This would entail aeration of the water by artificial means. One commonly employed method is the installation of a perforated pipe or hose at the bottom of a water body, through which air is then pumped. Some of the air in the rising stream of bubbles is dissolved, and oxygen is thus replenished.

c. Reduction of Aggravating Factors such as Filling, Diking, and Sedimentation

Filling and diking should be kept to an absolutely necessary minimum, especially at the mouths of estuaries, so as to: maintain the volume of water available for dilution and assimilation of wastes; to maintain the absorption of oxygen at adequate levels (absorption being roughly proportional to water surface area); to conserve aquatic vegetation, which produces oxygen by photosynthesis and transpires it directly to the water; and to prevent constriction of the cross-section through which exchange with the Bay occurs (except in such cases as the Back River, discussed above). Sedimentation fills channels, and produces still shallower depths in already shoal waters. Therefore, sedimentation should be controlled as strictly as possible. (The problem of sedimentation is considered in section D.)

d. Regulation of Diversion of Fresh Water

The denial of fresh water inflow is an extremely serious matter, and diversions of this essential contribution to estuaries should be permitted only when no other reasonable alternative sources of water are available. Indeed, augmentation of fresh water inflow is often highly desirable, particularly at times of low flow. This may be accomplished by carefully planned releases from upstream reservoirs.

Diversions of fresh water which would otherwise flow through the Bay, or which thus deny inflow to one or another particular sub-estuary should be carefully considered and regulated. The flow regimen of the Susquehanna River is of particular importance in this respect, and the rational management of its water resources is imperative. Diversions or consumptive uses of Susquehanna water should be permitted only on evidence of a clear and overriding public interest and should be strictly limited and monitored in any case.

The effective diversion of freshwater from the Bay because of the deepening of the Chesapeake and Delaware Canal could be minimized by the installation of tidal gates or locks.

e. Reduction of Storm-Induced Flooding

Because really severe storms are infrequent in the Chesapeake Bay, the kinds of flood-control measures necessary to reduce all but the most severe impact do not seem warranted. However, where new construction is extensive, such as in Baltimore's Inner Harbor, all elements of buildings easily damaged by flooding will be raised far enough above mean high tide to ensure their protection from all but the most extreme flooding. Thus, filling and raising of the shore should be permitted on the most valuable land judged to be least in conflict with other goals (such as conservation, living resources, etc.). In the case of certain waterfront industrial, commercial, or residential uses it may be not only possible but desirable to encourage the raising of buildings on "stilts" so as to preserve wetlands and living resources while satisfying development demands and avoiding the danger of flooding, a case of "having the cake and eating it too".

Such development is planned for the Hackensack Meadows area in northeastern New Jersey. (Ref. 8)

A rational approach to solving the problem will be the institution of "flood-plain" type zoning in shoreline areas, i. e., the restriction or prevention of development where it would be threatened by periodic flooding. It is considered to be unreasonable and unjustifiable to expend public monies for the encouragement and perpetuation of private folly.

f. Research into estuarine problems, particularly by use of both mathematical and physical models such as the proposed and authorized U. S. Corps of Engineers Bay model, will be expanded.

2.3 Summary -- Future Outlook

The overall outlook seems good with respect to the reduction of many of the "problem-increasing" forces, particularly those which have to do with the flushing of estuaries and shoreline flooding. However, the outlook with respect to the increasing diversion of fresh water inflow to the Bay is judged to be critical and far short of solution in the near future. Solutions to the increased outflow through the Chesapeake and Delaware Canal such as locks or gates have been proposed but have apparently found little support by the Corps of Engineers. And the Susquehanna will continue to be eyed thirstily by inhabitants and water resource agencies of other major basins in the eastern United States.

3 Water Movement: Goals, Objectives, Standards, Policies

3.1 Goal: Maximize Desirable and Minimize Undesirable Effects of Circulation of the Bay's Waters

Five aspects of water movement can be identified to define objectives under the above general goal: oxygen content, flushing, salinity, flooding, and erosion. Erosion will be considered under Goal D.

3.2 Objectives:

a. Maintain high levels of dissolved oxygen in the Bay's waters.
b. Provide adequate flushing action/dissolved oxygen relationship to ensure satisfactory water quality for living resources.
c. Ensure fresh water inflows adequate to maintain satisfactory fresh vs. salt water quality for living resources.
d. Eliminate negative impact and cost of tidal flooding and movement.

3.3 Standards:

Standards exist for each of the four aspects of water movement. Water quality standards regarding oxygen content are discussed under Goal E (Water Pollution). Oxygen content is to a degree a function of flushing action. While natural flushing action is not easily affected, standards can be adopted for minimum (and maximum) desirable flushing action for specific situations.

Flooding has a well established literature and set of standards applicable to the Bay. These standards relate to specific floods-of-record to identify boundaries of public responsibility (50-year flood, etc.).

3.4 Policies:

Policies for water movement and circulation establish principles for responding to specific situations regarding oxygen content, flushing, salinity and flooding. For example, where oxygen content is below acceptable amounts, policy would be to take action to modify the situation.

Specific policies regarding flooding include the progressive phasing out of uses within 50-year flood plains, and the adoption of land use and shoreline controls that minimize unnecessary future conflicts.

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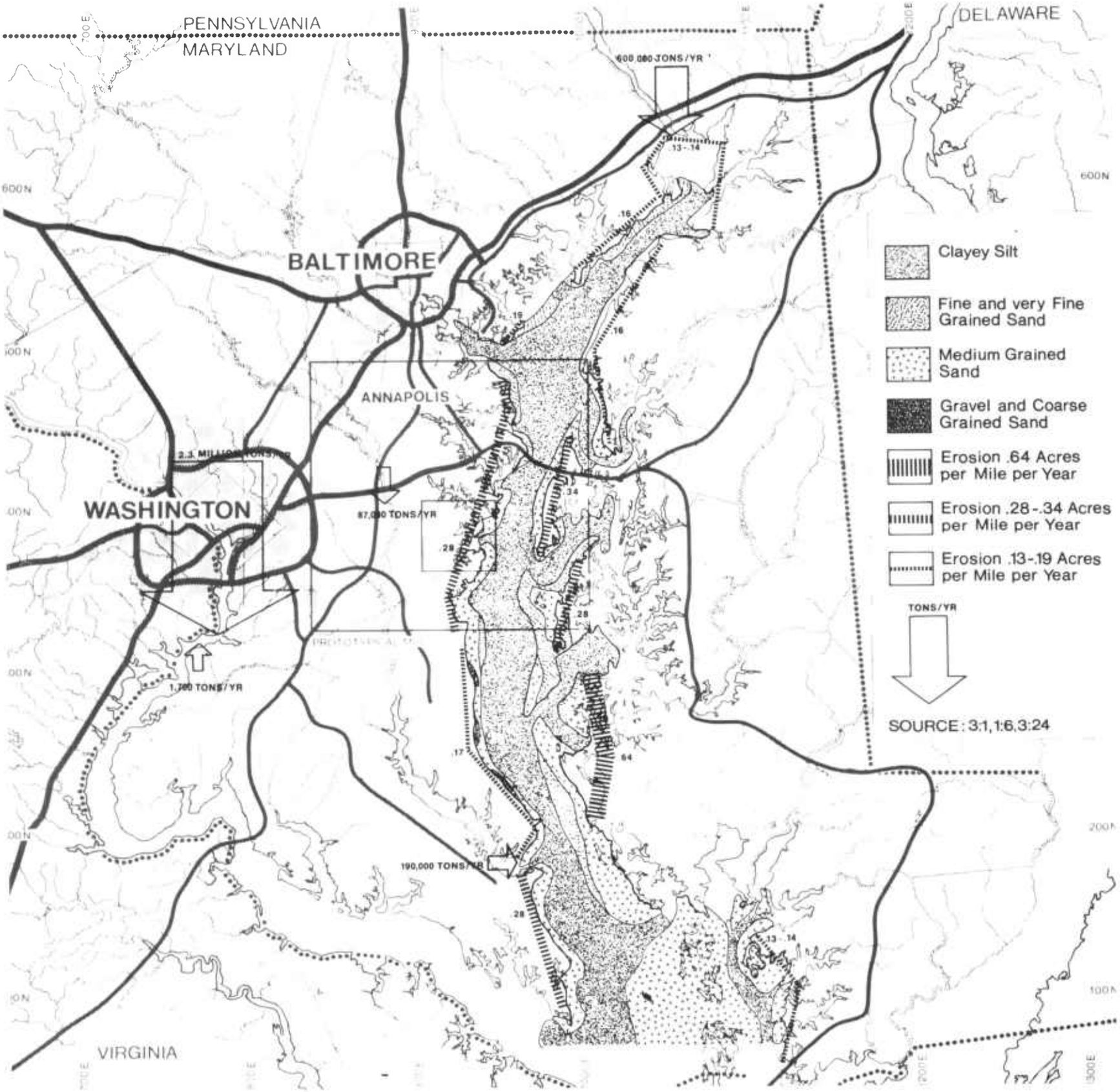
PLATE 7.: Shore Erosion and Bay Sedimentation



II. PROBLEMS AND GOALS

D. SHORE EROSION AND SEDIMENTATION 62

Plate 7: Shore Erosion and Bay Sedimentation 62

Da. SHORE EROSION 64

1. Shore Erosion Problem 64
1.1 Nature of the Problem 64
Table 1: Chesapeake Bay Shore Erosion in Maryland 64
1.2 Causes of the Problem 65
1.3 Location of the Problem Areas 67
1.4 Time Characteristics 67
1.5 Parties Affected 68

2. Future Dimensions of Shore Erosion Problems 68
2.1 Forces Tending to Increase the Problem 68
2.2 Forces Tending to Reduce the Problem 69
2.3 Summary - Future Outlook 72

Db. SEDIMENTATION PROBLEMS 73

1. Sedimentation Problems 73
1.1 Nature of the Problem 73
1.2 Causes of the Problem 73
Table 2: Sediment Discharge of Selected Tributaries 74
Table 3: Sedimentation at Selected Historic Towns Upper Chesapeake Bay Region 76
1.3 Location of the Problem Area 76
Plate 8: Shore Erosion and Sources of Sedimentation and Turbidity 77
1.4 Time Characteristics of the Problem 78
1.5 Paries Affected 78

2. Future Dimensions of Sedimentation Problems 78
2.1 Forces Tending to Increase the Problem 78
2.2 Forces Tending to Reduce the Problem 79
2.3 Summary - Future Outlook 80

3. Shore Erosion and Sedimentation Goals, Objectives, Standards, Policies 81
3.1 Goal 81
3.2 Objectives 81
3.3 Standards 81
3.4 Policies 81

Da
Shore Erosion

1 Shore Erosion Problem

The problem is how to control shore erosion in an economically, socially, and environmentally acceptable way so as to reduce damage to and limitations on present and potential shoreland uses.

1.1 Nature of the Problem

Shore erosion can damage or destroy recreational beaches, and seriously limit waterfront use and development. It can also cause damage to valuable wetlands. The 3,950 mile shoreline of the Maryland portion of the Chesapeake Bay and its tributaries is constantly subjected to attack by moving water driven by winds, tides, stream flow, and non-tidal currents.

Between 1845 and 1942 about 6,000 acres of land were lost to shore erosion along the 230 miles of shoreline of the Bay proper in Maryland. (Ref. 1). This is an average loss of 26 acres per linear mile of shoreline. The specific rate of erosion is highly variable and depends on a combination of many factors. These include: the shoreline configuration; the direction and speed of prevailing and storm winds; the reach of open water over which the winds blow (called the "fetch"); the movement of sediments by long-shore currents; and the composition and structure of the materials that make up the shore. Thus, during the period mentioned above, the shoreline has receded several thousand feet in some areas, but has remained virtually static in others (See Table 1 and Plate 7.)

However, "because the height of the coast varies markedly from place to place, the amount of land, or acreage, lost is

TABLE 1. CHESAPEAKE BAY SHORE EROSION IN MARYLAND (Tributaries Not Included)

	Miles of Shore-line	Net Loss 1845-1942 (Acres)	Main Shore-line Annual Erosion Rate (Acres/Miles)	Annual Volume Lost (Cu.Ft.)	Annual Rate of Volume Lost (Cu.Ft./Mi.)
Northern Bay Area					
Cecil	15.6	195	0.13		
Kent	36.9	578	0.16		
Harford	24.0	383	0.16		
Baltimore	9.3	164	0.19		
TOTAL	85.8	1,320	0.17		
Above Tolchester				4.4×10^6	62,300
Mid-Bay Area					
Queen Annes	17.6	592	0.34		
Talbot	11.3	286	0.28		
Dorchester	29.5	1,809	0.64		
Anne Arundel	40.3	1,041	0.30		
Calvert	31.3	530	0.17		
St. Marys	22.5	600	0.28		
TOTAL	152.5	4,858	0.34		

(Table Reproduced from Table 4 in Ref. 1)
(Data for Col. 1-3 from Ref. 2 and 3, Col. 4 and 5, Ref. 4.)

not a direct measure of the volume of erosion. In Calvert County the Calvert Cliffs are on the order of 100 feet high while in Dorchester County much of the shoreline is only 6 to 10 feet high. Thus the volume of land lost may be considerably higher along Calvert County despite the slower (linear) rate of erosion there compared to shoreline of Dorchester County. Accurate estimates of the volume of sediment lost are not available for most of the Bay. However, for the region from the mouth of the Susquehanna River to Tolchester in the northern Bay area Schubel (Ref. 4)has estimated that 4.4 X 10^6 cubic feet is lost annually representing a rate per mile of shoreline of 62,300 cubic feet." (Ref. 1).

One example of the public impact of severe shore erosion is discussed by S. P. Ellis (Ref. 5). His staff had "recently completed a feasibility study, for the Legislative Council, concerning the possible acquisition of Hart and Miller Islands (for recreational purposes). These islands are located east of Baltimore at the mouth of Back River. The two islands encompass an area of approximately 140 acres, with Hart Island being the larger of the two. The islands are relatively flat, ranging in elevation from one to three feet above MHW. The predominant natural feature is the existence of approximately four and one-half miles of beach. Because of constant exposure to the Bay, erosion is a major problem. In 1930, Hart Island contained approximately 150 acres, Miller Island, 51. Today, this acreage has been reduced to 111 and 33 acres respectively. . . . . If these valuable pieces of real estate are not stabilized soon, they will suffer the same fate as Sharps Island and will be no more."

1.2 Causes of the Problem

The major causes of the problem of shore erosion are the natural processes and forces involved, the characteristics of the shoreline acted on by these forces, and both the natural and socio-economic limitations on possible solutions to the problem.

a. Natural Processes and Forces

Storms:

Most shore erosion occurs during storms. The most intense storms that affect the Chesapeake Bay are hurricanes, violent cyclonic storms which are born in the tropics and travel generally from south to north through the region. The important aspects of storms with respect to their role in shore erosion are "their intensity, duration and frequency, and the high waves, runoff and winds associated with them." (Ref. 6)

Duration of a storm is an important factor. Waves can build up to great heights during a long storm and can thus be superimposed upon one or more high tides.

Intense but infrequent storms such as hurricanes produce the highest average annual erosion damage. The hurricane of August 1933 caused the greatest damage of record in the Chesapeake Bay. Less severe but still somewhat infrequent storms tend to have more or less permanent influences on the strength and direction of the longshore transport of sediments. This sediment movement is important because it may balance the erosive forces at work along the beach.

Friction between high winds (i.e., fast moving air masses) and large areas of water surface ("fetch") can produce very high waves. Fetch, combined with a long-lasting wind, is probably the most important factor in the creation of large waves, and the larger the wave, the more energy is available for the processes of erosion and transport of particles.

Hurricanes and other storms usually also produce intense rainfalls. This precipitation often falls on already saturated ground and thus produces extreme runoffs.

The high winds that accompany storms not only produce high waves as

explained above, but also strike directly on natural and man-made structures, at a time when saturation may already have weakened them. Wind speeds are generally higher for storms coming from the ocean than for those coming from overland, probably because of the lower friction at the water's surface.

Littoral Drift:

There is usually a prevailing longshore current that moves sediment along a coast. This "littoral drift" is mainly the resultant of two forces, the Coriolus force produced by the earth's rotation and the force exerted on the sand grains by the prevailing, wind-induced waves. The drift usually produces a net loss or gain of sediment and its intensity varies from place to place and from season to season.

Tidal and Stream Currents:

High tides occurring simultaneously with storms, or tidal currents superimposed on the prevailing littoral drift, can reinforce the total erosional force, as can currents caused by nearby stream inflow.

b. Influence of Shoreline Characteristics

Orientation of Shoreline:

The orientation of a shoreline with respect to the direction of the prevailing littoral drift can greatly reinforce the effect of the drift. The more nearly the shore parallels the direction of drift, the greater the movement of sediment along the shore will be.

If the shore faces a large body of open water, the fetch will be greater and the winds will generate higher waves than if the shore fronted on a narrow water body.

An even more important result of shore orientation is the quadrant effect in cyclonic storms, which was discussed above in the section on Water Movement (See section C.2.c. Causes of Storm Induced Tidal Flooding). This effect can cause extraordinary littoral movement, especially (in the Chesapeake Bay) on east-west or northeast-southwest trending, southward-facing shorelines, i.e. perpendicular or oblique to the usual path of hurricanes through the Bay area. Not only will funnel-shaped estuaries in such shorelines experience flooding but the erosive power of such surges is enormous. Hurricanes come up the Bay from the south and the "fetch" is thus the full length of the Bay by the time the Baltimore Harbor is reached. The Patapsco is an open funnel-type sub-estuary and is thus very vulnerable to these forces.

Shore Configuration:

"Beaches are energy dissipaters. Their efficiency in this role is greatly influenced by their profile. The nearer deep water is to the shore, the closer large waves can approach before their energy begins to dissipate because of bottom drag. The flatter the gradient both offshore and on the beach "run up" area, the longer and more gradual is this dissipation. A narrow, steep beach will be subject to much greater wave forces than a flatter beach. An offshore bar, breakwater or island will dissipate waves affording protection within the areas they shelter. However, offshore shoals and islands also tend to focus energy, resulting in sporadic concentrated damage areas along the shorefront." (Ref. 6, p.U-147.)

Shore Materials:

The resistance of a shore to erosion depends very heavily on the materials of which it is made. All other forces and characteristics being equal (storms, waves, littoral drift, orientation, etc.) a shore composed of a tough, crystalline rock such as granite will resist erosion much better than a shore made of a soft, friable sandstone. The sandstone in turn would probably withstand

erosion better than would the silty-clays that predominate on the western shore of the Bay.

A thick growth of rooted vegetation on the shore and in the foreshore (i.e., wetlands) will help to retard erosion and indeed may help to trap sediment particles and thus to cause deposition instead of erosion.

Value of Shore to Man:

Shoreline land that man regards as having high value tends to be more concentrated in some areas than in others. Obviously a storm that strikes Baltimore Harbor will have a greater, more immediate and apparent human impact than one that hits the southern part of the Eastern Shore, even though environmental impact and damage to the living resources of the Bay may be greater in the latter case.

Residential land that fronts on the Western Shore of the Bay has very high market value and this value alone, rather than the value of all other potential resources, may seriously influence decisions as to what part of the Bay shoreline merits protection against erosion.

c. Special Limitations on Possible Solutions

The natural processes and forces that cause shore erosion are so great and ubiquitous, and the shoreline of the Chesapeake Bay and its tributaries is so long, that it would be impossible to protect more than a small, selected portion of the shore against erosion.

The costs of protecting the shoreline are very high. Furthermore, methods used to protect the shore must be applied uniformly to the entire stretch of beach in question, lest the entire protective structure be outflanked or penetrated. With most of the Bay's shoreline in private ownership, this presents problems of equity with respect to the apportionment of costs among individual owners of the shoreline, and with respect to the question of public benefit accruing from the protection of private land. However, the scale of the measures necessary to control erosion usually necessitates spreading the costs over a larger sector of the public.

1.3 Location of Problem Areas

As mentioned above, the shore erosion rates vary considerably from one part of the Bay shoreline to another. Dorchester, Queen Annes, and Talbot Counties experienced the highest rates of erosion on the Eastern Shore from 1845 to 1942, while Anne Arundel and St. Marys Counties had the highest rates of the Western Shore Counties. (See again Table 1 and Plate 11. Although Somerset County had one of the lowest average erosion rates during the above period, it was second in the total net acreage lost. This is because the county has a very large shoreline and many offshore islands, including South Marsh and Smith Islands.

Information gathered during the State's wetlands inventory (Ref.7) indicates that about 100 wetland areas are currently being actively eroded. Almost all of the areas are on the Eastern Shore and are in reaches of the shoreline already noted above for high erosion rates.

1.4 Time Characteristics

Much severe shoreline erosion occurs during storms and the worst storms in the Chesapeake Bay region are hurricanes. They usually occur in August and September, with a frequency of about one every ten years. There are, of course, other storms throughout the year, but the worst ones usually occur from late autumn through early spring. There is no evidence to suggest that the severity,

location, or frequency of storms has changed significantly over the years or that they will change much in the years to come. Therefore, the erosion rates calculated for the period 1845-1942 provide a good predictive tool for determining which areas of the Bay shoreline will be most severely affected by erosion in the future.

However, what has changed and will continue to change is the value of the shoreline property to man. This will continue to increase, particularly on the Western Shore in Anne Arundel County and the Eastern Shore's retirement and recreation areas, as population, industry, commerce, and their demands on the Bay's resources continue to expand and multiply.

1.5 Parties Affected

Owners and actual users of shoreline land and users of the waters and shipping channels of the Bay are those most directly affected by shore erosion. Not only do residential, industrial and commercial landowners lose their property (under the common law doctrine still followed in Maryland the owners of private land abutting the Bay lose their property rights in all lands which, through erosion, become submerged at mean high tide [Ref.8]),but also users of both public and private recreational areas such as beaches, parks and picnic grounds lose the use of these areas, an already scarce and valuable resource.

Less obvious and direct is the loss of valuable shore and wetland habitat, which indirectly affects those who exploit and enjoy the living resources of the Bay.

The public is also required to bear at least part of the costs of erecting shore-protection structures, since there are both state and federal cost-sharing programs for such construction.

2 Future Dimensions of Shore Erosion Problems

As we have seen above, the major causes of shore erosion are the natural processes and forces involved and the characteristics of the shoreline acted on by these forces. Man has increasing capability to alter these basic aspects either directly through conscious action or indirectly through pursuit of other purposes (e.g., marine transportation, water supply, urban development, etc.). To attempt to predict the effects on shore erosion of possible alterations of basic natural processes and characteristics of the Bay would be very conjectural. It is enough, perhaps, to say that shore erosion effects of projects which would change tidal characteristics, shoreline configuration, shoreline materials, etc. should be considered in project planning.

2.1 Forces Tending to Increase the Problem

a. Shoreline residential and industrial development, by cutting into the shoreline and altering its configuration can increase shore erosion problems. It is likely that shoreline residential and industrial development will increase in the future and that much of the new development will be on portions of the shoreline which are more exposed to natural erosion processes. For instance, most of the recent development in the Baltimore Harbor has been along the shoreline of the Lower Patapsco River rather than along the less exposed shorelines of the Middle and Northwest Patapsco Branches, and the annual erosion rate along that part of the Bay Shore is 0.20 acres/mile or more.

b. The costs of protecting shoreline are increasing, and these interact with institutional problems and land ownership patterns to make protection of shoreline areas increasingly difficult. Methods used to protect the shore must be

applied uniformly to the entire stretch of beach in question, lest the entire protective structure be outflanked or penetrated. With most of the Bay's shoreline in private ownership, this presents problems of equity with respect to the apportionment of costs among individual owners of the shoreline and with respect to the question of public benefit accruing from the protection of private land. As costs increase the general public is increasingly called on to assist in shore protection programs. (Some examples of costs of shore protection are: groin construction or beach nourishment - over $100 per linear foot; revetments - over $500 per linear foot in exposed areas; bulkheading - about $100 per linear foot. Therefore, with an average cost of $100 per linear foot, it would cost $500 million to protect only half of the 2,000 miles of Maryland's Bay shoreline estimated to need such protection.)

2.2 Forces Tending to Reduce the Problem

Possible solutions to the problem of shore erosion are essentially local in nature and must be addressed to the causes of the problem, i.e. they will have to respond to the special problem causes such as: storms, littoral drift, tidal and stream currents; orientation, configuration, materials and human value of the shoreline; and special limitations on possible solutions.

a. Possible Solutions Addressed to Natural Processes

Storms:

Nothing can now be done directly about the intensity, duration, or frequency of storms. We can deal only with their concomitant effects, such as high waves, runoff, and winds.

Wave energy can be dissipated or absorbed by the construction of offshore bars and breakwaters. Natural bars and shoals perform this function very well and should be maintained where possible. Excessive stream runoff from inland areas could be managed by a whole battery of familiar flood-control and water-land management techniques. Both natural and man-made structures could be reinforced against the direct impact of the high winds associated with storms.

Littoral Drift:

To be effective, the design and placement of shore-protection structures must be responsive to the dynamics of the natural processes involved. Although groins or jetties can be very effective in minimizing the erosional effects of littoral drift, they can do so only if sand is being moved along the shore in the first place. However, by causing sand to accrete on their up-drift sides, they may cause corresponding "starvation" and erosion of the beach on their down-drift sides. Nevertheless, groins will often be an excellent, direct and generally permanent solution, especially if the down-drift areas are deemed less important or valuable than the protected reaches. A common solution to the problem of asymmetrical erosion/deposition at the base of a groin is simply to pump or dredge the sand from the accreting side to the starving side.

Beach nourishment will often be locally the best solution to the problem of shore erosion if an adequate, economical source is available and ecological side-effects can be minimized. This consists simply of transporting sand to the reach threatened by erosion and depositing enough to compensate for the loss to natural processes. If the renourished beach is to be stabilized, the grain-size distribution of the sand must approximate that of the natural beach material. Inland deposits usually result from different geological processes and thus have different char-

acteristics.

Probably the most practical method for large-scale renourishment of beaches will be to dredge the material from offshore. Underwater crawlercutters or suction dredges may be used. The sand will then be pumped through pipes to the shore. The Corps of Engineers has demonstrated the technological feasibility of this method in a pilot project at Sea Girt, New Jersey (Ref. 6). Ecological effects of this type of solution are discussed under Special Limitations below.

Tidal and Stream Currents:

Little can be done about the tides themselves (though it is possible to build tidal barriers or dams), but tidal and stream currents may be controlled or deflected by structures such as jetties, groins, bulkheads, or breakwaters, etc.

b. Possible Solution Addressed to Shoreline Characteristics.

Orientation of Shoreline:

The orientation of a shoreline cannot be significantly modified, but the concomitant effects of waves and littoral drift could be handled as outlined in both the preceding and following discussions.

Shore Configuration:

Beach profiles could be improved so as to make them more efficient and gradual dissipators of wave and tidal energy. The above-mentioned methods of beach nourishment (if carried far enough offshore) and groin-emplacement (if long enough to trap sand in a gently sloping gradient off the shore) could be very effective in changing configuration.

Wetland areas, by their very nature, have excellent energy-dissipating characteristics, and should therefore be maintained and enhanced.

Shore Materials:

Rip-rap, bulkheads, or seawalls would seldom be required to protect the hard crystalline rocks of much of the Maine coast, but if the natural materials of the shore are very easily eroded, as are the sediments of which most of the Bay shore is composed, then such measures may greatly improve the stability and erosion-resistance of the shore. However, these measures are very expensive and therefore, could only be justified when used to protect very high-valued land uses, such as coastal roads, airports, and other urban facilities.

Value to Man:

The more men value a particular stretch of shoreline or piece of shore property, the more they try to justify the expense necessary to protect it. However, these efforts may be unjustified in a wider, more complete, public cost-benefit analysis. Few facilities or land uses must be located directly on the waterfront. Thus, to minimize the public costs of protection the principles of flood and erosion-prone area zoning and management should be applied. Then, only essential waterfront uses would be allowable on the shore. In other words, if it would cost too much to protect a stretch of valuable shoreline, then reduce or limit its value by publicly regulating its use. The cost to the public may be thereby reduced, particularly if it is non-recurring.

In special cases, however, such as Baltimore's or Annapolis' waterfronts, special protection measures will be justified, even to the "floodproofing" of new buildings and the construction of extensive sea walls and bulkheads.

c. Reduction of Special Limitations on Possible Solutions

Sharing the Costs of Solutions:

The costs of solutions discussed above depend on the size of the projects and on the local availability of the materials. Groin construction may cost over $100 per linear foot of coastline protected depending on the dimensions of the waves and the beach, and beach renour-

ishment may cost roughly the same per linear foot of beach. Revetment costs are even higher than beach nourishment and can be over $500 per linear foot in exposed areas. (Ref. 6). Sound bulkheading cost roughly $100 per linear foot in 1968 (Ref. 1). Thus, taking the average cost of shoreline protection to be $100 per linear foot, it would cost $500 million to protect only half of the 2000 miles of Maryland's Chesapeake Bay shoreline estimated to need protection by Singewald and Slaughter. Obviously a high degree of selectivity will be needed in choosing shores that merit protection, and each proposed project must be carefully analyzed to ensure that costs are commensurate with anticipated benefits.[2]

Maryland passed legislation in 1964 that makes the State a partner in private ventures to control erosion. The State established a shore erosion control division within the Department of Chesapeake Bay Affairs. The new agency was empowered to make long-term loans for up to 25% of the total cost of protective structures to individual shorefront owners who formed themselves into erosion control districts. The State raised the limit for its share to 50% in 1968. In fiscal year 1969 the State's appropriations for this purpose totaled an estimated $352,000. At the above-assumed average of $100 per linear foot, and using the 50% sharing formula, this would be adequate to protect only about 1.4 miles of shore. However, the Maryland Geological Survey is helping greatly in the State's efforts to control shore erosion by studying erosional and depositional processes in the Bay, and by conducting research aimed at finding the most effective and efficient methods of erosion control.

"Federal participation is usually allowable when project solutions are beyond the reasonable capability of local authorities and when the benefits are public and exceed the cost. The cost of the study of eligible projects is born completely by the Federal government. Up to half the cost of feasible protective works for beach erosion control along publicly-owned shores is Federal, except in the case of parks and conservation areas which meet certain requirements. In these instances up to 70% Federal costs are authorized. Privately-owned shores are generally ineligible for [Federal] participation except when their protection is beneficial to a nearby public use or when the benefits to the private shore are incidental to the project....

Even when Federal surveys indicate that remedial measures are not economically feasible and thus ineligible for Federal aid, they can be undertaken by state or local interests in a regional development context. These projects can often benefit from the technical evaluation produced in the Federal survey." (Ref. 6)

Reduction of Undesirable Ecological Side-Effects:

During the planning of solutions, careful attention will increasingly be paid to the possible loss of ecological values. Some of the larger projects will have a potential for ecological damage that could be controlled or even reversed by careful design. For example, several kinds of ecological effects may result from a beach renourishment operation. These effects will occur either at the borrow area or at the site of deposition. The following summary discussion of effects is taken from Cronin et al: (Ref.10)

"Off-shore sands are put into place by the dynamics of the coastal circulation system and wave action. They usually contain a lower biomass than estuarine sediments. There is some

reason to expect that removed sand will be replaced and that the biological population will recover in a relatively short period of time, although we have seen no record of an adequate study of the sequence following such removal.

"Removal of benthic material from the lagoon or bay behind a barrier beach will have quite different effects in various circumstances. Some of these areas are of enormous importance as nursery and production grounds for many species of fish, for crabs, shrimp, oysters, clams and other marine forms. Damage to the existing ecological system can affect both local production and the catch of the species over a wide area. At other locations, the sediments behind the barrier beach are composed of hard sand, carried from the beach by aeolean drift, and they may contain and support very little biological activity. In these cases, pumping back onto the beach essentially reverses the wind-blown movement of sand.

"The creation of borrow holes in shallow lagoons frequently provides a new kind of habitat -- deeper water which is not swept vigorously by tidal currents. Such deeps might provide concentration sites for many fish and invertebrates, create an opportunity for some species to increase in abundance, and aid sports and commercial fisheries, swimming or navigation. The effects of such holes should be investigated.

"The receiving area must also be taken into ecological account in decisions on beach nourishment. Storm-lost beaches and stretches denuded by littoral drift are not as likely to contain problems as are natural low beaches which are proposed for elevation. Each such area contains a natural community, and it may contain rare and valuable species or some biological quality of unusual importance. If so, these must be given proper consideration."

Research should be conducted by the Maryland Geological Survey into feasible ways of protecting valuable wetland areas and other areas of high ecological value that are subject to erosion, without serious physical damage or destruction by conventional engineering methods.

2.3 Summary - Future Outlook

Increasing values of shoreline land will generate increasing forces to protect the shoreline from being eliminated or reduced through erosion. However, land values show wide variation in different shoreline areas and these may not correspond to erosion protection priorities considered on a comprehensive basis.

A continuation of present trends[1] would result in an average loss to erosion of about eight acres per linear mile of shoreline between now and the year 2000. The application of some of the approaches mentioned above, allocated on the basis of land values or local initiative, would not appreciably reduce the average loss over the entire Bay shoreline.

Db
Sedimentation

1 Sedimentation Problems

The problem, as with Shore Erosion, is how to control sedimentation in an economically, socially and environmentally acceptable way.

1.1 Nature of the Problem

All the rivers flowing into the Bay, but particularly those on the Western Shore, carry enormous loads of sediments to the Bay. In addition, as we have seen above, erosion of the Bay shoreline and bottom contributes great quantities of sediment. Once in the Bay these sediments are redistributed over the bottom by wave action and tidal currents.

This sedimentation creates many problems. Channels are filled and blocked, necessitating extensive and continuous dredging operations at great public cost. ("Something less than one foot per year of sediment must be dredged to maintain the ship channel from the Chesapeake Bay Bridge to the Baltimore Harbor."[Ref.1]) Harbors, large and small, and marinas may be filled and rendered useless. Estuarine portions of the Bay's tributaries, indispensable to the Bay's living resources, have been filled and are continuing to be filled. Sudden large accumulations of sediment may smother bottom-dwelling marine life or increase turbidity, which in turn creates an unfavorable environment for many desirable species of fish.

The actual volume and rates of sedimentation are variable and are due to a combination of factors: grain size distribution (i.e. gravel, sand, silt, clay), density of the sediment particles, human activity in the source watershed, bottom characteristics, stream discharge and gradient, speed and direction of currents in the Bay, location in the Bay,etc. Thus, while as much as 15 feet of sediment accumulated in the Patapsco River near Baltimore between 1845 and 1924, other areas with strong bottom currents have been kept relatively well scoured.

1.2 Causes of the Problem

The major causes of the problem of sedimentation are the natural processes involved, the influence of man's activities on these processes, and the environmental and economic limitations on solutions to the problem.

a. Natural Processes Involved

Each river that enters the Chesapeake Bay carries with it a load of sediment and other detritus. Although accurate data on the contribution of the various tributaries are not available, the Potomac and the Susquehanna are clearly the main contributors. (See Table 2). Schubel (Ref. 4) estimates that the Susquehanna River delivers about 600,000 tons of sediment per year to the upper Bay. However, the long term average annual sediment contribution of the Susquehanna may be somewhat higher, because his observations were made in a year of relatively low flow.

The estimated contribution of the whole Potomac basin is about 170 tons per sq.mi. or 2.5 million tons per year. Approximately 1.0 million tons per year (or 114 tons/sq.mi./yr.) are derived from the basin above Point of Rocks, Maryland.

There are few measurements of the amount of sediment carried by streams rising in the coastal plain. Data for Mattawoman Creek (see Table 2) and for some streams in the New Jersey coastal plain indicate that sediment loads in such streams are small, something on the order of 20 to 30 tons per square mile. This is in marked contrast to the streams that rise in the Piedmont and Appalachian Ridge and Valley provinces. For example, the Potomac's load above Fort Washington of 2.3 million tons per year calculates out to 180 tons/sq.mi./yr.

TABLE 2. SEDIMENT DISCHARGE OF SELECTED TRIBUTARIES, CHESAPEAKE BAY REGION

River	Location	Physiographic Province	Drainage Area (sq.mi.)	Sediment Discharge Tons/year	Sediment Discharge Tons/sq.mi./yr.
Susquehanna	Havre de Grace.	Piedmont	27,503	0.6×10^6	22
Potomac	Point of Rocks, Md.	Piedmont	9,651	1.1×10^6	114
Potomac	Fort Washington below D.C.	Piedmont & Coastal Plain	11,939	2.3×10^6	180
Patuxent	Hardesty.	Coastal Plain & Piedmont.	371	8.7×10^4	235
Patuxent	Unity.	Piedmont	34.8	4.5×10^3	130
Patuxent	Mouth.	Piedmont & Coastal Plain.		$.19 \times 10^6$	
Mattawoman	Pomonkey	Coastal Plain.	57.7	1.7×10^3	30
Average, several	New Jersey	Coastal Plain.	- - - -	- - - -	10-40

(Reproduced from Table 2 in Ref. 1)

Wolman (Ref. 1) "guesstimates" that the total amount of sediment being contributed to the Bay system by streams rising in the coastal plain, in the Appalachian plateau, valleys and ridges, and in the Piedmont would be about 8 million tons per year, and only 5% of this, or 40,000 tons, would be derived from the coastal plain. This assumes a yield of about 150 tons/sq.mi./yr. for the Piedmont and Appalachian streams, and about 30 tons/sq.mi./yr. for those in the coastal plain. This jibes very well with Ryan's estimates (Ref. 3) that "the average rate of sedimentation in Chesapeake Bay during this period [the 10,000 years since the close of the Pleistocene] has been about 6,115,000 cubic yards per year," if we assume a density factor of 1.3 tons per cubic yard of (dry) sediment.

When the tributary streams enter their estuaries, their current velocities are reduced and their sediment loads are deposited. The larger particles settle closest to the mouths of the rivers and the finer particles at successively greater distances. Schubel (Ref. 4) shows that virtually all of the sediment carried by the Susquehanna is deposited in the upper Bay above Tolchester (see Ref. 1, Figure 8). On the other hand, the Potomac transports its sediment load about 106 miles from the Fall Line to the Bay proper before depositing it.

Materials eroded from the shoreline are displaced only a relatively short way into the deeper waters of the Bay. Ryan (Ref. 3) shows that sands are confined to the margins of the Bay, with the deeper parts and narrow main channel containing silts and clays. For the Bay as

a whole, the modern bottom sediments consist of about 51% clayey silt, 12% fine and very fine sand, and 37% medium sand. (Ref. 1) Pl. 11 (largely derived from Ryan's map) clearly shows the overall pattern of near-shore sands and finer silts and clays toward the center of the Bay.

b. Influence on Man's Activities

The 600,000 ton annual sediment load of the Susquehanna represents a contribution of only 23 tons per year per square mile of drainage area. This apparently very low contribution is attributed at least partly by Wolman to the series of hydroelectric dams on the Susquehanna, which act as sediment traps. He estimates that the total contribution of the Susquehanna to the upper Bay "would be perhaps 1.7 times as great were it not for deposition which takes place in these reservoirs along the lower course of the river." On the other hand, roughly 25 to 30% of the one million tons reaching the Potomac estuary at Washington, D. C. is derived from the urbanizing metropolitan area alone.

Furthermore, evidence from early charts and maps, historical documents, and field studies and boreholes shows that the rates of sedimentation in different parts of the Bay have indeed varied over historic time. "Prior to settlement by colonists and the initiation of landclearing and agriculture, rates of sediment contribution from land under forest cover were perhaps on the order of 100 tons/sq.mi./yr. However, with the advent of extensive clearing for agriculture, these rates rose rapidly to values of 400 to 800 tons/sq.mi./yr."

"By 1800 such prominent harbors as Joppatowne at the mouth of the Little Gunpowder, Port Tobacco, Upper Marlboro on the Patuxent and others had begun to be severely affected by sediment, some as early as 1700. While the estimates are not precise, it can be seen that the landward edge of tidewater or head of navigation receded as much as two to ten miles in some of these harbors before the end of the eighteenth century." (See Table 3).

c. Limitations on Possible Solutions

High costs of remedial measures:

An excellent example of the sort of costs engendered by sedimentation is provided by the Potomac and Anacostia Rivers near Washington. Channel improvement and dredging operations have been almost continuous there since 1804. It has been estimated (Ref. 1, p.II-26) that the annual cost of dredging on the Potomac near Washington is about $150,000.

An even more striking example is that provided by the project to enlarge and deepen the Chesapeake and Delaware Canal, as authorized by the Congress in 1954. About 10 million cubic yards of sediment were dredged in 1965-67 from the channels in the Bay approaches to the Canal. An estimated 15 million cubic yards must also be removed in the next 50 years to retain the project dimensions of the channel. (Ref. 10) Assuming an average dredging cost of $0.50/cu.yd., this would mean a maintenance cost of roughly $7.5 million over the next 50 years or about $150,000 per year. The cost of disposing of spoils from the project may be as much as three times this amount.

Environmental effects:

Dredging requires not only removal of the sediments but disposal of the dredged material as well. In the past it has been customary to simply pump spoil material to nearby shallow water or wetlands, thus often "reclaiming waste land" while maintaining necessary channels. However, now it is recognized that such disposal in valuable, limited, and often fast-disappearing wetlands poses many possible environmental problems. Disposal of fine sediments on flat bottom areas will affect a wide area because of the spread of the semi-liquid spoil and the reworking of the sediments by currents after original deposition. Disposal into basins will affect smaller areas and help to reduce future mainten-

TABLE 3. SEDIMENTATION AT SELECTED HISTORIC TOWNS UPPER CHESAPEAKE BAY REGION

Town or Location	Founded	River or Creek	Approx. Time Sedimentation Recorded	Amount of Downstream Migration of Head Navigation (Miles)	Approx. Reduction in Depth (Feet)	Years
Bladensburg, Md.	1742	Anacosta	1875	2	3	1875-1937
Piscataway, Md.	1634	Piscataway	1807	1	3	1863-1945
Georgetown, Wash.,D.C.	1751	Potomac	1804	20[a]	9.25	1783-1837
Mt. Vernon	1752	Potomac	1793	--	1 to 4	1863-1904
Dumfries, Va.	1748	Quantico	1787	1.7	4	1796-1905
Iron Factory	1734	Neabsco	--	0.75	--	1734-1872
Port Tobacco	1658	Port Tobacco	1700	1	6	1800-1882
Upper Marlboro	1706	Patuxent	1773	8	7	1859-1944
Elk Ridge near Baltimore	1650	Patapsco	Before 1898	7	15 at Hanover St.	1845-1924
Joppa Town	1707	Gunpowder	1750	2.5	10	1750-1897

[a]Accumulation that would have taken place had there been no dredging of the harbor and creation of landfill such as Haynes Point or National Airport.
(Source: Table 3 in Ref. 1)

ance, but such areas often have special ecological values, e.g. as winter habitat for many valuable species of fish. Thus, dredging and overboard spoil disposal almost always destroy large numbers of bottom-dwelling organisms. The organisms are removed by the dredging or smothered by the spoils. Turbidity is increased markedly, and resuspended fine sediment may clog filter feeders such as clams and oysters, or the gills of fish.

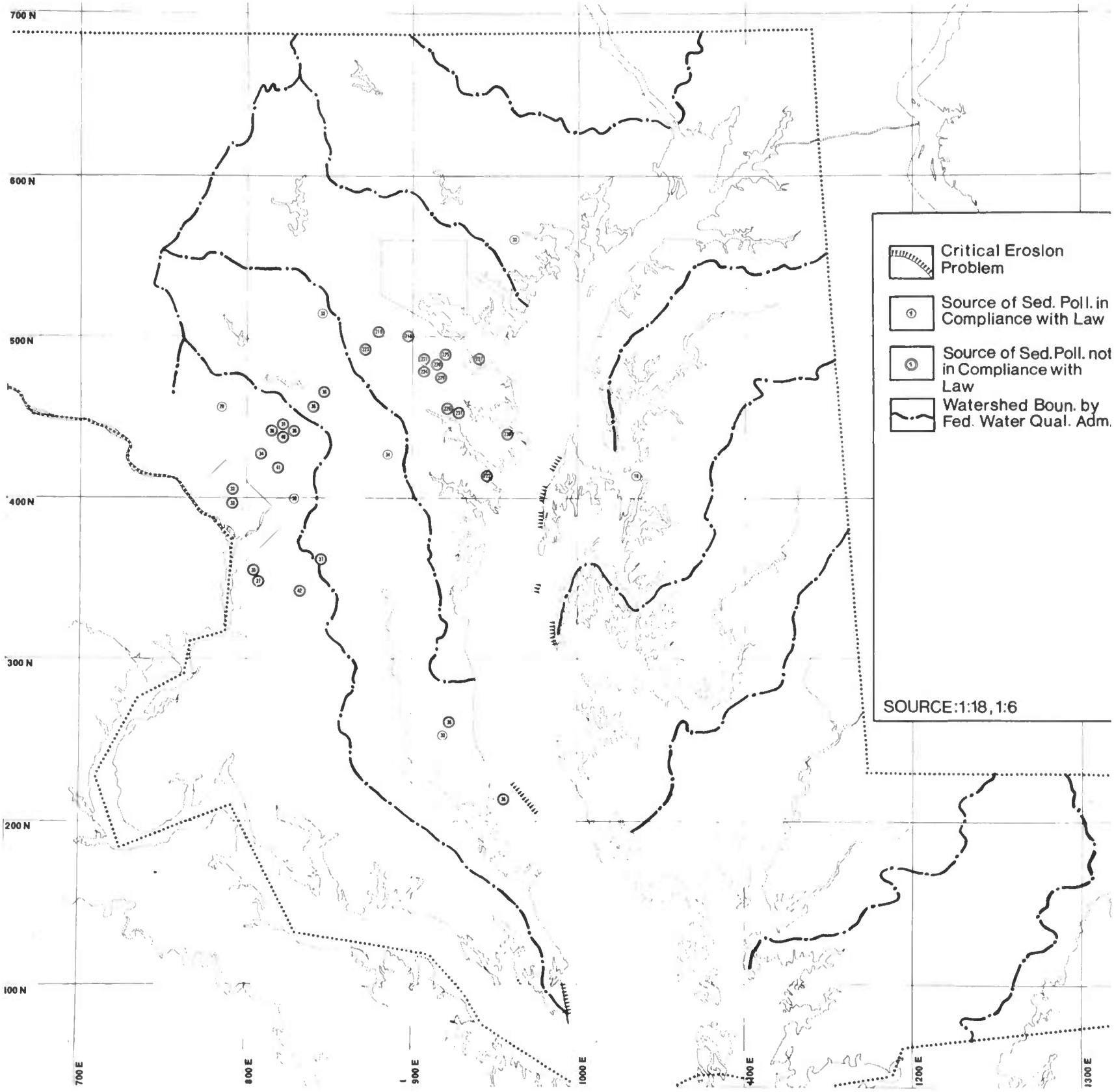
But these watery silts and muds are hard to dispose of on land because of the difficulty encountered in dewatering them. As much as 40 to 50 years may be required to create "dry" land if spoil is disposed of by filling behind bulkheads. (Ref. 1)

Thus, dredging and spoil disposal pose major problems of management and economics because of the conflicting values and uses in the Bay. More detailed information is needed to delineate areas of wetland that would be least harmed by disposal, which areas must be strictly protected, and what the costs would be of alternate methods of disposal, e.g. barging of the spoils to sea.

1.3 Location of Problem Areas

Plate 7 (Shore Erosion and Bay Sedimentation) shows the distribution of the Bay's modern bottom sediments with, as mentioned above, coarser sediments near the mouths of tributaries and near shore,

PLATE 8 : Shore Erosion and Sources of Sedimentation and Turbidity



and finer sediments towards the middle of the Bay and in deeper channels.

Plate 12 (Shore Erosion and Sources of Sedimentation and Turbidity) shows schematically the contributions of the Bay's major tributary streams.

Again, Table 3 emphasizes that the tributary estuaries themselves are the sites of the most dramatic and evident sedimentation, since almost all of their sediment loads come to rest within a relatively short distance from the mouths of the rivers, where they enter their estuaries.

1.4 Time Characteristics of the Problem

While the river flow into the Bay is seasonal, sediment inflow from the Potomac and Susquehanna is even more so. As much as 70 to 80% of the yearly sediment load may be carried by either river in just a few days of spring floods. Precipitation and runoff of meltwater are high, soils are beginning to thaw, rock and soil particles have been loosened by frost action, and there is less vegetation to hold soil in place. Thus, 80 to 90% of the annual load is carried to the Bay in February and March (see Ref. 1, Fig.7).

The deposition of sediments eroded from the shoreline continues throughout the year, but is probably more concentrated in the periods immediately following the storms during which much of the material is eroded.

1.5 Parties Affected

Users of the waters, shipping channels and harbors of the Bay are those most directly affected by sedimentation. Most of the materials eroded from the shoreline are displaced as sediment only a relatively short distance into the deeper waters of the Bay. They, together with sediments brought from inland streams, fill shipping channels, thus necessitating dredging at high public cost.

2 Future Dimensions of Sedimentation Problems

The problem is how to most economically control the adverse effects of sedimentation on other uses of the Bay.

2.1 Forces Tending to Increase the Problem

a. Expanding urbanization will involve construction activities of all kinds and this will produce increased sedimentation which will fill shipping channels at increasing rates, smother bottom-dwelling marine life, or increase turbidity, thereby affecting certain desirable fish species as well as water contact recreation. Highway construction, in particular, is a producer of sedimentation, because of the extensive grading involved. To the extent that highway construction results in increases in the costs of maintaining shipping channels, it is being subsidized by marine transportation.

b. A factor which will compound the effects of urbanization is the long-range trend toward lower densities and more extensive construction activity in urbanization. Not only does the average surburban development consume more land area per resident than would have been the case 20 years ago, but also, more extensive infrastructure and ancillary facilities are involved in suburban development. The conclusion is that the sedimentation impacts per capita of population growth will increase in the future.

c. The dredging of deeper shipping channels will tend to increase the rate of sedimentation into them and increase costs of maintaining the channels at their intended depths. Already about a foot per year must be dredged to maintain the ship channel from the Bay Bridge to the Baltimore Harbor.

d. The costs of dredging - including the monetary costs of the dredging activity itself, the costs of transporting spoil material to a suitable disposal site, and the difficulty of finding suit-

able disposal sites - will tend to increase in the future. Thus, even if the rates of sedimentation of shipping channels remained constant, the costs of dealing with this sedimentation would increase.

e. The rates of sedimentation associated with rural land areas could also increase. Noteworthy in this regard is the current intention of the State to cut down 277,000 acres of loblolly pine forest in order to combat infestation by the Southern pine beetle. (Ref. 11) The deforestation is likely to result in increasing rates of sedimentation from the acreage involved.

f. The use of the Bay for water-contact recreation and sport fishing is likely to be translated into higher public standards with regard to water turbidity, which will increase the urgency of sedimentation control activities.

2.2 Forces Tending to Reduce the Problem

As in the case of solutions to the shore erosion, possible solutions to the problem of sedimentation must be addressed to the causes of the problem -- the natural processes involved and the influence of man's activities on these processes, and natural and economic limitations on solutions.

a. Possible Solutions Addressed to Natural Processes and Man's Activities [3]

The construction activities that accompany increasing urbanization within the Chesapeake drainage basin contribute enormous quantities of sediment to local streams. Highway construction has been virtually a chronic offender in this respect. As noted above, 25 to 30% of the million tons per year entering the Potomac at Washington is estimated to derive from construction sites in the metropolitan area alone. In other words, as much as 300,000 tons, or 12% of the total 2.5 million tons contributed annually by an entire drainage basin of over 12,000 square miles, comes from perhaps 500 square miles or about 4% of the area. Therefore, it seems imperative that stringent ordinances be passed and firmly enforced to require good soil conservation techniques to be used on all construction sites. Nor should the large contribution of areas under cultivation be forgotten. It is usually much easier to reduce the sediment outflow than it is to remove the material after it has settled in harbors, estuaries, and channels.

The incorporation of soil conservation objectives into local land use planning and land use control procedures is perhaps the most promising approach to alleviating sedimentation problems in urbanizing areas. The effort to make urban development consistent with good soil conservation practices is already being made in some high quality urban developments (e.g., Columbia). This approach could be extended so that it is the general rather than the exceptional case.

Reforestation and the application of soil conservation techniques in agriculture could reduce sediment loads from rural areas. Perhaps the Soil Conservation Service could provide funds for such measures and practices in a program expanded from their present activities.

b. Reduction of Limitations on Possible Solutions

However, once sediments do reach the harbors and channels of the Bay and its tributaries, dredging is probably the only answer to the problem. So the problem now becomes one of minimizing the impact of the dredging and the spoils disposal.

The best way (environmentally speaking, that is) to dispose of spoils is probably to barge them to sea, but the costs would be prohibitive in most instances. However, some excellent guidelines for dredging and spoil disposal have been developed by Cronin et al. (Ref. 10)

Since the spoil pile in their study spread to reach a slope of about 1:500, they recommend that a safety zone appropriate to the thickness of the deposited spoil be estimated and maintained

near oyster or clam beds, or other important bottom-related resources. The special ecological values of confined, deeper basins should be considered when they are examined as possible sites for spoil disposal. Damage to bottom species is probably least in winter and early spring. In contrast, damage to fish eggs and larvae is most likely in November through January in deep water, and in April through August for shallow water. The periods of least probable damage to eggs and larvae are in February, September, and October. They conclude that (for the Upper Chesapeake Bay) the periods of least probable total damage from dredging and spoil disposal are in February-March or September-October.

Therefore, efforts to develop techniques of dredging and spoil disposal which have less adverse impacts on aquatic life will reduce problems associated with sedimentation. These include: 1) the development of alternative methods of spoil disposal -- e.g., barging of the spoils to sea, 2) research to delineate areas of the Bay that would be least harmed by spoil disposal, and 3) time-phasing of dredging and spoil disposal activities so that they cause the least probable damage to aquatic life.

Any change in the shoreline or bottom of the Bay, whether natural or man-made, alters the speed and direction of currents, thereby changing the carrying capacity of the currents of sediments. Therefore, any proposed structures or alterations in the shoreline or bottom should be designed so as to achieve the most desirable possible changes in the local pattern of sedimentation. If currents are obstructed or slowed, sedimentation will occur; if they are speeded up, say by straightening of a stream channel, sedimentation will decrease and scouring may even take place.

2.3 Summary -- Future Outlook

Current annual rates of sedimentation have been roughly estimated at about 30 tons per square mile from Coastal Plain areas and 150 tons per square mile from Piedmont areas. (Ref. 1) Annual rates of sedimentation from land under forest cover are estimated at about 100 tons per square mile. Areas under agricultural cultivation may contribute sediment at annual rates of 400 to 800 tons per square mile. (Ref. 3) The impact of suburbanization and highway construction increases these rates considerably, and the rate of sedimentation from areas of completed development remains high. Thus, the current trends indicate that sedimentation will increase and that streams in urbanizing areas will be most severely affected. The application of soil conservation practices in urban development has potential for reducing this problem considerably.

Dredging operations to remove sedimentation from shipping channels is a major monetary cost of sedimentation. The annual cost of dredging on the Potomac near Washington is about $150,000. (Ref. 1) The annual cost of maintaining the shipping channel approaches to the Chesapeake and Delaware Canal is also estimated at about $150,000. Data are not available on the total cost of channel dredging operations in the Maryland Chesapeake Bay Region. The future outlook is for the monetary costs of dredging and spoil disposal operations to increase steadily. This will be due both to increases in the total volume of material removed from shipping channels and to increases in the unit prices of removal and disposal. However, the application of better spoil disposal techniques can reduce the environmental impact of this activity.

It should be noted that the biological impact of sediments both in suspension and upon deposition can be a serious problem.

3 Shore Erosion and Sedimentation: Goals, Objectives, Standards, Policies

3.1 Goal: Stabilize Bay Shores Against Erosion and Minimize Negative Effects of Sedimentation

Part of Goal C. above, this goal has the related aspects of erosion, sedimentation-deposition and is related to water movement.

3.2 Objectives

a. Minimize erosion of wetlands that are most biologically important. Many of the most important wetlands are "prominent erosion casualties" (Ref. 6) but protective measures may change their nature.

b. Stabilize shorelines that are economically most important.

c. Reduce to a minimum deposition of sedimentation by water movement in ship channels, on wetlands and on other aquatic habitats. By the same token encourage deposition on potential beaches and where wetlands are forming.

d. Eliminate erosion and sediment runoff from land to water.

3.3 Standards

Standards for acceptable amounts of erosion sedimentation and deposition can be established that are related to economic solutions by benefit-cost-ratios.

It is evident that, as in other goals, we are dealing with a process of nature which is not easily amenable to economic solutions. Field research is needed to identify elements of the process for specific problem areas, and the U.S. Corps of Engineers' hydraulic model of the Bay will be extremely useful for this.

3.4 Policies

Many policies, or guiding principles related to erosion, sedimentation and deposition run into conflict with those for other goals. This is by virtue of the fact that most programs to control erosion and sedimentation within the Bay itself have substantial consequences for wetlands, water movement and living resources.

A systems approach would trace the implications of such policies as the following:

a. Identify all areas for which erosion and/or deposition is severe on biologically most important wetlands (as indicated by Goal B) or economically most important shoreline (as indicated by Goals J and K).

b. Conduct studies to determine erosion dynamics and consequences;

c. Examine possible methods of shore stabilization or other control in terms of consequences;

d. Develop benefit-cost accounts to include social and non-economic elements.

The key to being able to define the trade-offs in comparable units necessary between goals is to translate each into the policy and program level and into comparable units of input. These units can then be compared along with anticipated outputs (also translated into comparable units) in goal achievement between programs. This is the essence of a planning-programming-budgeting type approach to systems analysis.

Footnotes

1. Based on the data covering the years 1845 to 1942.

2. The present system (since 1970) provides for interest-free loans.

3. Reference should be to the Maryland Sediment Control Act for basic legislative mandate.

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II. PROBLEMS AND GOALS

E. WATER POLLUTION 84

1. Water Pollution Problems 84
1.1 Nature of the Problem 84
1.2 Causes of the Problem 84
1.3 Location of the Problem 88
Plate 9: Wastewater Discharge 89
Plate 10: Wastewater Discharge Diagram 90
Plate 11: Major Sewage Treatment Plants 91
Plate 12: Water Quality Problems 92
Plate 13: Public and Private Sources of Pollution 93
1.4 Time Characteristics 94
1.5 Parties Affected 95

2. Future Dimensions of Water Pollution Problems 95
2.1 Forces Tending to Increase the Problem 95
Table 1: Future Dimensions of Liquid Waste Generation and Discharge in the Bay Region, by County 94
Table 2: Future Dimensions of Liquid Waste Discharges, by Major Drainage Area 96
Table 3: Pounds BOD in One Million Gallons Wastewater Flow in Larger Sewage Treatment Plants in Bay Region 97
Table 4: Summary of Effects of Agricultural Return Waters on Receiving Waters 98
2.2 Forces Tending to Reduce the Problem 99
2.3 Summary - Future Outlook 102

3. Water Pollution Goals, Objectives, Standards, Policies 102
3.1 Goal 102
3.2 Objectives 102
3.3 Standards 103
3.4 Policies 103

E
Water Pollution

1 Water Pollution Problems

The problem is how to dispose of waterborne wastes in an environmentally and economically acceptable way.

1.1 Nature of the Problem

Water pollution is considered to occur when any addition to the water environment alters the water characteristics and quality to the point where a desirable property or use is impaired or lost. However, the problem is not, strictly speaking, how to eliminate pollution in the Chesapeake Bay, but rather to reconcile the need for waste disposal with the requirements of other Bay uses. In other words, optimum waste treatment and disposal might be considered achieved if water quality is at a high enough level so that the Bay's living resources are healthy and abundant, recreational uses of the Bay such as boating and swimming are possible, and the aesthetic enjoyment of the Bay is unimpaired.

1.2 Causes of the Problem

The causes of water pollution may be classified by: a) physical type, source, amount; b) institutional or organizational constraints on solutions; and c) knowledge gaps.

a. Types and Sources of Pollution

The most important sustained and continuous types of water pollution in the Chesapeake Bay are those from domestic, industrial, and agricultural sources. Also continuous, but less important, is seepage or leaching from solid waste disposal areas. Somewhat more discontinuous or intermittent is the pollution that results from storm runoff and discharge from combined sanitary-storm sewers, and pollution caused by marine transportation (such as oil spills) and boating.

Domestic Sewage:

Domestic sewage may be collected and discharged through a municipal sewer system or through private systems such as septic tanks or cesspools. In either case, it consists of human excrement, paper, soap, detergents, food wastes, and many other substances. It also contains pathogenic organisms that can cause typhoid, dysentary, cholera, and other diseases.

Domestic sewage is a major potential contributor to water pollution in the Bay because: 1) if visible it is obviously aesthetically obnoxious; 2) the biochemical decomposition process consumes much dissolved oxygen, thereby depleting the supply necessary for the maintenance of valuable aquatic life; 3) as mentioned above, it carries disease-causing agents of various kinds; and 4) it is rich in plant nutrients such as nitrates and phosphates, which may overfertilize the water and thus produce eutrophication.

A total of about 270 mgd (million gallons per day) of treated municipal sewage is discharged from Maryland counties into the Maryland portion of the Chesapeake Bay or its tributary estuaries. (Ref. 1) An additional 300 mgd is discharged into the Potomac estuary by Washington, D.C.'s Blue Plains treatment plant. Of the above total of 570 mgd about 5.4 mgd is discharged directly to the Bay.

Where municipal sewers are not available, state regulations require that sources of human wastes have septic systems. The discharge of such systems is not included in the above totals, and is not large by comparison, but nevertheless may cause local water quality problems.

Industrial Wastes:

Industrial wastes may vary from relatively clean rinse water or cooling water (heat content as a "pollutant" is considered in Section G. Thermal Waste Discharge) to extremely harmful materials, such as toxic chemicals, heavy metals such as the by now infamous mercury, lead, zinc or oil and grease. In some instances such wastes are discharged into municipal sewer systems, but in many cases they are discharged directly, with or without

treatment, to the receiving waters of the Bay and its tributaries.

Four major industry groups are usually the greatest contributors of industrial wastes on a nation-wide basis - paper, organic chemicals, petroleum and steel. However, much additional investigation is needed in order to develop quantitative waste coefficients by industry-type.

Agricultural Wastes:

The wastes from agricultural operations include enormous amounts of animal excrement, pesticides, herbicides, and fertilizers. Both surface runoff and percolating ground waters carry an undetermined amount of these pollutants to the Bay's waters.

The animal wastes and fertilizers pose the same problems as do human wastes, i.e. they are obnoxious to the senses, they represent extremely high BOD's (Biochemical Oxygen Demands), they contain large numbers of possible pathogens, and they contribute largely to the problem of overfertilization and subsequent eutrophication. The pesticides and herbicides, particularly the persistent varieties such as DDT, pose a critical threat to the health or even the continued existence of the Bay ecosystem, especially its valuable fish and shellfish species. For example, very low concentrations of dieldrin can kill crab larvae since their metabolic processes are very similar to the pests that are the originally intended targets of the poison.

Because of the widespread or non-point nature of the sources of agricultural pollution, no accurate figures are available as to the quantities of pollution from them. However, it has been estimated that livestock in the North Atlantic Region "currently produce a BOD load equivalent to that of about 82 million people." (Ref.2) This would indicate that the magnitude of the problem is at least as great again as that of municipal sewage production, while treatment is an immensely greater problem because of its non-point source nature.

Leaching from Solid Waste Disposal Sites:

The problem of Solid Waste Disposal is discussed separately in Section L. However, seepage from garbage dumps and sanitary landfills can often pose serious water pollution problems, albeit they are usually quite localized. Continuous leaching for less than a year of an acre-foot of sanitary landfill will produce a minimum extraction of: 1.5 tons of sodium and potassium; 1.0 ton of calcium and magnesium; 0.91 tons of chloride; 0.23 tons of sulphate; 3.9 tons of bicarbonate; and similarly large amounts of organic pollutants. (Ref.3)

Storm Runoff and Combined Sewer Discharge:

Much of the pollutant load carried by overland runoff is that already considered above under "Agricultural Wastes". In addition large amounts of air pollutants are washed down, and a wide variety of pollutants are washed from rooftops and pavements. There are also an undetermined number of untreated waste discharges from combined sanitary/storm sewers that become overloaded during periods of heavy rainfall.

Pollution Due to Marine Transportation and Boating:

The Chesapeake Bay usually has a large population aboard various kinds of vessels, from large ships to small pleasure craft. It is estimated that the sewage discharged from all vessels into the Chesapeake Bay is roughly equivalent to that from a city of 20,000 people. (Ref. 4) In terms of its overall impact on the oxygen or nutrient budget of the Bay, this load is not too significant, but it is serious for another reason. Vessels are most often relatively concentrated at places such as marinas or ship anchorages. If these areas are close to bathing beaches or shellfish harvesting areas, serious health problems may result from the overboard disposal of sewage. However, the most dreaded pollution potential of the marine transportation industry is the accidental

spillage or careless but deliberate discharge of large amounts of oil or other hazardous substances into the Bay. If a large oil tanker were to rupture or in some other way spill its cargo into the Bay, the damage to property and the Bay's living resources would be enormous.

"Perhaps the larger tankers will not be able to ply the waters of the Chesapeake, but to remain competitive, tankers on the Bay will probably get larger. More than likely, barges will be used to move oil and petroleum products on the Bay. Just as with tankers, the trend is toward the use of larger and larger barges.

The danger is not limited to the actual sinking or rupturing of the vessel itself. Oil spills also come from operating procedures. These include loading and unloading of oil, transfers of fuel within ships, bilge pumping, ballasting and tank cleaning. Neither is the source of oil pollution limited to ships and barges. Mistakes and accidents can occur on shore at docks, tank farms, pipelines, and any other place where oil is transported or stored." (Ref. 4)

Below are some excerpts from an account by Woods Hole Oceanographic Institution scientists of a small oil spill that occurred when an oil barge grounded in Buzzards Bay, Massachusetts.

"The interim results of our survey, coupled with research findings of other studies in this laboratory, indicate that crude oil and other petroleum products are a far more dangerous and persistent threat to the marine environment and to human food resources than we would have anticipated. Our most important findings are these:

Crude oil and petroleum products contain many substances that are poisonous to marine life. Some of these cause immediate death; others have a slower effect. Crude oils and oil products differ in their relative composition; therefore the specific toxic effect may vary. Crude oil, in general, is less immediately toxic than some distilled products, but even crude oil that has been weathered (altered by exposure to the weather) at sea for some time still contains many of the acutely toxic hydrocarbons. The more persistent, slowly acting poisons (for example, the carcinogens) are more abundant in crude oil than in some of the lower boiling distillates. These poisons are quite resistant to the environmental weathering of oil.

In spite of low density, oil may mix with water, especially in a turbulent sea during storm conditions. Hydrocarbons may be dispersed through the water column in solution in the form of droplets, and the compounds may reach the sea bottom, particularly if weighted down by mineral particles. On the sea floor oil persists for long periods and can continue to damage bottom plants and animals. Thus, a single accident may result in long-term, continual pollution of the sea. This is a very important finding since biologists have long agreed that chronic pollution generally has more far-reaching effects than an accident of short duration. Hydrocarbons can be taken up by fish and shellfish. When the oil enters the fat and flesh of the animals, it is isolated from natural degradation processes. It remains essentially constant in amount and chemically intact even after the animals are transplanted into clean water for decontamination. Thus, chemicals from oil that may be poisonous to marine organisms and other animals, including man, may persist in the sea and in biological systems for many months after the spill.

By killing the bottom organisms, oil reduces cohesion of the bottom sediments and thereby accelerates transport of the sediments. Sediment movements along the sea bottom thus are a common occurrence after an oil spill. In this way contaminated sediments may be spread over great distances under the influence of tide and wave action, and the oil may be carried to areas not immediately polluted by the spill.

None of the presently available counter-measures can completely eliminate the biological damage of oil spills. The rapid removal of oil by mechanical recovery or by burning appears most promising. The use of sinking agents or detergents, on the other hand, causes the toxic and undegraded oil to spread in the ocean; the biological damage is then greater than if the spill had been left untreated. Reclamation of contaminated organisms, marshes, and offshore sediments is virtually impossible, and natural ecological recovery is slow.

Conclusions: Our analysis of the aftermath of the West Falmouth oil spill suggests that oil is much more persistent and destructive to marine organisms and to man's marine food resources than scientists had thought. With the advent of objective chemical techniques, oil pollution research has entered a new stage. Earlier interpretations of the environmental effect of oil spills that were based on subjective observation, often over a short time span, have questionable validity. Crude oil and oil products are persistent poisons, resembling in their longevity DDT, PCB, and other synthetic materials. Like other long-lasting poisons that, in some properties, resemble the natural fats of the organisms, hydrocarbons from oil spills enter the marine food chain and are concentrated in the fatty parts of the organisms. They can then be passed from prey to predator where they may become a hazard to marine life and even to man himself.

Natural mechanisms for the degradation of oil at sea exist -- the most important of which is bacterial decomposition. Unfortunately, this is least effective for the most poisonous compounds in oil. Also, oil degrades only slowly in marine sediments, and it may be completely stable once it is taken up by organisms. It has been thought that many of the immediately toxic low-boiling aromatic hydrocarbons are volatile and evaporate rapidly from the oil spilled at sea. This has not been the case at West Falmouth, where the low-boiling hydrocarbons found their way into the sediments and organisms. We believe that the importance of evaporation has been over-estimated.

Oil laden sediments can move with bottom currents and can comtaminate unpolluted areas long after the initial accident. For this reason a single and relatively small spill may lead to chronic, destructive pollution of a large area." (Ref. 5)

"Although worldwide attention is focused on oil because of the recent events off England and in San Juan Harbor, similar risks attend the shipping of other hazardous substances. In the last 10 years a barge with 600 tons of chlorine sank in the Mississippi River; 2,500,000 gallons of soybean oil and 500,000 gallons of salad oil spilled from ruptured tanks into the Minnesota River; while unloading anhydrous ammonia from a barge, a hose ruptured causing 42 people to be hospitalized and millions of fish to die in the Illinois River near Peoria; and, in addition, there have been numerous reportings of truck and railway accidents where large amounts of hazardous substances have been spilled into waterways." (Ref. 4)

Finally, the maintenance of channels and harbors necessitates dredging, and dredging in heavily polluted areas may reactivate and release harmful materials that had precipitated out and had been covered by subsequent sedimentation.

b. Institutional or Organizational Constraints

"Both human sewage and industrial wastes contribute to the BOD load of the waters, but they are regulated and controlled separately -- the first by the Health Department, the second by the Department of Water Resources." (Ref. 6)

Thus, although there are state water quality standards administered by the Department of Water Resources, the State Health Department still has control over sewage disposal and drinking water supply. In addition, the County Health Departments also promulgate regulations

on sewage and water supply.

Recently, the State established the Maryland Environmental Service as "an implementing and operating agency with functions and responsibilities wholly distinct from those of the regulatory agencies, the Department of Water Resources, Environmental Health Services, and the Department of Natural Resources (acting for the Board of Public Works with regard to spoil disposal in wetlands). The Environmental Service must comply with regulations issued by the regulatory agencies in a deliberately designed system of checks and balances. The Service, with its power to raise funds by revenue bond sales which would be repaid by charges for treatment and disposal services, and its responsibility to accept and operate facilities upon the proper request or by directive originating in the regulatory agencies, represents a principal instrument of the State for insuring that needed projects are foreseen, funded and built. (Ref. 7)

The Environmental Service seems well-conceived and is apparently proving itself effective.

c. Knowledge Gaps

"Some of the major knowledge gaps are: 1) the effects of different degrees of water quality improvement on the environment and the incremental costs and benefits associated with these improvements; 2) the significance of non-point source pollutants and the means of controlling them; 3) methods for systematically integrating pollution control efforts regionally; 4) mechanisms of various transport and transformation processes influencing pollutant concentration in coastal waters; and 5) economical methods of overcoming problems introduced by combined sewer systems and by chemicals like nitrogen, phosphorus, organic carbon and heavy metals." (Ref.2)

An excellent report on knowledge gaps in wastes management in the coastal zone was recently released by the National Academy of Sciences and the National Academy of Engineering. (Ref. 8)

1.3 Location

The most significant pollution problems in the Chesapeake Bay occur in its constricted sub-estuaries located downstream from urban and industrial concentrations. Some examples of such tributary estuaries are: the Patapsco and Back Rivers ("downstream" from and virtually surrounded by metropolitan Baltimore); the lower Potomac (receiving the waste load of almost the entire Washington metropolitan region); the Magothy, Severn and South Rivers (the watersheds of which contain the relatively heavy urban and residential concentrations of northern Anne Arundel County, including Annapolis and Broad Neck); and the Patuxent estuary (the watershed of which is not only rapidly urbanizing while still carrying a heavy agricultural waste load, but which also is denied large amounts of oxygen-carrying, waste-diluting fresh water flow by diversion to other watersheds).

Plate 9 (Wastewater Discharge) and Figure 1 (Wastewater Discharge Diagram) each show: 1) the total discharge of treated waste water by each county; 2) the discharge by the county of both treated and raw wastewater into each of its major watersheds; and 3) the total discharge received and carried by each major watershed.

Plate 10 (Major Sewage Treatment Plants) shows the location of sewage treatment plants with flows greater than or equal to 0.5 mgd, and indicates whether the sewage is given primary or secondary treatment.

PLATE 9 : Wastewater Discharge

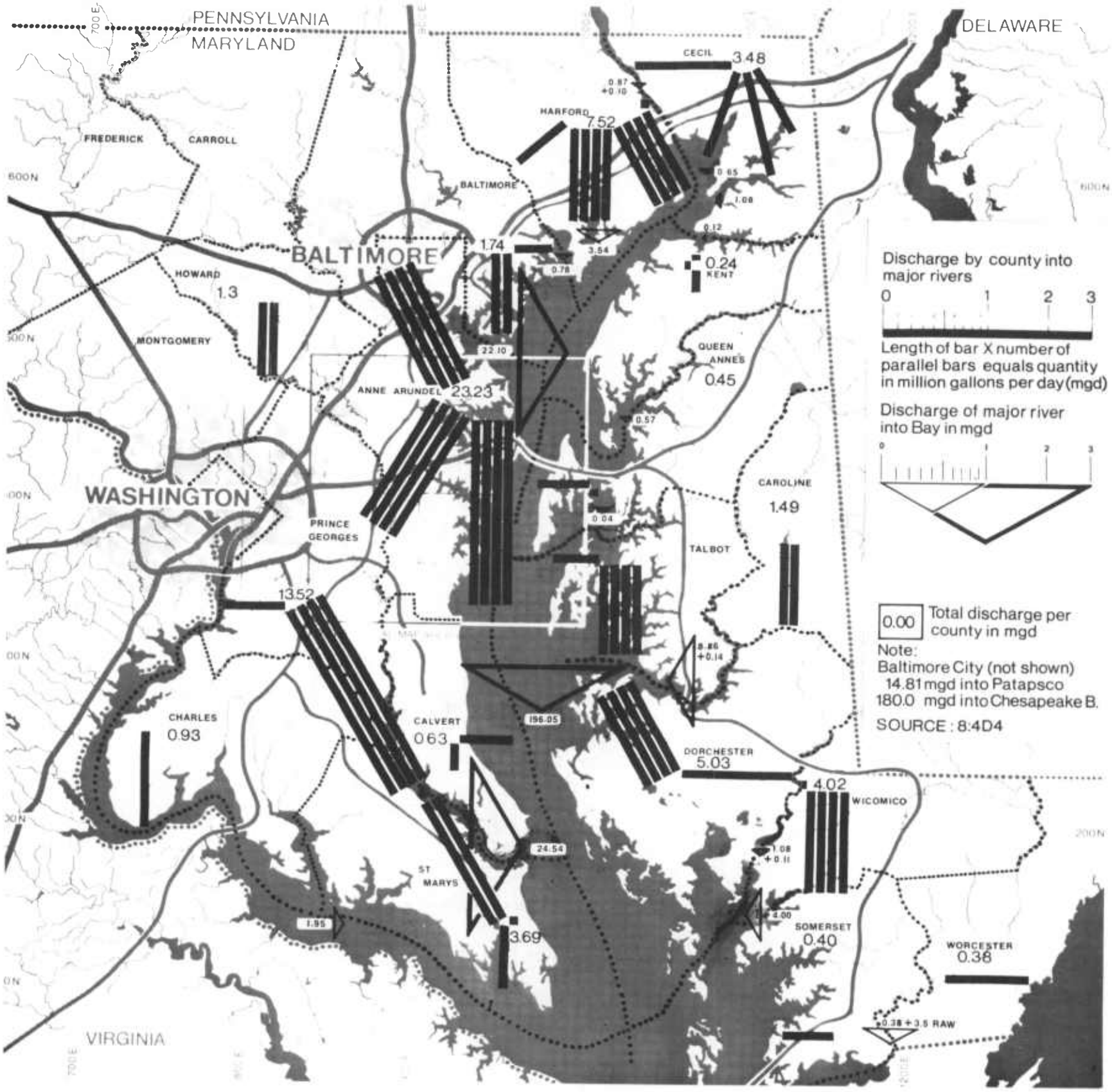


PLATE IO: Wastewater Discharge Diagram

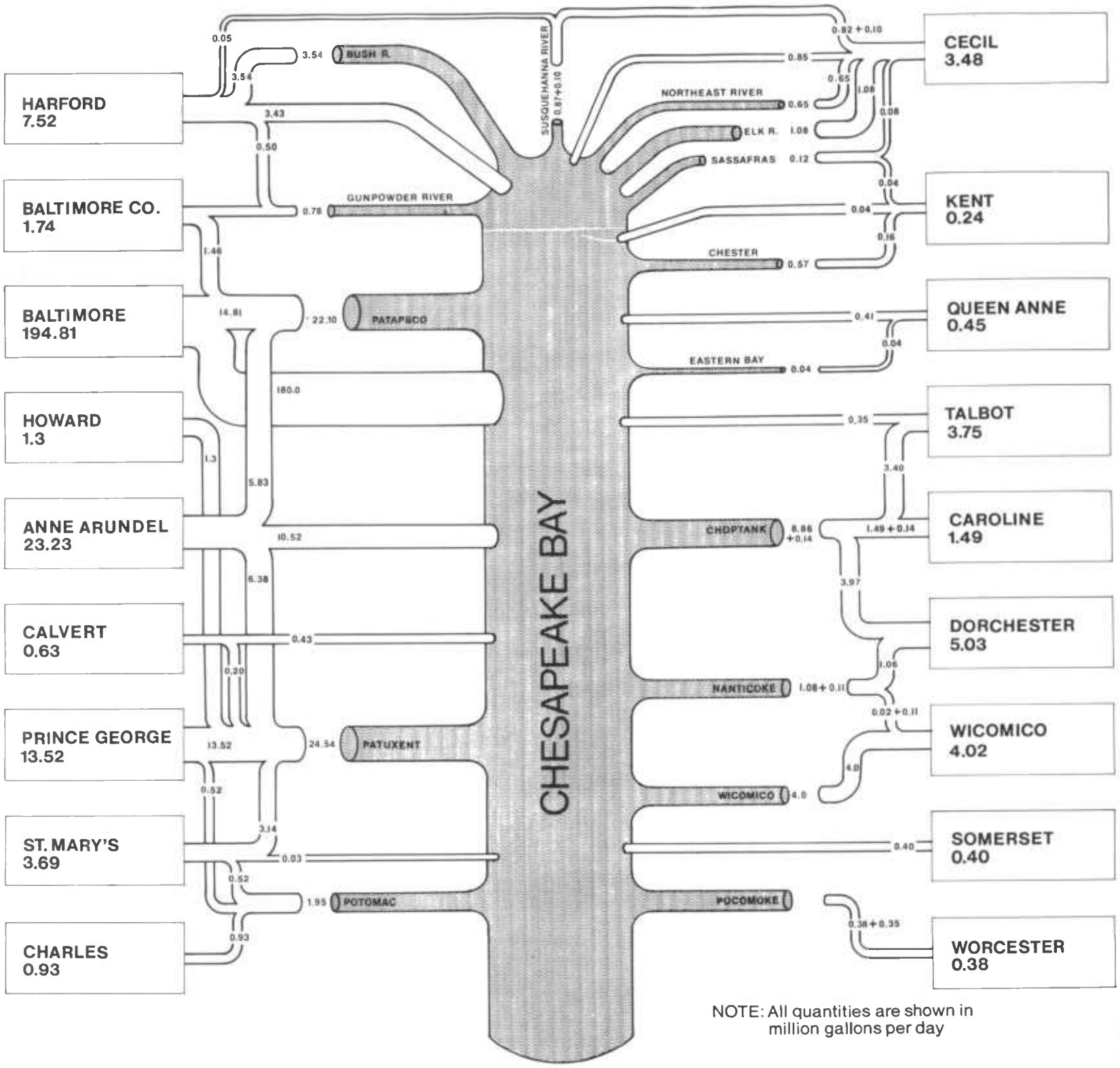


PLATE 11: Major Sewage Treatment Plants (Flows greater than 0.5 mgd)

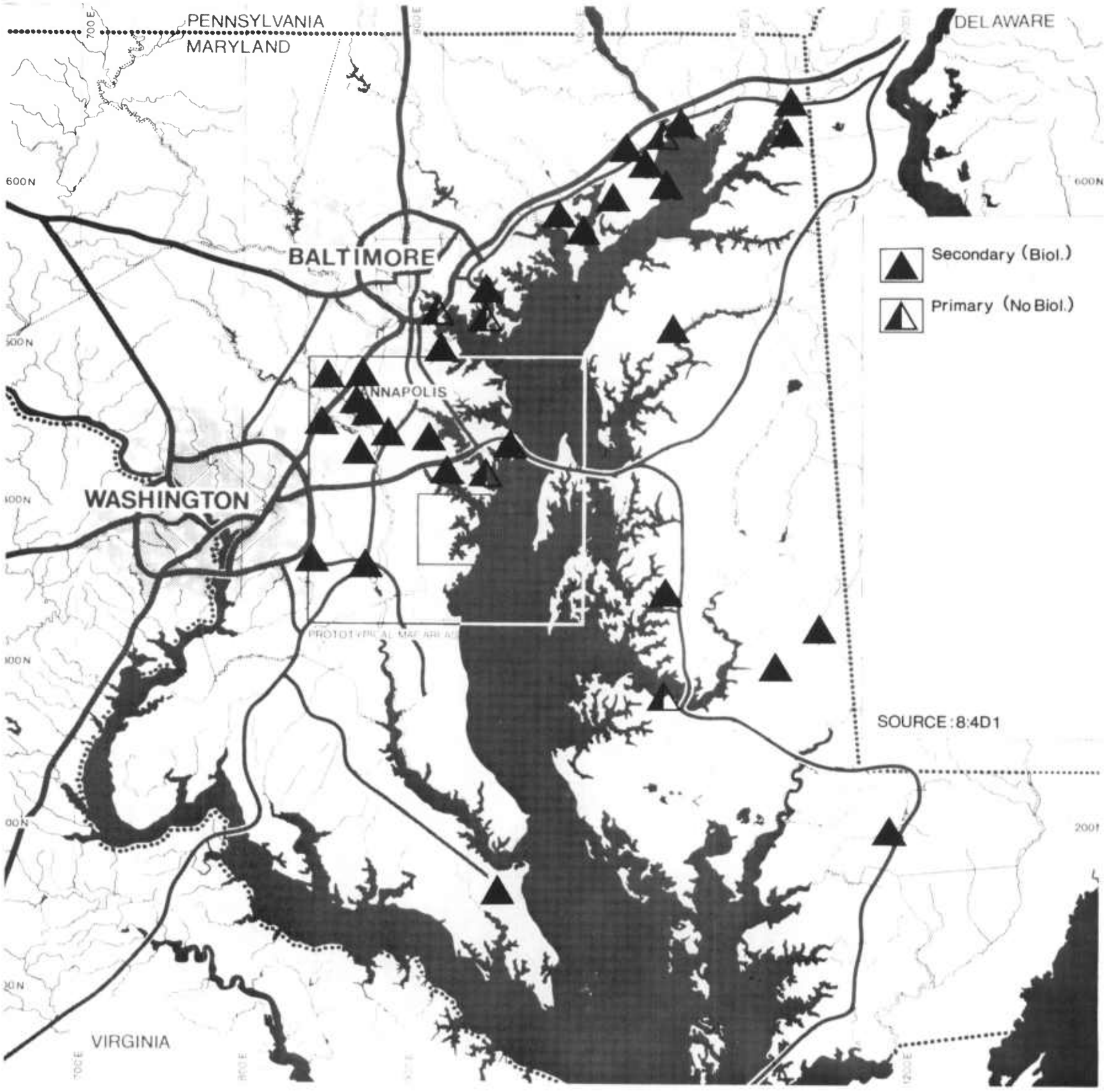


PLATE 12: Water Quality Problems

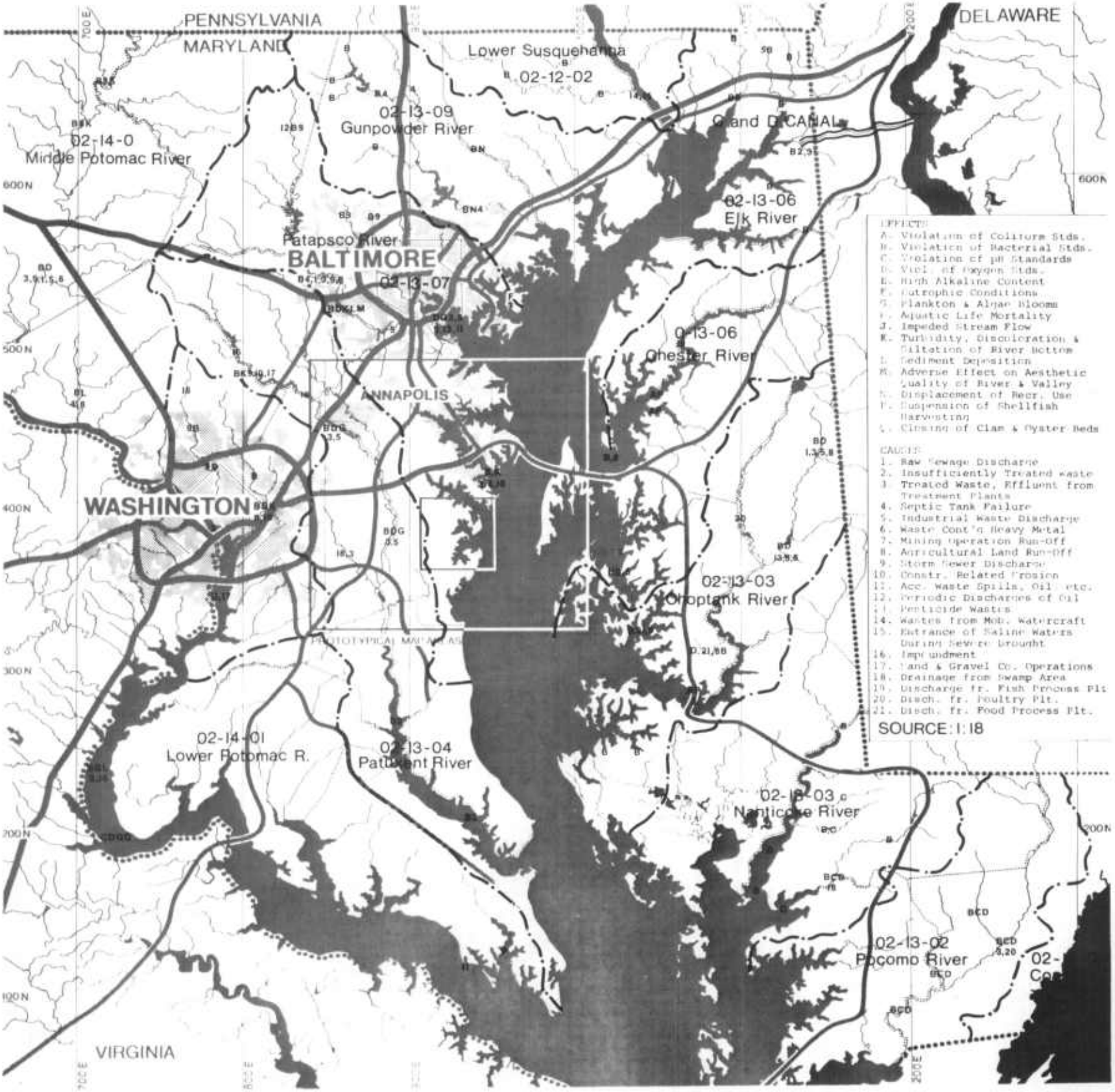
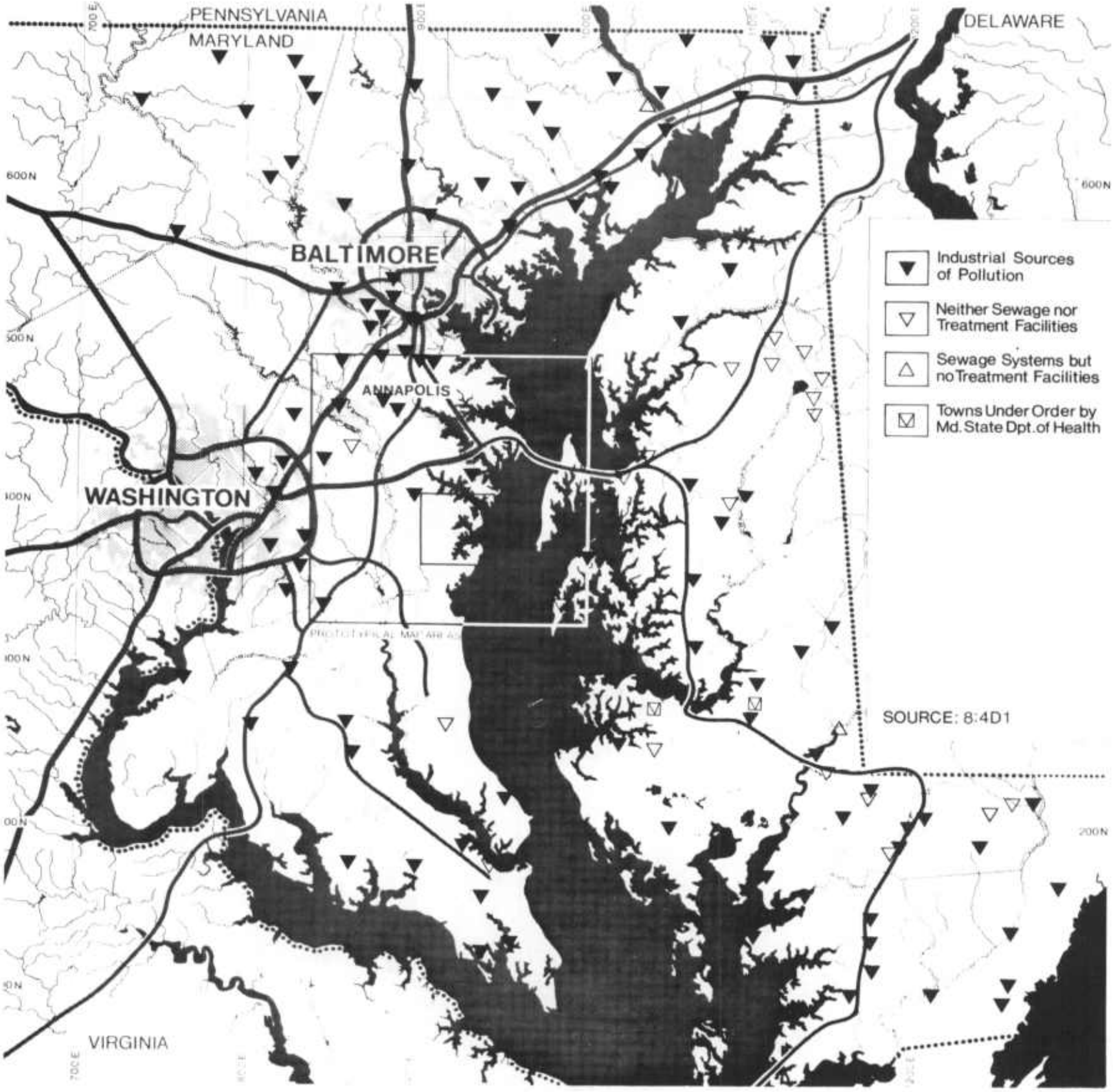


PLATE 13: Public and Private Sources of Pollution



Section 4.D. of the CBIPC Work Plan Outline (Ref.1) contains tables which list "Sewage Treatment Plants with Flows less than 0.5 mgd" (Table S2); "Towns with Sewage Systems, but No Treatment Facilities" (Table S4); "Towns under Specific Order" (Table S5); and "Towns with No Sewerage Systems and No Treatment Facilities, but Are in Need of Such" (Table S6).

Plate 12 (Water Quality Problems) shows approximate causes and effects of water quality problems which are listed in the map legend. It also shows the boundaries, 6-digit code numbers and names of the major watersheds.

Plate 13 (Public and Private Sources of Pollution) shows approximate locations of significant industrial sources of pollution and sewage treatment plants by major watersheds, both those in compliance and those not in compliance with the law.

1.4 Time Characteristics

Virtually all the major sources of pollution -- domestic, industrial, agricultural, leaching from dumps, air pollution washout and combined sewer discharge, and shipping and boating -- are more or less active in all seasons, as are major contributing factors such as water movement problems (i.e. constriction of sub-estuaries, tidal effects). The water pollution problem is therefore mainly a constant one, with some worsening in the summer.

This summer aggravation of the problem is due to several reasons. As water temperatures increase, the solubility of oxygen in the water decreases, just at the time when the rate of decomposition (i.e. the biochemical oxygen demand) increases in response to the higher temperatures. At the same time freshwater inflows are generally at their lowest levels, so that there is a much-reduced influx of dissolved oxygen and of diluting water. People also experience their closest and most extended contact with the water in summer. Aquatic life is probably operating near its maximum temperature threshold and is thus much more susceptible to water quality deterioration caused by pollution than in any other season.

By contrast to most water pollution, massive spills are not so much of a con-

TABLE 1: FUTURE DIMENSIONS OF LIQUID WASTE GENERATION AND DISCHARGE INTO BAY AND TRIBUTARIES, BY COUNTY

County	Population 1970	Liquid Waste Generation (lbs. BOD)@ .17 lbs. per capita per day	Estimated % BOD Removal by Sewage Treatment[1)]	Estimated Liquid Waste (lbs.BOD) Discharge Into Bay or Tributaries	Population Projection 2000	Liquid Waste Generation Range (lbs.BOD) @.17 lbs. per capita per day	Liquid Waste Generation Range (lbs.BOD) @ .20 lbs. per capita per day	Estimated Liquid Waste Discharge Assuming: 1)increased rate of waste generation (.20 lbs./capita/day) and 2)present % BOD removal	Estimated Liquid Waste Discharge Assuming: 1)increased rate of waste generation (.17 lbs./capita/day) & 2)present % BOD removal
Anne Arundel	291,300	37,300	64	13,400	600,000	102,000	120,000	43,200	10,200
Baltimore City	895,200	152,200	83	25,900	960,700	163,300	192,100	32,700	16,300
Baltimore County	615,700	104,700	66	35,600	1,050,000	178,500	210,000	71,400	17,900
Carroll	52,700	9,000	(70)	2,700	113,000	19,200	22,600	6,800	1,900
Harford	113,500	19,300	73	5,200	235,000	40,000	47,000	12,700	4,000
Howard	61,200	10,400	90	1,000	215,000	36,600	43,000	4,300	3,700
Baltimore Metro	2,029,500	332,900		83,800	3,173,700	539,600	634,700	171,100	54,000
Montgomery	520,700	88,500	(70)	26,600	870,000	147,900	174,000	52,200	14,800
Prince George's	657,600	111,800	83	19,000	1,002,600	170,400	200,500	34,100	17,000
D. C. Metro	1.178,300	200,300		45,600	1,872,600	318,300	374,500	86,300	31,800
Calvert	19,900	3,400	(70)	1,000	46,200	7,900	9,200	2,770	790
Charles	46,400	7,900	(70)	2,400	75,300	12,800	15,100	4,520	1,280
St. Mary's	46,000	7,800	(70)	2,300	72,000	12,200	14,400	4,320	1,220
South Maryland	112,300	19,100		5,700	193,500	32,900	38,700	11,610	3,290
Cecil	52,700	9,000	92	710	93,600	15,900	18,700	1,500	1,590
Caroline	19,500	3,300	96	130	25,600	4,400	5,120	200	440
Dorchester	28,700	4,900	79	1,020	44,500	7,600	8,900	1,870	760
Kent	15,700	2,700	94	160	28,000	4,800	5,600	340	480
Queen Anne's	17,500	3,000	(70)	890	24,000	4,100	4,800	1,440	410
Somerset	18,300	3,100	(70)	930	23,000	3,900	4,600	1,380	390
Talbot	22,100	3,800	67	1,240	38,000	6,500	7,600	2,510	650
Wicomico	51,900	9,000	79	1,890	75,000	12,800	15,000	3,150	1,280
Worcester	23,800	4,000	(70)	1,210	35,000	6,000	7,060	2,120	600
Eastern Shore	251,100	42,800		8,180	387,000	66,000	77,380	14,510	6,600
Md. Bay Region	3,510,100	595,100		143,280	5,626,800	956,800	1,125,280	283,520	95,680

tinuing year-long problem as they are a series of disconnected catastrophies. In any given locality they may be relatively rare or small, but their overall frequency and sizes are increasing year-by-year.

1.5 Parties Affected

Water pollution in the Chesapeake Bay and its tributary estuaries affects almost all those who commercially harvest its living resources, particularly its shellfish. Recreational users such as sport fisherman, boaters, swimmers, hunters, and picnickers are also directly affected. Shoreline property in the Bay has high market value because the Bay is such an attractive body of water. Thus, owners of shore property have a direct interest in the maintenance of high water quality.

The projected capital costs of water quality control in the Maryland portion of the Chesapeake Bay are (estimated cost of secondary treatment): for year 1980 -- $240 million; for 2000 -- $390 million; and for 2020 -- $675 million. The estimated additional cost of advanced waste treatment in 2020 will be $72 million. (Ref. 9) These costs will have to be at least partly borne by the citizens of Maryland.

Water quality improvement has little affect on the conduct of industry or marine transportation except that those engaged in industrial activities and shipping contribute significantly to the water pollution problem and they must bear their share of the costs of controlling the problem.

On the other hand, the control of agricultural pollution may necessitate profound changes in farming methods and practices, especially with regard to the use of persistent pesticides and the common practice of over-fertilization to ensure maximum crop-yields.

2 Future Dimensions of Water Pollution Problems

2.1 Forces Tending to Increase the Problem

a. Projected increases in population alone will increase the amount of liquid wastes generated in the Maryland Bay Region by a factor of 1.5. In addition, increasing affluence and the installation of such devices as garbage grinders may increase rates of liquid waste generation from 0.17 lbs. of BOD per capita per day to perhaps 0.20 lbs. in the future.

Table 1 indicates the future dimensions of the water pollution problem -- in terms of population and population growth, per capita rates of generation of oxygen-consuming material, and rates of BOD removal by sewage treatment facilities. Estimates of the percent of BOD removal are based on statistics collected by the Maryland Department of Health on "sewage treatment plants with flows greater than or equal to .5 mgd." (Ref.1) These rates are applied to the total estimated liquid waste generation in the county to yield an estimate of the amount of BOD discharged into the Bay and tributaries of the Bay. It is likely, however, that smaller treatment plants (for which rates of BOD removal are not available on a comprehensive basis) are in general less efficient than larger plants. Also, a small portion of the total liquid waste generation does not flow through sewer treatment

facilities at all and much of these wastes are inadequately treated. The rate of BOD removal for Prince George's County is high, because liquid wastes flowing through the Blue Plains treatment plant (which reportedly achieves only 75% removal) are not included in the statistics. In the less urbanized counties, the rates of removal derived from statistics on large treatment plants are suspect because small proportions of all wastes flow through such plants. Where data was not available, a 70% rate of BOD removal was used. It should be noted that the calculations are rough, that estimates are employed where precise information is unavailable, and that the effects of many of the factors mentioned below are not considered.

Table 2 presents an allocation of present and future liquid waste discharges to major watersheds feeding the Chesapeake Bay. Allocations of liquid waste discharge by county (see Table 1) to major drainage areas are made on the basis of statistics developed by the Maryland Department of Health on the proportion of total wastewater flows of each county into major drainage areas. The procedure assumes that the proportionate discharge of BOD is equivalent to the discharge wastewater flows. This may contain inaccuracies because of the varying amounts of BOD in various wastewater flows. Data for large sewage treatment plants indicate wide variabliity in the ratio of BOD to wastewater flow. (See Table 3).

TABLE 2: FUTURE DIMENSIONS OF LIQUID WASTE DISCHARGES, BY MAJOR DRAINAGE AREA

Major Drainage Area	Liquid Wastes Discharged 1970 (lbs. BOD per day)	A. Liquid Wastes Discharged 2000 (lbs.BOD) 1) Increased Rate of Waste Generation 2) Present % of BOD Removal	B. Liquid Wastes Discharged 2000 (lbs.BOD) 1) Present Rate of Waste Generation 2) 90% BOD Removal
Chesapeake Bay	34,190	59,310	22,890
Potomac R.	16,780	32,580	9,530
Patuxent R.	76,190	85,760	33,200
Patapsco R.	35,320	73,400	18,920
Gunpowder R.	6,680	13,880	3,570
Bush R.	2,440	5,970	1,880
Susquehanna R.	230	520	450
Northeast R.	130	270	290
Elk R.	210	450	480
Sassafras R.	40	90	110
Chester R.	920	1,530	690
Eastern Bay	80	130	40
Choptank R.	2,060	3,960	1,630
Nanticoke R.	270	490	200
Wicomico R.	1,830	3,060	1,240
Pocomoke R.	1,210	2,120	600
Total: Md. Bay Region	143,280	283,520	95,680

TABLE 3:

County	Ratio: BOD (lbs)/Wastewater Flow (mgd) in Sewage Plants with Flows Greater Than or Equal to .5 mgd.
Anne Arundel	464
Baltimore City	1,735
Baltimore County	378
Harford	500
Howard	1,690
Prince George's	152
Cecil	338
Caroline	215
Dorchester	660
Kent	171
Talbot	222
Wicomico	850

The procedure also assumes that the proportionate discharge of wastes into several streams remains constant in the future. The procedure does not consider several factors of major significance in water quality: the point of discharge of wastes, the time pattern of waste discharges, the assimilative capacity of the stream at various locations and times, other types of wastes discharged into the stream, water quality objectives for the stream.

b. With urbanization, increasing proportions of the total population are linked to public sewerage systems. While this should produce water quality improvements through better sewage treatment, what has often occurred is simply that existing treatment plants are overloaded. This situation is most strikingly illustrated in the Blue Plains plant on the Potomac River:

"Today, the Blue Plains plant still handles about 80 percent of the sewage from three million people in the 600-square-mile Washington metropolitan area, comprising the District of Columbia and parts of Maryland and Virginia.

"The Blue Plains plant is overloaded, handling about 250 million gallons a day against a designed capacity of 240 million. At this rate, it can give the sewage only cursory treatment, holding it for about two hours. The residue gushes into the Potomac dotted with four-inch-high clumps of undigested foam.

"To meet current standards, the plant should be removing upwards of 90 per cent of the principal pollutants -- oxygen-absorbing matter and phosphates and nitrates, which stimulate algae growth. In reality, the plant is removing less than 75 per cent of the oxygen-absorbing matter, only 15 per cent of the nitrates and only 10 per cent of the phosphates.

"This substandard treatment, in combination with the discharges of the other sewage plants, means that every day the Potomac is infused with wastes equivalent to about 80 million gallons of raw sewage." (Ref. 10)

Thus metropolitan population growth, in combination with insufficient allocation of public funds for sewage treatment, can increase water pollution problems or force undesirable restrictions or distortions on metropolitan growth patterns and wide-ranging economic repercussions:

"On May 20, (1970) because of 'a menace and a nuisance to the public health, safety and comfort from discharges of raw and inadequately treated sewage,' Maryland health authorities banned new sewer connections in sections representing 37 per cent of the Montgomery-Prince George's area, where there has been $175-million worth of home building in the last two years.

"A survey by the American University's real estate department indicated that in the next year, lost construction work, due to the sewerage restrictions, will amount to $67.1 million in Montgomery County, $194 million in Prince George's and $105.3 million in Fairfax." (Ref. 10)

"Among the hardest hit areas (by the ban on new sewer connections in

400 sq. miles of Montgomery and Prince George's Counties) was Montgomery's Interstate 70-S corridor, long envisioned by County planners as the heart of future development. Conservation leaders, concerned that a continued building freeze along 70-S would bring pressure for unwanted construction elsewhere, sought approval of temporary relief measures. In the minds of some, they got more than they asked -- approval for establishment of a 'temporary sewage holding basin' in what has been described as a key area of Seneca Creek State Park. In addition, a temporary 700,000 gallons-per-day package sewage treatment plant has been approved for Magruder Branch Regional Park near Damascus. Some Marylanders are deeply concerned about setting a possible precedent of using park lands for sewage facilities which may or may not turn out to be temporary. (Ref. 11)

c. Domestic wastewater is increasingly complicated by substances other than oxygen-consuming materials. The discharge of nitrates and phosphates due to greater use of detergents has increased considerably faster than population itself. The eutrophic effects of these substances severely limit the capacity of Bay tributaries to absorb oxygen-consuming materials. Without public policy intervention, it is likely that the discharge of nitrates and phosphates will continue to increase in the future.

d. Industrial activities increasingly produce liquid wastes of all kinds. Food and biological processing industries add to the oxygen-consuming materials generated by domestic activities. Even more significant, however, are the increasing amounts of chemicals in industrial waste waters. Industrial liquid waste generation varies according to the specific type of industry, the volume of production, and the type of industrial process. Available information is not sufficient to allow a projection of liquid wastes produced by industry in the Maryland Bay Region. The likelihood is, however, that expanding industrial production and evolving industrial production processes will severely damage water resource quality unless strong countermeasures are taken. Local competition for industry will tend to reduce the effectiveness of controls and spread the problem into rural as well as urban areas.

e. The increased use of pesticides and chemical fertilizers in agriculture will contribute to the water pollution problem in rural areas. Some of the effects of agricultural return waters on the water resource are listed in Table 4.

TABLE 4: SUMMMARY OF EFFECTS OF AGRICULTURAL RETURN WATERS ON RECEIVING WATERS (Ref.12)

Quality Factor	Observed Effect
Salts and ions	Increased more than five times.
Hardness	Greatly increased; most significant effect.
Total dissolved solids	Greatly increased.
Temperature	Significant increase in Yakima River. Similar effects to be expected in other areas.
Turbidity	High in some return waters. Little studied effect. Small effect in Yakima River due to dilution.
Color	Little studied factor. Increase observed in Yakima River due to large irrigation return.
Nutrients: Nitrates	Generally somewhat increased. Conflicting evidence. Evidence of increase in nitrogen but the relative importance of natural and irrigation return flows not investigated.
Phosphorus	May be brought in with plant leaves in return water. Little doubt that amount increased.
Tastes and odors	Evident in return flows

Quality Factor	Observed Effect
	as result of mineral salts and organic decomposition products, often from aquatic growth stimulated by nutrient content.
Insecticides and Herbicides	Problem exists in surface waters but the relative contribution of irrigation return water and surface runoff not clear. Potential problem exists.
Bacteria	Not a significant factor in agricultural return waters as compared to domestic.

f. The greatly increased use of Bay water for thermal waste discharge (see Section G) and for water supply (see Section F) projected for the Maryland Bay Region will tend to reduce the assimilative capacity of Bay waters for oxygen-consuming liquid wastes.

g. The proliferation of wastes produced by the emerging urban industrial economy increases chances of synergistic relationships of pollutants in receiving waters which would compound water pollution problems.

h. Changes in techniques for disposing of various types of solid wastes may have repercussions on liquid waste disposal and water pollution problems. More widespread use of garbage grinders, for instance, would convert a "solid" into a "liquid" waste and would place increasing burdens on public sewage treatment facilities, many of which are now overloaded. Public demands to phase out inefficient incinerators would mean that alternative disposal solutions would have to be found -- with possible impacts on water pollution problems.

i. Increasing use or use demands on the Bay and its shoreline for recreational, aesthetic and residential purposes will create greater conflicts with waste disposal uses of the Bay. This trend could lead to higher water quality standards or pressures for comprehensive enforcement of present standards -- which would increase water pollution problems.

2.2 Forces Tending to Reduce the Problem

a. Pollution Control Methods Aimed at Principal Types and Sources Discussed Above.

Domestic Sewage:

Expansion and upgrading of existing sewage treatment plants and construction of new ones where necessary will be the most obvious and probably the most widely used solution to the problem of sewage from primarily domestic sources. Primary treatment plants remove solids and floatables which represent only about one-third of the BOD's while secondary treatment at least partially decomposes the wastes and reduces the number of pathogens. Secondary treatment removes about 80 to 90% of BOD's. The average level of performance for all existing plants discharging to the Bay or its tributaries is about 80%. As population continues to grow, advanced treatment (sometimes called "tertiary" treatment) should be added to the first two steps of treatment. Advanced treatment entails the almost complete removal of BOD (up to 98%) and the removal of nutrients such as nitrates and phosphates.

Industrial Wastes:

There are several steps in the control of industrial pollution. First is detection and identification of the waste. Next is determination of the effects of the waste, both as an isolated agent and when combined with other pollutants or even with substances naturally present. Third is to trace the pollutant to its source. The fourth step is to determine how to stop the discharge of the material or alternatively how to treat it. This may entail the redesigning of the industrial process, or recycling of the wastes within the factory. A toxic waste might be chemically altered and discharged in a more acceptable

form, or at many outfalls so as to achieve greater initial dilution. The waste might be burned or stored underground, but this latter solution may simply trade water pollution for air or ground water contamination.

Agricultural Wastes:

The control of agricultural pollutants and practices with the greatest impact -- pesticides, herbicides, and over-fertilization -- must obviously be achieved at the source, since no effective control or treatment could be applied at the land-water interface. The use of DDT and the other related persistent pesticides should be banned outright. However, it would be difficult for the State to strictly control the practice of overfertilization by legislation. A program of education for farmers on the effects of the practice could do some good, but that is doubtful. Perhaps regulation of the fertilizer industry or heavy Federal taxes on fertilizers so as to increase the cost could be an effective measure. At any rate, this problem and that of the control of pollution from animal wastes obviously need more study.

Leaching from Solid Wastes:

The siting of sanitary landfills is more properly considered in Section L., but it should be mentioned that their traditional location in low-lying areas such as wetlands or stream flood-plains almost guarantees the maximum possible deleterious impact on water quality. Therefore, the practice of placing them in low areas should be stopped and their siting should be rigidly controlled and inspected by State water quality authorities. Proper construction of landfills, using periodic sealing beds of impervious clay can help eliminate harmful leachates at the source.

Storm Runoff and Combined Sewer Discharge:

The problem of combined sewer discharges can usually be corrected most readily by constructing separate sewer systems, but the costs are usually prohibitive, especially in highly urbanized areas with old and widespread sewer systems.

Overland runoff other than that from the agricultural practices mentioned above is almost impossible to treat or control at the source. It must be treated en route to the receiving water body or else treated in the receiving water itself.

Pollution Due to Shipping and Boating:

Because many of the boats and most of the ships that use the Bay are registered out-of-State if not outside the country, the abatement of human sewage pollution from vessels would be better achieved by a two-pronged State-Federal program. Legislation should be passed and strictly enforced to require the development and installation of effective shipboard treatment facilities for larger ships and, at the very least, effective chemical toilets for boats whose size and function would not permit more sophisticated treatment. For the smallest boats with no room for such facilities, little can be done, but their contribution to the total pollution load from vessels of all kinds is probably very minor.

Despite more primary control efforts, some oil spills. accidental or deliberate, will continue to occur, and improved methods of containing and removing the oil are badly needed. As we have seen above the use of sinking agents or detergents does not eliminate the harmful effects of oil spills, it only gives the illusion of a solution by removing the oil from sight. It actually helps spread the oil and the ecological damage is greater than if the spill had been left alone. The rapid removal of the oil by mechanical means or by burning will probably be the best solution. Large mechanical skimmers have been developed and are apparently proving quite effective.

The problem of disposal of contaminated spoil from dredging in heavily polluted areas is probably best resolved

by depositing all such spoil on land or behind dikes or bulkheads. The 1969 Maryland General Assembly appropriated $13 million for the construction of a containment area which will receive all the future spoil from Baltimore Harbor. This will help to eliminate a major source of water pollution in that area of the Bay.

b. Possible Institutional and Organizational Solutions

Maryland Environmental Service:

The above-mentioned Maryland Environmental Service was created by the State as its instrument for assuring that needed environmental protection works will be planned and executed. The law requires the Service to designate liquid and solid waste service regions and to prepare plans for them.

Federal Agencies:

"The key Federal agency is the new Environmental Protection Agency (EPA) which combines the pollution abatement responsibilities of a number of agencies. The most prominent of them are: (1) The Federal Water Quality Administration (FWQA) for water pollution [now the Office of Water Quality (OWQ)], (2) The National Air Pollution Control Administration (NAPC) for air pollution, and (3) The Bureau of Solid Waste Management (BSWM) for solid wastes pollution. FWQA provides substantial funds to states and municipalities for implementing approved programs. So far, however, these funds have been relatively small considering the great magnitude of the program being developed for treatment plants. The Army Corps of Engineers also has an important role in its administration of the River and Harbor Act of 1899 (commonly, the Refuse Act). However, the Corps' most important coastal pollution role is in the field of solid waste disposal at sea." (Ref. 2)

c. New Methods

A variety of new sewage treatment systems are becoming widely available at competitive prices. These types of sewage treatment could virtually replace septic tanks, reduce burdens on large public sewage treatment facilities and encourage new patterns of urban development (See Section K.). Probably most important of these are the so-called independent physical-chemical (IPC) systems, which can achieve 99% BOD removal, 98% suspended solids removal, and 96% phosphorus removal from typical domestic wastes. (Refs. 13,14,15)

It will be increasingly feasible to recycle certain wastewater, either in surface waters or by recharging groundwater reservoirs.

More comprehensive application of methods to increase the assimilative capacity of receiving waters (e.g. in-stream aeration) could help alleviate water pollution problems during periods of low stream flow.

Extension and refinement of existing methods for setting stream standards, regulating sources of water pollution and funding and developing waste treatment facilities can reduce water pollution problems. One often suggested extension of present regulatory approaches is effluent charges.

"An important question in water quality management is whether institutional mechanisms can be found to reduce wastes discharged to streams, estuaries, lakes, groundwater basins, and oceans. Effluent charges may be such a mechanism. An effluent charge is imposed on anyone discharging wastes to a water body; the amount of the charge depends upon the amount of wastes discharged. As an illustration, manufacturers might be charged $1.00 for each 5,000 pounds of BOD discharged to water bodies. Such charges would encourage those discharging wastes to seek ways of discharging fewer in order to lower the monthly charge imposed upon them.

"This might be done in several ways. The production process and/or raw materials might be altered in order to generate fewer wastes and thus lower the effluent charge. There might be materials recovery and/or production of by-products; that is, there might be attempts to recover wastes for recycling within the production process or for production of by-products. Finally, there could be

additional waste treatment. (Ref. 16)

2.3 Summary -- Future Outlook

A review of existing trends in the generation, treatment and discharge of wastes, especially when placed in juxtaposition with expanding uses of water resources for other purposes (e.g. recreation, thermal waste discharges), presents a foreboding future picture. A metropolitan surburban view of the future outlook is voiced by William H. Willcox, Commissioner, Maryland National Capital Park and Planning Commission:

"The seriousness and significance of the metropolitan area sewer problem cannot be papered over. Inadequate treatment facilities, sewer overflows, septic tank failures, an increasingly filthy river, losses to builders and the public treasury, encroachments on our parks to cope with emergencies which should have been foreseen, and the unedifying sight of each official body competing with the others to assign blame elsewhere than itself, are the fruits of years of lax planning. The present crisis carries a grim warning to developers, conservationists, every level of government, and every one of our citizens. We must redouble our efforts to rationalize development in the face of rapid regional population growth. If we fail, we will be beset and eventually overwhelmed by rising costs, pollution, depletion of vital natural resources, a severely damaged economy, and a declining quality of life." (Ref. 11)

Significant here are the tradeoffs between solutions to problems of water pollution and metropolitan area housing problems.

On the level of the Maryland Bay Region, a "continuation of present trends" would result in real trouble for bay water resource quality. The trouble would not be confined to the urbanizing western shore of the Bay but would affect Eastern Shore areas as well. The situation would severely limit other desirable uses of Bay water resources and shoreline areas.

Given energetic and comprehensive application of present water quality control approaches, it would seem that some aspects of the water pollution problem could be substantially improved while in other areas the situation would continue to decline. One area in which improvement could be expected would be in terms of the traditional measure of water pollution -- BOD (see Table 1). Areas in which continued declines might be expected are in increasing concentrations of exotic chemical wastes in receiving waters and in synergistic relationships between different types of liquid waste discharges.

A comprehensive application of traditional and emerging approaches in water quality control could make possible the achievement of presently recommended stream quality standards in the Bay and its tributaries. This approach would call for substantial increases in funding, monitoring, legislation, and organization for water quality control. It would make possible the maximum use of Bay waters for purposes other than the discharge of wastes.

3 Water Pollution: Goals, Objectives, Standards, Policies

3.1 Goal: Establish and Maintain Bay Water Quality at Levels Adequate for Living Resources and Human Enjoyment

This goal is paraphrased from the Legislative intent in establishing the Maryland Environmental Service as, "the preservation, improvement and management of the quality of air, land, and water resources [of the State]." (Ref. 17)

More specific objectives are:

3.2 Objectives:

a. Provide on a Bay-wide basis for dependable, effective and efficient purification of liquid and solid wastes.

b. Encourage reduction in the amount of waste generated and discharged to the environment.

c. Provide pollution abatement planning and operating service to waste generators.

d. Concentrate immediate efforts and priority on the Baltimore Harbor Project to achieve the above objectives.

3.3 Standards

Water quality standards for the Bay have been set by the Maryland Board of Health "insofar as their sanitary and physical condition affects the public health." (Ref. 18) The Department of Water Resources can set specific standards for its primary responsibility for the general enforcement of water quality standards. The Environmental Health Service exercises primary responsibility with respect to water pollution resulting from untreated or inadequately treated sewage.

A new entrant in the field of standards, the above-mentioned Environmental Protection Agency (EPA) has taken over responsibilities at the Federal level and most recently set standards for allowable spoil deposits in the Bay.[1]

3.4 Policies:

Five task objectives for the Maryland Environmental Services Baltimore Harbor Project are good examples of policies:

"1. Inventory pollution sources by type; assess their relative importance; and predict future demands for disposal.

"2. Acquire necessary data on the aquatic environment and water quality; analyze cause-effect relationships within the aquatic system; and predict the results of proposed pollution abatement measures.

"3. Acquire an expression of public needs and desires for water use from a review of related land-use plans and from local representatives; recommend desirable criteria for the development of water uses; and predict future water use demands.

"4. Prepare plans for wastewater transmission and treatment works, material reuse facitities and other protective facilities, based on receiving water requirements and the evaluation and integration of existing plans or alternatives.

"5. Recommend to regulatory and public works agencies such policy and operational measures as study reveals will contribute to the improvement and protection of water quality or the more efficient use of resources." (Ref. 7)

Policies now are in operation at various levels of government, some of which have been enacted into law. These policies can be organized by the six major sources of pollution: domestic sewage, industrial wastes, agricultural wastes, leaching from solid wastes (including spoil deposits), storm runoff, and shipping and boating.

As in Goal D., the costs of not polluting are often high, the offenders ubiquitous, and the benefits not immediately translatable into dollar equivalents. However, it is at the level of policy that this translation must be made. In a recent example, the spoil from dredging from Baltimore's Inner Harbor was to have been placed at Poole's Island in the Bay. The policy of the EPA is not to allow this if certain chemical and BOD levels are above their standards. The cost of placing the spoil in an alternate location was between $200,000 and $300,000, directly attributable to the adoption of the policy. While the cost of environmental degradation and consequent benefit of not using Poole's Island was not quantified, it could have been estimated with adequate scientific research. While in this particular instance the widespread concern for mercury made such quantification unnecessary, research must address itself to such specific spelling out of policy tradeoffs. In the Baltimore example, the policy with which tradeoff was made was related to waterfront residence and recreation in the Inner Harbor.

A more significant, but harder to

quantify, policy conflict results from the need to retain water in the Susquehanna River for water supply and power during periods of drought. The resulting flows dramatically affect both water quantity and water quality (salinity) in the Bay. Resulting fish kills are only the most visible evidence of the environmental impact.

In this last example of tradeoffs, a systems approach should be used to trace the effect of setting the standard for minimum flow on both water supply and power. These can be translated into dollar equivalents of input to an output to the Bay that quantifies the environmental benefits of adequate fresh water flow.

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II. PROBLEMS AND GOALS

F. WATER SUPPLY 106

1. Water Supply Problems 106
1.1 Nature of the Problem 106
1.2 Causes of the Problem 106
Table 1: Major Public Surface Water Supply Intakes 107
Table 2: Non-Residential and Residential Water Usage, Anne Arundel County 108
Table 3: Crosstabulation of State and County Jurisdictions with Twelve Major Watersheds Feeding the Maryland Portion of the Bay 109
1.3 Location of the Problem 109
Plate 14: Surface Drainage Pattern and Public Surface Water Intakes ... 110
Plate 15: Chesapeake Bay Water Budget 111
Plate 16: Generalized Geologic Map - Anne Arundel County 112
Plate 17: Structure Contours of Aquifers - Anne Arundel County 113
Plate 18: Aquifer Block Diagrams - Anne Arundel County 114
1.4 Time Characteristics 115
1.5 Parties Affected 115

2 Future Dimensions of Water Supply Problems 115
2.1 Forces Tending to Increase the Problem 115
Figure 3: Water Source Areas - Anne Arundel County 115
Figure 4: Residential and Industrial Average Daily Water Demands - Anne Arundel County, 1960, 2000 116
Table 4: Proportions of Total Industrial Water Use by Selected Types of Industry: Comparisons of National vs. Local (Anne Arundel County) Usage 118
Table 5: Water Consumption and Withdrawal, Domestic and Industrial, 1970 and 2000, by Region 119
Table 6: Proposed Water Supply Improvements, 1970-2000, by Water Service Area - Anne Arundel County 121
Figure 5: Water Sources and Water Demands - Anne Arundel County, 1960 and 2000 122
2.2 Forces Tending to Reduce the Problem 123
2.3 Summary - Future Outlook 124

3. Water Supply Goals, Objectives, Standards, Policies 125
3.1 Goal 125
3.2 Objectives 125
3.3 Standards 125
3.4 Policies 125

F
Water Supply

1 Water Supply Problems

The problem is how to manage the water resource so as to reconcile human demands with the natural supply without adverse environmental effects.

1.1 Nature of the Problem

With increases in her population, the concentration of these people in urban areas, and expansion of water-using industries, Maryland's water needs are increasing rapidly. Short-sighted, poorly conceived and hastily executed solutions may have irreversible ecological, economic and social effects.

1.2 Causes of the Problem

a. Demand

Major Public Surface Intakes:

Table 1 gives the locations of major public surface water intakes, aggregates this data for major streams and indicates the amount of water withdrawal (in million gallons per day) and the population served. This information does not, of course, indicate the total water usage in any watershed, jurisdiction or group of jurisdictions. Ground water supplies, run-of-the-river surface water intakes and water transported across watershed and jurisdictional boundaries may supplement total public surface water intakes. Nor does the data indicate what the water is used for. Comparison of the surface water intake with the population served reveals the following rates of water usage per capita:

Rockville	75	gal/day/capita
Washington Sub. Sanitary Comm.	206	"
Baltimore City	150	"
Washington D.C.	183	"
Bel Air	143	"
Havre de Grace	278	gal/day/capita
Elkton	197	"
Northeast	89	"

To some extent the variations may reflect variations in rates of residential water usage. Such rates are generally higher in luxury subdivisions than in "average" subdivisions and they are often higher in older sections of cities where the water supply system is inefficient. But most of the variation reflects non-residential use of public surface water supply.

The Rockville rate of water usage per capita (75 gallons per day) is close to the average for general residential activity. Water usage in excess of 100 gallons per capita per day may be attributed to industrial and other non-residential use of the public water supply and is not properly represented by a per capita rate.

Finally, the data does not indicate who receives the water withdrawn at the surface water intakes. The data indicates that Baltimore City, which now has less than 900,000 residents, supplies water to 1,125,000 persons - presumably 600,000 persons in the surrounding counties. Similarly, the data indicates that the Washington Suburban Sanitary Commission and the Rockville plants supply water to more people than currently live in Prince George's and Montgomery Counties. It is not clear in which jurisdictions the extra people served live; nor is it clear how many persons in Prince George's and Montgomery Counties are served by ground water supplies, and are thus not reflected in the data concerning population served by surface water supply.

Types of Water Usage:

In order to develop a comprehensive picture of the types of water usage, the sources and modes of water supply and their interrelationships in a single county, a review and graphic synthesis was made of the master water

TABLE 1.

MAJOR PUBLIC SURFACE WATER SUPPLY INTAKES
(DOES NOT INCLUDE GROUND WATER OR INDUSTRIAL WATER SUPPLIES)
(Source: Ref. 1, Plate W, Table W-1)

POTOMAC	PATUXENT	LITTLE PATUXENT	CURTIS CREEK	SEVERN RIVER
[a]Rockville (186A) 3.4 mgd 45,000 pop. [a]Wash. Suburban San. Comm. (249A) 150 mgd 725,000 pop. Washington, D.C. (250) 200 mgd 1,093,000 pop.	[a]Wash. Suburban San. Comm. (249B) 67 mgd 325,000 pop. [a]Wash. Suburban San. Comm. (249C) 67 mgd 325,000 pop. Bowie Race Track (190) (Used during racing season only)	Maryland House of Correction (34A) 1.0 mgd 4,500 pop. [b]Ft. George Meade (27) 3.0 mgd ? pop.	[b]Curtis Creek Coast Guard 0.6 mgd ? pop.	[b]Severn River Naval Command 0.4 mgd ? pop.
353 mgd 1,863,000 pop.	134+ mgd 650,000+ pop.	4.0 mgd 4,500+ pop.	0.6 mgd ? pop.	0.4 mgd ? pop.

PATAPSCO	GUNPOWDER	WINTERS RUN	BROAD CREEK	SUSQUEHANNA
[c]Balt. City (48A) Ashburton Plant Liberty-Patapsco 56 mgd (approx) 375,000 pop.(app)	[c]Balt. City (48B) Petty Boy-GNPDR 56 mgd (approx) 375,000 pop. (app) [c]Balt. City (48C) Montebello Plant Lock Raven-GNPDR 56 mgd (approx) 375,000 pop. (app)	Bel Air (159A) 1.0 mgd 7,000 pop. [b]Edgewood Arsenal (158A) 4.0 mgd ? pop.	Broad Creek (162) (Summer Use only) 0.4 mgd ? pop.	[c]Balt. City (48D) Susq. Diversion 56 mgd (approx) 375,000 pop.(app) Conowingo (163A) 0.02 mgd ? pop. Havre de Grace (167) 2.50 mgd 9,000 pop. Bainbridge (86A) 1.50 mgd ? pop. Perry Point (100) 0.05 mgd 700 pop.
56 mgd 375,000 pop.	112 mgd 750,000 pop.	5.0 mgd 7,000+ pop.	0.4 mgd ? pop.	60.1 mgd 385,000+ pop.

MAJOR PUBLIC SURFACE WATER SUPPLY INTAKES (continued)

MILL CREEK	NORTHEAST RIVER	BIG ELK CREEK
Perryville (99) 0.45 mgd ? pop.	Northeast (98) 0.15 mgd 1,700 pop.	Elkton (91) 1.10 mgd 5,600 pop.
0.45 mgd ? pop.	0.15 mgd 1,700 pop.	1.10 mgd 5,600 pop.

[a]Washington Suburban = 287 mgd; 1,420,000 pop.
1,178,000 (1970) pop. @ 80 gal/person/day
[b]Military = 8.0 mgd
[c]Baltimore City = 225 mgd; 1,500,000 pop.

plan for Anne Arundel County (Ref. 2). Available detailed information on the types of non-residential and residential water usage is shown in Table 2, which juxtaposes empirical data collected on current average rates of water usage by specific users and estimates of total water usage in broad residential and industrial categories. The data is reasonably but not precisely comparable. For instance, a portion of the Annapolis water supply, listed here as "residential", is used by industrial and other non-residential firms. The data indicates that estimates of non-residential water use are probably low and could be more precisely detailed. Twenty-four industries representing 80% of Anne Arundel County's manufacturing employment use more water than is estimated for all light and heavy industry. Other non-residential uses are not broken out in the water use estimates. There is no estimate, for instance, for the amount of water used in Anne Arundel County's large and growing office function. The empirical data gleened from the county water plan and presented in Table 2 represents 70% of total estimated current water usage in Anne Arundel County. More complete and detailed empirical data would assist in evaluating county land use plans for their water demand implications and in regulating water usage of various activities.

b. Supply

Interjurisdictional Nature of Supply:

The surface drainage pattern is of great significance in environmental management. It forms the context for many inter-dependencies among alternative stream uses at various locations. Upstream wastewater discharges may preempt downstream recreational uses or make water supply uses more expensive because of treatment costs. Upstream controls on stream flows in the form of dams and reservoirs limit run-of-the river uses

TABLE 2: Non-residential and Residential Water Usage, Anne Arundel County (Source: Ref. 2)

Water Usage based on empirical data, 1969		Water Usage based on general trends & indexes 1970	
Industry		Industry	
Ground water (6 industries including Parkway Industrial Area)	3.220 mgd	Heavy industry (375 ac)	
Surface water (15 industries)	2.683 mgd	Light industry (1445 ac)	
Total: 24 industries representing approx. 80% of total county mfg. employment (Table 3-4)	5.9030 mgd.	Total industrial water usage 1970	5.4400 mgd
3 motels, 3 marinas, 1 restaurant } Table B-5	.1006 mgd		
38 public & private schools (Table B-6) (including 30 AA Co. schools)	.3050 mgd		
Commercial (Table B-4 & B-7)			
4 shop. ctrs. & 2 large stores (mostly using ground water)	.1575 mgd		
Office			
Md. Dept. of Motor Vehicles (Table B-7)	.0289 mgd		
Military - that not included under residential (Table B-9)	1.1000 mgd		
Institutional			
2 hospitals, 1 state park } Table B-9, B-4	.6243 mgd		
Total non-residential water use accounted for in empiric data	8.2193 mgd	Total Estimated non-residential water use	5.4400 mgd
1970 population: 291,300		Projection 1970: 304,200	
5 municipalities & communities: (Annapolis, Md. City, Sylvan Shores, Rose Haven, Southdown Shores) (Table B-3)	6.6400 mgd	Population in water service areas served (227,800)	19.49 mgd
		Population in water service areas not served (64,100)	5.13 mgd
4 trailer parks (Table B-5):	.2151 mgd	Rural population not in water service areas (12,300)	.98 mgd
11 apt. complexes (Table B-7):	.4862 mgd		
Military bases			
Ft. Meade (23,000 residents, 20,000 transients)	3.5000 mgd		
Naval Acad. & Experiment Station (4,370 residents; 3,530 transients)	1.8000 mgd		
Institutions			
Md. House of Correction (3,000 residents)	1.0000 mgd		
Total Residential Water Use Accounted for in Empirical Data	13.6413 mgd	Total Estimated Residential Water Use, 1970	25.60 mgd
Total Water Use Accounted for in Empirical Data	21.8606 mgd	Total Estimated Water Use, 1970	31.04 mgd

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ENTENTE CONCORDIALE - Tuesday evening, April 30th - Rittenhouse Club, 1811 Walnut St. 5:30 p.m.

The English-Speaking Union and the Alliance Francaise are joining forces to offer you a Cocktail Party and a sensational new film which has just been released on the aircraft CONCORDE - THE EARTHSHRINKER.

As the audiences watch the Concorde's route-proving trip they will never forget the sight of the "great bird" flying over countries the world round.

Filmed in London, Bristol, New York, Athens, Bombay, Singapore, Tokyo and Sydney, and in the air over the United Kingdom, the British-French airliner cuts time in half, cruising at about 1400 mph, and the simulation of a transatlantic flight shows how a Concorde passenger coming to the U.S. from Europe seems to arrive before he leaves !

Don't miss this exciting half-hour film and the chance of mingling with friends both old and new who are members of the Alliance Francaise.

The admission charge is $3.00 (which includes a cocktail). Please use reservation slip on last page.

AN OPEN LETTER FROM OUR PRESIDENT, RICHARD K. STEVENS, ESQ.

My appeal in January for voluntary contributions to E-SU has produced very agreeable results. The total contributions amounted to $3,300. The gifts are very much appreciated. They are also very encouraging in the sense that they indicate a strong commitment and belief in E-SU.

I hope that additional members will be moved to add to the total so far received. Just send a check to the office. And many thanks.

CHIMING BELLS HERALD SPRING

On Monday, May 6th, 3:00 p.m., at the House of the Colonial Dames, 1630 Latimer Street, the Very Reverend Gilbert Thurlow, Dean of Gloucester Cathedral, will address us on the subject of "Church Towers, Bells and Ringers - A Thousand Year Story."

Dean Thurlow attained his M.A. at Selwyn College, Cambridge, then attended Cuddesdon College, Oxford.

Among his many accomplishments since: He was successively incumbent of two medieval churches in the Norwich area. The Church of St. George, Colgate, along with the Church of St. Clement and St. Edmund; later, the Church of St. Andrews along with the Church of St. Michael at Plea.

From 1955 to 1964 he was Vicar of the Parish of Great Yarmouth in Norfolk. Here his major task was guiding the rebuilding and restoration of "England's largest Parish Church." This was St. Nicholas Church at Yarmouth which had been completely gutted and burned in an air raid in 1942.

In 1964 he became a Residentiary Canon of Norwich Cathedral where he was Vice-Dean for 3 years. In October, 1972, he was appointed Dean of Gloucester Cathedral.

He is visiting America for a short period in May and while he must fill many important Church engagements he has agreed to take time to speak to us for one afternoon.

His illustrated talk will be accompanied by excellent recordings of some of the more famous rings of Bells in England.

Please use reservation slip on page 3. A bountiful tea will follow the lecture. Members $3.00; non-members $3.50.

SPRING TOUR

Spring generally means getting out of doors, going places and seeing things. This year E-SU members and their friends have that opportunity.

On Thursday, April 25, leaving the Sheraton, 18th and J.F. Kennedy Boulevard at 9:15 a.m., a trip is planned which will delight all who love art, gardens and history. The program includes the Brandywine River Museum, noted for its outstanding architecture and as the hub of creative tradition begun with Howard Pyle and continued by the Wyeths and others.

Then luncheon in an eighteenth century inn followed by a visit to Winterthur. The beauty of the gardens is difficult to describe, except to promise there will be an abundance of color.

There will be a very short walk (five minutes) through a garden, then a tour of the Museum and South Wings where outstanding examples of American decorative arts of the seventeenth through the early nineteenth centuries are on display. At 4:30 p.m. we will start homeward.

The day is planned to include highlights of the area, however, and will not prove overly tiring, we believe. For instance, we will spend 25 minutes in the morning observing a slide presentation in the Brandywine River Museum. The pace will be leisurely throughout the day.

The price of the complete package is $16.00 which includes admission fees to Brandywine, both wings of Winterthur and a delicious luncheon at Chadds Ford Inn.

Come with us and enjoy a delightful day. Bus limited to 40 passengers so sign up early to avoid disappointment. Reservation form on page 3.

MUSEUM SERIES - Thursday, April 18th at 12:20 p.m.

Come and see a bit of England with us when the E-SU visits the English Period Rooms at the Philadelphia Museum of Art (26th Street and Benjamin Franklin Parkway).

A delicious luncheon of Quiche Lorraine will be held in the dining-room of the Museum at 12:30 and a cash bar will be available. This will be followed by a guided tour at 1:30 p.m.

As an added bonus, members of the E-SU group need pay only 75¢ admission to the Museum instead of the full price, so be sure to identify yourself as an E-SU member at the admission desk. For senior citizens with identification, admission is only 50¢. Museum Tour and luncheon $5.50. Please see tear sheet for reservations.

LORD TREVELYAN (GCMG, KCMG, CMG, CIE, CBE) will be in Philadelphia on Wednesday, May 22nd, and our Branch plans to honor him on this occasion so mark your calendar and watch for further details in the May Newsletter.

****

A warm welcome to members joining or rejoining during the period February 25 to March 26, 1974:

* Thomas A. Allaway
Mr. & Mrs. George R. Clark
Mrs. R. Charles Davies
* Stephen S. Dittmann
Mrs. William H. Dutcher, Jr.
Mrs. Franklin A. Fleece
* Miss Geraldine Gorzoch
Mrs. John P. Green
John B. Hannum, III
Mrs. Barton H. Hunter
Mr. & Mrs. Arthur Bennett Lipkin
Louis Loewenstein
Mr. & Mrs. David W. Maxey
* Miss Mary A. McQuiston
* Mrs. I. Wistar Morris, III
Mr. & Mrs. James W. Oram
Mrs. Gordon Phillips
Mr. & Mrs. Vincent D. Ruff
* Dr. Martin E. P. Seligman
Mr. & Mrs. Earl A. Skinner
Mr. & Mrs. John W. Thacher
Frederick M. Swope
Mr. & Mrs. Edward F. Wagner
Miss Frances C. Walsh
Mrs. James I. Wendell
Mrs. James Reid Wilson
Miss L. Lee Winston

(*) indicates younger members' group

- -

The English-Speaking Union
2414 PSFS Building
Philadelphia, Pa. 19107

Please make reservations for me as follows:	Amount enclosed
Thursday, April 18 - Art Museum Tour & Luncheon ____ places at $5.50	$_____
Thursday, April 25 - Bus Spring Tour _____ places at $16.00	$_____
Tuesday, April 30 - Rittenhouse Club - Film & Cocktail _____ places at $3.00	$_____
Monday, May 6 - Colonial Dames - Lecture & Tea ___ places - members $3.00 - Non-members $3.50	$_____

Name:_____

downstream. Morever, the surface drainage pattern is decidedly interjurisdictional. Of the 12 major watershed areas feeding the Maryland portion of the Chesapeake Bay, not one lies within a single jurisdiction. Ten of the twelve are interstate - 6 including portions of Delaware, 3 including portions of Pennsylvania, and 2 including portions of Virginia. The two watersheds which are not interstate, overlap 6 and 7 Maryland counties respectively. Most of the interstate watersheds also overlap 3 or more counties. A cross tabulation of state and county jurisdictions with 12 major watersheds feeding the Maryland portion of the Chesapeake Bay can be found in Table 3. Such a crosstabulation could be developed by developing areal, population and major water usage breakdowns. Thus, water supply becomes an interjurisdictional problem. A major portion of the water demands in Northern Anne Arundel County may be met with water collected at Lock Raven reservoir on the Gunpowder River in Baltimore County. The Washington Suburban Sanitary Commission may be called on to help meet needs in western portions of the county. Municipal supplies may need to help meet needs in surrounding areas under county jurisdiction.

Table 3

CROSSTABULATION OF STATE AND COUNTY JURISDICTIONS WITH 12 MAJOR WATERSHEDS FEEDING THE MARYLAND PORTION OF THE BAY

Major Watersheds a) / Jurisdictions b)	Elk River	Chester River	Choptank River	Nanticoke River	Pokomoke River	Coastal	Lower Susquehanna	Gunpowder River	Patapsco River	Patuxent River	Washington Metro (Potomac River)	Lower Patuxent River
Cecil	●						●					
Kent	●	●										
Queen Anne's		●	●									
Talbot		●	●									
Caroline			●	●								
Dorchester			●	●								
Wicomico				●	●							
Somerset				●	●							
Worcester					●	●						
Harford							●	●				
Baltimore Co.							●	●	●			
Carroll								●	●			
Baltimore City							●		●			
Howard									●	●		
Montgomery										●	●	
Prince George's										●	●	●
Anne Arundel									●	●		
Calvert									●	●		
Charles										●		●
St. Mary's										●		●
Delaware	●	●	●	●	●	●						
Pennsylvania	●						●	●				
Virginia											●	●

a) Recommended by the Federal Water Quality Administration
b) Maryland Counties and Adjacent States

1.3 Location

Plate 14 (Surface Drainage Pattern and Public Surface Water Intakes) shows all major watershed boundaries in the area, and several of the more important secondary watershed boundaries of streams flowing directly to the Bay. Locations on these streams of public surface water intakes are also shown, as are the region's major reservoirs.

Table 1 above shows major surface withdrawals by supplying streams, and the population served by the withdrawals. Plate 15 (Chesapeake Bay Water Budget) schematically illustrates the internal "plumbing" of the hydrologic cycle in the Bay region. In other words, where water in the Bay system comes from, where it goes when it leaves the system, and what happens to it while it is resident in the system, or passing through it. Plate 16 (Generalized Geologic Map - Anne Arundel County) shows outcrop areas of the principal formations within which occur the major aquifers underlying the county. Plate 17 (Structure Contours of Aquifers - Anne Arundel County) shows contours of depths to the tops of principal aquifers in the County. Plate 18 (Aquifer Block Diagrams - Anne Arundel County) shows how the principal aquifers

PLATE 14: Surface Drainage Pattern and Public Water Supply Intakes

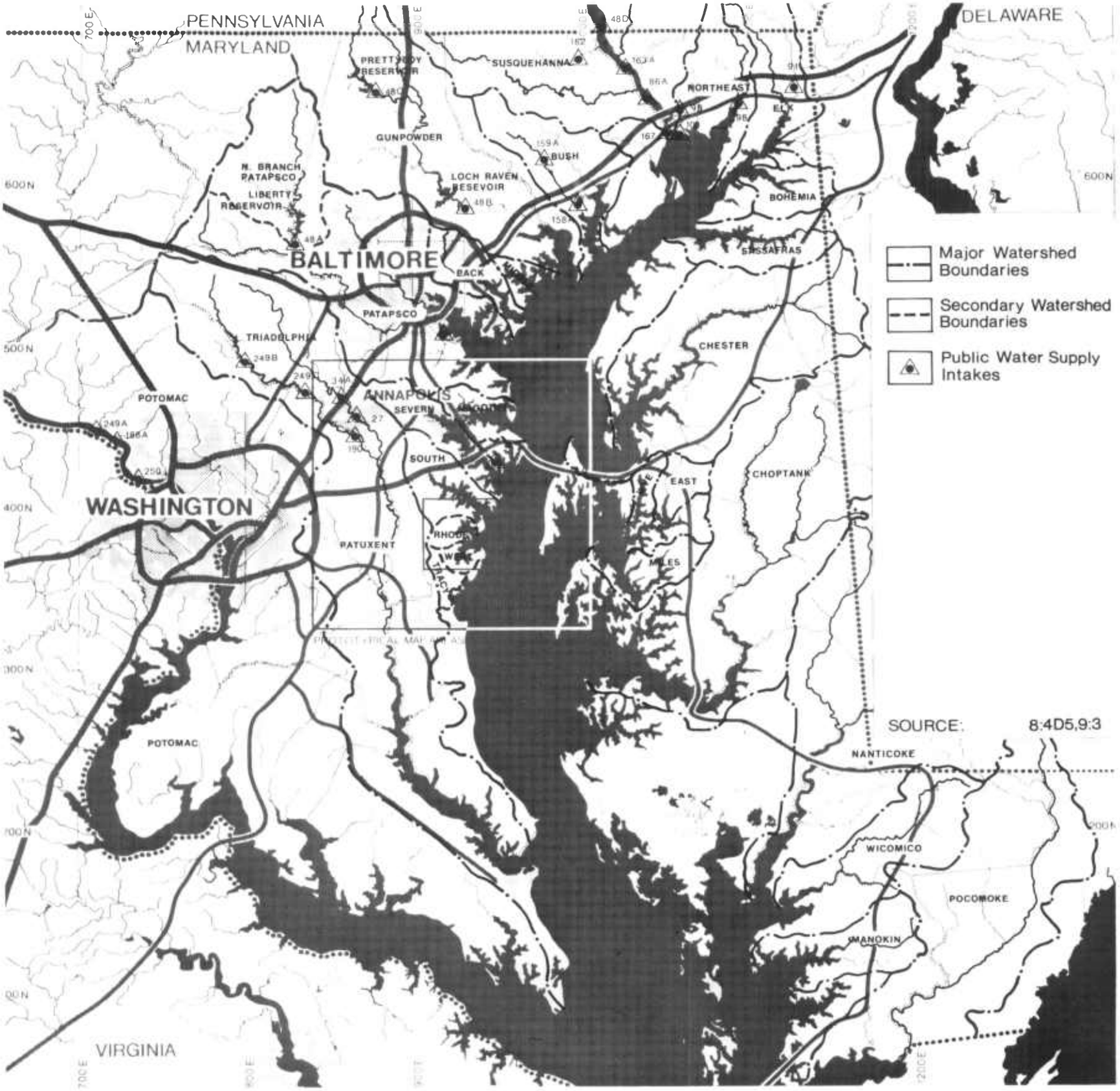
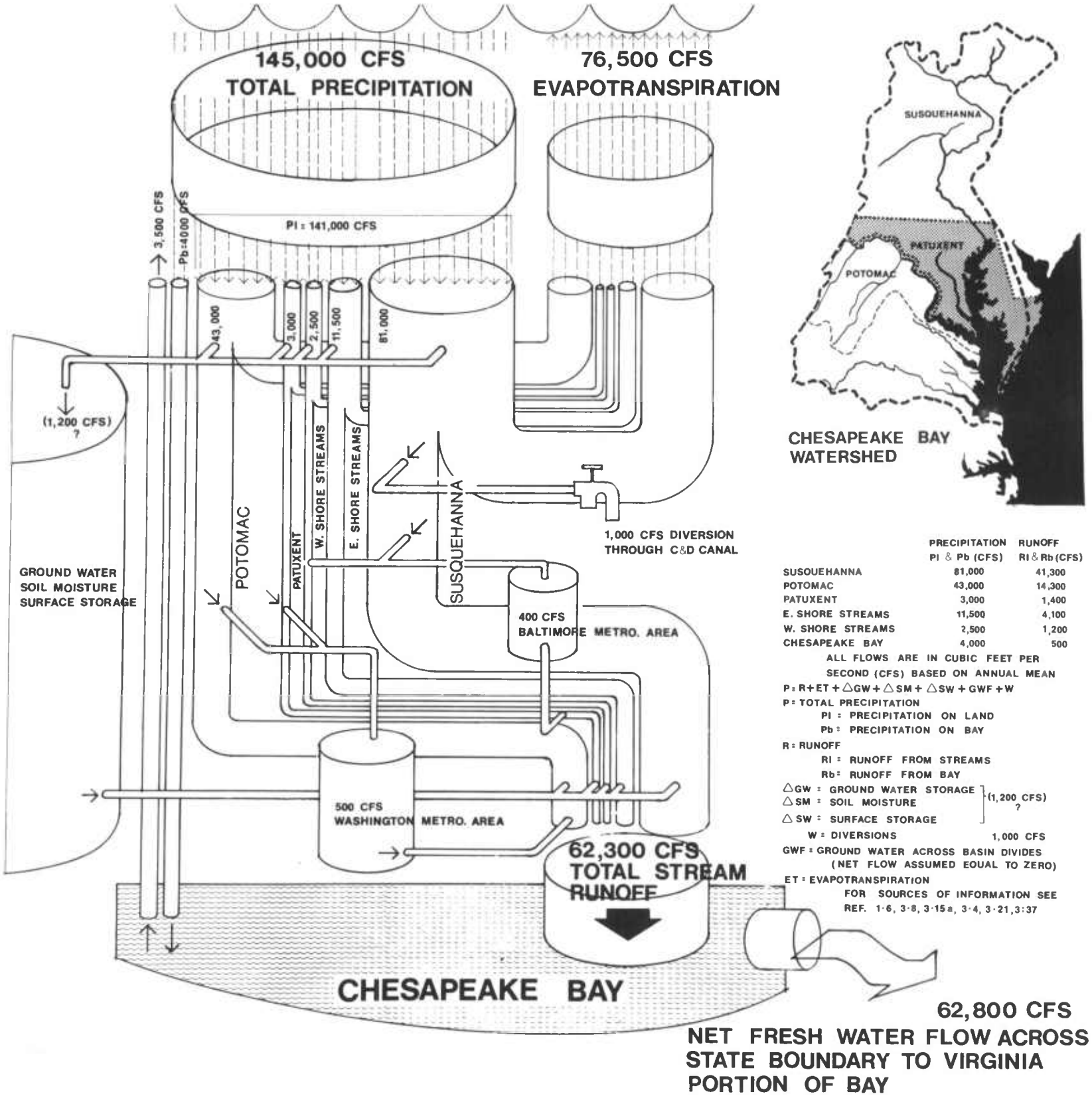


PLATE I5: Chesapeake Bay Water Budget



	PRECIPITATION PI & Pb (CFS)	RUNOFF RI & Rb (CFS)
SUSQUEHANNA	81,000	41,300
POTOMAC	43,000	14,300
PATUXENT	3,000	1,400
E. SHORE STREAMS	11,500	4,100
W. SHORE STREAMS	2,500	1,200
CHESAPEAKE BAY	4,000	500

ALL FLOWS ARE IN CUBIC FEET PER SECOND (CFS) BASED ON ANNUAL MEAN

$P = R + ET + \Delta GW + \Delta SM + \Delta SW + GWF + W$

P = TOTAL PRECIPITATION
- PI = PRECIPITATION ON LAND
- Pb = PRECIPITATION ON BAY

R = RUNOFF
- RI = RUNOFF FROM STREAMS
- Rb = RUNOFF FROM BAY

ΔGW = GROUND WATER STORAGE
ΔSM = SOIL MOISTURE
ΔSW = SURFACE STORAGE
} (1,200 CFS) ?

W = DIVERSIONS 1,000 CFS

GWF = GROUND WATER ACROSS BASIN DIVIDES (NET FLOW ASSUMED EQUAL TO ZERO)

ET = EVAPOTRANSPIRATION

FOR SOURCES OF INFORMATION SEE REF. 1·6, 3·8, 3·15a, 3·4, 3·21, 3:37

PLATE 16: Generalized Geologic Map, Anne Arundel County

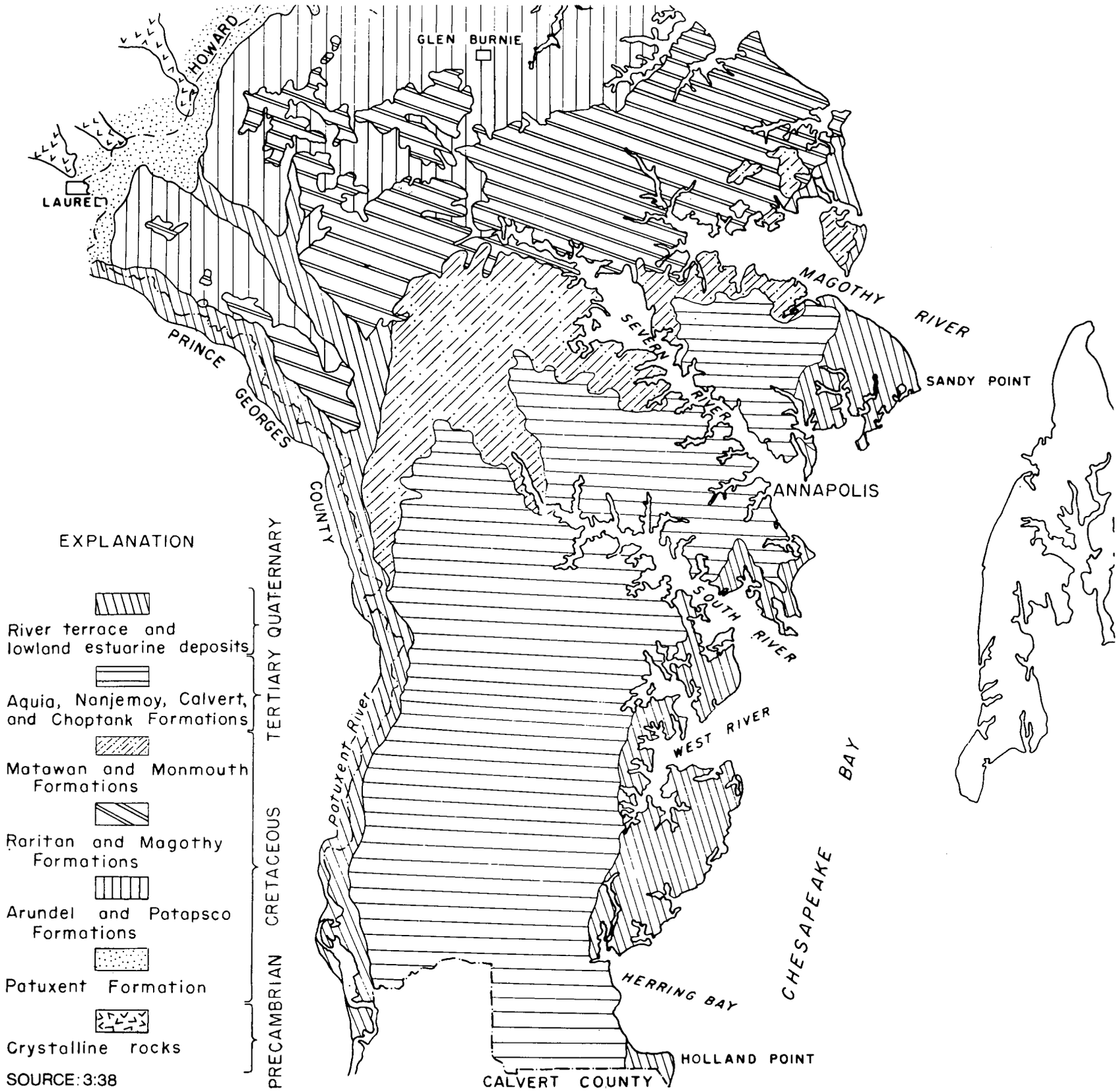
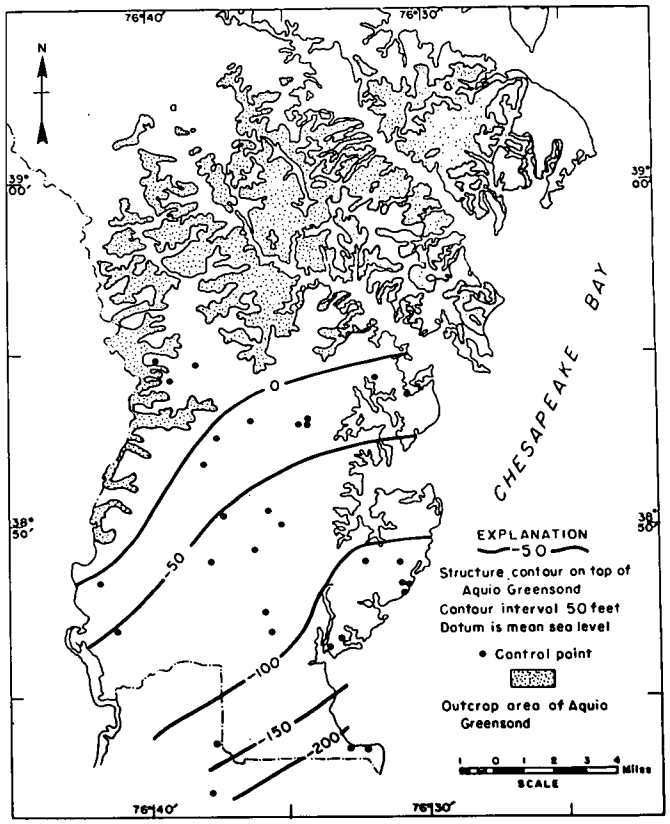
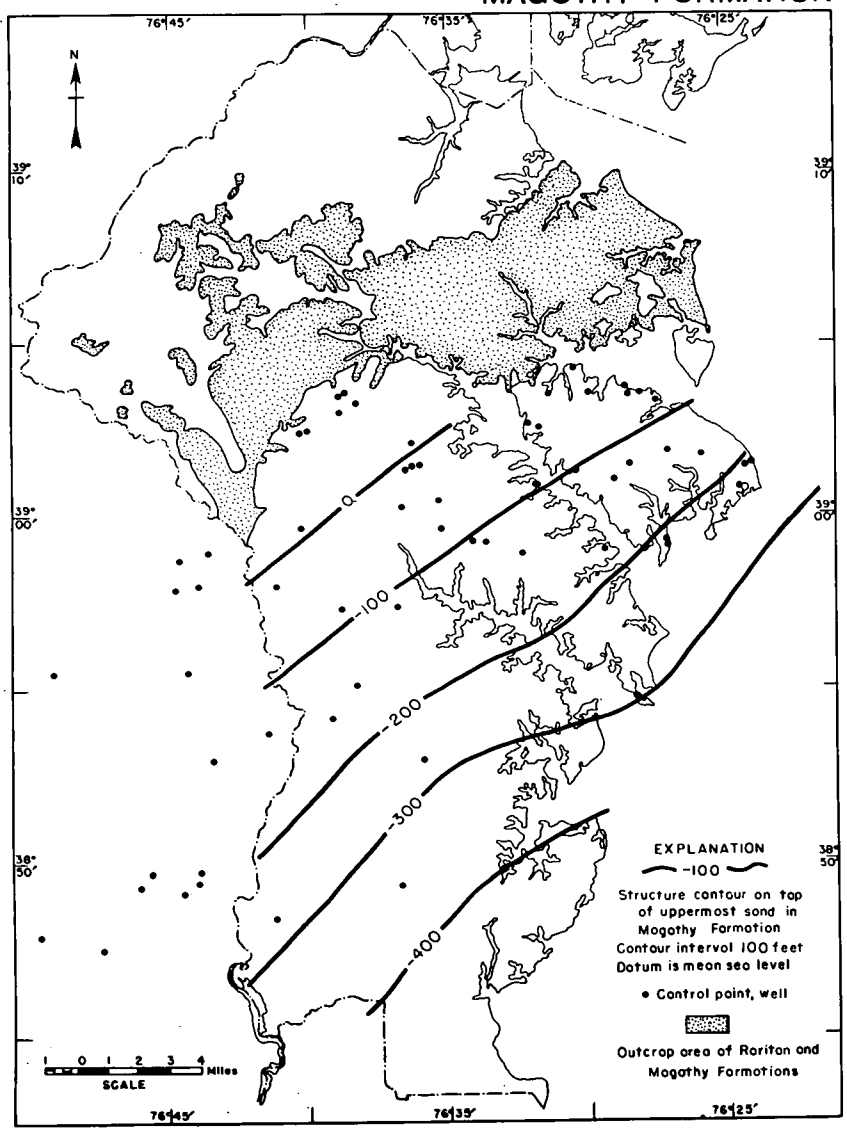


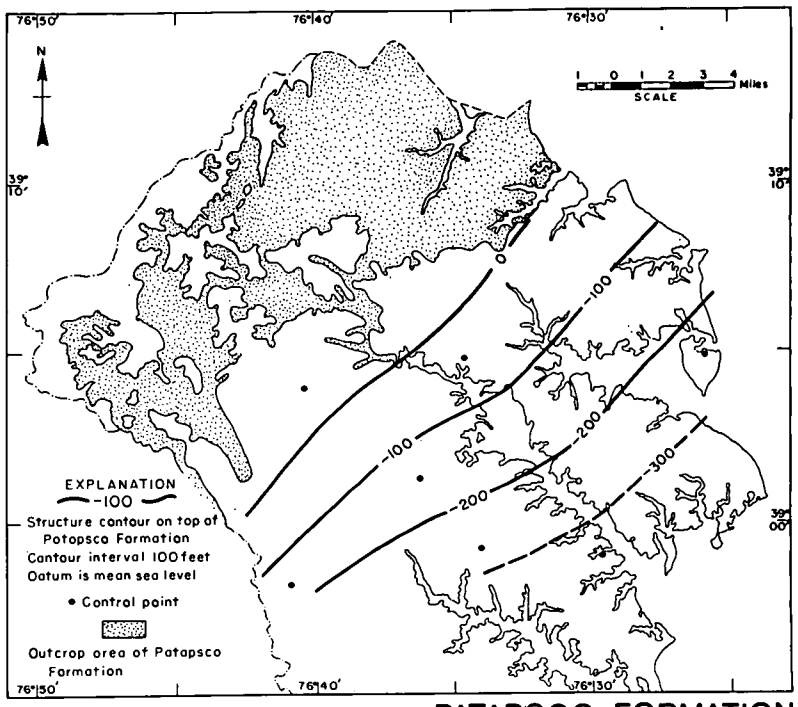
PLATE 17: Structure Contours of Aquifers, Anne Arundel County
(Section II-F, Ref. 4)

AQUIA GREENSAND



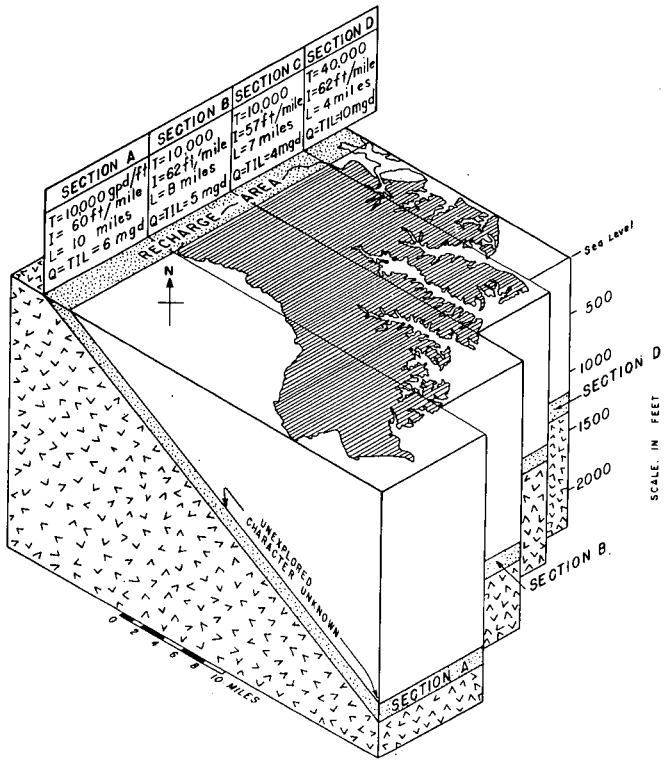
MAGOTHY FORMATION

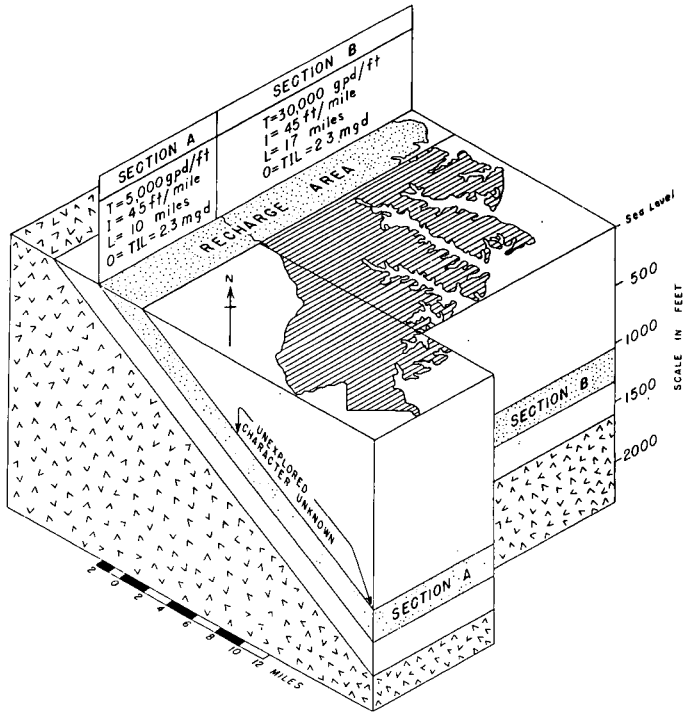


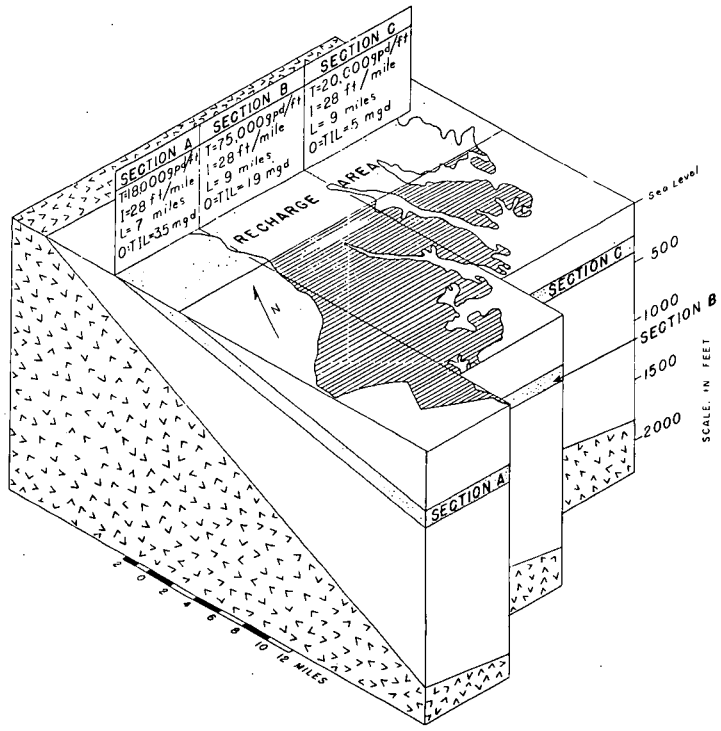


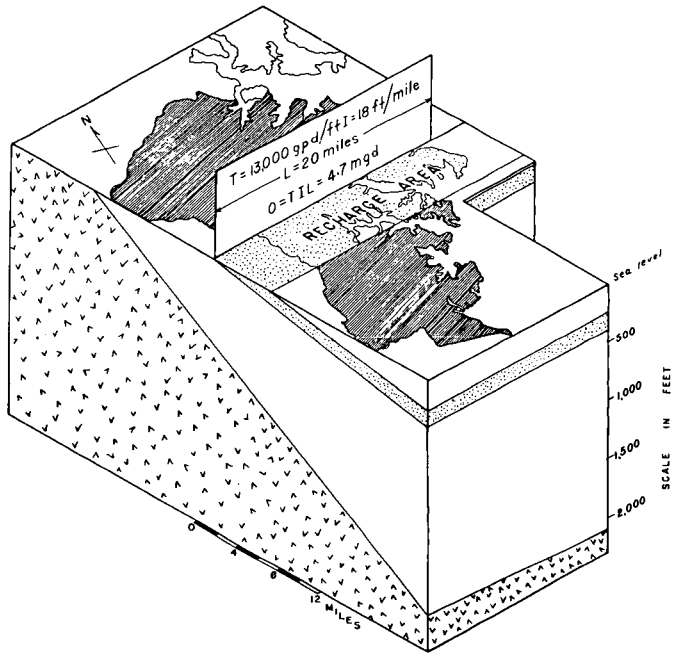
PATAPSCO FORMATION

PLATE I8: Aquifer Block Diagrams, Anne Arundel County









SOURCE: 3:38

act as conduits to transmit water southeastward and steadily deeper beneath the surface from their outcrop/recharge areas in the northwestern part of the County.

1.4 Time Characteristics

Water demands are fairly constant through the year except for summer when large additional amounts are used for irrigation (an almost totally consumptive use) and cooling. The fact that lowest surface flows in the supplying streams, and the greatest natural demands of evapotranspiration, occur in summer further aggravates the seasonal problem.

1.5 Parties Affected

All inhabitants of the Bay region, both human and non-human, are directly affected by the problem posed by the need to reconcile increasing water demands with a fixed natural supply.

2 Future Dimensions of Water Supply Problems

In describing the future dimensions of water supply problems, the following sections make particular reference to recent water supply and demand studies for Anne Arundel County. It is felt that the local perspective adds specificity to regional-level analyses and that the water supply problems of Anne Arundel County are similar in many respects to those in other urbanizing areas of the Maryland Bay Region.

2.1 Forces Tending to Increase the Problem

The provision of water supply for urban development is an increasing public concern. Nationally in 1960 about 43% of total estimated water use was for irrigation, about 7% was public water supplies, 2% for domestic (non-public) water use, 23% for self-supplied industrial uses, and 25% was used in the generation of electric power (Ref. 3). All of these uses are increasing -- at an average rate of 27% per decade. On the local level, a recent report (Ref. 4) estimates that water demands for residential and industrial uses in Anne Arundel County will increase five times between 1960 and 2000; the report does not give explicit consideration to two major national water uses -- irrigation and electric power generation. This means that water demands, instead of being a rather

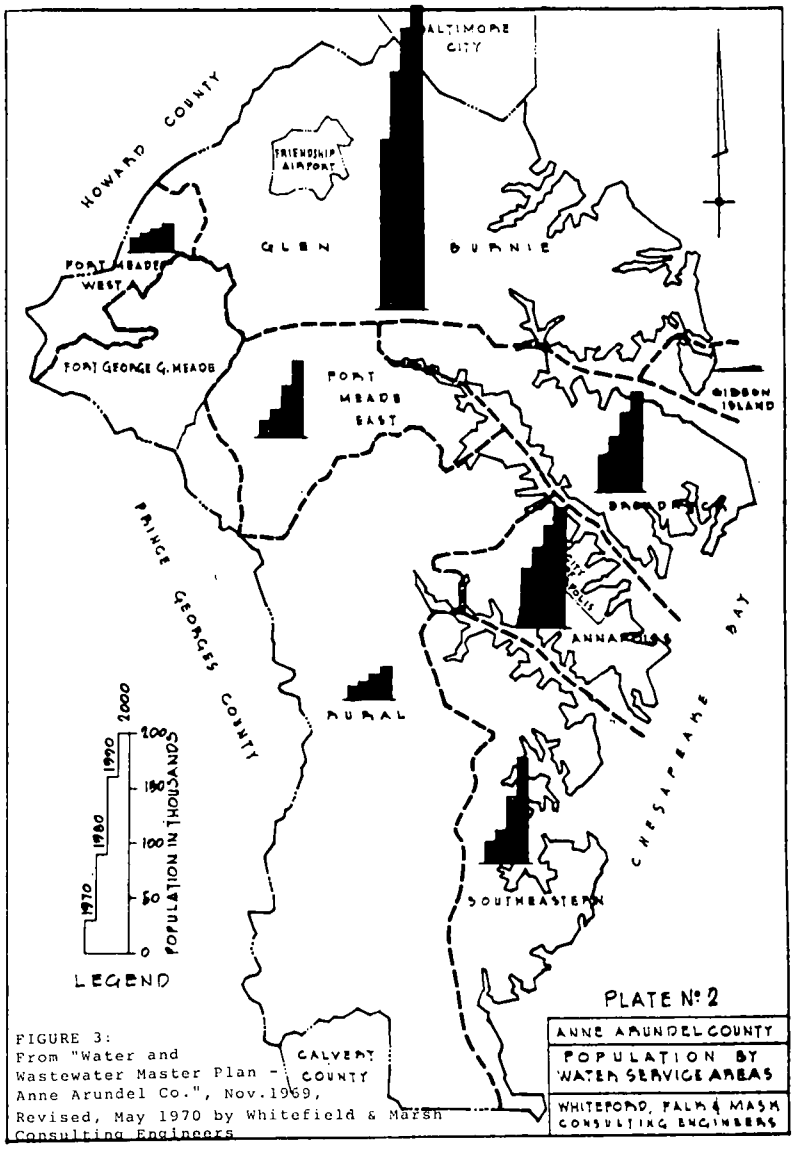


FIGURE 3:
From "Water and Wastewater Master Plan - Anne Arundel Co.", Nov.1969, Revised, May 1970 by Whitefield & Marsh Consulting Engineers

small percentage of the total natural water supply, will be a very large proportion.

This demand will use almost the full capacity (65-89 mgd) of Anne Arundel County's extensive ground water supplies. When "natural" surface waters are preempted by other uses such as wastewater disposal (the Little Patuxent is an example in Anne Arundel County), increasing reliance on ground water and/or major infrastructure facilities to transport water from other areas will be required.

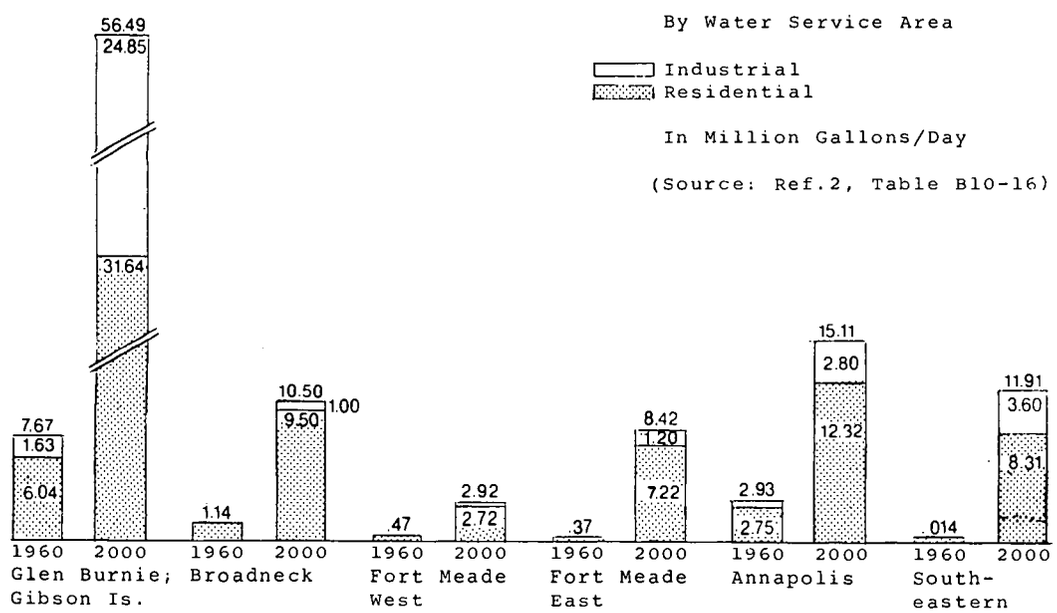
Figure 3 shows water service areas in Anne Arundel County and Figure 4 presents general trends of water demands for six of these areas and for broad industrial and residential categories. These trends indicate that water demands will increase dramatically in most of the water service areas. The increase in water demand in the Glen Burnie water service area alone will approach the total water intake at one of the four large reservoirs making up Baltimore City's water supply. Since other counties will also be increasing their water demands, the allocation of water among competing human demands and the impact of total water demands on the environment are likely to become major issues of regional public policy. The factors used in deriving residential water demands are: population growth, rates of use, and increases in proportion of population served by public water supply.

a. Population Growth

The year 2000 population used in the calculations was 723,200 -- some 123,000 more than the figure indicated in 1967 projections developed by the State Planning Department. Since both projections indicate a larger 1970 population than was revealed in the recent census, it may be concluded that the water plan's year 2000 projection and perhaps both projections may be too high.

Since water supply facilities are now being planned on the basis of the larger population, since 16 mgd of water demand may be involved, and since water supply facilities are expensive and have considerable environmental

FIGURE 4: Residential and Industrial Average Water Demands: Anne Arundel County, 1960, 2000



ramifications, the discrepancy in long-range projections may make a real difference.

b. Rates of Usage

The water plan posits that "high value"residential areas "demand" more water per capita than urban residential areas in general -- presumably because of a greater number of water-using appliances and fewer inhibitions on their use. And it posits that residents of urban areas use more water than those of unurbanized areas. Further it posits that rates of water use will increase steadily through the year 2000. In each decade, this increase is assumed to be 10 gallons per day per person in "high value" and "general" residential areas, and 5 gallons in "urban" areas. There does not seem to be general professional agreement on the base rates of water usage in various sorts of residential areas. The magazine Professional Builder, for instance, indicates that the average rate of water usage in luxury homes is 100 gallons per day per person -- about 30 gallons less than the water plan index for "high value" residential areas (Ref. 5). Similarly, the rates for average suburban areas and apartment houses are lower (80 and 75 gallons per day per person) than the water plan's index for urban residential areas (115 gallons).

c. Proportion of Population Served

The water plan posits that a steadily increasing proportion of the County's population will be served by the public water system. This is a reflection of economies of scale in water supply and possible public health impacts as urban development becomes more dense. However, in order to assess the environmental impact of a jurisdiction's water needs, the total demand for water -- public and private -- must be delineated.

Summary

The review of factors used in projections of water demand is presented as an example of the methodology used in developing projections of water demands which underlies long-range capital programs for water supply facilities. The review indicates that in an effort to be "on the safe side" in planning for water supply, the methodology tends to exaggerate total need and ignore other reasonable public choices. On the other hand, significant portions of residential and non-residential water needs are not included in projections of water demand. The effects of water use demands on the natural water supply are considered, but not in systematic and comprehensive fashion. Needed are alternative projections of total water demand for various water uses given specified public policies with regard to water use.

For each of the water demand alternatives, a water supply system -- combining various public and private, ground and surface sources of water supply -- can be delineated. The alternative water supply systems would provide a basis for a systematic evaluation of the cost and environmental impacts of alternative levels of water demand, which in turn would provide a basis for public choice regarding overall levels of water demand, and the allocation of a given water supply among competing users.

d. Industrial and non-residential Water Demands

The factors used in projecting water use by industry deserve special mention. In order to develop a rough projection of water need by industry, the county water plan makes a distinction between "heavy" and "light" industry, and applies indexes of water use to projections of industrial acreage. But, industrial water use is a much more complicated analytic problem than domestic water use. Various industries have widely varying needs for water in their manufacturing processes. Not only do these needs vary between broad industrial categories -- e.g. primary metals (SIC 33) vs. food and beverage industries (SIC 20), but

TABLE 4: PROPORTIONS OF TOTAL INDUSTRIAL WATER USE BY SELECTED TYPES OF INDUSTRY COMPARISONS OF NATIONAL VS. LOCAL (ANNE ARUNDEL COUNTY) USAGE

SIC Code	Type of Industry	Approximate Percentage of Total National Industrial Use (Ref.3)	Percentage of Industrial Water Use in Anne Arundel County [a]
33	Primary Metals	32	11
28	Chemicals & Allied Products	23	13.5
26	Paper Products	14	
29	Petroleum & Coal Products	9	
20	Food Industry	5	
32	Stone & Vitreous Products	2	
37	Transportation Equipment	2	
30	Rubber & Plastics	1	
35	Non-Electrical Machinery		15
34	Fabricated Metals		2
38	Instruments & Related Products	12	
31	Leather		
39	Miscellaneous Industries		
21	Tobacco Products		
25	Furniture		
36	Electrical Machinery & Equipment		32
23	Apparel		
27	Printing & Publishing		.5
		100%	100%

[a] Sample of 17 industries representing 70% of total county manufacturing employment (See Refs. 6,7)

they also vary considerably within each category; the processing of most vegetables requires more water per ton of product than making bread, for instance (See Table 4). Furthermore, as the availability of water supply and the quality of receiving waters increasingly become constraints on industrial location and operation, individual industries have contrived to use less water in their manufacturing processes. An example is the Kaiser Steel Plant at Fontana, California which uses 1400 gallons of water per ton of product; the steel industry as a whole uses water at approximately 40 times this rate (Ref. 3). On the other hand, constantly changing manufacturing processes often involve increasing water needs per unit of product.

It is interesting to place industrial (and other non-residential) water use in the context of total water use for various portions of the Chesapeake Bay region and to identify how industrial water use is apportioned among various industrial sectors. Again, the specific data presented is for Anne Arundel County. Water use by 24 industries representing approximately 80% of manufacturing employment in Anne Arundel County amounts to 19% of total current water use in the county (see Table 2). If information for other industries were available, industrial water use might amount to 25% of the total. In addition, there are schools, offices, stores, motels and restaurants for which available empirical data is incomplete. It can be seen that non-residential

Table 5. WATER CONSUMPTION AND WITHDRAWAL, DOMESTIC AND INDUSTRIAL, 1970 & 2000, BY REGION

	URBAN WITHDRAWAL			RURAL WITHDRAWAL			PROCESSING INDUS WTHDL			FABRIC INDUS WTHDL			TOTAL
	POP[a] (000)	RATE[b] gal/cap/day	TOTAL gal/day (000)	POP[a] (000)	RATE[b] gal/cap/day	TOTAL gal/day (000)	EMPLOY[c] (000)	RATE[b] gal/cap/day	TOTAL gal/day (000)	EMPLOY[a] (000)	RATE[b] gal/cap/day	TOTAL gal/day (000)	gal/day (000)
BALT. REG.													
1970 wthdl	1725	160	276 000	305	140	42 600	96.5	5700	550 000	112.2	250	28 000	896 600
cnsp		9%	24 900		20%	8 500		8%	44 400		4%	1 120	78 920
2000 wthdl	2857	160	457 000	317	140	44 200	100	5700	570 000	122	250	30 500	1 101 700
cnsp		9%	41 200		20%	8 800		8%	45 600		4%	1 220	96 820
DC. METRO													
1970 wthdl	1060	160	170 000	118	140	16 500	5.2	5700	29 700	8.9	250	2 220	218 420
cnsp		9%	15 400		20%	3 300		8%	2 380		4%	89	21 169
2000 wthdl	1780	160	284 000	93	140	13 000	6.8	5700	38 800	11.7	250	2 920	338 720
cnsp		9%	25 600		20%	2 600		8%	3 120		4%	120	31 440
SO. MD.													
1970 wthdl	22	160	3 520	112	140	15 700	.9	5700	5 130	.3	250	75	24 425
cnsp		9%	320		20%	3 140		8%	410		4%	3	3 873
2000 wthdl	87	160	13 900	107	140	15 000	.9	5700	5 130	.9	250	225	34 255
cnsp		9%	1 260		20%	3 000		8%	410		4%	9	4 679
E. SHORE													
1970 wthdl	49	160	7 810	149	140	20 800	11.5	5700	65 500	7.6	250	1 900	96 010
cnsp		9%	700		20%	4 160		8%	5 250		4%	76	10 186
2000 wthdl	117	160	18 700	176	140	24 600	10.6	5700	60 400	5.7	250	1 430	105 130
cnsp		9%	1 690		20%	4 910		8%	4 830		4%	57	11 487
CECIL CO.													
1970 wthdl	6	160	956	47	140	6 550	.3	5700	1 710	3.4	250	850	10 066
cnsp		9%	86		20%	1 310		8%	140		4%	34	1 570
2000 wthdl	15	160	2 400	45	140	6 280	.3	5700	1 710	3.9	250	970	11 360
cnsp		9%	215		20%	1 260		8%	140		4%	39	1 654
TOTAL													
1970 wthdl			458 286			102 150			652 040			33 045	1 245 521
cnsp			41 406			20 410			52 580			1 322	115 718
2000 wthdl			776 000			103 080			676 040			36 045	1 591 165
cnsp			69 965			20 570			54 100			1 445	146 080

a) 1970 population, by county, from Ref.8;
2000 population projection, by county, from Ref. 9;
Urban Renewal breakdown based on 1950,1960 Census data (Ref. 10).

b) Rates of Withdrawal, consumption (Ref. 11).

c) 1970 Employment, by region, from SPD (Ref. 12); 2000 Employment extrapolations (WMRT); 2000 Employment, different regions (Ref. 13); Processing-Fabricating Breakdown (Ref. 10).

water use represents a large share of total water use in Anne Arundel County.

Table 5 synthesizes at a regional level the water withdrawal and consumption implications of a number of the factors discussed in more detail in reference to Anne Arundel County (population increases, proportion of population using public water supplies, employment projections by broad industrial types, rates of water use). Available information was not sufficient to allow a comparison of water supply and water damands at the regional level, however.

e. Another factor tending to increase the problem is the effect of urbanization on rates of ground water recharge. Urban development of all kinds makes impervious surfaces which increase rates of precipitation run-off into surface drainage systems and lower rates of ground-water recharge. Many areas (e.g., Anne Arundel County) depend heavily on ground-water recharge.

f. Megalopolitan water needs may adversely affect water supply in the Maryland Bay Region. The proposed Susquehanna Diversion Project would remove large quantities of surface water from the Chesapeake Bay watershed entirely -- thus limiting the total water supplies on which the Maryland Bay Region can depend.

g. The cost of water supply facilities is another factor tending to increase water supply problems. These are exacerbated by the increasing future need to transport large volumes of water long distances to serve concentrations of urban development.

This is illustrated by plans by Anne Arundel County. The County has plans to build an 84" water main underneath the Patapsco River. The "Under Harbor Crossing" would cost $8 million and would be a joint venture with Baltimore City. The purpose is to support vigorous growth of residential and industrial development in the northern areas of Anne Arundel County without depleting ground water supplies. (These are connected under the surface to other areas of the County which will rely on them almost exclusively.) Since the smaller streams (Severn, Magothy, South) are unable to supply any adequate amounts of water, the County must tap surface water collected elsewhere in the region to support further urban development in its northern areas.

Anne Arundel County now receives about 2.5 mgd of Baltimore City water. This comes from two sources: the Liberty Reservoir on the Patapsco River and the Lock Raven Reservoir on the Gunpowder River. The plan is to increase the supply from the Liberty Reservoir to 10 mgd by the year 2000, and the supply from the Lock Raven Reservoir to 46 mgd. The water main crossing the Patapsco is prerequisite for delivering the 46 mgd from the Gunpowder River to Anne Arundel County and for most of the water facilities planned for the Glen Burnie water service area (i.e. the northern part of the county). Yet it accounts for only 20% of the cost of water facilities proposed for Glen Burnie between 1970 and 2000; and only 9% of the cost of water facilities proposed for the County as a whole (see Table 6).

Water Demand - Water Supply Relationships:

The above sections discuss residential and industrial water use. Empirical data collected in the Anne Arundel County water plan was synthesized to provide examples and concrete reference points for a more detailed breakdown of water users than is usually possible. The remaining question is how this water use -- now and in the future -- relates to sources of water supply. Again, Anne Arundel County is used as a specific example. Figure 5 relates water demands for various water service areas to sources of ground and surface water supply. Various "modes" of water supply -- interjurisdic-

Table 6 : PROPOSED WATER SUPPLY IMPROVEMENTS, 1970-2000, BY WATER SERVICE AREA ($000)

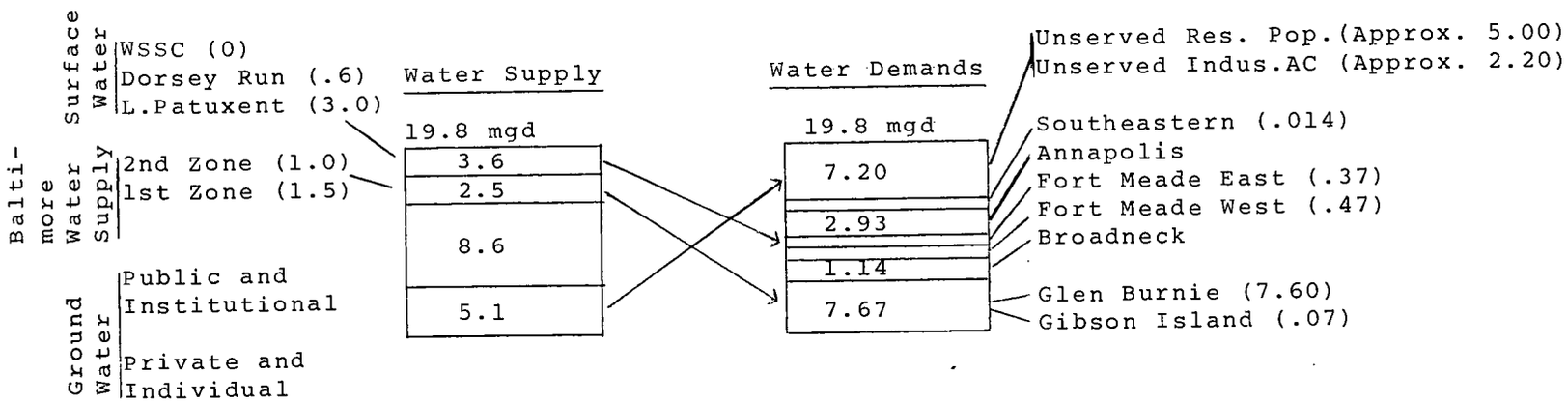
WATER SERVICE AREA	1970-1975			1975-1980		1980-2000	
	MASTER FACILITIES	COMMERCIAL & INDUSTRIAL EXTENSIONS	TOTAL 1970-1975	MASTER FACILITIES	SUB-TOTAL 1970-1980	MASTER FACILITIES	TOTAL 1970-2000
1. Glen Burnie Metro	16,853	6,547	23,400	8,480	31,880	7,400	39,280
2. Gibson Island	73	0	73	305	378	0	378
3. Broadneck	1,458	1,368	2,826	3,754	6,580	5,389	11,969
4. Fort Meade West	1,824	0	1,824	766	2,590	1,157	3,747
5. Fort Meade East	1,284	1,470	2,754	2,316	5,070	6,313	11,383
6. Annapolis	396	261	657	5,137	5,794	3,220	9,014
7. Southeastern	0	0	0	5,590	5,590	9,425	15,015
8. Rural	0	0	0	0	0	0	0
9. Incremental Costs if Ft. Meade and Maryland House of Correction Connected to U-H Crossing	0	0	0	401	401	432	833
GRAND TOTAL	21,888	9,646	31,534	26,749	58,283	33,336	91,619

tional water transfers, surface water intakes from various rivers, public and private ground water supplies -- are also indicated. Major sources of water for various water service areas are expanded upon in the notes accompanying Figure 5.

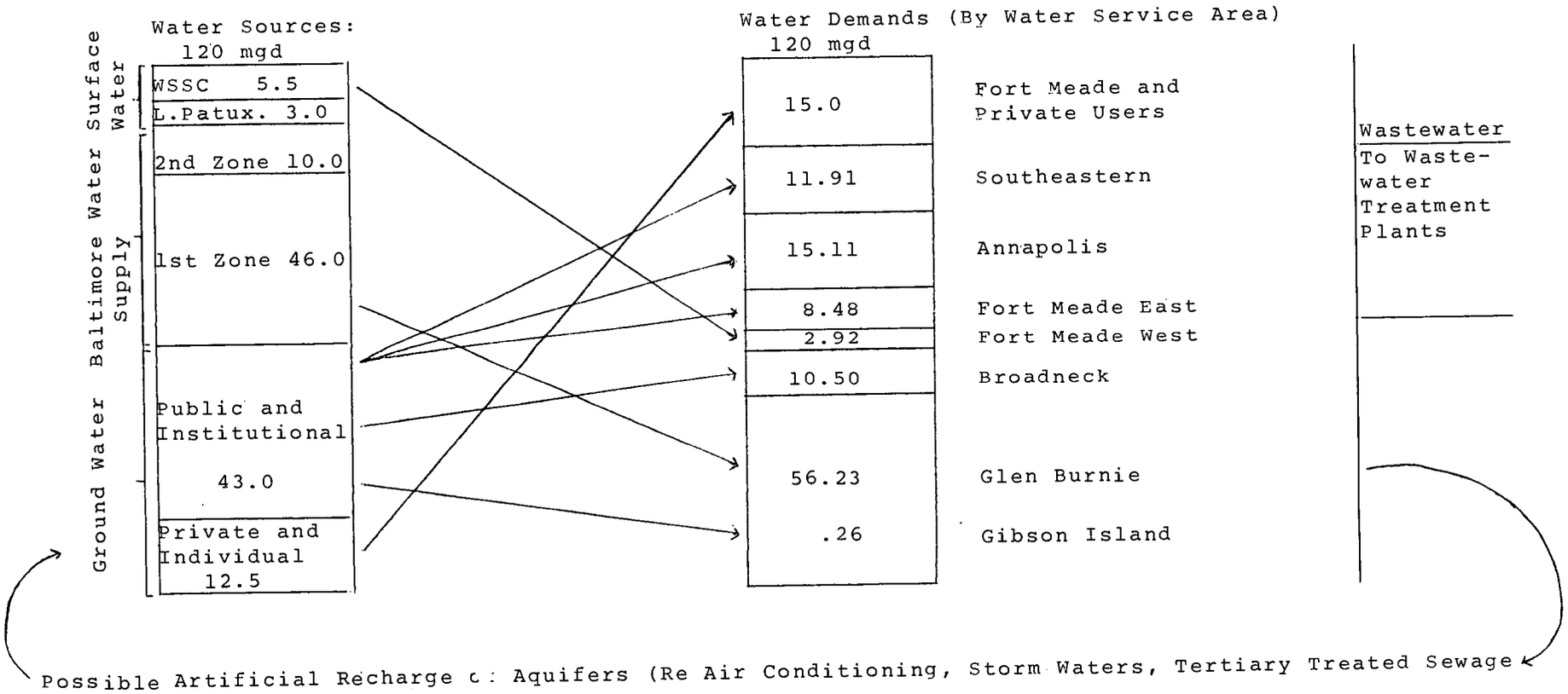
Man's Demands in the Context of Total Water Supply:

In the past, the proportion of total surface water and ground water which was used for human activities was relatively small in most communities. The effects of human use of water on overall water supply in the area were likely to be correspondingly small. In the future, greatly increased use of water in heavily urbanized areas, and the effective preemption of some water supplies by their use for other purposes (e.g. waste disposal) will result in human use of water being a much larger proportion of total natural surface and ground water supply. The potential effects of human use of water on the overall water system become critical to the existence of the water supply system. Management of water use in the emerging situation becomes correspondingly critical and raises issues which must be dealt with more and more precisely and more and more on a regional basis.

FIGURE 5: Water Sources and Water Demand: Anne Arundel Co.(1960)



Water Sources and Water Demand: Anne Arundel Co. (2000)



Competing Uses of Surface Water Supplies:

The two major rivers - - the Patapsco and the Patuxent -- which form borders of Anne Arundel County are already developed with dams and reservoirs to provide water supply to the Baltimore City Water System and the Washington Suburban Sanitary Commission. Because of the water supply development in Baltimore and Prince George Counties, the use of the portions of these rivers which actually flow past Anne Arundel County is restricted. Even if these portions of the rivers were not restricted as sources of water supply, the quality of the water would make it very difficult to convert for public water supply. (Industrial development along the Patapsco has long since reduced its water quality level; and the Patapsco will increasingly be used for wastewater discharge.)

Other streams such as the Little Patuxent and Dorsey Run are used for water supply to their practicable limits -- also because of reduced quality due to competing use for wastewater discharge. In the opinion of the authors of the water plan, the Severn, South, Magothy, the Rhode and other small streams in Anne Arundel County should not be used as sources of water supply.

The result is that the effective surface water supply in Anne Arundel County is quite limited. Where surface water is necessary to meet demands or to make it possible to develop a particular area, it must be arranged for by interjurisdictional agreement and transported from relatively distant sources to the area in question. Both the interjurisdictional agreement and the infrastructure facilities thus become constraints on development. These constraints necessarily involve the locality in regional water allocation decisions and increase the costs of development. The water plan indicates that Anne Arundel County will use 65 mgd of surface water in the year 2000 and that almost all of this will be provided by interjurisdictional transfer.

Heavy Reliance on Ground Water Supplies:

Ground water, where it is available is usually the more convenient and inexpensive source of water supply. Anne Arundel County is fortunate in having extensive ground water supplies. The water plan estimates that 65-82 mgd are available from "artesian" aquifers and 50 mgd from "water table" aquifers -- a total of 132 mgd. Because of the distribution of these supplies in the County and the distribution of water demand, it appears that four water service areas, including three bordering the Chesapeake Bay, have sufficient ground water supplies to meet prospective demand to the year 2000 (The Annapolis area is questionable in this regard.) One environmental danger in the close-to-capacity use of ground water sources in areas adjacent to the Bay is that brackish water could intrude into the ground water supplies if they are not adequately recharged. However, urban development in these areas will increase rates of surface water runoff, thus increasing chances of inadequate recharge of these resources.

2.2 Forces Tending to Reduce the Problem

a. Efforts to reduce rates of water demand can help reduce water supply problems. The Anne Arundel County Water Plan, like most similar local plans, is "service-oriented." It focuses on developing projections of water demands and proposes water facilities adequate to meet the demands, It does not speculate on the possibility of regulating water demands. However, it is possible that alternative land use allocation patterns might generate different water facilities program costs which could be evaluated. It is also reasonable to assume that much of the water use posited for the year

2000 is discretionary in nature and that citizens may not wish to pay for the water facilities necessary to supply such volumes nor suffer the environmental problems that may be entailed. Rates of water usage are subject to public policy control. As Anne Arundel County and other counties in the Maryland Bay Region approach the limits of their natural water supplies and as marginal increases in supply become more costly (in terms of capital facilities and environmental impacts), the public may wish to have their real choices clearly delineated for them. These will include possibilities of accepting regulations on discretionary water use in exchange for tax and environmental benefits.

b. Under certain circumstances estuarine waters can be used as a supplementary water supply source. This is the conclusion -- with regard to the Potomac Estuary -- of a recent study by the Chesapeake Technical Support Laboratory of the Environmental Protection Agency.(Ref. 14) The conditions are that waste water discharges into the estuary as well as water supply withdrawals be adequately treated. However, even the supplementary use of estuarine waters would require a wholly new system for transporting water to users.

c. Another possible source of additional water supply is direct reuse of treated effluent. "The major problem (besides psychological objections) in using treated effluent as a source of water supply are the viruses which may survive even advanced wastewater treatment and which could cause severe health problems if entered into the water supply." (Ref. 14)

d. Managing ground water supplies by recharging ground water supplies with water used in air-conditioning systems, storm water, or treated waste water can help counties which depend on groundwater supplies (such as Anne Arundel County) to meet water needs from their own water resources. An excellent, albeit relatively small first step in this respect would be a law requiring the recharge of all air-conditioning water drawn from wells in the state, as is the case on Long Island, New York.

e. A single agency (probably the Department of Water Resources) should be charged with the responsibility for implementation of a water resources plan and should be empowered to grant or deny permits for all withdrawals or diversions from state waters. The agency should be directed to only grant the permit if the proposed withdrawal or diversion is consistent with the water resources plan. In addition, the agency should be given discretion to charge users of the waters if it feels such a charge is justifiable.[2]

2.3 Summary - Future Outlook

Before the year 2000, many urbanized counties will reach the limits of natural water supply systems. That this conclusion applies to areas other than Anne Arundel County is indicated by the Chesapeake Technical Support Laboratory's study of future water supply needs in the Washington Region. The study indicated that even by 1980 water needs will be 570 million gallons per day (a "yearly average" figure which is exceeded by the "maximum monthly average" calculation, which is, in turn, exceeded by the "maximum daily average" calculation). "If this holds true, the Potomac's water supply often will be less than demand. There have been many instances when the River flow has been considerably less than 570 mgd. With this projection slated for a time less than 10 years away, one must bear in mind that it usually takes at least 7 years to build a reservoir."(Ref. 14) In these circumstances, it appears that urbanizing areas of the Maryland Bay Region will soon begin to be faced with difficult choices among alternative policy directions:

a. Regulate domestic per capita

water demands and strongly encourage industry to economize on water use in production processes.

b. Undergo the major expense of meeting projected water demands by means of conventional water supply systems.

c. Develop more comprehensive approaches to the management of natural ground and surface water systems and exploit new sources of water supply.

3 Water Supply: Goals, Objectives, Standards, Policies

3.1 Goal. Provide an Adequate Water Supply for All Needs

It will be noted that "needs" rather than "demand" or "requirements" has been used to indicate that standards for quantity(and quality) must be set. Water supply is increasingly limited in the face of growing population and expanding demand.

Objectives can be set for the general goal in at least five major areas:

3.2 Objectives

a. Ensure adequate quantity and and quality of water at reasonable costs for domestic supply.

b. Provide necessary quantity and quality of water at economic prices for industrial water users.

c. Make available an adequate water supply for agricultural needs.

d. Utilize water resources to the maximum for multiple purposes including amenity and recreation needs.

e. Satisfy the requirements of the natural landscape and wildlife for water.

3.3 Standards

In the long run there is only so much water in the world. Although Maryland would appear to have an adequate future supply, the supply is nevertheless limited. Ultimately, the differential availability of water may be the deciding factor in forcing a meaningful national urban growth policy. Standards for water quality and quantity should be set for each of the five objectives, and by geographic subdivisions.

Regarding domestic consumption, standards for quality are well established for drinking water, but the use of the same good water for car-washing, lawn-watering, air-conditioning, etc. is incredibly wasteful. Lower standards can be set, with alternate systems of distribution available.

For industrial and agricultural needs, only those users requiring top quality water need that which is expensively treated. Lower standards can be set for the major number of industrial and agricultural requirements.

The entire Bay is tidal, so water quantity is not a problem with regard to recreation and amenity. Water quality as far as standards of supply is considered under Goal A.

Standards for water quantity for various uses are not generally set except in time of drought. The only really feasible method for long-term storage of water is underground, and, although the price mechanism to a degree influences usage, quantitative standards for water supply are now set by effective demand, not need.

3.4 Policies

The field of water supply is replete with policies, all of which have tradeoffs with other goals.

A most obvious example of goal conflict is illustrated by the necessary tradeoffs between water supply and waste water discharge. Here the costs and benefits of specific alternate policies can be clearly quantified, that is the cost of bringing

water from another watershed, and the cost to that watershed can be arrayed against the price of waste water treatment, recycling etc. that would enable greater use of local streams for human water supply.

Policies for other uses are not so well articulated. A policy of multi-purpose recreation use of reservoir sites is recommended for Baltimore but not implemented. A Bay region policy of recycling water and artificial recharge of aquifers would help implement Objective 3.2.e. Research needs to be carried out to provide information regarding causal relations between such policies and costs and tradeoffs that would result. The most important policy questions lie in the area of pricing, and distribution, as water supply and waste disposal are the crucial factors in where and how urbanization occurs.

Footnotes

1. This refers to quality of overboard spoil disposal.

2. Many of these recommendations are now already in effect.

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II. PROBLEMS AND GOALS

G. THERMAL WASTE DISCHARGES 129

1. Thermal Waste Discharge Problems 129
1.1 Nature of the Problem 129
1.2 Major Causes 129
1.3 Location of the Problem 130
1.4 Time Characteristics 130
1.5 Parties Affected 130

2. Future Dimensions of Thermal Waste Discharge Problems 130
2.1 Forces Tending to Increase the Problem 131
Table 1: Rates of Increase in Commercial Electric Sales in Maryland: 1965-1969 131
Table 2: Projected Electricity Consumption in Maryland: 1960-2000 132
2.2 Forces Tending to Reduce the Problem 133
2.3 Summary - Future Outlook 135

3. Thermal Waste Discharge Goals, Objectives, Standards, Policies 136
3.1 Goal 136
3.2 Objectives 136
3.3 Standards 136
3.4 Policies 137

G
Thermal Waste Discharges

1 Thermal Waste Discharge Problems

The problem is how to meet needs for electrical energy with minimal environmental damage.

1.1 Nature of the Problem

To a significant degree, our standard of living is based on the availability of an abundant supply of inexpensive electrical energy.

A major concern in the economic growth of the Chesapeake Bay region, therefore, is how to efficiently meet increasing electrical energy requirements for a growing population.[1]

This concern relates to the Chesapeake Bay as a resource for conservation and development in three major ways:

a. The Bay is a major potential source of cooling water for the discharge of waste heat; but

b. Thermal additions to a water body may have negative effects on fish and other aquatic life; and

c. Other by-products of the process of generating electricity have potential negative effects on shore land uses.

Each of these relationships is conditioned by a number of factors:

a. The large size of the Bay and its proximity to major population centers make it a very attractive source of cooling water for electric power generation. However, the hydrology of the Bay and the moderate temperature of generally shallow Bay water somewhat limit the efficiency of the Bay for the discharge of heat.[2]

b. The effects of the discharge of waste heat on aquatic life are conditioned by many complex and various characteristics of aquatic life. Different species have different tolerances, or tolerance ranges for temperature variations. Also, different species may have varying capacities to move away from a point of waste heat discharge. The discharge of waste heat may indirectly affect aquatic life by making them more susceptible to the effects of pesticides, industrial wastes and disease than they ordinarily would be. Effects of waste heat on aquatic life may have synergetic relationships with other water quality characteristics, such as the amount of dissolved oxygen in the water.[3]

c. The type and intensity of shore land uses (existing and prospective) condition the possible effects which the generation of electrical power may have on them. The effects may relate to the preemption of land which has alternative residential uses, the reduced use of the Bay as a recreational resource, air pollution, construction side effects, etc.[4]

1.2 Major Causes

Industrial production processes generate waste heat, of course, but the amounts discharged into water bodies are minor in comparison to those discharged from electric power plants.

The two major means of producing electric power in the Chesapeake Bay Region are fossil fuel and nuclear plants. Fossil fuel plants are somewhat more efficient than nuclear plants in terms of the proportion of waste heat generated to electricity produced. Also, a significant proportion of the waste heat from fossil fuel plants is discharged into the air (creating air pollution) rather than into the water. Nuclear plants presently planned for the Bay will discharge all waste heat into water bodies. Thus, given present technology, there is a tradeoff between more air pollution from the burning of fossil fuels and more water pollution from the discharge of waste heat from nuclear reactors and possible additional hazard of radioactive air or water pollution, e.g., tritium in water.

As significant as the technology of electric power generation is, emerging economies of scale in the production process are equally important. Smaller plants

in previous years spread the effects of thermal discharges. Future economies of scale for the production of inexpensive electrical power require large plants, usually using nuclear fission which concentrates thermal effects.

Nuclear power plants can be designed to minimize their thermal pollution of the Bay by a variety of devices. However, all those presently envisioned raise the cost of production beyond present economic limits and bring fossil fuels back in as the cheaper source.

1.3 Location

Given present electricity transmission technology, the western shore of the Chesapeake Bay will be the scene of most future electric power plant siting issues. The sub-estuaries leading into the Bay have limited capacity to supply cooling waters to large modern nuclear power plants. (The Susquehanna River, which has larger potential capacity than the others, has been planned for extensive electric power plant development by the Philadelphia Electric Company.) The western shore is very close to the metropolitan areas of Baltimore and Washington. The Calvert Cliffs nuclear power plant of the Baltimore Gas and Electric Company is now under construction in Calvert County. Other nuclear plants proposed for Baltimore and Harford Counties are under discussion.

1.4 Time Characteristics

In the summer, Bay water is at higher temperatures than in the winter. The additional thermal discharges from electrical power generation are thus more likely to raise water temperature changes beyond tolerance levels of aquatic life.

Technological trends will bring about increases in efficiency in processes of electrical power generation, especially in nuclear power processes. However, offsetting trends in the increasing population in the Baltimore-Washington corridor, and in increasing per capita rates of electric power consumption must also be taken into account.

1.5 Parties Affected

Thermal additions to the Bay will affect both sport and commercial fishermen if the additions result in the replacement of valuable finfish and shellfish species by less desirable species that can adapt to warm waters.

As mentioned above, industries which use Bay water for cooling purposes may be affected by the decreased efficiency of heated water for cooling purposes.

Residential areas proximate to the power plant will be affected by the construction and operation of the quasi-industrial power plant land use. Also, thermal additions may affect the use of Bay waters for water-related recreation, which effects, depending on circumstances, may be either beneficial or detrimental.

Perhaps most significant are the possible long-range ecological consequences of thermal additions and the possible synergetic relationships of thermal additions with other uses of the Bay (e.g., the discharge of certain chemical wastes). The precise nature of these possibilities has not as yet been fully defined.[5]

2 Future Dimensions of Thermal Waste Discharge Problems

Introduction:

From the demand point of view, the problem is how to efficiently meet increasing electrical energy requirements for a growing population and economy with minimal environmental damage. From the supply side the problem is to make the best possible decisions with regard to the location, design, size and operation of power plants. The future dimension of the problem of thermal waste discharges is a function of a number of factors affecting the demand for and supply of electrical power.

2.1 Forces Tending to Increase Problems Relating to Thermal Waste Discharges

a. Increasing population will result in increasing demand for electric power. Between 1960 and 1970, Maryland's population grew by 25%, and it is expected to continue to increase -- though at declining percentage rates -- in each remaining decade of the 20th century. The population of Maryland in the year 2000 is expected to be over 1.5 times as large as in 1970.(Ref.3)

b. More significant than population growth alone, the per capita and per family rates of electricity consumption are increasing. This is a long-standing trend. In 1940, the average home consumed about 1,000 kilowatt-hours of electricity; today the average home consumption of electricity is in excess of 5,400 kilowatt-hours. (Ref. 4) In Maryland, per capita commercial electricity consumption in 1960 was 488 kilowatt-hours; in 1970 the rate was 1,470 kilowatt-hours per capita -- three times the 1960 rate. Commercial electric sales in Maryland (not adjusted for population increases) increased at an average annual rate of 11.4% between 1965 and 1969. Even if the future rate of increase in electricity consumption is one-half the average annual rate in these four years, electricity consumption in the year 2000 will be over 3,600 kilowatt-hours per capita -- 2.5 times the 1970 rate and 7.5 times the 1960 rate.

TABLE 1: RATES OF INCREASE IN COMMERCIAL ELECTRIC SALES IN MARYLAND: 1965-1969[a]

	COMMERCIAL			INDUSTRIAL			TOTAL (COMM. & INDUS.)		
	Sales[a]	Annual[a] Increase	% Increase	Sales[a]	Annual[a] Increase	% Increase	Sales[a]	Annual[a] Increase	% Increase
1969	5,107			7,954			13,061		
		478	10.3%		727	10.1%		1,205	10.2%
1968	4,629			7,227			11,856		
		507	12.3%		525	7.8%		1,032	9.5%
1967	4,122			6,702			10,824		
		408	11.0%		564	9.2%		972	9.9%
1966	3,714			6,138			9,852		
		423	12.9%		705	13.0%		1,128	12.9%
1965	3,291			5,433			8,724		
Average Annual Percentage Increase 1965-1969			11.4%			10.0%			10.4%

[a]Data from Ref. 8, pp. 176,177
[a]Millions of kilowatt-hours

TABLE 2: PROJECTED ELECTRICITY CONSUMPTION IN MARYLAND 1960-2000[a]

	1960	1970	1980			2000		
			No Per Capita Consump. Inc.	1/2 1965-69 Rate of Inc.	1965-69 Rate of Inc.	No Per Capita Consump. Inc.	1/2 1965-69 Rate of Inc.	1965-69 Rate of Inc.
Commercial Electricity Consumption								
Population in Millions (Projected)	3.101	3.875	(4.679)	(4.679)	(4.679)	(6.070)	(6.070)	(6.070)
Per Capita Electricity Consumption in KWHR	488	1,470	1,470	2,140[b]	3,640[b]	1,470	3,640[b]	25,200[b]
Electricity Consumption (Millions of KWHR)	1,517	5,699[a]	6,890	10,046	17,079	8,940	31,024	153,375
Industrial Electricity Consumption								
Mgf. Employment (Projected)	264,250	(278,290)	(288,450)	(288,450)	(288,450)			
Elec. Consumption per Mgf. Emp. (KWHR)	15,600	28,600	28,600	47,000[b]	78,500[b]			
Elec. Consumption (Millions of KWHR)	4,114	7,954[a]	8,260	13,600	22,693		36,095	152,671
Total Electricity Consumption								
Total Electricity Consumption in Md. (Millions of KWHR)	5,631	13,653	15,150	23,646 22,811[c]	39,772 38,686[c]		67,119 62,872[c]	306,046 307,495[c]

[a]Projected on basis of 1965-69 average annual rate of increase.
[b]Derived from electricity consumption and population projections.
[c]Projected on basis of total commercial and industrial electric sales.

c. The development of new electricity-using appliances and the steadily broadening use of air conditioners are major factors in recent increases in per capita consumption of electricity. These forces have by no means "played themselves out" and they will contribute to future increases in electricity demand.

d. Trade-offs between gas and electricity use have been promoted by utility companies. Notable among these are increases in the proportion of new dwelling units and commercial establishments which are heated by electricity. Also many older dwelling units have been converted to electric heat. This trend will help reduce peak winter gas space heating loads, but will increase electricity demands.

e. An expanding economy also results in increasing electricity demands. Industrial electricity consumption in Maryland almost doubled in the 1960-70 decade. The average annual rate of increase in the years 1965-69 (years of slow economic growth) was 10%. Even if the future annual rate of

increase in industrial electricity consumption is one-half the 1965-69 average, industrial electricity consumption in Maryland is likely to double by 1980, and double again by the year 2000.

f. Changes in industrial production methods, rather than increases in industrial employment will be the most salient factor in future industrial electricity sales. Between 1960 and 1970, the annual industrial electricity consumption attributable to each manufacturing employee almost doubled -- from 15,600 kilowatt-hours in 1960 to 28,600 kilowatt-hours in 1970. Thus, even though total manufacturing employment is expected to remain nearly static, industrial electricity demand will increase rapidly.

g. The marketing practices of utility companies have the objective of increasing electricity consumption. The 1969 Annual Report of the Philadelphia Electric Company says, "Sales and revenue continued healthy growth patterns during 1969, with each service -- electric, gas and steam -- posting gains...Each service benefited from stepped-up marketing efforts, which resulted in the addition of new customers and greater usage per customer... Expanded and refined market research supports the Company's full range of sales effort -- market planning, advertising, selling and promotion. To insure greatest profit return, efforts are concentrated on increasing off-peak use of both electricity and gas."(Ref.5)

h. Changes in electricity generation technology will result in sharply increasing proportions of total electric output being produced by nuclear plants. Nuclear power has significant advantages over fossil fuel plants. However, "a nuclear plant today discharges about 50% more heat to a water body than a comparable sized fossil fueled plant because the reactors must be operated at lower temperatures (lower efficiency) and because no heat is lost through a stack as is the case with a fossil fueled plant."(Ref.6) Thus, the technological shift to nuclear electrical power generation can be expected to increase problems of thermal waste discharges -- at least in the short run.

i. Trends toward larger electric power plants (fossil fuel and nuclear) will increase problems of thermal waste discharges by concentrating heat discharges in a few limited areas. Maximum plant capacities have doubled since 1960 and will double again by 1980.

j. The spread of urbanization in the Baltimore-Washington metropolitan region will make it increasingly difficult to find non-urban power plant sites accessible to the major areas of demand.

k. Increasing use of the Bay for waste disposal, commercial fishing, recreation and sport fishing, etc. may conflict with increased use of Bay waters for thermal heat discharges.

2.2 Forces Tending to Reduce Problems of Thermal Waste Discharges

a. Policies designed to reverse the sharp increase in per capita electricity demands and, especially, policies to reduce peak electricity demands in summer months will be necessary to slow the rates of increase in electricity consumption and keep problems of thermal waste discharges to manageable proportions. Historically, electric companies have encouraged increased use of electrical power. However, faced with extreme difficulties in supplying the demands generated and with increasing possibilities of "brown-outs" during summer months, some electric companies in the largest metropolitan areas are showing signs of taking the opposite tack. Public education programs or, more effectively, pricing policies, could be used to achieve "demand-side" objectives.

b. Expected improvements in nuclear power plant technology will reduce the difference in the amount of heat discharged

to estuarine waters by comparable sized fossil fuel and nuclear plants (see 1.2. h. above).

Relatively little can probably be done directly at the state or Bay level to accelerate the technological developments necessary to increase the efficiency of nuclear fueled electric power generation and transmission. However, the development and utilization of such improved technology can be greatly encouraged and stimulated by strongly drafted and stringently enforced legislative and administrative requirements for minimization of the environmental impact of thermal wastes.

c. The development and application of non-steam cycle electrical power generation technology is a long-run possibility for reducing the thermal discharge problem. Magnetohydrodynamic generation, fuel cells, electrogas dynamic engines, and direct electrical generation from fusion reaction are types of non-steam cycle generation that are being studied. (Ref. 6)

d. Better transmission technology may make it economically possible to locate nuclear power plants farther away from major areas of demand (perhaps on the ocean) thus easing the problem of site selection and diverting a portion of thermal waste discharge to other waters.

The ocean, of course, has great advantages over estuarine areas such as the Chesapeake Bay in quantity of water available for cooling purposes and in the rapid mixing of the thermal wastes discharges. However, many of the adverse effects of thermal additions mentioned above (e.g., effects on residential areas) would not be appreciably reduced on the Maryland-Delaware coast.

e. Beneficial uses of thermal discharges in aquaculture, agriculture, and urban and industrial activities can be developed and applied. (Ref. 7)

f. Other technological approaches to the reduction of problems of thermal additions to Bay waters relate to cooling techniques and techniques of mixing at the point of discharge. This affords the opportunity for creative thinking to offer new methods for dispersion. These methods could include spray irrigation of the heated water to lengthen the useable agricultural growing season or lagooning of waters to increase areawide recreation opportunities, enhance artifical groundwater recharge, or provide emergency water supply for domestic/industrial use or firefighting effort.

g. "Research which will contribute to improved ability to predict the physical, chemical and biological effects and the social and economic consequences of the use of tidewaters of Virginia and Maryland for cooling thermal-electric power plants...will provide a more adequate basis for decisions with respect to the location, design, size and operation of power plants." (Ref. 1)

The Governors of Maryland and Virginia have established two groups to consider the use of the Chesapeake Bay and its tidal tributaries for cooling thermal-electric power plants. One of these is a sponsoring group called the "Committee on Power Plants and the Environment." It includes representatives of Federal agencies, States, industries, conservation groups, action leagues and other Bay resource user interests. The second group includes scientists and engineers and is called the "Chesapeake Bay Cooling Water Studies Group." This group will plan and coordinate research on the environmental effects and the social and economic consequences of the use of the tidewaters for cooling thermal-electric power plants. The information developed will provide a more adequate basis for decisions with respect to the location,design, size and operation of power plants.

The Steering Committee of the Chesapeake Bay Cooling Water Studies Group included in its report (Ref.1) a statement of the nature of the problem of power plant siting and design as well as a summary of environmental influences associated with cooling water.

In outlining the research needed

to arrive at solutions, the Committee says, "In essence, a decision maker interested in assessing the values affected by the use of varying amounts of water for cooling of power plants requires four inter-related pieces of information. First, for a given plant capacity at a given site one must be able to predict the physical distribution of the temperature field in the adjacent water body. Second, from the known temperature distribution one must then predict or estimate the effects of the new temperature distribution on the biota subject to it. These biota include organisms which actually pass through the cooling system as well as those which reside or pass through the region affected by the new temperature field at some time during their life cycle. Third, in weighing the virtues and drawbacks of specific sites as well as the alternatives, values, either in monetary or other terms, must be assigned to the elements affected. Fourth, given an understanding of the physical system and the biological impact, and with estimates of the values affected, it becomes possible to compare the alternative technologies and to make trade-offs between such factors as the magnitude of the temperature rise, the volume of water diverted, and the area utilized for dispersion of the heat. Then with a knowledge of effects on the air and land environment, it becomes possible to consider other alternatives, such as those involving the use of direct dispersion to the air through cooling towers.

"Any comprehensive research endeavor must eventually deal with each of the above four elements. It is clear, however, that the present level of knowledge of each is markedly different and hence an initial set of investigations must take cognizance not only of the necessity of understanding each facet, but of the current state of the art."(Ref.1)

2.3 Summary -- Future Outlook

The consumption of electric power in Maryland is growing at a rate that will double total electricity consumption every six to seven years. Part of the increase is attributable to a growing population and economy, but most is attributable to increasing rates of consumption per capita and per employee.

Extension of recent rates of increase in electricity consumption in Maryland creates a foreboding future outlook. Given current[6] relationships between installed capacity for generating electricity, electric power production, and electricity consumption, seven power plants of the size of the new Calvert Cliffs Nuclear Plant (which itself will not be completed until 1974) would be necessary to meet the additional demands in 1980. And seventy-three 1,600,000 kilowatt plants would be needed to meet the additional demands in the year 2000. Since population projections indicate that over 80% of the State's population will continue to be concentrated in the Baltimore and Washington Metropolitan Areas, it is likely that most of the thermal waste discharge from additional power plants would impinge directly or indirectly upon the Bay. The environmental damage and the extent of conflict with other Bay uses from such an increase in thermal waste discharges is incalculable.

On the basis of the analysis described above, it seems clear that present rates of increase in electricity consumption in Maryland must be reduced. Even if recent rates of increase are halved (a change which would require significant shifts in policy emphasis) three power plants of the size of Calvert Cliffs would be needed to meet additional demands by the year 1980 and fourteen plants would be needed to meet additional demands for consumption in the year 2000. Given present approaches in the supply of electric power -- i.e., in the location, design, size and operation of power plants -- even drastically reduced rates of increase in electricity consumption could cause major environmental damage and extensive

conflicts with other Bay uses.

3 Thermal Waste Discharge: Goals, Objectives, Standards, Policies

3.1 Accommodate Thermal Waste Discharge by Use of the Bay

The location and size of the Bay makes it a logical source of cool water and outlet for discharge of waste heat for industrial, and particularly electric energy generation. At its present stage of technology, nuclear fission reactors for energy generation are most economic with such heat sinks. The environmental impact of plants on the Bay (one in construction and two more planned) is of course significant. The goal of providing the region's energy requirements thus collides with Bay goals for living resources, wetlands, water quality and recreation. It is generally in accord with or neutral to goals for waterfront industry and others.

3.2 Objectives

Objectives for thermal waste discharge by use of the Bay can be summarized as follows:

a. Provide electric energy in response to population and industrial needs as economically as possible, taking into account the full possibilities of technological change and innovation, and using the Bay.

At the level of objectives, "needs" and "economic possibilities" can be translated into more specific meanings.

b. "Estimate the load demand as determined by the economic base of the region.

c. "Analyze the costs of alternative combinations of generating units to meet this demand. The result of this step is a determination of the location, type, efficiency, and magnitude and time pattern of energy generated by various units.

d. "Estimate the gross cooling loads on the basis of heat rates, efficiencies, and sizes of different units. These will be the thermal loads discharged to the water courses assuming a once-through cooling system.

e. "Determine the impact of thermal discharges on water quality in the effects of the resulting spacial and temporal patterns of water quality on the uses of water (some of the effects may be negative and some positive).

f. "When sizeable external costs are imposed by thermal discharges (or when specific stream standards are not met) calculate the cost of alternative methods for reducing or offsetting thermal discharges -- as by recycling or provision of additional cooling water in stream or some combination of the two.

g. "Select the combination which minimizes the present value of total costs. Recompute the power system costs under the new costs of cooling water to see if a shift in the mix or location of generating units might result.

h. "Explore the marginal cost aspects of alternatives in reducing environmental impacts and examine the possible influence that different charges for service might have on the manner in which the Bay is used for cooling.

"Ideally, if demand and supply relations (can) be established as well as 'values' in the environment, one (can) presumably develop a model which would take into account both size and number of plants needed, and in turn their location in relation to these environmental values."(Ref.1)

3.3 Standards

Major research is underway to develop standards in at least three areas related to use of Bay waters for thermal waste discharge. They can be summarized as standards for technology, for environ-

mental matrices and interactions with the biosphere, and for social and economic implications.

3.4 Policies

Policies involving the way in which each of the above factors or standards are weighted in an interaction model are now being developed. These should produce a method for translating all objective functions into a unified social value system by which implications of choice and tradeoffs can be prepared for use in the decision process.

Methods considered include a linear programming of the objective functions with extremes of maximizing one or another: weighting objective functions differentially and attempting optimization; setting minimum standards (or levels of achievement) for objective functions and "minimaxing" or "satisficing" to use the language of the econometricians.

Until such a model is available, policies for electric energy production tend to be counterproductive by pitting the private against the public sector.

Footnotes

1. This statement of the problem emphasizes the demand for electrical energy by a growing population and economy. A statement which focuses on the "supply-side" would focus on the location, design, size and operation of power plants.

2. Several research projects suggested by the Steering Committee of the Cooling Water Studies Group (CWSG) focus on these aspects of the problem. (Ref.1, Appendix Sections B-1 and B-3).

3. Several research projects suggested by the CWSG focus on the ecological effects of power plants. (Ref. 1).

4. See evaluation framework suggested by CWSG (Ref.1, Appendix Section B-2-a).

5. See research projects suggested by CWSG (Ref. 1).

6. The latest year for which data are available is 1967 (Ref.8, p.177).

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II. PROBLEMS AND GOALS

H. MARINE TRANSPORTATION 140

1. Marine Transportation Problems 140
1.1 Nature of the Problem 140
1.2 Major Causes 140
1.3 Location of the Problem 141
Plate 19: Major Rail and Waterways 142
1.4 Time Characteristics 143
1.5 Parties Affected 143

2. Future Dimensions of Marine Transportation Problems 143
2.1 Forces Tending to Increase the Problem 144
Figure 1: Vessel Traffic Tonnage and Annual Rates of Change: Baltimore Harbor and Channels, 1960-1969 144
Figure 2: Make-up of Vessel Traffic Volume: Baltimore Harbor and Channels, 1969 145
2.2 Forces Tending to Reduce the Problem 146
2.3 Summary - Future Outlook 147

3. Marine Transportation Goals, Objectives, Standards, Policies 148
3.1 Goal 148
3.2 Objectives 148
3.3 Standards 148
3.4 Policies 148

H
Marine Transportation

1 Marine Transportation Problems

The problem is how to best enhance and increase marine transportation in the Bay as a vital element in the region's economic vitality.

1.1 Nature of the Problem

Commercial marine transportation is of vital importance to Maryland's economy. A recent study by the Maryland Port Authority measured the relationship with regard to the Port of Baltimore.(Ref.1) 12% of Maryland's 1966 gross state product is attributable to the Port. The survey showed that the industrial, commercial, and transportation complex making up the Port of Baltimore annually pours some $626.9 million into Maryland's economy while directly providing jobs for 62,138 Marylanders. "This primary impact generates, in turn, a secondary impact of almost equal magnitude." The survey further says, "The total of the primary and secondary impact of the Port of Baltimore is estimated at $1.56 billion, which represents 11.7% of the Maryland gross State product."(Ref.2)

Though marine transportation uses consume only a very small portion of the total Bay shoreline, the facilities directly related to marine transportation make a major imprint on the Bay. These include shipping channels and special facilities (e.g., the Chesapeake and Delaware Canal) extending the channels, harbors, special loading and unloading facilities and port-related storage areas. In addition, significant portions of the cost of other major infrastructure facilities -- e.g., the Bay Bridge, the Norfolk Bridge-Tunnel, the Baltimore Harbor Tunnel, the proposed water main crossing the Baltimore Harbor -- can be indirectly attributed to characteristics of height and depth necessary to accommodate the needs of marine transportation.

Continual improvement and maintenance of marine transportation facilities are needed in order to maintain the position of Chesapeake Bay ports (particularly the Port of Baltimore) vis a vis national and international competition. But these efforts produce a variety of ecological effects. Noxious dredge spoils can smother or poison marine life. The Chesapeake and Delaware Canal widening will affect salinity levels in the upper Bay.(Ref.3) The development of deep-water ports -- such as that proposed at Crisfield -- may have undesirable ecological effects.(Ref.4) Simply stated, the Bay problem with regard to marine transportation is to maintain and increase the Bay's competitive position with regard to marine transportation with a minimum of undesirable ecological side-effects.

1.2 Major Causes

a. One cause of Bay problems with regard to marine transportation is the sheer volume of commercial shipping in terms of visits and tonnage. Recent trends of commercial shipping and regional economic objectives indicate that volumes will increase in the future. Increasing volumes of commercial shipping generate needs for development and modernization of port and supporting land-based facilities. Increased traffic in confined port areas and in shipping channels increase problems of traffic control, probabilities of collisions and resulting "ecological disasters" from spills, and the amount of Bay pollution from normal ship operations.

b. Another cause of Bay problems

① as ship size has increased, number has decreased.
② Spills of other - gen. cargo, coal, iron ore? Pipeline movement of product + discontinuance of refining has cut into tanker transport
③ Fewer + faster ships, with smaller crews have reduced this exposure. U.S. + international regulations re sewage disposal will also reduce it.

related to marine transportation is the changing technology of commercial shipping. The advent of the containership in recent years and the considerable economies in general cargo handling through the use of containerization have contributed to the need to modernize port facilities. The development of shallow draft coasters have potential for dispersing more commercial shipping activity to smaller ports on the Eastern and Western Shores; there are both regional development benefits and ecological dangers in the possibility.

what development?

Perhaps the most significant technological change in marine transportation with regard to Bay problems, however, is the development of large-sized deep-draft bulk carriers. These vessels have considerable shipping cost advantages for bulk products such as petroleum, ore, coal, etc. But the channel depths required to accommodate them are greater than Chesapeake Bay harbors and shipping channels presently provide. Depths required for future dry bulk carriers serving the Atlantic Seaboard may range from 42-57 feet; channel depths required for future tankers may range from 62-72 feet.(Ref.5) Baltimore Harbor and the Chesapeake and Delaware Canal are presently being deepened to 45 feet. However, any future deepenings will encounter actual physical obstacles (e.g., the Baltimore Harbor Tunnel and the proposed Harbor-crossing and water main, if they are not bridged) as well as obstacles in the form of detrimental ecological effects. An ultimate possible depth for Chesapeake Bay shipping channels and harbors is set by the 57 foot depth of the Bridge-Tunnel at the mouth of the Bay. In this context, policy questions facing Bay management can be posed in the following form: How effective would possible Chesapeake Bay channel deepenings be in attracting future deep-draft commercial shipping? What effects would possible losses in Chesapeake Bay's competitive advantage with regard to certain categories of commercial shipping have on Maryland's economy?

Just presently in the Bay by any means

① Really?

② Really?

c. A third cause of Bay problems with regard to marine transportation is that the commercial shipping volume trends and technological changes discussed above will impinge upon the special estuarine ecology of the Chesapeake Bay. The ecological consequences of dredging, spoil disposal, ship sewage, and commercial shipping accidents are greatly magnified when they occur in the shallow estuarine waters with its slow flushing action and many ecologically significant wetlands and marshes.[1]

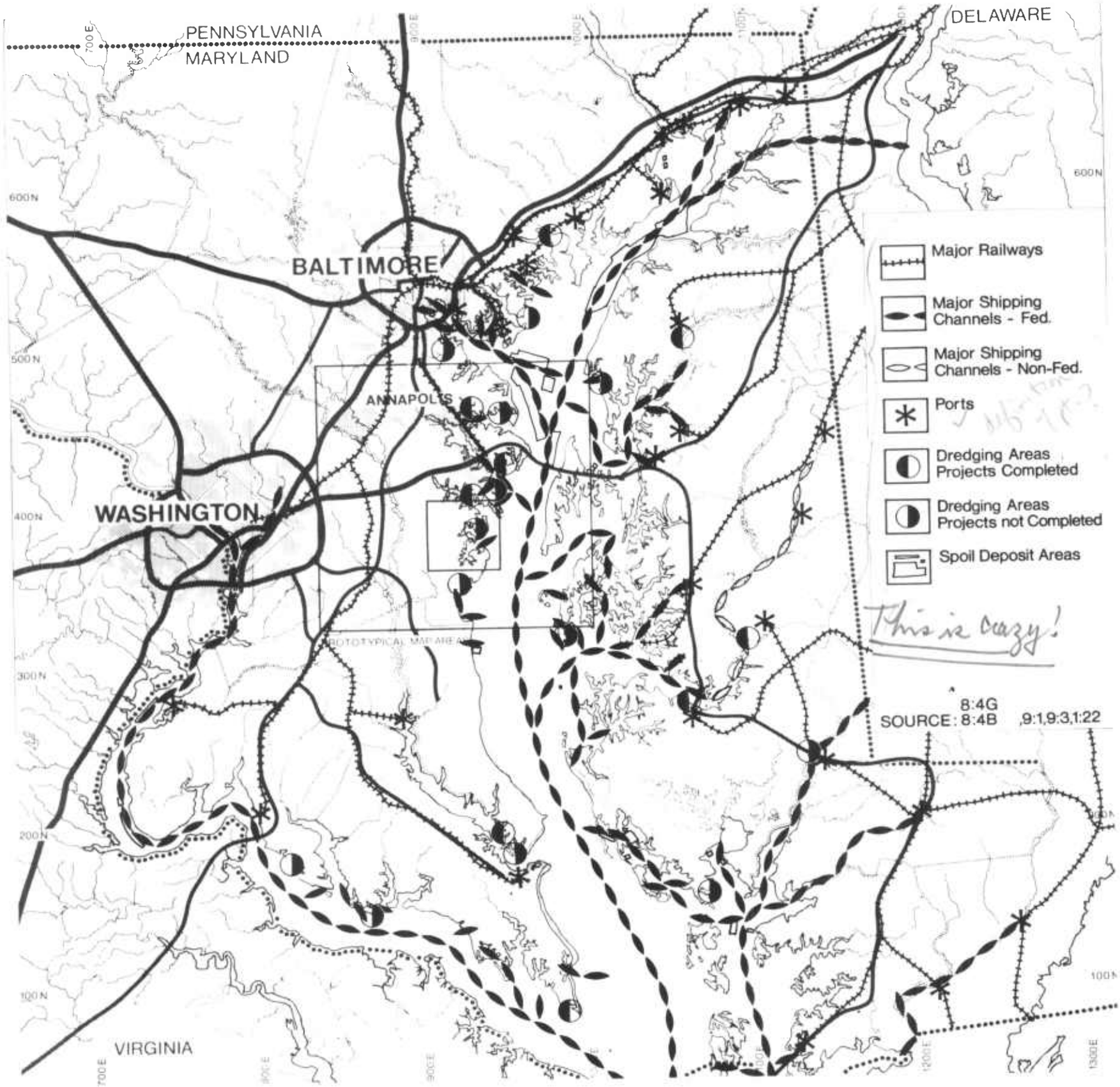
1.3 Location

The location of marine transportation facilities -- major shipping channels, ports, dredging and spoil deposit areas -- are mapped. This has been done at a regional scale (See Plate 19 Major Rail and Waterways). Maps describing the marine transportation facilities in Baltimore Harbor in greater detail have been developed by the Maryland Port Authority.(Ref.6)

Crazy, many crazy!

There are a number of issues with regard to the location of future marine transportation activity in the Chesapeake Bay. One of these relates to the amount and significance of future commercial shipping which will be oriented to Chesapeake Bay ports other than the Port of Baltimore. A number of technological development possibilities support the idea that there may be a significant increase in commercial shipping activity at smaller Bay ports. However, countervailing trends towards fewer and larger ports indicate that commercial shipping activity at the Port of Baltimore will continue to increase whatever happens at smaller ports and that Baltimore will remain the overwhelmingly dominant commercial port on the Chesapeake Bay.

PLATE 19: Major Rail and Waterways



Another issue with regard to the location of future marine transportation activity relates to the port area itself. Obsolescence of aging or technologically out-moded port facilities, competing recreation, housing and amenity uses for waterfront land in inlying urban locations, and changing industrial location and land requirements have resulted in the "migration" of the marine transportation facilities of the Port of Baltimore southeast towards the mouth of the Patapsco River (see discussion of problems relating to Waterfront Industry).

1.4 Time Characteristics

Since tidal effects on channel depths in the Chesapeake Bay are relatively minimal, and since winter ice does not pose major problems, some of the time characteristics impacting marine transportation in other Atlantic Seaboard areas do not affect commercial shipping in the Chesapeake Bay.

The major time characteristics affecting marine transportation in the Chesapeake Bay relate to technological changes in marine transportation, trends in the degree of economic dependence of the Maryland economy on various categories of commercial shipping, patterns of Bay management decisions responding to these changes and trends. Projections of marine transportation activity on the Chesapeake Bay thus require consideration of both "independent" and "policy" variables. The deepening of the Chesapeake and Delaware Canal puts Baltimore significantly closer to many foreign ports than its competitor Norfolk to the south.

advocating dredging

1.5 Parties Affected

Parties affected by problems relating to marine transportation include persons whose jobs are directly or indirectly dependent on commercial shipping activity. A recent study of the economic impact of the Port of Baltimore (Ref.1) indicates that some 62,000 jobs are directly related and approximately 155,000 jobs are indirectly related to the Port of Baltimore. Though similarly detailed studies for other Chesapeake Bay ports are not available, it can be assumed that they have analogous impacts on employment in their regions.

Another major category of affected parties is the industries dependent on goods delivered by marine transportation. The transportation component of the cost of inputs to their manufacturing processes affect these industries competitive position in national and international trade. The effectiveness of the Chesapeake Bay's response to marine transportation trends will affect industrial expansion and locational decisions.

A third category of parties affected is Maryland's commercial fishing industry. Dredging and spoil disposal activities related to commercial shipping have eliminated some valuable shellfish beds and contaminated others.

Where? Kent Is. N. of Bay bridge is only one claim, & claim has not been proven

Marine life is also affected by marine transportation -- most dramatically by the practice of using wetlands as spoil disposal areas.

Recreational users of the Bay are also affected by marine transportation activity. The most dramatic circumstance is the damaging of beaches by oil spills. Also to be considered are the dangers commercial shipping poses to recreational boaters and the preemption of certain waterfront areas from alternative use as urban amenity areas.

Isn't that too bad!

2 Future Dimensions of Marine Transportation Problems

The Bay management problem with regard to marine transportation is to maintain and increase the Bay's competitive position with regard to marine

transportation with a minimum of undesirable ecological side-effects.

2.1 Forces Tending to Increase the Problem

a. Increases in the volume of freight traffic in the Bay, in and of itself, would not necessarily increase the undesirable ecological side-effects associated with channel dredging. It might simply mean more ships using existing shipping channels. Increasing volumes of marine shipping to ports other than the Port of Baltimore (whether this resulted from the diversion of some of the traffic now oriented to the Port of Baltimore, or from the attraction to other Bay ports of activity which would otherwise not come to the Bay region) would result in the need for new shipping channels and the associated problems of spoil dredging. (Though the total freight traffic in "other" Maryland Bay ports was only 3.5% of that in Baltimore Harbor in 1969, freight traffic in the Nanticoke and Wicomico Rivers has increased substantially in the past decade. (Ref.7)

Domestic gasoline & fuel oil

Increasing marine shipping activity in existing shipping channels would increase the likelihood of accidents, which can result in major or minor ecological damage depending on the cargo of the vessels involved and the location of the accident.

Also, increasing marine traffic in the Bay would likely lead to increasing pollution from normal ship operations.

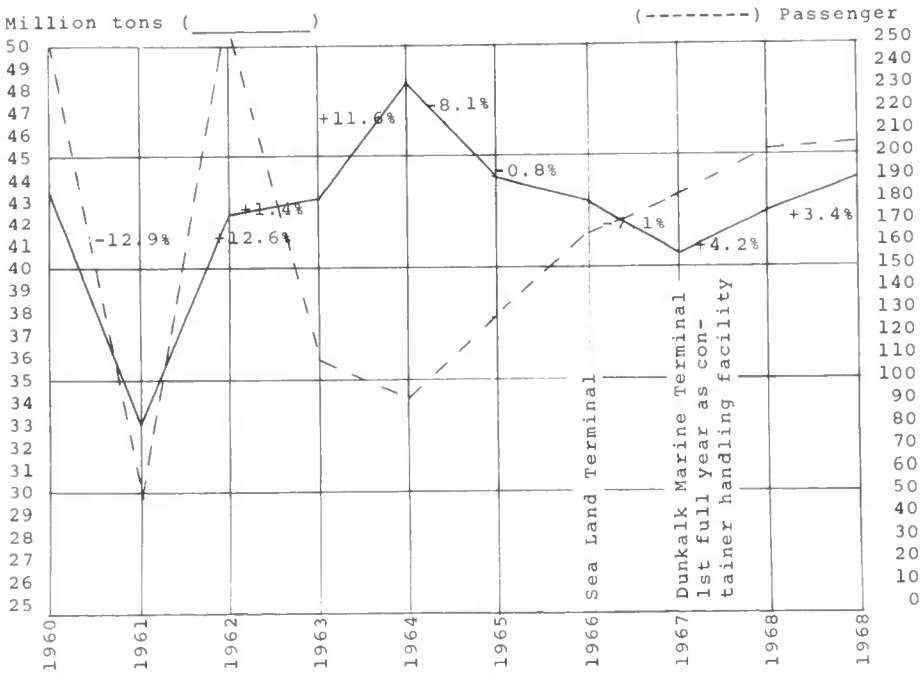
See

Vessel traffic in the Baltimore Harbor and Channels has followed a somewhat erratic course over the past decade. (See Figure 1.) There were significant total tonnage increases from 1961 to 1964, and significant declines from 1964 to 1967. Perhaps most significant for the future, however, are the increases in freight traffic since 1969 -- since the modernization

Not vessel traffic but all-cargo tonnage

FIGURE 1: Vessel Traffic Tonnage and Annual Rates of Change: Baltimore Harbor and Channels

(unit?)



Does this agree with our figures?

Hopefully but not certain. Good cargo ships - call increase may be offset by bulk ship - call decrease s/c ship size increase

Not Closed oil refineries & tend to pipelines. Decline in fertilizer + acid mfr. Growth in ore + coal

of Baltimore's Port facilities will be reflected in further increases in vessel traffic.

b. As significant as the total volume of commercial shipping is the make-up of freight traffic in the Bay. (See Figure 2) Major portions of the total tonnage are composed of iron ore and coal. However, smaller tonnages of crude petroleum (567,000 tons) chemicals (1,236,000 tons) and distillate fuel oil (4,534,000 tons)(Ref.7) have greater potential for causing ecological damage if discharged directly (by accident) or indirectly into the Bay.

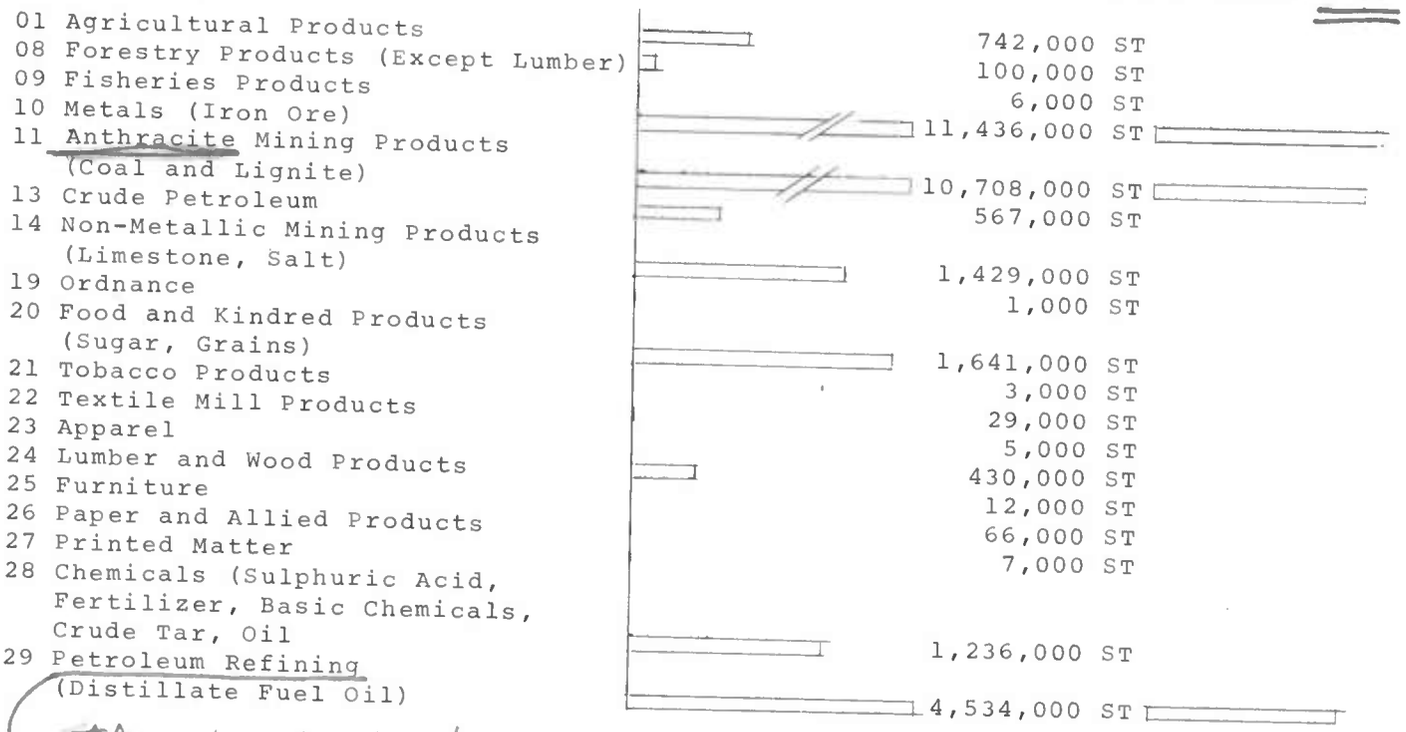
Though data on the trends in the make-up of freight traffic in the Bay is not readily available, it is likely that types which have greater potential ecological consequences (petroleum and petroleum refining products, chemicals, etc.) are increasing as a proportion of the total. In this, marine shipping in the Bay reflects the needs of the Maryland metropolitan economy and trends in the national economy. "The predominant factor in our industrial society's increased environmental degradation is neither population nor affluence, but the increased environmental impact per unit of production due to technological changes...With very few exceptions... the rapidly growing productive activities have intense environmental impacts which are markedly greater than the impacts of the activities which they displace..."2

Impact Study?

Events outside the Maryland Bay region (such as Delaware's new law prohibiting heavy industry along the Delaware Bay coastline as well as offshore facilities for transferring bulk cargoes) could have the effect of increasing the volumes of petroleum, petroleum products, chemicals, and other freight with potentially dangerous environmental effects in Maryland Bay freight traffic. This will increase the ecological dangers in marine accidents, accidental spills and leakage.

c. The changing technology of marine transportation includes forces which will tend to increase the problem

FIGURE 2: Make-up of Vessel Traffic Volume: Baltimore Harbor and Channels 1960



Indeed!

This is a product. Not refined here.

Have other trends about that further?

of deleterious ecological side-effects in marine transportation activity. Foremost among these is the increase in the size and draft of ships. These ships require deeper channels, which involves more extensive dredging of the Bay bottom and greater ecological problems associated with dredging spoil disposal. Also, the difficulties of maneuvering large ships in confined harbor areas may lead to more marine accidents with serious ecological consequences.

d. The scarcity of natural deep water port potential along the Bay and the general shallowness of Bay waters makes channel dredging a prerequisite for marine transportation in the Bay. Spoil disposal from channel dredging can have environmental consequences which range from limited to extensive depending on the location and manner of disposal and the amount of toxic substances in the spoil material. Maryland's economy, however, depends to a significant degree on marine transportation. Thus the growth of the regional economy is likely to result in increased environmental problems associated with efforts to accommodate modern marine transportation in shallow estuarine waters.

e. The expansion of Bay uses which potentially conflict with marine transportation activity is a force which will act to increase the problem as stated above. Expanding water-related uses (boating, fishing, swimming, etc.) are a source of conflicts with marine transportation activity. Increased use of shoreline areas for residences, vacation homes, recreation, visual access, etc. are also a potential source of conflicts with marine transportation activity. For the vacation home resident, the sight of a tanker moving up the Bay in stately fashion may have considerable aesthetic benefits, but these may not be outweighed by the appearance of small oil slicks along his beach.

How would it change the need for deep draft channels - ship coal & ore in containers?

f. Increasing public awareness of potential environmental damages associated with marine transportation and higher public objectives with regard to ecological side-effects of marine transportation are forces which will tend to increase the problem as stated above. Increasing public awareness is in part due to research on the environmental consequences of oil spills (See Section II.E.) and in part due to media accounts of the consequences of marine transportation accidents elsewhere. Higher public objectives are in part attributable to the increasing use of the Bay for recreation, leisure and aesthetic purposes.

2.2 Forces Tending to Reduce the Problem

a. Marine traffic control techniques and regulations can reduce the likelihood of commercial shipping accidents and of water pollution from ship operations such as bilge cleanout and sewerage disposal.

b. Growth of container shipment as a proportion of total freight volume would achieve economic goals without threatening major ecologic consequences in shipping accidents or in need for deep draft shipping channels.

The Port of Baltimore is making rapid strides in its ability to accommodate containerships. This would indicate that the prospects are good that Baltimore will be able to maintain its position as a handler of general cargo.

c. New marine transportation techniques such as LASH (lighter-aboard-ship) can provide ways of delivering bulk cargoes to Maryland Bay Ports without requiring deep channel dredging to accommodate ocean-going tankers. LASH, now being tested in the Gulf of Mexico, offers possibilities of combining the economies of large deep-draft bulk carriers for trans-oceanic shipment and the advantages of self-propelled shallow-draft barges for distribution to harbors of limited depth, such as those of the Chesapeake Bay. On the other hand, "LASH and sea-barge techniques will tend to make shallower tributaries

This will be news to the shipping industry

Costly, high-speed LASH ships are not intended for low-value bulk commodities

of the Bay more attractive as plant sites for industries that wish to use water transport for receipt of raw materials or shipment of products."(Ref.9) However, LASH should be examined and encouraged as a possible way of achieving the efficiencies of bulk shipping without the actual accommodation of deep-draft vessels within the Bay itself. Offshore tanker terminals in or off Delaware Bay with subsequent movement by barge through the C and D Canal or by pipeline may provide a solution to the problem of lack of possible accommodation for super-tankers.

the more exchanges the more chance for oil spillage

may be not

d. The most undesirable spoil disposal practices (e.g., disposal in wetlands) can be eliminated and alternative spoil disposal methods (e.g., disposal at sea, spoil disposal islands with possible recreational reuse) can be developed and made more efficient.

e. Regulations requiring installation of shipboard disposal or storage systems can be promulgated and stringently enforced to prevent the overboard disposal of raw sewage. However, this should probably be done at the Federal level, for otherwise Maryland might be placed in a disadvantageous position vis a vis other competing ports with a more permissive environmental attitude.

f. Effective measures must be developed to contain and clean up any spills which do occur.

g. Waterfront areas which are obsolete for commercial shipping activity can be reclaimed for urban recreational, residential, industrial and/or amenity uses. This is a process which has already begun in Baltimore's Inner Harbor.

h. Facilities should be established for the growing cruiseship business. Although passenger service is only a very small percentage of the total commercial shipping business, it is very important as a device to focus attention on the importance of maritime activities to the life of the region. Furthermore, wherever possible, harbor areas should be designed to permit public access to or viewing of harbor activities from view points, restaurants, shops, etc. that would not interfere with port operations.

2.3 Summary Future Outlook

On balance, it is likely that ecological problems associated with marine transportation activity and conflicts between marine transportation activity and other Bay uses will increase in the future. Given further modernization of Maryland Bay Port facilities, freight tonnages and the number of commercial ships using Bay shipping channels are likely to increase. If the average annual rate of increase in freight traffic in Baltimore Harbor since recent port modernization efforts began to have effect[3] is maintained in the future, freight traffic tonnage will triple by the year 2000. Because of the number and size of ships using Bay shipping channels and harbors, the likelihood of marine accidents and the difficulties of limiting the number of marine accidents would increase. Cargoes of marine freight traffic are likely to include increasing volumes of materials which threaten major ecological damage should accidents or leakage occur. New marine transportation techniques are likely to result in needs for deeper shipping channels and in dispersion of increasing volumes of marine transportation activities to shallower tributaries of the Bay. Thus spoil dredging volumes and the difficulties and cost of spoil dredging disposal are likely to increase. Continuing modernization of port facilities will require development of expansive port back-up areas for cargo storage and for transfer to land transportation modes. Increased demands for use of Bay waters and shoreland for recreation,

Do we agree?

What is basis for this assertion?

There is presently no requirement for this in the Md. Bay + I doubt that there ever will be.

leisure and aesthetic purposes will generate conflicts with increasing marine transportation activity.

3 Marine Transportation: Goals, Objectives, Standards, Policies

3.1 Goal: Provide for Maximum Development of Marine Transportation

Marine transportation has three major aspects to which Bay objectives can be addressed: channels and anchorages, port facilities, and technology of ships.

3.2 Objectives

a. Enlarge channels, anchorages and raise vertical obstructions to accommodate and invite the largest ships anticipated. This objective gets specific definition and dimension for the C & D Canal, the Baltimore Harbor Channel, the main ship channel, etc.

b. Improve port and connecting goods and passenger transfer facilities to accommodate container ships, super tankers, LASH (Lighter aboard ship) and BOB (Barge-on-Board) and ancillary facilities. Specific locations and quantitative dimensions are outlined in studies by the Maryland Port Administration.

No

c. Make use in the Bay of the most advanced marine movement technology such as hovercraft, LASH, BOB and air-water-land transfer facilities, to maximize the value of the Bay for marine transportation.

These objectives as translated into specifics, quantities and locations are potentially in conflict with goals for living resources, wetlands, water quality, and recreation. The current widening and deepening of the C & D Canal is an obvious example of this conflict, where spoils areas upset aquatic habitats, and the Delaware water table is polluted by saline water.

First I've heard of it

3.3 Standards

Two kinds of standards are possible to be set for marine transportation. The first are technical standards for shipping and shipping facilities. These are constantly being updated as technology changes and involve standards of price, efficiency, speed, safety, etc. Existing and evolving technical standards become the benchmarks against which goal and objective achievement can be measured.

The second kind of standards have to do with marine transportation's role in human affairs, currently measured by bulk and general cargo tonnage, sailings, and dollar values. These can also be related to jobs both in shipping and in related activity. The (Baltimore) Regional Planning Council now has a regional interindustry input-output model in operation which can trace the implications of alternate levels of marine transportation activity on all sectors of the economy. Standards thus can be set related to economic goals for the Bay region.

Interesting if true

3.4 Policies

Current policies for marine transportation are expressed by implication by the Maryland Port Administration in budget and program allocations, and by the U.S. Corps of Engineers program for maintaining and deepening the channels, and related activity. They are also expressed explicitly as principles regarding priority of location for port development and modernization and enlargement of facilities.

Marine transportation policy issues can be phrased as a set of trade-off problems. For example:

- Given specified marine transportation technologies in national and international trade (and assuming that Bay ports must compete on these terms) what is the total capacity of the Bay to accommodate commercial shipping? There are absolute limits on vessel size set by the C and D Canal and the Norfolk

Two Va. Capes north tunnel. There is a Norfolk tunnel that is something else.

tunnel. There are more flexible limits on vessel traffic set by the number and size of shipping channels and the capacity of port facilities. Within these constraints, how much spoil would have to be dredged and disposed of at what costs (given present approaches to these operations?) Are there market constraints on commercial shipping activity? Etc.

- Given specified marine transportation technologies, and given the present importance of deep-water ports in Maryland's economy, what environmental price will have to be paid to achieve current economic projections and aspirations? (The latter would have to be reformulated so as to lend themselves to such a policy analysis.).
- Given specified marine transportation technologies but reduced dependence of the State economy on deep-water ports (due to changing make-up of the State economy or to dominance of other freight shipment modes) to what extent could the State's economic projections and aspirations be achieved?
- Given radically different marine transportation technologies and/or spoil disposal methods and the current importance of port facilities in the Maryland economy, what would the economic and environmental tradeoffs be?
- Etc.

Footnotes

1. Recent research at the Woods Hole Oceanographic Institution indicates that the ecological consequences of small day-to-day oil spills are much greater and more persistent than previously thought. See "Water Pollution" (Section II-E above) for a more detailed discussion and citation.

2. Comments by Barry Commoner, included in a discussion of the economics of environmental improvement (Ref.8).

3. The average annual rate of increase in freight traffic in Baltimore Harbor and channels between the years 1967 and 1969 was approximately 3.8% (Ref.7).

References

1. S.J. Hille and J.E. Suelflow, "The Economic Impact of the Port of Baltimore on Maryland", June, 1969.

2. "A Billion Dollar Plus Port" - A review of highlights of the study "The Economic Impact of the Port of Baltimore on Maryland", undated.

3. Statements by Drs. D.W. Prichard and Eugene Cronin to the Committee on Public Works, Congress of the U.S. on "The Impacts of the Enlargement of the Chesapeake and Delaware Canal on the Ecology of the Chesapeake Bay".

4. Maryland Department of State Planning, report on impact of the proposed industrial park at Crisfield.

5. North Atlantic Regional Water Resources Study, Appendix U, "Coastal and Estuarine Areas", p. 120.

6. Port of Baltimore Handbook, 1971-72, pp.42-50).

7. Waterborne Commerce of the U.S., Calendar year 1969, Part I, Department of the Army, Corps of Engineers, pp.120-124; p. 120).

8. Conservation Foundation Letter, May, 1971.

9. Maryland Port Authority, CBIPC Materials 4:IV.G.1, "Transportation System -- Water", (pp. 5-11).

II. PROBLEMS AND GOALS

I. WATER-RELATED OUTDOOR RECREATION 152

1. Water-Related Outdoor Recreation Problems 152
1.1 Nature of the Problem 152
1.2 Causes of the Problem 152
1.3 Location 153
Plate 20: Developed Recreation and Open Space 153
1.4 Time Characteristics 155
1.5 Parties Affected 153

2. Future Dimensions of Water-Related Outdoor Recreation Problems 154
2.1 Forces Tending to Increase the Problem 154
Table 1: Economic Impact of Recreation Demand and Expenditures - 1960, 2000 154
Table 2: Summary of Existing and Needed Public Open Space and Outdoor Recreation Areas - 1970, 2000 156
Table 3: Summary of the Surplus or Deficiency of Open Space and Outdoor Recreation Areas - 1970, 2000 157
2.2 Forces Tending to Reduce the Problem 158
2.3 Summary - Future Outlook 159

3. Water-Related Outdoor Recreation Goals, Objectives, Standards, Policies ... 160
3.1 Goal 160
3.2 Objectives 160
3.3 Standards 161
3.4 Policies 161

I

Water-Related Outdoor Recreation

1 Water-Related Outdoor Recreation Problems

The problem is how to preserve areas for water-related outdoor recreation needs.

1.1 Nature of the Problem

Increasing population, urban living densities, leisure time, affluence, mobility and outdoor appreciation have resulted in greatly increased demands for outdoor recreation. The accoutrements and means of outdoor recreation, in fact, are a major growth industry.

The Chesapeake Bay and its shoreline lend themselves to many forms of outdoor recreation. The Bay proper and its irregular shoreline provide opportunities for boating of all kinds, particularly because of its many snug harbors. The sandy beach areas and the areas of good water quality provide a resource for water-contact recreation - swimming, water-skiing, etc. Certain species of aquatic life in the Bay and their habitats provide opportunities for sport fishing. Wetland areas harbor wild fowl and provide opportunities for hunting. Natural scenic areas in public ownership along the Bay shore provide opportunities for camping, hiking, picnicking, etc. The aesthetic qualities of the Bay and the Bay shore provide a resource for various kinds of passive recreation.

"Evaluation of recreation in terms of leisure and entertainment alone does not give a complete interpretation of its total value to the State. Recreation must be judged, also, on its role as an economic and locational force. There are no figures available to indicate the importance of bayside recreation to the economy of the Bay area or the State as a whole. Also unknown is the influence which recreation may have had in the decision of industry to locate on or near the Chesapeake Bay. Lack of pertinent data must not be construed as an indicator of the importance of recreation to the economy of the Bay area. The amount of money spent in connection with outdoor recreation and tourism is large and growing as demand for recreation continues to increase. As a result, the economic impact resulting from the development of outdoor recreation facilities in a given area is becoming a matter of more than passing interest." (Ref. 1)

The relation between outdoor recreation and environmental quality is a complex one. Intensive use of recreation areas can often result in damage of the very environmental qualities that were the original attraction. Also, different forms of outdoor recreation (e.g. active versus passive; boating versus fishing) can conflict with one another.

Outdoor recreation and open space planning is complicated by a diversity of types, needs and objectives. These can be classified as follows (Ref. 2):

- Needs in intensive urban areas -- intensively developed outdoor recreation facilities within urban areas; used primarily by urban residents who seek quick and immediate access to unique or infrequently savored recreation facilities for a half or full day.
- Needs in intensive transitional areas -- less intensively developed outdoor recreation areas that are predominantly enjoyed by day users and weekend users from a two or three County area and adjacent urban and suburban developments.
- General outdoor recreation areas -- extensive day, weekend, and vacation use types, usually more remote than class-a types but relatively accessible (15-35 miles) to centers of urban population.
- Natural environment areas -- areas which rely on the natural

environment to provide recreation activities for day, weekend, and vacation use.

- Outstanding natural areas-- unique and irreplaceable areas of high scenic or scientific importance which merit special protection and management to ensure preservation.

- Primitive areas -- extensive, remote, wild and undeveloped areas.

- Historic and cultural areas -- sites that signify the historic, traditional or cultural heritage of the Nation, State or local area.

1.2 Causes of the Problem

A major cause of problems (and opportunities) with regard to water-related recreation is increasing demand. In the 30 years between 1940 and 1970, all the factors of recreation demand have increased several-fold: 1) Maryland's population has increased 150%; automobile registration (and presumably mobility) has increased 300%; total income in the State has increased 600%; the number of leisure time days has increased 400%. In combination, these factors have resulted in an increase in public recreation usage of 400%. Not all of this State-wide demand for outdoor recreation focuses on the Bay or its tributaries, but much of it does.

The other major cause of water-related recreation problems relates to the supply. While demand for recreation as measured by public recreation users increased 400% between 1940 and 1970, the capacity of State recreation facilities increased only about 150%.[1] The limitations on the resources available to meet the demands are to a certain extent natural, but they also arise from conflicting uses of the Bay and from constraints on development of outdoor recreation facilities. The amount of wetland areas, for instance, constitutes a natural limitation of the Bay as a resource for hunting recreation or boating, the sheer area of water surface becomes a natural constraint at some point, but in the Bay the major constraint is the availability of suitably located marina facilities and the conflict between boating and other residential and recreational uses. Swimming and other water contact sports are limited by the lack of public access to the Bay shoreline and by conflicting waste disposal uses of the Bay.

1.3 Location

Bay problems with regard to outdoor recreation vary dramatically according to location. Some areas are the source of demands which must be satisfied elsewhere. The demands for weekend trips to the shore from Baltimore and Washington are examples. Other areas are points of conflict between outdoor recreation and other uses. Examples are the public beaches along the lower Patapsco River -- which find themselves in conflict with expanding Baltimore Harbor activities -- and the conflicts between boating and residential uses along the Severn River. At still other locations, the problems are developmental in nature -- which actions to take in order to realize the outdoor recreational potential of the area. Janes Island State Park near Crisfield is an example. (See Plate 20.)

1.4 Time Characteristics

The major time characteristic of outdoor recreation is seasonality. The "seasons" for various types of outdoor recreation vary, of course, but the result is that facilities that are practically unused for much of the year are very heavily used during the in-season months. This dramatic peaking of usage results in facilities either poorer in quality or fewer in number than would be the case if the same demand were spread over a longer time period.

Also, jobs associated with outdoor recreation have built-in

unemployment for the off-season period. Income from outdoor recreation employment does not provide a sufficient annual income and in declining rural economies, supplementary off-season jobs are often not available.

A second major time characteristic of outdoor recreation relates to weekly patterns. Because a large proportion of the population's total leisure time days comes on weekends, much of the pressure on outdoor recreation facilities and resources occurs in this time period. With the advent of the much-heralded four-day week, however, it is possible that the pattern of day trips will not peak so sharply on weekends.

1.5 Parties Affected

Among recreation users, there are several categories of affected parties which deserve special mention. One of these are persons who have less mobility than the rest of the population -- including many residents of inner city areas. The great preponderance of outdoor recreation trips are made by auto. Lack of access to automobiles effectively limits access even to public outdoor recreation opportunities.

Another category of affected party are citizens who must rely on public outdoor recreation opportunities. While an increasing portion of the population has access to private swimming pools, vacation homes, golf courses, etc., most outdoor recreation demand focuses on publicly provided facilities.

A third category of affected party is the portion of outdoor recreation users that does not lend itself to satisfaction in high intensity recreation areas. Demand for low intensity outdoor recreation experiences is sometimes so great that the few areas reserved for low intensity outdoor recreation (e.g., Assateague Island) are sometimes transformed into high intensity recreation areas and overused or "spoiled". Prevention of this would require degrees of control not now envisioned.

The portion of the economy which is directly related to outdoor recreation is difficult to identify precisely -- but it is considerable. It includes firms engaged in pleasure boat building, repair and servicing, manufacturers of other outdoor recreation equipment, and many service operations: motels, State regulatory officials, etc. It also includes many jobs in construction of vacation homes, highways and facilities which are closely associated with outdoor recreation. These are another category of party affected by decisions regarding the use of the Bay for outdoor recreation.

A final category of affected party are the residents of areas along the Chesapeake Bay which have declining economies (or major economic sectors which are declining) in combination with significant long-range potential for outdoor recreation. These residents are potentially affected by Bay policies which combine outdoor recreation, environmental and economic growth objectives.

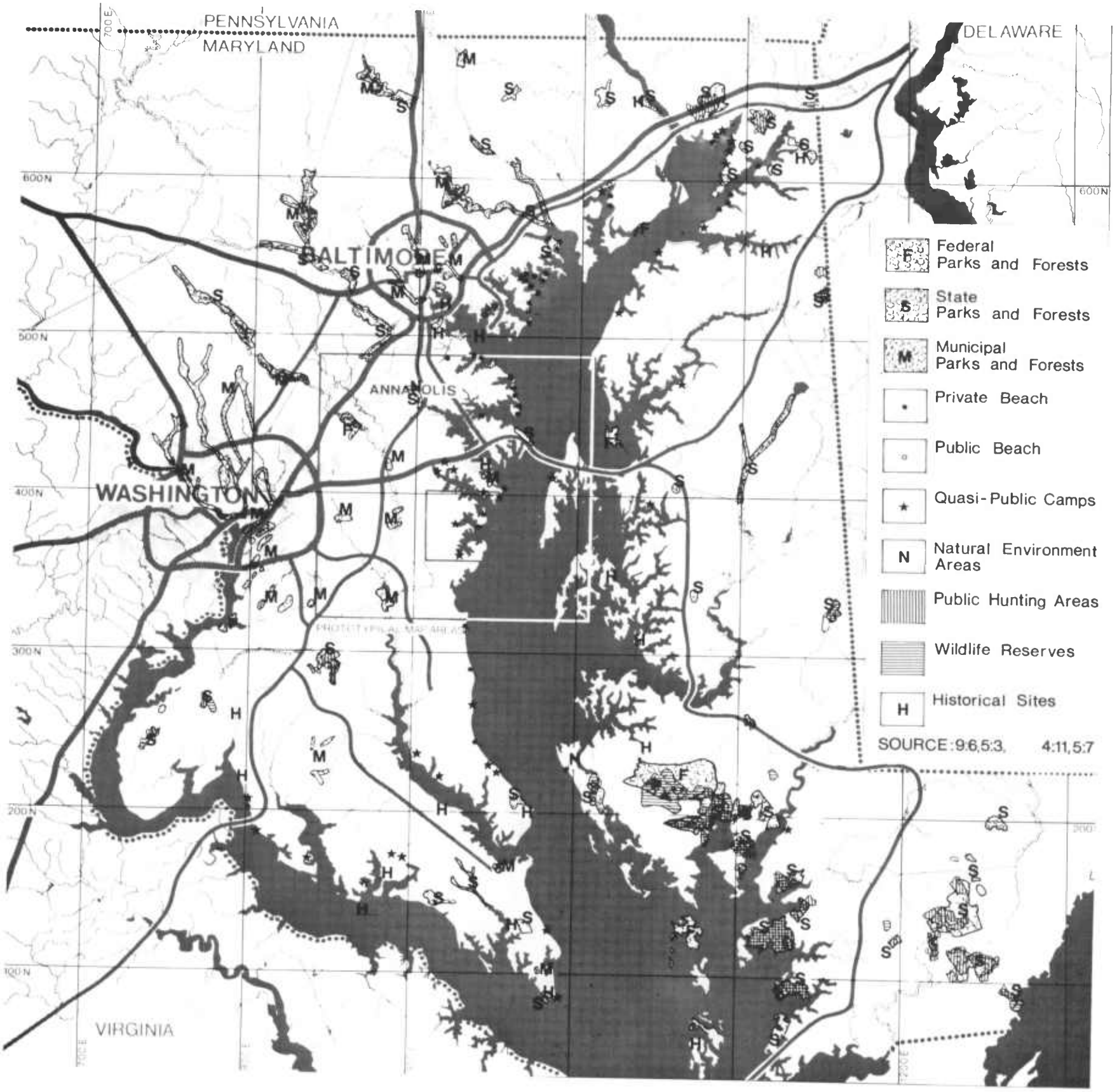
2 Future Dimensions of Water-Related Outdoor Recreation Problems

The Bay problem with regard to outdoor recreation is to increase the opportunity for a variety of outdoor uses of the Bay while reducing potential conflicts with other Bay uses as well as the environmental damage caused by recreation users themselves.

2.1 Forces Tending to Increase the Problem

a. Increases in population, mobility, and leisure time will result in an increase in public recreation usage in Maryland of 150% between

PLATE 20: Developed Recreation and Public Open Space



1970 and the year 2000.[1] Between 1970 and the year 2000, the State's population will increase by over 2.5 million people, auto registration (mobility) will increase by 160% and leisure time days will double.[1] All these factors will act to increase the demand for outdoor recreation opportunities. The demands generated by Maryland residents will be supplemented by the rapidly increasing number of out-of-State residents seeking outdoor recreation opportunities in Maryland.

Another view of the outdoor recreation demand picture relates population, income and outdoor recreation expenditures (see Table 1). Per capita income in Maryland increased from $2343 to $3742 from 1960 to 1968. (Ref. 3) Adjusting for inflation at 4%, this represents a real income gain per capita of over $500. Magnifying the effects of increases in income is the high income elasticity of demand for recreation. For each dollar change

TABLE 1: ECONOMIC IMPACTS OF RECREATION DEMAND AND EXPENDITURES: 1960-2000

	Maryland Population Over 12 Yrs. Old (Except W. Md.)[a]	Per Capita Annual Expend. Away from Home on Vacations, Outdoor Rec. Trips, and Outings[b]	Gross Recreation Expend. in Md. Bay Region (in Millions of Dollars)[c]	Recreational Expenditures for Water-Based Recreation (in Millions of Dollars)[d]	Economic Impact of Expend. for Purposes of Water-Based Rec. (in Millions of $)[e]	Impact to Rural Income From Expend. on Water-Based Rec. (in millions of $)[f]
1960	2,090,000	$103.7	$208.	$ 83	$125	$ 63
1970	2,650,000	$139.0	$368	$147	$221	$110
1980	3,220,000	$192.0	$618.	$248	$372	$186
1990	3,690,000	$260.0	$960	$384	$577	$288
2000	4,090,000	$428.0	$1750	$700	$1050	$525

[a]population over 12 yrs. = 74% of Total Population (see Md. Statistical Abstract, p. 13)
[b]1960 Expend. from ORRRC Report #19; assumes 1960-68 Rate of Increase in Per Capita Income, adjusted for inflation at 4%; assumes income elasticity of recreation at 1.5 (See NAR: Effects of Rec. Devel., Nov. 1969, p. 5) applied to real increases in income after 1960.
[c]In actual dollars (See Note #2); assumes rec. expend. of Md. Bay Region residents outside region = rec. expend. of outside residents in Md. Bay Region.
[d]40% gross rec. expend.: on basis of major purpose of trip (See NAR, Ibid., p. 10, 11)
[e]Multiplier for rec-related expend.: $1.50 (NAR, Ibid., p. 14, 15)
[f]Assumes 50% of Total Inc. increase spent in rural areas (NAR, Ibid., p. 17)

in income, expenditures on recreation change $1.50 to $2.00. Assuming that population increases according to current projections and that real per capita income continues to increase at the 1960-68 rate, gross expenditures for recreation in the Maryland Bay Region may increase four times by the year 2000 and half of the total will be water-based recreation primarily associated with the Bay.

b. Participation in many outdoor recreation activities for which the Bay provides a major resource will increase rapidly between 1970 and 2000. Statewide, swimming will increase by 75%, picnicking by 65%, boating participation will double, fishing will increase by 80%, hunting, camping and water skiing will double.[2] Much of the outdoor recreation demand represented by these state figures will focus on the Bay itself or its tributaries.

c. Rapid urbanization on the western shore of the Bay will consume much land that is suitable for outdoor recreation opportunities and will drive up the cost of land acquisition for outdoor recreation. Thus, it will become increasingly difficult to find and acquire the acreage needed. The Maryland Outdoor Recreation and Open Space Plan indicates (Table 2) that

TABLE 2: SUMMARY OF EXISTING AND NEEDED PUBLIC OPEN SPACE AND OUTDOOR RECREATION AREAS 1970-2000[a] (Ref. 2)

	Existing Acres	Needed Acres[b]				
Planning Region	1970	1970	1975	1980	1990	2000
West. Maryland	164,262	23,500	24,988	26,557	31,006	35,456
Baltimore	60,591	172,041	186,360	200,497	227,247	253,896
Surb. Washington	22,662	90,336	101,188	112,041	130,925	149,808
Southern Maryland	8,634	9,217	10,410	11,602	13,451	15,480
Eastern Shore	105,049	21,672	22,595	23,518	27,239	30,960
STATE TOTAL (in acres)	361,198	316,766	345,541	374,215	429,958	485,600

[a]1970 Source: Statewide inventory of existing open space and outdoor recreation areas, Urban Research & Development Corporation. Acres in private recreation are excluded.

These tables quantify the surplus or deficiency of open space and outdoor recreation areas in each of the five planning regions. They quickly indicate the disparity that now exists between the location of people and the location of outdoor recreation areas in Maryland.

The numbers must be used carefully because neither out-of-state visitors nor users from other regions were considered in determining needed acres. These visitors will be included when the information is available.

[b]Derived by multiplying recommended Open Space & Outdoor Recreation State Standard (80 acres per 1000 persons) times projected population.

TABLE 3: SUMMARY OF THE SURPLUS OR DEFICIENCY OF OPEN SPACE AND OUTDOOR RECREATION AREAS 1970-2000[a] (Ref. 2)

Planning Region	Surplus	Deficiency	Acres of Open Space and Recreation Areas[c] 1970	1975	1980	1990	2000
Western Maryland	X		140,762	139,274	137,705	133,256	128,806
Baltimore		X	111,450	125,769	140,006	166,656	193,305
Suburban Washington		X	67,674	78,526	89,379	108,263	127,146
Southern Maryland		X	583	1,776	2,968	4,907	6,846
Eastern Shore	X		83,377	82,454	81,531	77,810	74,089

[a]1970 Source: Statewide inventory of existing open space and outdoor recreation areas, Urban Research & Development Corporation. Acres in private recreation are excluded.

These tables quantify the surplus or deficiency of open space and outdoor recreation areas in each of the five planning regions. They quickly indicate the disparity that now exists between the location of people and the location of outdoor recreation areas in Maryland.

The numbers must be used carefully because neither out-of-state visitors nor users from other regions were considered in determining needed acres. These visitors will be included when the information is available.

[c]Derived by comparing the existing acres of open space and outdoor recreation with the number of acres that are needed as shown in the above chart.

by the year 2000, 254,000 additional acres for public open space and outdoor recreation will be needed in the Baltimore Region, 150,000 acres in the Suburban Washington Region and 15,000 acres in the Southern Maryland Region. Table 3 points up the current Baltimore, Suburban Washington and Southern Maryland deficiency of 180,000 acres and the current "excess" on the Eastern Shore of 83,000 acres. The "excess" points up the low number of people and economic opportunity of the latter region, which is too far away to be of much help in reducing the current deficiency in the urbanized areas. Because of the concentration of urbanization and land price increases in shoreline areas, it may be especially difficult to acquire the water-related portion of total public open space and outdoor recreation needs.

d. The increasing use of the Bay shoreline for private year-round and vacation homes will impose a further constraint on water-related

recreation land supply. Other urban uses which benefit from a shoreline location -- industries, powerplants, etc. -- will increasingly constrain the supply of available water-related recreation land.

e. The increase of incompatible[3] water uses, especially the use of the Bay for solid and liquid waste disposal, will constrain the use of the Bay for water-related recreation land.

2.2 Forces Tending to Reduce the Problem

a. One possible approach to the reduction of Bay problems with regard to outdoor recreation is from the demand side. Attempts can be made to modify burgeoning outdoor recreation demand by reducing total demand per capita, diverting demand from major present areas of focus (closely related to supply-side approaches) or spreading demand over longer time periods.

It is doubtful whether policies to reduce per capita outdoor recreation demands would be desirable or effective. In any case, Maryland State policies are implicitly oriented toward increasing outdoor recreation demand rather than reducing it. Economic development policies to increase and broaden affluence and mobility and to decrease congestion (e.g., the second span crossing the Chesapeake Bay) will loosen constraints on latent outdoor recreation demand.

Policies to divert demand from major areas of present focus could actually increase Chesapeake Bay problems with regard to outdoor recreation. This is because a major focus of present outdoor recreation demand is the Maryland and Delaware shore. The diversion strategy could involve satisfying more outdoor recreation demands of more kinds on the Chesapeake Bay.

Spreading outdoor recreation demands to moderate seasonal and weekend peaks is a desirable strategy and a probable nation-wide trend, but one over which State agencies have limited direct control.

Thus, the major approach to reduction of Bay outdoor recreation problems is from the supply-side: through increasing the number and variety of outdoor recreation opportunities along the Bay and through reducing conflicts with other Bay uses (e.g., waste disposal, waterfront industry) which can reduce the value of existing facilities.

b. An increasing awareness of the economic return potential of outdoor recreation in general and water-related recreation in particular should generate more political and economic pressure to acquire the acreage needed for water-related recreation opportunities and to resolve conflicts with incompatible Bay uses.

c. New methods of supplying recreation and -- such as the incorporation of recreation and open space opportunities in land development processes (e.g., PUD) or the joint use of industrial, institutional or power plant sites for outdoor recreation -- may ease problems of supplying water-related recreation land.

d. A variety of recreational facility management approaches can be employed to enable existing water-related recreation areas to meet more total demand without sacrificing the quality of the recreation experience.

2.3 Summary -- Future Outlook

Expenditures associated with trips for which water-related recreation is the major purpose may increase 5 times between 1970 and 2000 in Maryland. (See Table 1). Much of this economic potential is focused on Bay water and shoreline resources.

The Maryland Outdoor Recreation and Open Space Plan indicates that

year 2000 outdoor recreation and acreage needs in the Baltimore and Suburban Washington regions will be 6 times existing (1970) acreage for these purposes (see Table 2). Much of this need will be water-related recreation. Because of intense competition by competing water and shoreline uses in these regions, it may be impossible or undesirable to attempt to meet the water-related recreation needs of Maryland's metropolitan population within metropolitan counties. This would indicate an increased emphasis on outdoor recreation uses in non-metropolitan regions of the State. If half of the public open space and outdoor recreation acreage needs of the metropolitan counties are supplied in non-metropolitan regions of the State, the additional acreage should be oriented towards water-related recreation demands, the needed additional water-related recreation acreage in non-metropolitan regions of the State would be 142,000 acres between 1970 and 2000. This prospect carries significant economic potential for non-metropolitan areas of the State.

There is a greatly increased prospect for conflicts between water-related recreation uses of the Bay and Bayshore and competing uses (e.g., waste-disposal). There are also greatly increased prospects for conflicts among various water-related recreation uses, (e.g., motor-boating and swimming or shellfishing), and there are prospects for conflicts among public and private claims for use of Bay shoreline for water-related recreation opportunities.

3 Water-Related Outdoor Recreation: Goals, Objectives, Standards, Policies

3.1 Goal: Maximize Opportunities for Water-Related Recreation

3.2 Objectives

In accordance with the discussion in section 2.2 above, the general goal is stated from a supply-side perspective. Thus, with one exception (objective "a"), the objectives deal with the supply side. These objectives can be viewed as "external" or "internal." Internal objectives deal with the quality and amount of the resource; external objectives deal with the compatibilities with other goals.

a. Analyze latent demand (and need) by type of use (as above) and provide for all user classes on an equitably proportionate basis.

b. Provide a full range of types of water-related recreation facilities. These include day sailing and power boating, cruising, anchoring, small boating, waterskiing, swimming, snorkeling, scuba diving, paddling, viewing, etc. Each has its intrinsically suitable area, and in the not too distant future, forms of water zoning for different uses will be required.

c. Ensure that shore-related facilities necessary to water-related recreation are appropriately provided. This includes marinas, restaurants, retail, parking, etc.

d. Provide maximum public access to shoreline and water areas.

e. Potential recreation areas in six classes should be identified, an ecological inventory of each conducted and criteria for preservation established based on intrinsic suitability; intensive recreation; intensive transitional recreation; natural environments; outstanding natural areas; primitive areas; and and culturally unique areas. (Ref. 1,2)

f. Increase and improve all classes of natural areas to enlarge

aspects of the resource wherever possible. This should include the supplementation and creation of wetlands, beaches, islands, etc.

g. Establish a dynamic model of supply/demand relationship over time to give quantities and rates of change necessary for goal achievement.

3.3 Standards

While need and latent demand are difficult to quantify (in contrast to "effective" demand) they are the basis for the evaluation of standards. Most of the vast literature on recreation standards has to do with urban situations, middle-class clients, and "average" acreages per thousand population.

In addition to these standards which are for need, detailed standards must be set on the capacity of types of areas as related to anticipated use. Such standards as fishermen per foot of bank and boats per acre of water, etc., with allowances for weekly and seasonal peaks are suggested by recent studies. After areas are classified, such standards can be applied, related to the nature of particular environments, and the "capacity" of such areas set, with licensing and limitations on access as controls.

3.4 Policies

Statewide policies for open space and water-related recreation have been derived by weighing many of the above standards and objectives. The policies rephrase those in the Open Space Plan. (Ref. 2). Selected relevant policies include:

a. "Encourage multi-purpose use of conservation and recreation lands.

b. "Immediately initiate and enforce effective water and air pollution control measures to preserve the...water resources and to expand (their) recreational potential...

c. "Control shoreline development to discourage beach erosion.

d. "Encourage the use of submerged lands for wildlife and fish rather than draining for development.

e. "Create more wildlife sanctuaries or management areas in places that contain or are attractive to a variety of living things.

f. "Allow unusual habitats to exist in a natural state, permitting only such interference by man as will help restore virgin conditions.

g. "Use scenic roads and trails to link together park lands, conservation areas, scenic landscapes and historic sites.

h. "Develop guidelines for the attractive location and design of facilities in or near areas of scenic and historic distinction to protect the character of the area and to avoid unsightly...developments." (Ref. 2).

Footnotes

1. Figures derived from data in Ref. 2, p. 10

2. Figures derived from data in Ref. 2, p. 11

3. Visual characteristics of the shoreline, sea nettles, fish kills, litter, etc. all tend to reduce the recreation potential of the Bay.

References

1. "Chesapeake Bay: Bayside Recreation Inventory in Maryland," Department of Forests and Parks, November, 1969, p. 35.

2. "Maryland Outdoor Recreation and Open Space Concept Plan," Maryland Department of State Planning, Maryland Department of Forests and Parks, June, 1970, p. 18, 39, 40, and 61.

3. "Maryland Statistical Abstract," Maryland Department of Economic Development, 1970, p. 131.

II. PROBLEMS AND GOALS

J. WATERFRONT INDUSTRY 164

1. Waterfront Industry Problems 164
1.1 Nature of the Problem 164
Table 1: Categories of Industrial Activity According to Degree of Port Linkage 165
Table 2: Port-Dependent Manufacturing Firms and Employment, by SIC Code, by County 167
Table 3: Port-Dependent, Partially Port-Dependent, and Port-Serviced Manufacturing Employment, by Major Employment Category, by Region 168
1.2 Major Causes 169
1.3 Location of the Problem 169
Plate 21: Manufacturing Employment Centers and Port-Dependence 170
1.4 Time Characteristics 171
1.5 Parties Affected 171

2. Future Dimensions of Waterfront Industry Problems 171
2.1 Forces Tending to Increase the Problem 171
2.2 Forces Tending to Reduce the Problem 172
2.3 Summary - Future Outlook 173

3. Waterfront Industry Goals, Objectives, Standards, Policies 174
3.1 Goal 174
3.2 Objectives 174
3.3 Standards 174
3.4 Policies 175

J
Waterfront Industry

1 Waterfront Industry Problems

The problem is how and where to make adequate waterfront sites available for firms that need them.

1.1 Nature of the Problem

Though written in 1963, Dr. Dorothy Muncy's summary statement of the nature of waterfront industry problems is applicable today.

"The significance of the dwindling shoreline is just beginning to be recogized as a public policy problem. Metropolitan regions in the United States (as well as abroad) face population growth and mounting demands for recreational, industrial, and residential use of their shrinking supply of waterfront land. Industry's increasing dependence upon foreign raw materials, and improved shipping technology emphasize the need for deep-water industrial sites in portal regions...

"Without public policy decisions to guide shoreline development, opportunity to provide for employment and recreation needs of present and future generations of the Baltimore Region will be lost now by default.

"Neither residential nor commercial land uses have the critical location and space requirements of public recreation and industrial uses. Regional public beaches and shoreline wilderness areas require large land sites with special topographic features, but deep-water shoreland is not prerequisite. Industry's requirements, however, are the most critical of all waterfront land uses. Industries dependent upon water transport need large sites with existing or potential deep-draft navigation facilities...

"The Baltimore Region is faced with the prospect of a doubled population by the year 2000. To support this population, the Region must look to its unique economic assets; the greatest of these is its Port. Shorefront sites with deep-draft water accessibility are needed by an increasing number and variety of industries. Such sites, and especially large ones, are rare anywhere on the Eastern Seaboard. Further, it is evident that new waterfront industries will have greatly increased space needs over those shorefront industries built here 10 to 20 or more years ago.

"The Baltimore Region has only about half again as much of its present industrial shore-frontage reserved for future growth. This reserve is owner-restricted for expansion of existing plants or for either customer firms or those able to satisfy minimum freight transport quotas. Not all new industries can meet these conditions.

"Only 3% or 8 miles of the 266 mile Baltimore Region shorefront is vacant, unrestricted by prior ownership, and suitable for deep-draft transport; reservation of most of these 8 miles for future waterfront industry is not only significant in the national interest but represents the Region's best, and perhaps last, chance to grow as a world port." (Ref.1).

a. Types of Industrial Need

Certain industries, because of the nature of their operations, require waterfront locations (See Table 1). Some of these require access to deep-water shipping channels for receiving raw materials or sending processed materials. Examples are petroleum refineries, chemical plants, primary metals industries and ship-building and repair operations.

Other industries require access to waterfront locations because they use large volumes of water in their operations. Examples are electric power plants (discussed under "thermal waste discharge"), certain primary metals processing operations, and certain chemical and food processing operations. Where the water is used for cooling purposes, it can usually be of indifferent quality. Where the water becomes an integral part of the product

TABLE 1: CATEGORIES OF INDUSTRIAL ACTIVITY ACCORDING TO DEGREE OF PORT-LINKAGE[1]

Completely Port-Dependent - Industries concerned with bulk commodities and those involved in processing seafood or shipbuilding and repair.

SIC
2031 Canned and cured fish and seafood.
2036 Fresh or frozen packaged fish and seafoods.
2062 Sugar refining.
281 Industrial and inorganic chemicals.
291 Petroleum refining.
327 Concrete,gypsum and plaster products.
287 Agricultural chemicals.
33 Primary metals industries.
373 Ship and boat building and repair.

Partially Port-Dependent - Industries which rely on the larger basic industries.

SIC
(20) "Other" food and kindred products employment.
(28) "Other" chemicals and allied products employment.
(29) "Other" petroleum refining and related industries.
(32) Other stone, clay, glass and concrete products.
(34) Fabricated metal products.
(35) Machinery, except electrical.
(36) Electrical machinery, equipment and supplies.
(37) "Other" transportation equipment.

Port-Serviced--Industries which use water transportation infrequently but find the flexibility of an alternative mode of transportation a decided advantage in industrial location.

All Other Manufacturing Employment

Industrial-type uses not usually classified as waterfront industries are also important. Among these are sewage treatment plants, research and other institutions oriented to the water (e.g. Natural Resources Institute, Westinghouse Oceanographic, and Marine Engineers School), and of course military and related institutions. Patuxent Naval Air Station, Indian Head Naval Propellant Plant, Aberdeen Proving Grounds Edgewood Arsenal and the U.S. Naval Academy all have basically industrial character, need the water for one or another purpose, and are major employers.

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itself (e.g., certain food processing operations), water quality is more critical and must often be treated before use.

Some industries are indirectly tied to waterfront locations by virtue of critical linkages with port-dependent industries such as those mentioned above. Close physical proximity with their sources of raw materials enable these industries to minimize materials handling, inventory, and transportation costs.

Another category of port-related (as opposed to port-dependent) industries are those that use or can use shallow-draft barges for material sending and receiving. Producers of clay and concrete products and certain food processing industries are examples. These industries do not require deep-water ports needed by ocean-going vessels. They provide an opportunity area in which marine transportation can more successfully compete with rail and highway goods shipment.

Still other industries require waterfront locations for other reasons. Seafood processing operations, for obvious reasons, are usually found in port locations. Some industries fall into none of the categories mentioned above, but locate in waterfront areas simply because the railroads and highways that they do need access to, happen to be there. Some industries locate in waterfront areas for no functional reason at all; it was in these locations that they found cheap land suitably zoned.

b. Estimates of Present Port-Dependence of Maryland Industry

An attempt has been made to distinguish manufacturing firms (and employment totals) according to their degree of port-dependence. This breakdown, when

translated into acreage terms from numbers of employees, would enable an estimate of the amount of port-oriented land needed to accommodate projected industrial activity, which in turn would enable an assessment of local zoning and development plans with regard to the provision of industrial land.

Table 2 presents an estimate of various sorts of port-dependent manufacturing employment in Chesapeake Bay Counties. Tables 3a and 3b present a breakdown on port-dependent and port-serviced manufacturing employment, by major employment category, by region.

c. Importance of Waterfront Industries

Many of the industries that require waterfront locations are basic industries in the regional economy. They provide semi-finished materials (e.g., steel) which are inputs for many other firms. Thus, much of the regional economy is dependent -- directly or indirectly -- upon basic industries which require waterfront locations. This relationship is reflected in the conclusions of the recent study of the economic impact of the Baltimore Harbor. The production of port-dependent industries "provides some $442.2 million, or 67.3% of the total primary force of $626.9 million of the Port's impact on Maryland's economy. Nearly half of the cargoes arriving in Baltimore are destined for further processing in the Baltimore area. 'Consequently, the ability of the deep-water Harbor to attract industry to its shores is its greatest economic asset. Attraction of large manufacturing establishments to the Harbor will assure Baltimore's continued economic growth and development.'" (Ref.6)

d. Constraints on the Supply of Land

There are many constraints on the supply of waterfront land: access to deep-water channels, competition from alternative land uses, resistance from affected existing uses. Moreover, changing technology of industrial production generates changing demands for industrial land. The result is that there is a shortage of suitably located, suitably serviced available land for waterfront industry -- a situation which is a potential limitation on the growth of the regional economy. There are reports that available land in Marley Neck Industrial Park in Anne Arundel County is not being developed because of an uncertain long-range water supply situation or because of ownership policy regarding rail freight.

Land allocated to waterfront industry limits public access to the water just where the needs for such access are greatest. The Baltimore Harbor is the most important example in the Maryland Chesapeake Bay area. Here the development of deep water channels, modern loading and unloading facilities, and supporting highways and railroads make land adjacent to the waterfront suitable for industrial use. At the same time, however, the urban population surrounding the Harbor is cut off from the waterfront by the spread of industrial uses.

Development of waterfront industry on the few available shorefront sites with potential deep-draft water transportation can have environmental consequences so complex that it is inaccurate to portray the issue as a simple confrontation of development and conservation objectives.

Two studies -- one completed in 1963, the other now in progress -- provide an interesting perspective on planning for waterfront industry in the Baltimore Harbor area. Both studies communicate a strong sense of urgency. The Muncy Study (Ref.1) stressed the scarcity of shorefront sites with potential deep-draft transportation in the Baltimore Region. The current Baltimore Harbor Project (Ref.7) being carried out by the Maryland Environmental Service stresses the need to control environmental impacts of waterfront industrial development and operations through the adoption of pollution abatement plans.

Table 2.
PORT-DEPENDENT MANUFACTURING EMPLOYMENT, BY SIC CODE, BY COUNTY

COUNTY		2031 CANNED & CURED FISH & SEAFOOD	2036 FRESH OR FROZEN PKGD. FISH & SEAFOOD	2062 CANE SUGAR REFINING	281 INDUSTRIAL INORGANIC & ORGANIC CHEMICALS	287 AGRICULTURAL CHEMICALS	291 PETROLEUM REFINING	327 CONCRETE GYPSUM & PLASTER PRODUCTS	33 PRIMARY METAL INDUSTRIES	373 SHIP & BOAT BUILDING & REPAIRING	TOTAL
Anne Arundel	-Employ		113		328	120		277	818	496	2,152
	-Firms		2		2	2		11	3	27	47
Balt. City	-Employ	56	37	700	2,750	866	70	1,231	5,883	5,584	17,177
	-Firms	4	4	1	23	12	1	19	33	9	106
Balt. County	-Employ				97	15		889	33,393	5,672	37,066
	-Firms				6	1		17	11	4	39
Carroll	-Employ					19		118	12		149
	-Firms					2		4	1		7
Harford	-Employ				130			354	80	9	573
	-Firms				2			9	1	1	13
Howard	-Employ							141			141
	-Firms							4			4
Calvert	-Employ									108	108
	-Firms									2	2
Charles	-Employ							92			92
	-Firms							3			3
St. Marys	-Employ		77					31		28	136
	-Firms		4					2		3	9
Caroline	-Employ		110			6		17			133
	-Firms		1			1		2			4
Dorchester	-Employ		743			81		13	75	10	922
	-Firms		17			1		1	1	3	23
Kent	-Employ	550	56		48	8				25	687
	-Firms	1	2		1	2				2	8
Queen Annes	-Employ		548					54		10	612
	-Firms		12					3		2	17
Somerset	-Employ	7	945						150	12	1,114
	-Firms	1	24						1	1	27
Talbot	-Employ		1,435					21		68	1,524
	-Firms		11					2		8	21
Wicomico	-Employ		70			52		127	53	594	896
	-Firms		2			3		7	2	3	17
Worcester	-Employ		21			67		64	6		158
	-Firms		1			2		3	1		7
Montgomery	-Employ				13	31		187	93		324
	-Firms				1	2		8	3		14
Prince George	-Employ				380			976	131		1,487
	-Firms				3			23	4		30
Cecil	-Employ				19			53	375	623	1,070
	-Firms				2			4	1	5	12

Source: "Maryland Manufacturers" Directory 1969-70, Maryland Department of Economic Development.

NOTE: Data includes all employees of firms in the listed "Port-Dependent" manufacturing classifications, even though some firms engage in "Non-Port-Dependent" operations.

Table 3a

PORT-DEPENDENT, PARTIALLY PORT-DEPENDENT, AND PORT-SERVICED MANUFACTURING EMPLOYMENT, BY MAJOR EMPLOYMENT CATEGORY, BY REGION

PORT DEPENDENCE; REGION \ MAJOR EMPLOYMENT CATEGORY	20 FOOD	22 TEXTILES	23 APPAREL	24,25 LUMBER & FURNITURE	27 PRINTING & PUBLISHING	28 CHEMICALS & ALLIED PRODUCTS	30 RUBBER & PLASTIC	33 PRIMARY METALS
Port-Dependence	2031 2036 2062					281 287		33
Baltimore Region	906					4,325		37,186
Washington Metro Area	0					424		224
Southern Maryland	77					0		0
Eastern Shore	4,485					262		284
Cecil County	0					19		375
	5,468					5,030		38,069
Partially Port-Dependent	Other Food					Other Chemicals		Adjustment
Baltimore Region	19,931					9,028		(+8,214)
Washington Metro Area	1,919					1,102		(- 224)
Southern Maryland	472					0		(0)
Eastern Shore	5,357					(- 35)		(- 240)
Cecil County	114					1,220		(- 363)
	27,793					11,321		(+7,387)
Port-Serviced		22	23	24,25	27		30	
Baltimore Region		1,390	15,000	4,960	13,119		10,397	
Washington Metro Area		0	5	442	2,476		43	
Southern Maryland		0	0	305	58		0	
Eastern Shore		52	3,012	1,368	1,165		0	
Cecil County		114	268	46	67		0	
		1,556	18,280	7,121	16,885		10,440	

REGION; PORT-DEPENDENCE \ MAJOR EMPLOYMENT CATEGORY	34 FABRICATED METALS	35 MACHINERY EXCEPT ELECTRIC	36 ELECTRICAL MACHINERY	371 MOTOR VEHICLE EQUIPMENT	372 AIRCRAFT PARTS	373,4,5,9 OTHER TRANSPORTATION EQUIPMENT	19,32,38,39 OTHER DURABLE GOODS	21,26,29,31 OTHER NON-DURABLE GOODS	TOTAL
Baltimore Region									
P-D						11,761	3,010	70	57,258
PP-D	11,850	11,187	11,601	6,190	17,069	(-5,884)			89,186
P-S							8,939	8,453	62,258
Total	11,850	11,187	11,601	6,190	17,069	5,877	11,949	8,525	208,702
Washington Metro Area									
P-D							1,163		1,811
PP-D	1,112	614	1,780		1,862	8			8,173
P-S							716	392	4,074
Total	1,112	614	1,780	0	1,862	8	1,879	392	14,058
Southern Maryland									
P-D						136	123		336
PP-D					28	95			595
P-S							(- 53)		310
Total	0	0	0	0	28	231	70	0	1,241
Eastern Shore									
P-D						719	296		6,046
PP-D	642	720	319	536		(- 222)			7,077
P-S							297	36	5,930
Total	642	720	319	536	0	497	593	36	19,053
Cecil County									
P-D						623	53		1,070
PP-D	1	77	603		680	(- 577)			1,755
P-S							161	188	844
Total	1	77	603	0	680	46	214	188	4,032

TABLE 3b:
PORT-DEPENDENT, PARTIALLY PORT-DEPENDENT, AND PORT-SERVICED MANUFACTURING EMPLOYMENT BY MAJOR EMPLOYMENT CATEGORY, BY REGION

REGION; PORT-DEPENDENCE \ MAJOR EMPLOYMENT CATEGORY	20 FOOD	22 TEXTILE	23 APPAREL	24,25 LUMBER & FURNITURE	27 PRINTING & PUBLISHING	28 CHEMICALS & ALLIED PRODUCTS	30 RUBBER & PLASTIC	33 PRIMARY METALS
Baltimore Region								
P-D	906					4,325		37,186
PP-D	19,931					9,028		(+8,214)
P-S		1,390	15,000	4,960	13,119		10,397	
Total	20,837	1,390	15,000	4,960	13,119	13,353	10,397	45,400
Washington Metro Area								
P-D						424		224
PP-D	1,919					1,102		(- 224)
P-S			5	442	2,476		43	
Total	1,919	0	5	442	2,476	1,526	43	0
Southern Maryland								
P-D	77							
PP-D	472							
P-S				305	58			
Total	549	0	0	305	58	0	0	0
Eastern Shore								
P-D	4,485					262		284
PP-D	5,357					(- 35)		(- 240)
P-S		52	3,012	1,368	1,165			
Total	9,842	52	3,012	1,368	1,165	227	0	44
Cecil County								
P-D						19		375
PP-D	114					1,220		(- 363)
P-S		114	268	46	67			
Total	114	114	268	46	67	1,239	0	12

Note: Date developed from review of Maryland Directory of Manufacturers 1969-70 (Ref.3) and from 1970 employment estimetes in "The Labor Force of Maryland" (Ref.4, pp.140-153). Where the two sources were inconsistent, the discrepancy is indicated in parentheses.

PORT DEPENDENCE; REGION \ MAJOR EMPLOYMENT CATEGORY	34 FABRICATED METALS	35 MACHINERY EXCEPT ELECTRIC	36 ELECTRICAL MACHINERY	371 MOTOR VEHICLE EQUIPMENT	372 AIRCRAFT PARTS	373,4,5,9 OTHER TRANSPORTATION EQUIPMENT	19,32,38,39 OTHER DURABLE GOODS	21,26,29,31 OTHER NON-DURABLE GOODS	TOTAL
Port-Dependence						373	327	291	
Baltimore Region						11,761	3,010	70	57,258
Washington Metro Area						0	1,163	0	1,811
Southern Maryland						136	123	0	336
Eastern Shore						719	296	0	6,046
Cecil County						623	53	0	1,070
						13,239	4,645	70	66,521
Partially Port-Dependent	34	35	36	371	372	Remainder			
Baltimore Region	11,850	11,187	11,601	6,190	17,069	(-5,884)			89,186
Washington Metro Area	1,112	614	1,780	0	1,862	8			8,173
Southern Maryland	0	0	0	0	28	95			595
Eastern Shore	642	720	319	536	0	(- 222)			7,077
Cecil County	1	77	603	0	680	(- 577)			1,755
	13,605	12,598	14,303	6,726	19,639	(-6,580)			106,786
Port-Serviced							Remainder	Remainder	
Baltimore Region							8,939	8,453	62,258
Washington Metro Area							716	392	4,074
Southern Maryland							(- 53)	0	310
Eastern Shore							297	36	5,930
Cecil County							161	188	844
							10,060	9,069	73,416

1.2 Major Causes

One major current cause of problems relating to waterfront industrial land is technological change in marine transportation to which local industries must respond in order to remain competitive with other ports on the Atlantic Seaboard and in Europe. Such changes include the need to accommodate large tankers with deeper shipping channels, the need to utilize specialized loading and unloading facilities in order to reduce "turn-around time" for harbor visits, and the need for large storage areas adjacent to the waterfront. A related set of causes is changes in basic industry production processes which require larger industrial sites and more extensive supportive services (e.g., water supply, rail and highway linkages, etc.).

These determinants do not, of course, affect all industries in exactly the same way. Industries which can use shallow draft coastwise shipping can use land adjacent to more shallow channels, and, since shipments are generally smaller, they can use smaller storage areas. Industries which need large volumes of water (e.g., electrical power generation) can sometimes dispense with a harbor location altogether -- provided adequate highway or rail transportation is available.

The effect of the major causes mentioned above has often been to make formerly adequate waterfront industrial sites obsolete. The search for waterfront land suitable for modern industry has resulted in the migration of the Baltimore Harbor waterfront industry southwards along the banks of the Patapsco River; and the abandonment of former industrial sites has left a deteriorated, difficult-to-renew physical environment which requires intensive investment of public money and energy to transform to other uses. This has exacerbated problems of metropolitan population access to waterfront land, consumed land which had alternative recreation uses, and reduced the value of existing recreation areas in the vicinity. The waterfront land abandoned in this migration has been slow and difficult to convert to alternative uses. The work now in progress in Baltimore's Inner Harbor is only a beginning.

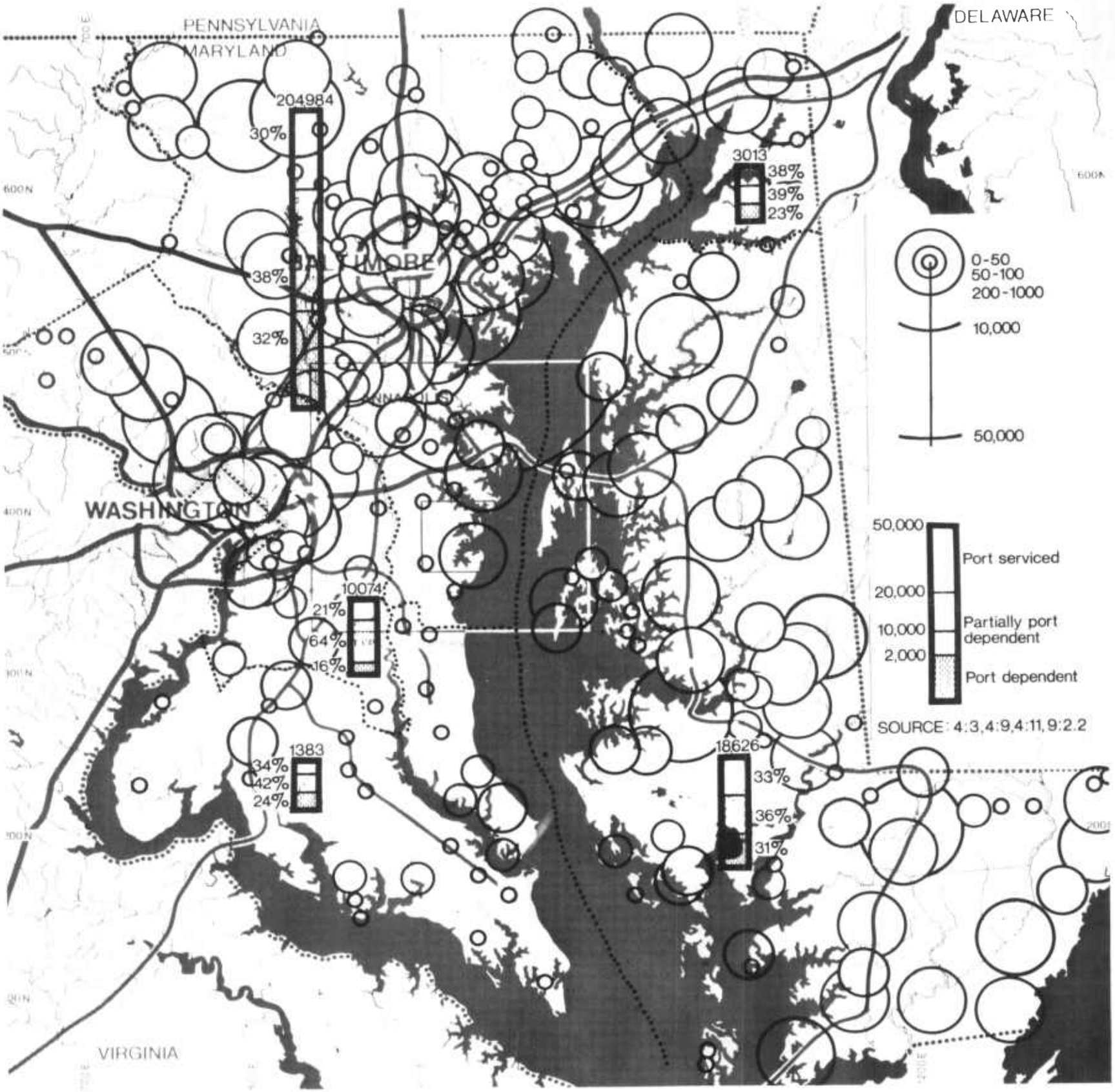
1.3 Location

The problem is primarily, but by no means solely a Baltimore Regional problem. There are few unreserved sites with deep-water potential. "The Baltimore Regional Port Area has only two large potential deepdraft sites not yet zoned for future industry. On Back River, in Baltimore County, a site of 1,500 to 1,700 vacant acres with over one mile of vacant shoreline in a few large ownerships, is one of the few remaining large waterfront sites in metropolitan regions on the eastern seaboard. Hog Neck, in Anne Arundel County, has approximately 1,100 acres vacant, held in a few large and many small ownerships, with an interrupted waterfront access totalling 0.6 miles. An additional adjacent 800 vacant acres, also in multiple ownerships, are interspersed with roads and some residential development."(Ref.1)

Problems relating to the supply of land for waterfront industry and conflicts between waterfront industry and other urban and environmental shoreline uses are most likely to arise in metropolitan areas. Metropolitan areas offer the ready access to consumer and manufacturing markets, the broad range of supporting facilities and services and the harbor facilities which are attractive to water-oriented industry. (See Plate 21).

Changing technology -- e.g., the development of shallow draft shipping -- may enable more Chesapeake Bay ports to compete effectively (with both deep-water harbors and highway-oriented industrial sites) for waterfront industry. This could result in a relative dispersal of waterfront industry to smaller port facilities on both the eastern and western shores. The proposed Annemessex Industrial Park near Crisfield represents a move in this direction. It has been discussed under "Conser-

PLATE 21: Manufacturing Employment Centers: Port Dependence by Planning Regions



vation of Wetlands" above.

More concentration of waterfront industry in the Baltimore Harbor has been advocated by some on the ground that the concentration of marine transportation terminals in a limited area would make it possible to limit the effects of "ecological disasters" such as oil spills which will occur whatever the precautions. Such a strategy, it is argued, would help in conservation of ecological values elsewhere in the Bay. Evaluation of such strategies must consider sub-regional growth objectives, potential supply of waterfront land possessing various characteristics, future waterfront land needs, likelihood and magnitude of ecological disasters related to waterfront industry.

1.4 Time Characteristics

Technological trends affecting waterfront industry can be considered exogenous variables: harbors and waterfront-oriented industries must respond to these in order to compete in national and international markets. However, there is also a decreasing inclination to accommodate such trends uncritically. The Governor of Delaware has stated publicly that the economics of deep-draft tankers and port facilities does not justify the fouling of the waters of the Delaware Bay.

Other trends affecting waterfront industry relate to regional population and economic growth. However, because of the importance of waterfront industry to the regional economy,(Ref.5) these trends can be considered dependent variables in the context of this discussion -- i.e. regional economic trends, (which produce demands for waterfront industrial sites, conflicts with competing uses and ecological consequences) are themselves dependent upon the region's ability to attract waterfront industry.

1.5 Parties Affected

Parties directly affected by problems relating to waterfront industry are the industrial firms involved, their employees and the agency most directly responsible for the development of Maryland's waterfront industry, the Maryland Port Authority (now part of the Department of Transportation).

Parties indirectly affected by problems relating to waterfront industry include other industries closely linked to basic waterfront industries and their employees, existing and potential users of alternative uses of waterfront industrial sites, suppliers of supportive facilities and services for waterfront industry.

2 Future Dimensions of Waterfront Industry Problems

The Bay management problem with regard to waterfront industry is how and where to make adequate waterfront sites available for firms that need them.

2.1 Forces Tending to Increase the Problem

a. Recent studies have indicated the dependence of Maryland's economy on its port facilities -- particularly the Port of Baltimore. The intermediaries between port facilities and the general economy are port-dependent and port-related industries. The conclusion is that if Maryland's economy is to continue to grow -- as projections and agency objectives indicate -- it will be necessary to continue to find suitable sites for port-related industries.

b. Perhaps more significant than economic growth or port-dependence by themselves are the changing locational needs of port-related industry. New industrial processes tend to demand larger sites and large areas for storage and handling. To provide such sites in urbanized areas -- close to labor and consumer markets -- is increasingly difficult and expensive. In the case of port-related industries, the additional need for access to deep-draft navigation

facilities further limits the supply of suitable sites.

c. Conflicts between waterfront industrial uses and other uses of shoreline areas are increasing. "Other" uses include various recreation, residential, aesthetic and transportation uses. These conflicts are particularly intense in metropolitan areas where the volume of activity which could potentially benefit from waterfront locations is large and where the supply of available shoreline land is small. Such conflicts will increasingly occur in areas proposed for industrial use and they will increase the difficulty of making suitable waterfront sites available for industry.

d. Even where sites of sufficient size and deep-draft navigation facilities are available, increasing industrial needs for water supply may increase difficulties of port-related industrial location.

Port-related industries tend to be particularly heavy water-users. Nationally, primary metals manufacturing accounts for 32% of total industrial water use, chemicals manufacturing for 23%, paper manufacturing for 14%, petroleum and coal products for 9%, food products for 5%, stone and vitreous products for 2%.(Ref.8) These types of industry include significant proportions that are port-dependent or port-related. Together, they account for 85% of total industrial water use.

Furthermore, industrial water use is a large proportion of total water use. In 1970, self-supply industrial water use was about 103 billion gallons per day; public water supplied (a portion of which goes to industrial users) and domestic water use was only 35 billion gallons per day. And, even from this larger base, industrial water use is increasing faster than public water use. (Ref.8).

Thus, not only will waterfront industry have increasing competition for available sites, but its water needs will increasingly generate conflicts with other water users in urbanized areas.

e. Wastes discharged by industry, including port-related industry, will generate conflicts with water-related recreation, commercial fishing, aesthetic and other uses. Even if wastes discharged by industry are held at present levels, it is likely that increases in activities which depend on higher levels of water quality will generate increased conflicts and increasing difficulties of waterfront industrial location in the future.

f. Increasing scarcity of suitable port-oriented land will contribute to difficulties of waterfront industrial location. In 1963, a study found that "Only 3% or 8 miles of the 266-mile Baltimore Region shorefront is vacant, unrestricted by prior ownership and suitable for deep-draft transport."(Ref.1) Comparable information describing the present situation in the Baltimore Region is not available. However, the likelihood is that the direction of change in the Baltimore Region has been toward a smaller supply of land available and suitable for port-related industry.

g. Finally, the increasing cost of preparing land for waterfront industry will increase difficulties of port-related industrial development -- even if a large supply of vacant, unrestricted and suitable land were available. These site preparation costs are particularly heavy in estuarine environments such as the Bay -- as is indicated by figures developed in conjunction with the proposed Annemessex Industrial Park.

2.2 Forces Tending to Reduce the Problem

a. Site allocation and site planning approaches can help reserve prime waterfront industrial sites for industries which most need them and enable industries to efficiently use limited port-oriented land.

Public supporting facilities can be planned in such a way that they neither encroach upon valuable waterfront industrial sites themselves nor encourage industries which do not need waterfront sites to compete for such locations with those

that do.

Provisions can be made in industrial site planning to retain public access for recreation and amenity uses. There are significant opportunities for this approach along the Lower Patapsco River.

b. Industries that do not actually require waterfront locations themselves, but that prefer to locate near basic processors that do need waterfront sites, could be encouraged to locate on non-waterfront industrial sites. A number of these have been identified by the Maryland Department of Economic Development. (Ref.9) Then product-linked plants could spread away from the waterfront while remaining functionally connected, e.g. pipelines connecting refineries and petrochemical plants.

c. In combination with new marine transportation technology, it may be possible to develop port facilities in areas of the Bay other than Baltimore Harbor -- thus alleviating constraints on suitable waterfront sites in the Baltimore Region. Such a dispersal strategy with regard to waterfront industrial development is likely to generate conflicts with other water and land uses as it eases constraints on port-oriented land supply, however.

d. Changes in industrial production processes can slow the increase in water usage by port-related industries. Also, more effective treatment of wastes generated by waterfront industry can reduce industrial demands on Bay waters for waste disposal. These developments would reduce conflicts between waterfront industry and other land and water uses, which would indirectly tend to reduce port-oriented industrial location problems.

e. More rapid reuse of obsolete industrial sites for other, potentially competing urban uses (e.g., open space, water-related recreation, public access to the Bay, etc.) can help to reduce conflicts in port-oriented industrial locations.

2.3 Summary - Future Outlook

It is very difficult to derive from available information and projections on manufacturing employment (by industry and degree of port dependence), industrial firms, or industrial production a precise picture of future port-oriented land needs. Projections indicate that manufacturing employment is growing slowly. The number of manufacturing firms has generally decreased in recent years. (Between 1960 and 1968 the number of firms in Baltimore City decreased from 1507 to 1195; in the rest of the Baltimore Region, the number of firms remained stable at almost 500; in Southern Maryland the number of firms decreased from 82 to 66; in Eastern Shore Counties and Cecil County the number decreased from 533 to 433).(Ref.10) Yet value added in manufacturing, manufacturing payrolls and presumably production has continued to increase. Continued increases in industrial production in combination with evolving production technology and the continued importance of port-oriented industry in Maryland's economy will continue to generate needs for port-oriented land in the future.

Nor is it possible, given available data, to match future port-oriented land needs with the currently available and potential supply of port-oriented land. In 1963, in the Baltimore Region 75% of the port shoreline was occupied (including 12% by industrial uses), 10% was vacant but committed (including 3% for industrial uses) and 15% was vacant and uncommitted (including only 3% with potential for deep-draft transportation).(Ref.1) The current industrial land situation in the Baltimore Harbor is part of a current study by the Maryland Environmental Service. Port-oriented industrial land potential (under varying port-development and marine transportation technology conditions) has not been systematically surveyed. In view of the Annemessex Industrial Park and other controversies, however, it may be reasonable to conclude that the effective supply of suitable port-oriented industrial

land in the Maryland Bay Region is decreasing.

Conflicts between port-oriented industry and other uses will probably increase in the future -- even with the applications of techniques to reduce water supply and waste disposal impacts per unit of production. This is both because production is expected to increase and because of the increase in the number of and propinquity of potentially conflicting uses. These effects will probably be especially severe in newly developing waterfront industrial areas.

3 Waterfront Industry: Goals, Objectives, Standards, Policies

3.1 Goal - Maximize Bay Opportunities for Water-Related Industry

All sites suitable for industry on the shores of the Bay are not necessarily suitable for water-related industry of all kinds, nor do all water-related industries need or want Bay-front locations.

3.2 Objectives

The objectives necessary to maximizing Bay opportunities for water-related industry are:

a. Identify and classify all Bay waterfront land as to present and potential value as sites for water-related industry. This includes use of all usual site selection criteria, including any public or private costs of filling and improving such sites or of acquiring already developed land for use by water-related industry. (This objective has to varying degrees already been accomplished).

b. Determine those industries (by at least four-digit S.I.C. categories) that need waterfront land for transhipment, or water in large quantities in their process, or need a large body of water for waste disposal, or combinations of these.

c. For each industry forecast growth or hypothesize Bay site attraction potential if sites were available.

d. Translate growth potential for Bay sites of water-related industry above into site utilization and locational requirements.

e. Determine economic and social implications of water-related industry by subregions and planning areas through use of regional input-output models or studies such as that done for the Crisfield proposal.

f. Reclassify Bay existing and potential waterfront sites by priority of importance taking all socio-economic and locational criteria into account.

g. Develop an environmental matrix by water-related industrial type that expresses site utilization characteristics such as coverage, utility requirements, nature of effluent, potential for new technology, etc.

h. Establish special Bay water-related industrial zoning that reserves most appropriate waterfront land for water-related industrial use.

i. Adopt a Bay-wide water-related industrial development plan, to include a process for making waterfront land available, and for rationally explicating effects of potential tradeoffs with other goals.

3.3 Standards

Standards for water-related industrial development are of three types. The first type includes standards related to industrial needs for sites, services, and locational linkages.

The second type of standard that must be elaborated is that of performance characteristics for industries of the kind evolved for industrial parks. These should be stipulated as part of a water-related industrial development plan for the Bay.

The third type of standard has to do with setting achievement levels of water-related industrial development in terms of general socio-economic needs and goals of the Bay region. If the role of

water-related industry in the economy is well understood through the input-output regional modelling procedure mentioned above, then standards of "performance" for water-related industry as a whole can be set.

3.4 Policies

Recent organization of the Department of Economic and Community Development enables the State not only to plan but to carry out major programs of all kinds, including water-related industrial development. Needed are consistent policies and priorities that recognize the importance of water-related industry in the context of other needs and goals.

a. Develop estimates of the amount of land needed for waterfront industry. This would require a breakdown of economic projections by degree of port-dependence, a translation of these projections into acreage terms, a comparison with supplies of existing and available waterfront industrial land.

b. Develop a plan for meeting future waterfront industry land needs. This plan would consider criteria for selecting sites appropriate to various waterfront industry types and alternative strategies for meeting future needs. It would consider costs of acquiring and preparing designated land for industrial use. It would relate waterfront industry to prospective port, highway, railroad, utility and other infrastructure developments. It would relate waterfront industry needs to competing uses for shoreline land.

c. Develop means for implementing the plan. These include zoning powers, renewal, advance acquisition, long-term options to purchase, taxation policies, and other approaches to be developed.

d. Develop special site development and performance standards for waterfront industry. These would provide a means for implementing desirable relationships between waterfront industry, urban infrastructure facilities and competing land uses and for promoting maximum efficiency in the use of waterfront industrial land. The Baltimore Harbor Project currently in progress(Ref.7) will provide a basis for a set of standards applicable elsewhere in the Bay Region.

Footnotes

1. Categories based on material developed in Reference, 2, p. 13, and comparisons with material in Reference 1, p. 19-21.

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II. PROBLEMS AND GOALS

K. WATERFRONT RESIDENTIAL DEVELOPMENT 178

1. Waterfront Residential Development Problems 178
1.1 Nature of the Problem 178
1.2 Major Causes 178
1.3 Time and Location Characteristics 179
Plate 22: Housing Subdivisions and Developments, 1950-67 180
1.4 The Parties Affected 179

2. Future Dimensions of Waterfront Residential Development Problems 181
2.1 Forces Tending to Increase the Problem 181
2.2 Forces Tending to Reduce the Problem 182
2.3 Summary - Future Outlook 183

3. Waterfront Residential Development Goals, Objectives, Standards, Policies . 183
3.1 Goal 183
3.2 Objectives 183
3.3 Standards 183
3.4 Policies 184

K

Waterfront Residential Development

1 Waterfront Residential Development Problems

The problem is how and where to make waterfront sites available for residential development.

1.1 Nature of the Problem[1]

Residential development of the shoreline and peninsular areas, particularly along the western shore of the Bay, is a major potential. These areas offer the amenity of the Bay, easy access to water-related recreational opportunities, and proximity to suburbanizing metropolitan jobs. The eastern shore also has major potential for vacation and retirement residential development but less current demand because it is further away from urbanization. As more persons seek to combine recreational opportunities with basic shelter needs in selecting a home and as vacation homes in alternative locations (e.g., the Maryland shore) become increasingly expensive, the residential development potential of the Bay shoreline will increase.

However, present development patterns in shoreline areas have severely limited the future potential of shoreline areas for residential development. Low density development has preempted long stretches of waterfront with a few houses and has, in the process, denied waterfront access to areas immediately inland. In this way, the residential development potential of the shoreline as a whole has been greatly reduced.

An aspect of the problem is the inappropriate use of septic tanks in much low density shoreline residential development. The result is often the discharge of inadequately treated wastewater into the Bay and its sub-estuaries. The development patterns described above, by reducing total development potential of the peninsula areas, have made off-site sewer systems uneconomic and have reduced the value of sites still available because of the resulting water pollution. The Severn, Magothy, South and Back Rivers are examples.

The low-density, relatively uncontrolled development along the shoreline has not only preempted the shore but the manner of development has frequently had severe effects on the environment. Increased runoff to the Bay and small streams (due to deforestation and hard surfaces) has increased erosion, sedimentation and clogging of natural stream channels and wetlands. Much of the soil next to sub-estuaries is highly permeable, and liquid waste effluent leaches quickly from septic tanks directly into the water. Water is drawn from aquifers (that receive less supply because of increased runoff) near the Bay and saline pollution from the Bay's water infiltrates the aquifers.

1.2 Major Causes

The expansion of the Baltimore-Washington metropolitan area has brought the peninsula areas in Anne Arundel, Baltimore and Harford Counties into the metropolitan housing market. Areas which were effectively outside these metropolitan areas in the 1950's will be developed for year-round housing in the 1970's and 1980's. Completion of US I-50, 309 and the Bay Bridge helped bring this about.

Increases in affluence as well as mobility have made it possible for more families to buy second, vacation homes. It is estimated that more than one in 10 of 1971's housing starts were for second homes. There are several forces (Ref.2) behind the second home surge:

The expanding amount of leisure time and the yearning to escape from congested cities and suburbs (longer vacations, the Monday Holiday Law legislating a minimum of five "mini-vacations" a year, etc.);

The long-run savings on family vacations resulting from a second home (in comparison with hotel-motel-restaurant or

resort costs);

the long-term investment value of a well-located second home;

the recent authorization (in 1968) of an FHA program to insure mortages on second homes;

the boom in boating and other outdoor recreation activities which spawn marinas, lakeshore developments, yachting clubs, etc.;

the long-term trend in the U.S. to have at least two of everything (cars, television sets, jobs, etc.).

The increased importance of recreational opportunities and amenities in the house-purchase decision (complemented by increased access to shoreline) will result in increased potential for residential use of shoreland for year-round as well as vacation homes.

As much as 35% of all Western shore housing was built prior to 1939. Its age increases the possibility of redevelopment of some of these areas to take advantage of current development potentials.

Because so much of the Bay shore frontage has been consumed by low density residential development, the remaining vacant parcels are subject to pressures for other uses -- e.g., waterfront industry, -- and public outdoor recreation such as marinas or commercial beaches. In addition, the demand for residential development, and new methods for providing urban services (e.g. sewerage) to the shore make possible the development of land which would previously have been considered unsuitable or undesirable for residential use.

1.3 Time and Location Characteristics

Bay problems with regard to shoreline residential uses are associated with the location and intensity of pressures for residential development. Such demand is associated with a range of factors: the availability of vacant developable shoreline, accessibility, the prospective availability of public utilities in any peninsula area, adjacent population growth patterns, land values and tax rates, and the nature of applicable zoning and subdivision regulations. Most of these factors are influenced by public policy at the State and local levels.

The major pressure for year-round shoreline residential development is on peninsula areas in the metropolitan portions of Anne Arundel and Baltimore Counties. Within the peninsula areas, the greatest pressure will be on the few remaining vacant waterfront parcels. Shoreline areas in Calvert and Harford Counties are appropriate for long-range residential development. (See Plate 22).

The location of vacation homes is, of course, associated with urban concentrations. Presently one-third of all second homes are within 50 miles of the owner's primary home. (Ref.2)

On the Eastern Shore the extension of the second span of the Chesapeake Bay Bridge and ultimately the other bridges will increase the pressure on shoreline in Kent, Queen Anne's and Talbot Counties for first homes, vacation and retirement residential development.

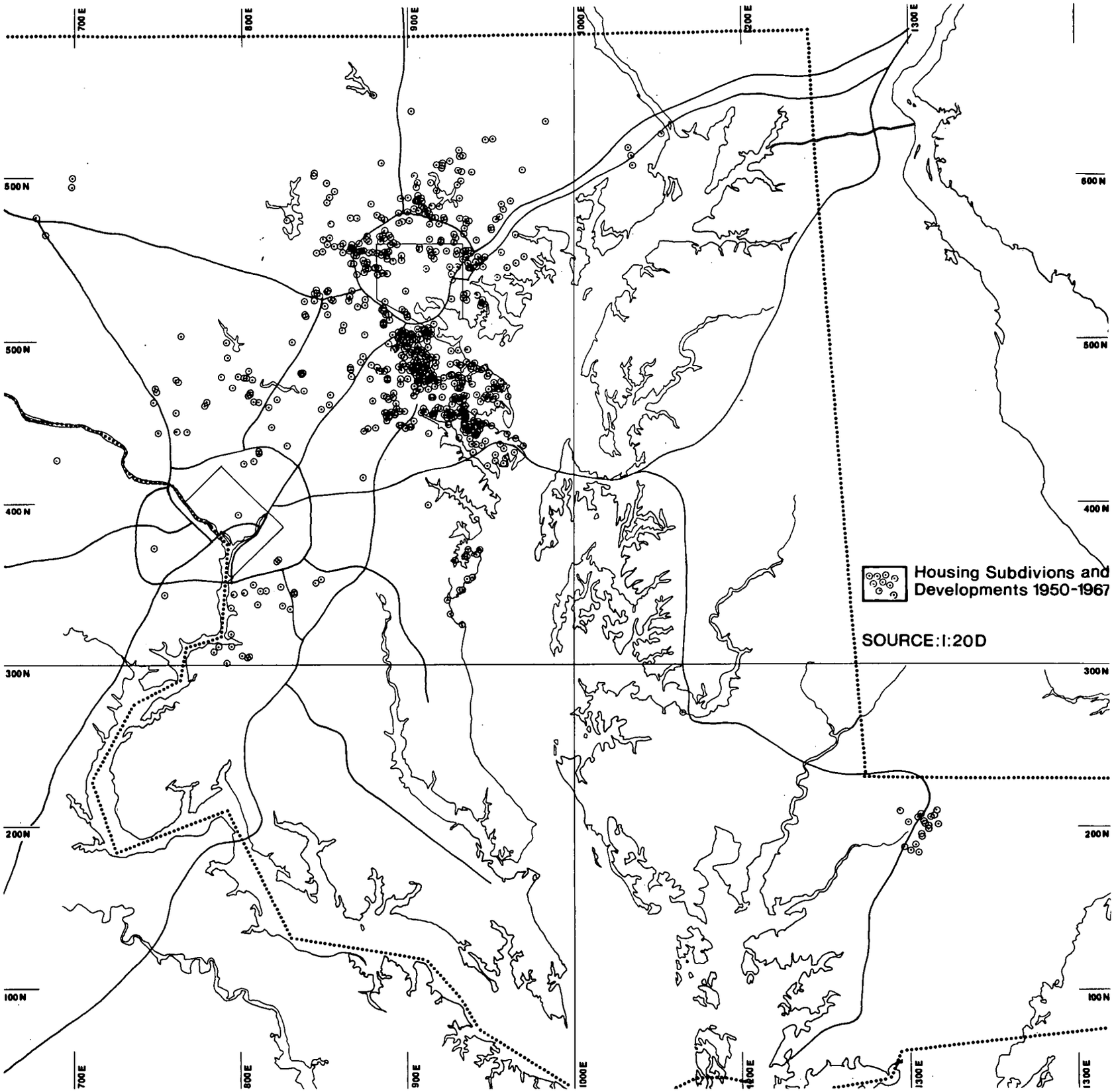
1.4 The Parties Affected

Present as well as prospective residents are the major parties affected by Bay problems with regard to shoreline residential development. The characteristics of prospective residents will vary according to whether year-round, vacation, or retirement residents are involved.

Another affected party is existing residents of low density development along the shoreline of peninsula areas. While more intensive residential development offers many potential benefits to present residents, the magnitude of the prospective change of familiar environments is likely to cause them considerable psychic costs.

A third category of affected party consists of people whose only access to the Bay shoreline is by public rights-of-way. Unless steps are taken to ensure that future residential development includes public access to the shoreline, present limits on public shoreline access are likely

PLATE 22: Housing Subdivisions and Developments 1950-1967



to become even more severe.

An indirectly affected party is the construction firm and its employees who might be employed to build the residences. In the metropolitan area of Baltimore, the same firms and employees will be involved whether the residential development is in the peninsula areas or elsewhere in the metropolis; on the eastern shore, residential construction may provide new jobs and economic activity, and the opportunity costs of development may be non-existent.

2 Future Dimensions of Waterfront Residential Development Problems

The Bay problem with regard to shoreline residential uses is how to realize the residential development potential of the shore but at the same time reduce adverse environmental effects associated with residential uses, avoid preemption of land which has major region-serving potential for industry or outdoor recreation, and achieve more access for more people to the Bay shore.

2.1 Forces Tending to Increase the Problem

a. Maryland's population is projected to continue to increase -- by 2 million persons between 1970 and the year 2000 -- and much of the increase can be expected to locate on or near the Bay shoreline. In the Baltimore Region, rough calculations indicate that the population of peninsula areas[2] will increase by 23,000 persons per year. If so, peninsula areas would absorb 65% of the projected population increase of the metropolitan area. By the year 2020, 1,140,000 persons may live in peninsula areas in the Baltimore Region.[3]

These residential development pressures in areas close to the Bay shore are reflective of at least two factors:

1. The expansion of the Baltimore metropolitan urbanized area has included many peninsula areas in the metropolitan housing market area;
2. Generally increasing affluence, leisure and mobility have combined to increase the importance of amenities and recreational opportunities in the house purchase decision -- which has increased the attractiveness of peninsula areas for home sites.

It is likely that a similar proportion of population increases in other counties bordering the Bay will locate in peninsula areas. If so, the population of peninsula areas in the Maryland Bay Region will increase by 27,000 persons per year, or by 810,000 persons between 1970 and the year 2000.

b. Population increase, however, is not the only cause of residential development pressure in shoreline areas of the Bay. Of major and increasing significance is the growth of the vacation housing market. Increasing affluence, water-related recreation demand (especially boating), and mobility (e.g. from the metropolitan areas on the western shore to the eastern shore) will result in greatly expanded use of shoreline areas for vacation residences. If, as recent data indicates, one housing start in 10 will be for vacation homes, if new housing starts in Maryland continue at the 1960-69 average annual rate (36,400 DU/yr.) (Ref.3) and if one-half of vacation homes built in Maryland are located on shoreline areas of the Bay, then vacation home construction on the Bay shore will proceed at a rate of 1800 dwelling units per year or 64,000 new dwelling units between 1970 and the year 2000.

c. Due to recent land development patterns, the increase in year-round and vacation residential development in Bay shoreline areas are forces tending to increase the problem of waterfront residential development as stated in the introduction to this section. Low density, relatively uncontrolled development has preempted long stretches of waterfront with a few houses and has, in the process, denied waterfront access to areas immediately inland. Also, the manner of development has frequently had severe environmental effects. Increased runoff to

the Bay and small streams (due to deforestation and hard surfaces) has increased erosion, sedimentation and clogging of natural stream channels and wetlands. With the increased runoff and with tapping of ground-water for domestic water supplies, aquifers near the Bay shore are sometimes inadequately recharged -- resulting in infiltration of saline Bay waters into aquifers. The inappropriate use of septic tanks has resulted in the discharge of inadequately treated wastewater into the Bay and its tributaries. These development patterns, by reducing the total development potential of peninsula areas, have made off-site sewerage systems uneconomic and have reduced the value of sites still available because of resulting water pollution. It is probable that if better residential development patterns prevailed, the pressure of year-round and vacation residential demand in shoreline areas could be a force tending to reduce the problem (so stated in the introduction) rather than a force tending to increase it.

d. The increase of conflicting Bay water and shoreline uses will tend to increase problems of realizing the residential development potential of peninsula areas. Chief among conflicting water uses is the use of the Bay for liquid and solid waste disposal. Certain recreational activities such as motor boating can conflict with shoreline residential uses. Shoreland uses which can conflict with residential development potential include some recreational uses (e.g., motor boating), the reservation or acquisition of areas for public access to the Bay shore, and industrial uses released from traditional locational determinants. Under unplanned, uncontrolled development conditions, these factors can become increasing threats to shoreline residential development potential.

2.2 Forces Tending to Reduce the Problem

a. New land development approaches (e.g. planned unit developments) can be applied to encourage residential development at higher densities with substantial areas reserved for open space and wildlife habitats and with provision for compatible uses (e.g. public access to the shoreline) and for high quality utilities service. In this manner scarce shoreline areas can serve more residents, unique opportunities of particular sites can be responded to, and provision can be made for compatible uses.

b. Systematic approaches for relating development to characteristics of the natural environment on a regional basis are being operationalized. In the Baltimore Region, the Regional Planning Council has analyzed land use capabilities on the basis of slopes, soil types and bedrock material.(Ref.4) This type of analysis can be used for multi-acreage assessment of land suitability.

c. Area-wide plans for shoreland use which balance the needs for residential development of shoreland against other objectives (development of waterfront industry, visual access to the Bay, public access to Bay-oriented open space and outdoor recreation, preservation of animal and aquatic habitats, etc.) could be developed and implemented.

d. New sewerage system techniques can be employed to serve residential development -- techniques which avoid the environmental dangers of septic tanks and the high costs of extending long sewerage lines down peninsula ridge lines.

e. Large tracts of military land (e.g., Edgewood Arsenal and Aberdeen Proving Grounds) could be released for other uses in the relatively near future. These areas should be planned for on a contingency basis so as to provide for the balanced needs of residential development, public open space and recreation, and other uses.

f. Renewal in waterfront areas can include high quality residential uses. Baltimore's Inner Harbor Project is an example.

2.3 Summary - Future Outlook

Very rough calculations indicate that residential development in peninsula areas will proceed at a rate of 9,000 year-round dwelling units and 2,000 vacation dwelling units per year. Most of the year-round dwelling units will be built on the fringes of urbanizing areas of the western shore. The vacation units will be built in areas of amenity on both shores of the Bay. It is not unreasonable to assume that 165,000 acres of Bay shoreland will be developed for residential use between 1970 and the year 2000.

But the issue cannot be adequately characterized in terms of the volume and acreage of residential development. Rather, the issue is residential development under what environmental conditions, at what densities, and in combination with what other uses. Present trends are discouraging in this regard. These indicate that future shoreline residential development will be poorly planned both at area-wide and site planning scales, that this development will preempt large stretches of shoreline for a fraction of potential demand, and that environmental values will suffer in the process. Action at the State level will probably be needed to reverse these trends.

3 Waterfront Residential Development: Goals, Objectives, Standards, Policies

3.1 Goal - Maximize Opportunity for Bay Waterfront Residential Development

The Bay is one of the most important reasons that Maryland is a "land of pleasant living". Maximizing residential development on the Bay cannot be considered in isolation of the potential impact of such development on the environment. Thus, even though the general goal procedure used thus far is to suggest maximization as a step toward explicating the need for tradeoffs with other goals, in this instance objectives for goal achievement must include those related to the environment.

3.2 Objectives

a. Adapt and apply an ecological planning method for identifying intrinsic suitability for all forms of development on the Bay's shores. Basic regional phenomena are examined in terms of processes, and data are represented as a model of an interacting system. Much of this will come out of field research in exploring the other goals and problems. The model constitutes the descriptions of the environment for interpretation and prediction of likely consequences to specific interventions.

The Baltimore Regional Planning Council currently has under way elements of this kind of analysis for that region but is not focusing on the shoreline nor involved in the whole Bay. (Ref. 4)

b. Classify sites intrinsically suitable for residential use by socio-economic criteria for development, based on nature of site, availability of utilities, goals of communities and housing demand and need.

c. When sites are already preempted by inappropriate development establish procedures whereby these can become non-conforming uses to be amortized and the sites made available.

3.3 Standards

Basic standards for residential developments are well established. What are not established are standards for environmental impact related to desirable residential environments. That is, development often sets in motion negative environmental consequences that in turn affect the quality of the development itself. This has been tragically true of many of the Bay's sub-estuaries.

These new standards will be for water quality, forestation, fish and wildlife, aquifer recharge, maximum runoff, etc., as well as visual amenity. The truly

great building sites along the Bay's edge can thus be protected and reserved for appropriate development.

3.4 Policies

County plans and policies are currently the key elements regarding whether maximum opportunities for waterfront housing are achieved. These plans generally reflect local goal aggregation and private owner aspirations, which together reduce to varying degrees the possibilities. Further, in most cases local zoning is not based on ecological considerations.

A major policy to be considered in achieving maximum residential opportunity can be the preparation of plans and their implementation by the Department of Economic and Community Development. The current State Development Pattern does not reach to the level of detail (e.g. subdivision) necessary to guide residential development location and characteristics in critical shoreline areas.

Further, formalized State environmental guidelines could be channeled to county governments for incorporation in local shoreline planning decisions. These guidelines could treat sediment control, visual modifications, provisions of public access, flood hazard, as well as the more traditional standards relating to setback, coverage and septic tank design.

Footnotes

1. The following discussion is based in part on the very useful analysis of shoreline residential land use in Ref. 1, pp. 67-83.
In addition, development of boating facilities in conjunction with waterfront residential development almost invariably puts severe pressure on marshlands, particularly on the Western Shore. Very often the most efficient means of acquiring deep water and adequate low, flat land is to dredge shallow bottoms and deposit the spoil on adjacent marshes.

2. Derived from projections by watersheds (Regional Planning Council): assumes 1/2 of Bush River and Back/Middle River watersheds in peninsula areas, 1/4 of Gunpowder Falls and Gwynn's Falls watersheds, 1/3 of Jones Falls and 1/10 of Patapsco River watersheds.

3. Derived from 2020 Population Projections for Alternate Regional Development Patterns, RPC, 1969, alternative I: Extension of policies implicit in the Suggested General Development Plan.

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II. PROBLEMS AND GOALS

L. SOLID WASTE DISPOSAL 187

1. Solid Waste Disposal Problems 187
1.1 Nature of the Problem 187
1.2 Major Causes 187
1.3 Location 188
1.4 Time Characteristics 188
1.5 Parties Affected 188

2. Future Dimensions of Solid Waste Disposal Problems 189
2.1 Forces Tending to Increase the Problem 189
Table 1: Annual Solid Waste Generation of Existing Population and Employment 190
Table 2: Annual Solid Waste Generation of Future Population and Employment: Assumes That Effective Policy Measures are Employed to Maintain the Rates of Solid Waste Generation Close to Present Levels 191
Table 3: Annual Solid Waste Generation of Future Population and Employment: Assumes That Rates of Solid Waste Generation Continue to Increase According to Current Trends 191
2.2 Forces Tending to Reduce the Problem 192
2.3 Summary - Future Outlook 193

3. Solid Waste Disposal Goals, Objectives, Standards, Policies 193
3.1 Goal 193
3.2 Objectives 193
3.3 Standards 194
3.4 Policies 194

L
Solid Waste Disposal

1 Solid Waste Disposal Problems

The problem is what to do with the mounting quantities of solid waste produced by people.

1.1 Nature of the Problem

In the Chesapeake Bay region, as elsewhere in the U.S., a growing urban population and economy is producing solid wastes of all kinds at increasing rates. "Solid wastes" are distinguished from liquid, thermal, and other types of wastes by the manner and form in which they are collected and disposed of. Most domestic garbage and refuse, office refuse and much industrial waste material are considered solid wastes. The categorization is not a rigid one, of course. The installation of garbage grinders, for instance, converts solid waste into liquid waste and transfers the burden of collection and disposal from the solid waste disposal system to the public sewerage system.

Each of the currently available disposal methods has a unique set of cost characteristics and side effects. Sanitary landfills involve the acquisition of land, which is increasingly costly in urban areas. Efforts to find cheaper urban land have sometimes led to the acquisition of wetlands for sanitary landfills -- and to subsequent ecological consequences. Sanitary landfill areas have potential for eventual recreation or amenity reuse, but these have generally failed to mollify nearby residents who must live with the landfill operation in the meantime. Incineration of solid wastes requires major capital costs and, in addition, can contribute to air pollution in urban areas. Measures to reduce the undesirable side effects of sanitary landfill and incineration methods of solid waste disposal generally increase their costs.

In addition, an increasing volume of solid waste material does not lend itself to traditional disposal methods. Toxic industrial wastes are not adequately treated by municipal sewage treatment plants. The residue from sewage treatment plants is not suitable for disposal by sanitary landfill.

1.2 Major Causes

There are several major causes of the increasing Bay problem with regard to solid waste disposal. One is the increasing volume of solid wastes produced by a growing urban population and economy. Estimates indicate that today each person will "generate" (throw away) about 6 lbs. of solid wastes. In 1920, a much smaller urban population produced solid wastes at a rate of less than 3 lbs. per day (Ref. 1).

A second cause of solid waste problems is the growing public awareness of the consequences of traditional methods of solid waste disposal. The techniques of solid waste management are very similar to what they were 25 years ago when the large municipal incinerator was introduced. "'Cities now pay from $10 to $30 a ton to collect and dispose of solid wastes, with the cost usually met through taxes on property.' Such assessments are not fair because they are 'almost wholly unrelated to the sources and volumes of refuse.'" (Ref. 2) Solid waste disposal consumes increasing proportions of municipal capital and operating budgets. Thus, solid waste disposal is an increasingly hot political issue.

Another cause is the growing volume of wastes which cannot be adequately disposed of by traditional methods. These are prime candidates for disposal by barging. A dramatic example is the U.S. Army's recent disposal of nerve gas off the North Carolina coast.

Still another cause relates simply to geography. The major source of solid waste generation is the Baltimore-Washington metropolitan area on the western shore of the Bay. This area is some 200 miles from the Atlantic Ocean. Thus, ocean disposal of solid wastes involves a major transportation cost component, which reduces its competitiveness vis-a-vis alternative disposal methods in the Chesapeake Bay region.

A final cause relates to the nature of the Bay -- its shallowness, its wetlands, its importance as an aquatic habitat, its recreational and amenity uses, etc. The Bay is already used for most disposal of dredging spoils from Bay waters. The ecological consequences of major additions of municipal solid wastes are not fully known but are potentially severe.

1.3 Location

Various portions of the Bay have different characteristics with regard to potential for solid waste disposal. The characteristics would include disposal cost, disposal capacity and ecological effects. An inventory of the Bay bottom vis a vis solid waste disposal potential would identify those areas which were least undesirable for this use. The possibility of the creation of islands such as Poole's Island can have good consequences.

1.4 Time Characteristics

The generation of solid wastes has few major seasonal characteristics which must be considered. Nor does the Bay itself have seasonal or other time characteristics affecting its assimilative capacity for disposal of solid wastes.

The major time characteristics affecting Bay problems regarding solid waste disposal, therefore, are trends -- almost all of which have a policy dimension:

a. The per capita rates and the per employee rates at which solid wastes are generated. . . and the effects of educational and recycling policies on the proportion of generated solid wastes which the public must find ways of disposing,

b. The proportion of total solid waste generation disposed of by alternative available methods. . . which implies cost-benefit analyses for comparison of alternative methods.

c. The impact of other uses of the Bay (e.g., recreation, marine transportation, sewage disposal) on its capacity for solid waste disposal use . . . and Bay management decisions affecting these aspects.

1.5 Parties Affected

A major category of parties affected by Bay management decisions regarding solid waste disposal are municipal taxpayers who must pay the monetary costs of public solid waste disposal. These costs are considerable now and they will increase in the future in response to the increasing complexity of the solid waste disposal problem in urbanized areas, and in response to policies which would include a larger portion of the environmental costs of waste disposal in the monetary costs which the taxpayer or consumer must pay.

A second major category of affected parties are persons impinged upon by the neighborhood effects of solid waste disposal facilities. These differ for different disposal methods and are differently evaluated by the persons affected. Adequate compensation of persons who must share their neighborhood with a sanitary landfill operation, for instance, would have the effect of transferring the additional burden to the broader population of taxpayers. Where the amount of the transfer can be accurately measured, it is desirable public policy that the transfer be made.

Still another category of affected party is persons whose jobs may be affected by solid waste disposal operations. Commercial fishermen, for example, may be affected

by ecological consequences of solid waste disposal in estuarine waters.

Recreational users of the Bay -- especially those engaging in water-contact sports and sport fishing -- are likely to be affected by solid waste disposal in the Bay.

2 Future Dimensions of Solid Waste Disposal Problems

The Chesapeake Bay problem with regard to solid waste disposal concerns the degree to which and the circumstances under which the Bay should or can be used for solid waste disposal.

The above problem statement focuses on the potential impact of solid waste disposal on the Chesapeake Bay rather than on solid waste disposal problems more generally. "Unlike gaseous and liquid wastes, which are regularly degraded by natural forces and/or assimilated by the natural environment, solid wastes degrade and compact only to a minor degree. Consequently, solid wastes accumulate. Since the land available for disposing of solid wastes within any given region is essentially fixed, there is an approximate limit to the capacity of the land to receive solid wastes. However, the amount of solid wastes which may be disposed of within the limited space available can be significantly altered in two ways: (1) by the methods used in the disposal system, i.e., incineration, compaction, recycling; and (2) by modifying the depth or height of the filling operation, i.e., contouring of final grade. Nevertheless, because of continuous accumulation, the most important consideration in the disposal of solid wastes is the amount of space available on and/or adjacent to the land in a region."(Ref.3) The potential impact of solid waste disposal problems on the Chesapeake Bay results from the fixed (or decreasing) supply of space available in the Maryland metropolitan areas.

2.1 Forces Tending to Increase the Problem

a. Population growth and economic growth would almost double solid waste generation in the Maryland Bay Region by the year 2000 even if rates of solid waste generation remained constant. Population is projected to increase by a factor of 1% between 1970 and the year 2000. The economy will also expand, though data in terms that relate directly to solid waste generation is not available.

b. The impact of population and economic growth on solid waste generation will be compounded by increases in rates of solid waste generation. Per capita rates of solid waste generation have been increasing for a long time and the likelihood is that they will continue to increase in the future. It is estimated that urban residents today produce solid wastes at a rate of about 6 lbs. per day. In the year 1980, the rate of solid waste generation per capita will be over 8 lbs. per day and in 2000 it may be over 10 lbs. per day.(Ref. 1) Rates of solid waste production by economic activities have also increased dramatically.

In all, generation of paper and paper products, garbage, demolition materials, cans, bottles, discarded furniture, debris from street sweepings and storm runoff, and abandoned vehicles has increased dramatically and is becoming a major public concern. The impact of the factors mentioned above on total solid waste generation in the Maryland Bay Region is indicated in Tables 1, 2, and 3. The calculations indicate that solid waste generation in the Maryland Bay Region may increase almost 4 times between 1960 and the year 2000 unless policy measures directed at reducing rates of solid waste generation are taken. In suburbanizing areas of the Maryland Bay Region, such as Montgomery and Prince George's Counties, the total solid waste generation may increase by over five times between 1960 and the year 2000.

c. The potential impact of solid waste generation on the Chesapeake Bay can begin to be seen in the rough calculations of landfill space needs required for disposal of

Table 1: ANNUAL SOLID WASTE GENERATION OF EXISTING POPULATION AND EMPLOYMENT

Existing Dimensions	1960 Pop.	Solid Waste Generation Per Capita[a]	Solid Waste Generation (Tons)
Baltimore Region	1,804,000	0.60 tons	1,090,000
Washington Metro Area	698,000	0.60 tons	420,000
Southern Maryland	111,000	0.60 tons	67,000
Eastern Shore Cecil County	244,000	0.60 tons	147,000

Existing Dimensions	1960 Employ.	Solid Waste Generation Per Capita[a]	Solid Waste Generation (Tons)
Baltimore Region	702,000	0.75 tons	528,000
Washington Metro Area	174,000	0.75 tons	131,000
Southern Maryland	23,000	0.75 tons	17,000
Eastern Shore	73,000	0.75 tons	55,000
Cecil County	14,000	0.75 tons	11,000

Existing Dimensions	Total Solid Waste Generation	Landfill Space Needs[b] @3.5 Cubic Yards/Ton [a](cu. yds.)
Baltimore Region	1,618,000	5,650,000
Washington Metro Area	551,000	1,931,000
Southern Maryland	84,000	294,000
Eastern Shore Cecil County	213,000	744,000
TOTAL	2,466,000	8,619,000

[a]Indexes from Ref. 3. (On a per capita basis, the rate of solid waste generation is about 5 lbs. per day.)

[b]Assumes no incineration, recycling.

Table 2: ANNUAL SOLID WASTE GENERATION OF FUTURE POPULATION AND EMPLOYMENT: ASSUMES THAT EFFECTIVE POLICY MEASURES ARE EMPLOYED TO MAINTAIN THE RATES OF SOLID WASTE GENERATION CLOSE TO PRESENT LEVELS

Projections Current Rates	2000 Pop.	Solid Waste Generation Per Capita[a]	Solid Waste Generation (Tons)
Baltimore Region	3,457,000	0.60 tons	2,080,000
Washington Metro Area	1,974,000	0.60 tons	1,190,000
Southern Maryland	220,000	0.60 tons	132,000
Eastern Shore Cecil County	408,000	0.60 tons	246,000

Projections Current Rates	1980 Employ.	Solid Waste Generation Per Capita[a]	Solid Waste Generation (Tons)
Baltimore Region	904,000	0.75 tons	678,000
Washington Metro Area	418,000	0.75 tons	314,000
Southern Maryland	38,000	0.75 tons	29,000
Eastern Shore	82,000	0.75 tons	62,000
Cecil County	18,000	0.75 tons	14,000

Projections Current Rates	Total Solid Waste Generation	Landfill Space Needs[b] @3.5 Cubic Yards/Ton [a](cu. yds.)
Baltimore Region	2,758,000	9,630,000
Washington Metro Area	1,504,000	5,260,000
Southern Maryland	161,000	562,000
Eastern Shore Cecil County	322,000	1,130,000
TOTAL	4,745,000	16,582,000 (+92%)

[a]Indexes from Ref. 3, pp. 90-94.

[b]Assumes no incineration, recycling.

Table 3: ANNUAL SOLID WASTE GENERATION OF FUTURE POPULATION AND EMPLOYMENT: ASSUMES THAT RATES OF SOLID WASTE GENERATION CONTINUE TO INCREASE ACCORDING TO CURRENT TRENDS

Projections, Trends	2000 Pop.	Solid Waste Generation Per Capita[a]	Solid Waste Generation (Tons)
Baltimore Region	3,457,000	1.15 tons	3,960,000
Washington Metro Area	1,974,000	1.15 tons	2,270,000
Southern Maryland	220,000	1.15 tons	252,000
Eastern Shore Cecil County	408,000	1.15 tons	468,000

Projections, Trends	1980 Employ.	Solid Waste Generation Per Capita	Solid Waste Generation (Tons)
Baltimore Region	904,000	1.50 tons	1,360,000
Washington Metro Area	418,000	1.50 tons	625,000
Southern Maryland	38,000	1.50 tons	57,000
Eastern Shore	82,000	1.50 tons	123,000
Cecil County	18,000	1.50 tons	27,000

Projections, Trends	Total Solid Wste Generation	Landfill Space Needs[b] @3.5 Cubic Yards/Ton [a](cu. yds.)
Baltimore Region	5,320,000	10,650,000
Washington Metro Area	2,895,000	10,170,000
Southern Maryland	309,000	1,820,000
Eastern Shore Cecil County	618,000	2,160,000
TOTAL	9,142,000	24,800,000 (+187%)

[a]Indexes from Ref. 3. On a per capita basis the rate of solid waste generation is about 8 1/2 lbs. per day

[b]Assumes no incineration, recycling.

solid waste (Tables 1, 2 and 3). These indicate that by the year 2000 the annual need for solid waste disposal sites in the Maryland Bay Region could be over 500 acres -- assuming landfills average 30 feet in depth.[1] Most of the solid waste generation creating this space need would be in metropolitan areas where vacant land is increasingly scarce and expensive. As land costs become an increasingly significant factor in solid waste disposal, and as local community opposition to proposed landfill sites becomes more intense, the Bay may become increasingly attractive as a site for solid waste disposal. In the Maryland Bay Region, the Bay has the added attraction that it is closer to metropolitan areas than alternative disposal sites in the ocean or in non-metropolitan areas. Thus Bay sites for solid waste disposal might offer low transportation costs in comparison to other available alternatives.

d. The increasing amount of toxic or non-degradable material in solid wastes will compound the environmental effects of solid wastes disposed of in Bay sites.

e. The increasing use of the Bay for other purposes -- e.g. marine transportation (with its own spoil disposal requirements), water-related recreation, etc. -- will result in increasing conflicts with proposals for solid waste disposal in the Bay.

2.2 Forces Tending to Reduce the Problem

a. Policies which have the effect of reducing the rates (or rates of increase) of solid waste generation in modern economies would help to reduce future pressures for use of Bay sites for solid waste disposal. Such policies could be directed at reducing per capita or per unit of production rates of solid waste generation or at recycling wastes that are generated. Such policies are being considered, but, for various reasons - political and economic - have had little practical effect so far. A special shoreline pollution subcommittee of the Maryland General Assembly Legislative Council recently "considered it inadvisable to take action on the basic issues of taxing containers and recycling processes without further study and deliberation."(Ref.4) The application of ideas for recycling has been limited, because the cost of separating valuable products from waste has not been worth the effort. (Ref.1) Recycled steel is awkward to process and thus has a value of only $20 per ton. Waste paper, which comprises a large proportion of total solid wastes generated, has an even lower recycled value. Recycled aluminum cans are worth $200 a ton, but they comprise a relatively small proportion of solid wastes. Effective policies for recycling will probably require national legislation and implementation.

Another proposal is a "one cent per pound tax. . .on manufactured goods and their packaging to provide funds for their disposal. . . (the tax) would be applied to any item requiring disposal within 10 years -- such as packaging, glassware, clothing, refrigerators, bedding, washing machines, television sets and automobiles."(Ref. 2)

However, policies to reduce the volume of solid wastes requiring disposal may very well gain momentum in the future.

b. Policies to improve the efficiency of solid waste disposal methods which are alternatives to disposal in estuarine waters would also help reduce pressure for use of Bay sites for solid waste disposal. High temperature incineration, ocean barging, and transportation to strip mines and quarries far away from metropolitan areas are examples of alternative disposal methods now being considered or developed.(Ref.5)

Giant high-temperature incinerators are already feasible from economic and engineering standpoints. Such plants may also be designed so as to provide the substantial additional benefit of generating large amounts of electric power, while producing less air pollution than comparable coal or oil fueled generating plants. (Such an

incinerator is being planned for the Hackensack Meadows of northern New Jersey. It will handle 6,000 tons of refuse a day - the output of 2 million people - and will be capable of producing 150,000 kilowatts of electric power. (Ref.6)

c. Research into the effects of solid waste disposal in Bay sites can provide better assessments of the environmental effects of such actions. The research program could be modeled on the current one with regard to the discharge of thermal wastes into Bay waters at various locations and under particular conditions. (Ref.7)

2.3 Summary - Future Outlook

The amount of solid wastes generated in the Maryland Bay Region will increase rapidly. The difficulty of finding space for landfill disposal will continue to increase -- especially in metropolitan areas. These factors, in combination with the cost of transporting solid wastes over long distances, will result in increasing pressure for the use of Bay sites for solid waste disposal. With regard to such proposals, the changing composition of solid wastes and the increase in conflicting Bay uses will exacerbate disposal problems.

3 Solid Waste Disposal: Goals, Objectives, Standards, Policies

3.1 Goal: Provide for Necessary Solid Waste Disposal in the Bay

A first distinction is made for purposes of viewing the Bay as a resource for solid waste disposal. It is assumed that for most solid waste disposal -- garbage, sewage sludge, trash, and mineral wastes -- the Bay does not now represent a prime target. Collection and transportation to available landfill locations account for about 80% of disposal costs, which effectively inhibits major use of the Bay for most solid wastes at the present time. (Ref. 8)

However, dredging spoil is a necessary by-product of channel and anchorage maintenance and enlargement and of port development, and the Bay is currently the most important (indeed, almost the only feasible) resource for disposal. An example is the deepening of the Baltimore Harbor channel where five contained disposal areas are to accomodate 88 million cubic yards of spoil. Hence, this section concentrates somewhat on dredging spoil as the predominant demand for solid waste disposal in the Bay itself.

3.2 Objectives

a. Establish a monitoring system for surveillance of Bay solid waste disposal.

b. Identify solid waste disposal (including spoils) requirements for achievement of goals for marine transportation, waterfront development and recreation. This will give dimension and location to future disposal activity, comparable to that for the Baltimore Harbor Study. (Ref. 9)

c. Explore most economically feasible spoil and solid waste disposal sites for future disposal requirements. Economically feasible sites may be environmentally damaging, but the costs of the trade-offs must be ascertained.

d. Determine characteristics of spoil to be displaced. The character of spoil makes a major difference in its environmental acceptability. Spoil from the Baltimore Inner Harbor had too high a mercury, zinc and BOD content to allow dumping at Poole's Island.

e. Determine all locations for spoil deposit that would be consistent with goals for recreation and waterfront development. Recreation goals can often be achieved by economic spoil disposal to create beaches and islands.

f. Determine all locations for

spoil and other solid waste disposal that would be consistent with or neutral to goals for living resources, wetlands and water movement.

g. Prepare a long-range solid waste disposal management plan for the Bay.

3.3 Standards

Standards for solid waste disposal generally must be set for maximum limits on volume, rates and percentages for recycling and reutilization, etc. These then will be guidelines for industry and municpalities to make it uneconomic to be wasteful.[2]

For spoil disposal, the EPA has set maximum acceptable limits on chemical (and other) content of spoil to be deposited in the Bay. These are based at present on concern for human health rather than aquatic habitats. Research is now underway which will ultimately produce measures of impact traceable to changes in habitats due to spoil deposit.

The U. S. Corps of Engineers hydraulic model of the Bay will be of major importance in tracing effects of alternate spoil deposit on water movement.

3.4 Policies

Except for dredging spoil from the Bay, solid wastes are generally unacceptable for deposit in the Bay at the present time. The Maryland Wetlands Bill and previous legislation gives the Department of Public Works and others such as Water Resources control over all dumping and filling in the Bay. Current surveillance methods should be increased to meet the above objectives.

Costs of the policies involved in carrying out the objectives need to be determined as inputs to the planning, programming, budgeting system approach to Bay planning and managagement.

Footnotes

1. This figure is twice the depth of many existing landfills.

2. For example, Maryland already imposes a $5 charge every six months on all junked vehicles over seven years of age, held six months or longer in a wrecker's yard.

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II. PROBLEMS AND GOALS

M. PUBLIC ACCESS TO AND APPEARANCE AND DESIGN OF SHORELINE 197

1. Shoreline Access and Appearance Problems 197
1.1 Nature of the Problem 197
1.2 Causes of the Problems 197
1.3 Location 197
Plate 23: Shoreline Ownership and Major Use 198
1.4 Parties Affected 197
1.5 Time Characteristics 199

2. Future Dimensions of Shoreline Access and Appearance Problems 199
2.1 Forces Tending to Increase the Problem 199
2.2 Forces Tending to Reduce the Problem 199
2.3 Summary - Future Outlook 200

3. Shoreline Access and Appearance Goals, Objectives, Standards, Policies 200
3.1 Goal 200
3.2 Objectives 200
3.3 Standards 200
3.4 Policies 201

M

Public Access to and Appearance and Design of Shoreline

1 Shoreline Access and Appearance Problems

The problem is how to make the Bay's shoreline accessible and observable by the general public.

1.1 Nature of the Problem

The general public has remarkably little access to the Chesapeake Bay shoreline. In part, this situation stems from the geography of the Bay. Major roads have been built inland where expensive crossings of sub-estuaries feeding the Bay were not necessary. In part, the lack of public access is due to the extensiveness of private uses of shoreline areas. Only some 3% is publicly owned and accessible. Some of the privately owned land is industrial and in institutional use but by far the major portion is low density residential.[2]

In part, the lack of public access is due to public actions or inactions. Large stretches of the Western shoreline of the Bay are preempted by military reservations, mostly for testing operations (e.g., Aberdeen Proving Grounds and Edgewater Arsenal). State and local governments either have not tried or not been able to reserve shoreline areas for park and recreational areas.

As a result, there are very few places where the general public can conveniently appreciate the major amenity and geographic features of the Bay area - i.e., the Bay itself. Views from Federal Hill and Fort McHenry, in Baltimore, the Chesapeake Bay and Susquehanna River Bridges, and the waterfronts of some of the old towns along the Bay (Annapolis, St. Michaels, etc.) are among the few opportunities.

Many Bay area residents go about their normal activities for months without any awareness that the Bay is there at all. They are often surprised to learn of the importance of the Port of Baltimore in the Maryland economy, are unresponsive to the pleas for conservation of wetlands, or choose the ocean shore even though the recreation resources of the Bay are practically in their backyards.

1.2 Causes of the Problems

Under pressure from market demands, local government has responded by zoning the shoreline for private and low-intensity uses. There is little shoreline suitable (reportedly less than 1% in a natural state) for beaches. The latter is a natural cause.

Furthermore, most trends indicate that the situation will get worse rather than better. Private residential development for vacation and year-round use will put pressure on remaining vacant shoreline areas. It is difficult and expensive to reclaim obsolete industrial areas (e.g., Baltimore's Inner Harbor) for public recreational shoreline access. Local governments are increasingly hard pressed to provide basic services and have insufficient funds to acquire needed shoreline land.

1.3 Location

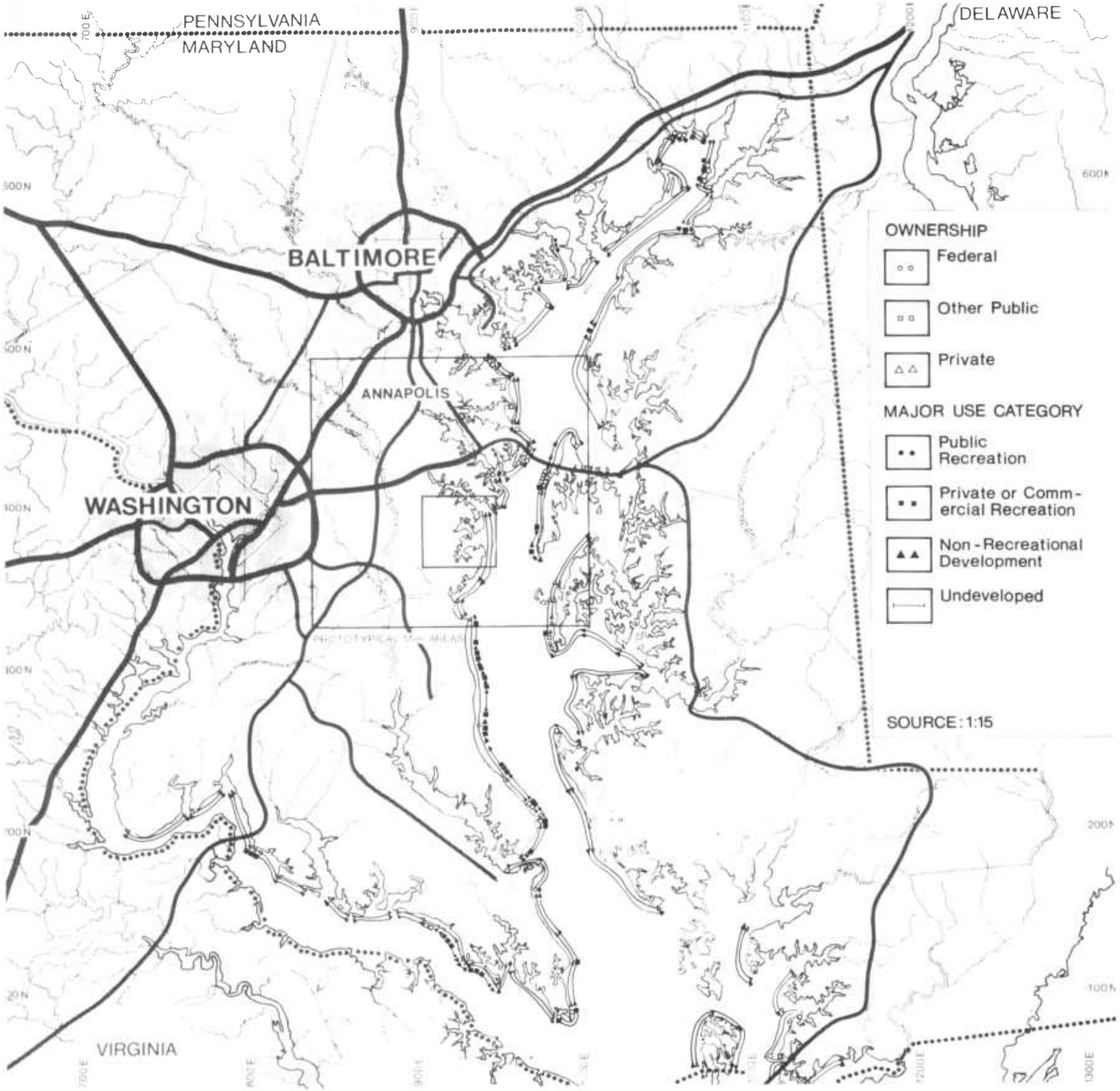
The problem of public shoreline access is most severe on the Western shore of the Bay where most of the public which would benefit from such access lives. It is also on the Western shore that the most dramatic possibilities and proposals for providing public access to the Bay exist: e.g., reuse of part of the Aberdeen Proving Ground/Edgewood Arsenal for public shoreline access; the major park proposals for the Susquehanna River and Patuxent River; development of public vista points in the Baltimore Harbor; public parkland acquisition programs such as that now underway by Baltimore County. (See Plate 23).

Access to the water itself is being increasingly provided by means of marina facilities; however, the availability of adequate parking, highway access, and other commercial back-up facilities for marinas is an increasing problem.

1.4 Parties Affected

The major party affected by Bay

PLATE 23: Shoreline Ownership and Land Use



problems with regard to public shoreline access are citizens who are either too poor to purchase private shoreline access (e.g., shoreline vacation homes, yacht club facilities and marinas) or are likely to be preempted from private shoreline access by those who got there first. As remaining vacant shoreland is turned over to development and as the price of shore frontage increases, this means practically everybody - perhaps 90% of the urban population.

Further intensive use of the shoreline affects citizens who are already using the shore. Many of the present residents of low density shoreline areas whose vacation environment will be adversely affected have an interest in preventing an influx of public Bay shoreline users.

The growing tourist services industry is also affected. Better public access to the Bay can be expected to assist in the expansion of tourism in Maryland.

1.5 Time Characteristics

The problem has increased dramatically in the last ten years with the rapid growth and approach of Baltimore-Washington urbanization. These two metropolitan areas together are among the fastest growing in the nation.

2 Future Dimensions of Shoreline Access and Appearance Problems

The Bay problem is how to provide increased access to the shore for the general public while at the same time making appropriately located shoreline areas available to private and institutional uses which have a legitimate need for them.

2.1 Forces Tending to Increase the Problem

a. Demand for low intensity private residential development for vacation and year-round use will put pressure on the remaining vacant shoreline areas. Parcelization of these tracts will effectively preempt conversion for publicly-oriented uses in the future.

b. It is increasingly difficult and expensive to reclaim obsolete waterfront development areas for public recreational shoreline access. Local governments are increasingly hard-pressed to provide basic services and have sufficient funds to acquire needed shoreline land.

c. The increasing amount of debris generated by modern industrial economy, in combination with the increasing expense and difficulty of collecting and disposing of these materials, will result in increasing amounts of debris conveyed in storm runoff and stream flows, which will collect along the Bay shoreline and further damage its appearance.

d. The demand for some forms of public access to the shoreline (e.g., marinas) often creates problems in the appearance of the shoreline and in water pollution.

2.2 Forces Tending to Reduce the Problem

a. More comprehensively planned and intensive use of shoreline areas (see Sections J "Waterfront Industry", K "Waterfront Residential Development") can conceivably absorb much of the demand for private shoreline access, thereby reducing development pressures elsewhere along the shoreline and easing problems of providing Bay shoreline access for the general public.

b. Policies to encourage institutional, industrial, and commercial uses which have shoreline frontage to make provision for public access. Such policies can provide access for the general public in areas where there would otherwise be none. Steps in this direction have been made by several major shoreline-using institutions.

c. Increasing public initiatives to take direct responsibility for providing public shoreline access -- through acquisition of vacant shoreline land, reuse or renewal -- would, of course, help reduce the problem. The Baltimore County park acquisition program is capable of wider application in Bay-shore counties. Use of public powers to help

transform obsolete industrial areas to provide public shoreline access (as well as other renewal uses) is being started in Baltimore's Inner Harbor. Planned reuse of public land for public shoreline access (e.g., the Aberdeen/Edgewood Proposals) is a variation of the same approach.

d. Maximum feasible public access to the water's edge should be included in the planning and design of all new developments -- whether industrial, commercial, or residential. Public policies (e.g., tax credits, cost-sharing) should be adopted which encourage waterfront companies to include such access wherever neither their operations nor the public welfare or safety would be endangered.

e. Visual access to the Bay and a total, ecological approach to route selection should be made an integral part of highway and bridge alignment and design.

Other aspects of design of the water's edge are equally as important as highway access. Examples of principles to be followed are described in the San Francisco Bay Plan Supplement (Ref.1) and the Potomac Report (Ref. 2).

2.3 Summary - Future Outlook

"Present trends continued" indicate that the problems of public shoreline access and shoreline appearance will increase in the future. Private demands for shoreline land will receive priority over public access needs (which have a significant latent component). As remaining possibilities for developing public access dwindle (especially in urbanized areas) the difficulties of meeting public needs will increase. As growing public shoreline access demands are increasingly focused on a few limited areas, the appearance and quality of these areas will decline.

Active pursuit of a variety of approaches to the provision of public shoreline access could reverse present trends in this area. However, difficulties of maintaining the appearance of the shoreline are likely to increase.

3 Shoreline Access and Appearance: Goals, Objectives, Standards, Policies

3.1 Goal - Maximize Public Access to the Bay, and Enhance the Appearance and Design of the Shoreline

Consideration of this goal divides between objectives of making the Bay more accessible, perceived and enjoyed, and standards and principles for improving its appearance and the quality of the environment.

3.2 Objectives

a. Develop a socio-economic and ecological classification system for the Bay's edge (water and land) that takes into account: urban-rural; ownership; type of area by slope, soils, vegetation, wildlife and aquatic habitat, aspect, water quality, movement and depth, appearance, appropriateness of and latent demand for access, etc.

b. Inventory all aspects of Bay shore and apply the classification system. This inventory should be carried out for the entire Bay and its results incorporated into a Bay Information System.

c. Establish specific plans for maximizing access to the Bay's edge from both water and land that are based on ecologically sensitive criteria. Where appropriate land is in private ownership, the use of public easements and acquisition of hunting and fishing rights may be considered.

3.3 Standards

Standards for amount of access and quality of appearance and design must at present be arbitrary and comparative.

In the face of the really limited access today, it is not appropriate to establish standards for access based on population and type of area until the inventory and classification outlines in Objectives a,b, and c are completed.

3.4 Policies

However, policies that can be adopted as design principles and that will, if followed, lead toward goal achievement, can be described. The currently appropriate level of government for their adoption and implementation is the county.

a. "Build shoreline development in clusters (leaving more open area around them) to increase the amount of shoreline accessible to the public and to permit more frequent views of the Bay.

b. "Include in every new development maximum opportunity for pedestrian access to the waterfront.

c. "Provide public access into natural areas...(on a controlled basis).

d. "Design any permitted fills to produce a net increase in amount of shoreline...for additional public access.

e. "Design roadways near the edge of the water as scenic parkways, discouraging thru traffic and encouraging safe pedestrian access.

f. "Design...bridges to permit maximum viewing of the bay.

g. "Design towers, bridges or other structures near or over the Bay as landmarks that suggest where the waterfront is...

h. "Design developments near the mouths of (subestuaries) to preserve the view of the juncture of the (subestuary) with the Bay as far upstream as the alignment of the waterway will permit..."(Ref.1)

i. Take advantage of opportunities for public water transportation on the Bay.

j. Negotiate with institutional and public agency land owners to make the water's edge publicly available.

k. Establish a design review system and review board to evaluate all development adjacent to the Bay and make recommendations to the appropriate decision-body for improvement.

Footnotes

1. A useful review of shoreline utilization characteristics in the Baltimore Region can be found in Ref. 4.

2. Section K, above, discusses how shoreline areas could be used more intensively for residential use, and how this objective could be compatible rather than in conflict with environmental goals.

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II. PROBLEMS AND GOALS

N. NON-LIVING RESOURCES - SAND AND GRAVEL 203

1. Non-Living Resources Problems 203
1.1 Nature of the Problem 203
1.2 Major Causes 203
1.3 Location 203
Plate 24: Surface Geology 204
1.4 Time Characteristics 205
1.5 Parties Affected 205

2. Future Dimensions of Non-Living Resources Problems 205
2.1 Forces Tending to Increase the Problem 205
2.2 Forces Tending to Reduce the Problem 205
2.3 Summary - Future Outlook 206

3. Non-Living Resources Goals, Objectives, Standards, Policies 206
3.1 Goal 206
3.2 Objectives 207
3.3 Standards 207
3.4 Policies 207

N

Non-Living Resources — Sand and Gravel

1 Non-Living Resources Problems

The problem is how to provide sand and gravel economically to meet the need.

1.1 Nature of the Problem

As the resource base for oil, gas and various metals is limited in the Chesapeake Bay area, the major non-living natural resource[1] extracted is sand and gravel.(Ref.1) Sand and gravel are used in constructing highways and the manufacture of construction materials. The demand for sand and gravel is thus closely associated with areas of urban development. As transportation makes up a significant portion of the final cost of these materials, there is a strong economic incentive to develop sources of sand and gravel supply close to the points of demand in urban areas.

Extraction of sand and gravel from on-land sites can cause a number of detrimental environmental effects. The open pit extraction technique can create erosion problems.[2] The washing of gravel can increase siltation of streams. The extraction and hauling activities can create dust and noise bothersome to nearby residents. Often no provisions are made for reuse of the pit after extraction is completed, and it remains an eyesore on increasingly valuable urban land.

Extraction of sand and gravel from streams, subestuaries and shallow Bay waters can cause even more environmental damage. Changes in the Bay bottom topography can cause changes in water currents which can affect erosion-accretion patterns. Silt from dredging operations can affect the turbidity of the water which can affect wetlands, aquatic life and wildfowl. A recent example is at Mattawoman Creek where the Potomac Sand and Gravel Company has a permit to conduct dredging operations which will damage fish and wildlife.(Ref.2)

1.2 Major Causes

One major cause of the problem is the pace of urban development which maintains the demand for sand and gravel at a high level. New or expanded demands for these resources -- such as the development and maintenance of everything from highways to sand beaches along the Bay shore -- would increase total demand and the pressure for extraction from the Bay itself as well as adjacent land sources.

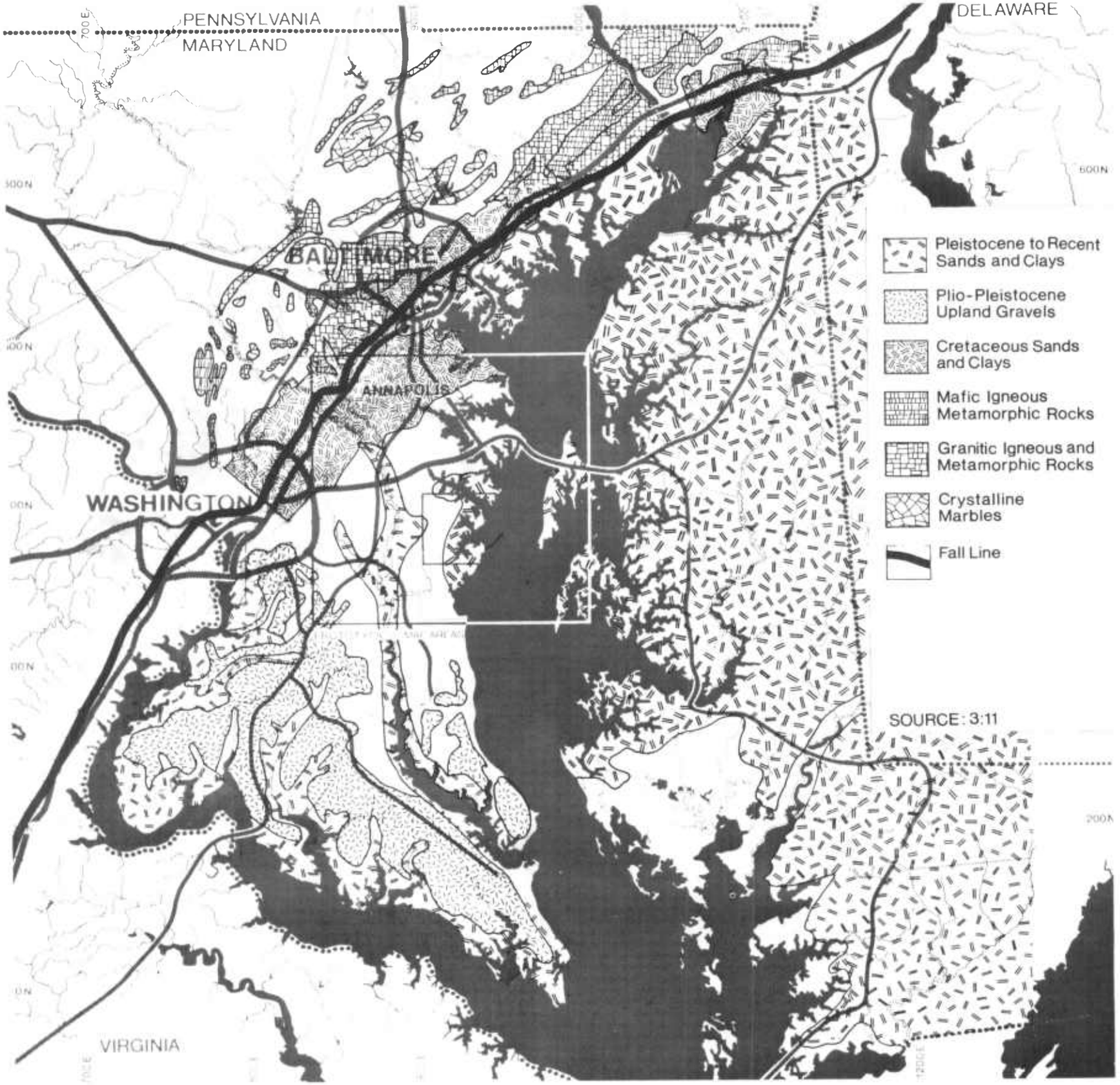
Another major cause of the problem is the increasing concern of residents for the environmental consequences of extractive activity. This concern has placed greater constraints on extractive activities on land in many residential areas around the Bay that may result in increased pressure on the Bay as a substitute source of these materials.

A possible cause is the depletion of the sand and gravel resource base in the Chesapeake Bay area and the improbability of developing economical substitutes for sand and gravel in highway and urban construction. A final cause is the improving technology of dredging which will make extraction from the Bay -- even in relatively deep waters -- increasingly competitive with on-land extraction.

1.3 Location

The areas of urban development on the western shore of the Bay are the major (although not the only) locations of demand for sand and gravel. There appear to be sufficient deposits of sand and gravel in these areas. Much of the Bay bottom is clayey silt. However, there are relatively small deposits of sand off the western and eastern shores -- especially in the area of the Bay off Dorchester and Somerset Counties (see Plates 7, 24).

PLATE 24: Surface Geology



1.4 Time Characteristics

Firms extracting sand and gravel tend to acquire sources in advance of their view of demand. However, they are in a race with urbanization and are always constrained by transportation costs.

1.5 Parties Affected

Managers and employees of the construction industry are one category of party affected by problems with regard to sand and gravel extraction. Increased costs of extracting and transporting sand and gravel will most directly affect this industry, and insofar as these costs rise, they will be passed on to the customer.

Residents in the immediate vicinity of on-land extractive activities are another category of affected party. Their concern over the environmental (and land value) effects of extraction in their neighborhoods is one force for increased use of the Bay for extraction of sand and gravel.

Recreational users can be affected positively or negatively by extraction activities. The use of sand for beach development can obviously create recreational benefits. On the other hand, sport-fishing and shellfish areas can be adversely affected, directly or indirectly by the change in wetlands or Bay hydrology. Participants in water contact recreation can be adversely affected by increases in turbidity associated with off-shore extraction.

2 Future Dimensions of Non-Living Resources Problems

The Bay problem with regard to sand and gravel extraction is to provide adequate sources of sand and gravel close enough to areas of urban development while at the same time minimizing conflicts with other land and water uses, minimizing damaging environmental effects and making provisions for appropriate reuse.

2.1 Forces Tending to Increase the Problem

a. The pace of urban development will maintain the demand for sand and gravel at a high level. This is true in spite of recent trends showing decreasing total production of sand and gravel in Maryland. (Between 1966 and 1967 sand and gravel production dropped 9%.) (Ref.3) Continued urbanization on the Western Shore will involve the development of everything from highways to sand beaches along the Bay shore. Since there is no ready substitute for sand and gravel in many construction activities, total demand for these resources may increase. Increasing total demand may create increasing pressures for extraction of sand and gravel from the Bay bottom as well as from on-land sources.

b. Increasing community reaction to the negative environmental effects of sand and gravel extraction from on-land sources, in combination with an increasing scarcity of on-land sources within metropolitan areas which do not generate such reactions, will place greater constraints on extractive activities from land sites and result in increased pressure on the Bay as a substitute source of these materials.

c. The improving technology of dredging will make extraction from the Bay increasingly competitive with on-land extraction.

2.2 Forces Tending to Reduce the Problem

a. Several measures can reduce the adverse aesthetic and environmental effects of sand and gravel extraction on land. Such measures will generally increase costs, nevertheless their adoption should be encouraged, for the economic costs of developing more remote alternative sites would probably be higher, while environmental costs would probably be unchanged.

b. Better planning can result in a range of reuses of extraction pits.

The preparation of the site for reuse will involve increased development costs; however, the increased value of urban land and the scarcity of large development sites in metropolitan areas will more often than not make such investments worthwhile. (Ref. 4)

c. It is possible that extraction of sand and gravel from the Bay bottom can increasingly substitute for on-shore sources of these materials. Research into the hydrology of the Bay and the environmental effects of dredging operations and care in the planning and design of such extraction programs may minimize detrimental environmental effects and even achieve ecologically beneficial results. (Ref. 5)

d. Development of marine transportation technology can make possible more economic transportation of sand and gravel from non-metropolitan extraction sites to metropolitan sources of demand.

2.3 Summary -- Future Outlook

Information which indicates the proportions of total Maryland sand and gravel extraction which comes from metropolitan, non-metropolitan or Bay bottom sites is not available. However, the indications are that extraction from the Bay bottom is currently a small proportion of total extraction activity. Total marine freight traffic in sand and gravel in 1969 was about 50,000 short tons. (Ref. 6) Half of this was directed to Wicomico River port facilities, 18% to Nanticoke River port facilities, 4% through Choptank River facilities and 28% through Baltimore Harbor facilities. Even if all or a large proportion of the marine freight traffic in sand and gravel consisted of material dredged from the Bay bottom, it would account for only 0.5% of total sand and gravel extraction in Maryland.

There are two possible conclusions from the above discussion. One is that the extraction of non-living resources from the Bay is a minor problem and is likely to remain so because of the difficulty and expense of conducting such operations. Spoil dredging, as a form of extraction, is a much larger problem with more serious environmental impacts. Considering the small scale of extraction from the Bay bottom, the washing of sand and gravel extracted from on-land sites poses more serious water quality problems for the Bay than does extraction from the Bay bottom itself. The other conclusion is that, even at low current levels, extraction of sand and gravel from the Bay bottom has significant environmental consequences, and that a minor shift in the total State extraction activity could have major effects.

3 Non-Living Resources: Goals, Objectives, Standards, Policies

3.1 Goal -- Take Maximum Advantage of the Bay's Non-Living Resources

The distinction between non-living and living resources is becoming a fine one, but water, oyster shells and sand and gravel are the Bay's major non-living resources.

Recent controversy about applications for permission to remove sand and gravel from Mattawoman Creek and the Potomac point up these non-living resources' value. The applicants intend to remove 10 million tons thereby eliminating 200 acres of state-owned and undesignated amount of private marsh. (Ref. 2) They claim to supply over 80% of the sand and gravel used in Washington, D. C. and stated that the price in the District would rise significantly if their proposed operation were not permitted. In a similar application, 5 million tons were to be dredged from the Potomac at Craney's Island. Both areas were environmentally very sensitive.

Therefore, it can be concluded that the resource is valuable but in

most cases its exploitation has serious ecological consequences.

3.2 Objectives

a. Inventory all commercially valuable deposits of sand and gravel in the Bay. These deposits are becoming more valuable as land sources are used up or become unavailable because of urbanization.

b. Develop a State sand and gravel extraction plan. This plan should utilize the regional input-output accounts methodology to trace the effects of alternate locations and rates of extraction on prices -- with differences introduced into models for economic-ecological tradeoffs.

3.3 Standards

As in standards for marine transportation, an important consideration of goals for non-living resources of the Bay is their role in the regional economy as measured by the regional accounts model mentioned above. Considerable research will be necessary to determine the value of the Bay resource and the relative scarcity of sand and gravel from other sources, before "performance" standards can be set for extraction from the Bay.

3.4 Policies

In the absence of such a plan and standards, State policy regarding non-living resources extraction from the Bay must continue to be ad hoc and pragmatic.

Footnotes

1. Rock for construction is a major resource, but except in isolated circumstances its extraction is not a Bay problem. Oyster shells are in a sense a non-living resource of fertilizer, chicken feed and lime industries. However, this is a rather fine distinction and the relevant problem is oysters so it is considered under that heading.

Other non-living resource extraction is possible but appears unlikely.

2. It can also provide sites for subsequent use for sanitary landfill operations.

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II. PROBLEMS AND GOALS

0. INFORMATION AND INFORMATION RETRIEVAL 210

1. Information and Information Retrieval Problems 210
1.1 Nature of the Problem 210
Table 1: General Status of Information on Waste Discharges for Waste Emission Rates and Characteristics 211
Table 2: General Status of Information on Waste Discharges for Waste Reactions in the Environment 211
1.2 Current Efforts Toward an Information System 211

2. Future Dimensions of Information and Information Retrieval Problems 212

3. Information and Information Retrieval Goals, Objectives, Standards, Policies 212
3.1 Goal 212
3.2 Objectives 212
3.3 Standards 213
3.4 Policies 213

O

Information and Information Retrieval

1 Information and Information Retrieval Problems

The information problem is how to make both existing information as well as that which is produced by research and monitoring available in forms and at times that are relevant to policy and decision processes regarding Bay management.

1.1 Nature of the Problem

a. Information relevant to Chesapeake Bay management is produced by many different agencies -- federal, state, local and private -- and in many different forms. Much information is produced as a by-product of on-going regulatory activities. Other information is produced by special studies. If all the information were assembled, it would fill a library of its own. It is, however, neither assembled nor synthesized. Part of the problem is that people who do research and produce information have in the past pursued relatively narrow objectives. As a consequence, while much information exists, it is not readily in a form that lends itself to decisions. An example is information relevant to the conservation of wetlands. Much is known about the role wetlands play in nature. But the questions decision-makers faced with conflicting demands ask are: are all wetlands necessary?; are some more important than others to aquatic life?; if aquaculture begins on a broad scale, will wetlands be as crucial as they are reported to be now?; and so on.

b. In the field of ecological planning one of the most distressing, yet promising circumstances is that the bulk of necessary data is likely to be available in reports and studies by the Weather Service,the U.S. Geological Survey, the Soil Conservation Service, the Forest Service, Fish and Wildlife Service, their State counterparts and studies conducted by university departments and faculty. Much data is available, but it is rarely being adequately employed. The ecological view promises that this data can be collected, integrated, and interpreted for its relevance to the planning process. However, it is only recently beginning to make good on these promises.

On the other hand, in the realm of socio-economic planning, available information is likely to be employed but the competitive nature of planners as "advocates" and the disparity in planning competence and emphasis in different units of government often tends to vitiate its value. More importantly, rarely has ecological data been synthesized with socio-economic information to produce a comprehensive planning process. Yet one without the other represents a profoundly inadequate basis for planning. Open space alternatives are one of the results of socio-economic and ecological planning.

c. "It is difficult to outline concisely the significant facets of a subject as diffuse as monitoring which includes evaluation of the sources and characteristics of wastes, measurement and recording of concentration levels of waste constituents in the receiving waters, and evaluation of environmental parameters. It is possible, however, to divide the overall problem into two parts:

1. Identifying the quantities and characteristics of the waste materials emitted by a particular type of waste generating activity.
2. Assessing the information available on the reactions and interactions of waste materials in the environment, and on the processes that alter their concentration profiles with time...

"Table 1 lists the status of available information on waste sources and discharges, and indicates the areas where the information is generally adequate or inadequate. Similarly Table 2 lists the status of available information on reaction of wastes in the environment. These tables

TABLE 1 General Status of Information on Waste Discharges for Waste Emission Rates and Characteristics

GENERALLY ADEQUATE INFORMATION

Flow rates of
- Municipal wastes
- Rivers and streams
- Storm-surface runoff

Common organic constituents—municipal wastes
- Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD)
- Suspended and settleable solids
- Coliform bacteria
- Organic nitrogen compounds

GENERALLY INADEQUATE INFORMATION

New and/or exotic materials
- Toxicants—generally
- Chlorinated hydrocarbons and biphenyls
- Lead, arsenic, and mercury compounds
- Petroleum and its degradation products
- Biostimulants including
  1. Conventional nutrients, N, P, and K
  2. Trace metals
  3. Organic growth factors, vitamins, etc.
- Taste- and odor-producing materials

Waste emission rates of natural runoff
- River discharges
- Surface (storm) runoff
- Agricultural drainage

Unit mass emission rates for significant wastes
- For cities (i.e., lb waste/person-day), etc.
- For industries (i.e., lb waste/10^3 lb product type), etc.
- For surface (and agricultural) runoff (i.e., lb waste/acre tributary area-day), etc.

Toxic and/or exotic wastes difficult to quantitate in environment
- Quantities of usage (materials balance) by drainage area
  1. Chlorinated hydrocarbons and biphenyls
  2. "Trace" toxic constituents (mercury, lead, etc.)
  3. Other trace organic constituents of concern
     - Taste and odor materials

Technology for handling pulse releases and spills
- Near instantaneous discharge of batch process wastes
- Massive spills (pipelines, transport vehicles, etc.)
  1. Toxic materials
  2. Oils, petroleum products

are not exhaustive, but they indicate generally the areas of needed investigation and research." (Ref. 1)

d. A major problem in Chesapeake Bay management is the need for comprehensive, accessible, continually up-dated and synthesized information on the state of the Bay. The collection of information

TABLE 2 General Status of Information on Waste Discharges for Waste Reactions in the Environment

GENERALLY ADEQUATE INFORMATION

Organic, oxygen-consuming reactions (BOD, etc., carbon, nitrogen, sulfur cycles)

GENERALLY INADEQUATE INFORMATION

Decay rates of bacteria (coliforms, etc.)

Decay rates of exotic materials
- Pesticides, insecticides
- Pathogens
- Viruses
- Hydrocarbon fractions
- Toxic materials

Biostimulation factors (i.e., growth rate data)
- Conventional nutrients, N, P, K, etc.
- Trace metals
- Organic stimulants, growth factors, etc.

Toxicity
- Organics
- Heavy metals
- Pesticides

on a Bay-wide basis will, in and of itself, assist in promoting comprehensive Bay decision-making. Information presented in non-technical form can be accessible to the broad range of decision-makers who must be concerned with environmental policy.

1.2 Current Efforts Toward an Information System

a. Chap. V, Sec. B-3 describes a graphic system for assembling and displaying locational aspects of salient Bay system elements. It is intended to be complementary to current efforts in State agencies to develop comprehensive information sources. The graphic information system would use a consistent Bay-wide scale for regional level environmental decision-making. It would be comprehensive in the range of subject-matter considered. And, the information would be in non-technical form so as to be readily accessible to a wide range of decision-makers.

b. There are a number of current efforts in State agencies to develop comprehensive information sources. Some of these

(e.g. Ref.2, "Report on Status of Water Quality and Significant Sources of Wastewater Discharge") have been developed in response to specific regulatory responsibilities, but have other environmental management applications. Other comprehensive information sources (e.g. Ref.3, "Maryland Manufacturers' Directory 1969-70"; Ref.4, "Manual of Coordinates: Maryland") are intended for broad policy use. Both types have common characteristics-- comprehensiveness, accessibility, regular up-dating -- that a Chesapeake Bay managemnt information retrieval system should extend and build upon.

c. Scientists at Johns Hopkins University, the University of Maryland, and Virginia Institute of Marine Science have developed an inventory methodology consisting "first, of the entities which are found within the region; second, the processes by which the entities create the products, by-products, and waste-products which by interaction with other entities affect the environment; and third, the characteristics by which the entities are described".(Ref. 5) The inventory method is designed to help reduce errors of omission by its prospective users: regulatory agencies, research administrators and researchers themselves.

d. The U.S. Army Corps of Engineers Chesapeake Bay Hydrologic Model, along with the accompanying data system, should considerably improve information on water movement in the Bay.

2 Future Dimensions of Information and Information Retrieval Problems

It would appear that the information problem is one that will improve dramatically in the next few years. Concern for the environment and the resources of the Bay has resulted in funding of a wide variety of programs described in this and other task memoranda. While on given problems and issues there will always be less information than analysts and planners would like, the information problem is not one of amount but of data storage, coordination, and retrieval.

As information grows, this problem increases at an exponential rate. Various plans are underway at the Federal level to establish environmental monitoring and data banks (e.g., EPA). These are discussed in a following section as are similar programs for inventorying land use and topographic "culture". Counterpart State programs should be underway. The need is for a State-wide system for information assembly, storage and retrieval of information about the Bay in forms that are immediately useful in its analysis and planning for its resources. Outlines of such a system that is at once centralized and decentralized are discussed in section V.B. below.

3 Information and Information Retrieval: Goals, Objectives, Standards, Policies

3.1 Goal - Make Adequate Information Available for Planning, Decision-Making and Management of the Bay's Resources

It is useful to consider this goal as a relatively short-term, pragmatic one, rather than in the abstract. The aim is a practical one and eminently realizable.

3.2 Objectives

a. Develop an information coordinating system plan for the Bay that utilizes and is compatible with present and emerging information systems, and can organize and help make available information from any member system. A key factor in Bay management is the retrieval of information in ways usable for decisions and issues. Methods for avoiding information overload and consequent rejection and insensitivity must be developed.

b. Establish an organizational structure to conduct the information coordinatign, storage, retrieval and dissemination function.

No present data gathering or information functions in government would be superseded, but rather enhanced by broader utilization.

3.3 Standards

Standards by which to measure goal and objective achievement should be applied based on information used. Library and information sciences have developed such standards of information relevance and obsolescence as guides to adoption of descriptors and retention of information in the system.

3.4 Policies

Most important to developing a Bay information coordinating system is the adoption by agencies at all governmental levels of a policy favoring the sharing of information relevant to resource management. It should also be the policy of the various agencies to participate actively in developing the necessary organizational structure for a coordinated Bay information system.

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II. PROBLEMS AND GOALS

P. SYNTHESIS AND PLANNING PROBLEMS 215

1. Synthesis and Planning Problems 215
1.1 Nature of the Problem 215
1.2 Causes of the Problem 215
1.3 Location of the Problem 215
1.4 Time Characteristics 215
1.5 Parties Affected..... 215

2. Future Dimension of Synthesis and Planning Problems..... 216

3. Synthesis and Planning: Goals, Objectives, Standards, Policies..... 216
3.1 Goal..... 216
3.2 Objectives..... 217
3.3 Standards..... 217
3.4 Policies..... 217

P
Synthesis and Planning

1 Synthesis and Planning Problems

The problem of synthesis and planning for the Bay is how to resolve conservation and resource development conflicts in such a way as to achieve economic goals and also preserve the integrity of ecological systems.

1.1 Nature of the Problem

Planning is viewed as a rational, continuous, action-oriented, problem-solving process which examines current and anticipated future conditions; compares them with goals; synthesizes plans; and recommends that course of action that optimizes goal satisfaction. Planning tends to be done in cycles and at the end of a cycle, after decisions are reached and acted on, a new set of conditions obtains. A new cycle of planning based on feedback to the previous state and revisions in goals and standards should ensue, which is what is meant by the need for planning continuity. The professional planner's responsibility is to spell out for decision-makers implications of various courses of action, the conflicts between different sets of goals, and the results of possible "trade-off" levels in goal-satisfaction.

1.2 Causes of the Problem

When applied to environmental planning, special difficulties ensue in using this model of planning, whether it be applied on a long-range or on an "incremental" and short-range basis.

The first difficulty is that there are no "solutions" in nature, only adaptations, and a course of action to correct a problem or seek a goal inevitably leads to a chain of impact causation with unintended consequences (e.g. DDT). Knowledge of such consequences is mostly limited to the first round of only a few effects. This is the information gap.

A second difficulty stems from lack of coordination of those doing planning, lack of coordination if not outright conflict between multiple clients with different objectives, and frequently client under-representation (e.g. future Bay users). Thus, the model presumes a smoothly functioning and equitable political "market place" which never exists.

1.3 Location of the Problem

The synthesis and planning problem has geographic, functional, and governmental level dimensions. The geographic dimension as a problem results from county boundaries in most places not coinciding with watershed, river or other environmental planning boundaries. The most serious example of this is the Maryland-Virginia State line which is on the south shore of the Potomac.

Functional lack of coordination for synthesis and planning occurs at all levels of government. The creation of the CBIPC is a recognition of this and a first step toward a State level solution to this problem.

Intergovernmental level coordination in synthesis and planning is perhaps the most serious "locational" problem, with counties the basic operative and decision-making level regarding land use and water management policy. Except for veto power in cases endangering public health and safety or involving public use, the State never preempts the zoning power.[1]

1.4 Time Characteristics

The pressure of problems has multiplied geometrically in the past ten years due to increasing population and urbanization, and the resulting development pressure on natural resources.

A critical time characteristic is the conflict between long-range research and planning that does not answer short-term questions, and immediate problem-solving.

1.5 Parties Affected

All agencies, levels of government and private groups engaged in planning are affected by the problems outlined above. The fragmented nature of current approaches reduces the efficiency and legitimacy of the various efforts now underway.

Although valid in their own right, many such current efforts are contradictory, self-defeating and tend to widen a planning credibility gap in which self-serving "entrepreneurs" are free to operate.

2 Future Dimensions of Synthesis and Planning Problems

The emerging issue of planning is how to do it effectively and equitably in a democratic, pluralistic society with widely disparate goals and within a representative government. This issue will become more serious as the full environmental impact of man's activities becomes better understood, and as the real "trade-offs" are spelled out. Early warning signs are communities demanding water pollution abatement only to find that their own municipal sewage treatment plants are major offenders. Faced with higher local taxes to pay for abatement, they frequently back down unless Federal funds are available.

There would appear to be no magic answer as the various protagonists have different values. The need is for creative planning solutions that encourage optimization with community consensus on the aggregation of goals. Many planning organizations and individuals must be involved in helping to invent solutions.

Planning, to be effective, must be an on-going process embodied as an integral part of decision-making. While it often is implicitly, the process must be an explicit and effective part of the decision-maker's activity. To view planning and action as separable is artificial, and the value of planning must be judged by its effect on decisions.

Planning in a context of the many agencies concerned with the Bay necessarily must adopt an approach that recognizes the lack of common authority, communication difficulties, and problems in transferring costs and benefits between agencies and levels of government.

A critical problem in Bay planning as presently practiced is the lack of mediating concepts and methods at an intermediate level between overall goals, and specific projects. With the system of the Bay partitioned into separate levels and governments, functional concerns, and sources of funds, there is an inevitable tendency to plan by aggregating many individual projects under a framework of goals so broadly stated as to be useless in making choices between projects.

One direction currently being pursued is to elevate conflicts between development and the environment to a higher level of government. Currently this means the State Department of Natural Resources, or the Federal Environmental Protection Agency which latter has been granted a kind of veto power over environmental degradation. This reflects the need for an overall planning system with emphasis on the organization of all components, and with a full capability for using sophisticated methods and techniques in order to sufficiently structure the decision field so that choices can be made with clear awareness of implications.

3 Synthesis and Planning: Goals, Objectives, Standards, Policies

3.1 Goal - Establish a Continuous Comprehensive Bay Planning Process for Optimum Bay Resource Management

Elements of a comprehensive planning process will be discussed in Chapters V, VI and VII. Here they appear as objectives,

including the preparation and adoption of a comprehensive plan.

3.2 Objectives

a. Develop a consistent information base adequate for understanding the Bay system and its resources. Most information exists on much of the Bay but is simply not available. This objective is to make it available.

b. Organize a planning clientele to include all levels of government involved and representation from major segments of interested population.

c. Prepare definitive goal and objective statements to be adapted by planning client groups.

d. Develop a planning, budgeting, programming, system type method of objective and performance evaluation to deal with problems of goal aggregation.

e. Carry out an ecological inventory and intrinsic suitabilities analysis for the Bay's edge. Priority can be established for key areas of special interest or controversy.

f. Establish planning sub-regions based on ecological and socio-economic criteria to be the basis for development of alternate plans.

g. Prepare alternate plans for Bay resource utilization that are both environmentally sensitive and respond to socio-economic needs and demands.

h. Evaluate and test alternate plans by comparison with goals, objectives, standards and policies, by both technical implementation and political criteria.

i. Select elements and alternate courses of action that most nearly meet goals and objectives and synthesize these into a comprehensive plan for the Bay.

j. Have the elements of the plan adopted in various forms (ordinances, resolution, policy, etc.) as appropriate at all levels of government.

h. Establish a plan-monitoring and feedback process for continuous revision, and include in the process requirements for citizen and client involvement and for mandatory reissue every five years.

3.3 Standards

Standards or benchmarks against which goal achievement may be measured are elusive. They usually include measures of effectiveness, equity, optimization, and implementability.

For the Bay, the real standard is in terms of extent to which planning enables a higher level of each goal's satisfaction, and a higher aggregate satisfaction than would be true without planning.

While such standards have usually been developed or applied to rather simple planning processes, evaluation procedures such as benefit-cost analysis and social accounts can be constructed for use in the Bay.

3.4 Policies

Policies are part of the essence of planning and are legion. It would be presumptuous to attempt a list. Special policies or principles that are fundamental to goal achievement here include a policy of full public information and involvement in the planning process. A great difficulty in planning for the Bay, as in all environmental planning, is in determining long-range and potentially irreversible commitments of resources.

Policy is now adopted (although not entirely operational as yet) for "guidance to Federal agencies for added cooperation with State and local governments in the evaluation, review and coordination of... programs and projects."(Ref.2)

Part of this evaluation and review deals with environmental considerations:

1. "The environmental impact of the proposed project;

2. "Any adverse environmental effects which cannot be avoided should the proposed project be implemented;

3. "Alternatives to the proposed project;

4. "The relationship between local short-term uses of man's environment

and the maintenance and enhancement of long term productivity; and

5. "Any irreversible and irretrievable commitments of resources which would be involved in the proposed project or action, should it be implemented." (Ref.3)

Footnotes

1. In a precedent-shattering case, the State of Delaware passed legislation imposing statewide zoning of coastal waters to exclude heavy industry. (Ref. 1)

References

1. Delaware House of Representatives, 126th General Assembly, House Bill 300, Chapter 70, Title 7, "Coastal Zoning Act".

2. Office of Management and Budget, Executive Office of the President, Circular No. A-95, Revised, February 9, 1971, p. 1.

3. National Environmental Policy Act of 1969, Section 102(2)(C).

II. PROBLEMS AND GOALS

Q. PUBLIC AWARENESS AND INVOLVEMENT 220

1. Problems of Public Awareness and Involvement 220
1.1 Nature of the Problem 220
1.2 Causes of the Problem 221
1.3 Location of the Problem 221
1.4 Time Characteristics 221
1.5 Parties Affected 221

2. Future Dimensions of Public Awareness and Involvement Problems 221

3. Public Awareness and Involvement: Goals, Objectives, Standards, Policies ... 222
3.1 Goal 222
3.2 Objectives 222
3.3 Standards 222
3.4 Policies 222

Q

Public Awareness and Involvement

1 Public Awareness and Involvement Problems

The problem is how to get the general public to be aware of and understand the issues related to conservation and development, and to be involved in the decision process.

1.1 Nature of the Problem

a. The Fragmented Public

Today everybody is increasingly aware of environmental problems and concerned about environmental quality. The public - in its demand for the benefits of leisure, affluence and technology - is also directly or indirectly responsible for many of the current threats to environmental quality. And the public, directly or indirectly, will bear much of the cost of restoration and maintenance of environmental quality. However, the "public" is a very fragmented and diverse entity. The person who is outraged over the filling of a wetland may have a faulty septic tank in his backyard. The same persons who demand better outdoor recreation facilities may litter the ones they use. The people, in general, have little sense of their ownership of and responsibility for the Bay.

b. What is the "general public welfare"?

What are public preferences with regard to difficult "tradeoff" decisions that elected or appointed officials must make between developmental and conservation objectives? This is a subject of considerable debate.

"In a free market economy a consumer will purchase an automobile no matter how foul the atmosphere and no matter how many others are adversely affected by his addition to the number of cars on the road. And why should he not? According to his calculus his addition to the foulness of the atmosphere is minimal and his desire for the automobile is great. This is true of all these products...The free market measures the value of the output to an individual consumer, but it takes no account of the damage done to all other inhabitants of the area." (Ref.1)

These issues are now bursting upon the public arena. The State of Delaware has passed a law(Ref.2) which will "...ban new heavy industry along the entire 100-mile Delaware Bay coastline, thus blocking several thousand new jobs and at least $750 million in developments that had already been announced... the entire coastline of the state - already industrialized along 30 per cent of its length - would be closed to heavy industry and available to light industry only under restrictive permits. Offshore facilities for transferring bulk cargoes would also be banned." In commenting on the bill, Governor Russell Peterson said, "There are many things we might forego that call for more industry and more industrialization, and I think most people now are willing to make such a choice." (Ref.3)

The stretch of the Delaware Bay involved is reported to be the only place on the eastern seaboard that can accommodate the super tankers and giant cargo ships that are now economic. Governor Peterson's response to this fact was, "Forego the use of large vessels and continue to use smaller vessels." (Ref.4)

The national interest is involved in the Delaware case as the U.S. Department of Commerce is said to be concerned with a possible undermining of America's "trading position" vis a vis world trade. Maryland's Annemessex Industrial Park involves the same issues at a smaller scale. Somerset County residents are more concerned about employment than wetlands which perform important but not easily demonstrated ecological functions.

Those properly concerned with a balanced approach to such conflicts in values are caught up in the general public's overreaction to both sides of the controversy. The world in which despoliation of nature can go unremarked is no more, but

most rational people agree that a "trade off market" must be developed which can serve the general public interest better than the present "trial by news media". In spite of a general public awareness of the issues of the environment, there is little specific public awareness of the true implications of choice on either side of the Delaware Bay example cited - except for a "gut" reaction that tankers mean oil and oil spills mean pollution and fouled beaches. Much of the same is true for the Annemessex Industrial Park. Although a number of studies have elaborated at least the first round implications for the economy and for the environment, these are not generally available to form the basis of public debate.

1.2 Causes of the Problem

Causes of the problem of lack of public awareness and involvement in issues about the Bay can be summarized as follows:

a. Lack of general public contact with, use of and enjoyment of the Bay.

b. Lack of understanding of the functions the Bay performs, both natural and more directly man-serving.

c. Difficulty of translating qualities of the environment and natural processes into values that can be balanced in a common accounting system with economic values.

d. Complexity of the issues involved and the difficulty of explaining their relevance and interaction.

e. The diversity of interests and values of "the general public" to the point where there is no "common denominator".

f. Inadequacy and incompleteness of professional and scientific understanding of causal relations re implications of actions.

g. Advocacy posture of many planning and development groups concerned with special interests or narrow legislative mandates.

h. General public lethargy and human nature.

1.3 Location

The huge extent of the Bay causes few people in one part to appreciate their community of interest with those in another except through lobbying in the State General Assembly, and in well-publicized crises. As models of the sub-systems of the ecosystem are more elaborately developed, the interconnections between elements will become better understood and location will decline as a problem of public awareness.

1.4 Time Characterisitcs

Not relevant.

1.5 Parties Affected

Most of the parties affected are not involved in any meaningful way in either the planning or the decision process. While local and state procedures for appropriate public hearings are provided, the factors causing lack of public awareness cited above inhibit attendance except by parties at interest in the narrowest sense.

2 Future Dimensions of Public Awareness and Involvement Problems

Public awareness of environmental problems has grown in the past ten years to become a force in all areas and all levels of life in the United States. As a result environmental concern is on the national and State agenda, vast sums are going into research and planning, the media have discovered a new source, and "everybody's doing it". Only now, however, are people becoming aware that the"solutions" have side-effects and are expensive.

The emerging issue in public awareness is over the amount of public control over private actions that is needed to avoid environmental despoliation and waste of natural resources. Two related issues are: (1) the cost of such public control, and how such costs are to be paid and by whom; (2) clear conflicts between local, regional and national interests that develop from different sets

of values. As scientific evidence increasingly supports the need for environmental management, these issues will become major points at controversy for the Bay. The need is for new political and decision-making instrumentalities that can deal effectively with the controversy and involve the public broadly.

In general, the public's understanding of its position of ownership and responsibility for the Bay should be heightened through public education. This effort should not be one-sidedly conservationist but should focus on the full range of Bay uses and functions. The communications process should provide information relevant to the discussion of particular issues. In addition, it should provide a broad perspective on the status of the Bay.

Another, entirely consistent approach is to arrange for individual consumer decisions to reflect the environmental as well as production costs. The proposal to impose a one cent per pound tax on any item requiring disposal within 10 years to provide funds for disposal is an example.(Ref.5) The economist Milton Friedman said that pollution control will result in higher prices to the consumer for the products that pollute, but not higher costs to the consumer. "The tendency to say that pollution control will make the cost of living higher is wrong. It will make total cost of living lower by making the cost of the things we buy higher but by making the costs imposed on us involuntarily lower."(Ref.1) This would have the effect of creating one "accounting system" for benefits and costs and translate non-monetary elements into the currency of economics.

3 Public Awareness and Involvement: Goals, Objectives, Standards, Policies

3.1 Goal- Increase Public Awareness and Maximize Public Involvement in Management of the Bay's Resources

Information, analysis, planning, implementation, and feedback are all considered as part of Bay management for purposes of this goal.

3.2 Objectives

a. Create an image of the Bay as a unified entity whose users have a community of interest in its well-being and wise use of its resources.

b. Establish a citizen's advisory organization concerned with the Bay to take part in its planning and management.

3.3 Standards

Many people are now well aware of the Bay and its importance, but as members of special interest groups or advocates of one or another position. It would be naive to suggest that these can easily be brought under one tent, but their involvement in the planning and management process can work in this direction and ultimately, the measure will be the extent of unanimity achieved regarding a comprehensive plan for the Bay and its implementation as expressed for legislation.

3.4 Policies

People will not spend the time to be involved in Bay affairs without a specific interest. "Maximum feasible participation" has taken on somewhat unmanageable dimensions in urban planning, (Ref.6) where people are often paid to participate. While policies for participation in Bay affairs are unlikely to go to these extremes, an official policy of involvement in planning rather than citizen acquiescence in plans already approved should be adopted.

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II. PROBLEMS AND GOALS

R. TOOLS FOR IMPLEMENTATION 225

1. Problems Regarding Implementation Tools 225
1.1 Nature of the Problem 225
1.2 Causes of the Problem 225
1.3 Location of the Problem 225
1.4 Time Characteristics 225
1.5 Parties Affected 226

2. Future Dimensions of Implementation Tools Problems 226

3. Implementation Tools: Goals, Objectives, Standards, Policies 226
3.1 Goal 226
3.2 Objectives 226
3.3 Standards 226
3.4 Policies 226

R
Tools for Implementation

1 Problems Regarding Implementation Tools

The problem is how to effectively "orchestrate" existing tools and develop such new tools as are necessary to deal with increasingly urgent and complex Bay information, planning and management issues.

1.1 Nature of the Problem

This section deals briefly with legal powers and responsibilities of appropriate governmental agencies and levels. It is generally agreed that with a few exceptions adequate tools for plan implementation and regulatory control now exist.

Recent legislation has placed at Maryland's disposal a wide variety of new and potentially effective tools. To cite examples, there are the Potomac River and Susquehanna River Basin Compacts; the new Wetlands Bills administered by the Department of Natural Resources; the newly formed Department of Natural Resources; the Maryland Environmental Service; and the Department of Transportation which combines the Maryland Port Authority with all other agencies concerned with transportation.

At the Federal level the most significant tool for implementation has been the adoption of the Environmental Quality Control Bill and creation of the Environmental Protection Agency (EPA). The Actions of EPA have already created a significant change in the nature of the problem of implementation as it is responsible both for the adoption of environmental standards but also for seeing that they are carried out.

Still, at all levels of government the nature of the problem is principally one of how to unify responsibility with authority, coordinate planning and action, and enlist fiscal support.

1.2 Causes of the Problem

The primary cause of the problem is the historic, fragmented pragmatic way by which legislative tools have evolved with consequent fragmentation of authority and responsibility. That is a situation not unique to Maryland and no worse there than elsewhere. However, the laws have scattered the legislative mandates by relatively narrowly construed functions throughout levels of government and among various agencies at each level so as to pit bureaucracies against one another, each operating on a valid but narrowly construed single mandated concept of public interest.

As a result, planning is divorced from operation and decision making, regulation from both, and fiscal responsibility from authority.

1.3 Location of the Problem

The most effective tools for implementation are at State and Federal levels. The local administrative units (counties and municipalities) in many instances have not adopted effective legislation which gives them the necessary powers to implement either appropriate development or conservation measures. This is particularly true of those less urbanized.

1.4 Time Characteristics

Most of the new agencies have finite time periods within which guidelines for control of wetlands (MDNR), pollution abatement plans (MES) and environmental quality standards (EPA) must be presented for legislative approval. However, most existing agencies have no specific time frame for the adoption of plans.

1.5 Parties Affected

The people most affected by problems of lack of unification of responsibility and authority coordination and fiscal support are Bay users: industries, maritime interests, vacationers, shoreline owners.

2 Future Dimensions of Implementation Tools Problems

It was stated that with few exceptions tools exist adequate for plan implementation and regulatory control. As the issues and implications of choice grow clearer, the nature of the public interest will sharpen into focus.

But tools for implementation must be wielded vigorously and effectively, and in many cases courageously -- or they are of little use.

What is needed is a plan for orchestrating the use of the tools that are available -- a plan that is so persuasive and broadly understood that the public demands their use. At a much smaller scale and a lesser degree of complexity, the San Francisco Bay Plan performs such a function. (Ref. 1)

3 Implementation Tools: Goals, Objectives, Standards, Policies

3.1 Goal Maximize the Value of Existing Tools for Implementation and Create New Tools only where Necessary

Consistent with the analysis of the problem as being one of how to effectively "orchestrate" existing tools, the need for new tools is relatively minor. Management organization is not considered a "tool for implementation" in this context. Public acceptance of a vigorous application of existing tools combined with excessive caution in their use are the major limiting factors.

3.2 Objectives

a. Examine all existing tools for implementation of various alternate plans to develop handbooks explaining their potential. An important approach to planning is to estimate what can be done, not only what ought to be done as a basis for evolving plans.

b. Ensure that local or State legislature mandates enable all appropriate levels of government to avail themselves of existing tools. In many instances, local governments do not avail themselves of State or Federal funding, which severely limits their potential for carrying out plans.

c. Broaden wherever possible the applicability of tools for implementation to relevant Bay agencies and governments. In many instances, problems cross legislative lines and agencies are restricted because of single-purpose mandates put on multi-problem situations. As a result, administrators do not have the "range of choice" necessary for effective management. (Ref. 2).

3.3 Standards

Standards for availability of tools for implementation can be developed after Objective "a" is reached, based on rates and methods of utilization by agencies and governments.

3.4 Policies

Policies for utilization of tools for implementation can only be developed after problems are defined and plans prepared by governments and agencies responsible and empowered to carry them out. With many of the

powers new and relatively untried, a policy of experimentation and calculated "risk taking" would appear more useful than too much caution.

References

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II. PROBLEMS AND GOALS

S. MANAGEMENT CAPABILITY 229

1. Management Capability Problems 229
1.1 Nature of the Problem 229

2. Future Dimensions of Management Capability Problems 230

3. Management Capability Goals, Objectives, Standards, Policies 230
3.1 Goal 230
3.2 Objectives 230
3.3 Standards 230
3.4 Policies 230

S
Management Capability

1 Management Capability Problems

The problem is how to attract, organize and coordinate management skills needed to resolve the complex multi-faceted environmental issues.

1.1 Nature of the Problem

a. Need for Public Management

The case for public management is not really an issue today, but the extent of that management is. There is an increasing and reluctant recognition for the need of police power of the state to be exerted to ensure the general health, welfare and safety regarding the Bay.

b. Management is Predominately Regulatory and "Permissive"

As a consequence of its evolution from early "mercantilist" philosophy, management of the Bay's resources is still viewed as "that management is best which manages least". The need is for a "stewardship" philosophy and a public developmental and conservation (combined) capability that goes beyond mere regulation and "laissez-faire" permissiveness.

c. Integration of Planning, Responsibility and Authority

The general consensus among informed people is that there is a serious problem for management due to the lack of integration of planning, responsibility, and authority. An example is the authority of local government to control land use and sewage disposal without responsibility or accountability for effects on the Bay. State departments have such responsibility but without authority to effectively deal with the problem. Another example is the responsibility of the Department of Natural Resources for setting criteria for review of wetlands filling, but permit approval is vested in the Department of Public Works (or U.S. Corps of Engineers in some cases). The disjunction of responsibility and authority also operates within levels of government. "Existing state legal institutions suffer from two major inadequacies. First, the state legislatures, clinging vestigially to the nineteenth century, have attempted to administer the Bay themselves. Rather than delegating broad managerial power to the executive branch, they have responded to narrow problems with narrow legislation. These responses rapidly become out-of-date but linger on as law. In short, the legislatures have refused to give administrators the 'range of choice' necessary for effective management.

"Second, those powers which have been delegated by the legislatures have been scattered throughout the states' administrative apparatus. Various state agencies have duplicating, overlapping and sometimes inconsistent powers, but in neither Maryland nor Virginia is there a single agency with the requisite authority to plan and coordinate the administration of the Bay and its resources." (Ref. 1)

d. Inadequate Information and Synthesis for Plan and Decision-Making

This has been discussed under Information Gaps but is repeated here for emphasis as a management problem.

e. Personnel Problems

Recruitment and training of dedicated personnel who have technical competence but also are able to rise above their disciplines, view problems comprehensively, and absorb new knowledge is a very serious problem of management.

2 Future Dimensions of Management Capability

Management problems are diffuse and complicated and don't appear to be getting less so. The dimensions of Bay management responsibility are likely to grow enormously as information and understanding of the implications of resource conservation and utilization increase.

The management issues that result stem from the need to centralize planning, responsibility, and authority on a multi-purpose organizational basis, a need which conflicts with the present way of doing things,and with a basic antipathy for centralization on such a scale.

3 Management Capability: Goals, Objectives, Standards, Policies

3.1 Goal Organize Management to Maximize Effective, Responsive, and Environmentally Sensitive Development and Conservation of the Bay's Resources

Information gathering, analysis, planning, operations, implementation development, and regulation are all considered part of management for present purposes.

The management goal is a realistic and not a utopian one. Many steps toward combining authority/responsibility, planning/regulation/operation are in the direction of the above goal. These can be defined as objectives but unless given more specific definition tend to be meaningless generalities.

3.2 Objectives

a. Unify responsibilty for planning for natural resources for the Bay and relevant adjacent land areas under one agency.

For many such resources, e.g. water, fish and wildlife, this has already been accomplished in the organization of the Department of Natural Resources. Bay-related land planning that involves natural resources does not come under the DNR.

b. Organize planning as a basic responsibility of management in decision-making.

c. Integrate service, operating programs and regulation of natural resources under a unified responsibility.

All of these objectives tend toward centralized planning, responsibility and authority on a multi-purpose organizational basis that can respond to the nature of the problems.

As in the maximization of other goals, the achievement of this goal tends to conflict with the way socio-economic planning is now organized and with the present distribution of powers throughout State and local government.

3.3 Standards

Standards for measurement of achievement of goals and objectives for management are part of the general literature on management, public administration and planning.

3.4 Policies

Present management policies are being developed for the new Department of Natural Resources. It is beyond the scope of this Study and premature to consider specific policies in advance of their experience.

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II. PROBLEMS AND GOALS

T. FISCAL SUPPORT 233

1. The Problem of Fiscal Support 233
1.1 Nature of the Problem 233
1.2 Causes of the Problem 233

2. Future Dimensions of Fiscal Support Problems 233

3. Fiscal Support Goals and Objectives 234
3.1 Goal 234

T
Fiscal Support

1 The Problem of Fiscal Support

The problem is how to attract adequate fiscal support from appropriate sources to deal effectively with Bay management.

1.1 Nature of the Problem

Fiscal resources are in scarce supply. To maintain and increase the quality of the Bay environment while steadily increasing the variety and amount of usage of the Bay will require increasing fiscal support for Bay management and the implementation of Bay plans. A wide range of factors are involved: information gathering and synthesis, and land use activity and environmental monitoring; research into aspects which have important management implications; resolution of conflicts; day-to-day management of the Bay resources; long-range planning for the Bay; communication with the public with regard to Bay plans and actions; the construction of facilities for the implementation of plans. The application of technological innovations may make some of these aspects of environmental management more efficient, but in most cases such applications will result in more comprehensive and sophisticated responses to the job, not smaller expenditures.

1.2 Causes of the Problem

Curiously lack of money can hardly be cited as the principal cause of the problem of lack of fiscal support. As Kenneth Galbraith points out, ours is an "affluent society" in which much higher levels of public spending than now are clearly warranted for poverty, public facilities and for environmental protection and enhancement.

So what are the causes? Three are evident as generalizations of a very complex pattern of causation.

a. Lack of Public Awareness and Understanding

In the absence of a clearly demonstrable set of interrelations between cause and effect, between development action and environmental impact, it is extremely difficult to convincingly demonstrate the need for public intervention, and the value of public expenditures. In many cases these expenditures, if made early, save vast sums later when crises occur.

As a result, in many instances benefits are intangible, and the value of future benefits has a very high discount rate in the here and now. While the role of the planner is to spell out future implications of present actions, he often has a low credibility because of the imprecision of his forecasts.

b. Competition and Conflict for Public Funds

Within the public sector, funding requests for resource management must compete with requests relative to health, education, mass transit, housing, etc. -- all areas in which there are many urgent unfilled needs. The conflicts are real and much of the public does not value a distant and elusive "environment" high in relation to "bread and butter" issues.

c. Public Antagonism to Public Spending

Within the context of the total economy, public values (e.g. ecological integrity) are up against the traditional American inclination to allocate most resources by means of the private market economy. Public spending of any kind is unpopular and more programs related to the Bay need to be viewed as fiscally interrelated toward a concept of self-support for all Bay activity.

2 Future Dimensions of Fiscal Support Problems

To avoid environmental degradation funds are needed at a whole order of magnitude greater than today. Full estimates are not available at the Bay level but for water pollution abatement alone, the bill

will be in the billions.

The emerging issue is between using public money for preserving the environment or using it for other pressing needs, most notably elimination of poverty, education, housing and war. These other demands are "gut issues" more widely understood and shared than Bay (conservation and development) issues.

The need is for a fuller understanding that in the not-too-long run many elements of environmental despoliation of the Bay may be irreversible, and nature cannot be easily "negotiated" with. With such an understanding, fiscal support for many programs may no longer be a matter of choice. However, this will be likely to obtain only for major problem areas such as water and air pollution. For others, the need for fiscal support will have to be dealt with in the context of more specific understanding of the implications of the choice.

An analogy that may be useful in looking for solutions may well be that of transportation where at long last, all forms of movement are seen as part of the same system and are related to the land uses (and land values) they generate. If this principle were applied to the Bay, shore and user values would be seen as appropriate sources of funds for Bay management, and marine transportation and waterfront industry, along with recreation and all other Bay functions could be viewed as Maryland's "newest county", or in more conventional terms a "conservation district".(Ref.1)

3 Fiscal Support: Goals and Objectives

3.1 Goal - Maximize Fiscal Support from All Sources for Bay Resource Utilization and Conservation

This goal is in very direct conflict at Federal and State levels with funding for all other programs. The way to maximize fiscal support is through achieving various of the other goals, specifically increasing public awareness of the importance of the Bay; producing a feasible and compelling comprehensive plan; involving a broad spectrum of citizens in its preparation; developing a convincingly capable management organization; and demonstrating the results of sound planning, enlightened regulation and creative project planning.

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III

Problems and Goals: by Planning Areas

III. PROBLEMS AND GOALS BY PLANNING AREAS

A. RELATIVE IMPORTANCE OF PRESENT PROBLEMS BY PLANNING AREAS 238

1. Introduction 238
1.1 Planning Area Definition 238
1.2 Weighting of Problem Significance 238

2. Importance of Bay Problems by Planning Areas 238
Figure 1: Relative Importance of Present Chesapeake Bay Problem 239
2.1 Cecil County 238
2.2 Harford County 240
2.3 Baltimore County 240
2.4 Baltimore City 241
2.5 Anne Arundel County 242
2.6 Calvert County 243
2.7 St. Mary's County (Bay Shoreline Area) 244
2.8 Western Shore Summary 245
2.9 Kent County 245
2.10 Queen Anne's County 245
2.11 Talbot County 246
2.12 Dorchester County 247
2.13 Somerset County 247
2.14 Eastern Shore Summary 248
2.15 St. Mary's County (Potomac Shoreline Area) 248
2.16 Charles County 248
2.17 Prince George's County 248
2.18 Potomac Shoreline Summary 248
2.19 CBIPC Study Area 248

B. MARYLAND CHESAPEAKE BAY PROBLEMS IN THE CONTEXT OF THE BAY'S WATERSHED AND THE NORTH ATLANTIC REGION 250

1. The Bay in the Context of Its Watershed 250
Figure 2: Problem Profile in the Chesapeake Bay Region 250

2. The Chesapeake Bay Watershed in the Context of the North Atlantic Region .. 251
Figure 3: Awareness of Coastal Problems 250

C. EMERGING ISSUES BY GEOGRAPHIC LOCATION AND PLANNING AREA 252

1. Relative Importance of Future Chesapeake Bay Problems by Planning Areas (Counties) 252
Figure 4: Relative Importance of Future Chesapeake Bay Problems 252
1.1 Cecil County 252
1.2 Harford County 252
1.3 Baltimore County 253
1.4 Baltimore City 253
1.5 Anne Arundel County 253
1.6 Calvert County 253

1.7 St. Mary's County (Bay Shoreline Area) 253
1.8 Western Shore Summary 253
1.9 Kent County 254
1.10 Queen Anne's County 254
1.11 Talbot County 254
1.12 Dorchester County 254
1.13 Somerset County 254
1.14 Eastern Shore Summary 254
1.15 St. Mary's County (Potomac Shoreline) 254
1.16 Charles County 254
1.17 Prince George's County 254
1.18 Potomac Shoreline Summary 254
1.19 The CBIPC Study Area - The Maryland Portion of the Chesapeake Bay 254

D. POPULATION CHANGE, ECONOMIC TRENDS, AND URBAN LAND ABSORPTION IMPACTS, BY PLANNING AREA 255

1. Population Change 255
1.1 Linkages Between Population and Environmental Management 255
Table 1: Population Change, 1960-1970, by County 255
1.2 Population Projections and Environmental Management 256
Table 2: Comparison of Actual and Expected 1970 Population, by County . 256
1.3 Population Growth Rates 256
Table 3: Net Population Growth Rates, Actual and Expected, 1960-2000, by Decade, by County 257

2. Economic Trends 257
2.1 Linkages Between Economic Projections and Environmental Management 257
2.2 Economic Projections for Maryland Bay Subregions 259
Table 4: Employment Projections 1960-1980, by Subregion and Rates of Growth, by Decade 258

3. Land Suitability and Urban Land Absorption Impacts 259
Table 5: Land Inventory with Implications for Future Population Growth by County 261
3.1 Inventory of Land Characteristics 259
3.2 Urban Land Absorption Impacts 263
3.3 Towards Regional Land Policy 263

E. PLANS AS GOAL STATEMENTS 266

Plate 25: Proposed Open Space and Outdoor Recreation System 267
Plate 26: Public Open Space Proposals 268
Plate 27: Water Quality Standards 269
Plate 28: Selected Major Proposals in Regional Infrastructure 270
Plate 29: General Land Use Plan 271
Plate 30: Areas Identified for Industrial Development 272
Plate 31: Wastewater Collection and Disposal Facilities: Existing to Year 2000 273
Plate 32: Water Supply Facilities: Existing to Year 2000 274

A

Relative Importance of Present Problems by Planning Area

1 Introduction

1.1 Planning Area Definition

In the following summary of the relative importance of present Chesapeake Bay problems, Maryland counties have been used as the basic planning area.

Two other planning area definitions were considered:

a. Watersheds

Much data relevant to Chesapeake Bay management -- particularly data dealing with water supply, water movement, and water quality -- are organized on the basis of watersheds. As an example, water quality summaries have been developed for eleven major Chesapeake Bay watersheds. (Ref. 6) However, counties were judged best for general purposes because:

1. Most data, particularly on socio-economic problems, are not organized by watershed, but by county.
2. the county is the smallest relevant management unit.

b. Regional Planning Units.

The regional planning units of the Maryland Department of State Planning and a number of other State agencies were rejected for two reasons:

1. the areas included counties not immediately contiguous to the Bay, and
2. the county is the unit of government that can do something about problems.

Planning areas (counties) were aggregated by the commonly accepted Western and Eastern Shore definitions as the next higher area. The Potomac River was included, although not by definition part of the Chesapeake Bay. This was done because it is in the State of Maryland, and because its lower reaches are part of the Bay's sub-estuarine system.

1.2 Weighting of Problem Significance

The three categories of "major," "significant" and "relatively insignificant" are self-explanatory. Putting a problem in any one category was a matter of judgement. For an area as a whole, e.g. Western Shore, there had to be at least two county planning areas in a classification for the Shore as a whole to merit that category. The same rationale was used for the Bay as a whole, except where all planning areas were in a "significant" category and the aggregate was considered to add up to "major."

Several of the problem categories used in the North Atlantic Regional Water Resources Study (Ref. 1) have also been used in this study. These include problem categories: Living Resources, Conservation of Wetlands, Shore Erosion, Water Pollution, Thermal Waste Discharge, Marine Transportation, Water-Related Outdoor Recreation, Solid Waste Disposal and Non-Living Resources. However, it is evident that there are some differences in problem awareness between the designations in the NARWR Study and in Chart 1. These are explained by the finer grain of information available to the CBIPC, and the difference in emphasis of the two studies.

2 Importance of Bay Problems by Planning Areas

Figure 1 presents a summary of the relative importance of present Chesapeake Bay problems by planning area. Explanatory notes for judgemental decisions made in developing the summary chart are included in the following text.

2.1 Cecil County

a. Living Resources are a "significant" problem because during periods of drought, flow of fresh water from the Susquehanna is shut down and aquatic life suffers. However, except in

FIGURE 1:

RELATIVE IMPORTANCE OF PRESENT CHESAPEAKE BAY PROBLEMS

		a Living Resources	b Conservation of Wetlands	c Water Movement	d Shore Erosion & Sediment	e Water Pollution	f Water Supply	g Thermal Waste Discharge	h Marine Transportation	i Water-Related Outdoor Rec.	j Waterfront Industry	k Waterfront Residential	l Access & Appearance	m Solid Waste Disposal	n Non-Living Resources	o Information Gaps	p Synthesis of Planning	q Public Awareness	r Tools for Implement.	s Management Capability	t Fiscal Support
2.1	Cecil	X	⊠	⊠	O	O	O	O	⊠	O	X	O	X	O	O				X	⊠	X
2.2	Harford	⊠	X	⊠	X	⊠	O	O	O	X	O	O	⊠	X	O				X	X	O
2.3	Baltimore	⊠	X	⊠	O	⊠	O	O	O	⊠	⊠	⊠	⊠	⊠	X				O	X	⊠
2.4	Baltimore City	O	O	⊠	O	X	O	O	⊠	O	⊠	O	⊠	⊠	O				O	X	O
2.5	Anne Arundel	⊠	X	⊠	⊠	⊠	⊠	O	O	⊠	⊠	⊠	⊠	⊠	X				O	X	⊠
2.6	Calvert	⊠	X	X	⊠	X	O	⊠	O	O	O	O	X	⊠	⊠				X	X	X
2.7	St. Mary's	⊠	X	O	⊠	X	O	O	X	O	O	O	X	O	O				X	X	O
2.8	Western Shore	⊠	X	⊠	⊠	⊠	X	X	⊠	⊠	⊠	⊠	⊠	⊠	X	⊠	X	⊠	X	⊠	⊠
2.9	Kent	X	⊠	X	O	O	O	O	O	O	O	O	O	O	O				X	X	X
2.10	Queen Anne's	⊠	⊠	X	⊠	X	O	O	O	O	X	X	X	X	O				X	X	X
2.11	Talbot	⊠	⊠	X	⊠	X	O	O	X	X	X	X	X	X	O				X	X	X
2.12	Dorchester	⊠	⊠	O	⊠	X	O	O	O	X	X	X	X	X	O				X	X	X
2.13	Somerset	⊠	⊠	O	X	X	O	O	⊠	O	⊠	O	O	O	O				X	X	X
2.14	Eastern Shore	⊠	⊠	X	⊠	X	O	O	O	X	X	X	X	X	O	⊠	X	X	⊠	⊠	⊠
2.15	St. Mary's	⊠	⊠	X	X	O	O	O	O	O	O	O	O	O	O				X	X	X
2.16	Charles	O	X	X		X	O	O	O	O	O	O	O	O	O				X	X	X
2.17	Prince George's	O	O	X		X	X	O	O	X	O	X	X	X	X				O	X	X
2.18	Potomac	⊠	⊠	X	O	X	O	O	O	O	O	O	O	X	O	⊠	X	X	X	X	X
2.19	CBIPC STUDY AREA	⊠	⊠	X	X	X	X	X	⊠	X	⊠	X	X	X	O	⊠	⊠	⊠	X	⊠	X
	NARWRS-AREA 18 (Ref.1)	⊠	X		O	⊠		⊠	⊠	⊠				O	O						

⊠ Major X Significant O Relatively Insignificant

() No Information

specific areas, water quality appears reasonably good.

b. Conservations of Wetlands is a "major" problem because they are an important percentage of the shoreline and are threatened not only with drought but with spoil and pollution from dredging.

c. Water Movement is a "major" problem because of low flow during droughts and fresh water diversion through the C & D Canal.

d. Shore Erosion and Sedimentation are considered "relatively insignificant"; dredging and spoil deposit create plumes; but these appear localized.

e. Water Pollution is a local problem of relative insignificance.

f. Water Supply, mostly from ground water sources, is a local problem of relative insignificance.

g. Thermal Waste Discharge,
i. Water-related Outdoor Recreation,
k. Residential Areas,
m. Solid Waste Disposal, and
n. Non-Living Resources:
are all considered to be strictly local problems that are "relatively insignificant" at the Bay scale.

h. Marine Transportation is considered a major problem because of the limitations on ship draft and maneuverability even with a widened and deepened C & D Canal.

j. Waterfront Industry:
Cecil County has more than 1000 employees in "port-dependent" employment (see section II,J), including almost 400 employees in primary metals industries and approximately 600 employees in boat building and repair. Waterfront industry is therefore considered a significant problem in the bay-wide context.

l. Access Appearance and Design are considered "significant" problems because access to Cecil County's shoreline is severely limited by water.

o. Information,
p. Planning, and
q. Public Awareness:
are treated only at the larger Shore planning area scale.

r. Tools for Implementation: It is considered that Cecil County faces "significant" problems of implementation of both conservation and development measures. The county does not have adequate zoning or land use controls to ensure proper conservation of ecologically important areas, and it lacks the means to take advantage of potential for development.

s. Management Capability: As in most rural counties, management is a "significant" problem because of limited personnel and leadership resources.

t. Fiscal Support is considered a relatively "insignificant" problem, as all current programs related to the Bay are

at the State of National level.

2.2 Harford County

a. Living resources are a "major" current problem because they are being endangered by pollution.

b. Conservation of Wetlands is considered a "significant" problem but not a "major" one because most wetlands in the county are under public control.

c. Water Movement is considered a "significant" problem primarily because of the shifting salt-water intrusion.

d. Shore Erosion and Sedimentation is considered a "significant" problem primarily because of sedimentation. See Map.

e. Water Pollution is a "major" problem because of sewer effluent.

f. Water Supply,

g. Thermal Waste Discharge, and

h. Marine Transportation:

are "relatively insignificant" problems at present.

i. Water-related Outdoor Recreation is a "significant" problem because much of the Bay near the Aberdeen Proving Grounds and Edgewood Arsenal is "off-limits" for the public.

j. Waterfront Industry and

k. Residential Areas:

are currently "relatively insignificant" as problems because of little pressure for development. This is, however, growing.

l. Access Appearance and Design are "major" problems for the same reasons as i above.

m. Solid Waste Disposal is a "significant" problem because of pressure on publicly owned land for fill and spoil areas.

n. Non-Living Resources constitute a "relatively insignificant" problem, as Harford County is still not under pressure, except locally.

o. Information,

p. Planning and

q. Public Awareness:

See same section under Cecil County.

r. Tools for Implementation is considered a "significant" problem because no mechanism exists for influencing the major public shoreline owners.

s. Management Capability is considered a "significant" problem because public agencies are uncoordinated and often in conflict with local goals for both conservation and development, albeit major employers.

t. Fiscal Support: see same section under Cecil County.

2.3 Baltimore County

a. Living Resources is a "major" problem because of pollution and elimination of wetlands.

b. Conservation of Wetlands is a "significant" problem because of the limited value of remaining wetlands due to pollution.

c. Water Movement is a "major" problem because of flooding and lack of circulation in sub-estuaries. Curiously, in Back River (now eutrophic) better circulation would also be a "major" problem as the pollution would then spread to the Bay.

d. Shore Erosion and Sedimentation are considered "relatively insignificant" in spite of heavy surface runoff and resultant sedimentation.

e. Water Pollution is a "major" problem. Back River acts as a tertiary treatment plant. All sub-estuaries are off-limits to shellfishing and are unpleasant for water recreation.

f. Water Supply is a relatively "insignificant" problem although well-water withdrawals have caused salt water intrusion in the ground water system.

g. Thermal Waste Discharge is not currently a problem, nor is

h. Marine Transportation.

i. Water-related Outdoor Recreation is a "major" problem both because of high demand and the deterioration of water quality.

j. Waterfront Industry: Baltimore County has 37,000 "port-dependent" employees (see Section II,J) concentrated

in primary metals industries and ship building and repair. Waterfront industry problems are thus considered "major" in the bay-wide context.

l. Access Appearance and Design are considered "major" problems because of limited access to the shore from land, and poor appearance of many obsolete and deteriorated water's edge uses and buildings.

m. Solid Waste Disposal is a "major" problem because of proximity to urbanization and lack of disposal sites.

n. Non-Living Resources are considered a "significant" problem because of the availability of sand and gravel close to and needed by urban construction and the problems its extraction develops.

o. Information,

p. Planning and

q. Public Awareness:

See same section under Cecil County.

r. Tools for Implementation is considered a "relatively insignificant" problem due to the sophistication and legislative mandate of the county government.

s. Management Capability is considered a "significant" problem because of lack of coordination and the widely differing consensus of the citizens of the county.

t. Fiscal Support is considered a "major" problem because of the record of the county in failing to support many public programs.

2.4 Baltimore City

a. Living Resources is considered a "relatively insignificant" problem because the Patapsco which is badly polluted, flushes better than most other major sub-estuaries, and is the subject of intensive work by the Maryland Environmental Service (MES) to develop pollution abatement plans. In this sense correction of pollution is already underway.

b. Conservation of Wetlands is also considered "relatively insignificant" as the few wetlands that remain mostly in the Lower Branch of the Patapsco, have already been eliminated by pollution from any effective role for living resources. They still perform functions re flood absorption and tertiary sewage treatment.

c. Water Movement is a "major" problem because of the Harbor's funnel shape with its axis on a long "fetch" for hurricanes, thus vulnerable, and whose shore installations are extremely valuable.

d. Shore Erosion and Sedimentation is considered "relatively insignificant", even though constant dredging is needed to keep the ship channel open.

e. Water Pollution is considered a "significant" problem rather than "major" primarily because most of the Harbor is not appropriate for water recreation (except for the Inner Harbor because of conflict with navigation) and the current Project will reestablish its use as an aquatic and wild fowl habitat.

f. Water Supply is a "relatively insignificant" current problem.

g. Thermal Waste Discharge is considered a "relatively insignificant" problem because, although many of the long-standing adjacent industrial uses heat the water, what aquatic life exists is presumed to have adjusted, and the Harbor industry is crucial to the Region. Any particularly negative environmental effects can be dealt with by the MES.

h. Marine Transportation is a "major" problem as far as the water is concerned because of the need for channel deepening (to 45') and maintenance, and the modernization of water-related shore facilities.

i. Water-Related Outdoor Recreation is a "relatively insignificant" problem because, except for specific urban shore needs, any great amount of water-related recreation within City-limits is in direct conflict with marine transportation (except for the Inner Harbor).

j. Waterfront Industry is a "major" problem because of the need for it here,

the appropriateness of the location for it, but the limiting factors such as obsolescence of present plant, industries preempting sites that don't really need water access, and private ownership policies not in accord with public policy.

k. Waterfront Residential is considered a "relatively insignificant" problem because of its inappropriateness for most of the City waterfront (again except for the Inner Harbor).

l. Access and Appearance and Design are considered "major" problems because of the poor standards of maintenance, difficulty of access to and inadequate design and layout of much of the current facilities, both those related to and those just visible from the water.

m. Solid Waste Disposal is a "major" problem because the City of Baltimore is the largest producer of waste and the Patapsco channel deepening alone will require five "contained disposal areas" for 88 million cubic yards, at a cost of $15 million to prepare the first portion. Sites for dumping and land fill using solid waste or Harbor spoil are limited here, and standards for dumping are rising rapidly.

n. Non-Living Resources is a "relatively insignificant" problem because there is little conflict between the Bay and extraction at this location.

o. Information,

p. Planning and

q. Public Awareness:

are treated only at the Shore planning area scale.

r. Tools for Implementation is considered a "relatively insignificant" problem because of the sophistication and depth of technical talent in the City of Baltimore.

s. Management Capability is a "significant" problem because of political and industrial opposition to solutions to the problems.

t. Fiscal Support is considered a "relatively insignificant" problem because of the availability of funds and support for most problem areas.

2.5 Anne Arundel County

a. Living Resources is a "major" problem because of the pollution of sub-estuaries, their importance to aquatic and bird life. The demand for water-related recreation and the general conflict of urbanization, septic tank pollution of sub-estuaries, marina development and so on, with natural resources.

b. Conservation of Wetlands is a "significant" problem rather than "major" because Anne Arundel County does not have many wetlands. Those that are all the more important to be conserved.

c. Water Movement is a "major" problem because the sub-estuaries do not flush sufficiently to reduce pollution. Flooding per se is a "relatively insignificant" problem.

d. Shore Erosion and Sedimentation is a "major" problem, because of significant loss of valuable land, and heightened runoff as urbanization takes place.

e. Water Pollution is a "major" problem in all of the County's sub-estuaries because of septic tank development on the highly permeable soil of the shoreline, inadequate treatment of sewage effluent, marina and boat waste, and inadequate flushing of the estuaries.

f. Water Supply is a "major" problem because of saline intrusion of ground water at Bay shoreline as wells draw down fresh water, and as paving of aquifer recharge areas denies natural recharge. Industrial needs exceed current supplies and to 1990 depend on connecting to Baltimore City's system. Beyond that, the deep aquifers must be tapped and artificial recharge of all aquifers must be undertaken.

g. Thermal Waste Discharge is a "relatively insignificant" overall problem although specific industries on the Patapsco discharge substantial amounts of heated water.

h. Marine Transportation is a "relatively insignificant" problem, except the County's section of the Patapsco (covered as part of Baltimore Harbor).

i. Water-Related Outdoor Recreation is a "major" problem because Anne Arundel County has the three ingredients for trouble -- high demand, a fantastic shoreline as a resource that has not yet been ruined, and almost totally private ownership of the shoreline.

j. Waterfront Industry is a "major" problem, primarily in the northern end of the County because of the same high-demand/supply situation as obtains for recreation. However south of the Harbor, most land is not suitable for waterfront industry for lack of one or another of the prerequisites. Anne Arundel County has over 2000 employees and almost 50 firms in port-dependent industries, including concentrations in chemicals manufacturing, primary metals and ship building and repair.

k. Waterfront Residential land is a "major" problem for the above high-demand/supply reasons.

l. Access and Appearance and Design is a "major" problem because of limited public access to the shoreline, its preemption by low-density development and the inadequacy and obsolescence of many of the structures along the shore.

m. Solid Waste Disposal is a "major" problem because of the high rate of urbanization in the County. Demand has virtually outstripped suitable disposal sites.

n. Non-Living Resources is a "significant" problem because of the need for sand and gravel and inadequate attention to the proper methods of extraction.

o. Information Retrieval,

p. Synthesis and Planning and

q. Public Awareness:

are all discussed at the Western Shore scale only.

r. Tools for Implementation are a "relatively insignificant" problem because of the magnitude and diversity of legislation on land use related to the Bay available in the County and State.

s. Management Capability is a "significant" problem because of the mixed record of success the County has experienced in dealing with problems in spite of competent technical staffs in all departments.

t. Fiscal Support is a "major" problem because, while tools and managers are available, costs or programs are very high because of land costs, etc.

2.6 Calvert County

a. Living Resources is a "major" problem area because of the value of the resources and the threats to its habitat by virtue of erosion, sedimentation, filling, solid waste disposal, diversion of fresh water, and thermal waste discharge.

b. Conservation of Wetlands is a "significant" problem. Although there are not that many in the county they are all the more crucial for that fact, and are threatened by pollution, filling, etc.

c. Water Movement is a "significant" problem, primarily because of diversion of fresh water from the Patuxent with the attendent problems of low oxygen, inadequate flushing, and high salinity.

d. Shore Erosion and Sedimentation is a "major" problem due to soil erosion in the Patuxent watershed, sedimentation in its estuary, and high rates of shore erosion (by volume).

e. Water Pollution is a "significant" problem because of low-density septic tank development in the northern shoreline of the County. Pollution of the Patuxent River is "major" but is not considered as a Bay problem.

f. Water Supply is a "relatively insignificant" problem, with local ground water resources adequate for current development.

g. Thermal Waste Discharge is a "major" problem because of the siting of the Baltimore Gas and Electric Company Calvert Cliffs nuclear reactor steam generating plant on the Bay shore. Its anticipated impact is now under intensive study. (Ref. 2)

h. Marine Transportation is a "relatively insignificant" problem as are:

i. Water-Related Outdoor Recreation,

j. Waterfront Industry, and

k. Waterfront Residential.

l.Access, Apprearance and Design is a "significant" problem primarily because of poor access which limits use of the Bay as a resource.

m. Solid Waste Disposal and

n. Non-Living Resources are "significant" problems because of degradation of floodplains and estuaries of tributaries by filling and by leaching from sanitary landfills, and because of water quality problems caused by sand and gravel operations.

o. Information Retrieval,

p. Synthesis and Planning, and

q. Public Awareness:

are discussed at the scale of the Western Shore.

r. Tools for Implementation,

s. Management Capability, and

t. Fiscal Support:

are all considered "significant" problems because of the relative inadequacy of local zoning, building and subdivision tools, few management personnel, and poor track record on fiscal support.

2.7 St. Mary's County (Bay Shoreline Area)

a. Living Resources is a "major" problem area because the County has many wetlands, sub-estuaries such as the Patuxent are polluted and the County is very important in terms of aquatic and bird habitat.

b. Conservation of Wetlands is a "significant" rather than a "major" problem simply because pollution and development pressures are not as severe here as further north.

c. Water Movement problems are "relatively insignificant".

d. Shore Erosion and Sedimentation are "major" problems chiefly because of the high volume rates of shore erosion.

e. Water Pollution is a "significant" but primarily local problem in sub-estuaries.

f. Water Supply in relation to current demand is a "relatively insignificant" problem because pressures for urbanization are low, and ground water resources are abundant.

g. Thermal Waste Discharge is a "relatively insignificant" problem as there is no relevant industry.

h. Marine Transportation is a "relatively insignificant" problem because of little industry and no ports.

i. Water-Related Outdoor Recreation is a "relatively insignificant" problem of a solely local nature, as are

j. Waterfront Industry and

k. Waterfront Residential, due to low demand.

l. Access, Appearance and Design is a "significant" problem area as lack of access inhibits the development of the great natural recreation potential of the waters and waterfront of the county.

m. Solid Waste Disposal and

n. Non-Living Resources are "relatively insignificant" problems because of distance from urbanization.

o. Information, Information Retrieval,

p. Synthesis and Planning, and

q. Public Awareness:

are discussed at the Western Shore scale.

r. Tools for Implementation is a "significant" problem because of inadequacy of local ordinances and mechanisms for dealing with local problems.

s. Management Capability is a "significant" problem due to limited staff and expertise.

f. Fiscal Support is a "relatively insignificant" problem because most

current problems do not require large amounts of money for correction.

2.8 Western Shore Summary

The rating system that has been used for the Western Shore is as follows: 1) if one county was rated "major" in a category, the Shore was rated "significant" in that category; 2) if two or more counties were rated "major", the Shore was rated "major"; 3) if all counties were rated "significant" in a category, the Shore was rated "major", otherwise "significant"; 4) if any counties were rated "significant" in a category, the Shore was rated the same.

o. Information and Information Retrieval is considered a "major" problem throughout the Western Shore even though it is the subject of intensive field research of all kinds. Retrieval and coordination of what is known is as much a problem as new information, with three levels of government and many institutions involved.

p. Synthesis and Planning is classed as a "significant" problem at the Western Shore scale rather than "major" because all the institutional and organizational mechanisms for those functions exist although not functioning very effectively in terms of both development and conservation.

q. Public Awareness is a "major" current problem at the Western Shore scale. Relativley few citizens are involved in Bay affairs except as users or exploiters of one or another of the Bay's resources.

2.9 Kent County

a. Living Resources is a "significant" problem area primarily because of the fluctuating salinity of the Upper Bay, fresh water diversion through the C & D Canal, and the quality and nutrient load of the Susquehanna River water, which flows into the Bay just above the County.

b. Conservation of Wetlands is a "major" problem for the above reason and by virtue of spoil deposits and dredging engendered by the deepening and maintenance of the C & D Canal.

c. through n. Problem Categories:
All these categories of problems are seen as "relatively insignificant" except at a localized scale.

o. Information and Information Retrieval,

p. Synthesis and Planning, and

q. Public Awareness:
are discussed at the Eastern Shore scale.

r. Implementation,

s. Management Capability, and

t. Fiscal Support:
are all classed as "significant" problems because of inadequate ordinances, limited technical staff and leadership and poor record of fiscal support for problem solution.

2.10 Queen Anne's County

a. Living Resources is a "major" current problem area because of the fluctuating position of isohaline lines and local pollution threats to aquatic habitats.

b. Conservation of Wetlands is a "major" problem for the above reasons also.

c. Water Movement is a "significant" problem rather than a "major" one because pollution and flushing are not as critical as in sub-estuaries on the Western Shore.

d. Shore Erosion and Sedimentation is a "major" problem area as the County has the second-highest linear rate of shoreline erosion in the Bay, and sedimentation of channels, marinas, and small harbors is relatively severe.

e. Water Pollution is a "significant" problem although still relatively localized and a result of marina development.

f. Water Supply,

g. Thermal Waste Discharge, and

h. Marine Transportation, and

i. Water-Related Outdoor Recreation:
are "relatively insignificant"

problems mainly by virtue of low demand.

j. Waterfront Industry:

Queen Anne's County has over 600 employees and 17 firms in "port-dependent" industry (see Section II,J) largely concentrated in seafood packing. Because of the current importance of this employment in the local economy, waterfront industry problems have been classed as "significant" in Queen Anne's County.

k. Waterfront Residential is a "significant" problem because of increasing demand and improved access.

l. Access, Appearance and Design is a "significant" problem due to increased demand for access and the difficulty of accommodating it.

m. Solid Waste Disposal is a "significant" and increasing problem because of proximity to urbanization and lack of suitable sites.

n. Non-Living Resources is still a "relatively insignificant" problem with only local demand.

o. Information and Information Retrieval,

p. Synthesis and Planning, and

q. Public Awareness:

are discussed at the scale of the Eastern Shore.

r. Tools for Implementation,

s. Management Capability and

t. Fiscal Support:

are all "significant" problems because of generally inadequate local codes and ordinances for conservation, lack of depth in management capability, and a weak record of fiscal support of the kind of programs necessary.

2.11 Talbot County

a. Living Resources is a "major" problem because pressures for urban change, pollution, and erosion and sedimentation all threaten the aquatic and bird habitats.

b. Conservation of Wetlands is a "major" problem so above and because the County has a significant share of the Bay's Wetlands.

c. Water Movement is a "significant" rather than a "major" problem because pollution of sub-estuaries is not as serious as it will be with more urbanization and thus flushing is currently adequate as are dissolved oxygen levels.

d. Shore Erosion and Sedimentation is a "major" problem in the County with significant losses of shore land to erosion and sedimentation affecting drainage and navigational channels and wetlands.

e. Water Pollution is a "significant" problem that still has not reached the proportions it has on the Western Shore.

f. Water Supply is a "relatively insignificant" problem of a local nature only. This is because of the generally abundant ground water resources.

g. Thermal Waste Discharge and

h. Marine Transportation: a "significant" problems because of St. Michael's efforts to improve its port and its maritime museum.

i. Water-Related Outdoor Recreation is a "significant" problem because of the extent of the natural resource, its relative inaccessability, and marine pollution.

j. Waterfront Industry:

Talbot County has over 1500 employees and 20 firms in "port-dependent" industries, almost all concentrated in seafood packing. Because of the importance of port-dependent employment in the local economy, waterfront industry problems are considered "significant" in Talbot County.

k. Waterfront Residential is a "significant" problem because of limited access and low density development pre-empting waterfront sites.

l. Access, Appearance and Design and

m. Solid Waste Disposal:

are "significant" problems as urbanization and need for access grows.

n. Non-Living Resources is a "relatively insignificant" problem area because of lack of demand.

o. Information and Information Retrieval,

p. Synthesis and Planning, and

q. Public Awareness:

are discussed at the scale of the Eastern Shore.

r. Tools for Implementation,

s. Management Capability and

t. Fiscal Support:

are all "significant" problems due to inadequate codes and ordinances, absense of management in depth, and limited fiscal support for necessary programs.

2.12 Dorchester County

Dorchester County faces much the same intensity of problems as Talbot County to its north. Special mention is made of:

c. Water Movement and

j. Waterfront Industry.

c. Water Movement is a "relatively insignificant" problem in the County because pollution is localized and not serious and thus there is less need for a strong sub-estuary flushing action, and less demand on dissolved oxygen for the function of waste-decomposition.

j. Waterfront Industry:

Dorchester County has over 900 employees and 20 firms in port-dependent industries (see Section II,J). As in Talbot and Queen Anne's Counties, the major concentration is in seafood packing. But Dorchester County also has significant employment in agricultural chemicals and primary metals manufacturing. Because of the significance and make-up of current port-dependent industry in Dorchester County and because of unemployment problems in the area, waterfront industry problems are considered "significant" in the Bay-wide context.

2.13 Somerset County

a. Living Resources is a "major" problem area because of the importance of the resource and conflicts with other uses that would eliminate or alter much of it.

b. Conservation of Wetlands is a "major" problem for the reasons above (See IV, A-2 above).

c. Water Movement is currently a "relatively insignificant" problem.

d. Shore Erosion and Sedimentation is a "significant" problem as sedimentation affects the wetlands, and the County has experienced the largest net loss of acreage due to shore erosion of any Maryland Bay County. (See Map B I 3).

e. Water Pollution is a "significant" but not yet "major" problem, mostly due to waterfront industries and marina pollution.

f. Water Supply and

g. Thermal Waste Discharge:

are "relatively insignificant" problem areas.

h. Marine Transportation is a "major" problem area because of the conflict between needs for waterfront industry (and related channel deepening) and natural resources.

i. Water-Related Outdoor Recreation is a "significant" problem area due to need for development of recreation as a "growth industry".

j. Waterfront Industry:

Somerset County has over 1100 employees and almost 30 firms in "port-dependent" industries (see Section II,J). This includes, in addition to a primary concentration of seafood packaging employment, a significant number of primary metals manufacturing employees. Somerset County has major needs for job development. It is the site of the proposed Annemesex Industrial Park and the focus of Bay-wide interest in the potential economic and ecological impacts of this project. In consideration of these factors, waterfront industry problems in Somerset County have been judged of "major significance".

k. Waterfront Residential;

l. Access, Appearance and Design;

m. Solid Waste Disposal and

n. Non-Living Resources:

are considered "relatively in-

significant" current problem areas.

o. Information and Information Retrieval,

p. Synthesis and Planning and

q. Public Awareness:

are discussed at the Eastern Shore scale.

r. Tools for Implementation,

s. Management Capability and

t. Fiscal Support:

are all "significant" problems that are being dealt with at the State scale, partly because local resources are inadequate.

2.14 Eastern Shore

The same system for problem summary evaluation that was used for the Western Shore was applied. Information etc. was not discussed by county and is dealt with here.

o. Information Gaps is a "major" problem area as it was on the Western Shore. Again, while much is known of the natural processes involved, little is known of the interactions etc. of the overall system within which these processes operate.

p. Synthesis and Planning and

q. Public Awareness:

are "significant" problems rather than "major" because they are better known and of greater concern at the State scale.

2.15 St. Mary's County (Potomac Shoreline Area)

St. Mary's County has a somewhat different level of problems on its Potomac shore than along its Bay Shoreline.

a. Living Resources and

b. Conservation of Wetlands:

are "major" problem areas because of the pollution of the Potomac sub-estuary and the effect on flow and salinity of up-stream fresh water use.

c. Water Movement and

d. Shore Erosion and Sedimentation:

are "significant" problem areas because of the slow flushing of the Potomac estuary and the heavy pollution and sediment load carried from the up-stream portions of the Potomac basin (largely from construction in urban areas).

Problem Areas e. - n. are judged:

"relatively insignificant" although in some cases important at a local scale.

Problem Areas o. - t. are discussed:

as part of the Western Shore.

2.16, 2.17, 2.18 Charles County, Prince George's County and the Potomac Shore

These counties are given a relative importance for comparative purposes but are not discussed because they are beyond the scope of this Report.

2.19 The CBIPC Study Area - The Maryland Portion of the Chesapeake Bay

Most of the evaluations are explained by the rating system. However several are not, and are discussed briefly below. For nine problem areas, it is possible to compare the summary evaluations of problem significance by this Study and the North Atlantic Regional Water Resources Study (Ref. 1) for the Chesapeake Bay area. Differences in the two evaluations are also explained.

b. Conservation of Wetlands is considered a "major" problem in this study due to the closer view, expressed concern, and more detailed knowledge of the problem by the CBIPC. (Ref. 3,4)

d. Shore Erosion and Sedimentation is a "significant" problem area in general consensus rather than "relatively insignificant" because of the sharper focus of the CBIPC, and the legislatively expressed concern as evidenced by State aid for private efforts at shore protection. Furthermore, sedimentation necessitates large expenditures for dredging, which in turn causes environmental problems.

e. Water Pollution is a "significant" problem rather than a "major" because there is general consensus that the Bay

as a whole is still in reasonably good condition.

g. Thermal Waste Discharge is a "significant" rather than a "major" problem, as is currently confined to the one major nuclear power plant site and a number of industrial installations.

h. Marine Transportation is a "major" overall problem even though it is classed as "major" only on the Western Shore, because of the need for deepening the channel and the ubiquitousness of the potential impact.

i. Water-Related Outdoor Recreation is a "significant" rather than a current "major" problem, mostly because of general public lack of awareness.

m. Solid Waste Disposal is a "significant" rather than a "relatively insignificant" problem because of current massive dimensions of solid waste output of urban areas, lack of suitable sites for sanitary landfills, and the large amounts of spoil from continuing dredging programs. (Ref. 5)

B

Maryland Chesapeake Bay Problems in the Context of the Bay's Watershed and the North Atlantic Region

This report and the work of the Chesapeake Bay Interagency Planning Committee have necessarily been restricted to considering Maryland portions of the Chesapeake Bay. This puts arbitrary blinders on, and is fundamentally antithetical to the ecological viewpoint.

Brief consideration of the previous work in the context of the North Atlantic Region Water Resources Study (Ref. 1) allows a Bay region perspective that includes the entire watershed. Of course even that watershed is a limiting and arbitrary boundary for some concerns, particularly with reference to the Delmarva Peninsula where the Chesapeake, the Delaware and the Atlantic Ocean intermingle.

1 The Bay in the Context of Its Watershed

The Maryland portion of the Chesapeake Bay is only a small part of the total watershed. The Bay's basin covers 74,000 square miles. The largest tributary, the Susquehanna River, drains 42% of the basin, the Potomac, 22% and the Rappahannock, York and James Rivers drain 24%. 12% is drained by smaller watersheds or directly into the Bay.

Figure 2 shows the NARWR Study's evaluation of problems for the Bay's major watersheds. It is evident that the Bay itself has problems at a level of intensity and kind greater than the remainder of the watershed.

This is a "downstream externality", that is the consequences of upstream pollution and sedimentation are on the Bay. For example a recent study of the Susquehanna watershed excluded the Chesapeake from the model, because"...it was

FIGURE 2:

PROBLEM PROFILE IN CHESAPEAKE BAY REGION (As Evaluated by North Atlantic Regional Water Resources Study) (Ref. 1)	Living Resources	Conservation of Wetlands	Non-Living Resources	Water Pollution	Thermal Effects	Solid Wastes Disposal	Recreation	Marine Transportation	Coastal Erosion and Tidal Flooding
Chesapeake Bay Region (NARWRS: Areas 17,18[part],19,20,21)	O	X	O	⊠	⊠	O	⊠	⊠	X
Susquehanna Basin (NARWRS: Area 17)	X	O	O	⊠	X	O	O	O	O
Upper Bay (NARWRS: Area 18 [part])	⊠	X	O	⊠	⊠	O	⊠	⊠	O
Maryland Bay Area (CBIPC:IIIA2.19)	⊠	⊠	⊠	X	X	X	X	⊠	X
Potomac Basin (NARWRS: Area 19)	X	O	O	⊠	O	O	X	O	X
Rappahannock/York Basin (NARWRS: Area 20)	X	O	O	X	O	O	O	O	X
James River Basin (NARWRS: Area 21 [part])	X	O	O	⊠	X	O	O	⊠	O
Delmarva Coastal Zone (NARWRS: Areas 18,21) [part]	O	X	O	O	O	O	⊠	O	⊠

⊠ Major X Significant O Relatively Insignificant

FIGURE 3:

AWARENESS OF COASTAL PROBLEMS (As Evaluated by North Atlantic Regional Resources Study) (Ref. 1)	Maine	New Hampshire	Massachusetts	Rhode Island	Connecticut	New York	New Jersey	Pennsylvania	Delaware	Maryland	Virginia	District of Columbia
Living Resources	⊠	O	⊠	X	O	X	X	O	X	⊠	⊠	O
Conservation of Wetlands	X	⊠	⊠	X	⊠	⊠	⊠	O	X	⊠	⊠	O
Non-Living Resources	O	O	X	O	O	X	O	O	O	O	O	O
Water Pollution	X	X	⊠	X	X	⊠	⊠	⊠	X	X	X	⊠
Thermal Effects	O	O	O	O	X	X	X	O	O	⊠	O	O
Solid Wastes Disposal	O	O	X	O	O	⊠	X	O	O	O	O	O
Recreation	X	X	⊠	⊠	X	⊠	⊠	O	X	X	⊠	O
Marine Transportation	X	O	O	X	O	⊠	⊠	⊠	X	⊠	⊠	O
Coastal Erosion and Tidal Flooding	O	O	X	X	X	⊠	⊠	O	X	X	X	O

⊠ Major X Significant ⊠ Relatively Insignificant

doubtful that effects on the Bay caused by activity in the Basin would feed back on the basin." (Ref. 7)

2 The Chesapeake Bay Watershed in the Context of the North Atlantic Region

Figure 3 from the NARWR Study indicates how the authors and experts interviewed see current "awareness of coastal problems".(Ref. 1) They summarize as follows: "For the (North Atlantic) region as a whole, the importance being attached to problems could be ranked about in this order:

Major concern: Water pollution and wetland conservation are being considered as the most important problems. Following a little behind are recreation and marine transportation. If the rating reflected a "man on the street" reaction, as distinguished from the informed opinion evaluated here, marine transportation would drop substantially. So far it is a problem which has not been conveyed to the public.

Significant concern: At midrange on the scale are problems of living resources and of coastal erosion and tidal flooding. If the ranking reflected a "man on the street" reaction, as distinguished from the informed opinion evaluated here, commercial fishing would probably rise and coastal erosion and tidal flooding would probably drop. Memories of losses in great tidal floods of the past are short lived and probability predictions for the future seem unreal. Except for shoreline property owners, the public seems to attach little relationship to their enjoyment of the shoreline and the effort to protect it and them.

Lesser concern: Although there are important local exceptions, for the region as a whole coastal problems associated with thermal dissipation, solid waste disposal, and the extraction of non-living resources are currently being considered as less important than the other six problems. Depending upon results from intensive current research on the effects of thermal and solid waste disposal on marine life, either of these two problems could move far up the perception scale or drop out of sight. The extraction of non-living resources, currently the lowest on the perception scale, could rise significantly if oil and gas are extracted off Maine and if the crisis some predict in the supply of sand and gravel is satisfied offshore." (Ref. 1)

C

Emerging Issues by Geographic Location and Planning Area

1 Relative Importance of Future Chesapeake Bay Problems by Planning Areas (Counties)

Figure 4 presents a judgemental summary of the relative importance of emerging Chesapeake Bay problems by planning areas. The approach is similar to that used in the review of the relative importance of present Bay problems in Section A above. The categories "major,"significant" and "relatively insignificant" are self-explanatory and assignment to categories was judgemental. A fourth category ("could become either more or less significant") was added to allow for divergent possible developments as a result of future decisions regarding Bay land or water uses (e.g. see items I-N for Harford County). Explanatory notes for judgemental decisions made in developing the summary chart are included in the following text.

CHART 4: RELATIVE IMPORTANCE OF FUTURE CHESAPEAXE BAY PROBLEMS [2)]

	a. Living Resources	b. Conservation of Wetlands	c. Water Movement	d. Shore Erosion & Sediment	e. Water Pollution	f. Water Supply	g. Thermal Waste Discharge	h. Marine Transportation	i. Water-Related Outdoor Rec	j. Waterfront Industry	k. Waterfront Residential	l. Access & Appearance	m. Solid Waste Disposal	n. Non-Living Resources	o. Information Gaps	p. Synthesis of Planning	q. Public Awareness	r. Tools for Implementation	s. Management Capability	t. Fiscal Support
1.1 Cecil	■	■	■	X	X	O	O	■	X	X	X	X	O	O				X	X	O
1.2 Harford	■	X	X	X	■	±	■	O	±	±	±	±	±	±				X	X	O
1.3 Baltimore	■	X	■	X	■	X	O	O	■	X	■	■	■	X				O	X	■
1.4 Baltimore City	O	O	■	X	X	X	O	■	O	■	O	■	■	O				O	X	O
1.5 Anne Arundel	■	X	■	■	■	■	O	O	■	■	■	■	■	X				O	X	■
1.6 Calvert	■	X	X	■	X	X	■	O	O	X	X	X	X	X				X	X	X
1.7 St. Mary's	■	X	O	■	X	O	O	X	O	O	O	X	O	O				X	X	O
1.8 Western Shore	■	X	■	■	■	X	■	■	■	■	■	■	■	X	■	X	■	X	■	■
1.9 Xent	X	■	X	O	X	X	O	O	O	X	X	O	O	O				X	X	X
1.10 Queen Anne's	■	■	X	■	X	X	O	O	O	O	X	X	X	O				X	X	X
1.11 Talbot	■	■	X	■	X	O	O	O	X	O	X	X	X	O				X	X	X
1.12 Dorchester	■	■	O	■	X	X	O	O	X	X	X	X	X	O				X	X	X
1.13 Somerset	■	■	O	X	■	X	O	■	X	■	O	X	O	O				X	X	X
1.14 Eastern Shore	■	■	X	■	X	X	O	O	X	■	X	X	X	O	■	X	X	■	■	■
1.15 St. Mary's	■	■	X	X	O	O	O	O	O	O	O	O	O	O				X	X	X
1.16 Charles	O	X	X		X	O	O	O	O	O	O	O	O	O				X	X	X
1.17 Prince George's	O	O	X		X	X	O	O	X	O	X	X	X	X				O	X	X
1.18 Potomac	■	■	X	O	X	O	O	O	O	O	O	O	X	O	■	X	X	X	X	X
1.19 CBIPC Study Area	■	■	X	X	X	X	■	■	X	■	X	X	X	O	■	■	■	X	■	X
NARWRS-Area 18	■	X		O	■		■	■	■				O	O						

■ Major X Significant O Relatively Insignificant

() No Information ± Could Become Either More or Less Significant

1.1 Cecil County[1]

a. Living Resources will become a "major" problem because low flows in the Susquehanna will be further reduced by diversion and consumptive uses, and increased outflow of fresh-water through the deepened C and D Canal will also lead to degradation of water characteristics and quality on which the living resources depend.

d. Shore Erosion and Sedimentation will become "significant" because the deepened C and D Canal will be a more effective sediment trap, even though the sediment loads carried to the area by streams and currents will remain relatively constant or increase slightly due to development in the County's watersheds.

e. Water Pollution will become a "significant" problem because of the reduced fresh-water inputs mentioned above in A-1 and because pollution loads in the Susquehanna will be increasing due to urban, industrial and agricultural development in its basin.

i. Water Related Outdoor Recreation will become a "significant" problem because of increased use of the rather limited water-related public open space in the County and the additional demands of people seeking recreational facilities on private land in conjunction with waterfront residences.

k. Waterfront Residential will become "significant" because of increased demands for second homes. The County will still be far enough from major urban areas so that demands for year-around housing other than retirement homes will be relatively light. Waterfront industry may also.

1.2 Harford County

f. Water Supply,

i. Water-Related Outdoor Recreation,

l. Access and Appearance.

m. Solid Waste Disposal and

n. Non-Living Resources:

could become "significant" or even "major" problems if, as has been proposed, large parcels of Federally owned land at either Aberdeen or Edgewood are released

and subsequently used as sites for new towns. On the other hand if, as has also been proposed, these large areas are converted to public open space then Water Supply and Non-Living Resources will remain "relatively insignificant" because of reduced demands. Water-Related Recreation will remain "significant" because of the resulting respective requirements for management and design. However, Solid Waste Disposal will remain "significant" or become "major" in this case as well, since sites will be preempted for parks, which might otherwise be used as disposal areas.

g. Thermal Discharge will become a "major" problem since the County has been proposed as the site of the next nuclear power plant to be built on the Bay after the Calvert Cliffs plant now under construction.

j. Waterfront Industry and

k. Waterfront Residential will probably become "significant" problems in either of the cases described above -- in the first case, because of the planning and management problems involved, and in the second because of the increased pressures on the remaining land for industrial and residential development if the large parcels of Federally-owned land become public open space.

1.3 Baltimore County

d. Shore Erosion and Sedimentation will become "significant" because increasing sediment loads from construction and other urban activities will increase flushing problems of sub-estuaries and necessitate more dredging to maintain shipping channels.

f. Water Supply will become a "significant" problem because virtually all feasible reservoir sites within the County have been used and water to meet the needs of growing population and industry will have to be increasingly imported from other basins, such as the Susquehanna or Potomac, which are already under pressure to supply water to other urban areas.

j. Waterfront Industry will become a "significant" problem if the second Bay crossing is built between Baltimore and Kent Counties.

1.4 Baltimore City

d. Shore Erosion and Sedimentation and

f. Water Supply:

will change to "significant" for much the same reasons as in Baltimore County.

1.5 Anne Arundel County

The relative future importance of the County's problems will remain very much as they are now.

1.6 Calvert County

f. Water Supply and

k. Waterfront Residential:

will probably become "significant" problems in the long-run because of increased demand for both first and second homes in the area (especially if the second Bay crossing is built here) the concommitant demands placed on the groundwater intrusion supply and the resultant possibility of salt-water intrusion into aquifers underlying the developed waterfront areas.

j. Waterfront Industry will become a "significant" problem in addition to the above if the second Bay crossing is built from Calvert County to Dorchester as has been proposed.

1.7 St. Mary's County (Bay Shoreline Area)

Relative future importance of problems will stay much as they are now.

1.8 Western Shore Summary

The rating system is the same as in Section A 2 above, i.e. 1) if one county was rated "major" in a particular category, the Shore was rated "significant"; 2) if two or more counties were rated "major", the Shore was rated "major"; 3) if all counties were rated "significant", the Shore was rated "major"; 4) if any county was rated "significant" in a category, the Shore was rated the same.

In accordance with this scheme only

g. Thermal Discharge changes from the present relative importance. This is because Thermal Discharge will become a "major" problem in Harford County with the siting there of the next nuclear power plant, and this will make two "major" ratings for the Western Shore of the Bay.

1.9 Kent County

a. Living Resources will probably become a "major" problem because of increased consumptive use and diversion of Susquehanna water, and because of increased fresh-water outflow through the deepened C and D Canal.

e. Water Pollution,

f. Water Supply,

j. Waterfront Industry, and

k. Waterfront Residential:

will all become "significant" problems if the second Bay crossing is built from Baltimore County to Kent County.

1.10 Queen Anne's County

f. Water Supply will become an increasingly "significant" problem because of the increased demand generated by proliferating waterfront residences and the concommitant problems of lowered water levels and danger of salt water intrusion.

1.11 Talbot County

There will be little change in the relative importance of the County's problems in the foreseeable future.

1.12 Dorchester County

f. Water Supply will probably become a "significant" problem if the County is selected as the site of the second Bay crossing. This will be due to increased demand from stimulated waterfront industrial and waterfront residential demands.

1.13 Somerset County

e. Water Pollution and

f. Water Supply:

will be upgraded to "major" and "significant" problems respectively if the proposed Annemessex Industrial Park is built, with its demands for waste assimilation and industrial fresh water supplies.

i. Water-Related Outdoor Recreation and

l. Access and Appearance:

will become "significant" problems as well if the above industrial complex is built because of the possible conflict with the Janes Island State Park.

1.14 Eastern Shore Summary

The overall rating for

f. Water Supply will be upgraded to "significant". Otherwise overall relative ratings for the Eastern Shore will remain roughly the same.

1.15, 1.16, 1.17, 1.18

St. Mary's County (Potomac Shore), Charles County, Prince George's County, and the Potomac Shore

The ratings as to the relative importance of future problems in these areas are judged to be unchanged for the most part.

1.19 The CBIPC Study Area -- The Maryland Portion of the Chesapeake Bay

The ratings of future importance of problems remains much the same, with the exception of:

g. Thermal Discharge. This is judged to probably rate as a "major" future Bay problem because several more nuclear power plants are proposed for location on the Bay shore.

D

Population Change, Economic Trends and Urban Land Absorption Impacts, by Planning Area

1 Population Change

1.1 Linkages Between Population and Environmental Management

Population is the source of demands for open space, recreation facilities, and environmental quality. On a typical summer weekend in 1965 (Ref. 8), it is estimated that about 90,000 of Baltimore Region's population swam in the Bay. About 170,000 picnicked, 130,000 boated or sailed, 145,000 fished, and 20,000 hiked. And this does not include persons from other counties and states who come to the Baltimore region to participate in these activities. Participation in other activities such as swimming (in the ocean) hunting and camping are the source of much of the travel between the western and eastern shore - and thus forms part of the justification for major facilities such as proposed additional Bay crossings, which would in themselves produce extensive environmental effects.

TABLE 1 POPULATION CHANGE, 1960 - 1970, BY COUNTY

County and Region	1960 Population[a)]	Net Population Increase (+) or Decrease (-) 1960 to 1970	1970 Population[a)]
Anne Arundel Co.	206,600	+ 90,900	297,500
Baltimore City	939,000	- 33,300	905,800
Baltimore Co.	492,400	+128,600	621,100
Carroll Co.	52,800	+ 16,300	69,100
Harford Co.	76,700	+ 38,700	115,400
Howard Co.	36,200	+ 25,800	61,900
Baltimore Region	1,803,700	+267,000	2,070,700
Montgomery Co.	340,900	+181,900	522,800
Prince George's Co.	357,400	+303,200	660,600
Washington Metro	698,300	+485,100	1,183,400
Calvert Co.	15,800	+ 4,900	20,700
Charles Co.	32,600	+ 15,100	47,700
St. Mary's Co.	38,900	+ 8,500	47,400
Southern Maryland	87,300	+ 28,400	115,700
Caroline Co.	19,500	+ 320	19,800
Dorchester Co.	29,700	- 260	29,400
Kent Co.	15,500	+ 670	16,100
Queen Anne's Co.	16,600	+ 1,850	18,400
Somerset Co.	19,600	- 700	18,900
Talbot Co.	21,600	+ 2,100	23,700
Wicomico Co.	49,100	+ 5,190	54,200
Worchester Co.	23,700	+ 710	24,400
Eastern Shore	195,200	+ 9,880	205,000
Cecil Co.	48,400	+ 4,880	53,300
Md. Chesapeake Bay Region	2,833,000	+795,200	3,628,200

a) Bureau of Census
Maryland Population and Housing Characteristics
Tabls 9 "Population and Land Area of Counties: 1960 & 1970" p.22-15
(figures rounded to nearest 100)

The importance of the relationship of population to Chesapeake Bay management is obvious, although many of the linkages are not clearly established. On the average, each person generates about 1,200 lbs. of solid wastes per year, which may be translated into needs for landfill sites, possible threats to wetlands and considerable social costs for handling and transport. On the average, each person uses 80-100 gallons of water per day, which creates needs for major water supply facilities and indirect effects on stream flow and assimilative capacity. Moreover, each person is responsible for .17-.20 pounds of BOD daily, which either pollutes streams or generates need for considerable public expenditure for sewage treatment plants. Demands for housing and mobility contribute to sedimentation problems in the construction of subdivisions and highways, and also permanently transforms the land - thereby preempting other alternative uses such as open space and aquifer recharge.

Thus, a picture of population has major environmental management implications. Table 1 presents 1960, 1970 and net 1960-70 population change for Maryland Bay counties. The figures indicate that population in the Maryland Bay Region increased by 28% during the past decade. However, the distribution of the increase is notably uneven. 99% of the total net population increase occurred in the suburban counties of the Baltimore and Washington metropolitan regions. While population in the region increased 28%, the increase in Eastern Shore counties was only 5%. These differences are the source of a range of conservation and development problems.

1.2 Population Projections and Environmental Management

Population projections both reflect realistic development goals and provide the basis for planning facilities and services (sewerage systems, recreation and open space, solid waste disposal facilities that are crucial to the maintenance of environmental quality. Where actual population growth exceeds expections, it is likely that needed facilities and services have not been anticipated. Where actual population growth falls short of expected growth, it is likely that hoped for development did not occur or was ineffective in attracting or retaining population in the area. Of course, the activities of a population which either has no net population change or which changes in accordance with expectations requires major continuing efforts in environmental management. To the degree that projections are contradicted by events, however, additional conservation and development problems are likely to occur.

Table 2 presents a comparison of actual 1970 populations and the expectations as reflected by projections developed in the mid-1960's. For the Maryland Bay Region as a whole, the projections of 1970 population were very accurate. For smaller areas, however, the differences between actual and expected 1970 population are significant. With the exception of Queen Anne's and Talbot Counties, none of the Eastern Shore counties achieved expected 1970 population levels. The actual 1970 population in Southern Maryland was very close to expected levels; however, the distribution of the population among the three counties of the region was very different from expectations. Though a net increase of 431,000 persons between 1960 and 1970 was expected in Montgomery and Prince George's Counties, the actual 1970 population levels exceeded expectations by 54,000 persons. These discrepancies between actual and expected events both reflect and in some cases, are partial causes of current conservation and development problems. They will prompt adjustments in existing projections for 1980 and the year 2000, and investigations into the reasons for the discrepancies, resulting in refinements of projection methodology. They may also prompt innovations in the area of development controls and incentives which will enable more effective control of population shifts and the environmental consequences of population shifts.

TABLE 2 COMPARISON OF ACTUAL AND EXPECTED 1970 POPULATION, BY COUNTY

County and Region	Actual 1970 Population[a]	Expected 1970 Population[b]	Excess (+) or Shortfall (-): Actual 1970 Population vs Expected	Percent Excess (+) or Shortfall (-)
Anne Arundel Co.	297,500	316,800	-19,300	- 6.5%
Baltimore City	905,800	946,200	-40,500	- 4.5%
Baltimore Co.	621,100	645,200	-24,100	- 3.9%
Carroll Co.	69,100	66,500	+ 2,600	+ 3.7%
Harford Co.	115,400	110,500	+ 4,900	+ 4.2%
Howard Co.	61,900	65,300	- 3,400	- 5.4%
Baltimore Region	2,070,700	2,150,500	-79,800	- 3.9%
Montgomery Co.	522,800	508,100	+14,700	+ 2.8%
Prince George's Co.	660,600	621,100	+39,500	+ 6.0%
Washington Metro	1,183,400	1,129,200	+54,200	+ 4.6%
Calvert Co.	20,700	21,900	- 1,200	- 5.8%
Charles Co.	47,700	42,600	+ 5,000	+10.6%
St. Mary's Co.	47,400	50,700	- 3,300	- 7.0%
Southern Maryland	115,700	115,200	+ 500	+ 0.5%
Caroline Co.	19,800	20,600	- 800	- 4.0%
Dorchester Co.	29,400	30,600	- 1,200	- 4.1%
Kent Co.	16,100	18,000	- 1,800	-11.2%
Queen Anne's Co.	18,400	18,300	+ 130	+ 0.7%
Somerset Co.	18,900	19,000	- 80	- 0.4%
Talbot Co.	23,700	23,400	+ 240	+ 1.0%
Wicomico Co.	54,200	56,000	- 1,700	- 3.2%
Worchester Co.	24,400	25,300	- 900	- 3.7%
Eastern Shore	205,000	211,700	- 6,700	- 3.3%
Cecil Co.	53,300	59,200	- 5,800	-11.0%
Md. Chesapeake Bay Region	3,628,200	3,665,800	-37,600	- 1.0%

a) Bureau of Census:
Maryland Population and Housing Characteristics
Table 9 "Population and Land Area of Counties: 1960 & 1970" p.22-15
(figures rounded to nearest 100)

1.3 Population Growth Rates

Table 3 presents expected net population growth rates for the decades 1960-2000, and the actual growth rates experienced in the 1960-1970 decade. Expected growth rates for most already urbanized counties exhibit a gradually declining pattern in successive decades. However,

TABLE 3 NET POPULATION GROWTH RATES, ACTUAL & EXPECTED, 1960-2000; BY DECADE, BY COUNTY

County and Region	1960 Actual[a]	1970 Expected[b]	1970-1980 Expected[b]	1980-1990 Expected[b]	1990-2000 Expected[b]
Anne Arundel Co.	44.0%	53.3%	31.2%	22.2%	18.1%
Baltimore City	- 3.5%	0.8%	0.5%	0.5%	0.5%
Baltimore Co.	26.1%	31.0%	24.4%	15.4%	13.4%
Carroll Co.	30.7%	26.0%	13.1%	25.1%	20.1%
Harford Co.	50.4%	44.1%	36.1%	28.1%	21.9%
Howard Co.	71.3%	80.5%	72.9%	45.3%	31.2%
Baltimore Region	14.8%	19.2%	16.6%	13.3%	11.7%
Montgomery Co.	53.3%	49.0%	24.0%	19.0%	16.0%
Prince George's Co.	84.8%	73.8%	24.0%	15.1%	13.1%
Washington Metro	69.5%	61.7%	24.0%	16.9%	14.4%
Calvert Co.	30.7%	38.3%	19.7%	38.2%	27.6%
Charles Co.	46.4%	30.9%	36.5%	14.7%	12.8%
St. Mary's Co.	21.8%	30.3%	19.6%	9.4%	8.6%
Southern Maryland	32.6%	32.0%	25.9%	16.7%	14.3%
Caroline Co.	1.6%	5.7%	0.1%	12.1%	10.8%
Dorchester Co.	- 0.9%	3.2%	4.9%	19.3%	16.2%
Kent Co.	4.3%	15.9%	4.9%	24.3%	19.6%
Queen Anne's Co.	11.2%	10.4%	6.6%	11.5%	10.3%
Somerset Co.	- 3.6%	3.1%	4.9%	7.7%	7.1%
Talbot Co.	9.8%	8.6%	13.4%	21.5%	17.7%
Wicomico Co.	10.6%	14.1%	4.5%	14.1%	12.4%
Worchester Co.	3.0%	6.8%	0.5%	19.3%	16.2%
Eastern Shore	5.1%	8.5%	4.6%	16.2%	14.0%
Cecil Co.	10.1%	22.2%	22.4%	14.6%	12.7%
Md. Chesapeake Bay Region	28.1%	29.4%	18.6%	14.7%	12.8%

[a] Bureau of Census:
Maryland Population and Housing Characteristics
Table 9 "Population and Land Area of Counties: 1960 & 1970" p.22-15
(figures rounded to nearest 100)
[b] based on: "State of Maryland Population Projections, 1960-2000" (Ref. 13)

many counties which presently are lightly urbanized are expected to experience sharply increased rates of population growth in coming decades. Five of the twenty Maryland Bay Region counties are expected to have higher growth rates in the 1970-1980 decade than were expected in the 1960-1970 decade. Ten counties are expected to have higher growth rates in the 1980-1990 decade than in the 1970-1980 decade. Notably, however, no counties are expected to have higher growth rates in the 1990-2000 decade than in the 1980-1990 decade. The implications of actual 1960-1970 population growth rates on expected patterns are as yet undetermined. Will the patterns remain as expected while magnitudes are increased or decreased? Or will expected patterns of growth rates in succeeding decades also change with counties which fell short of expectations in the 1960-1970 decade "recouping their losses" before the turn of the century (and vice versa)? Other than vacant land supply, what are the effective governors of population growth rates? These and other questions with regard to population growth rates have major implications for future Bay management.

2 Economic Trends

2.1 Linkages Between Economic Projections and Environmental Management

The relationship between economic goals, natural resource supply and environmental quality is extraordinarily complex. Often the focus has been on the demands of economic growth for natural resources. Economic growth translates into demands for land, demands for water supplies, and demands for the use of water and air resources for waste discharge. In this sense, the supply of natural resources acts as constraints on economic growth -- either by imposing "absolute" limits on certain kinds of economic growth or by imposing problems of resource allocation. Thus commercial fishing and certain mining operations face certain "absolute" limits imposed by natural resource supply. And, problems of allocation of limited supplies of suitably located land for port-dependent industries constrain economic growth.

It is increasingly found in a mobile society that environmental quality is a factor (sometimes a prerequisite) for certain kinds of economic growth. The tourist industry and recreation-related enterprises are obvious examples which increase in importance with increases in mobility, incomes, leisure time, etc. But the repercussions are more broad-ranging. Many growth industries depend on professional personnel who are able and willing to make environmental quality a factor in job choice, and developments in communica-

TABLE 4: EMPLOYMENT PROJECTIONS 1960-1980, BY SUBREGION AND RATES OF GROWTH, BY DECADE

		EMPLOYMENT (000)			PERCENT OF TOTAL EMPLOY.[a]			RATES OF GROWTH	
		1960	1970	1980	1960	1970	1980	1960-1970	1970-1980
BALTIMORE REGION									
INDUSTRY GROUPS									
Agriculture	(SIC 01-09)	17.0	12.7	12.4	2.4%	1.6%	1.4%	-25.2%	- 2.3%
Mining	(SIC 10-14)	1.2	1.2	1.6	0.2%	0.2%	0.2%	0.0%	33.3%
Construction	(SIC 15-17)	40.5	46.4	54.7	5.8%	5.9%	6.1%	14.5%	17.8%
Manufacturing	(SIC 19-39)	205.0	208.7	213.5	29.2%	26.7%	23.6%	1.8%	2.2%
Transp.Communic.&Pub.Util.	(SIC 40-49)	55.2	53.5	56.4	7.9%	6.8%	6.2%	- 3.0%	5.4%
Wholesale Trade	(SIC 50)	35.8	45.8	60.0	5.1%	5.9%	6.6%	27.9%	31.0%
Retail Trade	(SIC 52-59)	112.7	128.8	148.2	16.0%	16.5%	16.4%	14.2%	15.0%
Finance, Ins., Real Estate	(SIC 60-67)	36.7	43.8	52.1	5.2%	5.6%	5.8%	19.0%	18.9%
Services	(SIC 70-89)	131.0	165.0	215.7	18.6%	21.1%	23.9%	25.9%	30.7%
Government[b]	(SIC 91-93)	67.3	76.7	89.1	9.6%	9.8%	9.9%	13.9%	16.1%
Total		702.4	782.7	903.7	100.0%	100.0%	100.0%	11.4%	15.4%
Population (000)									
Actual		1804	2071					14.8%	
Expected			2151	2507				19.2%	16.6%
DC METRO REGION (MD.PART)									
INDUSTRY GROUPS									
Agriculture	(SIC 01-09)	8.0	6.1	6.0	4.6%	2.2%	1.4%	-23.7%	- 1.6%
Mining	(SIC 10-14)	0.8	0.8	1.2	0.4%	0.3%	0.3%	0.0%	50.0%
Construction	(SIC 15-17)	16.6	30.3	48.3	9.5%	10.7%	11.5%	82.5%	59.4%
Manufacturing	(SIC 19-39)	10.1	14.1	16.2	5.8%	5.0%	3.9%	39.6%	14.8%
Transp.Communic.&Pub.Util.	(SIC 40-49)	4.9	7.8	11.2	2.8%	2.7%	2.7%	59.1%	43.5%
Wholesale Trade	(SIC 50)	2.9	9.2	15.2	1.7%	3.3%	3.6%	217.2%	65.2%
Retail Trade	(SIC 52-59)	34.6	66.5	93.3	19.9%	23.4%	22.3%	92.1%	40.3%
Finance, Ins., Real Estate	(SIC 60-67)	8.6	20.8	33.1	4.9%	7.3%	7.9%	141.8%	59.1%
Services	(SIC 70-89)	54.8	85.4	133.1	31.5%	30.1%	31.9%	55.8%	55.8%
Government[b]	(SIC 91-93)	32.9	42.8	60.2	18.9%	15.1%	14.4%	30.0%	40.6%
Total		174.1	283.9	418.3	100.0%	100.0%	100.0%	63.0%	47.3%
Population (000)									
Actual		698	1183					69.5%	
Expected			1129	1401				61.7%	24.0%
SOUTHERN MARYLAND									
INDUSTRY GROUPS									
Agriculture	(SIC 01-09)	7.2	5.5	5.6	30.5%	19.0%	14.9%	-23.6%	1.8%
Mining	(SIC 10-14)	0.0	0.0	0.0	0.0%	0.0%	0.0%	0.0%	58.3%
Construction	(SIC 15-17)	0.8	1.2	1.9	3.3%	4.3%	5.2%	50.0%	33.3%
Manufacturing	(SIC 19-39)	1.4	1.2	1.6	5.9%	4.3%	4.2%	-14.2%	60.0%
Transp.Communic.&Pub.Util.	(SIC 40-49)	1.1	1.0	1.2	4.5%	3.6%	3.3%	- 9.0%	20.0%
Wholesale Trade	(SIC 50)	0.5	1.1	1.4	2.1%	4.0%	3.9%	120.0%	27.2%
Retail Trade	(SIC 52-59)	3.4	5.2	7.7	14.5%	18.0%	20.5%	52.9%	48.0%
Finance, Ins., Real Estate	(SIC 60-67)	0.7	0.8	1.0	3.0%	2.8%	2.7%	14.2%	25.0%
Services	(SIC 70-89)	4.9	7.2	10.1	20.8%	24.9%	27.0%	46.9%	40.2%
Government[b]	(SIC 91-93)	3.6	5.6	6.9	15.5%	19.3%	18.5%	55.5%	23.2%
Total		23.5	29.0	37.6	100.0%	100.0%	100.0%	23.4%	29.6%
Population (000)									
Actual		87	116					32.6%	
Expected			115	145				32.0%	25.9%
EASTERN SHORE									
INDUSTRY GROUPS									
Agriculture	(SIC 01-09)	18.3	13.5	13.4	25.1%	17.6%	16.4%	-26.2%	- 0.7%
Mining	(SIC 10-I4)	0.I	0.I	0.I	0.I%	0.I%	0.I%	0.0%	0.0%
Construction	(SIC 15-17)	2.7	4.0	4.5	3.7%	5.2%	5.6%	48.1%	12.5%
Manufacturing	(SIC 19-39)	18.6	19.1	18.1	25.6%	24.8%	22.2%	2.6%	- 5.2%
Transp.Communic.&Pub.Util.	(SIC 40-49)	3.2	4.0	4.4	4.5%	5.2%	5.4%	25.0%	10.0%
Wholesale Trade	(SIC 50)	2.8	3.2	3.4	3.8%	4.2%	4.2%	14.2%	6.2%
Retail Trade	(SIC 52-59)	8.7	11.5	13.8	11.9%	14.9%	16.9%	32.1%	20.0%
Finance, Ins., Real Estate	(SIC 60-67)	1.9	2.6	2.8	2.6%	3.4%	3.4%	36.8%	7.6%
Services	(SIC 70-89)	13.4	15.5	17.0	18.4%	20.2%	20.9%	15.6%	9.6%
Government[b]	(SIC 91-93)	3.0	3.4	3.9	4.2%	4.5%	4.8%	13.3%	14.7%
Total		72.8	76.9	81.5	100.0%	100.0%	100.0%	5.6%	5.9%
Population (000)									
Actual		195	205					5.1%	
Expected			212	222				8.5%	4.6%
CECIL COUNTY									
INDUSTRY GROUPS									
Agriculture	(SIC 01-09)	2.0	1.5	1.4	14.1%	9.5%	7.9%	-25.0%	- 6.6%
Mining	(SIC 10-14)	0.1	0.1	0.1	0.5%	0.5%	0.6%	0.0%	0.0%
Construction	(SIC 15-17)	0.3	0.6	0.9	2.0%	3.7%	5.1%	100.0%	50.0%
Manufacturing	(SIC 19-39)	3.0	3.7	3.7	21.7%	23.9%	20.2%	23.3%	0.0%
Transp.Communic.&Pub.Util.	(SIC 40-49)	0.8	0.4	0.4	5.5%	2.5%	1.9%	-50.0%	0.0%
Wholesale Trade	(SIC 50)	0.3	0.3	0.4	2.2%	2.0%	2.2%	0.0%	33.3%
Retail Trade	(SIC 52-59)	1.7	2.4	2.9	12.3%	15.6%	16.0%	41.1%	20.8%
Finance, Ins., Real Estate	(SIC 60-67)	0.3	0.3	0.4	2.5%	2.3%	2.5%	0.0%	33.3%
Services	(SIC 70-89)	3.4	3.9	5.0	24.7%	25.5%	27.4%	14.7%	28.2%
Government[b]	(SIC 91-93)	2.0	2.2	2.9	14.5%	14.5%	16.0%	10.0%	31.8%
Total		13.9	15.3	18.1	100.0%	100.0%	100.0%	10.0%	18.3%
Population (000)									
Actual		48	53					10.1%	
Expected			59	72				22.2%	22.4%

a) See Reference 9.

b) Excludes public education employees included in the services group.

tions enable employers to base site location on this basis. Thus, environmental quality is an increasingly important factor in a region's ability to attract new economic enterprises.

Considerations of the relationship between economic (and population) growth, natural resource supply, and environmental quality lead to attempts to evaluate the relationships in the light of notions of human well-being. And this leads to questioning of goals of economic growth themselves. Such questions are very difficult to resolve (efforts to increase environmental quality rely to a large extent on the wealth of the region), but limitations on population and economic growth are being considered for some metropolitan areas (e.g., Denver) and some states (e.g. Oregon).

2.2 Economic Projections for Maryland Bay Subregions

Table 4 presents selected data from economic projections for Maryland Bay Subregions (Ref. 9) along with expected rates of economic growth and selected population data. For environmental management purposes, data in terms of employment is less useful than data relating directly to productivity. For example, though agricultural employment was expected to decrease substantially in every subregion in the 1960-1970 decade [3] indications are that agricultural production did not decline nearly so rapidly [4], if at all. And it may be that the use of pesticides and other potentially polluting substances per unit of agricultural production actually increased. Furthermore, environmental management demands economic data by industry rather than by broad industry group, as various industry types within the broad groups pose very different environmental management problems. Finally, the 1970 employment estimates have not been verified against actual events - though comparison of actual and expected population growth rates suggests that the expected economic growth rates for the 1960-1970 decade may be somewhat high in the case of the Baltimore and Eastern Shore Subregions and somewhat low for the Washington Metropolitan Counties.

3 Land Suitability and Urban Land Absorption Impacts

The following analysis relates future population growth and urban land absorption to an inventory of land characteristics in Maryland Bay counties. As the discussion makes clear, the analysis is based on available data and is very crude in its present form. However, refinements of the analysis outlined below and applications at smaller scales could become very useful environmental management tools. By providing a framework which relates land characteristics to urban land demands, the analysis provides a needed perspective on land management problems.

3.1 Inventory of Land Characteristics

a. Time Reference of Data

Because it is developed by various state and local agencies, available information on urban development and natural land characteristics[5] often refer to different points in time. One of the purposes of the land characteristics accounts system would be to maintain current information on both natural and urban development land characteristics.

b. Urban Land Use Categories

There are no consistent categories or category definitions used in the inventories of urban land uses in the several counties. Naturally enough, each land use survey is organized according to the needs and interests of the particular county. Thus, Calvert County distinguishes between "year-round" and "seasonal" residential uses; Anne Arundel County distinguishes between single and multi-family residential uses; and Somerset County organizes its residential land inventory around the "farm", "non-farm" distinction. The same pattern holds for commercial, industrial and other broad land use categories. A land inventory accounts system would require a set of land use categories and category definitions which both serve the particular interests of individual counties and are capable of aggregation at the regional level. This would also assist in relating regional projections of land needs[6] to local plans and implementation policies.

c. Relating Urban Land Use to Urban Population

It is also difficult to identify how comprehensive the county land inventories actually are. This makes it difficult to relate the land inventory with population data and to make conclusions as to what proportion of the county's population and activity the land inventory represents. For instance, St. Mary's County reportedly has 6,724 acres of permanent (non-seasonal) residential land. But whether this residential land represents urban population plus population in places of 1,000-2,500 (8,320 in 1960) or includes all or part of the county's rural population (30,595 in 1960) is unclear. In the analysis discussed below it is assumed that residential and other urban development land represents "urban" population plus population in places of 1,000-2,500, unless more precisely specified. In Dorchester and Somerset Counties, two counties which made a distinction between farm and non-farm residential land, this assumption yields net residential densities of 10.2 and 8.3 persons/acre respectively, on farms and 4.0 and 2.3 persons/acre elsewhere.

d. Preemptive Relationship Between Urban and Natural Land Uses

It is assumed in the Table 5 that land characteristics imposed by human activities preempt natural land characteristics. This was done in order that certain land would not be double-counted in the "developed" and "undeveloped" portions of the inventory. The assumption is not completely representative of reality in the case of residential land -- where a portion of the site is often left in approximately the natural state -- and it is not necessarily true in the case of "public and semi-public" land -- which may include parks specifically designed to conserve natural land characteristics in urban development. Many developing land use controls are designed to reduce the preemptive impact of urban development on natural land characteristics. An example is the relatively new "planned unit development" as an alternative to traditional subdivision planning. Planned unit developments often leave 25-30% of the site

TABLE 5: LAND INVENTORY WITH IMPLICATIONS FOR FUTURE POPULATION GROWTH BY COUNTY (Ref. 11,12)

	A.A. County	Baltimore County	Carroll County	Harford County	Howard County
Forested Lend					
Prime Potential Agri.	35,696	26,194	14,298	25,134	15,112
Steep Slope	26,284	42,268	21,211	29,004	11,981
Poor for Septic Tank	14,103	6,798	100	14,195	869
Non-Forested/Uplend Marsh					
Prime for Agriculture	41,422	86,211	91,394	54,441	62,585
Steep Slope	3,843	25,770	35,249	23,512	7,292
50 yr. Flood Plain	16,022	--	--	633	--
Poor for Septic Tank	5,848	3,219	--	5,376	1,383
Marsh Area	2,316	1,711	--	2,575	--
(1) Unsuiteble for Urben Devel.	145,534	192,171	162,252	154,870	93,237
Military Installation	16,559	1,049	--	42,000	--
Urban Development Area (1960)	31,478	79,676	7,564	9,885	5,574
(2) Unavailable for Urban Devel.	48,037	80,725	7,564	51,885	5,574
Total Land Resource Area	266,880	390,400	289,920	286,720	160,000
Unsuitable and Unaveileble (1+2)	193,571	272,896	169,816	206,755	98,811
(3) Availeble & Suitebla for Urban Devel.	73,309	117,504	120,104	79,965	61,189
Urban Development 1960	31,478	79,676	7,564	9,885	5,574
Urban Pop. 1960[a]	104,153	420,840	10,931	24,159	7,083
(4) Index: Urban Devel. Area/Person (1960)	.320	.189	.690	.408	.787
Expected Pop. 2000	600,000	1,050,000	113,000	235,000	215,000
Population 1960	206,634	492,428	52,785	76,722	36,152
(5) Pop. Change 1960-2000	393,366	557,572	60,215	158,278	178,848
(6) Urban Devel. Acreage Raquirement (4 x 5)	125,460	105,110	41,710	82,400	140,990
Available & Suitable for Urban Devel. (3)	73,309	117,504	120,104	79,965	61,189
(7) Urban Land Surplus (+) Or Deficit (-) (6-3)	-52,151	+12,394	+78,394	-2,435	-79,801

a) Population in "Urbanized Areae", "Othar Urban Territory" and "Pieces between 1000 and 2500 Population".

TABLE 5: LANO INVENTORY WITH IMPLICATIONS FOR FUTURE POPULATION GROWTH BY COUNTY (Ref. 11,12)

	Calvert County	Charlee County	St. Mary's County	Montgomery County	Princo George's County
Forested Land					
Prime Potential Agri.	7,258	57,064	42,121	17,049	42,795
Steep Slope	41,652	25,566	29,955	5,668	34,369
Poor for Septic Tank	11,699	49,171	(13,965)	772	33,475
Non-Forested/Upland Marsh					
Prime for Agriculture	19,801	44,960	48,206	75,390	44,448
Steep Slope	4,421	3,250	1,256	820	9,610
50 yr. Flood Plein	7,424	7,335	11,973	--	14,929
Poor for Septic Tenk	725	6,567	10,937	591	12,246
Marsh Area	3,722	5,866	2,585	--	3,360
(1) Unsuitable for Urben Devel.	96,702	199,799	160,998	103,289	195,232
Military Installation	--	4,530	9,197	1,620	6,104
Urban Development 1960	3,411	12,764	9,197	52,629	41,871
(2) Unavailable for Urban Davel.	3,411	17,294	18,394	54,249	47,975
Total Land Reeource Area	140,160	293,120	(234,880)	315,520	310,400
Unsuitable and Unavailable (1+2)	100,113	217,093	179,392	157,538	243,207
(3) Available & Suitable for Urben Devel.	40,047	76,027	55,488	157,982	67,193
Urben Oevelopment 1960	3,411	12,764	9,197	52,629	41,871
Urban Pop. 1960 [a]	?	2,262	8,320	293,387	301,010
(4) Index: Urban Devel. Aree/Person (1960)	5.66	5.66	1.07	.182	.137
Expected Pop. 2000	46,200	75,300	72,000	870,000	1,002,600
Population 1960	15,826	32,572	38,915	340,928	357,395
(5) Pop. Chenge 1960-2000	30,374	42,728	33,085	529,072	645,205
(6) Urban Devel. Acraage Requlrement (4 x 5)	172,300	242,500	35,200	97,520	88,130
Available & Suiteble for Urben Devel. (3)	40,047	76,027	55,488	157,982	67,193
(7) Urban Land Surplue (+) Or Deficit (-) (6-3)	-132,253	-166,473	+20,288	+60,462	-20,937

a) Population in "Urbenized Areae", "Other Urban Territory" end "Placee between 1000 and 2500 Population".

TABLE 5: LAND INVENTORY WITH IMPLICATIONS FOR FUTURE POPULATION GROWTH BY COUNTY (Ref, 11,12)

	Caroline County	Dorchester County	Kent County	Q. Anne's County	Somerset County
Forested Land					
Prima Potential Agri.	16,709	15,511	9,517	7,925	4,086
Steep Slope	2,059	289	5,342	4,198	42
Poor for Septic Tank	45,661	60,840	20,385	(39,935)	60,744
Non-Forasted/Upland Marsh					
Prlme for Agricultura	84,474	66,682	93,267	129,804	25,212
Steep Slope	48	144	2,213	287	--
50 yr. Flood Plain	10,304	5,056	7,360	12,480	832
Poor for Septic Tank	19,415	46,861	15,758	18,001	38,974
Marsh Area	2,600	78,226	3,995	4,904	52,305
(1) Unsuitable for Urban Devel.	181,270	273,609	157,837	227,534	182,195
Military Inetallation	--	5,095	--	--	--
Urban Development 1960	10,370	6,317	5,552	6,661	4,685
(2) Unavailable for Urban Devel.	10,370	11,412	5,552	6,661	4,685
Total Land Rasource Area	204,800	371,200	181,760	238,720	212,480
Uneuitable and Unavailable (1+2)	191,640	285,021	163,389	234,195	186,880
(3) Available & Suitable for Urban Devel.	13,160	86,179	18,371	4,525	25,600
Urban Development 1960	10,370	6,317	5,552	6,661	4,685
Urban Pop. 1960[a]	5,158	13,274	4,675	1,863	4,891
(4) Index: Urban Devel. Area/Person (1960)	2.01	.476	1.18	4.12	.969
Expected Pop. 2000	25,600	44,500	28,000	24,000	23,000
Population 1960	19,462	29,666	15,481	16,569	19,623
(5) Pop. Change 1960-2000	6,138	14,834	12,519	7,431	3,377
(6) Urban Devel. Acreage Requirement (4 x 5)	12,257	7,040	14,790	30,600	3,270
Available & Suitable for Urban Devel. (3)	13,160	86,179	18,371	4,525	25,600
(7) Urban Land Surplue (+) Or Deficit (-) (6-3)	+903	+79,139	+3,581	-26,075	+22,330

a) Population in "Urbanized Areas", "Other Urban Territory" and "Places between 1000 and 2500 Population".

TABLE 5 LAND INVENTORY WITH IMPLICATIONS FOR FUTURE POPULATION GROWTH BY COUNTY (Ref. 11,12)

	Talbot County	Wicomico County	Worcester County	Cecil County
Forested Land				
Prime Potential Agri.	16,020	20,706	34,232	11,300
Steep Slope	1,079	408	48	14,278
Poor for Septic Tenk	--	80,955	104,685	7,291
Non-Forested/Upland Mereh				
Prime for Agriculture	76,055	50,911	56,888	81,696
Steep Slope	--	396	--	4,544
50 yr. Flood Plain	4,992	4,416	--	3,934
Poor for Septlc Tank	23,516	30,856	49,239	11,841
Mersh Area	4,756	15,429	21,721	4,005
(1) Unsuitable for Urban Devel.	126,418	204,137	266,812	138,919
Military Installation	--	--	--	1,269
Urban Development Area (1960)	3,829	6,000	5,889	6,300
(2) Unavailable for Urban Devel.	3,829	6,000	5,887	7,569
Total Land Reeource Area	178,560	243,200	309,120	225,280
Unsuitable and Unavailable (1+2)	130,247	210,137	272,701	146,488
(3) Available & Suitable for Urban Devel.	48,313	33,063	36,419	78,792
Urban Development 1960	3,829	6,000	5,889	6,300
Urban Pop. 1960[a]	7,821	18,740	7,686	8,721
(4) Index: Urban Devel. Area/Person (1960)	.490	.320	.768	.723
Expected Pop. 2000	38,000	75,000	35,300	93,600
Populetion 1960	21,578	49,050	23,733	48,408
(5) Pop. Change 1960-2000	16,422	25,950	11,567	45,192
(6) Urban Devel. Acreage Requirement (4 x 5)	8,040	8,270	8,890	32,722
Available & Suitable for Urban Devel. (3)	48,313	33,063	36,419	78,792
(7) Urban Land Surplue (+) Or Deficit (-) (6-3)	+40,273	+24,793	+27,529	+46,070

e) Population in "Urbanized Areas" "Other Urban Territory" and "Places between 1000 end 2500 Population".

undeveloped, including the portions with the most salient natural characteristics. Refinements of the land inventory accounts system would incorporate such considerations -- thus giving the accounts system a policy orientation. In the land inventory however, it is assumed that urban development irreversibly transforms undeveloped land, preempting its natural characteristics -- an assumption which is unfortunately usually more true than not.

e. Environmental Effects of Urban Development

The above discussion points to an information need: the need for better general indicators of the environmental effects of urban development. Urban development increases the rate of surface water runoff, affects the natural recharge of aquifers, and can cause sedimentation problems. The complete range of such environmental effects needs to be identified, related to various types of urban development and associated with natural land characteristics where the effects are likely to occur. State and local regulations already exist to guard against some of the most salient environmental effects. Examples are the State Department of Health's regulations regarding the use of septic tanks, and the Department of Natural Resources' regulations on the use of land in wetlands areas. But, when the scope of

1) environmental effects,
2) natural characteristics of interest,
3) types of urban development,
4) state, federal and local agencies, and
5) types of regulations and implementating devices

is considered, it becomes apparent that the existing land management system is a patchwork.

f. Land "Unavailable" or "Unsuitable" for Urban Development

In the land inventory presented in Table 5, undeveloped land is differentiated according to its availability and suitability for urban development. All land already preempted by urban development -- despite the fact that urban renewal and other development processes enable some already-developed areas to be redeveloped with new uses at higher densities. Other undeveloped land which has special natural characteristics is considered "unsuitable" (other things being equal) for urban development. Land identified as "prime for agriculture", "steeply sloped", "poor for septic tanks", "in 50 year flood plains", or "marshlands"(Ref. 12) are considered "unsuitable" for urban development. There are conceptual problems in the descriptive designation "unsuitable": under certain conditions "unsuitable" land may in fact be suitable for urban development, and vice versa. These considerations could be included as refinements to a land inventory accounts system. In the meantime, the above mentioned natural characteristics are considered of sufficient significance to provide a starting point for development of a comprehensive land inventory relating to a regional policy of land conservation and allocation.

g. Land "Available and Suitable" for Urban Development

In Table 5, land which is neither "unavailable" nor "unsuitable" is considered "available and suitable". The descriptive terms, of course, are used in the context of the present analysis.

h. Mapping Land Characteristics Information

It is noteworthy that comprehensive regional information on salient natural land characteristics is presented in general acreage terms. Locational information relating to these characteristics is not available on a compre-

hensive basis. Yet many regional and local planning agencies have developed considerable locational information with regard to the natural characteristics of land in their study areas. For instance, the Regional Planning Council has mapped "the location of large open tracts adjacent to the Bay", "wet land areas", "aquifer outcrops" and other natural characteristics of interest. The Cecil County Master Development Plan has located areas in the county with regard to the underground water potential, the soil percolation quality; also located are wetlands, areas of over 15% slope, etc. This locational information could provide the basic data for an inventory of natural land characteristics for the entire Chesapeake Bay area.

3.2 Urban Land Absorption Impacts

Table 5 also relates the land inventory to urban development needed to accommodate expected population growth to the year 2000. The analysis is based on "existing trends" -- i.e., the amount of urban development acreage (residential, commercial, industrial, etc.) used in accommodating the present population. In line with assumptions developed in section b above, urban development acreage has been related to 1960 urban population plus rural population in places of 1,000-2,500. Because of possible inconsistencies in the comprehensiveness of land use inventories in the several counties (and indeed, because of possible inconsistencies in the census categorization of 1960 population) the index relating total urban development acreage to population is a rough one at best. It does, however, make it possible to sketch through the analysis and raise a number of questions with regard to environmental management and the development and uses of a land inventory accounts system.

The conclusion of the analysis compares, for each county, the year 2000 urban development acreage requirement against the supply of "available and suitable" land. The result is an indication of a land surplus or deficit, assuming that new urban development will occur:

- outside presently developed areas;
- at existing densities; and
- on land considered "available and suitable" for urban development on the basis of its natural characteristics.

The analysis indicates that seven counties will have an "urban land deficit" due to:

- the high proportion of their total land resource deemed desirable for conservation,
- a large expected population growth,
- the low density of existing urban development, or
- a combination of these factors.

For opposite reasons, 12 counties are designated as having an "urban land surplus." Thus, Queen Anne's County is indicated as having an "urban land deficit" within the context of the analysis. A review of the data in the land inventory indicates how this conclusion was reached. 95% of the total area of the county has characteristics which have been designated "unsuitable" for urban development. (58% of the total land area is prime agricultural land.) And existing urban development is very liberal in its consumption of land. Carroll County illustrates the opposite situation. A much lower proportion (58%) of its total land area is designated "unavailable or unsuitable" for urban development. Existing urban development is at relatively high densities in comparison to Queen Anne's County. Thus, despite considerable expected population growth, an "urban land surplus" is indicated.

3.3 Towards Regional Land Policy

a. Land conservation and development

tradeoffs.

What kinds of policy conclusions can be derived from an analysis which juxtaposes an inventory of natural land characteristics of interest with estimates of land needs in urban development? One conclusion is that, however effective controls on the location of development, some counties will be faced with tradeoff decisions between preservation of land with natural characteristics of interest and land needs for urban development. The policy issue related to the value of the land in alternative uses. Prime agricultural land, for instance, has economic value related to its crop producing potential (this is the basis for land assessment in rural areas in Maryland). It also produces a certain amount of local and state revenue. And, it has often unidentified environmental and ecological values. While, other things being equal, it may be considered desirable from the environmental management point of view to preserve prime agricultural land, it must be granted that other things are rarely equal. To attempt to preserve prime agricultural land in Queen Anne's County would either stymie development of the county (because so much of the total land area is so designated) or cause greater environmental disruption (if development were thereby channelled into flood plains, steep slope areas or marsh lands). The key lies in identifying how much prime agricultural land should be available for urban development, for which alternative uses under what conditions. And these judgements will be dependent not only on the inherent characteristics of various land types, but also on the land inventory situation in the particular locality.

b. Land absorption by future population growth

The above discussion is based on the assumption that urban development will continue to consume land at current rates. This, of course, need not be the case. Most county plans assume that future urban development will consume less land per capita. The Anne Arundel County Land Use Plan (Ref. 14), for instance, indicates[7] that the 1965 population consumed 0.232 acres per capita, that the 1980 population will consume 0.193 acres per capita, and that development between 1965 and 1980 will consume only 0.143 acres per capita. But such plans are based on the assumption that effective land use controls will be argued that an increasingly affluent and mobile population will require more urban development acreage per capita rather than less. In this light, the analysis provides a broad indication of the objectives and performance requirements of land use control policies in terms of their ability to preserve valuable natural land characteristics in the various counties.

c. Land use controls

A related point is suggested by the observation that the matrix of land designated "available and suitable" for urban development corresponds only coincidentally with actual urban development pressures. Land use controls can limit the impact of urban development on natural land characteristics in at least three ways:

1) reducing the rate of land consumption by various types of urban development;
2) channelling urban development into areas which do not have natural characteristics of interest; and
3) controlling urban development so that, even as it extends into undeveloped land, it does not destroy important natural land characteristics.

d. Goals and objectives for land use control and open space policy

Implicit in the above discussion are goals and objectives for developing and implementing land use controls and open space policies. The Regional Planning Council, in the context of developing an open space plan for the

Baltimore Region,[Ref. 15] has identified six objectives relating to the goal of resource conservation. The RPC's "water quality enhancement", "flood damage protection", and "ecological area protection" objectives directly relate to natural land characteristics identified by the State Planning Department on a state-wide basis.[8] The RPC's objectives of "geomorphologic area", "botanic area" and "historical and cultural area protection" also relate closely to areas identified state-wide.[Ref. 16] To these, the analysis of the Chesapeake Bay area may also want to include:

1) additional conservation values (e.g., relating to aquifer recharge areas);
2) economic values of prime agricultural lands, marsh lands and certain mineral resource areas to the farming, fishing and manufacturing industries; and
3) objectives relating to urban development costs and densities (e.g., soils poor for septic tanks, areas of possible higher excavation costs).

E
Plans as Goal Statements

When plans are officially approved, they represent composite goal statements. That is, goals can be inferred from them, even if they are not explicitly stated.

Plates 25-32 present selected regional plans and proposals of major significance for the Bay:

Plate 25 presents a concept plan for an open space and outdoor recreation system for the Maryland Bay region (Ref. 13) and more specific plan proposals for the Baltimore subregion. (Ref. 15)

Plate 26 collects public open space proposals for the Maryland Bay region from several sources (Ref. 17,18). Information from many additional sources could also have been included.

Plate 27 presents a graphic reference map for water quality standards of Bay tributaries (Ref. 19).

Plate 29 shows selected major proposals in regional infrastructure (Ref. 20,21).

Plate 29 shows the general land use for Anne Arundel County (Ref. 22).

Plate 30 shows the locations of areas identified for industrial development in Anne Arundel County in relation to existing urban areas (Ref. 23).

Plates 31 and 32 show proposed sewerage and water supply facilities for Anne Arundel County.

By presenting plans and proposals at consistent scales, two related purposes are served. First, a locational dimension is given to discussions of goals and objectives. Second, by cross-referencing plans and proposals for various functional areas and agencies, areas of potential goal conflict can be identified. More systematic examination of existing plans and proposals can assist in identifying problems (goal conflicts), tracing interrelationships and repercussions and setting priorities for action.

PLATE 25: Proposed Open Space and Outdoor Recreation System (Ref. 13, 15)

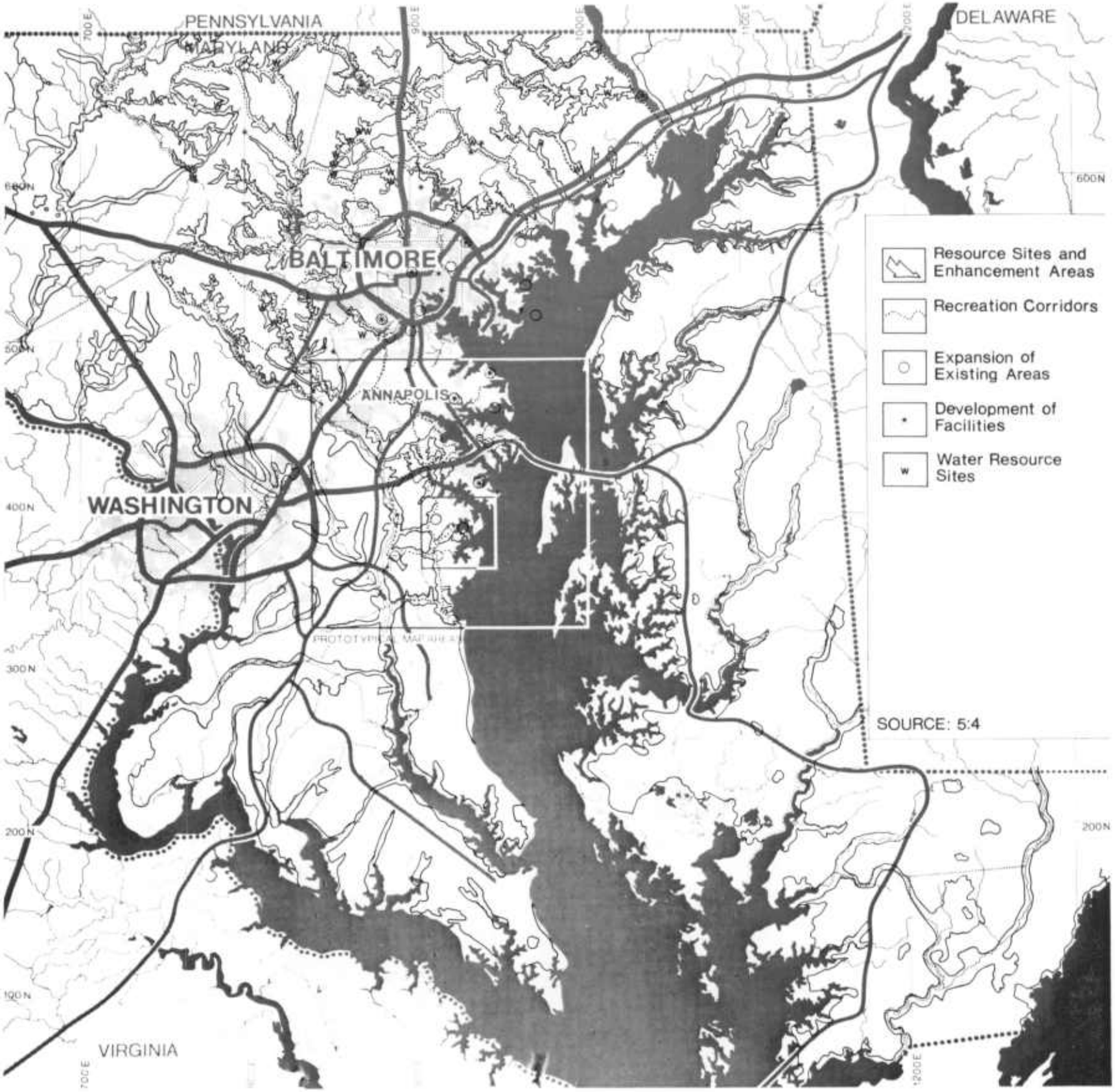
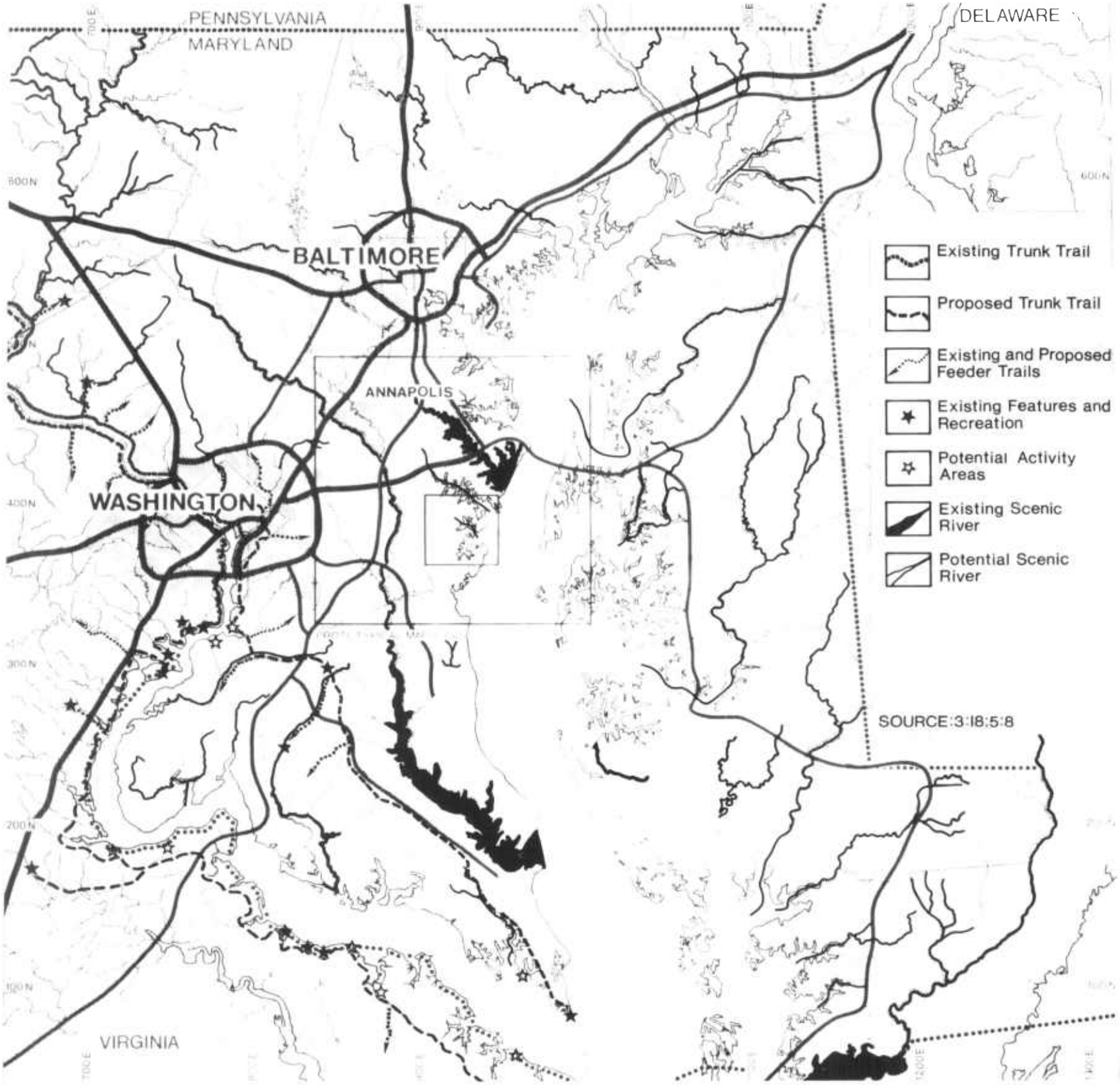


PLATE 26: Public Open Space Proposals (Ref. 17, 18)



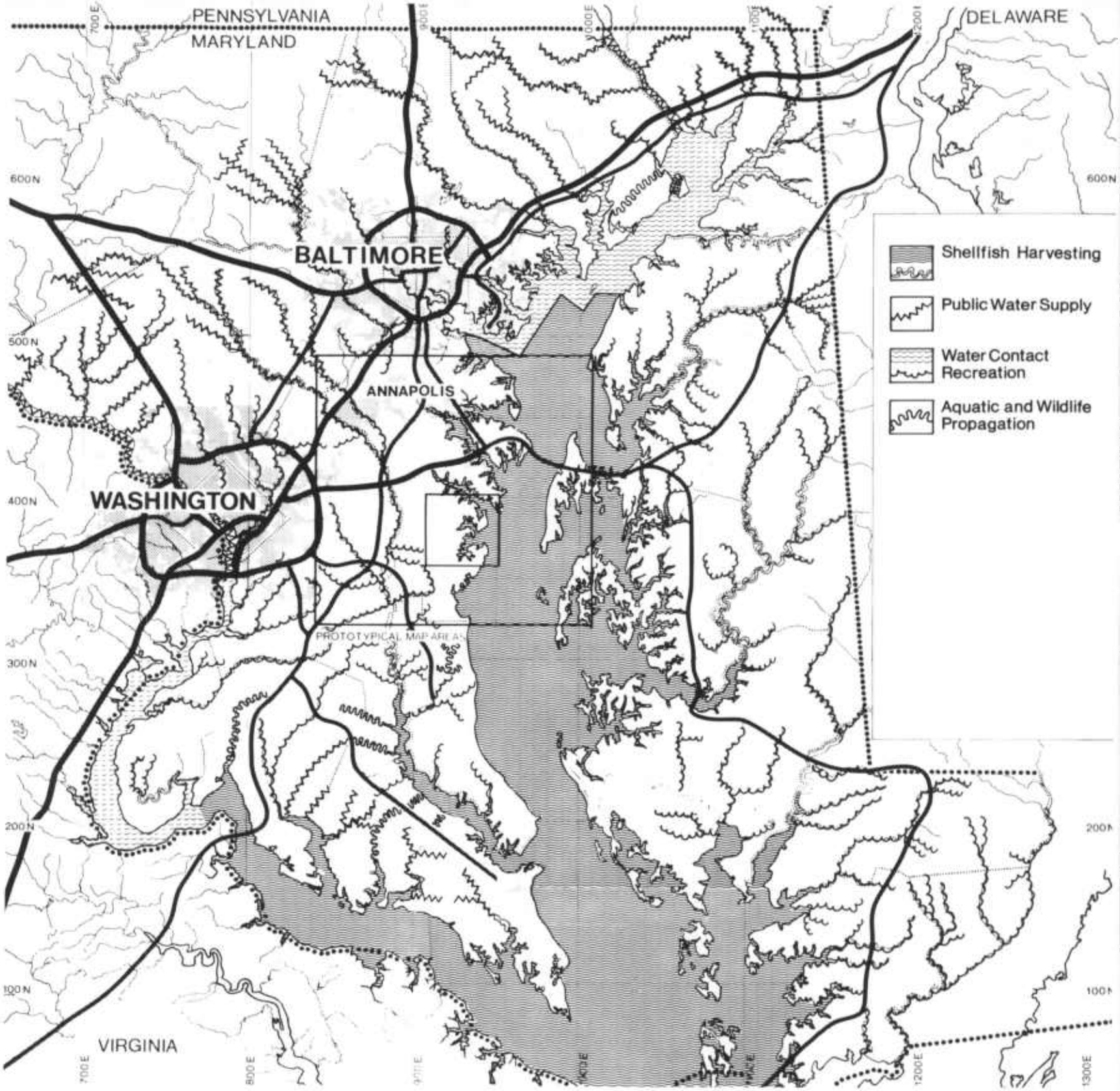

PENNSYLVANIA
MARYLAND
DELAWARE
VIRGINIA
BALTIMORE
ANNAPOLIS
WASHINGTON
PROTOTYPICAL MAP AREA
Shellfish Harvesting
Public Water Supply
Water Contact Recreation
Aquatic and Wildlife Propagation
600N
500N
400N
300N
200N
100N
700E
800E
1200E
1300E

PLATE 28: Selected Major Proposals in Regional Infrastructure (Ref. 20,21)

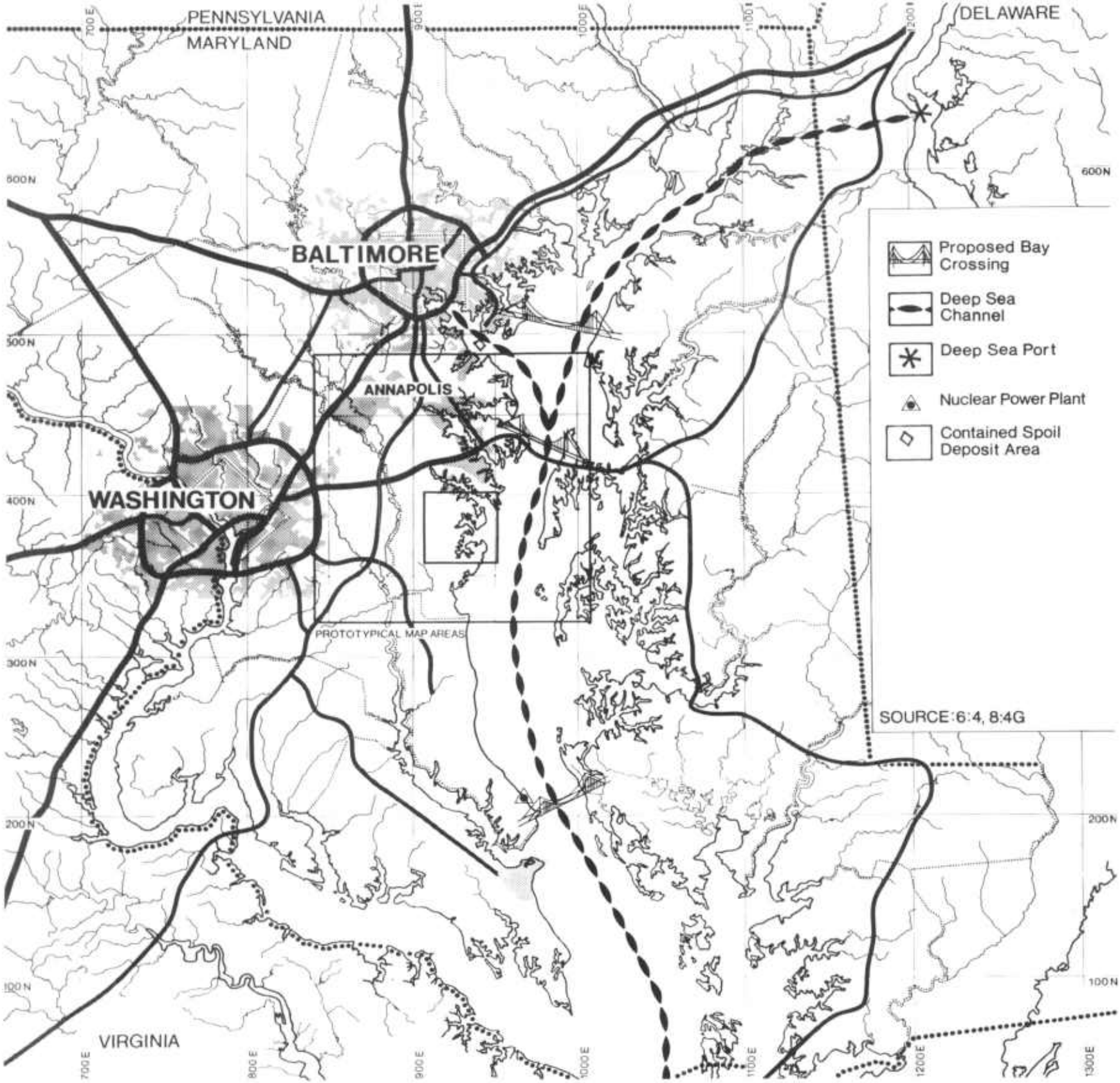


PLATE 29: General Land Use Plan Example: Anne Arundel COunty (Ref. 22)

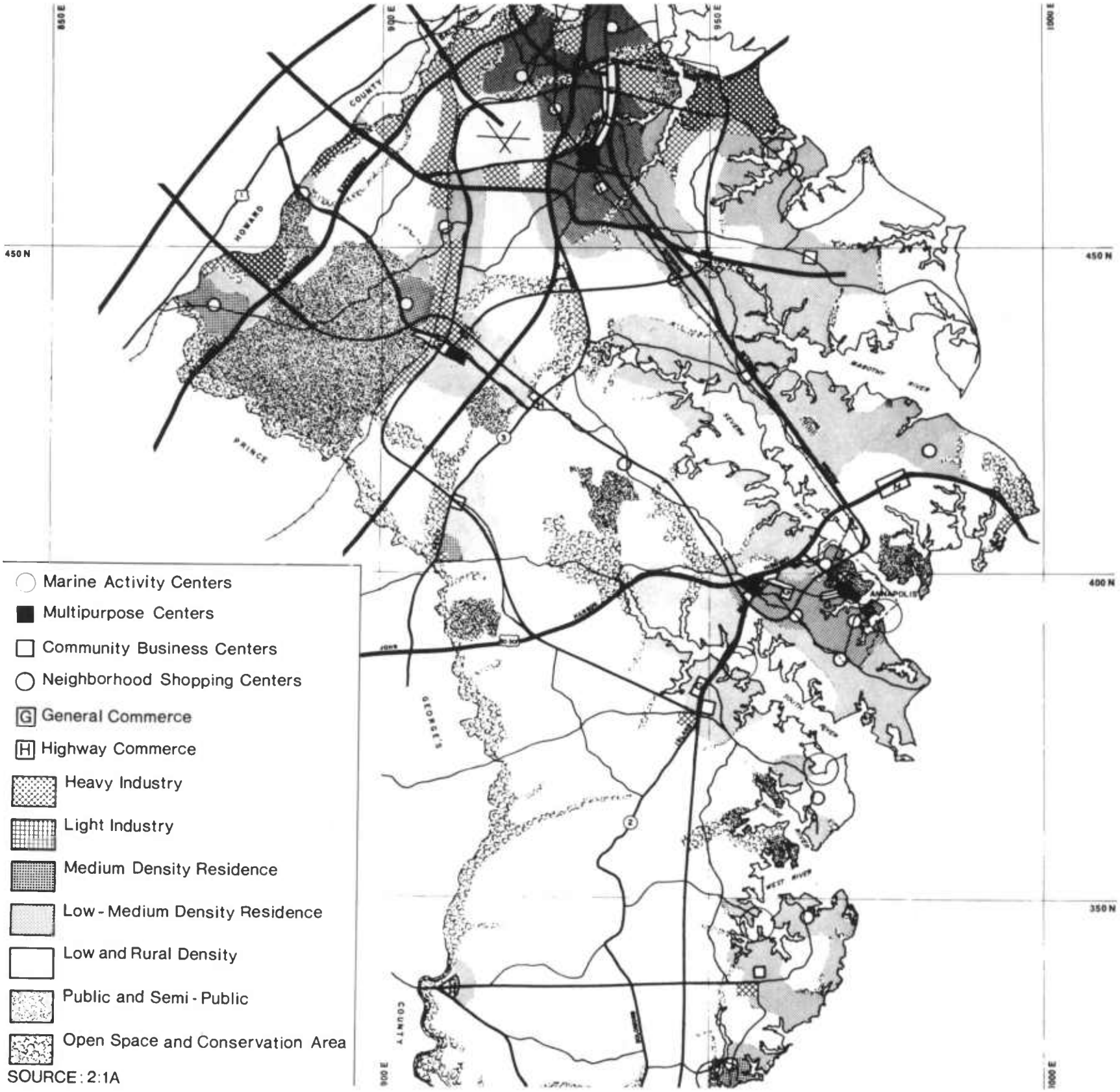
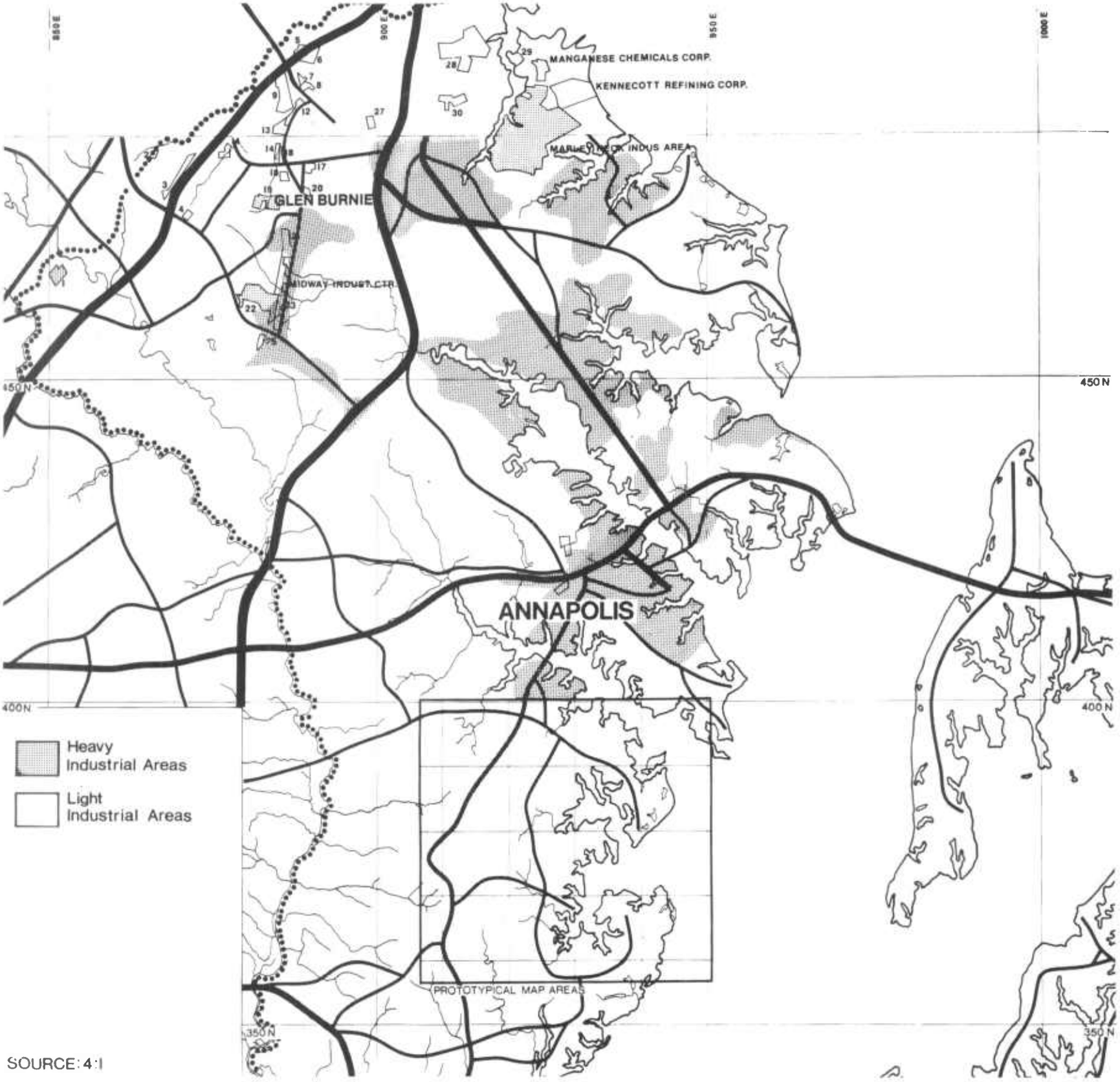


PLATE 30: Areas Identified for Industrial Development (Ref. 23)



SOURCE: 4:I

PLATE 31: Wastewater Collection and Disposal Facilities: Existing to Year 2000 (Ref. 24)

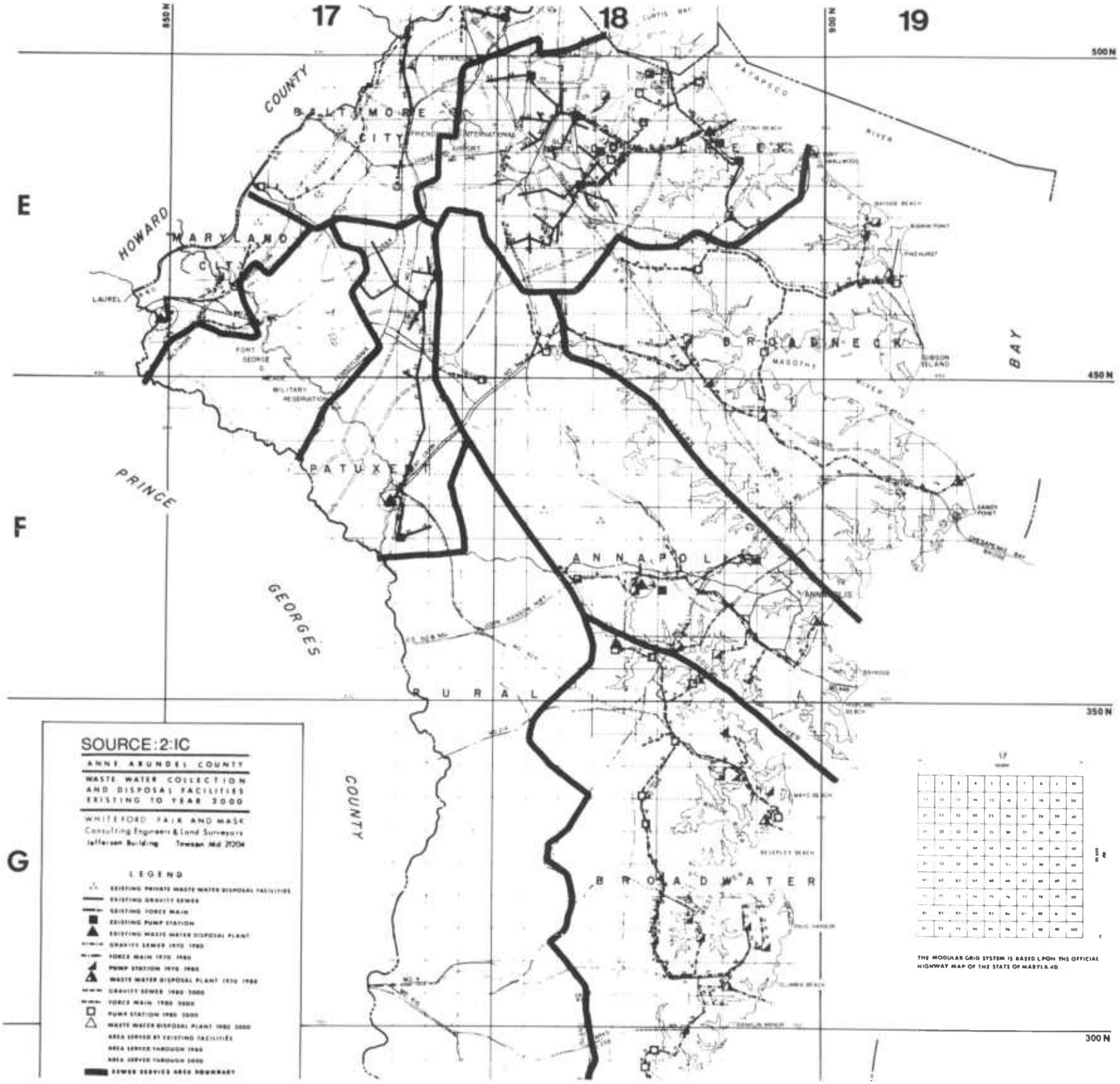
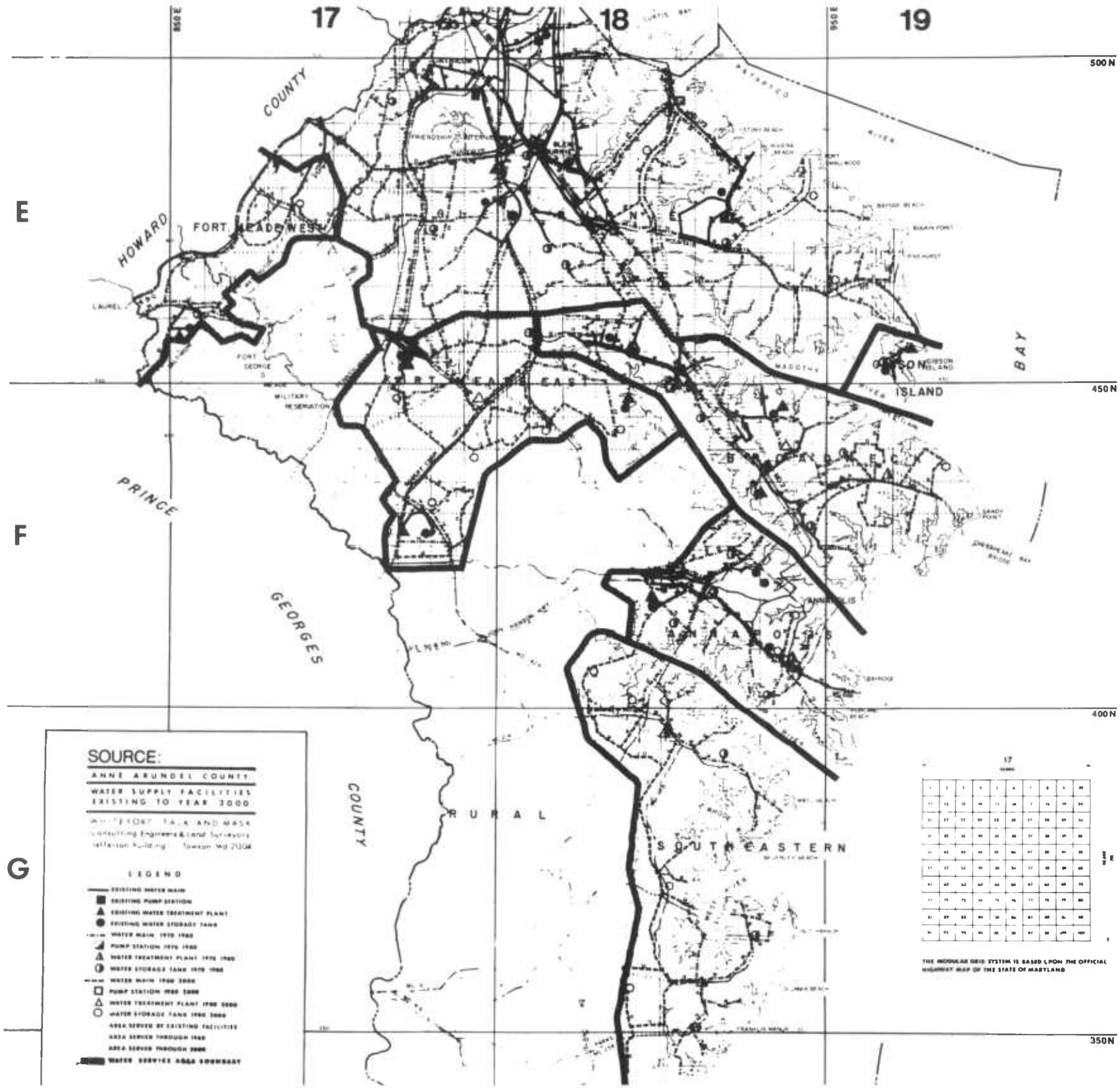


PLATE 32: Water Supply Facilities: Existing to Year 2000 (Ref. 24)



Footnotes

1. Lower case sub-headings in this section and in Charts 1 & 4 refer to major problem areas discussed at greater length (and for the entire Bay area) in the sub-sections of Chapter II. The sub-sections of Chapter II have upper case headings which correspond to the lower case sub-headings used in this section.

2. Categories a,b,d,e,g,h,i,m,n are the same as those used in the North Atlantic Regional Water Resources Study, Appendix U.(Ref. 1)

3. The number of farm workers did decrease from 39,000 to 33,000 between 1966 and 1968.(Ref. 10)

4. See data on livestock and poultry production.(Ref. 10)

5. Reference 11 includes available information on urban land characteristics; Reference 12 includes available information on natural land characteristics.

6. As an example, see pp. 31, 61 in Ref. 13.

7. The indexes are not comparable to those in Table 5 - which relate urban development acreage to urban, not total-county population.

8. That is, "steep slope areas", "50 year flood plains", "marsh lands" in Table 5 and Ref. 12.

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IV

Who Manages the Bay?

IV. CURRENT MANAGEMENT AND MANAGEMENT GOALS

INTRODUCTION 280

A. FEDERAL BAY MANAGEMENT 281

1. Federal Bay Management - Executive Branch 281
1.1 Department of Agriculture 281
1.2 Department of Commerce 281
1.3 Department of Defense 281
1.4 Department of the Interior 283
1.5 The Department of Transportation 283

2. Federal Bay Management - Independent Offices 284
2.1 The Atomic Energy Commission 284
2.2 The Environmental Protection Agency 284
2.3 National Council on Marine Resources and Engineering Development 285
2.4 The Smithsonian Institution 285
2.5 The Water Resources Council 285

B. FEDERAL-STATE BAY MANAGEMENT 286

Table 1: Federal Agencies with Jurisdiction 286

C. STATE BAY MANAGEMENT 287

1. The Governor of Maryland 287
1.1 Authority and Responsibilities 287
1.2 The Chesapeake Bay Interagency Planning Committee 287

2. The Division of Economic Development 287

3. The Maryland Port Administration 288

4. Department of Natural Resources 288
4.1 Department Organization and Responsibility 288
4.2 Departmental Agencies 289
4.3 Specific Legislation 292

5. The Department of Health and Mental Hygiene 292
5.1 Specific Legislation 292

6. The Maryland Environmental Trust 293

7. The Department of State Planning 293

8. The State Roads Commission 294

9. Joint Management Responsibilities..... 294
9.1 Scenic Rivers Review Board..... 294
9.2 State Soil Conservation Committee..... 295

D. INTRASTATE BAY MANAGEMENT..... 296

1. The Regional Planning Council..... 296
2. Tri-County Council for Southern Maryland..... 296
3. Delmarva Advisory Council..... 296

E. "LOCAL" BAY MANAGEMENT..... 297

Table 1: Typical County Management..... 297
Table 2: Land Use Regulations - August 1971..... 297

F. NON-GOVERNMENTAL BAY MANAGEMENT..... 298

1. The Wye Institute..... 298
2. The Chesapeake Bay Institute..... 298
3. The Chesapeake Research Council..... 298
4. The Water Resources Research Center..... 298
5. Chesapeake Bay Foundation, Inc. 298

G. MARYLAND STATE MANDATES AS CHESAPEAKE BAY STATEMENTS..... 299

1. Department of Economic and Community Development..... 299

2. Department of Health and Mental Hygiene..... 299

3. Department of Natural Resources..... 300
3.1 Department of Chesapeake Bay Affairs..... 300
3.2 Fish and Wildlife Administration..... 300
3.3 Department of Forests and Parks..... 300
3.4 Maryland Geological Survey..... 301
3.5 Department of Water Resources..... 301

4. Department of State Planning..... 302

5. Department of Transportation..... 302
5.1 Maryland Port Administration..... 302
5.2 State Highway Administration..... 302

Introduction

Who manages the Bay is a very complex subject. This chapter briefly reviews current Bay management responsibilities at various governmental levels: federal, federal-State, State, Intrastate, local, non-governmental. All have important environmental management roles. Legislative mandates for State agencies with major environmental roles are summarized as a reasonable approximation of State agency goals and responsibilities in reference to the Bay.

A
Federal Bay Management

1 Federal Bay Management—Executive Branch

1.1 Department of Agriculture

The Soil Conservation Service of the Department of Agriculture is involved in the creation of Soil Conservation Districts through and with the cooperation of the "State Soil Conservation Programs".

The "Soil Conservation Service" administers programs related to soil erosion, sedimentation, flood control and related activities as provided for in Federal law and closely dovetails with the State programs.

1.2 Department of Commerce

The Oceanic and Atmospheric Administration was created under Reorganization Plan #4 of 1970, and came into being in October of 1970, to combine together "within a single administration several Federal programs dealing with the oceans and the atmosphere. The programs are, for the most part, scientific and research oriented. Components of the new agency that relate to our areas of interest are:

The Environmental Science Service Administration which contains the "Weather Bureau" (now the "National Weather Service") and the "Coast and Geodetic Survey" (now the "National Ocean Survey").

The Bureau of Commercial Fisheries (with some exceptions relating to the Great Lakes, Missouri River Research, Trans-Alaska pipeline and Gulf Breeze Laboratory) formerly in the Department of Interior.

The Marine Sports Fishing Program of the Bureau of Sport Fisheries and Wildlife in the Department of Interior.

The Office of Sea Grant Programs of the National Science Foundation.

Of these functions the "National Weather Service" will continue to develop and give data on weather, and marine, river and flood forecasting and warning; the "National Ocean Survey" continues to function in accomplishing "earth and marine description, mapping and charting."

The Bureaus of Commercial Fisheries and Sport Fisheries and Wildlife in their new role and agency have the "dual" function of strengthing the fishing industry and promoting conservation of fishing stocks." "Research on important marine species and on fundamental oceanography" is continued.

The "Office of Sea Grants" permits the Federal Government to assist the academic and industrial communities in developing marine resources and technology.

A "National Oceanographic Data Center" formerly in the Navy Department also became a part of this new "Administration" and will be "responsible for the collection and dissemination of oceanographic data accumulated by all Federal Agencies."

The role that these sections of the new "National Oceanic and Atmospheric Administration" can play in future development and management of the Chesapeake Bay is significant."

Maritime Administration

The Maritime Administration is concerned with large maritime shipping and the operation scheduling and coordination of vessels.

1.3 Department of Defense

a. Department of the Army

Corps of Engineers -- The Corps has perhaps the most influential Federal role in the Cheaspeake Bay. The Corps' range of activities includes: harbor, channel and navigation improvements; flood control projects; beach erosion control activities; dam and impounding structures; water-resources studies; comprehensive river basin planning;

evaluation and approval prerogatives and responsibilities for construction of piers, docks, bridges, and other types of structures in navigable waters; collection and removal of drift to afford relief from various conditions of obstruction; and channel dredging and spoils disposal.

A recent Supreme Court decision clarifies for the Corps of Engineers its responsibilities for investigating and evaluating environmental impacts of its projects.

The wide scope of the Corps' activities embraces not only engineering and construction projects for military installations and operations, but also responsibility in the vast field of Civil Public Works outlined above. The legal requirements of these activities place the Corps of Engineers in close liaison with the Public Works Committees of Congress on a continuing basis.

The Corps has had many years of experience in Comprehensive River Basin studies, as reflected by recently completed plans and programs for the Susquehanna River Basin, and continued involvement over many years in the Potomac River Basin.

The Corps, through its North Atlantic Division in New York, is managing the "North Atlantic Regional Study" of water resources for the New England and Middle Atlantic States, as far south as Virginia. That area includes Chesapeake Bay and all its tributaries.

The Corps' Chesapeake Bay Study -- The Rivers and Harbors Act of 1965 (Section 312) authorizes the Corps to study Chesapeake Bay and construct a hydraulic model. Section 312 of the Act is as follows:

"(a) The Secretary of the Army, acting through the Chief of Engineers, is authorized and directed to make a complete investigation and study of water utilization and control of the Chesapeake Bay Basin, including the waters of Baltimore Harbor, and including, but not limited to the following: navigation, fisheries, flood control, control of noxious weeds, water pollution, water quality control, beach erosion and recreation. In order to carry out the purposes of this section, the Secretary, acting through the Chief of Engineers, shall construct, operate and maintain in the State of Maryland, a hydraulic model of the Chesapeake Bay Basin and associated technical center. Such model and center may be utilized by any department, agency of instrumentation of the Federal Government or of the States of Maryland, Virginia and Pennsylvania, in connection with any research, investigation or study being carried on by them of any aspect of the Chesapeake Bay Basin. The study authorized by this section shall be given priority."

The "objectives of the study" listed in the Corps' "Plan of Study -- Chesapeake Bay" are to:

1. Make a complete investigation and study of water utilization of Chesapeake Bay.
2. Formulate a long-term sound water-land management plan for the development and use of the Bay area's resources, with special attention to improving the economic and social well-being of the people of the Chesapeake Bay area.
3. Define an early action program setting forth those elements which require prompt execution in order to: (a) prevent deterioration of the Bay's resources and environment; and (b) meet present needs.
4. Make recommendations for implementation of the plans and programs, including institutional arrangements, cost sharing and management of the Bay's resources.

The prosecution of the study is divided into five (5) general areas:

1. Economic Projections
2. Water Quality and Supply, Waste Treatment, and Noxious Weeds

3. Flood Control, Navigation, Erosion and Fisheries
4. Recreation
5. Fish and Wildlife Coordination

The "Plan of Study" in the "Scope" of the Study states in part: "The study will be coordinated with all agencies of the Federal Government having any interest in Chesapeake Bay and affairs related to the Bay, and with the States, counties, cities, small communities and private agencies within the Bay area."

To this end the Corps of Engineers, as coordinator, has arranged for inputs from and participation in the Study by: states; Atomic Energy Commission; Smithsonian Institution; National Science Foundation; Departments of Interior, Agriculture, Commerce, Housing and Urban Development, Health, Education and Welfare, Transportation, Navy; Federal Power Commission; Maritime Administration; and, of course, the Corps of Engineers as a technical agency as well as coordinator.

The Study contemplated is a long-range all inclusive detailed study scheduled for completion in Fiscal Year 1977 (July 1, 1976) subject to adequate and timely funding.

The Chesapeake and Delaware Canal-- The Chesapeake and Delaware Canal is operated and maintained by the Corps of Engineers to expedite marine shipping between Chesapeake Bay and Delaware Bay. Its proposed widening and deepening has caused much alarm on the possible outflow of substantial quantities of water from the Chesapeake Bay with possible raising of salinity levels in the upper Bay.

Military Bases -- Aberdeen Proving Grounds and Edgewood Arsenal function as self-contained units. Aberdeen, particularly, controls a vast area of Bay-front property and restricts and regulates uses of adjacent Bay waters in carrying out its arms testing programs. Fort Meade is also in the Chesapeake Bay drainage area.

b. Department of the Navy Installations

The Navy operates a number of large installations in the Chesapeake Bay region, including The Naval Academy, the Naval Ship Research and Development Center, the Naval Ordnance Station at Indian Head, the Patuxent Naval Test Center, and the Mine Test Center.

Additionally, the Navy has occasionally used Maryland areas in the lower Bay near the Virginia line, and in the Virginia part of the Bay, it has conducted surface gunnery tests.

c. Department of the Air Force Installations

The only major Air Force installation in the Chesapeake Bay drainage area is Andrews Air Force Base.

1.4 Department of the Interior

The Department of the Interior's "Bureau of Outdoor Recreation" administers the "Land and Water Conservation Fund", with application to the State as a whole for acquiring open spaces, recreation and conservation lands.

The "Bureau of Fish and Wildlife" manages areas such as "Blackwater National Wildlife Refuge", (Dorchester County), and "Eastern Neck National Wildlife Refuge" (Kent County). It also administers Federal programs in the Fish and Wildlife areas including enforcement and policing, migratory considerations, propagation of fish and wildlife and the like.

The "Federal Water Quality Administration" as previously cited is now a part of the "Environmental Protection Agency". The "Bureau of Commercial Fisheries" previously part of Interior is now located in the "National Oceanic and Atmospheric Administration", as is the Marine Sports Fishing Program of the "Bureau of Sports Fisheries and Wildlife".

The "National Park Service" of the Department of Interior manages Fort McHenry located in Baltimore Harbor.

1.5 The Department of Transportation

a. United States Coast Guard

The U.S. Coast Guard in addition to having a large ship construction facility in the Curtis Bay section of Baltimore Harbor has many responsibilities and obligations relating to maritime commerce in navigable waters.

The Coast Guard supplies and locates channel buoys and markers, enforces Federal Boating Laws, inspects ship construction and licenses passenger vessels. It works very closely with the Marine Police of the Department of Chesapeake Bay Affairs enforcing Federal Law, while the State Agency enforces State law. The Coast Guard designates and marks anchorages; enforces marine safety; provides for emergency rescue services; helps with monitoring and enforcing pollution violations; cooperates with Customs and Quarantine surveillance; and coordinates activities with the Port Authority, Maritime Commission and Corps of Engineers; it marks obstructions and hazards, and generally assists in ascertaining the safe and beneficial usage of navigable waters and maritime shipping.

b. The Bureau of Public Roads

The Bureau of Public Roads sets standards, guidelines, safety measures, and controls relative to the Interstate Highway system and appurtenances, and generally functions in the development and construction of highway facilities financed in part by Federal Funds. The plans and programs of the State Highway Administration in Federally-aided, and Federally-assisted highway projects including "Scenic Highways", are subject to Bureau of Public Roads approval.

On certain Federal installations, the Bureau of Public Roads handles the design and construction of major roads, and coordinates location and adjoining highway services with local and state authorities.

The Bureau of Public Roads has a wide range of responsibilities in its programs relating to location, site acquisition, loss and replacement of housing and services.

2 Federal Bay Management—Independent Offices

2.1 The Atomic Energy Commission

The Atomic Energy Commission has jurisdiction over nuclear facilities nationwide. It would relate in the Bay to the nuclear aspects of power generation stations.

Some of the responsibilities of this activity may now be located in the Environmental Protection Agency but because of the newness of the latter, A.E.C.'s area of responsibility is not clearly understood.

2.2 The Environmental Protection Agency

The Environmental Protection Agency was created under Reorganization Plan No. 3 of 1970 and came into being December 1970. It is composed of various departments and agencies heretofore functioning under other administrative direction. These functions are in the areas of: water quality, air pollution, radiology, solid wastes, and pesticides.

The "Water Quality Office" in the new agency is the successor to the Federal Water Quality Administration of the Department of Interior. This office has a field station and laboratory in Annapolis and works on water quality problems in the Bay and related areas. It has participated in a study of water quality problems in the Bay and related areas. It has participated in a study of water quality problems in the Potomac estuary, and in investigations relating to the Sandy Point Sewerage Treatment facility which, when put in operation, will be the first treatment plant releasing its effluent directly into the Bay. Studies are undertaken by the Water Quality Office when water quality problems are interstate, when State and Local governemnts lack

adequate facilities or background, or by request of a State or Local agency for evaluation of a problem.

The Office does have enforcement capability relative to the Federal Water Quality Act of 1965 and similar legislation. In cooperation with the Corps of Engineers it investigates dredging proposals before the Corps of Engineers issues dredging permits, it cooperates with Maryland's Department of Water Resources in evaluating chemical and biological composition and effect of dredging spoils. It is also involved in the evaluation of the effects of the proposed deepening of the Chesapeake and Delaware Canal.

The "Air Pollution Office" of the Agency succeeded the National Air Pollution Control Administration, formerly in the Department of Health, Education and Welfare.

The "radiology" function succeeds the environmental radiation protection standard-setting functions of the Atomic Energy Commission, to the functions of the Federal Radiation Council, and some of the functions of the Bureau of Radiological Health, formerly in the Department of Health, Education and Welfare.

The Solid Wastes Office succeeds the Bureau of Solid Wastes Management and the Bureau of Water Hygiene, formerly in the Environmental Control Administration of the Department of Health, Education and Welfare.

The Pesticides Office has assumed the pesticides registration responsibilities of the Department of Agriculture and the pesticides research and standard-setting program of the Food and Drug Administration in the Department of Health, Education and Welfare.

The Agency will also conduct ecological research to the Council on "Environmental Quality".

All of the functions of the Environmental Protection Agency have significant bearing in carrying out Federal legislation as it may be applied to the Bay in concert with State efforts, singularly in the absense of adequate State provisions, or in pursuit of interstate problems and relationships.

2.3 National Council on Marine Resources and Engineering Development

The National Council on Marine Resources and Engineering Development has its prime focus by law "in the oceans", but it has an overlap zone with the Water Resources Council in the "coastal zone". There is increasing inquiry and interest in this area and a particularly vital relationship with the tie-in of Chesapeake Bay and its waters in relation to the "coastal zone" and continental shelf.

2.4 The Smithsonian Institution

The Smithsonian Institution's property on Rhodes River, recently acquired, functions as a field biology research center on the Chesapeake Bay. It occupies about 700 acres and concentrates on research and education including "inventorying plants and animals -- on land and in the adjacent estuaries -- to provide a scientific base for the study of all aspects of the Natural environment." The scientific programs at the Center are guided by Smithsonian scientists in conjunction with an academic consortium of Johns Hopkins University and University of Maryland faculty.

A significant study under way is the control and recording of the amounts of chemical fertilizer applied to the Center's cultivated lands, to study the effects of nutrient runoff on adjacent estuaries. It is further described in Chapter IV.

Considerable private funding from foundations, corporations, and private benefactors assists the Smithsonian effort in the operation of the Center.

2.5 The Water Resources Council

The Water Resources Council (P.L. 89-90) was created "to encourage the

conservation, development and utilization of water and related land resources of the United States on a comprehensive and coordinated basis by the Federal government, States, localities and private enterprise with the cooperation of all affected Federal agencies, States, local governments, individuals, corporations, business enterprises, and other concerned.

It is primarily a planning body without management authority and includes in its authorization power to create joint State-Federal planning bodies as provided in Title II of the Act. It is believed that this arrangement could apply to Chesapeake Bay as a "River Basin".

The membership of the Water Resources Council consists of the Secretaries of: the Army; Agriculture; Health, Education and Welfare; Interior; Transportation; Commerce; and Housing and Urban Development; and the Chairman of the Federal Power Commission.

B

Federal—State Bay Management

Recently an Interstate-Federal Compact, for the Management of the Water and related resources of the Susquehanna River Basin, has been passed by the Federal Congress and by the States of Maryland, New York and the Commonwealth of Pennsylvania. The Commission created by this Compact is about to initiate its operation. Relative to the Chesapeake Bay, the Compact as enacted includes the following language: "The Comprehensive Plan shall take into consideration the effect of the plan or any part thereof upon the receiving waters of the Chesapeake Bay."

A similar proposal for an Interstate-Federal Compact for the Management of the Water and related resources of the Potomac River Basin has been passed by the Commonwealth of Virginia, with action still pending in the other jurisdictions. Again with respect to the Chesapeake Bay, the Potomac Compact language reads as follows: "The Commission shall consider the actual and potential effect of such action upon the receiving waters of the Chesapeake Bay."

Table 1. Federal Agencies with Jurisdiction by Law or Special Expertise to Comment on Various Types of Environmental Impacts:

	1	2	3	4	5	6	7	8	9	10
Agriculture		x	x	x		x			x	x
Commerce			x	x	x	x	x	x	x	
Interior	x	x	x	x		x	x	x	x	x
E.P.A.	x	x	x	x	x	x	x	x	x	x
H.U.D.		x		x	x			x		
H.E.W.	x		x		x	x		x	x	
Defense	x	x	x	x		x	x		x	
Transportation	x	x	x	x	x	x	x	x	x	
A.E.C.		x	x			x				
F.P.C.		x								

Source: Second Annual Report of the Council on Environmental Quality, August 1971.

1 - Air Quality & Air Pollution Control
2 - Energy
3 - Hazardous Substances (toxic materials, pesticides, herbicides)
4 - Land Use and Management
5 - Noise
6 - Physiological Health and Human Well Being, e.g. (contaminations, sanitation)
7 - Transportation
8 - Urban, e.g., congestion, rodent control, urban planning
9 - Water, e.g., Quality and Pollution control, marine pollution, stream channelization
10- Widlife

C
State Bay Management

1 The Governor of Maryland

1.1 Authority and Responsibilities

The Governor of Maryland has the authority to organize principal departments and transfer responsibilities and services between and among those departments. The applicable legislation (Chapter 156 of the Acts of 1969) reads as follows:

"The Governor, as Chief executive officer of the State Government, shall be responsible for the continuing review of executive organization. He shall propose, approve and order not inconsistent with the law such reorganization as he may deem necessary and desirable. He shall be responsible for the organization of the principal departments and for the transfer of departments, agencies, other units of State government programs, services and responsibilities between and among such departments. The Governor shall recommend to the General Assembly the placement of all new programs, departments and other instrumentalities, within the appropriate principal department, and he shall have the authority to assign new units of the State Government, departments and programs to such departments at the time of creation unless assigned by law. Nonstatutory units of the State government and programs may be assigned to the appropriate principal department by the Governor.

"Notwithstanding any other provision of this article, the Governor may, when circumstances dictate, establish task forces for programs which cut across departmental lines. This shall be limited to programs which require integration of services so as to achieve a governmental program which cannot efficiently be performed through a simple cooperation between departments. Such task forces may exist for not more than one year unless their existence is specifically continued by the Governor."

1.2 The Chesapeake Bay Interagency Planning Committee

In February of 1969, the Governor directed the formation of what has become known as the "Chesapeake Bay Interagency Planning Committee". In a letter in which he asked "the State Planning Department to coordinate the Department of Chesapeake Bay Affairs, the Department of Economic Development, the Department of Forests and Parks, the Department of Game and Inland Fish, the Department of Health, the Maryland Geological Survey, the Maryland Port Authority, the State Roads Commission and the Department of Water Resources in the preparation of a comprehensive plan for the Bay and its related resources." The Governor cited the "biotic, economic, aesthetic and cultural values" of the Bay as of "the greatest importance to the people of the State of Maryland" and expressed concern that these resources and attributes "are being placed under increasing intensive use for shipping, seafood production, industrial development, residential and recreational home location, pleasure boating, sport fishing, swimming and other purposes." He said that "the State has a major responsibility for insuring that the threat to one of Maryland's major assets is met on a timely basis and that the total values of the Bay and its related resources are planned, developed and managed in such a way as to meet the needs of present and future generations." The Interagency Committee was brought into being to address itself to these concerns.

2 The Division of Economic Development

The Division of Economic Development (formerly the Department of Econ-

omic Development) is a part of the newly created Department of Economic and Community Development (Art. 41 Section 257A & FF-Ch 527 Acts of 1970). The former Department was created in 1959 (Ch 185 Acts of 1959), "the Division of Economic Development...shall have the general purpose of advancing the economic welfare of the people through programs and activities to develop, in a proper manner, the State natural resources and economic opportunities, and to promote and encourage the location of the new industries and business in the State of Maryland..."

The Director of the Division "shall be selected because of his known experience and interest in the development of natural resources and industrial opportunities..." The Division sees its role as carrying out its mandate within the guidelines of wise utilization of the Bay's resources.

3 Maryland Port Administration

The Authority was created in 1956 (Art 62B of the Maryland Code) and included within the newly created Department of Transportation (Ch 526 Acts of 1970 -- Art. 41 Section 207(c) as the "Maryland Port Administration" (as of June 30, 1971).

Among the broad-based powers of this agency are the "Promotion of Commerce" and the "Preservation and Protection of Navigation", They include "Acquisition, etc. of Port Facilities" and the "Acquisition and Disposition of Property" (including by Eminent Domain).

Its powers would also include acquiring, leasing, conveying, or otherwise disposing "of real and personal property of every kind and description, and any right title, interest, franchise, or privilege therein, including lands lying under water or any riparian rights in and adjacent to lands, and also including property which is already devoted to a public use in, adjoining or in the vicinity of the navigable waters within its territorial jurisdiction."

The "Port Administration" shall "... provide for the preservation of navigation within its territorial jurisdiction, including the establishment of lines beyond which no piers, bulkheads, wharves, pilings, structure obstructions or extensions of any character may be built, erected, constructed, made, or extended;" and also "adopt reasonable rules and regulations in order to prevent any material, refuse, or matter of any kind from being thrown into, deposited in or placed where the same may fall, or be washed into any navigable waters;" and "make surveys or charts of navigable waters under its jurisdiction, and to ascertain the depth and courses of the channels of the same."

The "Port Administration" also is to participate in any hearings by agencies of Government related to the "design, establishment, construction, extension, operation, improvement, repair, or maintenance of any project operated by the Authority (Administration);" it is also to concern itself actively in matters relating to such areas of interest as "river and harbor improvements, aids to navigation, permits for structures in navigable waters and all other matters affecting the physical development of and the business interest of the Authority (Administration) and those it serves;" (Art 62B Section 5).

4 Department of Natural Resources

4.1 Department Organization and Responsibility

The principal legislation relating to natural resources in the State is included in Article 66C of the Code. Initially, a Department of Natural Resources is created as a principal department of State government under the direction of the Secretary of Natural Resources as spelled out in Article 41, Sections 232 and 239. The Department is the successor to the old Board of Natural Resources.

The Department is established as "a State agency which shall, in addition to its

other functions, review and evaluate all natural resources policies, plans, programs, and practices of State, County, Regional, and Federal agencies and institutions; which shall coordinate all natural resources activities within the State; which shall be a center for collecting and organizing information on the natural resources for the guidance of the Governor and the General Assembly; and which shall otherwise unify, coordinate and promulgate policies, plans, programs, and practices which will ensure the preservation, development, wise use, and enjoyment of all the natural resources for greatest benefits to the State and its citizens."

"The Secretary shall be responsible for the coordination and direction of comprehensive planning in the area of Natural resources. In addition, he shall keep himself fully appraised of plans, proposals, projects, and programs of the departments and other agencies or units within the jurisdiction of the Department of Natural Resources, and shall have power to approve, or modify any plan, proposal, project, or program, provided that any action approving, disapproving, or modifying plans, proposals, projects, or programs not be inconsistent with law."

"The Secretary shall have the right and authority to transfer any function or activity common to two or more of the departments and agencies within the jurisdiction of the Department of Natural Resources, together with the staff, funds, and equipment associated with that function..."

"The Secretary may transfer from any department or agency within his jurisdiction to any other department of agency within his jurisdiction, any function or activity..."

Among the departments, agencies, boards, and Commissions included within the Department of Natural Resources are: the Department of Chesapeake Bay Affairs; the Fish and Wildlife Administration; the Department of Forests and Parks; the Maryland Geological Survey; the Department of Water Resources; the Maryland Environmental Service; and the respective Advisory Commissions serving these agencies. Also included in the scope of the Department of Natural Resources,as previously mentioned here, is the administration of programs relating to "Wetlands"; "Open Spaces and Areas"; "Shore Erosion Control"; "Scenic Rivers"; "Sediment Control"; and "Maryland Environmental Trust".

Also assigned to the Department of Natural Resources are functions embracing Maryland representation in interstate activities relating to the Susquehanna and Potomac River Basins; the Atlantic States Marine Fisheries Commission; the Potomac River Fisheries Commission, and the Interstate Oil Compact Commission. It also relates to the Patuxent River Watershad Advisory Commission, the Water Science Advisory Board and other such entities.

Specifically as to the Chesapeake Bay: "the Secretary of Natural Resources is directed to make all effort necessary toward the enactment of appropriate intergovernmental agreements with other states to preserve the optimal state of the Chesapeake Bay through the organization of an interstate body to plan, manage, coordinate, and enforce the proper use of the Bay, so that all users of the Bay area can obtain the maximum advantage of the Bay (Art. 66C, Sec.2)(Ch 154 Acts of 1969)."

Of the individual departments and agencies under the Department of Natural Resources specific reference has already been made to the "Maryland Environmental Service". Brief comment as to the particular assignment of the other departments follows.

4.2 Departmental Agencies

a. Department of Chesapeake Bay Affairs

This department has responsibilities which are geographic as well as functional, whereas the other Department of Natural Resources agencies are mostly functional (Art 66C, Section 6 and following).

Legislation respecting Department of Chesapeake Bay Affairs contains the

following language: "(a) It is the intention of the General Assembly in the enactment of this sub-heading that the planning, development, management, and conservation of the Chesapeake Bay and all other tidal waters and the shore line and bottoms thereof are the proper responsibilities of the State of Maryland."

"(b) In order to assure that these responsibilities will be carried out in a manner which will best serve the economic growth and social needs of the State there is hereby created a Department of Chesapeake Bay Affairs, which shall be part of the Department of Natural Resources."

The powers of the Department include: "general supervisory power, regulation, and control over the natural resources of the State within the bounds of tidal waters;" licensing and regulation relating to fish, oysters, clams, and crabs; issuance of permits for removal of sand, gravel, minerals and other resources from the public lands under the public navigable waters of the Bay; administration of Wetlands and Shore Erosion legislation; administration of the State Boat Act; administration for Maryland of the Atlantic States Marine Fisheries Compact and the Potomac River Fisheries Compact and many related responsibilities.

b. Department of Water Resources --

This department, also constituted within the Department of Natural Resources, has its duties spelled out in Article 96A, Sections 1 and following. Its responsibilities include "supervising and planning the multiple purpose development of the waters of the State for the best interest of all its inhabitants. The Department shall prepare and develop a general water resources program which contemplates the proper conservation and development of the waters of the State, in a manner compatible with multiple purpose management on a watershed and/or aquifer basis or other appropriate geographical unit thereof. The program shall recognize and be consistent with the functions of the Department of Chesapeake Bay Affairs and other State agencies. The program shall serve as a guide to the Department in the performance of its duties..."

The Department is charged with control of the appropriation of the surface and underground waters of the State, including the control and supervision of the construction, reconstruction, and repair of dams, reservoirs, and all other waterworks in any of the waters of the State. It has major powers in the control and abatement of pollution and industrial wastes in the waters of the State and in the setting of water quality and effluent standards applicable to the waters of the State including the effects of water temperature changes and dredging operations. The Department has strong powers in restraining violators; it functions jointly with the Department of Health in carrying out and reporting on the comprehensive water pollution program; it assumes responsibility for developing and operating programs to prevent and contain oil spillage in Maryland waters. The department also establishes requirements and licences "well drillers", and manages the "Maryland Potomac Water Authority"; it cooperates with the Federal and local governments in developing and carrying out a long range program for controlling flood waters of the State; and investigates and takes steps to correct any condition "indicative of damage to aquatic resources."

c. The Maryland Geological Survey is covered in the Statutes of Maryland in Article 66C (Sections 15-17); it functions as part of the Department of Natural Resources. Its powers and responsibilities include: "the conduct of topographic, geologic, hydrographic and geophysical surveys"; "the preparation of topographic, geologic, and other types of maps to meet specific needs"; "the preparation of reports on the extent and character of the State's geology, mineral, and water resources"; and "the investigation and recommendation of plans and policies for the protection of the waterfront of the State against erosion and deposition and the cooperation necessary for carrying into effect plans for the development of the waterfront property of the State."

d. The Fish and Wildlife Administration, formerly the Department of Game and Inland Fish, was established as the successor to that Department by Ch252 Acts of 1970 (Article 66C 112A), and is now a part of the Department of Natural Resources. The Fish and Wildlife Administration has responsibility for administration of "The Game Law and The Game and Fresh Water Fish Law". The Administration through its Director is "vested with the necessary power, and authority to determine when, to what extent, if at all, and by what means it is desirable to enlarge, extend, restrict, or prohibit in any degree the provisions of law obtaining in this State for the hunting, taking, capture, killing, possession, sale, purchase, shipment, transportation, carriage or export of any wild bird, wild animal, or fish from inland waters and may adopt regulations for such purpose." In addition to powers to "regulate", the Administration can issue licenses, police, assess penalties and in general fully administer activities in these areas. It has jurisdiction over certain designated wildlife sanctuaries and refuges and "may acquire title to or control of lands or waters within the State suitable for protection and propagation of game and fish or for hunting purposes..." or "establish and maintain State game refuges for the protection and propagation of game and fish on all or any portion of State game lands where any game and furbearing animals shall not be hunted, pursued, trapped, disturbed or molested at any time." These sanctuaries and refuges may be in and on tidal waters which would embrace the Bay and its immediate tributaries.

e. The Department of Forest and Parks, Art. 66C, Section 343 and following, was "created as a part of the Department of Natural Resources to promote, administer, and manage all State-owned or leased forests, parks, scenic preserves, natural areas, parkways, historic monuments and recreation areas, the administration of all laws, rules, and regulations relating to forests, parks, scenic preserves, natural areas, parkways, historic monuments and recreation areas, fire control, roadside trees, the restoration of deforested or denuded areas and the operation of the State forest nursery." The responsibilities include the administration of "Program Open Spaces"; protection of watershed areas; participation in the Federal "Land and Water Conservation Fund" program; abatement of fire hazards in the forests and open spaces of the State; operation of Forest Conservancy Districts; participation in operation of the Patuxent River Watershed and the Severn River Watershed.

f. The Maryland Environmental Service --Ch240 of the Acts of 1970 created the "Maryland Environmental Service" as an agency within the Department of Natural Resources. The State of Maryland is to provide through the "Service" for dependable, effective, and efficient purification and disposal of liquid and solid wastes; to encourage reduction in the amount of waste generated and discharged to the environment; and to serve its political subdivisions and economic interests."

The "Service" includes in its responsibility: "...acquisition, design, construction, reconstruction, rehabilitation, improvement, operation, maintenance, and repair of waste water purification and solid waste disposal projects either pursuant to an order of the Secretary of Health and Mental Hygiene or the Secretary of Natural Resources as further provided for... or pursuant to a mandatory agreement to provide requested services..."

The "Service" has no authority or power to perform services for a district or area which in the opinion of the Secretary of Health and Mental Hygiene is receiving adequate service...except upon the request of the specific municipality or pursuant to a voluntary contract.

The "Service" has bonding and funding authority; can create regions and districts throughout the State; charge for its services; and enter into waste

management contracts.

4.3 Specific Legislation

a. Wetlands Legislation (Article 66C, Section 718)--This legislation was created by Ch241 of the Acts of 1970 wherein it was "declared to be the public policy of this State, taking into account varying ecological, economic, developmental, recreational, and aesthetic values, to preserve the Wetlands and to prevent the despoilation thereof."

"State Wetlands" are defined as "all land under the navigable waters of the State below the mean high tide, which is affected by the regular rise and fall of the tide."

The promulgation of rules and regulations relating to Wetlands, and the general administration is vested in the Secretary of Natural Resources and assigned by him to the Department of Chesapeake Bay Affairs.

b. Open Spaces and Areas -- "Program Open Space" was created by Ch403 of the Acts of 1965 (Article 66C, Section 357B-357G) and provides for expediting "the acquisition of outdoor recreation and open space areas before the escalating cost of land prevents its purchase for public use and before potential areas are devoted to some other uses;" and also for accelerating "the development of needed outdoor recreation facilities."

This program is administe the Department of Forests and Parks (part of Department of Natural Resources) and is to be funded from time to time by the General Assembly to assist the fulfillment of acquisition and development programs at both the State and local levels.

Its possible effect on areas bordering and surrounding the Chesapeake Bay Area can be very significant.

c. Shore Erosion Control -- A program to fund and stimulate activity in the Control of "Shore Erosion" is detailed in Article 66C, Section 756, and is assigned to the Department of Natural Resources and currently vested in the Department of Chesapeake Bay Affairs. The program calls for educational, financial, and technical help in encouraging Shore Erosion Control projects and measures and calls for cooperation with the Corps of Engineers, State Roads Commission, Soil Conservation Service, and others.

d. Sediment Control was defined in Ch245 Acts of 1970 (Article 96A, Section 105-110) to prevent and control the despoliation of the lands and waters comprising the watersheds of the State from erosion and sediment deposition. The program calls for the development of project plans to minimize erosion and sedimentation. The program is administered through the Department of Natural Resources.

e. The State Boat Act (Article 14B) -- This Act is administered jointly by the Department of Chesapeake Bay Affairs and the Fish and Wildlife Administration (successor to the Game and Inland Fish Department) under the Department of Natural Resources. It includes provisions for the promotion of safety of life and property; licensing of boats; development of plans for improvement and promotion of all the Waters of Maryland for recreational purposes; plans for the improvement of the Waterways of Maryland through the deepening of channels, acquisition, and development of access areas, removal of obstructions, building of docks and clearing waters of aquatic vegetation.

There is specific provision in the Act (Section 12) for "the clearing of waterways of logs, debris, and other material detrimental to navigation"; for marking channels in tidal and nontidal waters; and for creation of waterway improvement districts.

5 The Department of Health and Mental Hygiene

5.1 Specific Legislation

a. Comprehensive Water Pollution Control Program

A comprehensive water pollution control program was created by Ch446 of the Acts of 1968 (Article 42, Sections 718 to 736). This program, under the

jurisdiction of the Department of Health and Mental Hygiene, includes a high level Science Advisory Board. Its goal is to intensify water pollution control programs throughout the State. It includes funding for treatment facilities, water quality monitoring, data processing, and laboratory services. It also embraces policy and regulation promulgation for design of sewage collection and transmission facilities; controlling waste from marinas and watercraft; training of technical personnel; regulation of sanitarians and related considerations.

The Department of Water Resources performs a close cooperative role with Department of Health and Mental Hygiene in administering this program.

b. Water Supply and Waste Disposal Plans

Article 43, Section 387C, calls for the development of comprehensive county plans for "public water supply, sewerage and solid waste disposal systems" by January 1, 1970, and a "complete county plan dealing also with solid waste disposal systems and solid waste acceptance no later than January 1, 1974."

Plans developed are to be submitted first to Department of Water Resources for review of "matters pertaining to water allocation, adequacy of industrial waste treatment, and the effect of proposed withdrawals and waste discharges on waters of the State." The program is administered by the Department of Health and Mental Hygiene.

c. Air Quality Control (Art. 43, Sec. 690 & ff)

The Department of Health and Mental Hygiene has under its responsibility an "air quality" program which reflects the declared policy of the State of Maryland "to maintain that degree of purity of the air resources of the State which will protect the health, general welfare, and property of the people of the State." The program divides the State into "air quality control areas" and establishes and enforces standards for these areas.

6 The Maryland Environmental Trust

The Trust was created by Ch648 Acts of 1967 (Article 41, Sections 181L to 181X) to conserve, improve, stimulate, and perpetuate "the aesthetic natural, health and welfare, scenic and cultural qualities of the environment, including but not limited to land, water, air, wildlife, scenic qualities, open spaces, buildings or any interest therein, and other appurtenances pertaining in any way to the State of Maryland and through educational, and other media to encourage and motivate the populace of the State and others to do so, and to promote continuing interest in and the study of such matters."

7 The Department of State Planning

In Chapter 155 of the Acts of 1969, the Department of State Planning was recast as one of the principal State agencies headed by a Secretary who serves as a member of the Governor's Advisory Council (Cabinet) (Article 41, Section 226).

The basic powers and duties of the Department are relatively unchanged. They include:

To "prepare, and from time to time revise, amend, extend or add to, a plan or plans for the development of the State, which plan or plans collectively shall be known as the State Development Plan. ... In preparing the State Development Plan..., the Department of State Planning may seek the cooperation and advice of appropriate departments, agencies, and instrumentalities of Federal, State, and local government, regional and metropolitan planning commissions, educational institutions and research organizations,...and of civic groups and private persons and organizations";

making "studies and investigations... of the resources of the State and of existing

and emerging problems of agriculture, industry, commerce, transportation, population housing, public service, local government, and of allied matters affecting the development of the State...";

acting"...as the Governor's principal staff agency in planning matters concerning the resources and development of the State...";

preparing"...the State's capital program and the annual capital budget...";

revising "inventory listings of the State's Natural Resources...";

advising "the Governor on means and methods available to coordinate plans and programs of all State Departments, agencies, commissions, and instrumentalities in order to establish relative priorities and to avoid duplication and conflict"; and

advising "the Governor as to the means and methods available to coordinate the plans and programs of Federal, State, local, regional, metropolitan, county, and municipal governments, in order to avoid duplication and conflicts..."

In carrying out its functions, the State Planning Department has subdivided the State into six regions for planning purposes and has staff planners located in or assigned to regional organizations.

8 The State Roads Commission

In July, 1971, the State Roads Commission (Md. Stat. Art. 898) will become the State Highway Administration, under the new Department of Transportation. The head of the State Highway Administration will be the "State Highway Administrator", also Chairman of the State Roads Commission, and will serve at the pleasure of the Secretary of Transportation. The Director of Highways shall have "exclusive jurisdiction and control over the location, construction, geometrics, design, and maintenance of highways that embrace the interstate system of highways and the highways that embrace the primary system of highways..." "He shall have authority to consult, confer, negotiate and conclude agreements with the Bureau of Public Roads and other agencies of the United States Government, representatives of other states, and other agencies within this State, on all questions relating to all highways on the interstate system and all highways on the primary system of highways."

The director shares these powers and responsibilities with the Commission members on the secondary system of roads.

The Highway Administration has strong legal base in the "location" of "a highway or portion thereof"; and has the power to "build bridges" for the purpose "of making and maintaining connections between any highways or the parts of any highway constructed or improved..."

The construction of bridges is "subject to all valid and applicable provisions of laws of the United States concerning bridges over navigable waters of the United States."

The Highway Administration may "acquire strips of land for the restoration, preservation, and enhancement of scenic beauty within and adjacent to the Federal-aid highways of this State and to acquire land for and construct rest and recreation areas adjacent to the interstate and Federal-aid Primary system of highways."

The Highway Administration may also "regulate and restrict the establishment, operation, and maintenance of 'Junk Yards' in areas adjacent to the interstate and primary systems within the State."

It may also control and regulate "outdoor advertising" as stipulated in the law.

9 Joint Management Responsibilities

9.1 Scenic Rivers Review Board

A program relating to the "outstanding scenic, fish, wildlife, and other recreation values of many of the rivers of the

State and the related adjacent land areas" is provided for in Article 66C, Sections 759-762. The program declares it to be State policy to protect "the water quality of such rivers and to fulfill vital conservation purposes through the wise use of resources within the scenic river system."

Included in the scenic rivers system are areas such as: "spawning and propagation areas"; "trout streams"; "wetlands" areas; "sections of streams where encroachment is imminent"; and "sections of streams which are important as food production areas, areas supporting migratory waterfowl, and spawning areas for shellfish".

This program is administered by a "Scenic Rivers Review Board" composed of representation of the State Planning Department, Department of Natural Resources, and the Maryland Environmental Trust.

9.2 State Soil Conservation Committee

Soil conservation programs in the State originate from the "Soil Conservation and Domestic Allotment Act" (Public Law 46, 74th Congress as amended). The administration of this activity for the State is the University of Maryland, with authority given under the State law for creating a State Soil Conservation Committee and Soil Conservation Districts. The aim of soil conservation programs is to preserve the farm and grazing lands of the State from erosion by the institution and encouragement of proper land-use practices, which can prevent silting and sedimentation of stream channels, reservoirs, dams, ditches, and harbors.

The State Soil Conservation Committee includes among its members representation of the State Board of Agriculture and the Department of Natural Resources and its member departments and agencies.

D
Intrastate Bay Management

At the regional level are planning and development organizations, the territorial jurisdictions of which coincide with several of the State planning regions as defined by the State Planning Department.

1 The Regional Planning Council

The Regional Planning Council (Art. 78D, Ch. 753 of the Acts of 1963) includes the City of Baltimore, and Anne Arundel, Baltimore, Carroll, Harford and Howard Counties. The Council is to create a General Development Plan for the region and in its adoption have it serve as a guide for regional growth and development. The Regional Planning Law contains provision for mandatory referral of plans and projects to the Council. While a State or local agency or body must submit its plans or projects for conformity with the General Development Plan, it may in actuality proceed under the law, without the approval of the Regional Planning Council. Certain Federal funds that may be available for various projects may possibly not be released for use without the Council's approval. On other projects the Council simply has the power to focus attention and public consideration on the areas' projects, programs and plans.

In other functions, the Regional Planning Council can assist and service local groups and programs by supplying informational data and advice.

The Regional Planning Council is a State Agency by Law but with broad and considerable local participation and funding.

2 Tri-County Council for Southern Maryland

The Tri-County Council was created by Executive Order in May of 1965 and later established by Statute (Ch 586 Acts of 1966). It was formed "to initiate and coordinate plans and projects for the development of human and economic resources of the southern Maryland counties" (Calvert, Charles and St. Mary's). The Council, in addition to local members, has representatives of the State Department of Planning and the State Division of Economic Development on its roster.

3 Delmarva Advisory Council

This Council was initiated in 1963 with joint representation of Maryland (Eastern Shore counties), Delaware, and Virginia (Eastern Shore counties), with the purpose "to advance the economic and cultural welfare of the people of the Delmarva Peninsula through advice, counsel, and assistance of such governmental agencies and private organizations as are concerned with programs and activities to develop the resources and economic activities of the area." In 1967, the Council and the Delmarva Peninsula as its focal point was designated to function as the "Delmarva Economic Development District" by the U.S. Department of Commerce under the terms of the Federal Public Works and Economic Development Act of 1965.

E
Local Bay Management

The local level functions associated with day-to-day living planning, taxing, licensing and controls. These include: the Courts and administration of justice, health regulations, trash collection and other municipal services and operations; schools; road maintenance and traffic control, policing, granting of building permits, and a wide range of other operations and services. Each of these is concentrated in the local county government (or in some cases municipal governments) in all the counties of the State. Although the organization and operating procedures of both governments vary, their functions are similar. Table 1 lists management positions in a typical Maryland local government. Of particular significance is the local control of all zoning (Article 66B and in local laws) and planning, including subdivision controls, general development regulations and the like. These functions are administered by local Boards and Commissions, locally appointed and locally oriented.

Table 1: Typical County Management

County Council	Plumbing Inspector
Board of Appeals	Dept. of Public Works
Appeals Tax Court	Bureau of Engineering
County Executive	Utilities Operation Bur.
Super. of Assessments	Planning & Zonning Off.
Bur. of Com. & Ind. Aff.	Planning Advisory Bd.
Economic Development	Zoning Hearing Officer
Board of Education	Dept. of Rec. & Parks
Supt. of Schools	Rec. Advisory Board
Library Board	Comm. Action Committee
Health Officer	Coop. Extension Service
Police Chief	Circuit Court Judges
Fire Administrator	States Attorney
Civil Defense	Sheriff
Inspections & Permits	State Senators
Building Inspector	Members, House of Dele.
Electrical Inspector	

Table 2. Chesapeake Bay Counties of Maryland - Land Use Regulations, August 1971.

County	Zoning	Marina Reg.	Soil Erosion & Sedimentation*
Anne Arundel	x	x	x
Baltimore City	x	x	-
Baltimore County	x	x	x
Calvert	x	-	x
Cecil	x	-	x
Dorchester	x	-	x
Harford	x	-	x
Kent	x	-	x
Queen Anne	x	-	-
St. Mary's	-	-	x
Somerset	x	-	x
Talbot	x	-	x
Wicomico	x	-	-

*Conforming ordinances required by State Erosion and Sedimentation Law Deadline for approval of proposed ordinances - March 1, 1971.

Each county has a "sanitary district" organized on county lines under the jurisdiction of a deputy State Health Officer or County Health Officer who has broad powers administering health laws and regulations at the local level including inspecting and reporting upon the sanitary conditions of streams and sources of public water supply, sewerage facilities, dairies, creameries, slaughterhouses and the like.

Perhaps the key functions at the local level are county and municipal control over land use, building and subdivision permits and methods, and almost anything that happens at the crucial water's edge.

The recent wetlands legislation clarified the aspect of ownership of the wetlands. However, where the water's edge is firm goound, this "seam" of interaction as well as the interface between underground water and the Bay is under local control with little if any State or Federal surveillance.

F

Non-Governmental Bay Management

Beyond the public realm are private, semi-public and non-governmental activities involving the Bay. Private has direct real management influences on the Bay by offering knowledge and expertise concerning Bay-related matters. Some of these activities and organizations must be mentioned in recognition of the work being done and the potential they offer.

1 The Wye Institute

The Wye Institute, a non-profit private organization, is located at Cheston-on-Wye, Wye River, Queen Anne's County, Maryland. The Institute's purpose is to work with the people on the Eastern Shore of Maryland in their efforts to strengthen and expand education, cultural and economic opportunities.

2 The Chesapeake Bay Institute

The Chesapeake Bay Institute, a division of Johns Hopkins University, conducts research in oceanography and related fields with particular involvement in matters in the Bay and its tributaries. The Institute undertakes contract research for State, Federal and other agencies.

3 The Chesapeake Research Council

The Chesapeake Research Council, a scientifically-oriented group operating in the Chesapeake Bay Area, representing extensive estuarine research expertise. The Council includes the Chesapeake Bay Institute of Johns Hopkins University, the Virginia Institute of Marine Science, an affiliate of the College of William and Mary, and the University of Virginia, and the Chesapeake Biological Laboratory of the University of Maryland. The Chesapeake Biological Laboratory does contract research for some of the Maryland State agencies in the field of Natural Resources, and maintains academic programs for the University in these areas.

4 The Water Resources Research Center

The Water Resources Research Center of the University of Maryland is, a publicly supported wholly academic group. It is located at College Park and its purpose is "to stimulate, facilitate and coordinate research in all aspects of water resources development, management and conservation at the University with particular attention to problems of importance to Maryland".

Additionally, a consortium of experts from Smithsonian Institution, Johns Hopkins University and the University of Maryland are engaged in a "study of the Chesapeake Bay region as a total system". Four topics slated by this group for investigation are:

1. Inventory of elements which together and interactively comprise the total Bay system;
2. Formulation of statements of research objectives;
3. Identification of component parts of a comprehensive research plan and the kinds of institutions best capable of carrying out the investigations delineated;
4. Study of central organization best suited to administer such a program.

5 Chesapeake Bay Foundation, Inc.

Chesapeake Bay Foundation, Inc. - a private, non-profit organization created to foster interest in and concern for the preservation of the integrity of the Bay as a great Natural Resource. Its headquarters are in Annapolis.

G
Maryland State Mandates as Chesapeake Bay Goal Statements

All levels of government -- Federal, the several states, regional and local -- have developed goals, objectives, standards and policies that are relevant to the Chesapeake Bay. However, it would be presumptuous and counterproductive for this study to attempt to collect, screen, or evaluate them. This is an important and appropriate function of the Maryland Department of State Planning and other relevant agencies.

At the present time there is no consistent format or system within which agencies are responsible to the executive or legislative branches for organizing, comparing and defining in operational terms their goals, objectives, standards and policies. With or without the P.P.B.S.-type approach mentioned previously, it is highly desirable that agencies carry out this process so that a beginning can be made toward inter-program comparisons of input and output.

The following is a list taken from the Governor's 1971 Budget Message (Ref.1) which both summarizes legislative mandates by agency, and states the general goals of each in a succinct form.

1 Department of Economic and Community Development

To Advance

...the economic welfare of the people of Maryland.

To Encourage and Promote

...the location of new industries and businesses in the State and other matters intended to foster and develop gainful employment.

To Guide

...the building [of an] economic base which will support a total environment of the best quality in Maryland.

To Initiate, to Implement, and to Support

...programs and activities to develop in a proper manner the State's natural resources and economic opportunities.

To Encourage

...development of recreation areas and tourist business.

To Promote and Assist

...sound community development.

To Inform

...the public of the State's historical background and progress.

To Encourage

...formation of local and regional development organizations.

2 Department of Health and Mental Hygiene

To Assist

...local health departments with the medical, dental and other health professions, with private health associations and with citizens' groups in carrying out a wide variety of public health programs.

To Cooperate

...with State and Federal agencies with the medical, dental and other health professions, with private health associations and with citizens' groups in carrying out a wide variety of public health programs.

To Protect

...the public health through elimination of environmental hazards, promotion of individual preventive health supervision, and active control of communicable diseases.

3 Department of Natural Resources

3.1 Department of Chesapeake Bay Affairs

To Plan, to Develop, and to Manage

...the Chesapeake Bay and all other tidal waters and the shorelines and bottoms thereof.

To Improve and to Maintain

...waterways.

To Issue

...permits for the mineral exploration and exploitation of the Chesapeake Bay bottom.

To Preserve

...the contribution of wetlands to the biological, aesthetic, and recreational productivity of the Bay.

To Provide

...safe and sufficient enjoyment of the boating resources of the Bay.

To Provide

...leadership in Bay matters involving all agencies within the Department of Natural Resources.

To Reduce

...losses to land and water resources, both publicly and privately, due to erosion.

To Represent

...the Department of Natural Resources on Bay matters in dealing with Federal, State, and local governments.

3.2 Fish and Wildlife Administration

To Evaluate

...[wildlife and fish] population and harvest parameters, environmental factors, and management techniques to insure sustained production and use [of wildlife and fish].

To Maintain

...abundant populations of shellfish, fish, and wildlife through biologically sound management of the environment.

To Provide

...commercial and recreational opportunities for consumptive users through controlled harvest of commercial and game species.

To Provide

...recreational opportunities for non-consumptive users [of fish and wildlife].

3.3 Department of Forests and Parks

To Advise and to Assist

...landowners on management of their woodlands.

To Promote, to Administer and to Manage

...all State-owned or leased forests, scenic preserves, parkways, historic monuments, and recreational areas.

To Administer

...laws, rules and regulations for all State-owned or leased forests, parks, scenic preserves, parkways, historical monuments and recreation areas for fire

control, roadside trees, and restoration of deforested or denuded areas.

To Encourage
...economic development and use of natural resources.

To Operate
...a State forest nursery.

To Preserve
...natural beauty.

To Promote
...recreational interest throughout the State.

To Protect
...watersheds for the improvement of local economy.

3.4 Maryland Geological Survey

To Cooperate
... in carrying into effect plans for the development of waterfront property of the State.

To Conduct
...topographic, geologic, hydrographic, and geophysical surveys.

To Issue Permits, to License and to Control
...the drilling of oil and gas wells.

To Investigate and to Recommend
...plans and policies for the protection of the waterfront of the State against erosion and deposition.

To Prepare
...reports on the extent and character of the State's geology, mineral and water resources.

To Supervise
...the Bureau of Mines and the Division of Archeology.

3.5 Department of Water Resources

To Acquire
...interest in rights in real property for land and watershed management.

To Cooperate
...with the Federal Government.

To Conduct
...joint study to define boundaries of tidal and non-tidal waters.

To Control
...water pollution.

To Control
...the appropriation of surface and underground water through a permit system.

To Control and to Supervise
...construction of channels, dredging and other construction in tidewater.

To Control
...well drilling through a permit system.

To Develop
...a long range program for flood control.

To Implement
...an abandoned Mine Drainage Control Program.

To Implement
...a program to control agricultural drainage that impairs water quality.

To Plan
...multiple purpose development of all State waters.

To Provide
...technical assistance to local governments.

To Provide
...for the training of industrial wastewater treatment operators.

To Provide
...leadership for, and oversee, a State-wide program for soil erosion and sediment control in urbanizing areas.

To Supervise
...multiple purpose development of all State waters.

To Supervise
...discharge of waste waters.

4 Department of State Planning

To Assist
...State agencies, regional councils and local governments in planning matters.

To Coordinate
...approximately 50 Federal planning and construction grant programs, and the Model Cities program.

To Coordinate
...its planning activities with the planning activities of the other State departments and agencies and instrumentalities and the local government.

To Guide
...planning assistance to State agencies, regional councils and local governments.

To Prepare and to Maintain
...a program for the development and effective employment of all State resources, known as the State Development Plan.

To Prepare
...the State annual capital budget and the five-year capital improvement program.

To Represent
...the State in the Office of Intergovernmental Relations.

To Represent
...the State on Federal river basin planning projects.

To Stimulate
...public interest and participation in the development of the State.

5 Department of Transportation

5.1 Maryland Port Administration

To Develop
...trade.

To Enhance
...advantages of the ports of the area.

To Improve
...the physical port facilities important to maritime commerce of the State.

To Promote
...maritime businesses of the area.

To Protect
...advantages of the ports of the area.

5.2 State Highway Administration

To Plan and to Control
...[exclusive] the location, construction geometrics, design and maintenance of the highways.

To Formulate

...matters of policy relating to location, type, design, construction and maintenance of the secondary system of highways.

To Perform

...the construction and maintenance of highways on the secondary system.

Reference

1. Governor Marvin Mandel; Maryland State Budget, ending June 30, 1972; Submitted to the General Assembly of Maryland, January, 1971, p. 1035.

V

Criteria and Organizational Alternatives for Bay Resource Management

V. CRITERIA AND ORGANIZATIONAL ALTERNATIVES FOR BAY RESOURCE MANAGEMENT

A. IS GOVERNMENT ADEQUATELY ORGANIZED FOR BAY RESOURCE MANAGEMENT? 306

1. Current Limitations of Effective Bay Resource Management..... 306

2. General Criteria in Designing Resource Management Institutions..... 307

3. Particular Aspects of the Bay Relevant to the Design of Institutional Arrangements for Resource Management..... 307

4. Conclusions..... 308

B. ORGANIZATIONAL ALTERNATIVES FOR BAY RESOURCE MANAGEMENT.....

1. Inter-State Compacts..... 309

2. Federal-Inter-State Compacts..... 309

3. River Basin Commissions..... 311

4. Federal-Regional Agencies..... 311

5. Regional-Federal-State Commissions..... 312

6. River Basin Inter-Agency Committee..... 313

7. Federal Administrator of Operations..... 313

8. Intra-State Special Districts..... 313

9. Council of Governments..... 314

10. The Single State Super Agency..... 314

11. Summary Conclusions on Organization for Bay Resource Management..... 315

A
Is Government Adequately Organized for Bay Resource Management

1 Current Limitations of Effective Bay Resource Management

Governmental organization for water resource management has been under almost continual study for the past decade. Studies have been conducted by State agencies and non-State agencies, often with support of State agency staff. The studies have taken various perspectives on the Bay. In some, the Bay has been considered as part (or not part, for administrative purposes) of the larger Susquehanna watershed; others have focused on Maryland's water resources without specific reference to the Bay; still others have focused on the Bay itself. In some studies water resources policy has been the focus; in others the focus has been broadened to include many land and natural resource concerns associated with water resource policy; in still others, administrative arrangements for administering the array of State policy responsibility, rather than policy in a particular functional area, has been the concern. In combination and sequence, these efforts provide a valuable perspective on evolving Bay resource management.

As recently as 1970, the following summary of inadequacies of institutional arrangements for Bay resource management was offered:

"...Existing state legal institutions suffer from two major inadequacies. First, the state legislatures, have attempted to administer the Bay themselves. Rather than delegating broad managerial power to the executive branch, they have responded to narrow problems with narrow legislation. These responses rapidly become out-of-date but linger on as law. In short, the legislatures have refused to give administrators the "range of choice" necessary for effective management.

Second, those powers which have been delegated by the legislatures have been scattered throughout the states' administrative apparatus. Various state agencies have duplicating, overlapping and sometimes inconsistent powers, but in neither Maryland nor Virginia is there a single agency with the requisite authority to plan and coordinate the administration of the Bay and its resources." (Ref. 1)

However, this assessment was made before the reorganization of Maryland State Government, the establishment of the Maryland Environmental Service or the formation of the Chesapeake Bay Interagency Planning Committee.

Three potential limitations on effective Bay resource management are considered here in summary.

The first is organization and institutional arrangement for management. It is fair to say that Maryland State Government has been effectively reorganized. Departmental responsibilities are clearly established to enable effective Bay resource management. Federal-State relations and State-local relations are not so clear in terms of divisions of responsibility. Citizens find the State more responsive to Bay problems and more sought after for answers than either Federal or local governments. (Ref. 2)

The second limitation is more important and binding: that of fragmented and anachronistic legislation. This has been discussed under "problems" and is being progressively addressed by the newly organized departments.

The third limiting factor considered is the lack of a central planning function. General consensus in State government is that this is badly needed, and in fact the Governor responded to this need by the

first step of creating the Chesapeake Bay Interagency Planning Committee.

The purpose of this Report is, among other things, to recommend the next steps toward the development of a comprehensive plan for the Bay.

2 General Criteria in Designing Resource Management Institutions

Despite the potential of recent Bay management organization the problem of defining appropriate institutional arrangements for Bay resource planning and management is not yet completely resolved. "The (major) requirement for resolving conflicts (after identifying the physical and biological systems in the Bay, and understanding the the value trade-offs associated with each possible course of action) is for institutional arrangements which encourage choosing the alternative solution which provides the most favorable trade-off. This requirement is the most difficult to perceive. We can identify in today's policy structure certain obstacles to choosing optimal courses of action, but the prescription of institutional changes which will encourage such choice is much more difficult." (Ref.3)

3 Particular Aspects of the Bay Relevant to the Design of Institutional Arrangements for Resource Management

The Chesapeake Bay area has several natural and institutional aspects which make it unique and which must be considered (in addition to resource conservation and development issues in the design of institutional arrangements for resource management.

3.1 The Eastern and Western shores of the Bay present dramatically different resource management problems. The Western Shore is dominated by the rapidly growing metropolitan economy of the Baltimore-Washington corridor, the Eastern Shore by gradually declining fishing and farming economics. Thus Bay-wide objectives of resource conservation and development are complicated by various and, at least, partially conflicting sub-regional economic objectives.

3.2 In general, the Maryland economy is growing. Most of the impetus for this growth comes from private market forces. State and local agencies are involved to varying degrees in assisting, guiding and controlling this growth. The major impetus for economic growth, however, comes from the private sector which must be viewed as a "partner" as well as client in Bay management.

3.3 The estuarine nature of the Bay presents Bay resource planners and managers with a very different set of physical and biological interdependencies than those faced in river basin management. Institutional arrangements appropriate for river management may be inappropriate for the Bay for this reason.

3.4 For reasons beyond the interstate nature of Bay water movement patterns, the Federal Government has major interests (navigation, military facilities, wildlife refuges, etc.) in the Bay area.

(However, the Federal Government can be expected to cooperate with, or defer to, effective State action that is consistent with Federal goals.)

3.5 Bordering areas -- e.g. the Susquehanna River Basin, the Potomac River Basin, the Delaware River Basin, the Delaware Bay shoreline -- are organizing for coordinated management of water resources. The interests of the Bay vis a vis nearby water resource planning areas must be articulated and adequately represented.

3.6 The northern half of the Bay is completely within the State of Maryland. This is a sufficiently broad area for effective management. The southern portion within Virginia or Delaware jurisdictions must also proceed on much the

same basis as Maryland to the point where an integrated management plan can be produced and operationalized.

3.7 Many of the major tributaries feeding the Bay form boundaries between county jurisdictions. Most of the State of Maryland is drained more or less directly by the Bay. These aspects point up the need for State-wide planning and management.

4 Conclusions

There are several conclusions that can be drawn from the above points and from the summary of Bay problems and goals in Chapters II and III.

4.1 The Bay is a unified ecosystem that should be dealt with for planning purposes as an entity using a systems approach.

4.2 The fundamental factor which urges comprehensive planning and management of the Bay's resources is increased conflict among Bay uses and users which results from increased demands on the Bay for liquid waste discharge, water supply, shoreline residential sites, water-related recreation, marine transportation, thermal waste discharges, etc. "As use pressures upon the Bay grow, the interdependencies (physical and biological) operate to preclude some uses and to depreciate most. Losses sustained by users or would-be users create conflict situations and generate demands for governmental instruments to resolve it. Conflicts inherent in intensive use pressures demand decisions -- decisions which have fundamental economic, social and political import but for which we have no appropriate governmental decision structure." (Ref. 3)

4.3 Economic development and utilization of the Bay's resources is central to the economic and social well-being of the State and region.

4.4 However, the protection and preservation function is more demanding of a Bay-wide organization than is the opposite function of developing the special attributes of the Bay...This is not to say that the protection and preservation thrust is more important than the development one...but...that our present stage of development, the dominant forces for coordinated management of the Bay are the social diseconomies which are now multiplying at an increasing rate with the growing use and development of the Bay." (Ref. 3)

4.5 "The need is not so much for new programs (nor indeed for adjustments in old ones) as it is for governmental institutions which can resolve the conflicts resulting from one user interfering with another. This is not to say that no new programs are needed, that existing programs do not need expansions nor that their administration does not need improving. But rather...these actions are not a direct or adequate response to the problem of conflict which is central to the demand for resource management of Chesapeake Bay." (Ref. 3)

4.6 The recent reorganization of Maryland State Government has more clearly established departmental responsibilities in Bay resource management. However, areas of Federal-State responsibility and local-State responsibility in Bay resource management are unresolved, as is the coordination of Bay resource management with similar activity in adjacent areas -- the Susquehanna River Basin Compact and the States of Delaware and Virginia. Alternatives addressed to the interstate and watershed aspects of Bay problems are discussed next.

B

Organizational Alternatives for Bay Resource Management

This section reports on organizational alternatives that have been considered in a long list of studies. The alternatives are listed here briefly.

1 Inter—State Compacts

a. General Description

The Inter-State Compact is a legal instrumentality involving two or more states, which must be consented to by Congress, providing for the conduct of one or more operations in which the specific states that are parties to the compact are jointly interested. The Federal Government is not a signatory party to such a compact, but, in most interstate compacts relating to water resources, the Federal Government assists in the work of the compact-administering agency through a Federal representative. The scope and coverage of the operation is spelled out in the establishing legislation.

b. Appropriateness in Chesapeake Bay

An Inter-State Compact between Maryland and Virginia would seem to have potential application in certain Bay resource management areas. One frequently mentioned problem area is in fish and shellfish management. The productive potential of this valuable Bay resource has not been realized, and an Inter-State Compact may be one element in a solution. In a paper presented at The Governor's Conference on Chesapeake Bay, Dr. J. L. McHugh presents some of the background:

> "Maryland does not have a single large and reliable natural seed oyster bed like the James River in Virginia, although setting is good in many places. Indeed, the small acreage of private ground does not require a large supply of seed. Virginia laws prohibit shipment of seed oysters out of the State, unless special circumstances warrant it. Maryland also has had a shortage of shell for planting back on oyster grounds. Public policy and fishery laws of the two States effectively prevent maximum use of the Bay for growing oysters. If these legal barriers did not exist the Bay could be managed as a gigantic oyster farm, making best use of the characteristics of each part of the environment to produce seed, to serve as growing grounds, or as fattening or holding grounds." (Ref. 4)

However, the Inter-State Compact, because it usually focuses on a particular problem area requiring inter-state cooperation, would not seem to be an appropriate institutional arrangement for comprehensive resource management. Most Bay resource management problems have more pervasive intra-state than inter-state dimensions.

2 Federal—Inter—State Compacts

a. General Description

Federal-Inter-State Compacts generally follow the pattern of Inter-State Compacts but with two essential differences:

1) The Federal Government is a signatory party to the compact; and
2) The exercise of certain Federal powers in the planning, construction and operation of projects becomes subject to the Compact Commission.

The Susquehanna River Basin Compact recently activated by the United States, Maryland, Pennsylvania, and New York is a Federal-Inter-State Compact as is the proposed Potomac River Basin Compact of which the United States, Maryland, Pennsylvania, Virginia and

West Virginia are to be the participating entities.

b. Appropriateness in Chesapeake Bay

Both the Susquehanna and Potomac -- the principal fresh water suppliers to the Bay -- have Federal-Inter-State Compact arrangements either in being or contemplated, each of which makes concern for the integrity of the "receiving waters of the Chesapeake Bay" a substantial, if not a major objective. During the process of developing and translating into law the details of the Susquehanna Compact, the question was frequently raised as to why not include the Chesapeake Bay within the framework of the Susquehanna proposal. Among the reasons cited for not seeking such an arrangement were: the difference in the water resources problem -- fresh water in the river versus brackish and salty water in the Bay; the different fisheries and shell fish problems, the nature of the port and waterborne operations on the Bay as opposed to those on the river system; the wetlands and marshes on the Bay and the role played by them in the total ecological picture. Moreover, such an action would bring the influence of New York State and Pennsylvania directly into the Bay, and require the addition of Virginia, West Virginia, District of Columbia and probably Delaware to the Susquehanna structure. This could require very complex managerial arrangements which were judged undesirable.

However, arguments against the inclusion of the Chesapeake Bay in the Susquehanna Compact would not apply to proposals to create a Federal-Inter-State Compact between Maryland, Virginia, the United States (and perhaps Delaware) specifically for the Chesapeake Bay. Garrett Power analyzes the advantages and disadvantages of such an organization. The major advantage is that the compact " . . . could be given territorial jurisdiction over the whole Bay. Theoretically, at least, the state legislatures could delegate broad power to the compact commission which could exercise them in coordinated, autonomous fashion (free from state legislative interference) for the compact's duration . . . But the compact model also has disadvantages. It adds yet another tier to the existing surfeit of Bay governments. It would be difficult to integrate such a compact with the already negotiated and proposed Potomac River Basin Compact which has powers over the estuarine portions of the Potomac. Finally, it would be difficult to negotiate a compact which gives adequate powers to the governing commission and still be acceptable to both Virginia and Maryland. Although Maryland and Virginia have a common interest in various aspects of Bay management, they also have disparate and competitive interests in preserving the Bay resources within their respective boundaries exclusively for themselves and their citizens. At best, such a compact would take years to negotiate; at worst, it would be emasculated through the retention of powers by the states." (Ref. 1)

Most existing Federal-Inter-State Compacts have relatively narrow resource management focuses, and therefore may be inappropriate instruments for comprehensive resource management planning. Once particular problem areas involving both Federal interests and State interests are defined, however, the Federal-Inter-State Compact may be useful.

The degree to which a Federal-Inter-State Compact would be effective in guiding actions of Federal agencies is an open question. The long range goal should be to include the total package of the Federal Government in any such relationship lest Federal agencies should continue to go their individual way in administering programs relating to the Bay. Because of constitutional requirements and limitations, the Federal Government always approaches such marriages with suspicions and usually with lukewarm blessings ultimately ending up in a series of reservations which make their participation a little less

than complete or satisfactory.

A practical disadvantage of the Federal-Inter-State Compact is that they have often taken years to negotiate. The negotiations leading to the Susquehanna Compact took approximately seven years and negotiations for the Potomac Compact have already taken six years. This leads to the conclusion that much of the planning for comprehensive Bay resource management should be directly responsible to the State executive.

3 River Basin Commissions

a. General Description

River Basin Commissions are authorized by Title II of the Water Resources Planning Act (which also created the Federal Water Resources Council) and can be described as "separate federal and state institutions assisted by joint federal-state planning bodies." (Ref. 5)

It is authorized to prepare and keep up to date a comprehensive program for water and related land resources development within a river basin; to make recommendations as to priorities for data collection, and for investigation, planning and construction of projects; and to submit through the umbrella of the Water Resources Council, a development program including recommendations for implementation.

The basic Water Resources Planning Act evolved as a result of past experience of Federal Agency coordination and joint Federal-State Planning Committees. Many agencies working together in joint program planning, as visualized in such institutional arrangements as this, bring about a great amount of cooperation in management and administration.

b. Appropriateness to Chesapeake Bay

Many of the activities that the Water Resources Planning Act authorizes the River Basin Commission to undertake are similar in scope and purpose to those recommended for the Chesapeake Bay. However, in Maryland, State government has already been or could be authorized to undertake planning of similar scope. Given a choice between federal or State sponsorship for similar planning activities, it would seem desirable to have State sponsorship in order to reflect the breadth of State concern with regard to Bay uses and the States' intimate concern with the Chesapeake Bay in particular. The River Basin Commission, or some similar institution, may, however, be an appropriate planning vehicle for planning studies leading to an interstate compact between Maryland and Virginia or a Federal-Interstate Compact. The River Basin Commission is primarily oriented to planning (including programming for resources management, establishing priorities, making recommendations, etc.). They do not have authority to operate or construct projects or to regulate. This separation of planning and implementing power is ultimately a major disadvantage in terms of effective water and related-land resources management. The executive branch of State government does not suffer this liability. It now has significant powers to regulate and construct projects and is capable of taking on new powers as planning studies demonstrate their need and purpose.

4 Federal—Regional Agencies

a. General Description

In a Federal-Regional Agency, local and state governments have no legal powers in formulating or executing policies or programs. The Agency seeks and receives the cooperation of State and local governments and non-governmental agencies as advisors and collaborators. An agency of this nature would be financed by Congressional and State appropriations and by government revenue and other types of bonds and operated by a presidential governing board.

The only well-defined example of the Federal-Regional Agency in the United States is the Tennessee Valley Authority.

b. Appropriateness to Chesapeake Bay

The TVA was created in response to a very different situation than that which exists in the Maryland Chesapeake Bay Area in the 1970's. The TVA was organized in part to create a vehicle for the construction of major public works infrastructure for regional economic development. In the Chesapeake Bay Area, the need is for sensitive and effective management mechanisms for balancing multiple demands for resource conservation and development.

The TVA was created for an area in which the state and local government had proved ineffective in raising the economic well-being of citizens. In the Maryland Chesapeake Bay Area, State and local government is much better organized to bring to bear appropriate levels of expertise and regulatory and implementing power for effective resource management. It is unlikely that State government would be willing or feel it necessary or desirable to entrust management of Bay resources to a Federal agency.

The outlines of such an organization for the Bay can be found in proposed legislation for a Chesapeake Bay Area Authority introduced by Delegate Boyer into the Maryland General Assembly as House Bill 200, January 21, 1970. The bill called for an Authority formed by Maryland, Virginia, and Delaware and the Federal government to "develop and adapt a Comprehensive Bay Management Plan." (Ref.6) Powers would include: review and approval of projects by others; water supply storage and release; water quality management; flood protection; watershed management; recreation; and amenity plans for river zones.

5 Regional—Federal—State Commissions

a. General Description

Regional Federal-State Commissions are provided for in Federal Public Works and Economic Development legislation.

Such a Commission includes representation of the Federal Government and two or more State governments. It is authorized to plan and prepare programs, and to coordinate the activities of the agencies responsible for administering projects and activities included in the programs. The boundaries of such Federal-State Commissions are related to an area in which intensive effort to achieve economic growth is needed, rather than to the specific confines of a river basin, drainage area, estuary or the like.

The Appalachian Regional Commission is the most widely known operational Regional Federal-State Commission.

b. Appropriateness to Chesapeake Bay

The Regional Federal-State Commission is likely to have more implementing effectiveness than the River Basin Commission (see "3" above) due to its authority to "coordinate" the activities of state and federal agencies whose programs are instrumental in the Commission's plans. On the other hand, the Regional Federal-State Commission has less implementing power than the Federal-Regional Agency (see "4" above) since it does not have power to construct or operate facilities itself. This middle-ground position may have potential applicability in Chesapeake Bay resource management.

Under present legislation, Regional Federal-State Commissions usually focus primarily on problems of economic growth and development. This is reflected in the boundaries selected by these commissions which are usually related to an area in which intensive effort to achieve economic growth is needed, rather than to an area defined also by resource protection and preservation concerns. In Maryland, the Department of Community and Economic Development has economic growth and development as a major purpose; "the protection and preservation function is ...more demanding of a Bay-wide organization than is the positive function of developing the special attributes of the Bay." (Ref. 3)

6 River Basin Inter—Agency Committee

a. General Description

A River Basin Inter-agency Committee is established by Federal inter-agency agreement rather than being a legal entity created by statute. State agencies may agree to participate in the proposed program. The basic thrust of such a Committee has been to coordinate planning with some evolving posture to coordinate and review subsequent programs. Committees such as these cannot undertake the construction or operation of projects but can seek out common ground on studies and investigations and establish priorities for continuing attention.

The Water Resources Council has several of such committees functioning as Field Committees.

b. Appropriateness in Chesapeake Bay

While coordination of planning and programming efforts among Federal agencies is a worthy endeavor, this is not the major need for comprehensive Bay resource management from the State's point of view. From the State's point of view, the major need is to coordinate State agency planning, regulation, construction, etc., for conservation and development of Maryland Bay resources. The State would then be in a position to expect federal agencies to coordinate their activities with its comprehensive plan for Bay resource management.

7 Federal Administrator of Operations

a. General Description and Existing Example

The Department of the Interior has responsibility for administering the Colorado River -- an arrangement which was established by a Federal Enabling Act and which incorporates provisions of a prior interstate compact.

b. Appropriateness to Chesapeake Bay

The management of Bay resources is less a matter of operation of major physical facilities than a matter of standard-setting, regulation, establishing priorities, examining alternative means etc. Also, various State and local agencies -- the Maryland Environmental Service, the Port Administration, and local sanitation departments have responsibility for operating waste treatment plants and port facilities in the Bay area.

8 Intra—State Special Districts

a. General Description and Examples

Intra-State Special Districts are local units of Government established by State law with authorization to plan, construct and operate local projects of one or several types. The most common examples of such districts are soil and water conservation districts, irrigation districts, water supply districts, and flood control districts. The boundaries of such districts might include all or parts of several counties, or be smaller than a county, or even be coterminous with a county. These districts are often financed through special assessments that they are authorized to levy on lands in the district supplemented by State appropriation and often having substantial Federal assistance.

b. Appropriateness to Chesapeake Bay

Special districts have been effective in doing relatively well and narrowly defined jobs for which there is widespread public support (e.g. flood control). Their effectiveness stems from their characteristics of combining all the aspects of the job (e.g. planning, construction, operation, etc.) in a single organization, in their ability to define an appropriate area for their operations without regard to local jurisdictional boundaries, and in their relative isolation from local and state political disputes. Unfortunately this does not describe the nature of the job of Bay resource management: which involves

difficult trade-off decisions among multiple objectives, the weighing of costs and benefits for a wide range of alternative means, and the resolution of issues involving many legitimate political interests.

9 Council of Governments

a. General Description

The "Council of Governments" approach is capable of creating valid associations of city and county governments. It acts as a forum to review and discuss regional problems. It tries to build on existing conditions without disturbing the legal status of cities and counties.

The Regional Planning Council for the Baltimore Region, the Tri-State Planning Commission for Southern Maryland and the Delmarva Planning Council for the Eastern Shore are councils of government operating in the Maryland Bay Region. The Washington Metropolitan Area has a similar organization.

b. Appropriateness to Chesapeake Bay

A combination of the existing council of government organizations in the Maryland Bay Region or a new council of local governments including Bay-shore counties could be an element in Bay resource management, particularly in terms of development infrastructure.

However, the council of government approach does not effectively incorporate State functions, or responsibilities in Bay resource management. Also, councils of government are limited in authority -- usually offering recommendations but not engaging in regulation, construction, or operations.

10 The Single State Super Agency

a. General Description

A significant device for approaching the Bay resource management could be through a strengthened single State Agency with its powers expanded and augmented. In the case at hand, the State Department of Natural Resources would seem closest to fitting the case with its all encompassing mandate for resources management and conservation. There is already specific provision for the Secretary of Natural Resources "to seek the preservation of the optimal state of the Chesapeake Bay through the organization of an interstate body to plan, manage, coordinate and enforce the proper use of the Bay..." But to be effective in such a role the agency would have to achieve control (either through its law or through an aforementioned interstate body) over development factors affecting the Bay as well as those of a conservation nature. Additionally, a spread of effectiveness through the other levels of government would have to be attained.

A newly created State agency might be visualized with broad enough powers and functions to cope with the problems of the Bay and its management. An agency with shared responsibility with other levels of government, with significant functional as well as political representation, and with the power to plan, to manage and to regulate might be conceived. Such an agency would have to have broad functional and activity prerogatives and would have to be able to lace together in a network -- even though probably complicated -- a modus operandi to accomodate the many-faceted problems.

b. Appropriateness to Chesapeake Bay

The Chesapeake Bay and its area of related influence takes in most of Maryland and Maryland State functions. Creating a super agency with a multipurpose mandate would be tantamount to recreating another -- and competitive -- State government. It is not considered as a serious proposal.

11 Summary Conclusions on Organization for Bay Resource Management

Maryland State Government is now well organized to carry out Bay resource management and single-purpose planning. There is little purpose in proposing structural changes in a system that has just been instituted.

Federal-State responsibilities and State-local areas of authority are not so clear. Each level operates with a considerable lack of communication if not outright mistrust of the other.

And most specifically, the organization for responsibility of developing and updating a comprehensive overall planning function for the Bay does not now exist.

Footnote

Perspective on Bay Resource Management Studies

Governmental organization for water resource management has been under almost continual study for the past decade. Studies have been conducted by State agencies and non-State agencies, often with support of State agency staff. The studies have taken various perspectives on the Bay. In combination and sequence, these efforts provide a valuable perspective on evolving Bay resource management. The following items are a few highlights:

a. Future Administration of State of Maryland Water Resources Activities, (A Report to the Governor), March 1961, Maryland State Planning Department.

b. "Maryland - State Laws, Policies and Programs Pertaining to Water and Related Land Resources", September 1966, Maryland State Planning Department. (A summary of steps taken by the Maryland Legislature in 1964 in realigning state agency responsibilities relating to natural resources.)

c. "Maryland's Role in Water Resources Development", 1966, Craine, Lyle E. (A study for the Water Resources Study Committee of the University of Maryland. The study reviewed emerging water resources problems in Maryland, considers the role of the State in water resource development and concludes that "the State has three general types of responibility regarding water use and development: 1) to prosecute Maryland's interest in interstate waters; 2) to assure optimal use and development of natural waters under its jurisdiction; and 3) to assure efficiency in the provision of water and sewerage service in the overlapping metropolitan areas around Baltimore, Washington and Annapolis." (p. 1).

d. "Susquehanna River Basin Compact", Revised January 1967, Interstate Advisory Committee on the Susquehanna

River Basin. (For several reasons, among them the different stages of planning and analysis for the Chesapeake Bay vis a vis the remainder of the Susquehanna watershed, the Susquehanna River Basin was defined for administrative purposes to not include the Chesapeake Bay.)

e. Maryland State Government Reorganization 1970-71. (Formation of super State agencies to coordinate State policy in major functional areas: natural resources, transportation, economic and community development.)

References

1. Power, Garrett, Chesapeake Bay in Legal Perspective, March 1970, (part of National Estuarine Pollution Study by the Federal Water Pollution Control Administration, U.S. Dept. of the Interior), pp. 223, 224; p. 224.

2. Central Atlantic Environmental News, Vol. 1, No. 10, October 29, 1971, p. 3.

3. Craine, Lyle, "Problems of Organizing for Coordinated Resources Management in the Chesapeake Bay", Proceedings of the Governor's Conference on Chesapeake Bay, 1968, pp. 209; p. 206; p. 207; p. 208, 209; p. 208.

4. McHugh, Dr. J. L., "Fisheries of Chesapeake Bay", Proceedings of the Governor's Conference on Chesapeake Bay, p. II-153.

5. Water Resources Planning Act, Title II.

6. Maryland House of Delegates Bill #200, January 31, 1970, Section 3.02.

VI

Major Elements of a Comprehensive Plan for the Chesapeake Bay

VI MAJOR ELEMENTS OF A COMPREHENSIVE PLAN FOR THE CHESAPEAKE BAY

A. WHY MARYLAND STATE GOVERNMENT SHOULD TAKE THE LEAD IN PLANNING FOR THE BAY 319

B. GENERAL NATURE OF THE COMPREHENSIVE PLAN 320

C. SUMMARY OUTLINE OF MAJOR ELEMENTS 321

D. COMPONENT PLAN DESCRIPTION 322

1. Water Resource Element 322

2. Natural Resource Element 323

3. Shoreline Protection Element 324

4. Bay Related Activities Element 325

5. Coordination and Implementation Element 327

6. Summary Remarks Regarding Component Plans 327

E. STEPS FOR PLAN PREPARATION 328

1. Steps to Formation of Organizational Entity and Funding for Plan Preparation 328

2. Steps Subsequent to Formation and Funding of Organization for Plan Preparation 328

F. SUMMARY OF ELEMENTS OF A COMPREHENSIVE PLAN FOR THE CHESAPEAKE BAY 329

Plate 33: Schedule for Preparation of Components and Elements of a Comprehensive Plan for the Chesapeake Bay 330

A

Why Maryland State Government Should Take the Lead in Planning for the Bay

Maryland State Government has recently reorganized in a manner that lends itself to effective Bay resource management. The five major State Departments involved can deal effectively with operating problems but need a comprehensive plan containing a unifying set of guidelines and concepts, prepared through a clearly articulated, centralized, visible and accessible process of planning to give coherence, direction and integration to their programs.

The nature of this planning effort and the kind of plan to be prepared are major factors in deciding who should prepare it. Therefore, the elements of the plan and the steps necessary to its preparation are considered here.

The case can be made that only a portion of the Bay lies within Maryland and therefore a Bay Plan should be prepared by an agency of the Federal Government or a Federal-interstate compact organization. Time, urgency, the size and other key aspects of Maryland's portion of the Bay all point toward Maryland State Government taking the lead in developing a comprehensive plan for coordinated Bay resource management.

The northern half of the Chesapeake Bay is entirely within the State of Maryland. Almost all of the State of Maryland is within the Chesapeake Bay watershed. By its estuarine nature, the Chesapeake Bay presents resource management problems different from those of the major fresh water streams and rivers feeding it.

Of course, comprehensive planning for the Maryland portion of the Chesapeake Bay should not preclude a future formal agreement with Virginia to encompass the southern portion of the Bay. However, it is felt that such an agreement should follow the present comprehensive planning efforts rather than precede them.

Resource management problems in the Maryland portion of the Bay are urgent. In many cases, these problems are separable from those in the southern section of the Bay. Many of the inter-state dimensions of problems have not been adequately documented. Also, a formal agreement (e.g. an interstate compact) between the states must focus on particular resource management problem areas -- which should be defined and documented by preceding planning efforts.

Even if a full complement of interstate arrangements is ultimately created, these will be likely to deal with selected problem areas which benefit from interstate management. There would remain a large area of resource management problems particularly for economic development which must be dealt with in an intra-state context. Most inter-state compacts, in fact, have a relatively narrow problem area focus, though they seek comprehensiveness in geographic scope. Thus, much coordination and conflict resolution among problem areas would remain to be dealt with at the intra-state level.

Local jurisdictions bordering the Bay should participate in comprehensive planning for Bay resource management. However, any institutional arrangement for planning should avoid geographic representation per se since final approval of a Bay plan by General Assembly ensures equity on a geographic basis when final trade-offs are made. It is necessary to preserve a Bay-wide geographic scope for comprehensive planning efforts.

Federal agencies with Bay resource management responsibilities (e.g. Corps of Engineers; Environmental Protection Agency, etc.) should participate in comprehensive planning for Bay resource management. The State must adopt an institutional planning process that gives a central point of contact and responsibility for relations with Federal and other agencies.

B

General Nature of the Comprehensive Plan

Traditional models of comprehensive plans are not applicable to the Chesapeake Bay. Those for large urban areas do not deal with resource allocation problems. Historic as well as recent examples(Ref.1) of river basin plans tend to focus on land use and do not take cognizance of the dynamics of the water system.

There is no exact counterpart for the kind of plan needed for the Chesapeake Bay. While portions of a plan must address themselves to typical functional (e.g. transportation) or areal (e.g. portions of the Bay) requirements, the need is for a plan for management of the Bay as a system and series of sub-systems.

This kind of plan must recognize that there are no "solutions" since any action to modify problems sets up new situations and new problems. We do not have adequate information to tell the full effect beyond the first round of changes in the system and, therefore, except for short-range management, the traditional "problem-solving" posture of planning is inadequate. Instead, a multiple objective approach is needed, even though the difficulties of developing choice criteria for incommensurate goals and other conceptual as well as operational weaknesses are major.(Ref.2) The San Francisco Bay Plan(Ref.3) appears an appropriate instrument for control of some aspects of that Bay, but is not an adequate model, except in part, for the Chesapeake situation. What is needed is a shift from "management by (limited) objective" to a "management of means".[1]

Elements of a Chesapeake Bay Comprehensive Plan must deal much more directly with all aspects of the Bay system than any previous plans for a similar area: the water component and processes; the natural resource component (other than water); and the human activity that actually happens on, in, or over the Bay.

It must also provide a suitable mechanism for coordination with present on-going planning by all levels of government for the Bay and adjacent areas. It must take a posture of "facilitating" and coordinating other planning, not trying to pre-empt it.

On the issue of whether a plan for such a huge area and such a diverse client can lay claim to "comprehensiveness" i.e. that it can aggregate goals, examine all feasible alternatives, provide adequate measures of equity, stand the tests of time, and include full means of implementation, the answer must be no, if the test is a theoretical ideal.(Ref.4) Plans at this scale are more or less comprehensive on a continuum rather than comprehensive or not. The plan for the Chesapeake Bay must aspire to as great a degree of comprehensiveness as possible.

Most specifically, the plan and the planning process must take account of all of the following:

a. The entire Maryland portion of the Bay, including all sub-estuaries;

b. The relation of the Maryland portion of the Bay to the rest of the Bay and to the Bay's watershed;

c. The entire scope of Bay functions and problems;

d. Water and land planning interrelationships;

e. Resource conservation and resource development objectives;

f. The wide range available of alternate means of implementation;

g. And, the range and diversity of citizen and governmental interest and involvement in Bay affairs.

C

Summary Outline of Major Elements

The five major elements of a comprehensive plan for the Chesapeake Bay are: (1) Water Resource Element; (2) Natural Resource Element; (3) Shoreline Protection Element; (4) Bay-Related Activities Element; and, (5) Coordination and Implementation Element. For description purposes, the sub-elements of each major element will be called "plans". The network of elements, and component plans follows, with a description of each in the succeeding text.

1. Water Resource Element
   - 1.1 Hydrologic System Plan
   - 1.2 Water Supply Plan
   - 1.3 Water Pollution Abatement Plan
   - 1.4 Waste Discharge Plan
   - 1.5 Flood Control Plan
2. Natural Resource Element[2]
   - 2.1 Fisheries Plan
   - 2.2 Wildlife Plan
   - 2.3 Wetlands Plan
   - 2.4 Resource Extraction Plan
3. Shoreline Protection Element
   - 3.1 Natural Process System Plan
   - 3.2 Shore Recreation and Open Space Plan
   - 3.3 Shore Development Guidelines Plan
   - 3.4 Soil Conservation Plan
4. Bay-Related Activities Element
   - 4.1 Marine Transportation Plan
   - 4.2 Water-Related Industrial Plan
   - 4.3 Water-Related Power Plan
   - 4.4 Waterfront Access Plan
   - 4.5 Water Recreation Use Plan
5. Coordination and Implementation Element
   - 5.1 Intergovernmental Relations Plan
   - 5.2 Citizen Participation Plan
   - 5.3 Legislative Plan
   - 5.4 Financial Plan
   - 5.5 Information System Plan
   - 5.6 Continuing Planning and Research Plan
   - 5.7 Economic Evaluation Plan

D
Component Plan Description

Each of the component plans is described below with a brief list of steps or work program items to be developed in its preparation.

1 Water Resource Element

1.1 Hydrologic System Plan

The concept of this plan is that it is a descriptive model of the hydrologic system of the Bay (water budget) to which performance goals can be applied. The U.S. Corps of Engineers hydrologic model is an essential tool to this end in that, at a gross level, implications of water withdrawal and major projects for the performance of the system can be evaluated. Similarly, micro-climatic effects of the elimination of forest cover or evapotranspiration can be weighed.

What will make this a plan, rather than simply a descriptive model will be the application of goals for performance. The analysis of alternative ways of effecting the multiple objectives involved, and decisions regarding courses of action should be translated into specific legislation and acts.

In the process of development of the plan, sub-estuary hydrologic system models and plans will have to be prepared, and calibrated with the overall model. At first crude, such models can be made increasingly sophisticated as research is carried out on the interaction of the subsystems.

Particular attention must be paid to fresh water input, diversion and land/water interchange subsystems.

The adoption of Water Resources Regulation 4.8 "General Water Quality Criteria and Specific Water Quality Standards for All Maryland Waters"[2] (Ref.5) establishes the basic benchmark for water quality for Maryland waters. As part of this planning process, specific water use zones are identified. Current standards need to be detailed and made more specific as constraints related to flow, duration of flow, odor, chemical content, appearance and turbidity. The EPA has also set standards which need to be coordinated with the above. Particular attention must be paid to parts of the system (ground water, and surface drainage standards) that affect Maryland waters. Since the water use zones already established respond to present water quality, they need re-examination and revision, as anti-pollution steps are taken. The Water Use Categories (Shellfish Harvesting, Public or Municipal Water Supply, Water Contact Recreation, Propograiton of Fish, Other Aquatic Life and Wildlife, Agricultural Water Supply, and Industrial Water Supply) will also need to be revised as Use Zones change.

1.2 Water Supply Plan

The Hydrologic System Plan is a "water supply plan" for water in the Bay. This plan component deals with supply for human use, both for consumption and in economic processes. The Water Quality Standards also serve as goals in this plan. To date water supply has been dealt with on a piece-meal basis, albeit a regional one. Protection measures for ground water and aquifer use must be incorporated on a Bay-wide basis if localized problems are to be resolved.

Since the question of water supply is also tied to that of the location and timing of economic and social growth, forecasts of Bay-region growth and agreement on water need and utilization must be dealt with as part of the planning process.

1.3 Water Pollution Abatement Plan

The Maryland Environmental Service is committed to preparation of water pollution abatement plans for natural areas wherever pollution exceeds water quality standards set for such an area.

The overall plan envisioned here must not only be an aggregation of constituent sub-estuary plans but also establish priorities and set the parameters of the Bay-wide need. Obviously one way of reducing or increasing the "pollution problem" is to redefine zones. The economics involved in the study and reduction of water pollution require the use of linear programming inter-industry input-output models to enable an adequate level of specific knowledge as to the trade-offs involved.

1.4 Waste Discharge Plan

This component plan also is integral to the Maryland Environmental Service's mandate for pollution abatement plans for sub-estuaries. Both liquid and solid wastes are involved, with steps to include the evaluation of all current plans, and a determination of the receptive capacity of the Bay for future increases in the need for waste disposal.

1.5 Flood Control Plan

To a large degree flood control is a Federal responsibility. However, Federal programs need to be incorporated into local plans. There are many flood-prone areas that do not come under Federal jurisdiction and/or priority, and development of the shoreline may increase or decrease flood exposure.

The Flood Control Plan should collect data on flood impact in a form appropriate for benefit-cost accounting and PPBS-type program evaluation (see Economic Evaluation Plan infra).

2 Natural Resource Element

2.1 Ecosystem Plan

This plan would provide for completion of the required understanding of the complex and productive ecosystem present in the Bay and development of the guidelines which will protect and enhance the essential components and characteristics of that system. Many human uses of the Bay are directly dependent upon the efficient functioning of the total ecosystem, including commercial harvesting of fish and wildlife, most recreational activities including fishing, waste disposal capacity, and the aesthetic appearance of the Bay and its tributaries. For instance, the Maryland segment of the Bay, including as it does the low-salinity high-population portion of the nation's largest estuary, involves vast nursery areas for fish which are important to the entire Mid-Atlantic Region. In these areas, the ecosystem supports essential food supplies, precludes dangerous predators, and require specific and positive protection from excessive alteration.

2.2 Fisheries and Wildlife Plan

This plan deals with the harvested living resources of the Bay. These living resources require a series of sub-plans for each major type of resource: e.g. shellfish, anadromous fish, game birds, etc. These plans should set productivity goals, establish gaps between performance and goals, analyse alternate courses of action to narrow the gaps, propose appropriate programs and policies for implementation, and outline action research to provide feedback into the planning process.

2.3 Wetlands Plan

The program initiated by the DNR under the Wetlands Act should be formalized to produce a plan component of the Natural Resource Element. Obviously this is a "hinge" component between water and other natural resources. Based on identification and description of the role of wetlands, a method for weighing relative importance and establishing priorities must be evolved, not only for current wetlands but also for the creation of new wetlands areas. The wetlands plan component should embody a classification

system for wetlands that establishes priorities in the natural regimen that indicates degree of vulnerability to change, and that provides for acquisition and/or preservation in a natural state where appropriate. An important input to the preparation of the Wetlands Plan will be the biological models[3] that will enable an understanding and evaluation of the specific role of each wetland in each small sub-ecosystem.

2.4 Resource Extraction Plan

A first step in the preparation of this plan is to compile an inventory of all known valuable deposits of sand, gravel, and other non-living resources. They should then be examined (on a priority basis) for their potential environmental impact of their extraction.

An important aspect of the evaluation of the extraction plan is the issue of whether other sources are available for urban growth, and the cost implications of restricting Bay sources.

3 Shoreline Protection Element

3.1 Natural Process System Plan

Shoreline land use planning is a function of local government and it is not the intention of this plan component to preempt that function. Rather, the purpose of the Shoreline Protection Element and its component plans is to determine the nature and extent of Bay-wide -- and therefore State -- interest in local land use decisions vis-a-vis the Bay system. Thereafter the questions that must be asked are: Is the Bay-wide interest being served by local decisions? And, if not, what steps must be taken?

The Natural Process System Plan begins with an ecological inventory of the shoreline by sub-estuaries. The areas involved will be determined by a "zone of interaction" between land and Bay using water in motion as the linkage. The next step is the reconstitution of the natural phenomena identified by the inventory into dynamic biophysical processes, and thence to the formulation of the area under study as an ecological model of interacting biophysical processes.

The second phase of these ecological planning studies consists of reconstituting these data as a social value system -- that is, attributing values that can be widely shared to the processes and to the environment. The ecological model then enables the planner not only to trace the effects on the whole system of any change in part of it, but also to demonstrate a benefit-cost accounting that includes non-economic as well as economic values.

The next step in this planning process interprets the above data in terms of intrinsically suitable land uses by matching uses and areas on the basis of disturbing the natural system least in a "creative fitting". This synthesis also shows how various uses, by skillful design and engineering, can be accommodated with little damage or even beneficial effect on the ecosystem.

Paralleling the above steps is a socio-economic and physical planning study that explores (through socio-economic "growth" analysis and evaluation of current plans, projects, and aspirations) the extent to which these development proposals are in conflict or congruent with (or neutral to) the intrinsic suitabilities of the area and its ecology.

The preparation of the Natural Process Plan then involves posing alternate courses of action to minimize conflicts and maximize congruence of planned development with the intrinsic characteristics of the ecosystem.

It should be noted that at least one county (Anne Arundel[4]) and the Regional Planning Council (Ref.7) have taken significant steps toward the preparation of such Natural Process Plans, and the Department of Natural Resources has several sub-estuaries already under similar types of study.

3.2 Shore Recreation and Open Space Plan

The Department of State Planning in conjunction with the Department of Forests and Parks have published a State-wide Outdoor Recreation and Open Space Concept Plan.(Ref.8) This plan is at a quite general level and did not have the background research and understanding of small ecosystems, or of disaggregated growth patterns that will result as outputs of other plans and elements outlined herein. The major input will be the Natural Process Plan and other plans, with areas specified for permanent open space in accord with criteria of intrinsic suitability, amenity, historic value and particular vulnerability to environmental despoliation. This Plan is conceived as a refinement of the present State-wide plan, plus the inclusion of devices for its implementation.

3.3 Shore Development Guidelines Plan

The Shore Recreation and Open Space Plan will say where not to build. The Natural Process Plan will spell out intrinsic suitabilities for each specific area, conflicts and congruences between likely and planned development and intrinsic land suitabilities.

The Shore Development Guidelines Plan has these basic plans as input. It has as its principle component an environmental matrix.[9] An environmental matrix defines the environmental impact characteristics of all kinds of land uses and human activity. Based on these as "input" to the environment, the objective is to "match" specific uses with ecological areas that can accommodate the "input" with minimum negative effects.

The Shore Development Guidelines Plan establishes criteria -- based on Bay-wide (i.e. State) interest in local planning and development -- that stipulate the conditions under which any particular land use decision will be permitted. If local decisions are consistent with the criteria, then zoning changes and ultimate development are unaffected. If proposed development violates these criteria, then the burden of proof must be on local initiators and a process of review and higher decision developed as part of the Coordination and Implementation Element below. To a degree this might represent withdrawal of full zoning authority at the local level. In fact it is a formalization of authorization the State now has through its concern for overall public health, safety and welfare.

3.4 Soil Conservation Plan

Soil conservation palns have been prepared for many counties by the USDA Soil Conservation Service. Much of the land around the Bay has been classified for soil type and soil characteristics and this work is a central input to the various plans above, particularly the Natural Process Plan.

Full coverage has not been achieved and positive plans for soil conservation as a major factor in the drainage of sub-estuaries and the minimization of siltation and pollution have not been completed. Soil stabilization and reforestation are crucial to control of the water regimen. With the input from other component plans, sub-estuary soil conservation plans can be aggregated to Bay-wide scale as the Soil Conservation Plan and properly related to other components and elements.

4 Bay Related Activities Element

4.1 Marine Transportation Plan

Much planning has been done for the major harbors and for the Bay as a whole by the U.S. Army Corps of Engineers and the Maryland Port Administration. However, this work has not been aggregated formally as a Bay-wide plan, and it has not had the advantage of input from other component plans, particularly other components in the Bay-Related Activities Element.

The development of this Plan should begin by forecasting alternative futures regarding marine activity and casting these into the development projects necessary to their implementation. Central to the evaluation of these alter-

nate futures for marine transportation (as well as for water-related industry: see 4.2 below) is the development and use of a regional inter-industry accounts model. A working model already exists for the Baltimore Region(Ref.9) and at a more general scale for the Eastern Megalopolis.[5] Use of these models as well as more conventional economic benefit-cost analysis will enable an adequate evaluation of the value of channel deepening, harbor development and other projects. These values can then be introduced in the PPBS-type evaluation proposed in the Coordination and Implementation Element.

The resulting Marine Transportation Plan can then clearly spell out the goals, alternatives, expected environmental impact and socio-economic implications, actions proposed, and financial requirements for carrying out the Plan -- not as an isolated set of projects but as part of the overall Bay-Related Activities Element of the Comprehensive Plan for the Bay.

4.2 Water-Related Industrial Plan

Bay and water-related industrial planning has been carried out largely on an ad-hoc basis in response to economic problems of local communities. These separate plans should be screened, coordinated and aggregated into a Bay-wide plan. All possibilities of developing the Bay shoreline for water-related industry should be examined for their direct and indirect impacts on local and regional economies. With the impacts of industrial development proposals estimated "in terms of total production volume changes and their accompanying labor requirements",(Ref.9) the explicit impact of environmental "trade-offs" can be ascertained and recommendations for compromise reached through the Coordination and Implementation Element of the Bay-wide Plan.

4.3 Water-Related Power Plan

This Plan will involve the establishment of long-range goals for use of the Bay for power plant location, examination of alternate sites and criteria for location of power plants[6], and the examination of potential implications and/or "trade-offs" necessary for less than optimal locations. Through environmental impact studies and interaction with work in other components, such as the Natural Process Plan, the most suitable sites from a Bay-wide view can be reserved, and the special guidelines for plant development can be specified.

4.4 Waterfront Access Plan

County and State transportation plans do not directly address the access problem of the Bay. While this Plan will be a part of such plans, it is necessary to have a transportation component that outlines proposed shoreline access as an important "agent of change" in encouraging (or discouraging) specific Bay uses. Highway plans should be related to plans for marinas, open space, industrial and residential development, and conservation areas. Since current transportation plans also have been prepared without benefit of the input from intrinsic suitability analysis (Natural Process Plan) they need reexamination to determine the Bay-wide (and therefore State) interest in them.

4.5 Water Recreation Use Plan

Water recreation use is considered a component of the Bay-Related Activities Element even though it is closely related to the Shore Recreation and Open Space Plan in the Shoreline Protection Element (see 3.2 above). The reasoning is that as water recreation demand grows, recreational use of water areas will increasingly have to be more closely and directly controlled (through use zoning, boat licensing, and the development of commercial recreation) than will be possible through shoreline control or the setting of water quality standards alone. This control will be largely an operating responsibility, and only its long-term implications regarding development projects would be part of the Plan.

5 Coordination and Implementation Element

5.1 Intergovernmental Relations Plan

In the development of this Plan, the output of other components will be continuously surveyed in terms of the relationship of Bay planning by State agencies with that of other levels of government. Basically, this is a plan for the long-term intergovernmental relations for management of the Bay's resources. Its output will be specific recommendations for changes (if any) in assigned responsibilities and coordinating mechanisms. It should set up a mechanism for review of current projects, and county, regional and Federal plans as regards their conformance or conflict with elements and components of the Bay-wide plan.

5.2 Citizen Participation Plan

The initial purpose of this Plan is to establish the basis for citizen participation in the process of preparing the Comprehensive Plan for the Bay, and to recommend the continuing relation of citizens to both planning and operating levels of management of Bay resources. A program for public education regarding Bay planning will be a part of this Plan.

5.3 Legislative Plan

Each of the component plans and Elements will produce (to varying degrees) proposals for changes in legislation. The purpose of this Plan is to integrate these proposals and provide for scheduling and priority determination in their presentation to the Governor and the General Assembly.

5.4 Financial Plan

The Financial Plan will play a function similar to the above as an overall aggregating and synthesizing component.

5.5 Information System Plan

The idea of an information system network (CBIN) will be developed, clearing houses selected, procedures established for data selection, storage, and retrieval, and data banks established. The Graphic Encyclopedia (mapping) procedures[8] will be developed to integrate the massive graphic output of the various Plan components and Elements.

5.6 Continuing Planning and Research Plan

This Plan should outline procedures for future long-range planning, research, and feedback which will be needed to update the Bay-wide Plan, its elements and components. It should also recommend what organization or organizations should be responsible for continued planning.

5.7 Economic Evaluation Plan

Economic evaluation is seen as a service function in both preparation of components and elements and in continuing planning. The organizational capability for operating the Bay-wide inter-industry regional accounts model, and the application of benefit-cost accounting and PPBS-type evaluation techniques is the output of this Plan.

6 Summary Remarks Regarding Component Plans

It is at once apparent from the above outline that many rearrangements and consolidations of component plans are possible. Even though division of the overall task into elements and components inevitably does some damage to what is conceived as an interlocking web, it is necessary for purposes of division of labor and responsibility. The task of reintegration into a coherent, internally consistent, and defensible comprehensive plan will be a major feat of technical and managerial skill and the art of government.

E
Steps for Plan Preparation

Is is estimated that three years will be required to prepare a Preliminary Comprehensive Plan for the Chesapeake Bay. A shorter time is not realistic when considering the complexity and size of the task. A longer time cannot be taken due to the urgency of many issues.

It is important to realize that there will be output from the planning process that will aid in decisions during the three year period. In fact parts and recommendations will be put into implementations long before the Preliminary Plan is ready for formal presentation to the Governor and General Assembly.

Steps toward preparation of the Plan include, but of course, are not limited to the following.

1 Steps to Formation of Organizational Entity and Funding for Plan Preparation

1.1 Discussion, modification and agreement by CBIPC on nature of Comprehensive Plan for Chesapeake Bay and organizational requirements for its preparation.

1.2 Recommendation to Governor on next steps.

1.3 Preparation by relevant departments of working papers on study outline and responsibilities and preliminary cost estimates.

1.4 Consideration by CBIPC of working papers.

1.5 Preparation of documentation for governmental assignment of responsibility for plan preparation.

1.6 Discussion with Federal and local agencies of proposed procedure.

1.7 Discussion with civic, business, and academic interest groups of proposed procedure.

1.8 Adoption by government of organization and method of funding for and steps toward preparation of plan.

1.9 Approval of funds for preparation of Comprehensive Plan.

1.10 Formal initiation of organization for Plan preparation.

2 Steps Subsequent to Formation and Funding of Organization for Plan Preparation

2.1 Recruitment of necessary director and staff. Assignment to task forces of various department staff.

2.2 Preparation of draft study design by relevant staffs and consultants.

2.3 Formation of citizen and intergovernmental coordinating committees.

2.4 Preparation, Review and Approval of Final Study Design.

2.5 Commencement of Study

2.6 Monthly progress reports to Governor, and semi-annual progress reports to General Assembly and public.

2.7 Preparation of draft component plans as completed.

2.8 Review and approval of component plans as completed with continuing public meetings and discussion.

2.9 Preparation of draft Preliminary

Comprehensive Plan.

2.10 Submission of draft Preliminary Plan to Governor and departments for review.

2.11 Modifications in draft and Submission of Preliminary Plan to General Assembly.

2.12 After review and public hearings, approval of Comprehensive Plan for the Chesapeake Bay (Maryland) in principle, and enactment of relevant legislation.

F

Summary of Elements of a Comprehensive Plan for the Chesapeake Bay

Five elements and twenty-five component Plans have been identified to constitute a Comprehensive Plan for the Chesapeake Bay. The nature of this Plan should influence decisions regarding organizational responsibility for its preparation.

Generally, interdisciplinary teams should be formed to prepare component plans working on sub-estuary and special area assignments. Thus, Natural Process Plans would be prepared for each sub-estuary over the first two years of the study, and then aggregated in the first half of the third year. As each sub-estuary plan was completed, its input to the various other plans -- e.g. Water Pollution, Flood Control, Wetlands-- would be made, with a feedback from those planning processes before the aggregate Natural Process System Plan for the Bay was completed.

For Bay-wide and functional scale planning of components, work would be by groups of specialists within one or a few disciplines. Thus, the Hydraulic System Plan would begin by a preliminary concept of the whole Bay-wide and watershed system during the first six months. This would be followed by sub-estuary water budget delineation for an estimated year during which work teams would be interdisciplinary. For the final year work would refocus at the Bay-wide scale to prepare for input from all of the other components.

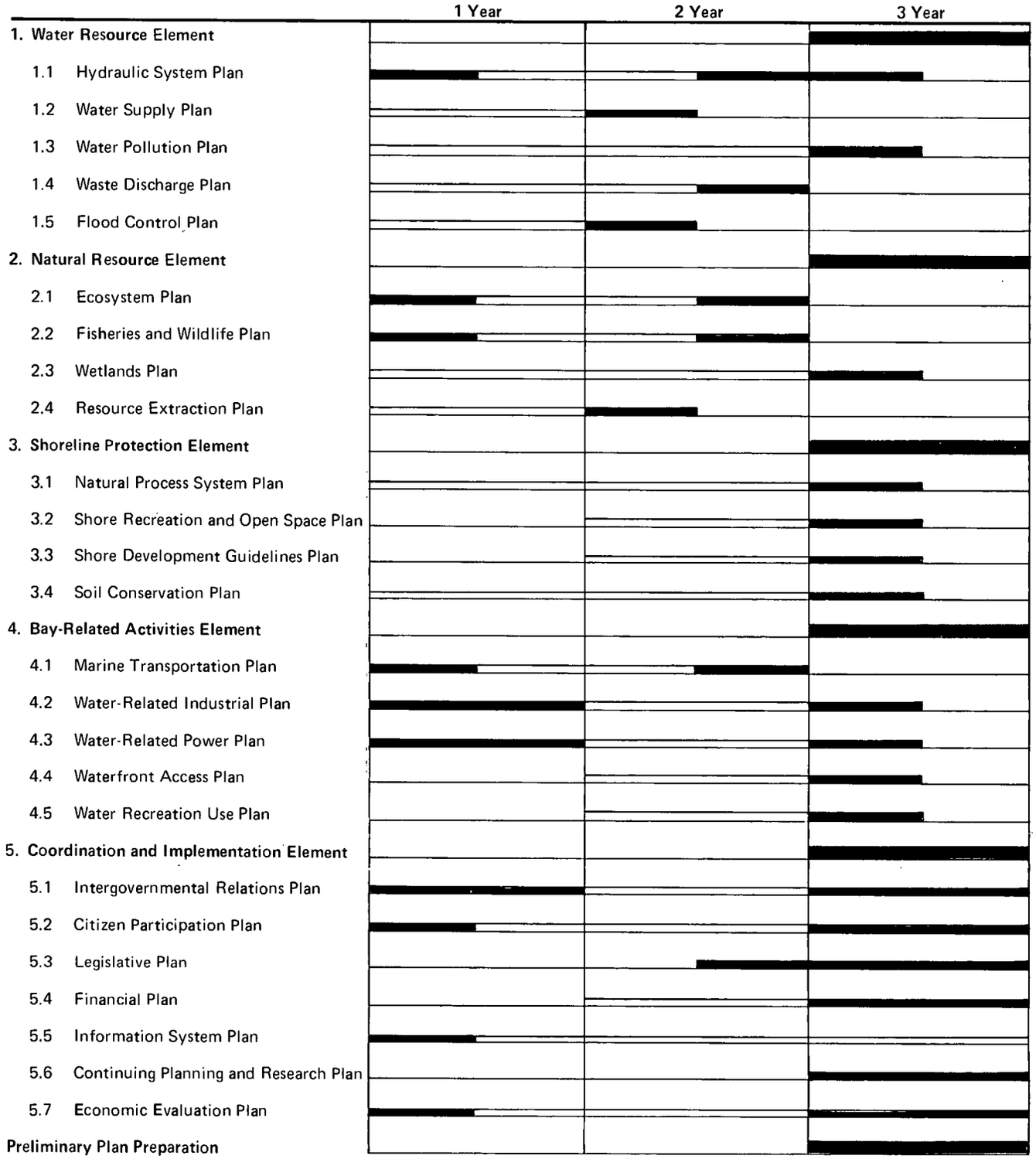
Work programs beyond the scope of this Report must be developed for further delineation of team and task force assignments. The next chapter considers the appropriate general form of organization for preparation of the twenty-five component plans, five elements, and Comprehensive Plan for the Chesapeake Bay.

PLATE 33:

Schedule for Preparation of Components and Elements of a Comprehensive Plan for the Chesapeake Bay

Geographically specific focus

Bay-wide focus



Footnotes

1. The Bay might be looked at as a giant refinery. Its management involves control of a complicated series of physical and chemical processes to ensure the objective of high octane fuel production.

2. Water is, of course, a natural resource. However, it is a natural resource of such fundamental importance that it is dealt with as a major plan element in its own right.

3. The biological models would be similar to those proposed for development by the University Consortium. (Ref.6)

4. Work in progress by the Anne Arundel Department of Planning and Zoning.

5. The "Eastern Seaboard Model", being developed by the Regional Science Institute in Philadelphia, generates information for eight industrial classifications at a County level of detail with regard to estimating economic and employment changes and impacts.

6. This examination should draw on current work of the Chesapeake Bay Cooling Waters Study Group in developing "information that will provide a more adequate basis for decisions with respect to the location, design, size and operation of power plants". (Ref.10)

7. See sub-section V-B-2 above.

8. See sub-section V-B-3 above.

9. See sub-section V-A.

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VII

Who should prepare a Comprehensive Plan for the Chesapeake Bay?

VII. WHO SHOULD PREPARE A COMPREHENSIVE PLAN FOR THE CHESAPEAKE BAY?

A. CRITERIA FOR BAY PLANNING 334

1. General Criteria 334
1.1 Comprehensiveness 334
1.2 Coordination 334
1.3 Responsibility 334

2. Specific Criteria for Plan Preparation 334
2.1 A Major Effort 334
2.2 Planning Period 334
2.3 Separation from Operational Activities 334
2.4 Interdisplinary Planning 334
2.5 Temporary Commission 334
2.6 Access and Visibility 334
2.7 Accountability 335
2.8 Technical Capability 335

B. ORGANIZATIONAL ALTERNATIVES FOR COMPREHENSIVE PLAN PREPARATION 335

1. Alternative One: Assignment to a Single Agency 335
1.1 Possible Assignments 336
1.2 Evaluation 336

2. Alternative Two: Continuation of CBIPC 336

3. Alternative Three: Assignment to a Temporary Commission 337

C. FORMATION, ORGANIZATION AND POWERS OF A TEMPORARY CHESAPEAKE BAY COMMISSION 337

1. Composition of the Chesapeake Bay Commission 337

2. Powers and Responsibilities of the Chesapeake Bay Commission 338
2.1 Plan Review and Coordination Approach 338
a. Water Resources and Natural Resources Elements 338
b. Shoreline Land Use Element 339
c. Bay-Related Activities Element 339
d. Bay Coordinative Management Element 339
e. Information Storage and Retrieval Element 340
2.2 The Task Force Approach 340

3. Report to the Governor 341

D. SUMMARY OF RECOMMENDATIONS 341

A
Criteria for Bay Planning

The formation of the Chesapeake Bay Interagency Planning Committee with its ten (original) members was in recognition of the need for a comprehensive plan and a rationalized management system for the Bay. The reorganization discussed in Chapter VI above has sharply focused management responsibility -- as evidenced by the present five member agencies of CBIPC. It was concluded that changes in management of operating programs, except those internal to the various departments, are not desirable, at least for the present.

The fact of five agencies -- each with planning functions that affect the Bay and jurisdictions adjacent to the Bay -- more than ever argues for a centralized planning function, at least for the development of a comprehensive Bay plan.

1 General Criteria

Capabilities of a Bay planning organization should include: information, research, planning, (limited) operations, citizen participation, feedback and adaptation. In addition, a Bay planning agency should have the following characteristics:

1.1 Comprehensiveness
An agency that can take into account the full range of interests, disciplinary points of view, and values of all jurisdictions related to the Bay with a Bay-wide approach.

1.2 Coordination
An agency that does not displace existing agencies at state or local level, but is capable of coordinating them by means of a single plan and unified program, at the same time utilizing the expertise and efficiency of existing agencies.

1.3 Responsibility
An agency that is politically responsible to all jurisdictions related to the Bay, directly or indirectly.

2 Specific Criteria for Plan Preparation

In a systems approach to adaptive management, the planning process is seen as a subsystem of management and operations.

However, as has been emphasized, no single agency is authorized to prepare a comprehensive plan for the Bay, nor is one currently geared to do so.

The conclusion is drawn, therefore, that a planning task force must be formed with appropriate institutional backup. This is necessary for eight reasons.

2.1 The importance of the task must be recognized as requiring a major effort. No agency alone has the capability under current funding.

2.2 The time period for the development of a comprehensive plan for the Bay must be no longer than about three years. Resource issues cannot wait. This accelerated pace means that current staff of State agencies, even in concert, will have great difficulty mounting the effort required.

2.3 The long-range and goal-setting nature of the task requires a reasonable separation from day-to-day, short-range operational planning and management.

2.4 The interdisciplinary nature of the responsibility involved requires skills and levels of staff commitment not available currently in any single agency.

2.5 The temporary nature of the development of a Plan militates toward a task force approach in contrast to a continuing need for modifying and updating the Plan and for implementing its programs.

2.6 The democratic nature of the responsibility requires that the process be accessible and visible to the general public, that affected interest groups and concerned agencies be involved, and that the Executive Branch be accountable.

2.7 The administrative nature of the responsibility requires assignment to an organization not only accountable to the Governor, but one that will act as a contact point for Federal and local planning and research.

2.8 The responsible nature of the assignment means that investigative, analytical and planning capability must be available to fully investigate resource utilization issues as background for recommendations on decisions.

B

Organizational Alternatives for Comprehensive Plan Preparation

The nature of the Plan to be prepared, and the criteria for the process of its preparation should influence the decision as to who should prepare it. Three major alternatives open to the Governor are considered -- assignment of the responsibility to:

1. One or another of three major departments: the Department of State Planning (DSP), the Department of Natural Resources (DNR), the Department of Economic and Community Development (DECD). (The Departments of Health and Transportation are not considered as appropriate candidates).

2. All three major departments, with agreed upon specific assignments for planning elements as follows:

   a. DNR - Water Management and Natural Resource Management Element.
   b. DECD - Bay-Related Activity Management Element.
   c. DSP - Shoreline Management Element; Bay Management Coordination Element.

   The organizational device for coordination would be the continuation of the CBIPC in its present form.

3. Assignment to a temporary plan-preparation commission (Chesapeake Bay Commission) formed to prepare a plan to be presented to the Governor with recommendations concerning the plan's implementation and the commission's continuing role. (Two variations within this alternative are considered in Section C2 below).

The following paragraphs consider the advantages and disadvantages of the three alternatives.

1 Alternative One: Assignment to a Single Agency

The first alternative for the

preparation of a Comprehensive Bay Plan -- assignment to a single agency -- has points to commend it. However, it involves potential bureaucratic difficulties as well as the implication that the Bay Plan would be dominated by one set of values or point of view.

1.1 Possible Assignments

The Department of Natural Resources has the greatest stake in operating responsibility,and its mandate could,without much stretching,include performance criteria for all land uses regarding their impacts on the Bay. It could have the responsibility for plan coordination and preparation, form a board for interest group involvement, and, in effect, "subcontract"with DECD and DSP for their elements.

The Department of Economic and Community Development is a less likely candidate. Its legislative mandate and operating responsibilities would have to be radically broadened, and its public image as "development oriented" would have to be modified.

Nevertheless its competence does not exist elsewhere in State government and it could "sub-contract" water and natural resource elements.

The Department of State Planning has the responsibility for preparation and updating of the State Development Plan that contains plans for geographic parts (e.g. plans for counties and regions) and functional elements (e.g. plans for highways, water supply, outdoor recreation, etc.) of the State. Its particular assignment is planning and coordination. It could take on the responsibility for a comprehensive plan for the Bay and establish any necessary boards for interest group participation. This choice might work if it were recognized that the substantive elements would be prepared by relevant department experts, either assigned to a DSP task force, or coordinated by such a task force.

1.2 Evaluation

The nature of the comprehensive plan would allow any one of the three possible assignments mentioned above, but the criteria for Bay planning (Section A above) would suggest none of them as completely adequate. The importance of the Comprehensive Bay Plan and the short time available for its preparation suggest a task force and consultant approach that needs to be tightly integrated and orchestrated by a central responsibility.

The major trouble with either DNR or DECD taking on the job is the fact of their operating responsibilities. The plan preparation is like making a major commitment to the development of the atomic bomb while carrying on the war. The analogy cannot be pushed too far, but a reasonable separation of comprehensive planning from operating responsibilities (but with feedback and involvement of those operationally responsible) is critical. Because of their operating responsibilities, no department, not even State Planning, can afford the full-time assignment or major involvement of their top people.

State Planning is the least involved in operations but deeply involved in day-to-day crises of an operational nature as advisors to the Governor. It is also deeply involved at regional and local levels. Any board it would convene would serve at the Secretary's pleasure, and therefore would be responsible to the Secretary, not the Governor. The highest level citizen involvement would be more difficult to achieve than if any board reported to the Governor. For these reasons, any version of Alternative One is not recommended.

2 Alternative Two: Continuation of CBIPC

The CBIPC has been effective to a degree but has been hampered by lack of staff, and by divergent views as to what it should do. As a committee it serves at the pleasure of the Governor

whose attention must be focused to a large degree on the day-to-day decisions.

As a committee, CBIPC does not have the stature or institutional responsibility necessary for the major task of preparing a Bay plan. It has served as a forum for different ideas and views, but is not a decision-making group. If it made decisions they would not be necessarily binding on the constituent departments.

Although the CBIPC could be adequately staffed, partly from the departments and partly with its own personnel, its "informal" status is a compelling reason for its rejection.

3 Alternative Three: Assignment to a Temporary Commission[2]

The third alternative is to reconstitute the CBIPC as a formal, albeit temporary, Commission, either by assignment from the Governor, and concurring resolution by General Assembly, or by Act of General Assembly. The latter is not necessary but is desirable to indicate legislative intent. In either event, the Commission should be responsible to the Governor.

A temporary commission best meets the various criteria for the planning process. It centralizes responsibility for preparation of the plan. Assuming adequate funding[1], the commission alternative recognizes the importance of the effort and would provide for a task force of staff and consultants to carry it out. Its work would be separated from day-to-day management planning, but related to it.

An official Commission would have status to attract top professionals and responsible citizens. It would be fully accessible and visible through public hearings. It could be assigned as the contact point for coordinating Federal and local agencies within its areas of concern. Precedent for such a Commission is that formed by the State of California to prepare the San Francisco Bay Comprehensive Plan.

C

Formation, Organization and Powers of a Temporary Chesapeake Bay Commission[3]

Examination of the three alternatives in the light of the nature of the planning task and the criteria for its preparation suggests adoption of the third alternative. A temporary commission for the preparation of a Comprehensive Bay Plan meets the criteria of comprehensiveness, coordinative role and responsibility set up in Section A above. The commission should be established by Act of General Assembly. The proposed title is the Chesapeake Bay Commission. Until the commission becomes operative, the CBIPC should be authorized to act in its stead.

1 Composition of the Chesapeake Bay Commission

The Commission would be made up of both technical and lay representatives. Technical representatives would be from State and local agencies, lay representatives from Federal, State and local governments, in a manner similar to the San Francisco Bay Conservation and Development Commission.

State agencies represented include:

- Department of State Planning
- Department of Natural Resources;
- Department of Transportation;
- Department of Economic and Community Development;
- Department of Health and Mental Hygiene

Public representatives should be drawn from:

- science - academia;
- industry;
- conservation.

In addition, there should be "associate" memberships in the CBC so that a broad range of potentially affected groups can be informed during the planning process. These groups could include:

- regional and local planning agencies directly affected;
- other states and interstate agencies
- Federal Agencies: e.g. the U.S. Army Corps of Engineers, the Environmental Protection Agency, the Soil Conservation Service (U.S. Dept. of Agriculture), the Department of the Interior.

2 Powers and Responsibilities of the Chesapeake Bay Commission

Two general approaches would be available to the Chesapeake Bay Commission in carrying out its responsibilities. The first approach can be described as "plan review and coordination" with no changes in State agency planning authority. The second approach is the CBC task force with temporary assignment of planning functions relating to the Bay.

2.1 Plan Review and Coordination Approach

Under this approach, the CBC would have no planning staff. It would review plans developed by State agencies, and provide a forum for discussion and coordination. No changes in State Department authority would be required. The legislation establishing the CBC, in addition to forming the Commission, would simply place an additional responsibility on existing departments -- to join together to produce a comprehensive plan for the Bay.

The planning process would respect existing functional areas of State agency planning authority. In rough outline, these are as follows:

a. Water Resources and Natural Resources Elements, including:
   - water quality objectives and means;
   - relation of water quality and water quantity;
   - impact of domestic, industrial and commercial activities on water quality and quantity;
   - conservation and development of natural resources.
   - priority for conservation and/or development of wetlands.

The Department of Natural Resources would prepare the water resources and natural resources elements of the Comprehensive Bay Plan. The Secretary of the Department of Natural Resources is "responsible for the coordination and direction of comprehensive planning in the area of natural resources".(Ref.2) The Department of Natural Resources has responsibility to "unify, coordinate, and promulgate policies, plans, programs and practices which will insure the preservation, development, wise use, and enjoyment of all the natural resources for the greatest benefits to the State and its citizens".(Ref.2) Thus, though "Chesapeake Bay" is not specifically mentioned, DNR has clear authority in the area of comprehensive planning for natural resources and water resources management.

In developing a comprehensive plan for Bay resource management, DNR would carry out its responsibility in the area of water resources and natural resources. Though this planning would focus on the Bay itself, it would also have to recognize the impacts of domestic, industrial, commercial, and institutional processes on the water resources and natural life of the Bay.

The various subsections of DNR now have a considerable array of relevant regulating and implementing powers. However, as yet, a comprehensive plan for their application has not been prepared.

While recognizing that "the protection and preservation thrust is (not) more important than the development one" and that, in fact, "protection and development are but different sides of the same coin", Lyle Craine argues that "the protection and preservation function is...more demanding of a Bay-wide

organization than is the positive function of developing special attributes of the Bay".(Ref.3) The planning effort described above would have development aspects, particularly in the natural resources area, but the main emphasis would be in protection and preservation of the integrity of the estuarine system.

b. Shoreline Protection Element, including:
- allocation of public uses to shoreline erosion control;
- priorities for shoreline erosion control;
- comprehensive plan for recreational use of the shoreline;
- preparation of shoreline development guides.

In detailed shoreline land use planning and regulation, a variety of State agencies have major and legitimate interests. The relevant agencies include the Departments of State Planning, Economic and Community Development, Transportation, and Natural Resources.

However, the land uses are so various, land and water resources management are so interrelated in shoreline areas, and conservation and development objectives are so intricately intertwined, that no single State agency has been given major authority for planning in this area. The Department of State Planning, however, has special authority for coordinating the plans and programs of State departments, and for suggesting means for intergovernmental planning coordination of plans and programs of Federal, State, local, and regional agencies.(Ref.2) It is therefore suggested that the State Planning Department undertake a coordinating role in shoreline land use planning.

Present land use planning and development control in shoreline areas is primarily a local responsibility. However, there is increasing recognition of the need for planning for these areas which would be more comprehensive in terms of geography, functions, and objectives. Many shoreline land uses -- ports, industrial areas, recreation facilities and parks, electric power plants, etc. -- have impacts and user patterns which far transcend local boundaries. Further, the Bay shoreline is increasingly seen as a limited resource; comprehensive planning from a Bay-wide perspective is needed to ensure optimal use of the resource for conservation and development.

Shoreline land use planning at the State level would not duplicate local land use planning efforts. The State level effort would consider a broader range of functions -- ecological and developmental -- than do most local efforts. For the limited shoreline area, the State level effort would very likely be based on different land use planning objectives, and oriented towards a different set of development controls than local land use plans. Thus, the Bay-wide shoreline land use plan would not be equivalent to a compilation of local plans for these areas.

c. Bay-Related Activities Element, including:
- marine transportation program and plan;
- water-related industrial development plan.

The newly organized Department of Economic and Community Development has the capability and mandate to develop the various sub-plans under this element, working with the Department of Transportation (Maryland Port Administration) and local planning agencies. Its promotional and development efforts can be paralleled with the establishment of long-range plans for the assigned areas. The Department of Economic and Community Development is most sensitive to the importance of the Bay and its resources to the whole economy of the State.

d. Coordination an Implementation Element, including:
- needed legislation for Bay resource management;
- organization for application of technology and research in

Bay resource management (e.g. systems models development and maintenance);
- interstate resource management initiatives;
- the permanent role and stature of the CBC.

Under this approach the CBC would have responsibility to monitor the comprehensive planning process, to provide a forum for discussion of various planning efforts contributing to the overall plan, to recommend legislation and other implementation tools for the plan and to make recommendations on organization for implementing the plan and continuing the planning process. The mandate establishing the CBC would give it the authority to address these tasks. It should be possible to make recommendations on the topics mentioned above with the assistance of limited special staff and consultants assigned to the CBC itself.

An important part of the total planning effort is to give special attention to the needs of implementation and for future organization for planning and plan implementation while the substance of the plan is being developed, as well as hold public hearings and provide citizen involvement.

e. Information System Plan-Part of Coordination and Implementation Element including:
- Development of the Chesapeake Bay Information Network (see Section V-B2);
- Development of Graphic Encyclopedia (see Section V-B3).

Under either approach to comprehensive Bay planning, the CBC could have a special information storage and retrieval function. Individual agencies would continue to gather information relating to their specific planning, regulating and implementing functions. The CBC, however, could assemble all this diverse information for comprehensive planning purposes and coordinate State information efforts with parallel efforts (often using advanced technologies) of other agencies: e.g. Federal agencies which are collecting environmental information by means of space satellite; the Johns Hopkins Maryland/Virginia academic consortium which is developing techniques for cataloging the results of Bay-related research, etc. The information storage and retrieval function can be a major coordinating force in and of itself. The CBC should have staff to enable it to perform this function. The staff involved would not be policy planning staff but specialists in library and information science. The future State government organization for information storage and retrieval can be separated from the question of the ultimate organization for Bay resource management. On the basis of experience in Bay resource planning, decisions can be made on whether to extend centralized information services to a broader functional and geographic scope, and on what sort of State agency should perform these services. In any case, the comprehensive planning effort for Bay resource management and the CBC provide a suitable task and organizational vehicle for an experiment in centralized information handling.

2.2 The Task Force Approach

The task force approach differs from the plan review and coordination approach in that the CBC would have a substantial task force staff with technicians hired specifically, and borrowed from relevant agencies. In addition major "assignments" could be undertaken by Department specialists as well as by consultants.

The Commission's strength would be by virtue of being the recipient and distributor of all funds for plan preparation. It would be designated the agency for receipt of Federal grants[1] as well special State appropriations for planning related to the Bay as determined by the Commission.

The CBC would have power to hold public hearings as well as access to any public data that it required for its

work. The CBC would have temporary jurisdiction for Bay planning activity now assigned various Departments, and their operational plans would be required to be referred for review and comment to CBC. The Commission's temporary powers should also include mandatory review and comment before issuance of permits for all projects designated by it as within its jurisdiction

3 Report to the Governor

The CBC should, at the conclusion of the planning period, deliver to the Governor and the General Assembly the Preliminary Comprehensive Plan for the Chesapeake Bay. The Plan should be then subjected to legislative debate and public hearings, and, as modified and as appropriate, approved in principle by resolution

The comprehensive plan for Bay resource management would then become a part of the State Development Plan prepared by the State Planning Department to guide the economic and physical development of the State. Whatever the organizational arrangements for comprehensive Bay planning, the product should be suitable for inclusion in the State Development Plan

The CBC should make recommendations to the Governor regarding additional powers needed to implement the plan; concurrence or non-concurrence of agency plans, including operating plans, with the Comprehensive Plan; directions with regard to inter-governmental relationships; and its own permanent role and stature, if any.

D
Summary of Recommendations

1. Chesapeake Bay Commission (CBC)

Form the CBC by Act of General Assembly.

2. Composition of Commission

a. Secretaries of the Departments of State Planning, Natural Resources, Economic and Community Development, Transportation, Health and Mental Hygiene.

b. Citizen members from science, academia, industry and conservation.

c. Associate (non-voting) members from Federal, regional and local governments and agencies.

3. Powers and Responsibilities

a. Complete within three years a Comprehensive Plan for the Chesapeake Bay.

b. Retain an Executive Director and such staff as are deemed necessary.

c. Be the designated recipient and disburser of all planning funds for Bay-related activity within assigned jurisdiction.

d. Have mandatory review for comment over all plans of constituent agencies.

e. Have mandatory reviews for comment before issuance of permits for all projects of constituent agencies.

f. Be designated the contact point for all Bay-related matters for Federal, regional and local levels of government.

g. Be authorized to conduct research and to engage in such educational and promotional activities as necessary.

h. Develop and maintain the Chesapeake Bay Information Network and Graphic Encyclopedia with the cooperation of all State agencies.

i. Hold public hearings and have the power to subpoena testimony during the preparation of the plan.

Footnotes

1. U.S. Senate Bill #582 (Ref.1) would "establish a national policy and develop a national program for the management, beneficial use, protection, and development of the land and water resources of the nation's coastal and estuarine zones". It would provide up to $600,000 per state for three years for plan preparations on a 2/3:1/3 matching basis, and administration grants thereafter for 2/3 of the cost of implementation.

2. Three variations on the third Alternative considered were:

a. Create a "Chesapeake Bay Commission" through the Governor's sanction (executive order) and/or legislative mandate. Said group would be composed of the Governor (or Lt. Governor) of Maryland as permanent Commission Chairman with the Secretaries of State Planning, Natural Resources, Community and Economic Development, Transportation and Health and Mental Hygiene as Commission members. The "Commission" should meet annually within one month prior to the Susquehanna River Basin Commission's annual summit meeting attended by the Secretary of Interior and governors of the three signatory states as the four commissioners. Each CBC member would designate an alternate to represent the policies, programs and technical abilities of his respective agency. The parent CBC would direct the alternate from the Department of State Planning to supply staff services to the Commission in addition to his other responsibility. The Alternates Commission would meet at least quarterly. To insure that a broad spectrum of the citizenry would be involved in Bay decision-making, committees would be created at the discretion of CBC. However, one permanent committee composed of various members of the conservation-industry-scientific sector would be established to serve as an advisory council. While the specific scope of CBC responsibilities would not be finite, generally, the "Commission" would serve as a forum for discussion of major issues affecting the Bay; have mandatory advisory responsibilities on overall programs of Baywide significance including legislative review and initiation; offer a broad range of working policies, technical expertise, and strategies for Bay management; and, responsibility for developing a Bay "road map" for long-range management similar to the Susquehanna and Potomac Commissions.

b. Create a "Chesapeake Bay Commission" through the Governor's sanction and legislative mandate. The "Commission" composition would be the same as a.(above) with the addition of two members appointed by the General Assembly. Areas pertaining to Alternates and generalized scope of responsibilities would be the same as above with the possible addition of more closely knitting the executive, legislative and citizen sectors to implement Baywide management.

c. Create a "Chesapeake Bay Commission" through modification of the existing legislative intent of Chesapeake Bay Affairs (CBA), an agency of the Department of Natural Resources. Said group shall be composed of the members of the existing CBIPC with staff services provided by CBA. Generally, the role of this Commission would be policy planning for comprehensive Bay management and advisory responsibilities on land and water related issues. The informal directive of this group would be a comprehensive policy plan to aid the Governor and legislative decision-makers in prudent management of the Bay's resources.

3. In all cases it should be borne in mind that this is a Maryland Chesapeake Bay Commission. Hopefully it will be followed by Virginia and Delaware Chesapeake Bay Commissions and coordinating action at the Federal level.

References

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2. "The Annotated Code of Maryland" Article 41, Section 234, Article 32A, Section 4, Article 88C, Section 2.

3. Craine, Lyle, "Problems of Organizing for Coordinated Resources Management in the Chesapeake Bay", Proceedings of the Governor's Conference on Chesapeake Bay, September, 1968, p. 208, 209.

Appendix A:

Management and Planning Approaches to Conflict Resolution

A. MANAGEMENT AND PLANNING: APPROACHES TO CONFLICT RESOLUTION

INTRODUCTION 347

A. DAY-TO-DAY BAY MANAGEMENT: REACTIVE FRAMEWORKS 348

1. Reactive Frameworks and Environmental Matrices 348

2. Geological Survey Circular 645 - A Procedure for Evaluating Environmental Impact 348
   Figure 1: Environmental Impact Matrix: Existing Environmental Characteristics and Conditions vs. Proposed Actions 349

3. Maryland Wetlands Framework 350
   Figure 2: Framework for Display of Information Regarding Wetlands Decisions 351

4. Benefit-Cost Analysis 350
   Plate 34: Field Data Stations to be Established 353

B. AN INFORMATION AND INFORMATION RETRIEVAL STRATEGY: PREACTIVE FRAMEWORKS .. 352

1. Inventorying and Monitoring 352
1.1 Inventorying Bay Characteristics, Activities and Facilities 352
1.2 Monitoring Environmental Change 352

2. A Chesapeake Bay Information Network (CBIN): A Proposal 354
2.1 A CBIN Prototype: ERIC 354
2.2 Outline of a Chesapeake Bay Information Network 355

3. Steps Toward the Implementation of CBIN: The Graphic Encyclopedia 356
3.1 Usefulness of the Graphics Approach in Regional Environmental Management .. 357
3.2 Design Criteria for the Graphic Encyclopedia 357
3.3 The Graphic "Telescope" and Examples of the Map System 358
   Plate 35: Scale A: Interstate Context of the Maryland Chesapeake Bay Study 359
   Plate 36: Scale B: Regional Scale (Maryland Portion of the Chesapeake Bay) 360
   Plate 37: Scale C: County Scale (Anne Arundel County as Example) ... 361
   Plate 38: Scale D: Local Scale (Rhode River-West River Area as Example) 362
   Plate 39: Scale E: Soils Survey (Parish Creek-Cedarhurst Area as Example) 363
   Plate 40: Scale F: Property Ownership (Parish Creek-Cedarhurst Area as Example) 364
   Figure 4: Aggregation of Data by Means of the Graphic Telescope 366

Plate 41: Composite Legend 367
Plate 42: Map Composite: Scale C (Anne Arundel County as Example) . 368
Plate 43: Map Composite: Scale D (Rhode River-West River Area as Example) 369
3.4 Technological Support for a Graphic Encyclopedia 366

4. Steps Toward the Implementation of CBIN: Coordination of Information Systems 371
4.1 Chesapeake Ecological Data and Inventory System 371
4.2 State Agency Environmental Management Information Needs 372

C. SYSTEM MODELING AND PLANNING - ADAPTIVE FRAMEWORKS 374

1. The Relation of Synthesis and Systems Modeling and Resource Management ... 374
Figure 5: General Interaction Diagram - Estuary Segment 375

2. Current Systems Modeling Efforts 374
2.1 U.S. Corps of Engineers Hydrological Model of the Bay 375
2.2 Baltimore Regional Economic Study 376
2.3 The Linkage of Ecologic and Economic Systems 376
Figure 6: Conceptual Framework for Linkage of Economic and Ecologic Systems 377
2.4 Systems Simulation for Regional Analysis 378
Figure 7: Structure of Susquehanna River Basin Model Elements 378

3. Ecological and Socio-Economic Planning..... 379
3.1 Introduction..... 379
3.2 Phase I - Formulation of an Ecological Model..... 380
3.3 Phase II - Interpretation of the Area for Intrinsically Suitable Land Use. 381
3.4 Phase III - Socio-Economic Planning Study..... 383
3.5 Phase IV - Match of Ecological and Growth Models..... 384
3.6 Phase V - Plan Formulation..... 384

D. IMPLEMENTATION TOOLS..... 385

1. Wetlands Conservation..... 385

2. The Maryland Environmental Service..... 385

3. Water Pollution Control..... 386

4. Comprehensive Water Pollution Control Program..... 386

5. Water Supply and Waste Disposal Plans..... 386

6. Shore Erosion Control Program..... 386

Introduction

The Environmental Policy Act of 1969 directs all Federal agencies to "identify and develop methods and procedures which will insure that presently unqualified environmental amenities and values are given appropriate consideration in decision-making along with economic and technical considerations." This section deals with necessary responses to this and similar State directives.

The need for systematic frameworks and methods for relating conservation of the Bay's resources and resource utilization objectives is acute. The point has been made before that a critical problem of planning as it is now practiced is the lack of "mediating" concepts and techniques at an intermediate level between overall goals and specific projects.

Broadly stated goals are of little specific use in making choices between projects and only serve as emotional arguments. Yet specific projects must be related to broad planning goals if the benefits of comprehensive Bay management are to be achieved.

The objectives, standards and policies outlined for twenty problem areas in Chapter II are intended to help fill this "intermediate" gap and to assist the planner in evaluating goal interaction. However, relatively sophisticated methods are necessary to utilize the results of goal formulation in a process of plan making and management decision.

The approaches discussed in this chapter are oriented towards making reasonable, confidence-inspiring decisions in the context of much uncertainty about the factors and interrelationships involved and in situations involving great pressure for decisions -- where delay and further study are, in effect, decisions.

The methods and frameworks discussed below follow a sequence from reactive response to projects with an environmental component, through preactive response (the development of capability to respond to as yet unannounced projects) to adaptive response (efforts to understand and quantify the interactions among ecological and economic system elements)[1]. Adaptive frameworks attempt to conceptualize and understand interrelationships within larger portions of the total reality with which management is attempting to cope. In the case of Bay management, this involves the integration of more economic and ecological system entities and processes for more comprehensive geographic areas. Preactive frameworks involve procedures to make information available in an appropriate scope, form and level of detail for Bay management decision-making. Preactive frameworks should reflect and assist in the development of adaptive frameworks, but they focus on decisions regarding the types of information needed to inform environmental management decisions, the monitoring of environmental conditions and the problems of information retrieval. Reactive frameworks refer to procedures for responding to the day-to-day management decisions that in the aggregate make up environmental management policy. The reactive frameworks discussed below are attempts to incorporate available information and knowledge into day-to-day decisions and to ensure a reasonable consistency of day-to-day decisions with broad adaptive frameworks, while maintaining responsiveness and decisiveness in public policy.

Most public policy efforts include reactive, preactive and adaptive aspects in some degree. Also, to a certain extent, the reactive, preactive and adaptive frameworks are applicable under different conditions, to different subjects, and at varying "states of the art". But to a significant extent they are compatible and complementary, reflecting different areas and levels of concern and management purposes.

A

Day-to-Day Management: Reactive Frameworks/ Environmental Matrices

1 Reactive Frameworks and Environmental Matrices

Day-to-day management is the cutting edge of environmental policy-making, the point at which necessary decisions are made or not made in the light of available knowledge and informational resources. Often, of course, there is neither the time nor the money to conduct major systems studies as background for particular decisions and environmental managers are called on to make judgemental evaluations of impacts and tradeoffs based on their accumulated knowledge of the geographic area and subject matter involved. Environmental matrices have been developed both to apply the judgements of competent environmental managers to decisions in which environmental policy is now made by default and to expose these judgements to review by other environmental managers. The environmental matrices act as an organizing framework for the application of accumulated knowledge and professional judgement, and as a display device to indicate the variety and magnitude of linkages between land use and activity and environmental consequences. Thus, for example, a shopping center can be described by hard top coverage, runoff rate, and effect on siltation, aquifer recharge, etc. Many environmental matrices are being developed for various management purposes. (Ref. 1) Two are summarized below for illustration.

2 Geological Survey Circular 645 — A Procedure for Evaluating Environmental Impact

"This circular suggests an approach to [determine the probable impact of a proposed action on the environment] by providing a system for the analysis and numerical weighting of probable impacts. This type of analysis does not produce an overall quantitative rating but portrays many value judgements." (Ref. 2)

Analysis involves definition of two aspects: definition of the magnitude (degree, extensiveness or scale) of the impact on specific sectors of the environment, and weighting of the degree of importance of the specific action on each environmental factor under analysis.

The authors warn that "assignment of numerical weights to the magnitude and importance of impacts should be, to the extent possible, based on factual data rather than preference. Thus the use of a rating scheme such as the one suggested here discourages purely subjective opinion and requires the author of an environmental impact statement to attempt to quantify his judgment of probable impacts. The overall rating allows the reviewer to follow the originator's line of reasoning and will aid in identifying points of agreement and disagreement." (Ref. 2)

The matrix method is not however a "resolver" of conflicts. It does, however, serve as "a checklist or reminder of the full range of actions and impacts" (Ref. 2) and is an aid in identifying ways in which the proposed action can be modified to reduce the potential environmental impact. What the matrix method does not do is point up the importance of the action that is proposed (objectives). Nor does it suggest any ways in which the conflicts it spells out may be ameliorated or reconciled.

Figure 1 displays 100 actions which may cause environmental impact and 88 environmental characteristics which may be impacted by particular actions. In the circular, the two lists are juxtaposed to form the matrix.

The lists are not intended to be exhaustive but illustrative. With some actions and environmental situations, the lists would be reduced, or expanded in parts.

Figure 1

ENVIRONMENTAL IMPACT MATRIX
GEOLOGICAL SURVEY CIRCULAR 645 (Ref. 2)

I. Existing Characteristics and Conditions of the Environment

A. Physical and Chemical Characteristics

1. Earth
   - a. Mineral resources
   - b. Construction material
   - c. Soils
   - d. Land form
   - e. Force fields and background radiation
   - f. Unique physical features
2. Water
   - a. Surface
   - b. Ocean
   - c. Underground
   - d. Quality
   - e. Temperature
   - f. Recharge
   - g. Snow, ice, and permafrost
3. Atmosphere
   - a. Quality (gases, particulates)
   - b. Climate (micro, macro)
   - c. Temperature
4. Processes
   - a. Floods
   - b. Erosion
   - c. Deposition (sedimentation, precipitation)
   - d. Solution
   - e. Sorption (ion exchange, complexing)
   - f. Compaction and settling
   - g. Stability (slides, slumps)
   - h. Stress-strain (earthquake)
   - i. Air movements

B. Biological Conditions

1. Flora
   - a. Trees
   - b. Shrubs
   - c. Grass
   - d. Crops
   - e. Microflora
   - f. Aquatic plants
   - g. Endangered species
   - h. Barriers
   - i. Corridors
2. Fauna
   - a. Birds
   - b. Land animals including reptiles
   - c. Fish and shellfish
   - d. Benthic organisms
   - e. Insects
   - f. Microfauna
   - g. Endangered species
   - h. Barriers
   - i. Corridors

C. Cultural Factors

1. Land Use
   - a. Wilderness and open spaces
   - b. Wetlands
   - c. Forestry
   - d. Grazing
   - e. Agriculture
   - f. Residential
   - g. Commercial
   - h. Industrial
   - i. Mining and quarrying
2. Recreation
   - a. Hunting
   - b. Fishing
   - c. Boating
   - d. Swimming
   - e. Camping
   - f. Picnicking
   - g. Resorts
3. Aesthetics and Human Interest
   - a. Scenic views and vistas
   - b. Wilderness qualities
   - c. Open space qualities
   - d. Landscape design
   - e. Unique physical features
   - f. Parks and reserves
   - g. Monuments
   - h. Rare and unique species or ecosystems
   - i. Historical or archaeological sites and objects
   - j. Presence of misfits
4. Cultural Status
   - a. Cultural patterns (life style)
   - b. Health and safety
   - c. Employment
   - d. Population density
5. Man-Made Facilities and Activities
   - a. Structures
   - b. Transportation network (movement, access)
   - c. Utility networks
   - d. Waste disposal
   - e. Barriers
   - f. Corridors

D. Ecological Relationships Such as:

- a. Salinization of water resources
- b. Eutrophication
- c. Disease-insect vectors
- d. Food chains
- e. Salinization of surficial material
- f. Brush encroachment
- g. Other

E. Others

- a.
- b.

II. Proposed Actions which May Cause Environmental Impact

A. Modification of Regime

- a. Exotic flora or fauna introduction
- b. Biological controls
- c. Modification of habitat
- d. Alteration of ground cover
- e. Alteration of ground water hydrology
- f. Alteration of drainage
- g. River control and flow modification
- h. Canalization
- i. Irrigation
- j. Weather modification
- k. Burning
- l. Surface or paving
- m. Noise and vibration

B. Land Transformation and Construction

- a. Urbanization
- b. Industrial sites and buildings
- c. Airports
- d. Highways and bridges
- e. Roads and trails
- f. Railroads
- g. Cables and lifts
- h. Transmission lines, pipelines and corridors
- i. Barriers including fencing
- j. Channel dredging and straightening
- k. Channel revetments
- l. Canals
- m. Dams and impoundments
- n. Piers, seawalls, marinas, and sea terminals
- o. Offshore structures
- p. Recreational structures
- q. Blasting and drilling
- r. Cut and fill
- s. Tunnels and underground structures

C. Resource Extraction

- a. Blasting and drilling
- b. Surface excavation
- c. Subsurface excavation and retorting
- d. Well drilling and fluid removal
- e. Dredging
- f. Clear cutting and other lumbering
- g. Commercial fishing and hunting

D. Processing

- a. Farming
- b. Ranching and grazing
- c. Feed lots
- d. Dairying
- e. Energy generation
- f. Mineral processing
- g. Metallurgical industry
- h. Chemical industry
- i. Textile industry
- j. Automobile and aircraft
- k. Oil refining
- l. Food
- m. Lumbering
- n. Pulp and paper
- o. Product storage

E. Land Alteration

- a. Erosion control and terracing
- b. Mine tailing and waste control
- c. Strip mining rehabilitation
- d. Landscaping
- e. Harbor dredging
- f. Marsh fill and drainage

F. Resource Renewal

- a. Reforestation
- b. Wildlife stocking and management
- c. Ground water recharge
- d. Fertilization application
- e. Waste recycling

G. Changes in Traffic

- a. Railway
- b. Automobile
- c. Trucking
- d. Shipping
- e. Aircraft
- f. River and canal traffic
- g. Pleasure boating
- h. Trails
- i. Cables and lifts
- j. Communication
- k. Pipeline

H. Waste Emplacement and Treatment

- a. Ocean dumping
- b. Landfill
- c. Emplacement of tailings, spoil and overburden
- d. Underground storage
- e. Junk disposal
- f. Oil well flooding
- g. Deep well emplacement
- h. Cooling water discharge
- i. Municipal waste discharge including spray irrigation
- j. Liquid effluent discharge
- k. Stabilization and oxidation ponds
- l. Septic tanks, commercial and domestic
- m. Stack and exhaust emission
- n. Spent lubricants

I. Chemical Treatment

- a. Fertilization
- b. Chemical deicing of highways, etc.
- c. Chemical stabilization of soil
- d. Weed control
- e. Insect control (pesticides)

J. Accidents

- a. Explosions
- b. Spills and leaks
- c. Operational failure

K. Others

- a.
- b.

3 The Maryland Wetlands Framework

The Maryland Wetlands Bills (House Bills 285 and 286) represent a major new area of State decision-making and responsibility in environmental management. These Bills require Maryland State Government to take environmental concerns into account in the disposition of State-owned wetlands and in regulating various activities on all wetlands. In assessing how to meet the new responsibilities, the Department of Natural Resources and cooperating State agencies have designed a decision-assisting framework (Ref. 3) which focuses on wetlands and the particular environmental management decisions which will arise as a result of the laws.

The checklists and the information display frameworks in the implementation plan for the Wetlands Bills do not dictate a decision-making process. They do not specify how to aggregate and weight the various factors, and they do not indicate conditions under which one or another decision should be made. But they do call attention to the kinds of information relevent to wetlands decisions, to the variety of State agencies which are potential suppliers of the information and to possible sources (e.g., aerial surveys) of continually up-dated information. The set of accounts calls attention to:

- economic and employment impacts
- developmental impacts
- recreational impacts
- impacts on shore erosion and risk of flood damage
- impacts on aquatic life
- impacts on large ecological systems
- aesthetic impacts
- etc.

4 Benefit-Cost Analysis

The significance of certain projects is such that special efforts are justified to collect relevant information, trace impacts and repercussions, quantify the importance of various factors as a basis for management decision. Though environmental matrices such as those mentioned in Section 2 and Section 3 above incorporate many structural elements of benefit-cost analyses, the term is usually reserved for the more elaborate efforts to identify, quantify and weigh the impacts of a proposed project and to relate these directly to decision-making criteria.

One project whose economic and environmental consequences appear to justify benefit-cost analysis is the proposed Annemessex Maritime Industrial Complex. The proposal has been the subject of extensive discussion and investigation which has been collected and reviewed by the Maryland State Department of Planning. (Ref. 8)

Although it has not been possible to put this information in benefit-cost analysis form, an example of how this could be done has been prepared by the Chesapeake Bay Research Consortium. (Ref.9) The example is based on a preliminary project description and impact analysis (Ref. 10), and this is intended to be illustrative of the benefit-cost analysis method. The analysis considers direct and indirect economic and environmental impacts of the project.

Figure 2

FRAMEWORK FOR DISPLAY OF INFORMATION
REGARDING WETLANDS DECISIONS (Ref. 2)

ECOLOGICAL ACCOUNT a)

Checklist Reference	Status Quo	Proposed Alteration	Alternative Alteration
#2:7c1	Rockfish, perch etc.	10% reduction in area	7% reduction in area
Fish Spawning	Important area	Loss would make significant reduction	Mitigating features would reduce effect by one-half
. . .			
etc.			

ECONOMIC ACCOUNT a)

Checklist Reference	Status Quo	Proposed Alteration	Alternative Alteration
#2:1a	Supports about 20 full time fishermen	Would force one-half to drop out of industry. Would depress village and strain about 30 families	No change to local fishery
Local Employment-Fishermen	Rich local fishery	Unacceptable loss	No change to local fishery
. . .			
etc.			

a) Note: Above the dotted line -- indication of predicted condition. Below the dotted line -- expression of the value of this condition either in absolute or relative terms.

Generalized Checklist for Review of Any Wetlands Issue Involving Physical Change[2]

A. Ecological account: (F&WA)

1. How is the area related to a larger ecological system (such as a sound, bay, reach, or the Bay itself) or to neighboring areas of the same general scale? (Ref. 4)
   a. What are the outputs of the area? (nutrients, organisms, etc.)
   b. How would modification of these outputs affect other systems?

2. Is the area ecologically unusual, rare, or unique?(Ref. 5)
   a. As a unit?
   b. Because of particular species present?

3. Does the area have value as a site for ecological research?

4. What is the intrinsic value of the area (independent of the production of any goods or services)?

5. What contribution does the area make to the natural life support system of the region?

6. What are the relevant ecological measures available?(Ref. 6)
   a. Species count?
   b. Community type?
   c. Standing crop?
   d. Biomass production?
   e. Edge/area?
   f. Index of diversity?

7. What are the specific biological outputs of the area?
   a. Total energy
   b. Nutrients
   c. Fish
      1) Spawning
      2) Resident
   d. Game
   e. Other organisms

B. Economics account:

1. What is the impact on the following economic sectors in terms of personal income, employment, and gross revenue?
   a. Commercial fishermen (F&WA)
   b. Marine services (Boating Division)
   c. Tourist services (DE&CD)
   d. Fish processing (F&WA)
   e. Local government (?)
   f. State government (?)
   g. Marine construction (?)
   h. Recreation suppliers (?)

2. What is the economic impact of proposed new uses of wetlands on economic sectors other than those listed above?

3. Who are the chief beneficiaries and losers of the various alternative situations? (Include opportunities foregone.)

4. What are the income redistribution effects of the various alternatives?
   a. Between sectors
   b. Within the county
   c. Within the State
   d. Interstate and interregional

5. What are the economic measures of effects of the alternatives on:
   a. Shore erosion loss?
   b. Flood damage loss?

C. Developmental account:

1. What are the effects of the alternatives on:
   a. Public services (roads, schools, etc.)?
   b. Private services (lodging, restaurants)?

2. What other development might the alternatives induce to the area?

3. What would the overall developmental pattern be if the alternatives set land use precedents for the area?

D. Recreational account: (Ref.7)

1. What would the effect of the alternatives be on the following recreational uses:
   a. Boating
   b. Fishing
   c. Hunting
   d. Bird watching
   e. Nature study
   f. Other

2. What would the effects be on the quality of these experiences?

E. Aesthetic account:

1. What would be the landscape character of the area under the various alternatives?

2. What would be the overall aesthetic quality of the area under the various alternatives?

3. How will the alternatives affect the accessibility of the area for aesthetic enjoyment?

B

An Information and Information Retrieval Strategy: Preactive Frameworks

Preactive frameworks are those which put the State (and constituent governments) in a posture of preparedness for future crises and potential actions. They involve developing a capability for intelligent reacting by preaction, or anticipating the kind of information that will be needed in the future. This information is not just for projections or forecasting, but also for management decisions.

Preactive planning includes at least three interrelated functions: inventorying, monitoring change and information storage and retrieval. Also involved is the task of developing priorities and techniques for information gathering and the consideration of relationships of preactive activities with current crises, operational planning, and long-range planning. In this section, discussion of the current status and need for inventorying and monitoring will be followed by a proposal for the creation of a coordinated information system as a key element of a comprehensive planning process for the Bay, and a discussion of steps towards implementation of the proposed information system.

1 Inventorying and Monitoring

1.1 Inventorying Bay Characteristics, Activities, and Facilities

A wide variety of inventories of the Bay and related land have been completed or are in progress. These include inventories of sources of industrial waste (Ref. 11), natural areas (Ref. 5), wetlands location, types, and characteristics (Ref. 12), local economic characteristics (Ref. 13), manufacturing firms (Ref. 14), port-oriented land (Ref. 15), shoreline utilization (Ref. 16), Bay-side recreational facilities (Ref. 17), public wastewater treatment facilities (Ref. 18), soil characteristics (Ref. 19), property ownership (Ref. 20). The massive inventory proposed by the Chesapeake Research Consortium (Ref. 9) will shortly be under way. It will initially focus on a compilation of presently known data, organized as entities, processes and characteristics. The calibration of the hydrologic model being developed by the Army Corps of Engineers (Ref. 4) will extend inventories of water movement characteristics of the Bay.

The extensive amount of information being developed on Bay characteristics and Bay-related activity needs to be coordinated and broadly accessible. Needed is a coordinated map system for all information, coded by geographic reference as well as the basic inventory catalogue, and capable of being printed out by any series or combination of descriptions desired.

Two facts suggest a whole different order of magnitude as both possible and desirable for future inventorying. These are the advent of space photograph (Ref. 21) and current legislation in the U.S. Congress to authorize funds for ecological inventories.

1.2 Monitoring Environmental Change

If the inventory were static it would be relatively useless although the "obsolescence" rate of information varies widely.

Monitoring of water quality is already underway in the Bay by the Department of Water Resources and the Department of Health and Mental Hygiene (Ref. 11). Monitoring of property ownership and transfer by the State Department of Taxes is up-to-date (Ref. 20). The need is for a more complete monitoring system to include additional categories of information. Four general categories of information are as follows:

a. Physical, including land, air, and water resources, with the aim of

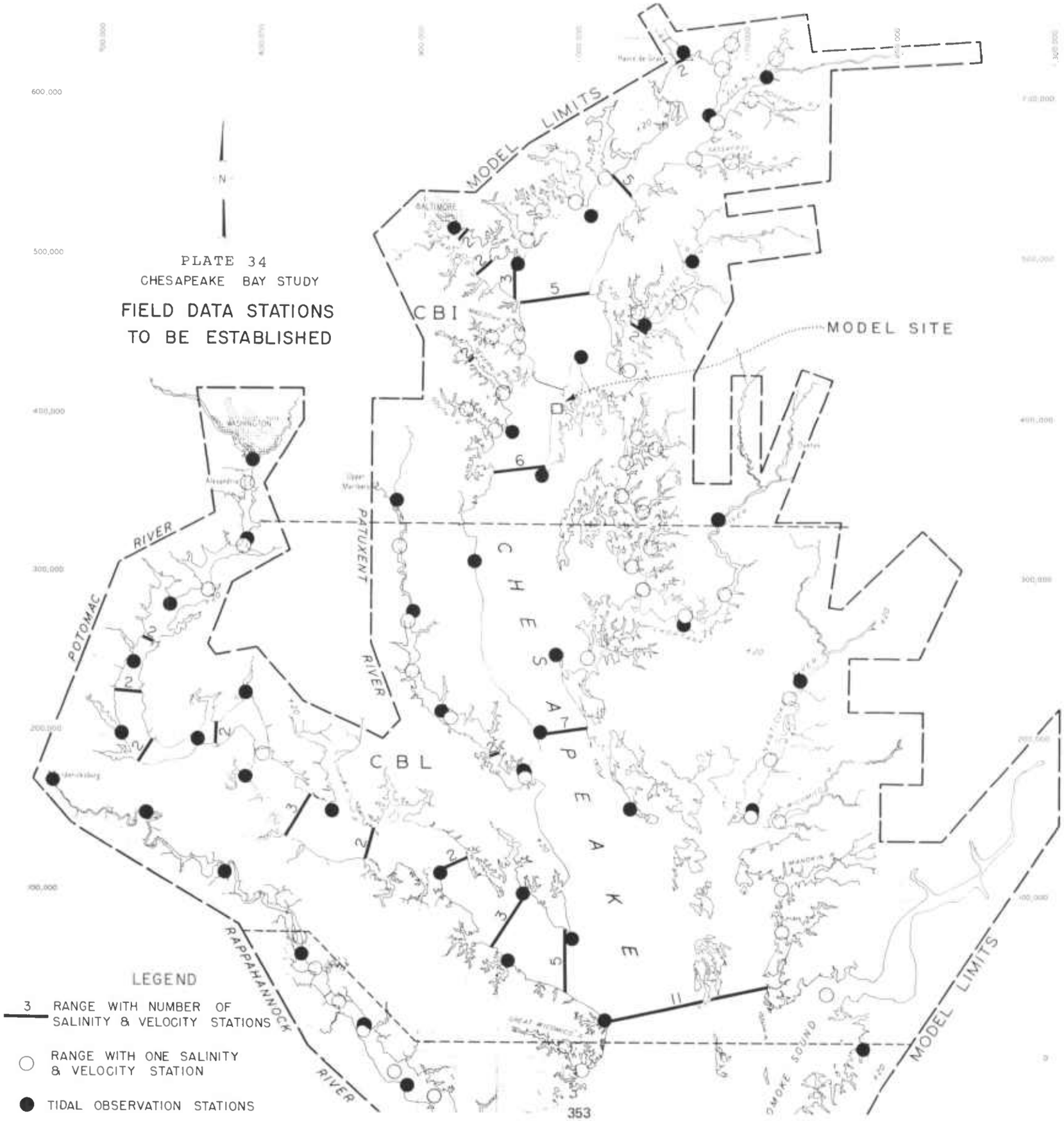


PLATE 34
CHESAPEAKE BAY STUDY
FIELD DATA STATIONS
TO BE ESTABLISHED
N
MODEL LIMITS
MODEL SITE
CBI
CBL
CHESAPEAKE
POTOMAC RIVER
PATUXENT RIVER
RAPPAHANNOCK RIVER
SMOKE SOUND
BALTIMORE
WASHINGTON
Alexandria
Fredericksburg
600,000
500,000
400,000
300,000
200,000
100,000
LEGEND
3 RANGE WITH NUMBER OF SALINITY & VELOCITY STATIONS
RANGE WITH ONE SALINITY & VELOCITY STATION
TIDAL OBSERVATION STATIONS

recording all changes in land use and air and water quality.

b. Biological-Ecological, to include the effects of changes in the physical environment on the biological system.

c. Cultural, to include population, income, employment, health, housing, etc.

d. Economic, to include all consumption and production elements.(Ref.22)

Adjustment and verification of the Bay hydrologic model being developed by the Corps of Engineers (Ref.4) will require extensive monitoring of water movement characteristics of the Bay. "The tides, tidal current velocities, tidal current directions, and salinities (will) be measured at many locations to provide a valid basis for...verification that model hydraulic and salinity phenomena are in acceptable agreement with those of (actual Bay water movement characteristics). The field data collection stations are shown on Plate 34."

2 A Chesapeake Bay Information Network (CBIN): A Proposal

No single inventory or monitoring system -- even the most comprehensive -- will contain all the information desired by particular users. Detail must often be compromised in a trade off with universality. An information system that attempted to record all sources would be doomed to irrelevance and failure. Nevertheless, the need has never been greater for information pertinent to decisions of increasing complexity and scope.

2.1 A CBIN Prototype: ERIC

The concept of CBIN is based on the example of the Educational Resources Information Center (ERIC), supported by the U.S. Office of Education (HEW) and other Federal agencies supporting research of interest to the educational community. ERIC is a nationwide decentralized information system designed to help advance research and development on educational problems and processes and to accelerate widespread adoption of research-based education programs. ERIC consists of four major interrelated components:

a. Central ERIC Headquarters staff in the Division of Information Technology and Dissemination, Bureau of Research, USOE, is responsible for developing, managing, and coordinating the system.

b. The network of 19 clearinghouses: Each clearinghouse focuses on a specific topic or field (such as Adult Education -- Syracuse University; Counselling and Personnel Service -- University of Michigan; Disadvantaged -- Columbia University Teachers College).

c. An ERIC Facility, currently operated under contract by the North American Rockwell Co.(NR), to provide centralized document processing activities as well as computer, lexicographic, and technical services. This contractor prepares the magnetic tape for the issues of Research in Education (RIE), the major abstracting and indexing publication of the Office of Education, as well as all other major output products which are computer generated using the ERIC files.

d. The ERIC Document Reproduction Service (EDRS) operated under contract by the National Cash Register Company: EDRS sells the full text of documents cited in RIE at nominal cost.

ERIC is unique in its attempt to combine the advantages of both centralization and decentralization in the operation of an information facility.[4] "The centralized model has many attractive features, including the advantages of having all staff under one roof with consequent managerial efficiency, savings in operational costs, and fast processing of documents. This model, though, had certain obvious shortcomings when applied to development of a resources management information system. Prominent features of Bay resource management are decentralization and proliferation of professional organizations and interest groups. These characteristics suggested

that information services might well be organized around major content areas, problems, or, administrative foci of current Bay management. Each extreme model, a centralized information processing and disseminating facility or a large number of uncoordinated, subject- or problem-based information efforts, had several attractions and limitations... The appeal of the centralized effort was its efficiency, lower cost, faster start-up, ease of thesaural and indexing development, and greater opportunities for tighter management control. Offsetting these benefits were the greater liabilities of the centralized approach. The first of these potential limitations of the centralized approach concerned information acquisition...(Due to the decentralized nature of much Bay resource management) interpersonal, discipline-based, content-focused, or even problem-centered contacts certainly would aid in developing and maintaining a comprehensive (information) acquisition network..." (The second criterion concerns practical matters: the ability of any single centralized facility to retain) the number and variety of highly qualified specialists on the many topics needed for the operation of a centralized facility and for the generation of information analysis products...(its ability to) be assured of benefitting from the judgments of persons in leadership positions in their specialized fields... (the danger that) a centralized processing facility without intimate ties to (agencies involved in Bay resource management might) tend to minimize rather than optimize the movement of information through already existing communication channels, professional organizations, and (Bay management) agencies...

But the decentralized route, attractive as it was, also had its drawbacks. A completely decentralized system, with each subject-based effort operating with complete autonomy, was out of the question. Costs would be prohibitive, quality would vary outrageously, and users would be frustrated and forced to pay an exorbitant cost in time and money, if they had to maintain contact with each operation to find materials that straddle several topics, as most do in Bay resource management.

Therefore, (in ERIC), a creative synthesis...of the two approaches was developed. This synthesis (is designed to be) highly compatible with the decentralized (Bay resource management) system... Consequently, ERIC was built upon the operation of decentralized clearinghouses. Each clearinghouse focuses on a major (resource management) field or topic... The clearinghouses are solely responsible for the selection of (information for broader) dissemination and for the operation of an independent information analysis program... But each clearinghouse participates in a general system in fulfilling its documentation function... (In brief) those functions that can best be conducted by professional staff in their academic and organizational settings in behalf of their colleagues are reserved to the clearinghouses. Those functions to which machine processes can be applied, where economies of scale become important, and where user requirements indicate centralization are centralized. (Ref.23)

2.2 Outline of a Chesapeake Bay Information Network

Using the ERIC model, more properly described as a "net work", CBIN could be organized as follows:

a. Central CBIN - A headquarters staff established in an appropriate location in State government. A temporary alternative might be to utilize the Chesapeake Research Consortium to develop CBIN under contract to the State, to be taken over as a State function.

b. The CBIN Clearinghouses would be such as the Department of Natural Resources, and constituent Departments and Bureaus, the Department of Economic and Community Development, the Department of State Planning,

the Department of Health, and the Department of Transportation and Constituent bureaus and administrations.

University facilities such as the Chesapeake Bay Institute and other existing information centers could also act as clearinghouses for special information.

The Federal government has an overall information and various kinds of monitoring systems now under study. CBIN could become an element in such a national network.

3 Steps Toward the Implementation of CBIN: The Graphic Encyclopedia

Reasonably up-dated and efficiently disseminatable information relevant to current and emerging policy issues is an essential component of any successful planning and management operation. The nature and extent of the interactions among elements of the Bay are currently incompletely understood and are the subject of considerable current research effort. In the meantime, the discipline of displaying currently available information on a consistent set of maps provides a sound basis for developing an approach to regional environmental management.

This section focuses on one part of the overall information need -- a graphic system for assembling and displaying locational aspects of salient Bay system elements. It develops the concept of a "Graphic Encyclopedia" and considers its compatibility with other existing or developing information systems.

With such a graphic system, makers should be able to quickly review information in a regional context on both natural aspects and man-related activities. Information needs can be identified and management problems posed. The graphic system is intended to be extended and developed -- a process already begun with regard to aquatic habitats by staff of the Chesapeake Bay Institute. It is called a Graphic Encyclopedia to emphasize its fundamental purpose: to make the widest possible variety of information graphically available at appropriate scales in both a compatible and often a composite form.

The complexity of ecosystems (natural and man-related phenomena) is such that often only generalized graphic representations can be achieved. Nevertheless, the underlying assumption is that previously unrelated phenomena can be better understood, in terms of inter-relationships by having been given graphic representation and "address". These relationships can also be represented symbolically and as processes and by composite mapping.

Considerable quantities of information regarding many aspects of environmental management presently exist. Additional information is being produced at increasing rates, and new sources of information (e.g. aerial surveys, hydrologic models, space satellites) are being rapidly developed. It is clear, therefore, that something more than an aggregation of existing information sources is required. The new information systems must be carefully selective in their areas of emphasis and cognizant of the areas of the overall complexity thereby chosen for emphasis.

At the same time, new information systems must be designed around mutually supportive relationships with other information systems (existing or currently developing) relative to other aspects of Chesapeake Bay management. These "information systems" may be as "simple" as a report on an isolated aspect of Chesapeake Bay management or as complicated as a hydrologic model or a catalog of considerations relevant to a specific management decision. Any new information system relies on these other information systems for much of its input, and it translates the input into a form suitable to its purposes of comprehensive policy review. Reciprocally, the

new information system should be a source of specific data, context, and overview, and policy directions for other information systems.

3.1 Usefulness of the Graphics Approach In Regional Environmental Management

This Report takes a graphic approach to the description of the Chesapeake Bay system. This approach is taken because of the importance of readily accessible knowledge on the location of various "entities" -- industries, population centers, marshlands, sewage treatment facilities, surface and ground-water supply intakes, etc. -- in day-to-day management of the Chesapeake Bay system. The graphic approach also provides a set of addresses for attaching descriptive information about various entities. For example, what sort of manufacturing process is a located industry engaged in? What is the magnitude of its productive capacity? And how is this related to its employment, its water requirements, and its discharge of various types of pollutants? Furthermore, the graphic approach facilitates the recognition of spatial interrelationships between entities (e.g., a heavy-industrial park, a commercial beach, information on Bay sedimentation and erosion) not often found on one map.

The graphics approach described herein is designed to be developed, elaborated, and maintained as part of Bay planning and management. It is complementary and intermeshed with on-going efforts to coordinate research into the complexity of inter-relationships that make up the Chesapeake Bay system.(Ref.4,9) However, public policy decision-making cannot wait until all relationships among a mass of entities and processes can be identified and analysed. In many cases, public policy decision-making cannot even consider the entire range of variable involved in a particular decision.

The need for an information system which is useful now, which is capable of incorporating the insights of on-going research, and which, by virtue of its usage by day-to-day policy-makers on Chesapeake Bay management issues, contributes to the establishment of research priorities and directions. The Graphic Encyclopedia is believed to be of major importance to such efforts.

The Graphic Encyclopedia proposed in this section is designed to play three main roles in comprehensive Bay planning and management:

- It's maps can be summary documents for policy review of the comprehensive scope of existing and emerging Bay problems and of the aggregated effects of specific management decisions.
- It can provide a framework in which to incorporate the results of research efforts into functional relationships among various aspects of the Bay as these relate to the task of comprehensive environmental management.
- It can be a source of information in as much depth as desired relevant to specific policy decisions, particularly locational information for facilities, characteristics, proposals, etc.

3.2 Design Criteria for the Graphic Encyclopedia

In formulating an information system capable of playing the above planning-management roles, several design criteria (areas of emphasis and de-emphasis) were developed:

- The information system should be comprehensive in the range of subject matter considered. Various natural and man-related phenomena relating not only to water areas but to adjacent shoreline land and political jurisdictions should be included.
- The information system should be "telescopic" in nature. There is an appropriate scale for every sort of graphic information; summary information or further detail can be presented

at larger or smaller scales. A policy-related information system should not be confined to generalized Bay-wide summaries or to detailed information for limited areas. The scales chosen should be the smallest number necessary to correspond to the various specific-decision-making contexts, levels of management responsibility, and major information sources.

-The information system should have a problems-policy orientation. It should concentrate on areas of existing or developing State environmental management responsibility. This orientation should determine the categories by which information is stored. In addition, this orientation argues for an emphasis on including specific locations of facilities/characteristics proposals, etc., so that issues can be discussed in relation to a specific context.

-The information system should not only describe the existing situation but should also catalog (with locational addresses) identified existing problems, proposals for change, emerging problems, etc.

-The information system should not "weight" various aspects according to their relative importance in environmental management. The importance of various factors is a matter reserved for the users of the information system. In practice, weighting of various factors is a policy input by the responsible agency or agencies with regard to the particular environmental management decision at hand. The information system concentrates on the efficient display of the variety of aspects present in the particular situation.

-The information system does not incorporate functional relationships among the many elements of the Bay system. There is no attempt to construct simulation models of various processes of the Bay system. Much current and prospective research effort, notably the Corps of Engineers hydrologic model (Ref.4), the research program of The University Consortium(Ref.9), the regional economic model being put into operation by the Baltimore Regional Planning Council (Ref.24) and the recent investigation into the economic impact of the Port of Baltimore(Ref.25), are intended to spell out functional relationships among Bay system elements. Reactions to "what will happen if" (i.e., impact analysis) a particular environmental management decision is or is not taken will of course be left to the judgment of policy-makers as informed by on-going research and information gathering efforts.

-An information system does not specify decision-making structures with regard to particular environmental management decisions. It does not tell policy-makers how to reach decisions in particular cases, nor does it assure them that the decisions made are the best ones possible under the circumstances. It should supply a broad range of located aspects for consideration in many environmental management decision situations.

3.3 Graphic "Telescope" and Examples of The Map System

a. Levels of Detail in the Graphic Encyclopedia

In the Graphic Encyclopedia, information is presented at various scales appropriate to its level of detail.

Scale A shows the interstate context of the Maryland Chesapeake Bay Study. It includes large portions of Pennsylvania, Virginia, and Delaware, the entire watersheds of the Susquehanna and Potomac Rivers. This is, for instance, the scale appropriate for discussions of the Susquehanna and Potomac Compacts.

PLATE 35 Scale A: Interstate Context of Maryland Chesapeake Bay Study

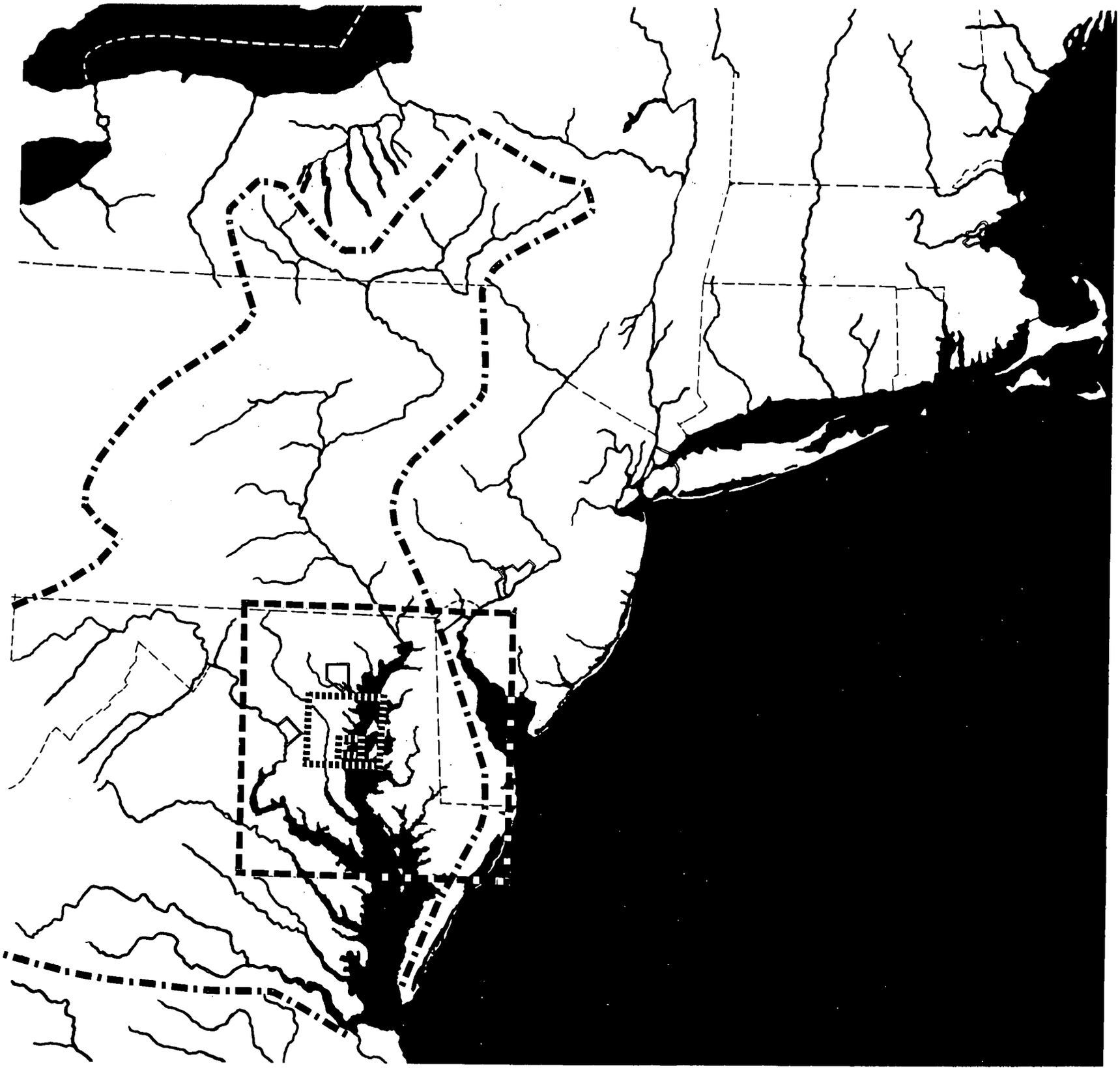


PLATE 36 Scale B: Regional Scale (Maryland Portion of the Chesapeake Bay)

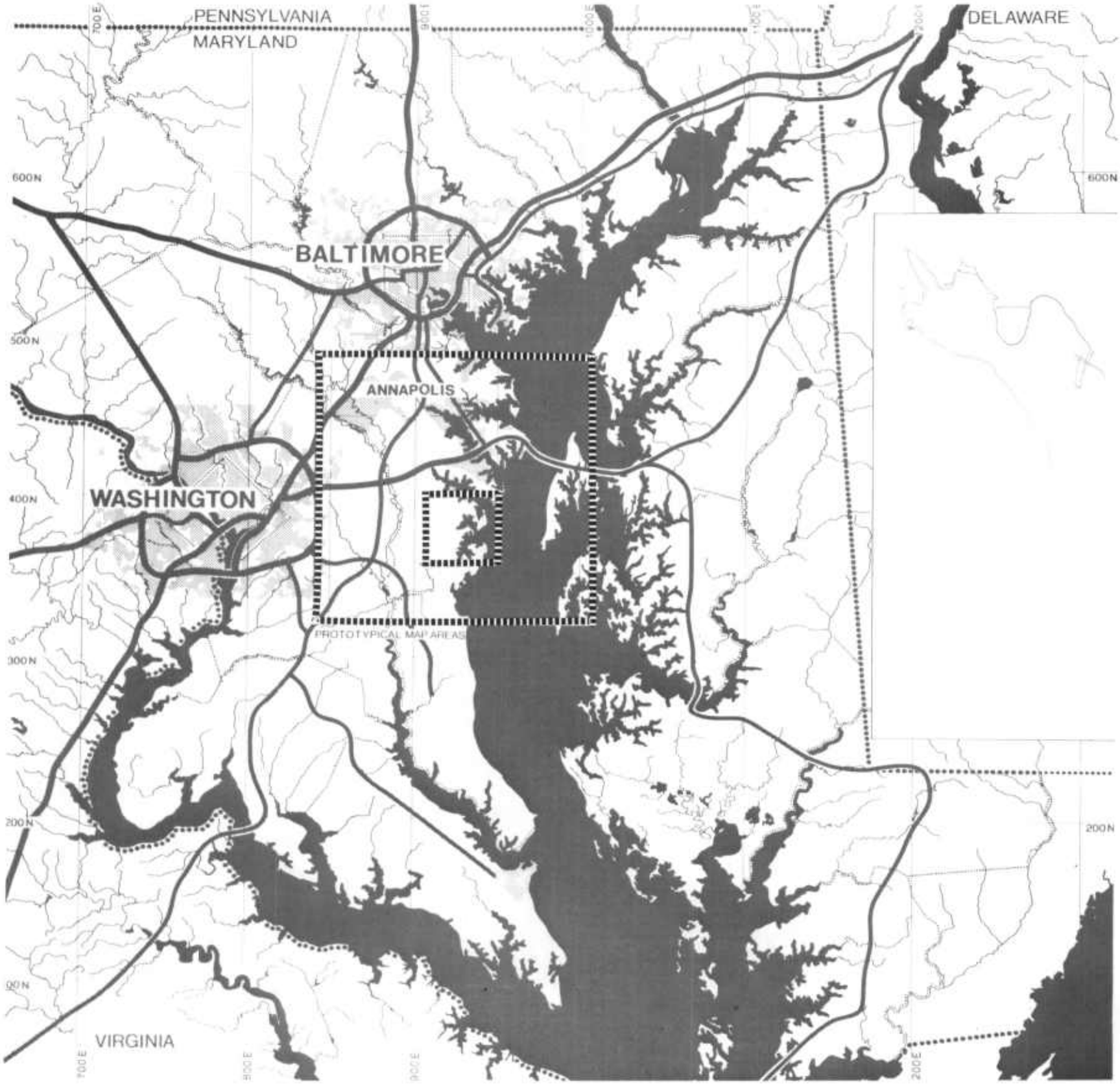


PLATE 37 Scale C: County Scale (Anne Arundel County as Example)

PLATE 38 Scale D: Local Scale (Rhode River - West River Area as Example)

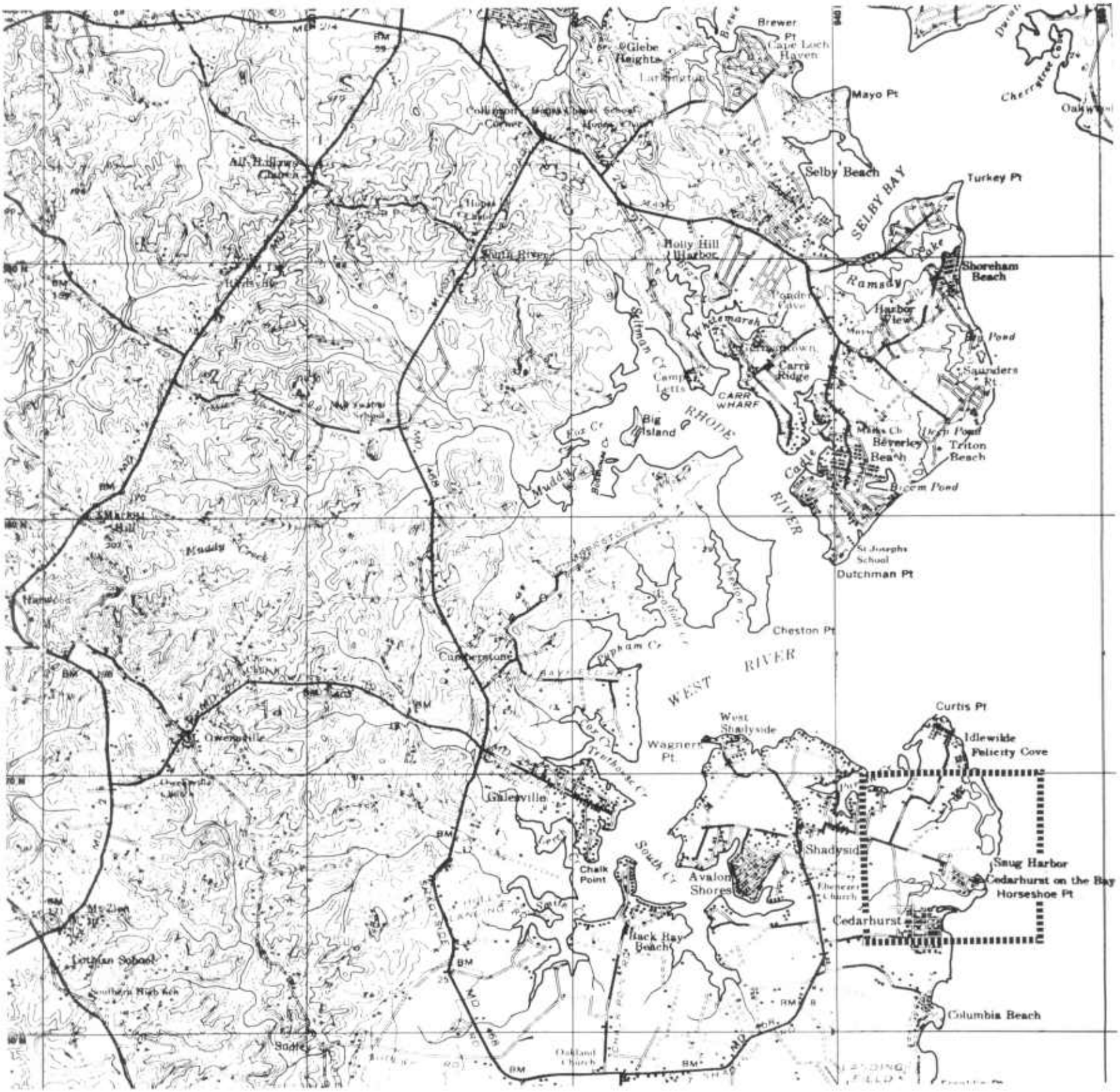
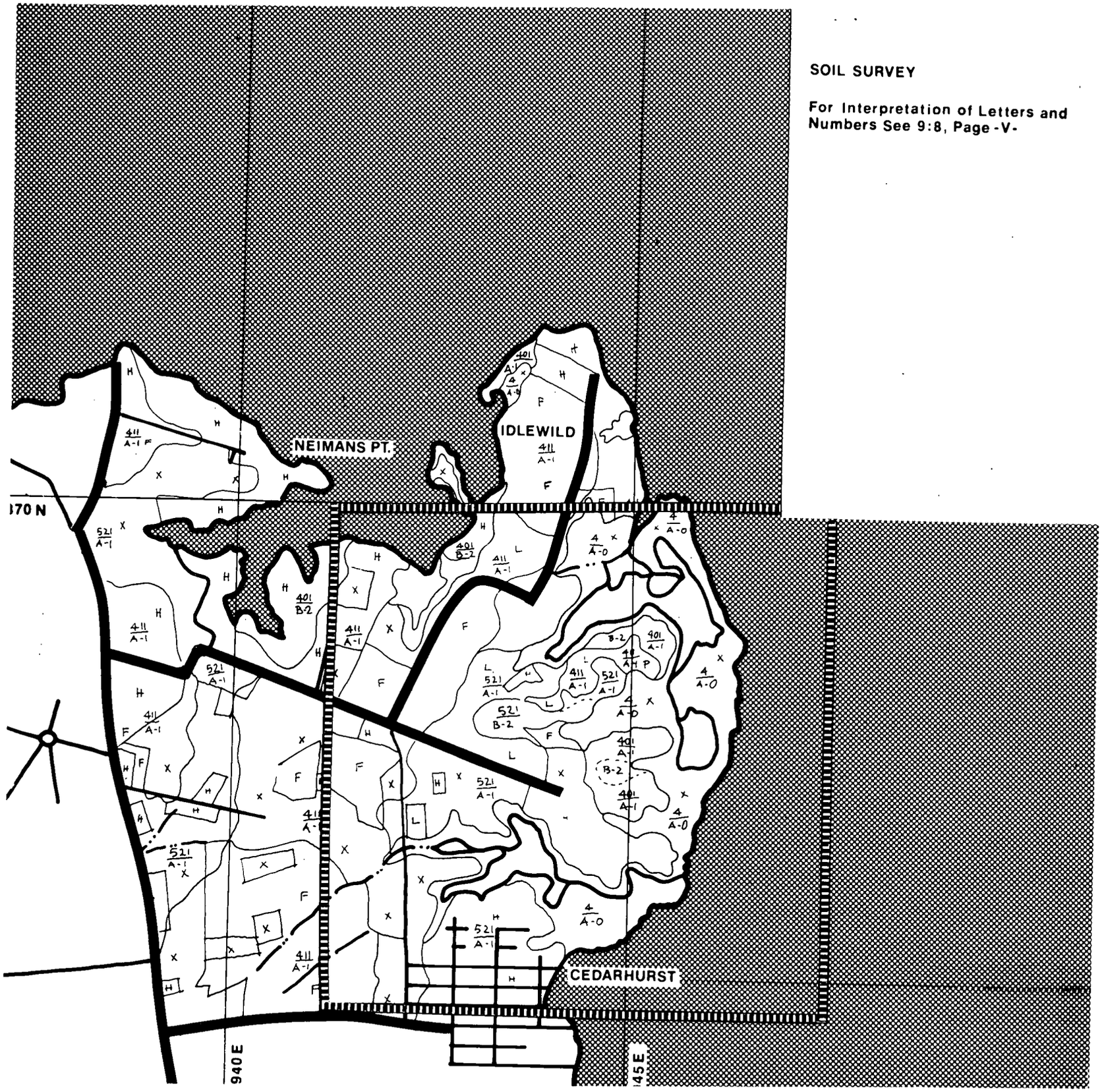


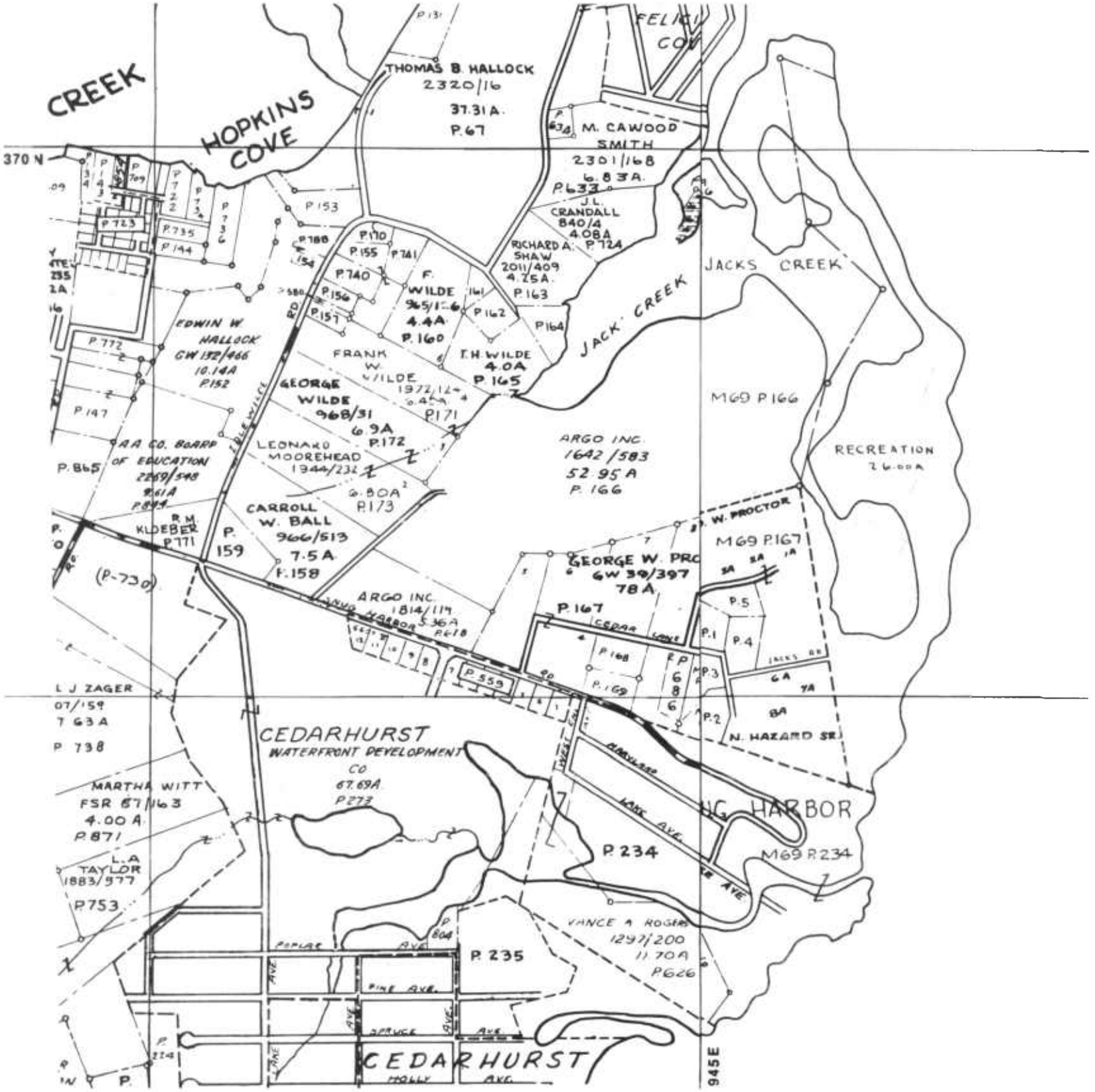
PLATE 39 Scale E: Soils Survey (Parish Creek - Cedarhurst Area as Example)



SOIL SURVEY

For Interpretation of Letters and Numbers See 9:8, Page -V-

PLATE 40 Scale F: Property Ownership (Parish Creek - Cedarhurst Area as Example)



Scale B, called the "regional" scale, provides a comprehensive overview of the Maryland portion of the Chesapeake Bay. It includes the entire watershed of the several Eastern Shore tributaries of the Bay, and it includes western shore tributaries at least up to the Fall line. For purposes of socio-economic analysis, the regional scale includes 5 of the 6 Maryland sub-regions or 20 of Maryland's 24 counties. This is the scale appropriate to discussions of how Maryland State government can organize itself for better management of the Bay.

Scale C, the county scale, is appropriate for focus on a particular county, or a similar size portion of the Maryland Bay region. This scale is chosen to be consistent with the scale of much of the local planning effort. It is appropriate, therefore, for coordinating local plans and programs with overall Chesapeake Bay management.

Scale D, the local scale, is suitable for including topography, subwatersheds and other planning detail. This scale is appropriate for consideration of many planning proposals of regional significance -- e.g., the Baltimore Harbor Study; possible alternative uses of the Aberdeen Proving Ground-Edgewood Arsenal area; the Annemessex Canal Industrial complex; the local impacts of a proposed additional Chesapeake Bay crossing, etc.

Scale B is approximately four times as large as Scale A, and Scale C is four times as large as Scale B. Scale D, the local scale, is, in turn, approximately four times as large as Scale C.

Scales E, F, G, H, and I show how the graphic telescope can be extended to include details of road alignment, utilities, and other site planning parameters. The first of these, Scale E, is identical to Scale D, but was reproduced at actual drafting scale in order to show the amount of detail appropriately represented at this scale. Scale E is the scale at which the Soil Conservation Service maps soils information. This information is invaluable for analysis of development suitabilities. It is a scale appropriate to the presentation of an ecological inventory and interpretations used as background for development proposals.

Maryland is unique among the states in having a comprehensive, continually updated property ownership mapping system. This information is mapped at Scale F and is currently used extensively by several State departments. It is appropriate for the detailed evaluation of specific development proposals and policies.

b. Considerations re the Dissemination of Graphic Information

If the mapping system is to be operational -- continually up-dated and continually feeding into policy decisions -- the maps themselves must meet several criteria not required of illustrations in ad hoc studies. The maps themselves must be of a drafting size such that additions and modifications can conveniently be made. If drafting is done by hand, the map size must simply be one that is not unwieldy for draftsmen to work with. If drafting is done by computer, the map size must be consistent with the size of the drum or flat bed plotter which is to be employed. Also, the maps must be adaptable both for presentation at meetings and for publication in reports. Current maps should be available with a minimum of extra effort for either purpose.

c. Map Compositing

The graphic telescope consists of a range of scales appropriate for mapping entities at various levels of detail. Information is graphically represented at the scale most appropriate to the grain of data and most suited to relate them to the planning context. As the scale increases, data are represented more accurately as their significance become more important to local conditions. Analysis of existing conditions, emerging problems, and alternative development plans require aggregation of mappable data. In the Graphic Encyclo-

pedia this requirement is accomplished by superimposing a series of maps. Such composites are represented at the next larger scale. In addition to the composite, more detailed information is mapped at the larger scale. This detailed information is, in turn, aggregated to form a new composite at the next larger scale. This method permits aggregation of data from the smallest to the largest scale. Conversely, it permits generalization of data which are collected and mapped at the largest scale, i.e., fine grain entities and processes are simplified as their significance decreases in wider context.

FIGURE 4: [illegible] OF DATA BY MEANS OF THE GRAPHIC TELESCOPE

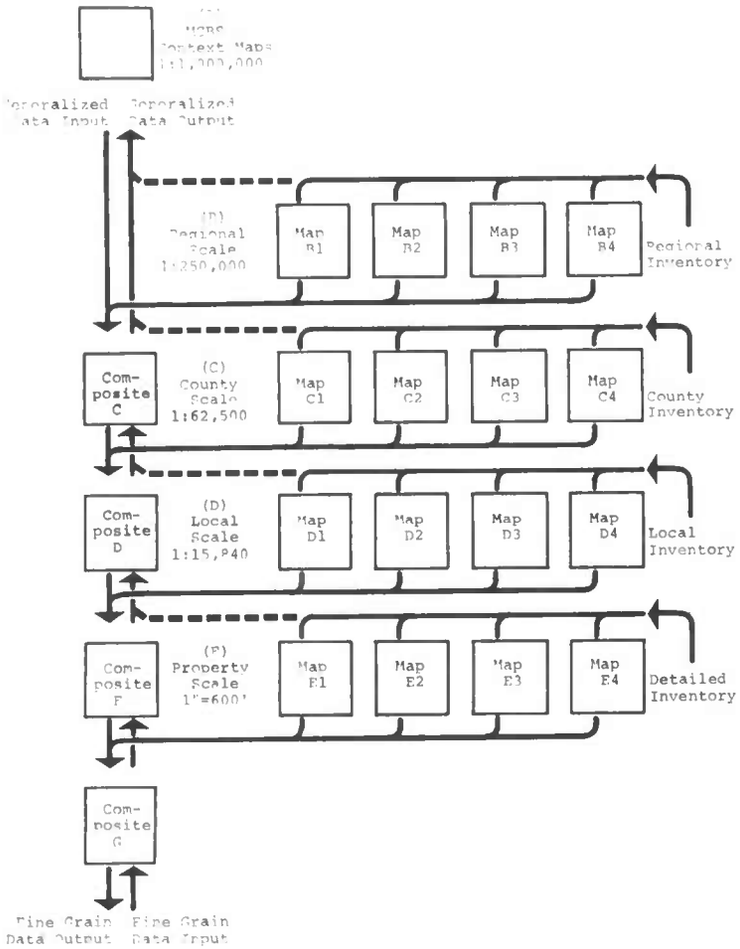


Figure 4 illustrates the in-put and out-put system, the aggregation of data at each scale, as well as the carrying over of data from one scale to the next larger or smaller one. Plates 43 and 44 present illustrative composite maps at the county and local scales (scales C and D). The composite maps display information on the following subjects: mineral resources, shore erosion and bay sedimentation, aquatic habitats; major highway network, existing land cover, population of major centers, major rail and waterways, manufacturing employment centers and their relative port dependence, wastewater discharge, sewage treatment plants, developed recreation and public open space, shoreline ownership and major use, and water quality standards. The maps do not attempt to interpret the possible significances of the conjunction of various portions of data, nor does it attempt to resolve apparent conflicts between mapped subjects or activities. (These matters are considered in Chapter II). The reliability of the information presented in the composite map examples varies considerably, due to the multiplicity of scales at which source data was available. As the graphic encyclopedia system is operationalized, this problem can be eliminated. It is felt that a refinement of the map compositing system should be incorporated into the on-going mapping process, and that this is important as a means to facilitate output from the Graphic Encyclopedia for purposes of Chesapeake Bay management.

3.4 Technological Support for a Graphic Encyclopedia

A Graphic Encyclopedia for regional environmental management has immediate potential for showing the location of various facilities (e.g., sewage treatment plants, deep-water port facilities, navigation channels), resource characteristics (e.g., existing and potential shellfishing beds, wetlands, steep slope areas) and environmental management characteristics (e.g., recent oil spills, polluted shellfish beds, areas unsuitable for septic tanks) region-wide.

PLATE 41: Composite Legend

MINERAL RESOURCES

- Pleistocene to Recent Sand and Clay
- Plio-Pleistocene Upland Graven
- Cretaceous Sand
- Mafic Igneous Metamorpic Rock
- Grantic Igneous and Metamorphic Rock
- Crystalline Marbles

SURFACE DRAINAGE PATTERN

- Major Watershed Boundary
- Secondary Watershed Boundary

SHORE EROSION AND BAY SEDIMENTATION

- Clayey Silt
- Fine and Very Fine Grained Sand
- Medium Grained Sand
- Gravel and Course Grained Sand
- Erosion over .50 Acres per mile per year
- Erosion .25 - .50 Acres per mile per year
- Erosion under .25 Acres per mile per year

AQUATIC HABITATS

- Striped Bass Spawning Area
- Oyster Bed
- Soft Shell Clam Bed
- Blue Crab
- Area Closed to Shell Fishing
- Water Quality - See Map B-III-2

EXISTING LAND COVER

- Wetlands
- Forest Cover
- Highway Access Fully Controlled
- Multilane Divided Highway
- Primary and Secondary Undivided Highway
- Urban Areas
- Military

POPULATION OF MAJOR CENTERS

0-500
-1,000
-2,000
-10,000
-50,000
100,000
200,000
300,000
400,000
500,000
1,000,000 People

MAJOR RAIL AND WATERWAYS

- Major Railways
- Major Shipping Channel Federally Maintained
- Major Shipping Channel Non-Federally Maint.
- Port
- Dredging Area Project Completed
- Dreding Area Project not Completed
- Spoil Deposit Area

MFG. EMLOYMENT CENTERS

0-50
-100
-200
-1000
10,000
50,000

PORT DEPENDENCE BY PLANNING REGIONS

50,000
20,000
10,000
2,000 Employees

Port Serviced
Partly Port Dependent
Port Dependent

WASTEWATER DISCHARGE

Discharge by County into major Rivers in mgd

0 1 2 3

length of bar X number of parallel bars equals quantity in million gallons per day (mgd)

Discharge of Major River into Bay in mgd

0 1 2 3

MAJOR SEWAGE TREATMENT PLANTS

- Secondary (Biol.)
- Primary (No Biol.)
- Major Municipal Surface Water Supply Intakes

DEVELOPED RECREATION AND PUBLIC OPEN SPACE

- Federal Park and Forest
- State Park and Forest
- Municipal Park and Forest
- Private Beach
- Public Beach
- Quasi-Public Camp
- Natural Environment Area
- Public Hunting Area
- Wildlife Reserve
- Historical Site

OWNERSHIP

- Federal
- Other Public
- Private

MAJOR USE CATEGORY

- Public Recreation
- Private or Commercial Recreation
- Non-Recreational Development
- Undeveloped
- Commerce
- Industry
- Residence
- Open Space, Public and Semi-Public

PLATE 42: Map Composite: Scale C (Anne Arundel County as Example)

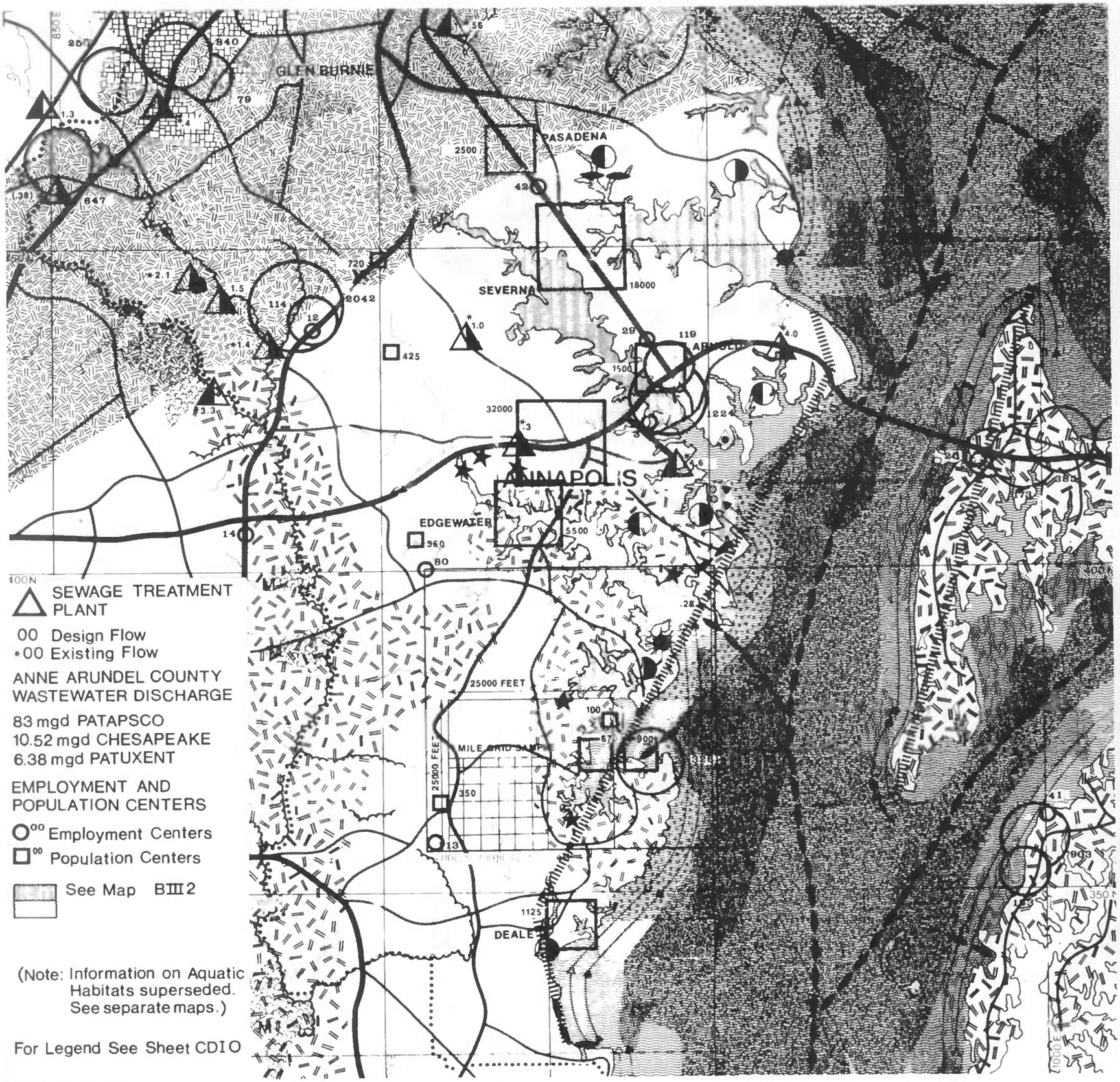


PLATE 43: Map Composite: Scale D (Rhode River - West River Area as Example)

The Graphic Encyclopedia enables (and disciplines) staff personnel to display their specialized knowledge of elements of the Bay system in a consistent graphic form which is easily accessible to other specialists and to policy-makers. The policy-maker concerned with residential development regulation cannot be oblivious to the fact that a certain area is important as an aquifer recharge area because it is clearly displayed on a map -- not buried in an esoteric report. Staff personnel, on the other hand, are kept on their toes by policy-makers' use of the Graphic Encyclopedia system. If a particular map does not adequately represent the Bay-wide pattern of a particular resource or characteristic, what changes are appropriate? If certain unmapped elements are significant in particular areas, why can't they be represented graphically? This will at least call the attention of policy-makers to the existence of the characteristic and the specialist staff can be asked to elaborate with regard to particular decision situations.

By this process, the maintenance of a Graphic Encyclopedia can -- in and of itself -- improve regional management of Bay resources. The incidence of a set of facilities and characteristics in an area affected by a policy-decision will call attention to possible interrelationships and impacts. However, the type and degree of interrelationships among elements in a particular decision situation are developed on a judgmental basis or are the subject of special investigations.

a. Information Gathering

Application of emerging systems technology can assist in developing the Graphic Encyclopedia in several ways. One of these ways is in information gathering.

ERTS:

The "ERTS" (Earth Resources Technology Satellite) system now developing will enable the gathering of of much environmental data by means of space satellites. Technology is now being developed to more efficiently glean information developed through aerial photography. It may soon become possible to cheaply and efficiently monitor land and water use characterisitics (natural and man-imposed) over the entire region.

Other Environmental Monitoring:

Information gathered by means of environmental monitoring devices such as those being used to calibrate the Corps of Engineers hydraulic model of the Chesapeake Bay could also be summarized in widely accessible graphic form as an entry in the Graphic Encyclopedia information system.

Housing and Urban Growth Monitoring:

Much information on various proposed changes, various permit applications, etc., can be efficiently gathered region-wide by the use of consistent recording forms, electronic data processing, and the use of the Maryland grid system for specifying location/address. Thus, the appendix section of the Maryland Manual of Coordinates dealing with "Housing Subdivisions and Developments" could be extended to include, development acreage, number and type of dwelling units, land coverage, and other information of significance in environmental management. With the application of systems technology this information could be published annually in a graphic summary as an entry in the Graphic Encyclopedia system.

b. Information Storage and Retrieval

Another way that emerging systems technology could assist in developing the graphic information system is in information storage and retrieval.

As the Graphic Encyclopedia develops, it will become increasingly important to be able to efficiently compare data from combinations of map entries. A computer map compositing system being developed in the Economic Development Administration indicates that systems

technology can be applied to this task. (Ref. 26) The discussions of existing and emerging problems in Chapter II of this Report provide preliminary guidelines as to which Graphic Encyclopedia entries should be composited.

4 Steps Toward the Implementation of CBIN: Coordination of Information Systems

The Graphic Encyclopedia, as it becomes operational, must be able to generate output relevant to policy-decisions, as well as to accept input from on-going research. A number of information systems are currently being developed either to organize research on functional relationships among elements of the Bay system or to support specific decision-making responsibilities of State agencies with regard to environmental management. This section will indicate potential linkages between the Graphic Encyclopedia and other currently developing information systems. Its major point is that the several information systems are compatible and should develop in concert.

4.1 Cheaspeake Ecological Data and Inventory System

The research program (Ref. 9) of the University Consortium includes an inventory of Bay system entities, characteristics and processes. The inventory emphasizes the general systems approach as opposed to the more limited problem-oriented approach. Use of the inventory system provides a multiple check list for identifying possible functional relationships between Bay system entities. This provides an excellent basis for identifying gaps in understanding of various processes and coordinating the cumulative results of the investigations.

As studies about as important and complex a system as theChesapeake Bay proliferate, fewer and fewer experts will have a real appreciation of the current level of understanding of the Bay system (as regards other separate disciplines). Non-experts, including most policy-makers, cannot hope to keep abreast of such dispersed, various and esoteric research activity. Since persons are free to ignore what they are only vaguely aware of, the uncoordinated, ad hoc nature of current research activity can be presumed to limit the effectiveness of environmental management of the Bay.

The general systems approach and the inventory of entities, characteristics and processes will provide a framework into which myriad pieces of knowledge can be gathered. By maintaining a summary of the level of understanding of Bay system, processes and relationships (both in terms of what is known and what is not), the general systems inventory can become a major resource for policy-making in environmental management.

Potential Linkages with the Graphic Encyclopedia:

The Graphic Encyclopedia and the general systems inventory are therefore mutually supportive. The general systems inventory is an aid in identifying research priorities and assembling the results of research investigations. It also can serve as an "index" to the Graphic Encyclopedia with its headings "descriptors" for classifying information.

The Graphic Encyclopedia is designed to inform regional environmental management. It is important that Chesapeake Bay environmental management be able to efficiently and continually incorporate the results of on-going research. Evolving efforts in environmental management will raise issues and reveal information gaps and these should assist in establishing research priorities.

Differences of Emphasis: Sources of Compatibility:

Because of the differences of purpose, the Graphic Encyclopedia and the general systems inventory have a

number of differences of emphasis. First, the Graphic Encyclopedia emphasizes the display of the locations (Maryland Grid System addresses) of Bay system elements. It places considerable importance on the need to be able to efficiently map various aspects of the Bay system and to show various elements in their geographical relationships to one another. Second, the Graphic Encyclopedia lends itself to a problem orientation as opposed to a general systems orientation. Entries in the Graphic Encyclopedia are selected and grouped in response to major areas of State and local management responsibility. Thus "mineral resources" includes those minerals which have significant economic value; and efforts are made to differentiate industry according to its degree of port and water dependence.

As public responsibility and authority in environmental management grows, so should the breadth and depth of the Graphic Encyclopedia entries. Also, the Graphic Encyclopedia places considerable emphasis on maintaining descriptions of the existing situation, current problems, proposals and emerging problems -- all in accessible mappable form. It is correspondingly less detailed in its description of functional interrelationships among elements of the Bay system.

Finally, the Graphic Encyclopedia does not attempt to meet the needs of rigorous analysis. In a decision-making context characterized by multiple goals, complexly overlapping client groups, and myriad unidentified or unmeasured relationships, the Graphic Encyclopedia attempts to improve decision-making simply by means of displaying information more efficiently, suggestively and in composite relations.

4.2 State Agency Environmental Management Information Needs

The Maryland Wetlands Bills (House Bills 285 and 286) (Ref. 3) represent a major new area of State decision-making and responsibility in environmental management. These Bills require Maryland State Government to take environmental concerns into account in the disposition of State-owned wetlands and in regulating various activities on all wetlands. In responding to the new responsibilities, the Department of Water Resources and cooperating State agencies are developing an information system which focuses on wetlands and the particular environmental management decisions which will arise as a result of the laws.

The information being collected (Ref. 12) anticipates questions and issues which will be raised by use of the decision-assisting checklists (discussed in Section A 3 above) in particular wetlands decisions. It is thus the preactive complement to the reactive checklists and information display frameworks, and it will enable responses to issues raised by the checklists to be based on a quantitative evidence. Thus, though the final weighting of the ecological and economic accounts and the decision as to the appropriate management response in a particular case will be judgmental, the preactive efforts will supply quantitative assessments of sub-issues. They can thus help reduce conflict over the facts of the case, even though disagreement as regards the appropriate management response will surely remain.

Potential Linkages with the Graphic Encyclopedia:

The Graphic Encyclopedia relates to the wetlands regulation checklists and other specifically policy-related information systems in two potential ways. First, the Graphic Encyclopedia provides a summation device and an overview of the aggregated Bay-wide effect of many scattered policy actions. In maintaining this summary, the Graphic Encyclopedia can be the source of a periodic report on "the state of the Chesapeake Bay". It could thus be a basis for regional policy decisions regarding the Chesapeake Bay -- but one which is derived from the specific, localized, on-going activities of

regulating agencies.

Second, the Graphic Encyclopedia could be a source for mapped information regarding many ecological and socio-economic factors. Many portions of the wetlands checklist could be assembled on the basis of information presently incorporated, or proposed to be incorporated, in the Graphic Encyclopedia. The Graphic Encyclopedia should not be a sufficient source for any specific policy decision, but it could provide a developable information base for many specific policy issues.

The regulation of wetlands is only one of numerous areas of State responsibility with regard to environmental management. Other responsibilities reside in other agencies, or combinations of agencies and at other governmental levels. Decision-making in each area of responsibility involves an "information system". (The information system may be elaborate or sketchy, and adequate or inadequate to the demands made upon it.) The Graphic Encyclopedia should relate to information systems needs in on-going environmental management decisions as well as to information systems which coordinate and assemble the results of research efforts.

C

System Modeling and Planning — Adaptive Frameworks

Reactive and preactive frameworks and methodology each have their role. But unless Bay management is able to get into a posture of a fuller understanding of and adaptive response to the changing nature of the Bay system, man's needs, and the limitations on the Bay's resources, little more than ad hoc responses to problems will be possible.

On the other hand, efforts at system modeling require the support of extensive information gathering (preactive) efforts and are eventually justified as they are reflected and referred to in day-to-day resource management (reactive) decision-making. The University Consortium provides a useful overview of system modeling (Ref. 9), parts of which are quoted here.

1 The Relation of Synthesis and Systems Modeling and Resource Management

"Synthesis...involves pulling together fragments of understanding and information into gradually larger blocks of coherent relationships. The purpose is to develop a sufficient understanding of the complex systems so that predictions can be made about future states and reactions to changes...

"The goal of synthesis is a family of functional models which can be used to predict the burden which cultural and economic forces will place on the estuary, the effect that burden will have on the estuarine water quality and ecology, and the impact that constraints on the use of the resource and that changes in the water quality and ecology will have on society. Such models would permit the evaluation of alternatives available to decision makers responsible for management of the Chesapeake Bay.

"The basic building blocks of the synthesis process are the descriptions of the entities and their interactions ....the systems analysts will construct diagrams showing the interactions between the entities in a system and the processes and characteristics involved in those interactions.

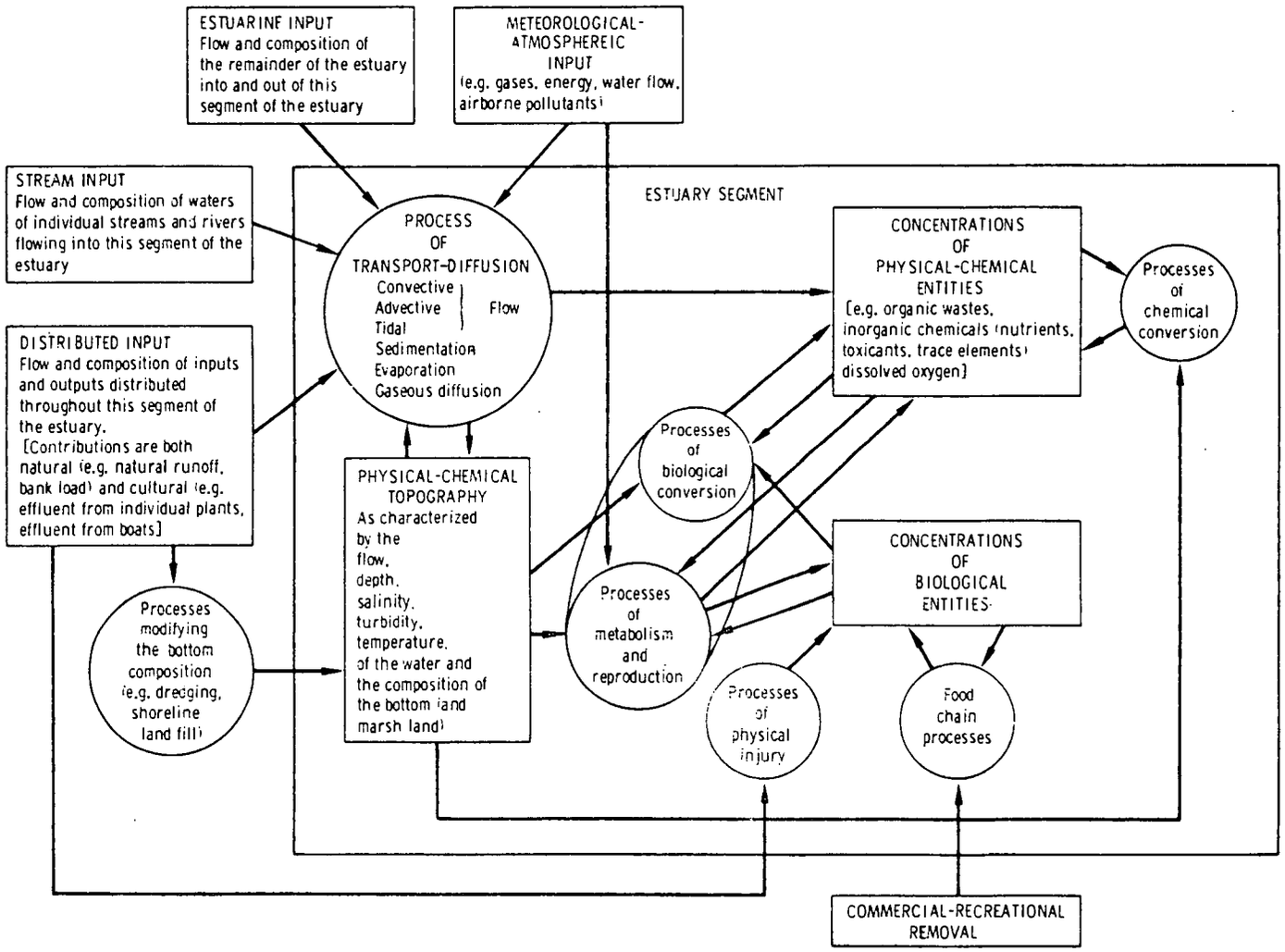
"As an example, Figure 5 illustrates the interactions within a generalized segment of the estuary. It shows the direct interactions of that segment with the environment....(The interactions include those with) other parts of the estuary itself, those (with) streams and rivers which flow into it, those (with) natural phenomena, and those (with) man-related activities." With a general system conceptually outlined, particular subsystems can be developed based on priorities established by management concern.

"How will the synthesis efforts be brought to bear on the needs of the regulatory agencies governing the Bay?.... (These efforts have) the long range objective of obtaining a reasonably comprehensive understanding of the estuary. However, decisions are being made now and will be made in the future which will have important bearing on the Bay. These decisions necessarily will be made with insufficient knowledge of the consequences or alternatives. In addition to responsibility for contributing to the acquisition of knowledge, participants in this research program will have the responsibility to see that existing knowledge is used as effectively as possible....the basic concept is that the complexity of the problems facing society requires a formal, continuing program of synthesis."

2 Current Systems Modeling Efforts

A number of systems modeling efforts currently underway have potential significance in Bay resource management. Some of these focus on functional or geographic sub-systems of Bay activities and processes; others do not relate directly to the Bay but have potential application in

FIGURE 5: **GENERAL INTERACTION DIAGRAM ESTUARY SEGMENT** (Ref. 9)



Bay management.

2.1 U.S. Corps of Engineers Hydrological Model of the Bay

In order to "make a complete investigation and study of water utilization and control of the Chesapeake Bay Basin" the Rivers and Harbors Act of 1965 (Section 312) authorizes the Secretary of the Army, acting through the Chief of Engineers, to "construct, operate and maintain....a hydraulic model of the Chesapeake Bay Basin." (Ref. 4)

"The hydraulic model has been increasingly used in recent years in estuarine water quality studies. The hydraulic model of Chesapeake Bay will be particularly useful...in making studies related to the following topics:

1. The salinity distribution within the Bay system, and interrelationships of significant parameters affecting salinity distributions.
2. The mechanics of estuary flushing.

3. Waste water and heat dispersion.
4. Time of passage of pollution loads.
5. Investigations for better site locations of sewage treatment plants, sub-aqueous outfalls, nuclear and fossil fuel thermal power plants, and port facilities.
6. Study of projects that involve both major changes in the fresh water inflow regime and alterations in existing estuarine hydraulic geometry." (Ref. 4)

2.2 Baltimore Regional Economic Study

Responding to a "need for some way to make.... anticipatory estimates of the regional impact of a wide range of alternative economic developments in terms of total production volume changes and their accompanying labor requirements", the Regional Planning Council in Baltimore has developed "locally tailored methods to be used on a continuing basis for estimating changes in the regional economy following from various known, anticipated, or assumed changes in that economy. Such changes (can) be estimated for each of nearly 500 private and governmental sectors representing the broad array of economic activities making up the overall regional economy. The estimates for each economic grouping (are) expressed as dollar volumes of production or sales. Such estimates (are) also converted to required employment changes by occupational skill category for each industry and the region as a whole." (Ref. 27)

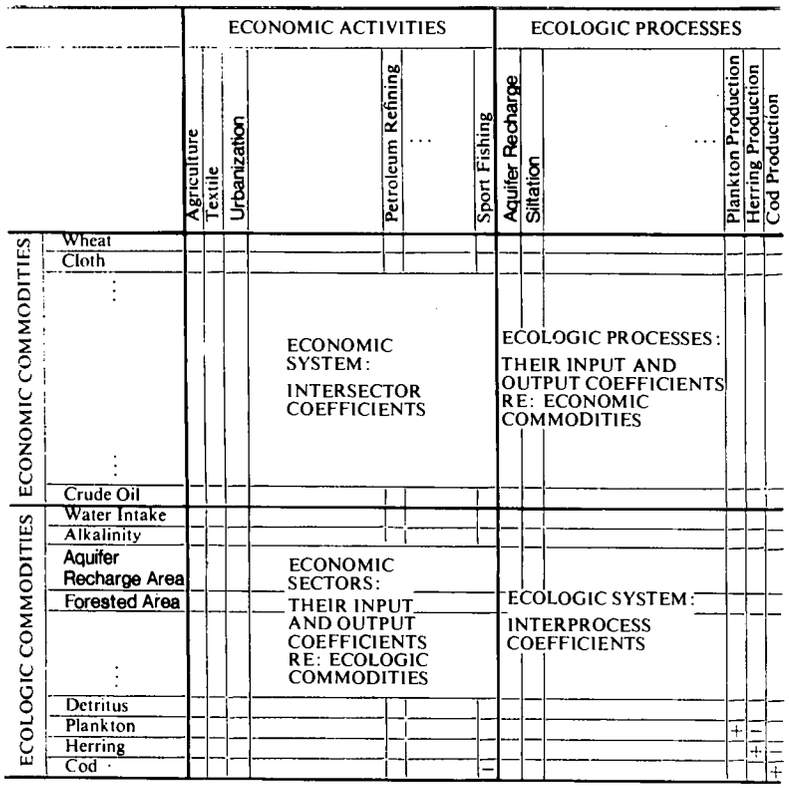
The limitations of the RPC effort in the light of Bay management needs are two-fold: 1) the economic system analysis is limited geographically to the Baltimore metropolitan region and 2) there is no means to estimate environmental impacts of proposed economic changes. Still the input-output description of the structural interdependence of the Baltimore economy can be of great use in planning marine transportation and waterfront industrial development; extension of the input-output analysis to a broader range of impacts is an area of refinement which is receiving considerable research attention.

2.3 The Linkage of Ecologic and Economic Systems

Walter Isard and his collegues are developing "a new conceptual framework... to link both economic and ecologic systems ....The conceptual framework...is in essence a framework for a linear system. It approaches the problem from a traditional input-output or, more strictly, a linear programming standpoint....(The) first step in developing this framework is to set down....a traditional coefficient table with columns representing sectors (industries and activities) and rows representing commodities associated with these sectors as outputs and resources." This is the upper left block of cells (the economic system: intersector coefficients) in Figure 6.

(The) second step in developing the framework "involves the hypothesis that one can fruitfully view the ecologic system in input-output or activity analysis format. Thereby, the ecologic system is considered as a very large set of interdependent activities, involving as inputs and outputs many commodities, only a few of which correspond to those of the economic system. Not only do these activities feed upon each other, that is provide each other with inputs, but also to the exogenous economic system they furnish final outputs or deliveries (in the sense of exports to the economic system). In turn these ecologic activities are dependent on the economic system (that is currently require or receive from it) various commodities (in the sense of imports) to be used as inputs. These imports from the economic system are at the same time exports or deliveries of the economic system to the world exogenous to it, while the exports from the ecologic system are at the same time imports into the economic system, again from the world exogenous to it. To the extent that one system's imports and exports are the other

FIGURE 6: Conceptual Framework for Linkage of Economic and Ecologic Systems (Ref. 28)



system's exports and imports respectively, to that extent the ecologic and economic systems can be effectively linked. And correspondingly the typical input-output or activity analysis coefficient table for the economic system can be many times enlarged to encompass a comprehensive accounting framework for a fused ecologic-economic system." (Ref.28)

In effect, the second step adds three major blocks of cells to the conceptual framework presented in Figure 6:

1) the ecologic system and its interprocess coefficients,
2) the inputs and outputs of ecologic commodities by economic sector, and
3) the inputs and outputs of economic commodities, by ecologic process.

In the article cited, Isard goes on to illustrate how coefficients can be developed for sportfishing as an economic activity with a certain amount of cod as an ecologic commodity to be caught and consumed. Cod is an ecologic commodity produced by an ecologic process (activity) involving a system which produces herring, etc. with the food chain ultimately completely described.

This conceptual framework has great potential for the Chesapeake Bay. In an expansion of the activity-process and commodity blocks a number of rows and columns can be added to illustrate its usefulness.

For example, aquifers next to the Bay are important water resources, are connected to the Bay as illustrated in the water budget (Fig.1,Sec.II,F) and are affected by land made impervious to percolation by industrial development. If we place aquifer recharge land in a row as an ecologic commodity, and aquifer recharge in a column as an ecologic process, we can quantify the rate at which this process occurs as a coefficient of input-output. Next, industrial (or any) development can be introduced as an economic activity one of whose inputs is (the elimination of) aquifer recharge land, which in turn reduces the coefficient and the rate of aquifer recharge. This in turn reduces the water available to be used as an input to the industrial commodity.

Any aspect of land or natural resource can be treated in this fashion as an ecologic commodity that is an input to both ecologic and economic processes, and as man intervenes and changes their availability as an input, he affects the processes in quantifiable ways. Agriculturally rich areas, steep slopes, flood plains, forests, and marshes, for example are ecologic commodities as input to such ecologic processes as siltation, evapo-transpiration, flooding, food production, etc.

While it may not be useful, and indeed may be counter productive to attempt to view all ecological elements as "commodities", it is an extremely useful and innovative application of economic concepts

to a heretofore intractable subject -- how do we really value the ecologic processes around us on which we depend?

2.4 Systems Simulation for Regional Analysis

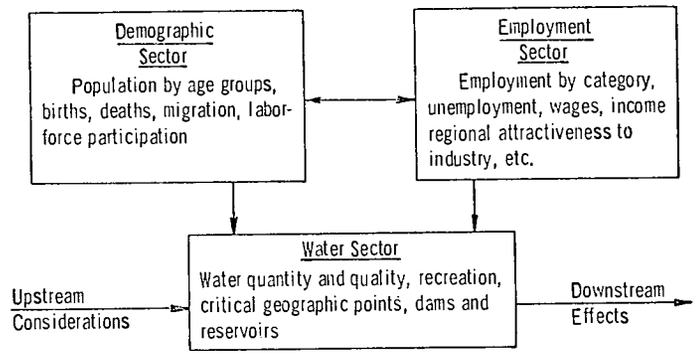
Recent efforts of a Battelle Memorial Institute research team for the Susquehanna River Basin Utility Group (Ref. 29) have explored how systems simulation ("large-scale computer simulation as a technique...for gaining insight into complex problems") can be applied to regional analysis.

"Because demands on the water resource would be largely determined by population levels and by the levels of economic activity in the region (the study attempted to tie) water quality and quantity variables...to those demographic factors that are relevant in terms of shaping water demands and influencing water quality." Using systems simulation techniques, the team succeeded in "incorporating the normally considered regional economic variables and those directly relating to the water resources of the region within the same analytic framework." Figure 7 presents an overview of the structure of the model.

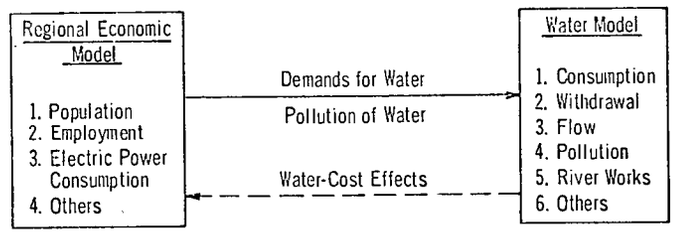
"The water sector is viewed as a 'technical sector'; it could be replaced or augmented in a model of this type by other technical factors that might be of particular importance to a given region, for instance, a forest resource sector, a minerals sector, or a transportation sector. In fact, the modular construction of the model, with its groups of interrelated equations combined into sectors and sub-sectors and united by simple connecting relationships, allows expansion of many parts of the model without disturbing the remainder in a major way."

Besides its sophistication in interrelating demographic, economic and water sectors, the simulation techniques make possible "inexpensive experiments on the effects of changes in parameter

Figure 7: Structure of Susquehanna River Basin Model Elements (Ref. 29)



The three major sectors of a subregional model.



Two submodels forming the regional model

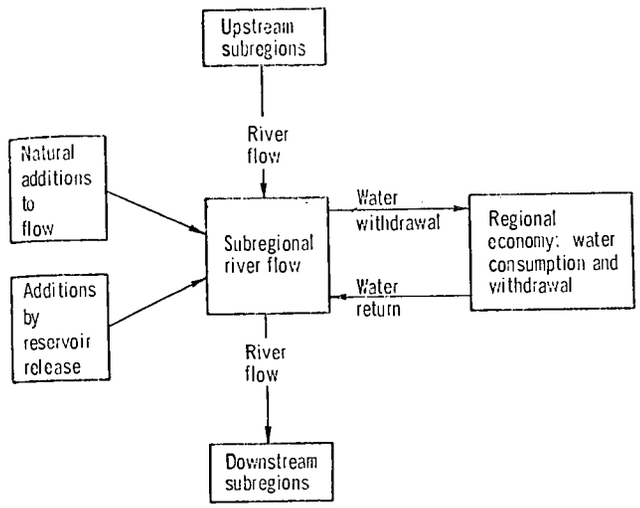


Diagram of the water-flow submodel.

values" in combination with a high degree of data disaggregation so that "the model yields information specific to the various sub-regions of the basin and to particular geographic points within these sub-regions." These features point the way towards making "regional planning a more cohesive and continuing process, rather than a group of separate inputs concerning an over-all problem that are often difficult to integrate."

With regard to potential applicability in the Chesapeake Bay Area, the Susquehanna model has two present limitations. First, "most potential feedbacks from the water sector to the demographic and employment sectors were judged to be inoperative. That is, while growth of population and industry obviously affects the river in terms of water quantity and quality, it was judged that the resultant changes in the river will not be of sufficient magnitude and kind significantly to alter industrial and population growth patterns except in some specific instances as in the case of certain recreation developments." Second, "some elements of comprehensive basin planning are not included in the Susquehanna model. For instance, those elements having a large engineering input, such as flood control, are not embodied. Also, navigation and irrigation did not seem important enough in the Susquehanna River Basin to warrant inclusion." (Ref.29)

3 Ecological and Socio-Economic Planning

The previous frameworks have progressed from inventory through monitoring to system modeling. This portion deals with the next big step- and outlines a method that integrates ecological and socio-economic planning. This is the key step that represents an innovative ecological approach to planning. It is a method that is applicable to planning anywhere, with local variations. Its utility for Bay management is in its concern for the critical Bay Shoreline, the water, and the zone behind it that is most ecologically related to it.

3.1 Introduction

To proceed to relate ecological planning to socio-economic planning, this Memorandum summarizes its view of planning. Planning consists of the presentation of alternative courses of social action related to the costs and benefits of such action. Adaptive planning includes feedback into the system and reiteration or the process. Increasingly, costs have been at the expense of the environment, reflect in environmental degradation, and these operate in the realm of non-price costs and benefits. It is for this reason that ecological planning has leapt into prominence. Based upon the natural sciences, integrated through ecology, it represents these insights competent to perceive the environment as an interacting, bio-physical process. Yet, ecological planning is not an alternative to socio-economic planning but rather is complementary to it. Both are essential. The case for the latter is assured. It represents the orthodoxy of planning. Ecological planning is still sufficiently novel that it requires both explication and justification. This is the reason for the relative emphasis given to it here.

An ecological approach to a comprehensive planning process begins with an ecological inventory, proceeds to the second stage where natural phenomena are reconstituted into dynamic biophysical processes, and thence to the formulation of the region as an ecological model consisting of interacting biophysical processes. This concludes the first phase.

The second phase consists of reconstituting these data as a social system, identifying, evaluating and locating the attributes of air, water, land and location most propitious for each of the major

land uses - urbanization, agriculture, recreation, forestry - and finally developing a synthesis of intrinsic suitabilities for the region.

In the third phase socio-economic data are collected and collated, first as phenomena, next as social processes, thereafter as a social value system. From this base projections are developed from which alternative growth models are constructed, based upon explicit hypothesis.

The next phase envisages alternative matches of the ecological model with alternative growth models. This is linked to fiscal and legislative components and together with alternate sewer, water, high and other infrastructure layouts constitutes a testing phase. The final phase is the formulation of the plan, and its adoption and implementation procedures. Citizen involvement is of course presumed throughout.

3.2 Phase I - Formulation of an Ecological Model

The proposition which underlies ecological studies is one of profound simplicity; it is merely that the knowledge of biophysical systems, ecosystems, is indispensable for the intelligent conduct of human affairs. If this is accepted, then it becomes necessary to identify those sciences wherein reposes knowledge of the biophysical world. Weather, climate and life are studied by bio-meterologists, geological evolution and process are the province of geologists; physiography is the realm of physical geography; water processes, both surface and ground are the competence of hydrology; aquatic biology is the province of limnology; plants of botanists; zoologists study animals. The degree to which these sciences are integrated is the science of ecology - the study of the interactions or organisms and environment (which includes other organisms).

a. Inventory of a Region as a Biophysical Phenomena

The first stage of an ecological planning study is an inventory - the identification of the region as phenomena - climate, rocks, physiography, water, soils, plants and animals. The information derived is mapped, represented in diagrams and described in written form.

Inventory of the Region as Phenomena

(i) Climate
(ii) Bedrock Geology
(iii) Surficial Geology
(iv) Physiography
(v) Hydrology, Surface Water
(vi) Hydrology, Ground Water
(vii) Soils
(viii) Plant Ecology
(ix) Animal Ecology
(x) Limnology
(xi) Land Use

b. Review of Phenomena as Process

When the inventory has been completed it is necessary to assemble the scientists involved and require them to explain phenomena in terms of historic and dynamic processes which are continuing. That is, time must be added - time past and time future. At the conclusion of this step the region under study is revealed as consisting of biophysical processes. The material developed from this part of the study will consist of text supplemented by diagrams and maps.

Review of Phenomena as Process

Climate)	
Geology)	
Physiography)	
Hydrology)	
Soils)	x time and
Plant Ecology)	interactions
Animal Ecology)	
Limnology)	
Oceanography)	
Land Use)	

c. Representation of the Area by and Ecological Model

The final step of the first phase

is the representation of the area as an interacting system. Climate factors affect geology, geology affects hydrology, all of these determine soils which influence plants which affect climate, all of which affect man and are affected by his actions. It is now required to represent the region as inter-dependent, interacting, biophysical processes, and, moreover to identify the major processes and interactions in the region. This requires the construction of an ecological mode. It can be simply descriptive, certain processes can be quantified and the whole can, if required, be simulated with computer models. The formulation of an ecological model of a region completes the first phase. This phase has a justification in its own right. With such a model it should be possible to predict the biophysical consequences of certain proposals - an atomic reactor, a sewage treatment plant or the location of an interstate highway.

3.3 Phase II-Interpretation of the Area for Intrinsically Suitable Land Uses

a. Reconstitution of Biophysical Processes into a Social Value System

The ecological model and its descriptions of phenomena and process can be given vastly increased value by being reviewed and reconstituted as a social value system. It is important to understand how ecosystems work, but it is of even more value for planning, if the biophysical processes can be seen to offer both opportunities and constraints for all prospective land uses. We can identify the factors of climate, bedrock geology, surficial geology, physiography, hydrology, soils, plant ecology, animal ecology, limnology, and land use which are most beneficial for every land use. We can also identify factors in each of these categories which are detrimental. Moreover, we may be able to identify degrees of tolerance or intolerance of ecosystems to prospective uses.[1]

In each category there will be gradient of values - for example, rocks in terms of value for foundations, water in a range of quality, soil productivity, scenic beauty, historic value, etc. Similarly, when the selected attributes are ranked - conditions necessary for crop agriculture are more stringent than for small grains which are, in turn, more demanding than for pasture, and so for every land use.

In this phase each subject heading - climate, geology, etc. - is monitored for attributes of air, water, land, life and location, both advantageous or detrimental to all prospective land uses. Each of these factors is evaluated in gradient. This material is mapped and represents the area as a social value system.

Biophysical Processes as a Social Value System

Climate: Precipitation, temperature, frost-free days, insolation, frost, fog, snow, etc.
Geology: Foundation conditions, economic value, scientific importance, uniqueness, etc.
Physiography: Physiographic features, uniqueness, slopes, aspects, etc.
Hydrology: Surface water - water quality, quantity, flood plains, scenic quality, recreational value, chemistry, biology, pollution sources, etc.
Soils: Physical properties, drainage, distance to bedrock, seasonal high water table, erodibility, compressive strength, suitability for septic tanks, etc.
Animal Ecology: Terrestrial and aquatic - species, populations, habitats, abundance and scarcity, economic value, recreational value, etc.
Plant Ecology: Terrestrial and aquatic - communities, stages of succession, type, quality, age, uniqueness, scientific importance, scenic quality, recreational importance, etc.
Limnology: Species, population, chemistry, as indicators of water quality, etc.

Land Use: Urban, agricultural, forestry, extractive minerals, transportation, institutional; historic value, scenic value, scientific value, etc.

b. Optimization for Single Intrinsic Land Uses

It is now possible to review the evaluation of the region and select, from each category, the attributes most propitious and most detrimental for all prospective land uses. For example, the case of a new town would select factors of climate - insolation, temperature, humidity, wind, absence of fog, exposure; it would select superior foundation conditions, an appropriate range of slopes from physiography as well as propitious physiographic features and good aspect. From hydrology we would require adequate amounts of good quality water and a recipient source for sewage disposal; soil requirements would include compressive strength, adequate drainage, absence of slipping, low susceptibility to erosion, and where necessary, suitability for septic tanks. Plant ecology would be searched for scenic quality, tolerance, recreational value; animal ecology for richness of habitat and for recreation. For each land use it is possible to assemble and evaluate the intrinsic suitability of the region for that land use in a range of types and values. Maps can be made showing the region optimized for each land use - urbanization, agriculture, recreation and forestry. The maps are accompanied by explanatory text.

Optimization for Single Intrinsic Land Uses

Urbanization:
- Residential - high density, intermediate density, low density
- Industry - water-related by type, other by type
- Commerce - regional retail, regional wholesale
- Transportation - corridors
- Agriculture - by type
- Recreation - terrestrial by type, aquatic by type
- Forestry - hardwood, softwood
- Extraction Industry - by type
- Protection - areas to be regulated for the health and safety of society, areas of unique value of vulnerable resources

c. Synthesis

When the single optimizations have been completed it becomes possible to make a synthesis in which the region is shown in terms of the sum of highest uses of areas best able to support the entire spectrum of prospective land uses. As this is a pre-emptive method, a decision must be made on priorities. If the decision calls for a hierarchy of protection, agriculture, recreation, urbanization, forestry and extractive minerals, the result will differ from that in which the hierarchy is changed. Should the study be computerized, it would be possible to see the consequences of all permutations. A synthesis can be developed showing the region as intrinsically suitable for single land uses, compatible multiple land uses. It will also show areas in competition.

When the region has been thus identified it is possible to locate areas propitious for future development and to perceive others as unsuited for the type of development envisaged. Even more valuable, this evaluation permits any proposal to be seen as changing the existing social value system. It is therefore possible to test any proposal for its effects upon the ecosystem and measure these in terms of social costs and social benefits. When the metropolis is identified as a hierarchy of social values which are explicit, when the effects upon the ecosystem resulting from planning proposals can be predicted and evaluated as social costs and benefits, then the planning process can also be explicit and overt. Society can approve or disapprove of development proposals based on explicit data,

explicit consequences, explicit social costs and benefits.

There are criteria for ecosystems. The most advanced are complex, diverse, stable and evolving, as opposed to simple, uniform, unstable and degenerating. There are criteria for the selection of environments - whether for a plant, animal, man or industry - these refer to fitness. Is the environment fit for the organism or institution? There will be degrees of fitness - for agriculture, recreation, urbanization, a power plant or a pulp factory. The more fitting the location the less the work of adaptation. Good fitting is creative in thermodynamic terms; it represents a maximum benefit/least work solution. The final criterion, which subsumes the attributes of complexity, diversity, stability, and the accomplishment of creative fitting, is the presence of health - physiological, social and mental in plants, animals, micro-organisms or entire ecosystems and human societies. An ecological study is a necessary prerequisite to creative fitting and successful adaptations which can maintain health.

3.4 Phase III - Socio-Economic Planning Study

As was stated earlier planning consists of identifying alternative courses of action related to social benefits and oosts. However, ecological planning must start as a value system offering varying degrees of opportunity and restraint to all prospective land uses. It remains necessary to identify the demands now being made and future demands, and match social policy with intrinsic opportunities. This requires an inventory of the present society, an understanding of the present through historical perspective, and projections into the future based upon different hypotheses. These projections, or growth models, can be matched to the opportunities represented by the regional ecosystem. The best matches will be minimum social cost/maximum social benefit solutions. These, then, can become the bases for social policy.

While the majority of planning studies emphasize socio-economic determinants that proposed here differs in certain fundamental respects from the orthodoxy. The first major distinction is that economic opportunity is related to the intrinsic opportunities represented by the regional ecosystem. This exhibits degrees of opportunity, degrees of tolerance, degrees of intolerance and thus outer limits. Further, the same ecosystem has been represented as a social value system so that society can choose to accept or reject exchanges of social values - for example, the transformation of a virgin forest into pulp. The most important difference lies in the criteria used to measure performance. Money is the measure of socio-economic planning. In ecological planning the criteria used to assess natural ecosystems applied are stability, the demonstration of creative fitting and the evidence of success is the presence of health - physiological, social and mental.

The method to be employed is a parallel to the ecological study - it is an exercise in human ecology.

The first step is the assemblage of information of the region as social phenomena - population, employment, income, land use, land value ownership, control and the like. This is the base line for planning. An inventory provides little information until it is seen as a product of historical process. Through careful study, using the perceptions on anthropology, sociology, and ethology, the underlying motives and aspirations which generated the growth and development of the region and its sub-areas may be understood.

Aspirations and motives differ, aspirations cannot be fully achieved, conflicts are inevitable. The region must be seen as, not only an ecological model, but a human ecological model wherein changes

affect not only biophysical but also social processes. What values do people attribute to family, in homes, neighborhoods, schools, churches, city halls and state houses. Of all buildings, places and spaces which are most cherished, which least? The region must be seen in terms of social values attributed to artifices for interventions - be they highways or urban renewal projects - must be measured for their effect upon this social value system. With the completion of this stage the region can be represented as a social value system including both biophysical and social phenomena and processes. Upon this value system it is now possible to predict future growth patterns, match these to opportunities and measure their effects as social costs and benefits.

Market analysis is made for each sector - housing, industry, commerce, agriculture, recreation, etc. Parallel projections can be made for collateral public facilities - transportation, utilities, community facilities, etc. These are interdependent and each market analysis will be linked to time and to certain associated factors.

It is possible to establish hypothetical conditions and project growth potential by sectors and assemble these into alternative growth models. One of these models, used for comparison, should be an Uncontrolled Growth Model which shows the face of the future assuming the extension of the present with similar social conditions.

With the conclusion of this phase there are available the components necessary for planning - the proclivities of the region as biophysical process and the present and potential future demands upon its resources.

3.5 Phase IV - Match of Ecological and Growth Models

In the ecological study the region can be optimized for each major land use - urbanization, agriculture, recreation, forestry. The growth models can be applied to these and searched for development opportunities and constraints within each sector.

The product of this would be the identification of locations most fitting for the anticipated demand by type. The single optimization patterns can be assembled to achieve synthesis wherein the total amount of development by type is located in the most propitious locations. This can be done for each growth model and these can be compared for the degree of social benefit and cost which they produce.

3.6 Phase V - Plan Formulation

The degree to which anticipated growth is within the power of the region will have been included in the formulation of the growth models. However, when these models have been matched with intrinsic opportunities it becomes possible to formulate plans to achieve selected objectives. This will involve public and private policies. It will employ fiscal and legislative tools, capital investment in highways and utilities. It will include planning and regulatory powers. Only when the social objectives are identified, and the means to achieve them have been allocated, is there an adaptive planning process. This is dynamic and continuous, a process of action and feedback, responsive to the ecosystem and social aspirations, continuously engaged in creative fitting, its success revealed in the health of the ecosystem and the society.

D
Implementation Tools

Maryland's array of legislative and regulatory tools for environmental management has been rapidly expanding in recent years. These provide improved means for resolving resource conservation-development conflicts. In the context of this chapter of the Report, implementation tools complete the linkage of reactive, preactive and adaptive approaches to conflict resolution. The implementation tools mentioned below are based on current knowledge of the relationships among Bay system elements as established and demonstrated in systems models. They also delineate appropriate areas of public responsibility and authority for effective "reactive" management in day-to-day decision-making, as informed by data collected in accordance with "preactive" frameworks. Several recent initiatives in developing implementation tools for Bay management are briefly described below.

1 Wetlands Conservation

The Maryland Wetlands Act of 1970 (Ref. 30) is concerned not only with the prevention of destruction of wetlands by dredging and filling but also with the restriction of activities that would degrade wetlands without actually destroying them. The major provisions of the Act that support the State's policy of preserving wetlands and preventing their despoliation are:

Section 718 of the Act declares that it is "...the public policy of this State, taking into account varying ecological, economic, developmental, recreational and aesthetic values, to preserve the wetlands and to prevent the despoliation and destruction thereof."

Section 721 - "It shall be unlawful for any person to dredge or fill on State wetlands, except that he has been issued a license to do so by the Board of Public Works."

Section 722 - "The Secretary of Natural Resources...may for the purpose of promoting the public safety, health and welfare, and protecting public and private property, wildlife and marine fisheries, promulgate rules and regulations governing dredging, filling, removing or otherwise altering or polluting private wetlands."

Although examination of the Act and of similar statutes in other states indicates that certain changes may be needed to further strengthen the law, (Ref.31) Maryland has taken a significant stride toward conservation of its wetlands by the passage of this legislation.

2 The Maryland Environmental Service

The "Maryland Environmental Service" creates what is in effect a state-wide sanitary district directed to plan for and provide liquid waste treatment and solid waste disposal facilities on a wholesale basis to Maryland's communities and industries.

It "was created...as an operating and implementing agency and as an instrument of the State for assuring that the needed environmental protection works are foreseen and put into operation at the proper time...[it has] functions and responsibilities wholly distinct from [them]...[It has]...power to raise funds by revenue bond sales which would be repaid by charges for treatment and disposal services, and...responsibility to accept and operate facilities upon the proper request or by directive originating in the regulatory agencies...

"The Service...represents a principal instrument of the State for insuring that needed projects are foreseen, funded and built. The existence of the Service is evidence of the State's commitment to raise the necessary funds when needed and to have repaid to it the cost of environmental projects." (Ref. 32)

3 Water Pollution Control

Authority for water pollution control in Maryland is shared by the Department of Water Resources and the Environmental Health Services of the Department of Health and Mental Hygiene. In 1970, the Maryland Water Resources Law was amended "to strengthen and streamline the authority of the Department to control pollution of State waters." (Ref.11) The new law places responsibility and authority on the Department of Water Resources to serve written complaints upon violators of the State pollution abatement laws and regulations, and on the Attorney General to enforce the law by means of injunction ("without the necessity of showing a lack of adequate remedy at law") and criminal prosecution as appropriate and at the request of the Department of Water Resources. (Ref. 33)

"The collection, treatment and discharge of sewage from domestic sources are under the jurisdiction of the Environmental Health Services of the State Department of Health and Mental Hygiene.... State law (Ref.33) gives the Department detailed authority to discuss with municipal and utility organizations those actions needed to control pollution and maintain the Water Quality Standards of the State, to approve plans for such sewerage facilities and, when necessary, to require by official legal action the installation of such improvements as are needed to protect the State waters." (Ref. 11)

4 Comprehensive Water Pollution Control Program

The "Comprehensive Water Pollution Control Program" is designed to intensify water pollution control programs Statewide including: treatment facilities; control of waste from marinas and shops; training of personnel to operate facilities; and the development of design standards for collection and transmission facilities.

5 Water Supply and Waste Disposal Plans

Each county in Maryland is required to produce a water supply and waste disposal plan to guide local efforts in these efforts over a 15-20 year projection period. It is not always clear, however, that the plans for the various counties are consistent with one another or with region-wide objectives in water resource management.

6 Shore Erosion Control Program

Maryland passed legislation in 1964 that makes the State a partner in private ventures to control erosion. The State established a shore erosion control division within the Department of Chesapeake Bay Affairs. The new agency was empowered to make long-term loans for up to 25% of the total cost of protective structures to individual shorefront owners who formed themselves into erosion control districts. The State raised the limit for its share to 50% in 1968. In fiscal year in 1969 the State's appropriations for this purpose totaled an estimated $352,000. At the assumed average of $100 per linear foot, and using the 50% sharing formula, this would be adequate to protect only about 1.4 miles of shore. However, the Maryland Geological Survey is helping greatly in the State's efforts to control shore erosion by studying erosional and depositional processes in the Bay, and by conducting research aimed at finding the most effective and efficient methods of erosion control.

The Maryland Scenic Rivers Act of 1968 makes it State policy to protect

the water quality and to fulfill vital conservation purposes of rivers and related adjacent land areas possessing outstanding scenic, fish, wildlife, and other recreation values. The Act sets up a Scenic Rivers Review Board to do the necessary inventorying, planning, and priority setting, and it empowers the General Assembly to establish a program to implement the scenic rivers plan. (Ref. 35)

Footnotes

1. The classification of reactive, preactive and adaptive responses was suggested by Dr. Russell L. Ackoff, Director of the Management Sciences Center, University of Pennsylvania.

2. "This checklist is not purported to be complete or final in its identification and organization of wetlands value elements. The list will grow and be reshaped by inputs from persons in the Department who will use it and from persons outside State government who will want their values identified and expressed.

"The purpose of such a list is to attempt to identify wetlands values as explicitly as possible. It is by no means intended to restrict comment on a particular wetlands issue.

"The information display framework into which the answers from this checklist will be plugged, is not the only format for displaying information relevant to a wetlands decision. The supplier of information should view the checklist-matrix as a guide, not a constraint."(Ref.3)

This generalized checklist is supplemented by special checklists for particular types of wetlands decisions -- e.g. "the advisability of conveying State submerged lands to riparian owners" (Checklist #1) and "considerations involved in private wetlands decisions" (Checklist #3).(Ref.3)

References 4-7 mention existing or developing information sources responding to various portions of the checklist.

3. The example is based on analyses made by EBS Management Consultants, Inc. in 1968.(Ref.10)

4. To make clearer our proposed use of ERIC as a prototype for a Chesapeake Bay Information Network, the term "Bay resource management" has been substituted for references to educational agencies in Mr. Burchinal's presentation.(Ref.23)

5. This information has been superceded by new maps produced by the Chesapeake Bay Biological Institute.

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Appendix B:

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Bibliography and Graphic Reference

Much information relating to Chesapeake Bay management is produced by Federal, State and local agencies.

This information is produced for a wide variety of purposes, and it is presented in many different formats and at several levels of detail.

One purpose of an information system with regard to Chesapeake Bay management would be to continually monitor the information produced by various agencies; and to synthesize it through incorporation into the graphic encyclopedia so that it is accessible to a wider group of decision makers.

This section is a bibliography of publications and maps relating to Chesapeake Bay management. Included are indications (See "Graphic Encyclopedia Reference" - G.E.R.) of where the information appears in the graphic encyclopedia. The bibliography is organized as follows:

1. State and Federal Publications
2. County Publications
3. Publications on Natural Processes
4. Publications on Socio-Economic Factors
5. Publications on Recreation
6. Other Publications on the Chesapeake Bay
7. Related Publications
8. CBIPC Work Plan Outline Materials
9. Basic Map Sources

Page	Reference
393	State and Federal Publications
394	County Publications
395	Publications on Natural Processes
398	Publications on Socio-Economic Factors
399	Publications on Recreation
400	Other Publications on Chesapeake Bay
401	Related Publications
402	CBIPC Work Plan Outline
403	Basic Map Sources

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Surface Salinity (%) - Spring Average, p. II-61.

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      (3) Major Points of Sewage Discharge Outside of Delineated Area, Table S3; Towns with Sewerage Systems, but No Treatment Facilities, Table S4; Towns under Specific Order, Table S5; Towns with No Sewerage Systems and No Treatment Facilities, But Are in Need of Such, Table S6. (BII1)
      (4) Waste Water Discharge, by County, Drainage Area. Maryland State Department of Health. (BI10, SI3)
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   e. Recreation (DCBA, GIF, F & P).
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9 Basic Map Sources

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