A Chesapeake Bay Review: Research and Responsibilities

Volume I

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A Chesapeake Bay Review: Research and Responsibilities Volume I

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ABSTRACT

This report was prepared for the staff of the Chesapeake Bay Program, Region III, Environmental Protection Agency. It describes the major research activities, jurisdictional responsibilities, studies, monitoring programs, and cooperative relationships which relate to the water quality of the Chesapeake Bay.

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1.0 INTRODUCTION

1.1 Purpose of Report

This report was prepared under contract with the Environmental Protection Agency and is designed to serve as a source of information useful to the Agency's Chesapeake Bay Program. The primary goal of the Program will be to develop a management system which is designed to maintain and improve the overall water quality of the Chesapeake Bay. The Program will emphasize the coordination of existing Bay programs being conducted by current planning and regulatory agencies and will focus on the impacts of nutrients, toxic substances, non-point source pollution, physical alterations, the causes of problems associated with the impacts, and the existing institutions, policies, and regulations which relate to these areas. The purpose of this report is to identify and to summarize the ongoing activities of the major institutions and agencies in the Bay area, especially with respect to the problem areas of primary interest to the Chesapeake Bay Program. This report will be utilized by the staff of the Chesapeake Bay Program to pull together information relevant to on-going activities which will be useful to the development of a coordinated management program for the Bay.

1.2 Content of Report

This volume contains a description of the major research activities, jurisdictional responsibilities, studies, monitoring activities, and cooperative relationships which pertain to the

water quality of the Chesapeake Bay. Within this report, at least eleven federal departments and forty-five state and regional agencies are described. Monitoring activities are described for fifty-one monitoring programs representing over thirteen thousand sampling stations where some of over fifty parameters are measured.

A description of the activities of federal agencies and state/regional agencies is presented in Section 2.0 and 3.0, respectively in this volume of the report. The activities of academic institutions and other agencies are described in Section 4.0 and 5.0. Section 6.0 summarizes recent studies or reports on the Bay. Section 7.0, together with Appendix I, presents an overview of the major monitoring programs being carried out on the Bay and its tributaries. Section 8.0 and Appendix II depict more-or-less formal arrangements whereby agencies interact to promote coordination with respect to activities relating to the Bay. Section 9.0 identifies research and management programs on similar bodies of water which may be useful as models for the development of a management program for the Bay. Appendix III is a listing of comments and recommendations received from administrators and researchers interviewed during the course of this study and which may be useful to the development of a responsive management program. Table 1.1 of this Section is a categorical index by page number to the four problem areas of interest to the Chesapeake Bay Program and broken down according to various sections of this report relating to current activities or studies performed on the Bay.

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1.3 Sources and Limitations of Information

The information contained within was obtained largely from representatives of various agencies or institutions in the Chesapeake Bay area during personal or telephone interviews conducted in the course of this study. This report is not intended to provide definitive information with regard to every agency or institutional activity with respect to the Bay. Rather, it is intended to provide an overall perspective and a summary of the activities of agencies and institutions with a jurisdictorial responsibility or active interest in the quality of the Bay.

2.0 FEDERAL AGENCIES

2.1 Introduction

Many federal agencies are active in research, planning, surveillance, and enforcement activities in the Chesapeake Bay Basin. Although not usually known for their efforts to protect the water quality of the Bay, federal governmental units such as the Department of Agriculture (acting through the Soil Conservation Service and cooperative arrangements with state conservationist officials) promote the soil conservation practices of contour farming, use of sod waterways, terracing, and various land use policies which in effect hinder or prevent the movement of fine particulates from eroded soils into the Bay or its tributary estuaries.

Through the activities of fisheries research, tidal and meteorological monitoring, coastal zone management, data inventories, mapping, and the issuance of contracts under the Sea Grant Program, the National Oceanic and Atmospheric Administration (NOAA) represents the federal agency having the most diverse programmatic efforts with respect to the Bay. The responsibility for the enforcement of marine law on the Bay lies with the United States Coast Guard. The Environmental Protection Agency conducts surveillance and enforcement activities in the Bay Basin in support of regulations issued under the Federal Water Pollution Control Act Amendments of 1972 (PL 92-500). To date the Corps of Engineers has been the lead Federal agency with respect to the support of a unified and comprehensive approach to the

understanding of the economic, demographic, land and resource development trends within the Basin, and of the vitality of the Bay and its tributary estuaries. This section describes the salient activities of these and other federal agencies as they relate to the Chesapeake Bay.

2.2 Department of Commerce

Although having an indirect influence upon the Chesapeake Bay through the Economic Development Administration and the Maritime Administration, the Department of Commerce supports major planning efforts and research activities through the Department's National Oceanic and Atmospheric Administration (NOAA). The following is a description of NOAA's activities with respect to the Chesapeake Bay.

The National Marine Fisheries Service conducts research on the life history, population dynamics, and various factors influencing the growth, survival, and distribution of marine mammals, fish, and shellfish and promotes the development and marketing of fisheries products. The Service maintains an extensive library on marine sport fish and fisheries at its Middle Atlantic Coastal Fisheries Center, Sandy Hook Laboratory, Highlands, New Jersey. The major subjects covered in over 4,000 volumes and 14,000 reprints include marine biology, oceanography, conservation, marine pollution, and the fisheries of coastal estuaries, and near shore areas.

In cooperation with the Fisheries Administration of the Maryland Department of National Resources, the National Marine Fisheries Ser-

vice jointly funded a comprehensive survey of anadromous fish (fish which migrate upstream from saline waters to breed) spawning areas in the Potomac River and upper Chesapeake Bay drainage basins. The survey was conducted over the period July 1970 - January 1975 as part of Maryland's Anadromous Fish Stream Survey Program. The findings of this study are presented in Section 6 of this volume.

The Service maintains a research laboratory in Oxford, Maryland. Recent studies have centered on the development of neoplasms in the Baltic clam (Macoma balthica), an abundant filter feeding organism in the Chesapeake Bay. Several locations within the Bay have been sampled for the occurrence of neoplasms in the clams. Studies also have centered on the parasites and diseases of Rangia cuneata, a brackish water clam common in areas within the Bay characterized by low salinity. Other studies at the laboratory involved hystological analyses on striped bass and oyster ova, and the development of a mariculture system.

As part of a Menhaden Catch Sampling Program conducted by the Atlantic Estuarine Fisheries center of the National Marine Fisheries Service, menhaden are sampled during a five-day period throughout the annual fishing season at two processing plants located in Reedville, Virginia. The program involves the estimate of population size and the length, weight, and age relationships for the species.

The National Marine Fisheries Service, in cooperation with the Environmental Protection Agency, has supported a National Estuarine

Monitoring Program initiated at VIMS during 1965. During the period 1965-1972, oysters and other shellfish were collected from various areas of the upper Chesapeake Bay and from the James, York, Rappahannock, and Elizabeth Rivers and analyzed for pesticides. Residues of DDT were observed to be as high as 0.070 ppm in Maryland and 0.68 ppm in Virginia. However, in both states most oyster samples contained DDT levels in the 0.011 to 0.100 range (Munson and Huggett, 1972). Subsequent to 1972 until June of this year, the Program has been conducted under the aegis of the Environmental Protection Agency wherein yearling fish have been sampled at six month intervals in as many as 11 tributaries to the Chesapeake Bay (see Appendix - "Major Monitoring Programs").

The National Ocean Survey conducts an extensive program of monitoring with respect to tidal currents, heights, and time of occurrence. The Survey played a major role in the gathering of basic data for use in the development and construction of the Corps of Engineers, Chesapeake Bay Hydraulic Model.

For various studies, the Survey moors buoys at strategic locations where data collected on salinity, temperature, and currents are telemetered to a shore-based station. The National Ocean Survey contributed most of the data recorded for Maryland's baseline survey of the Chester River (funded jointly by Westinghouse Electric Corporation and the State of Maryland). The National Ocean Survey retains extensive archival data on the Chesapeake Bay at its office in Rockville, Maryland.

The National Weather Service maintains two meteorological monitoring and observer stations in the Bay area and three automated stations. The collected data are utilized in forecasts of weather conditions over the Bay. Extensive data files relevant to meteorological conditions in the Bay area are stored and available through the Environmental Data Service of NOAA.

Predictions of freshwater flow into the Bay are available from the National Weather Service River Forecast Center at Harrisburg, Pennsylvania. The Center is responsible for predicting flows of coastal rivers from the James River to the Hudson River. At present, short-range predictions of only a few days are available, however, longer range predictions expressed in terms of probability can be made available upon request.

The Office of Coastal Zone Management of NOAA promotes effective protection and use of the land and water resources of the coastal zone through administration of the Coastal Zone Management Act of 1972. The Office enters into the planning process,

> "when a state or territory decides to develop a coastal zone management plan and applies for a federal grant under Section 305--a strictly voluntary action based on a decision by the Governor. The state must be able to provide funds or services to match by one-half the total of the federal grant it requests (so that the effort is funded on a two-thirds federal, one-third state basis).
>
> The Governor must designate a state agency responsible for administering the grant and completing the work plan. The grant application describes the responsibilities of that agency and all other state agencies involved; the status of coastal zone management activities; data sources and needs; state goals, problems

and priorities; means for involving the public and various levels of government in plan development; means of coordinating plan development with agencies administering excluded federal coastal lands; and the strategy to be pursued in developing the management plan and program."*

With regard to the implementation of the management program, a state may apply for and receive as many as

"three annual Section 305 planning, or program development, grants. During this time, the state program would be developing consistent with federal guidelines which are designed to prepare the state to request and receive federal approval of its management plan--and federal grants to implement it.

Central to this goal are six items the state must address in its planning program:

(1) identification of the boundaries of the coastal zone;

(2) an inventory and designation of areas of particular concern;

(3) broad guidelines on priority of uses in particular areas including specifically those uses of lowest priority;

(4) a determination of permissible land and water uses which have a direct and significant impact on coastal waters;

(5) the means by which the state proposes to control those uses; and

(6) the organizational structure which would implement the management program.

* Source: Office of Coastal Zone Management. 1975. "Considering Coastal Zone Management. The Law. The Participants. The Program." National Oceanic and Atmospheric Administration, U. S. Department of Commerce, Washington D.C.

The Act specifies three optional types of controls: (1) direct state regulation; (2) local regulation consistent with state established standards; or, (3) local regulation subject to state review.

When the state program is developed, federal approval may be sought from the Secretary of Commerce. He judges whether the management process the state has developed meets the general goals of the Act. The pursuit of federal approval is again a voluntary action by the state. To secure federal approval, the Governor must have approved the program and the state must have developed the powers, arrangements and authorities necessary to implement it. This is encouraged through Section 306 program implementation grants. Substantially more funds are authorized by the Act for the annual implementation grants it allows. The state must again match the total federal grant it requests by one-half.

Authorized by Section 312 of the Act, an estuarine sanctuary grant is made on a 50% - 50% matching basis. It enables a state to acquire estuarine water bodies and adjacent waters, wetlands and uplands and to operate and maintain that area for education and research in support of its coastal management efforts.

Sanctuaries will be selected throughout the nation. Areas selected are to be representative of the nation's various ecosystem types, rather than being unique ecological areas.

Criteria used in selection are based on ecological characteristics, size and selection of boundaries, cost, enhancement of non-competitive uses, proximity and access to existing research facilities, availability of suitable alternative sites already protected, and conflict with existing or potential competing uses in the area or nearby.

Some marine areas merit preservation or restoration for their conservation, recreational, ecological or esthetic values. Congress recognized this in Title III of the Marine Protection, Research & Sanctuaries Act of 1972 (Public Law 92-532; enacted October 23, 1972).

That Act provides that any individual, organization, state or federal agency may nominate an area to be designated a marine sanctuary. This area would be

acquired and operated with full federal funding (where funding is necessary), and could be managed in a variety of ways through agreements with various federal or state agencies.

Marine sanctuaries may be established in ocean waters as far seaward as the outer edge of the continental shelf in coastal waters where the tide ebbs and flows; and in the Great Lakes and their connecting waters.

The marine sanctuaries program, administered by the Office of Coastal Zone Management, is coordinated closely with the coastal management program. For both sanctuaries programs, a public hearing process is called for after nomination and prior to designation."*

The lead state agencies for coastal zone management contracts in the Chesapeake Bay area are the Energy and Coastal Zone Administration of the Maryland Department of Natural Resources, and the office of the Virginia Coastal Zone Management Program, Office of the Secretary of Commerce and Resources. Discussion relevant to the status of involvement of these States within the coastal zone management program is given with the presentation of the responsibilities of the appropriate state agency.

The National Oceanographic Data Center of NOAA's Environmental Data Service maintains the Environmental Data Base Directory (EDBD). The EDBD is a computerized inventory of environmental data bases located at federal, state, and local government agencies, educational and research institutions, and private industry in the U.S. and Canada.

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* Source: Office of Coastal Zone Management. 1975. "Considering Coastal Zone Management. The Law. The Participants. The Program." National Oceanic and Atmospheric Administration U.S. Department of Commerce, Washington D.C.

At present, 3500 environmental data files are described. These pertain largely to Great Lakes and coastal areas of the U.S. A goal is to complete a comprehensive nationwide inventory by 1980.

Each environmental data base description (a characterization of a data file or unbroken series of collected data) lists the geographic area of data collection, types of data parameters and methods used to measure them, when and where the data were collected, the sensors and platforms used, data formats, restrictions on data availability, publications in which the data may be found, whom to contact for further information, and the estimated cost of obtaining the data. This inventory is searchable interactively on any of the items listed above. Search results can be tailored to the user's needs.

In order to catalog and to determine the extent of such data files for the Chesapeake Bay, the Environmental Data Service has contracted with the Virginia Institute of Marine Science for the periodic updating and expansion of an environmental data index to data files on the Bay. This index or directory may be obtained by querying the entire data file of the Environmental Data Service with respect to the existence of data files for the Bay. The output is a listing and description of each data file. A search of the data base conducted for this report revealed the existence of 1,182 data files pertinent to the Chesapeake Bay area (Environmental Data Service, 1976). The listing is not complete (lacking EPA data files, Tri-County Council for Southern Maryland, etc.), but represents a

comprehensive directory of the various kinds and sizes of data files on the Bay. A breakdown of the number of data files for each type of data storage is presented in Table 2-1.

Each data file represents a certain amount of sampling or monitoring effort. The collected data often are not readily compatible with rapid information retrieval unless stored on punched standard 80 column Hollerith cards or on digital magnetic tape.

Most of these automated data files are located at the Virginia Institute of Marine Science. Of these, the following four are examples of the type of surveys for which the data exist on magnetic digital tape:

1. Monitoring data of temperature and salinity from 1972 to the present. Values measured every 30 minutes (March to November) at two Rappahannock River stations.
2. Current speed and direction measurements every twenty minutes for five-day periods at about 100 stations in the lower Chesapeake Bay and its tributary estuaries (March - September 1973).
3. Current speed and direction measurements every twenty minutes in the Rappahannock River and Mobjack Bay (May - August 1970).
4. Current speed and direction measurements every twenty minutes at 25 stations in the lower Bay (June - August 1972).

TABLE 2.1

DATA FILES RELATING TO THE CHESAPEAKE BAY AND ENVIRONS

Number of Data Files	Type of Storage
4	Charts (Map or atlas)
296	Data Sheets (Local or standard data forms manually recorded and stored in files)
1	FOSDIC Film (Film sensing device for input into a computer)
17	Magnetic Disc
2	Magnetic Tape Analog (Any kind of analog magnetic tape)
62	Magnetic Tape Digital (Standard 1/2 inch computer compatible tapes)
7	Microfiche (Sheet of microfilm containing multiple micro-images in a grid pattern)
7	Microfilm (16 min or 35 mm, cartridge or reel)
22	Original film (Analog data stored on film)
161	Photoprints (Any photoprint system for storage of analog data)
76	Punched Cards (Standard 80 column Hollerith cards)
502	Reports (Data stored in printed form such as books, data reports, pamphlets)
8	Samples (Any samples of the environment available for study, this includes reference collections)
13	Strip Charts (All recorder produced analog records)
4	X-Y Plots (Graphic plots shown on Cartesian coordinates)
1,182	

SOURCE: Environmental Data Service, 1976.

The Institute retains 47 data files on punched cards. Forty-six of these are results of biological sampling efforts. Of these 8 represent the results of continuous collecting efforts (striped bass, 1967, 1968, and 1972 to present; benthic fauna, 1972 - present; rock crabs, 1970 - present; anadromous fishes 1966, 1967, and 1967 to present). The non-biological monitoring study dealt with extensive nutrient sampling of Virginia estuaries during July 1967 - June 1970.

Automated data files exist at 30 other agencies and institutions. Many of these files represent collected data from biological surveys. A few represent continuous physical or chemical monitoring data through the present. A copy of the listing of the 1,182 Chesapeake Bay data files is available for study at the EPA - Region III headquarters in Philadelphia, Chesapeake Bay Program Office.

The Environmental Data Service also maintains an information retrieval system termed OASIS (Oceanic and Scientific Information System) which provides a reference to published technical literature in the areas of chemistry and biology. The system services include retrospective searches as well as providing the selective dissemination of information or current awareness citations on a periodic basis.

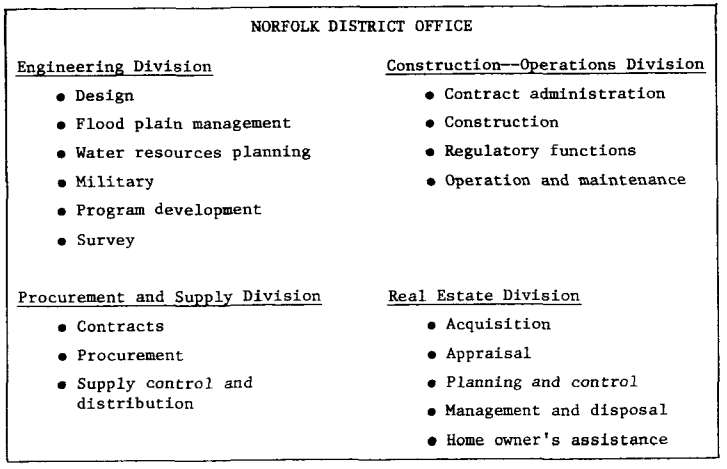
NOAA also provides other services useful to activities in the Chesapeake Bay Basin including the preparation of nautical charts, nautical publications (tide tables, bench marks, current charts),

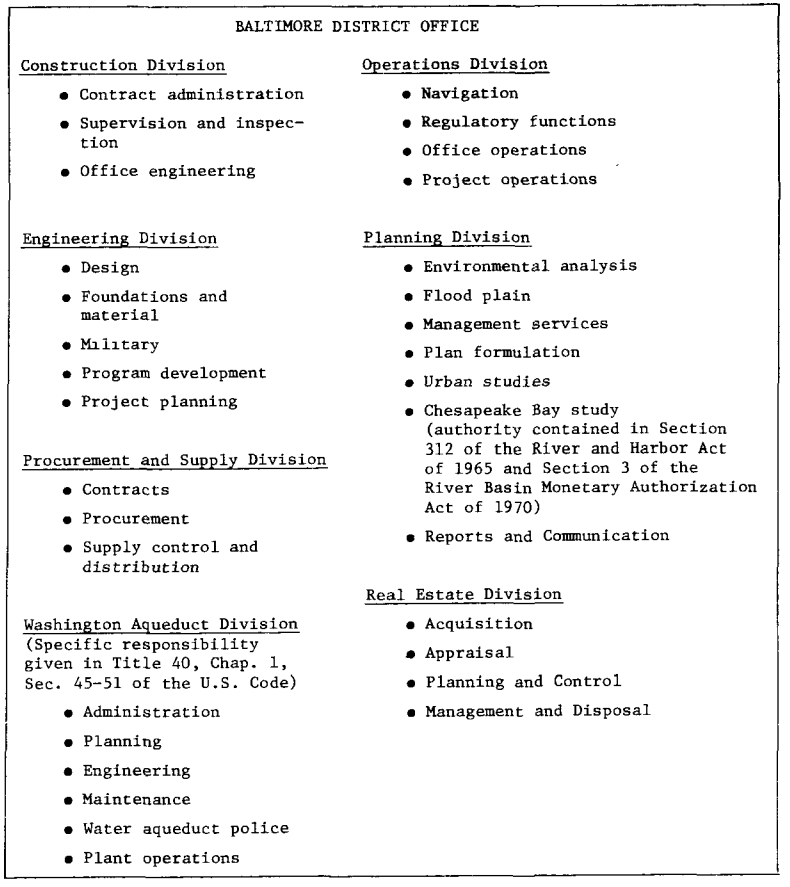
bathmetric maps, coastal mapping, geodetic surveys, hydrographic surveys, and aeronautical charts. NOAA also administrates the National Sea Grant Program established by NOAA to provide grants to colleges, universities, and other research institutions for programs and projects to develop and conserve marine resources. The academic institutions within the Chesapeake Bay area which have received grants under the Program include the Virginia Polytechnic Institute and State University, the Virginia Institute of Marine Science, the University of Delaware, and the University of Maryland.

2.3 Department of Defense

To date the United States Army Corps of Engineers, of the Department of Defense, has been the lead federal agency with respect to the development of a unified and comprehensive approach to the understanding of the economic, demographic, land and resource development trends within the Basin, and of the vitality of the Bay and its tributary estuaries. As for research in other areas, the Corps of Engineers conducts research studies on impact assessment, management and conservation of ecosystems, engineering construction to control the environment, and industrial siting. Methods are developed for the control of aquatic weeds, waste disposal, and management of pollution associated with dredging, bulkheading, and other physical alterations (see structure of Bay Offices - Figure 2.1).

The Army Corps of Engineers permit responsibilities are primarily contained within the following enactments: The River and Harbor Acts





Primary statutory concern relevant to overall Bay activities:

River and Harbor Act of 1899.

National Environmental Policy Act of 1969.

River and Harbor Flood Control Act of 1970.

Federal Water Pollution Control Act Amendments of 1972.

Marine Protection and Sanctuaries Act of 1972.

Coastal Zone Management Act of 1972.

FIGURE 2.1
ORGANIZATION OF CORPS OF ENGINEERS DISTRICT OFFICES LOCATED IN THE CHESAPEAKE BAY BASIN

of 1899, 1902, and 1965; The Federal Power Act of 1920; The Fish and Wildlife Coordination Act of 1956; The Water Resources Planning Act of 1965; The National Historic Preservation Act of 1966; The Estuary Protection Act of 1968; The National Environmental Policy Act of 1969; The Federal Water Pollution Control Act Amendments of 1972; The Marine Protection and Sanctuaries Act of 1972; and The Coastal Zone Management Act of 1972.

A major responsibility of the Corps relates to the granting or denial of permit applications for physical alterations in navigable waters. In this regard, any individual, firm or agency who plans to build a structure in, on, under or over a navigable waterway in the United States must obtain a permit from the Corps. If a body of water is considered navigable, its entire surface falls under federal permit authority, including adjacent wetlands, even though wetlands cannot support watercraft uses. With this respect, permits must be obtained for any work in bays, estuaries, or wetlands which are subject to tidal action.

With respect to the Chesapeake Bay, the Corps authority to conduct its Chesapeake Bay Study and to construct a hydraulic model of the Bay is contained in Section 312 of the River and Harbor Act of 1965:

> 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 the 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, subject to such terms and conditions as the Secretary deems necessary, by any department, agency, or instrumentality 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."

As a result of Tropical Storm Agnes, which caused extensive damage within the Chesapeake Bay, the Supplemental Appropriation Act of 1973, Public Law 92-607, provided for an additional study relating to the impact of the storm on the Bay. Most of this study was subcontracted to the Chesapeake Bay Consortium. The results are summarized in Section 6 of this volume.

At the present time, Phase I of the study has been completed and culminated in a seven volume study of existing conditions. The report does not include the entire drainage area for the Bay. Coverage is very close to that of the study area for Maryland and Virginia's Coastal Zone Management Programs, i.e. to counties adjacent to the Bay and its tributaries.

Phase II should be completed by the end of 1976. It will consist of 15 volumes on the future conditions of the Bay. The report will project future resource needs and problem areas within the Chesapeake

Bay Basin and will include recommendations for future studies and model testing required to establish a management program for the Bay.

The present direction of the Corps' Chesapeake Bay Program is to concentrate on the beneficial uses of the Hydraulic Model.

After the Model is calibrated (scheduled for completion in the spring of 1977), a few projects (perhaps three) may be funded the first year. At present, the initial tests to be conducted include (Corps of Engineers, 1976):

1. Low Freshwater Inflow Test to determine the impact on the Bay of either natural or man-made reductions in the amount of freshwater entering the Bay.

2. Baltimore Harbor Test to determine the effects of deepening the Baltimore Harbor and channel to 50 feet.

3. Potomac Estuary Test to study water supply and waste water disposal in the Potomac Estuary.

Although the Model would be useful in identifying impacts due to construction activities and point source discharges in the Bay, the Model lacks the "quick response" needed for this kind of use, i.e., the projects for which the Model will be used need to be designated a year or more ahead of time, and the Corps would hesitate "bumping" a designated project for a quick study such as an environmental assessment of a local or temporary problem.

2.4 Energy Research and Development Administration

Established by the Energy Reorganization Act of 1974, the Energy Research and Development Administration (ERDA) was formed by the assembly of energy related programs of the Atomic Energy Commission

(no longer in existence), the Department of the Interior, the National Science Foundation, and the Environmental Protection Agency.

Within the Chesapeake Bay area, ERDA has funded studies initiated by the former Atomic Energy Commission. Many involve cooperative support provided by other agencies such as the National Science Foundation and the Office of Naval Research. Many of these studies relate to the uptake and release of phosphorus in the Bay, the relationship between the concentration of plant pigments and the amount of light reaching intertidal sediments, the cycling of nitrogen and phosphorus in open waters of the Bay, and the distribution of the dominant predaceous cladoceran (a planktonic organism) Podon polyphemoides in the Bay. Most are conducted by scientists at the Chesapeake Bay Instititute of the Johns Hopkins University. Other studdies, such as an analysis of the pre-operational and post-operational environmental conditions in the area of the Calvert Cliffs nuclear power plant, are carried out by the researchers of the University of Maryland.

2.5 Environmental Protection Agency

The Chesapeake Bay Basin is within the jurisdictional boundaries of Region III of the Environmental Protection Agency (EPA). The regional office, located in Philadelphia, Pennsylvania, maintains a local field office in Annapolis, Maryland.

The Annapolis Field Office (AFO) is charged primarily with the collection and analysis of water and bottom samples, to determine

existing water quality problems and their causes, and the publication of technical reports documenting investigations of the Chesapeake Bay, Delaware Bay, Atlantic Coastal bays, and the tributaries to these bays. The AFO provides technical support to Region III activities in enforcement, planning, surveillance and other programs. The areas of support encompass the disciplines of chemistry, ecology, biology, and engineering with special capability in nutrient-phytoplankton relationship studies and the application of mathematical modelling techniques to air and water quality (Environmental Protection Agency, 1972d).

The Annapolis Field Office has recently assembled a hydraulic and water quality model of the Upper Chesapeake Bay. This model has provided information on the probable effects of increased nutrient loadings from point and nonpoint sources to the Upper Chesapeake Bay. Other math models have been applied to the Patuxent River Basin, Potomac River Estuary, James River Estuary, and Rappahannock River Estuary.

The Annapolis Field Office was a major coordinator and contributor of water quality data to a comprehensive resource study for the Corps of Engineers Chesapeake Bay hydraulic model. This study involved collection and storage of water quality and data and municipal and industrial wastewater inventories from all sources (ICMSE, 1976).

A new model that represents the state-of-the-art in the area of eutrophication dynamics has recently been developed and is undergoing

sensitivity testing at the Annapolis Field Office. The model should have the predictive capability to assess light, temperature, and nutrients as rate limiting factors in the eutrophication process of the Chesapeake Bay.

The Annapolis Field Office provides continuing support to the planning efforts in the Potomac River Metropolitan Washington Area, which includes conducting water quality investigations in that segment of the estuary. The results of the investigation have been utilized in mathematical model verification studies, determination of allowable wastewater loadings, and the quality effects of water supply withdrawals from the upper estuary (Environmental Protection Agency 1971; 1972b; 1972c; 1975).

Since 1965, the Annapolis Field Office has collected biological and water quality data for the tidal and freshwater portions of many tributaries flowing into the Bay. These include the Potomac, James, Patuxent, Bush, Gunpowder, Middle, Severn, South, West Rappahannock, York, Northeast, Elk, Bohemia, Sassafras, Chester, Choptank, Nanticoke, Wicomico, and Pocomoke Rivers (see Appendix I-Major Monitoring Programs). A study on nutrient input to the Bay from the significant tributaries was conducted from 1969-1970 (Environmental Protection Agency, 1972a). A subsequent study delineated the major nutrient sources within the lower Susquehanna Basin (Environmental Protection Agency, 1974b).

Water quality samples from the problem areas in the Chesapeake Bay Basin are analyzed for coliform bacteria, dissolved oxygen,

biochemical oxygen demand, total and organic carbon, dissolved solids, pH, alkalinity, chlorides, turbidity, chlorophyll-a, plant carotenoids, phaeophytin, and nutrients, which include carbon, nitrogen, and phosphorous fractions. In special instances, water and bottom samples are analyzed for heavy metals, oils and greases, and other constituents.

The biological capability of the Annapolis Field Office currently includes the enumeration and identification of freshwater and estuarine rooted aquatic plants; a limited capability for identification of estuarine larval fish; several methods for collection and identification of estuarine and marine fishes; and estimations of estuarine benthic communities.

Data are continually being obtained in the open water of the Upper Bay and in the Middle Bay to provide background data for detecting nutrient and phytoplankton standing crop increases and species changes resulting from proposed treated waste discharges.

Through the administrative direction provided by Region III, EPA is initiating a Chesapeake Bay water quality program. The primary goal of the program will be to develop a management system designed to maintain and improve the overall water quality of the Bay. The program will emphasize the coordination of existing programs conducted by various planning and regulatory agencies of Maryland, Pennsylvania, Virginia, Delaware, West Virginia, Section 208 PL 92-500

authorities, the Corps of Engineers, and the National Oceanic and Atmospheric Administration. The program will interface with existing water quality management programs within EPA such as the NPDES permit program which is a vehicle to control the quantity of pollutants discharged from industrial and municipal point sources into the Bay. Section 404 (PL 92-500) authorizes EPA to control dredge and field operations. The program also will utilize and coordinate area-wide Section 208 planning and statewide 303 planning agencies to integrate their efforts in the development of a Bay-wide management plan.

2.6 Federal Council for Science and Technology

An Interagency Committee on Marine Science and Engineering (ICMSE) was formed in 1971 by the Federal Council for Science and Technology to coordinate marine programs. The membership of the Committee is composed of representatives of agencies (see Appendix II-Cooperative Relationships) which have interest in oceanographic research. The Chesapeake Bay Subcommittee was formed by the Corps of Engineers following an ICMSE request in 1971.

The Subcommittee membership is available to federal agencies with a strong commitment or research interest in the Bay. Representatives from the States of Maryland and Virginia sit as observers on the Subcommittee.

The mission of the Chesapeake Bay Subcommittee is to allow for the planning and coordination of federal and state programs relating to the Bay. The goal is to avoid unnecessary duplication of research

programs and to identify research, development, or demonstration needs as they relate to the vitality of the Bay.

The Subcommittee soon will release a report identifying various agencies and institutions concerned with the water and related resources in the Chesapeake Bay Basin.

2.7 Department of Health, Education and Welfare

The Food and Drug Administration of the Department of Health, Education and Welfare maintains an office in Baltimore which supports the National Shellfish Sanitation Program. The Program is a voluntary cooperative project conducted by the Food and Drug Administration with 23 coastal States and the shellfish industry. The program office which has jurisdiction in the states of Pennsylvania, Delaware, Maryland, Virginia and West Virginia is located in Philadelphia, Pennsylvania.

Staff of the Philadelphia office and of the local office in Baltimore advise the States with respect to their shellfish programs and prepare evaluations of such programs based on a 1965 manual of operations (Department of Health, Education, and Welfare, 1965) for the sanitation of shellfish growing areas and of the harvesting and processing of shellfish. In 1974, the Environmental Protection Agency's Office of Water Program Operations prepared a guidelines bulletin (Environmental Protection Agency, 1974c) for compliance with the manual of operation in order to provide for the protection of shellfish waters which receive effluents discharged from municipal wastewater treatment plants constructed with EPA funds.

At present the Food and Drug Administration does not have extensive enforcement powers under the National Shellfish Sanitation Program. Currently, regulatory activity is limited to the disallowance of the interstate shipment of contaminated shellfish.

2.8 Department of the Interior

Within the Department of the Interior, functions of the former Fish and Wildlife Service and the Bureau of Sport Fisheries and Wildlife have been assumed by the Fish and Wildlife Service which provides for the protection of wildlife refuges on islands and shoreline areas of the Bay.

These National Wildlife Refuges include the Susquehanna (Hartford Co., Md.) Eastern Neck (Kent Co., Md.) Blackwater (Dorchester Co., Md.), Martin (Somerset Co., Md.), Mason Neck (Fairfax Co., Va.), Presquile (Chesterfield Co., Va.), Fisherman's Island (Northampton Co., Va.). The refuges are managed for the production, migration, and wintering of migratory birds and for the protection of endangered species.

The Service also conducts an extensive research program on the accumulation of chlorinated hydrocarbons in migratory waterfowl at its Patuxent Wildlife Research Center. The Center collects the wings of ducks killed by hunters and natural causes as they migrate along the Atlantic Flyway. These wings, are analyzed for the presence of chlorinated hydrocarbons and the results are reported on a state by state basis by the Center's Gulf Coast Field Station in Victoria, Texas.

The objective of the project is to establish trends in the uptake of these compounds over time. Collections have been made every three years.

The Migratory Bird and Habitat Research Laboratory of the Center is conducting an extensive study related to an apparent change in the feeding habits of wintering populations of the canvasback, Aythya vallisneria, in the Bay. During the last 10 years, the species apparently has changed from a mixed diet of aquatic vegetation, primarily wild-celery, Vallisneria americana, and invertebrate organisms, to one composed almost entirely of invertebrates (preliminary findings indicate the Baltic clam, Macoma balthica, to be the predominant food organism). Future studies will relate to seasonal dietary variations and daily feeding patterns. Other Bay investigations conducted by the Center relate to the population trends and reproductive success of ospreys. These studies include the effects of pollutants on the reproductive rates.

The United States Fish and Wildlife Service also maintains an office in Annapolis. One of the main functions of this office is to review environmental impact statements. The Service is empowered under the Fish and Wildlife Coordination Act (PL 85-624) to review and comment on actions which are determined to be harmful to the fish and birds of the Bay.

The United States Geological Survey of the Department of the Interior is involved in coordinating the acquisition of water data

for streams, lakes, reservoirs, estuaries, and ground waters as part of its National Water Data Network. The network is an organized system for collecting specific information at a series of stations selected to satisfy a specific monitoring objective. Information on the data acquisition activities by federal, state and local agencies, and private organizations that acquire water data directly in the field and laboratory is reported to the Office of Water Data Coordination (OWDC) of the Geological Survey. The information reported to OWDC is published every two years in a catalog (U. S. Department of the Interior, 1974). This catalog is a file of information concerning the water-data acquisition activities (station names, locations, period of record, storage of data, parameters measured, frequency of measurement, and reporting agency), and is not a file of water data, which must be obtained from the reporting agencies. The catalog reports listings for stations which monitor streamflow and stage, and the quality of surface and ground water.

The Geological Survey maintains its own series of data-collection sites in its National Stream Quality Accounting Network (NASQAN). This network consists of sites at the mouth of 325 hydrographic "accounting units" and is designed to gather data on the quantity and quality of water moving from one accounting unit to the next (Pickering and Ficke, 1976). Within the Chesapeake Bay drainage area, the Geological Survey operates seven NASQAN stations (see Appendix I - Major Monitoring Programs).

Through the stations operated by the Geological Survey under NASQAN and the National Water Data Network, and participating agencies, the Geological Survey stores and disseminates about 70 percent of the water data used by state, local, private, and other federal agencies through its National Water Data Storage and Retrieval System (WATSTORE). The system is operated and maintained at a central computer facility at its National Center in Reston, Virginia. The Survey is currently establishing a National Water Data Exchange (NAWDEX) to improve access to water data. One of the first projects of NAWDEX will be the development of a Water Data Sources Directory which will identify organizations that collect water data, sources of water data, media in which the data are available, types of data, and geographic areas represented.

The Office of Water Research and Technology of the Department of Interior administers a program of water resources research and training authorized by the Water Resources Research Act of 1964, as amended. Major program goals are to: develop through problem-oriented research technology efficient methods for resolving local, state and nationwide water resource problems; train water scientists and engineers through their on-the-job participation in research work; and facilitate water research coordination.

Under Title I of the Act, the Office provides annual funding allotments to support one state university water resources research

and training institute in each state. Additional funds are also provided to these institutes for specific research project work on a dollar-for-dollar matching-fund basis. Other universities and colleges may participate in the Title I program work of the designated State institutes. Under Title II of the Act, grants and contracts are made with academic, private, public, or other organizations and individuals having water research competence.

The Virginia Water Resources Research Center at the Virginia Polytechnic Institute and State University conducts numerous studies related to the management of areas upland to the Bay. These studies have a direct application to the control of non-point source discharges entering the Bay (See Academic Institutions: Virginia Polytechnic Institute and State University). A similar Water Resources Research Center is situated at the University of Maryland.

Several of the academic institutions within the Chesapeake Bay area have interacted, on various subject matters, with the newly formed Office of Biological Services within the U. S. Fish and Wildlife Service. This Office has established new programs such as a National Wetlands Inventory, and Power Plant Siting, Stream Alteration, and Coastal Ecosystems projects within its Aquatic Ecosystems Program. It is envisioned that this office will become involved increasingly in future research and planning studies in the Bay area.

2.9 National Aeronautics and Space Administration

The National Aeronautics and Space Administration (NASA) established by the National Aeronautics and Space Act of 1958, maintains

and operates a Chesapeake Bay Ecological Program Office at the NASA Wallops Island Flight Center on Wallops Island, Virginia.

The primary mission of the Chesapeake Bay Program Office is the transfer of remote sensing technology to the user community. The Program Office has conducted remote sensing flights over the Chesapeake Bay since 1970. Copies of all photographs and imagery are on file at the NASA Wallops Island Data Center. The Office has the capability for ground verification of remote sensing data.

Photos derived from information collected by remote sensing devices aboard aircraft and unmanned and manned orbiting spacecraft have been used by regulatory officials, planners, and academic researchers in the detection of pollutant concentrations, analysis of sediment transport, surveying of circulation patterns, and wetlands vegetation mapping.

2.10 National Science Foundation

The National Science Foundation (NSF) established by the National Science Foundation Act of 1950 initiates and supports fundamental and applied research. Financial support is provided through grants, contracts, and cooperative agreements to colleges, universities, non-profit institutions, and other research organizations.

Most of the NSF sponsored Chesapeake Bay projects are funded by the Research Applied to National Needs (RANN) Program and are carried out by the Chesapeake Research Consortium, Incorporated (CRC). These

projects include studies relating to the wetlands, shorelines, and shallows of the Bay; a summarization of knowledge of the biota of the Bay (funding originated from the Corps of Engineers); the sources, sinks, dispersion, and biological transformations of pollutants entering the Bay; an inventory of sewage treatment plants along the tidal portions of the tributaries to the Bay; and criteria for sewage effluent loading. A recent RANN project is the entering of data from permits for physical alterations into a Research and Management Shoreline (RAMS) Data Bank (IBM 360-91 computer system) situated at the Johns Hopkins University Applied Physics Laboratory (JHU/APL). The study is associated with the Wetlands/Edges Program of the Chesapeake Research Consortium and was initiated in 1973.

2.11 Department of Transportation

Many activities within the Department of Transportation such as those within the Federal Highway Administration, the Federal Railroad Administration and the Urban Mass Transportation Administration have an indirect bearing on the quality of the Bay through the transportation of material resources, finished products, and induced development in and around the port areas of the Bay. The Federal Aviation Administration regulates air traffic operations around airports serving the Bay area including an airport on Tangier Island in the Bay and those related to a proposed airport on Smith Island. Having a more direct contact with Bay related operations is the United States Coast Guard.

The Coast Guard maintains rescue vessels, aircraft stations, and radio stations to carry out its function of saving life and property in and around the navigable waters of the United States. This function includes the removal of hazards to navigation. Under provisions of the Federal Boating Act of 1958, Coast Guard boarding teams inspect small boats to insure compliance with required safety measures.

Related to its mission of marine safety, the Coast Guard establishes uniform safety standards for recreational boats; educates small boat operators in safety requirements; and assures compliance with Federal laws and regulations through education, inspection, and law enforcement. The Coast Guard is assisted in boating activities by private citizens within the Coast Guard Auxillary.

Within the Bay, the Coast Guard establishes and maintains aids to navigation including light structures, lightships, buoys, day beacons, and long-range electronic aids. It also enforces regulations governing the anchorage, movement of ships, and the loading and unloading of dangerous cargos.

Although the Coast Guard is involved with marine aspects of law enforcement on the Bay, much of its activity relates to Federal Water Pollution Control Act Amendments of 1972 and of the River and Harbors Act of 1899 in regard to the prohibition of discharges of oil or hazardous substances (defined by EPA) in navigable waters. The Coast Guard also supervises the cleanup and removal of the spillage of such materials. With respect to other agencies the Coast Guard cooperates

in regard to the enforcement of laws related to marine environmental protection and conservation.

2.12 Smithsonian Institution

The Smithsonian Institution, created by Congress in 1846 (as a result of funds bequeathed by James Smithson), was established to increase and disseminate knowledge (9 Stat. 102). The Smithsonian Institution contributed in a significant manner to the preparation of the first comprehensive summary of the state of knowledge concerning the biota of the Chesapeake Bay for inclusion in the Corps of Engineers, Chesapeake Bay Resource Study. The findings were published in a supplement to Volume 13 of Chesapeake Science (Chesapeake Research Consortium, Incorporated, 1972).

The Smithsonian Institution, a member of the Chesapeake Research Consortium, supports the Chesapeake Bay Center for Environmental Studies at Edgewater, Maryland. The center is a Bureau of the Smithsonian Institution from which it receives about 50 percent of its funding. Other funds are obtained through grants and contracts from governmental entities such as the National Science Foundation and the Environmental Protection Agency.

Research at the Center focuses upon upland watershed and estuarine systems in the subject areas of nutrients, herbicides, bacteria (including pathogens), general water quality parameters, hydrology, land use, plankton, and benthic organisms in estuarine systems and upland watersheds. Current studies relate to a long-term investiga-

tion of the Rhode River system and a relatively short-term study of the Severn and South Rivers. The Center also has initiated bioassay analyses of higher aquatic plants in an effort to relate an apparent recent trend in the reduction of higher aquatic plants in the Bay to herbicide contamination.

A monumental research effort, conducted by the Institution with support from the Nature Conservancy, Kingsford Charitable Trust, led to an inventory, assessment, and prioritization for acquisition of natural areas of the Chesapeake Bay Region. The study involved the mapping of all areas in the Bay region protected from uncontrolled development and those preserved and managed as natural areas, and the identification and mapping of all locations of ecologically significant flora, fauna, biotic communities, and ecosystems. Selected ecological criteria were assigned numerical ratings and, by the use of overlay maps and a computerized data storage and retrieval system, those areas identified as ecologically significant were assigned a numerical rank. A report of the findings of the research effort was published by the Center for Natural Areas, Ecology Program, Smithsonian Institution in May 1974 (Center for Natural Areas, 1974; see Section 6 - Major Studies On The Bay). Most of the studies of the Chesapeake Bay Center for Environmental Studies are published through the Chesapeake Bay Consortium as they reflect cooperative research efforts within the Consortium.

With regard to water quality, the Center maintains and operates

nine monitoring stations on the Bay and its tributaries. The first of 18 planned stations was established in 1973. All data are stored on magnetic tape in digital format at the main office of the Smithsonian Institution, 1000 Jefferson Drive, S. W., Washington, D. C. The Chesapeake Center for Environmental Studies is linked to the data file through a terminal located at the Edgewater, Maryland facility.

3.0 STATE AND REGIONAL AGENCIES

3.1 Introduction

The following is a discussion of the responsibilities, missions, and roles of each major office of state government and selected local offices as they relate to the Chesapeake Bay and its watershed. The information was obtained primarily from personal interviews with spokesmen for various state and local agencies.

The responsibilities for each county office are not presented. However, most counties bordering the Bay, especially in Maryland, have initial land use and soil or water conservation authority. Access to the local governmental officials may be obtained through the appropriate county commissioner's office. A directory to such local offices is presented in Volume II of this report.

3.2 Delaware

For the most part, the State of Delaware does not play a major role in the protection or the enhancement of water resources within the Bay. The jurisdiction of the State over waters entering the Bay is confined to the headwaters of tributaries on Maryland's eastern shore and to the Chesapeake and Delaware Canal. The following agencies relate to water quality within the state.

The Water Resources Section of the Environmental Control Division, Department of Natural Resources and Environmental Control, focuses on three mission areas: water supply (allocation for consumption), planning (with respect to PL92-500), and water pollution

control (NPDES permit program, review of construction grant permits, and compliance monitoring program). A technical services group provides sampling and analytical services in support of the Division's responsibilities. In support of the Delaware Environmental Protection Act, the Water Resources Section collects samples on a regular basis from the Chesapeake and Delaware Canal. These monitoring points are located at Delaware Route 896 - Summit Bridge, U. S. Route 13 - St. Georges Bridge, and Delaware Route 9 - Ready Point Bridge.

Through the enforcement of Title 7 of the Delaware State Code, the Fish and Wildlife Division is responsible for the protection of all fish and wildlife resources within the state, including the protection of wetlands and other wildlife habitat areas. The Division primarily is active in the protection of fishery resources within the Delaware Bay.

Also active in the administration of Title 7 of the Delaware Code (Chapters 39-41), the Soil and Water Conservation Division works closely with soil conservation districts. The main concerns of the Division are land erosion, agricultural irrigation drainage, and beach erosion.

In the enforcement of Title 17 of the Delaware Health and Safety Code, the Bureau of Environmental Health is responsible for the quality of drinking water, waters utilized for swimming, institutional and camp health, and general sanitation within the State. The Bureau conducts monitoring of streams (ones used as sources of potable water) and shellfish waters.

3.3 District of Columbia

Although the District of Columbia comprises only a small portion of the entire Chesapeake Bay Basin, it is the hub of a Washington Metropolitan Area wherein urban population and employment growth rates of 143 percent have been estimated for the period 1970-2020 (Corps of Engineers, 1973). Various offices of the District's Department of Environmental Services have responsibilities relating to the water quality of adjacent areas of the Potomac River estuary. The following is a brief summary of the work of these offices.

The major emphasis of the Bureau of Air and Water Pollution Control, Department of Environmental Services, is public education and enforcement. The Bureau issues permits and initiates enforcement actions through Federal courts. The office of Environmental Planning operates the District's sewage treatment plant and is responsible for the compliance of the plant with Federal laws. The responsibility of the Office of Water Resources Management is to assure the District of an adequate supply of water. The source of water supply for the District is the Potomac River.

The main water planning efforts in the metropolitan Washington area (Northern Virginia, the District of Columbia, and suburban Maryland) are being conducted by the Water Resources Planning Board of the Metropolitan Washington Council of Governments (COG). In June, 1975 COG initated an areawide 208 (Section 208, PL 92-500)

planning effort. A draft of a 208 plan is to be produced in June, 1977, and adopted by the Water Resources Board by February 1978. In August 1975, the Water Resources Planning Board delegated the Northern Virginia Planning District Commission (NVPDC) with the responsibility for developing a 208 water management program for the Occoquan River Basin in Virginia. As part of the study, NVPDC will develop washoff correlations transferable to urban land uses in other watersheds. The Water Resources Planning Board intends to test the regional application of these correlation factors in the Watts Branch and Seneca Watersheds of Montgomery Country, Maryland.

It is envisioned that future efforts of the Council will concentrate on the following general areas:

- The adoption of a water shortage emergency plan alterantives
- The development of water resource projections and waste load allocations.
- The definition of wastewater treatment and conveyance system needs.
- The definition of institutional, financial and regulatory alternatives
- The establishment of a draft areawide water quality plan (Section 208, PL 92-500) by the end of June, 1977.

To assist the Council of Governments in its work, water resources advisory committees such as the Water Resources Technical Advisory Committee (TAC) and the Water Resources Citizens Advisory Committee (CAC) have been formed.

3.4 Maryland

Within the State of Maryland, the main responsibilities for the monitoring of water quality within the Chesapeake Bay Basin reside within the Department of Health and Mental Hygiene and the Department of Natural Resources. The relationship of state agencies which conduct activities related to the water quality or marine resources of the Bay is shown in Figure 3.1 . All departments and agencies of the state were created by Chapter 527, Acts of 1970 except the Department of Agriculture, which was established by Chapter 342 of the Acts of 1972.

The portion of the Chesapeake Bay which lies within the State of Maryland encompases those parts of the open Bay and its tributary estuaries which lie north of Smith Point, at the entrance to the Potomac River. The state owns the Potomac River, but not its southern tributaries (the Virginia-Maryland boundary crosses from headland to headland) nor the portion in the District of Columbia. The interstate boundary crosses the Bay from Smith Point through the middle of Pocomoke Sound on Maryland's eastern shore. Maryland's portion includes the deepest hole in the Bay (near the south end of Kent Island), the Bay's narrowest segment (location of the Chesapeake Bay Bridge), and part of the widest region, located at the interstate boundary line (Lippson, 1973).

For the last several years the overall authority and responsibility for planning, research, monitoring, and regulation of most

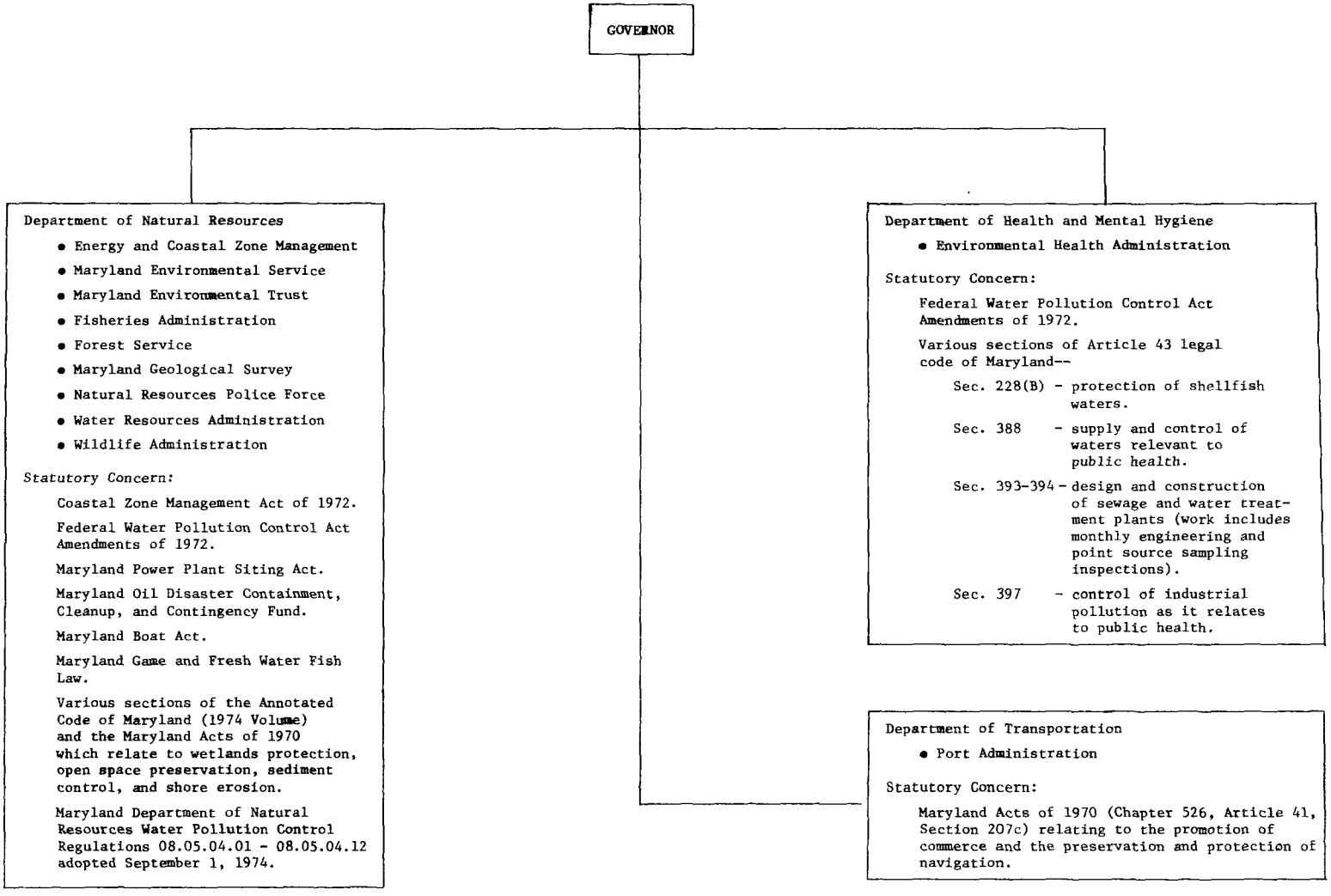


FIGURE 3.1
RELATIONSHIP OF MARYLAND AGENCIES CONCERNED WITH WATER RESOURCES IN THE CHESAPEAKE BAY BASIN

matters relating to the water quality and ecology of Maryland's portion of the Chesapeake Bay has resided in the Department of Natural Resources (DNR). Within DNR, Bay related planning and enforcement activities are carried out primarily by the Energy and Coastal Zone Administration, Fisheries Administration, Maryland Geological Survey, Natural Resources Police Force, and the Water Resources Administration. Other offices such as the Maryland Environmental Trust, Maryland Environmental Service, and the Wildlife Administration are involved indirectly with the water of the Bay.

The State of Maryland has approved a continuing planning process as authorized in Sections 303 (e) and 208 of PL 92-500 for 16 sub-basins tributary to the Chesapeake Bay. These subbasins include the Lower Susquehanna, Pocomoke, Nanticoke, Choptank, Chester, Elk, Bush, Gunpounder, Patapsco, West Chesapeake Bay, Patuxent, and the lower, middle, upper, North Branch, and Metropolitan Washington areas of the Potomac River. For each of these subbasins, water quality management plans and implementation plans are being prepared. Phase I basin plans which focus on point source control needs have been completed. Phase II planning, which incorporates the findings of 208 areawide studies into an expanded statewide planning program focusing on non-point pollution problems is underway and is scheduled for completion by a court ordered mandated deadline of November 1, 1978 (applicable to all states, see Federal Register, Vol. 40, No. 230-November 28, 1975: 55321-55326 and 55334-55349). The Water

Resources Administration (DNR), Environmental Health Administration (Department of Health and Mental Hygiene), and the Maryland Environmental Service (DNR) prepared a report which documents the state of water quality, trends of water quality, an inventory of nonpoint sources, and an assessment of nonpoint source impacts on water quality for each of the subbasins (Maryland Department of Natural Resources and the Department of Health and Mental Hygiene, 1975). The major finding of this report are summarized in Section 6.0 "Major Studies on the Bay."

The Energy and Coastal Zone Administration established in July 1975, is a new agency created through the reorganization of various programs. The administration is responsible for the implementation of Maryland's Coastal Zone Management and Power Plant Siting Programs.

In 1973, the Governor of Maryland designated DNR to receive and administer grants under the Coastal Zone Management Act of 1972. Under the Act, the state has three years to develop a management program for the coastal zone which is acceptable to local, state, and federal agencies. Currently Maryland is in its second year of program development. The program has several long-range goals which include the identification and development of mechanisms to protect coastal areas, the development of guidelines and standards regarding activities which impact the coastal environment and the setting of priorities for the utilization of coastal resources.

Until now emphasis has been on data collection. In the third year the Energy and Coastal Zone Administration will shift emphasis to data analysis, development of a management plan, and review of existing statutes and regulations to determine the need for additional legislation required for program implementation. Specific projects planned for the third year of the program include the definition of the coastal zone boundary which reflects the environmental factors of coastal plain soils, tidal inundation, and vegetation; the identification and priortization of natural areas of particular state concern; the mapping of submerged lands (to be conducted by the Maryland Geological Survey); and the identification of archeological sites in coastal areas.

A major program effort with regard to critical developmental areas is to work with local governments to protect and enhance coastal wetlands and waters. The effort centers on an agreement with the Regional Planning Council (RPC) to develop an approach to coastal zone management for the Baltimore Metropolitan Area (Maryland Department of Natural Resources - Regional Planning Council, 1976). The agreement was entered into during August, 1975 by DNR, RPC, Baltimore City, and the counties of Anne Arundel, Baltimore, and Hartford. The agreement focuses on the unique management problems of an urban coastal area and the development of a coastal zone program to meet the requirements of both the Coastal Zone Management Act of 1972 and the land use planning requirements of HUD's "701" grants program (Section 701 of the Housing Act of 1954, as amended).

The Power Plant Siting Program (PPSP) focuses on the environmental assessment of proposed power plants, the acquisition of potential power plant sites, the evaluation of impacts resulting from existing power plants, and special research studies. The program is financed by a surtax on electric energy operations in the State.

The environmental assessment of future power plants involves an evaluation of their potential effects on physical, chemical, biological, and socioeconomic resources. The results of these studies form the basis for recommendations submitted by the PPSP to the Public Service Commission on the requirements that must be incorporated into the design, construction, and operation of the proposed plant in order to provide environmental compatability. Regional aquatic studies are planned to occur through June 1977 on the Chesapeake and Delaware Canal (site of proposed Philadelphia Electric Company plant); at Bainbridge (former Naval Training Center in Cecil County-proposed Baltimore Gas and Electric power plant); and at Stillpond Neck in Kent County (a proposed site for acquisition).

In compliance with the Maryland Power Plant Siting Act (1971) the site acquisition program of PPSP must purchase and retain a minimum of four and a maximum of eight potential power plant sites in a land bank inventory for future purchase from the program by utility companies. The priority for initial acquisition is given to sites in north and south-central Maryland where they would serve

the two largest power companies in the state (Baltimore Gas and Electric Company and the Potomac Electric Power Company). To date, only the Elm's site, located in St. Mary's County (south-central Maryland) has been purchased. The state has approved the Bainbridge site (north-central Maryland) for acquisition. A third site, Stillpond Neck, in eastern Maryland has been investigated and will be considered for purchase after other eastern Maryland sites have been studied.

At sites of existing plants, biological and water quality monitoring is being conducted to develop a quantitative basis for the Water Resources Administration, DNR and EPA decisions on 316a (Section 316a, PL 92-500) applications for waiver of the required backfitting of cooling towers. Extensive studies are conducted at the new Calvert Cliffs nuclear power plant (see Appendix I - Major Monitoring Programs), and to a lesser extent the Morgantown, Chalk Point and Dickerson fossil fueled power plants. These studies as well as surveys of the biotic resources of the Bay require coordination among consultants, utility companies, and state and federal agencies through the Environmental Research Guidance Committee of the PPSP (see Appendix II - Cooperative Relationships).

The research program of PPSP is designed by and receives technical review from the Environmental Research Guidance Committee. High priority research areas currently under study include the effects of thermal stresses on fish eggs and larvae, the development of a captive

technique for in situ studies of heat stress on planktonic organisms, and fish behavior near power plant intakes and discharges (Energy and Coastal Zone Administration, 1976).

The Fisheries Administration (DNR) conducts studies of finfish and shellfish in the state. The programs include an assessment of the condition of oyster beds, the cultivation of natural oyster bars, and the planting of oyster seed. Currently, the Administration is conducting an inventory of all clam and oyster beds within the Bay and its tributary estuaries. Its monitoring activities also include the sampling for marine parasites and fungi and an annual survey to determine trends of fish populations in the Bay. The Administration also maintains an intensive annual anadromous fish/stream survey program designed to provide information on the relationship between water quality and the location and productivity of anadromous spawning areas (see Section 6.0 Major Studies on the Bay; Appendix I - Major Monitoring Programs).

The Maryland Geological Survey (DNR) conducts topographic, geological, hydrographic and geophysical surveys within the state. In relation to the Bay, the survey investigates and recommends plans for the protection of waterfront lands against erosion and deposition. The agency currently is initiating an inventory of geologic and mineral resources of the Bay and its tributaries. The program entails the collection of sediments and analyses for metals and various physical parameters from over 3000 stations in the Bay. The sampling effort is expected to be continuous over at least a five year period (see Appendix I - Major Monitoring Programs).

The Natural Resources Police Force is responsible for the enforcement of the State of Maryland's boating and conservation laws on the Bay and its tributary estuaries. The Police Force is empowered to make inspections of Bay fish and other seafood which is caught or sold. The Police Force frequently assists in the field operations of other sections of DNR.

The Water Resources Administration (WRA) of DNR is responsible for the control and abatement of water pollution in the State of Maryland. Its activities include the establishment and enforcement of water quality and effluent standards, water quality monitoring, and water resources planning. In addition, WRA administers and coordinates several permit and licensing programs. Many of these permits relate to water quality within the Chesapeake Bay. The following is a brief summary of the types of permits issued:

1. Waterway Construction Permit. Required before construction can begin in or alongside a non-tidal stream or any construction that changes the course, current or cross-section of that stream or its floodplain. For example: construction of a bridge or culvert over a stream; placing fill, embankments, or structures of any type within the floodplain of any stream.

2. Waterway Obstruction Permit. Required before construction can begin on dams, reservoirs, or on ponds in excess of the requirements for small ponds.

3. Small Pond Permit. Required after the Soil Conservation District in a county approves a plan for a small pond project. Generally, a permit is not required for a pond less than 12 acres but it must have Soil Conservation District approval and meet Water Resources Administration safety standards.

4. Water Appropriation and Use Permit. Required before construction can begin on any structure which may require the withdrawal

of surface or underground waters. Water for domestic use, single or double household unit, or water for farms and livestock is exempt.

5. Discharge Permit. Required for discharges to be in compliance with the National Pollutant Discharge Elimination System (NPDES) program.

6. Well Drilling Permit. Applied for by the Master Well Driller, licensed by the State Board of Well Drillers, and must be obtained before a well can be drilled or driven.

7. Toxic Materials Permit. Required for aquatic life management purposes before one can add toxic materials to surface water for the control of algae, aquatic weeds or fish.

8. Oil Operation and Handling Permits. Required before one can store, transfer, transport, or dispose of oil and petroleum products. A fee is required. The revenues from these fees are used for defraying costs of the immediate cleanup of oil spills in the Bay.

9. State Wetland License (issued by the State Board of Public Works upon a recommendation of the Department of Natural Resources). Required before any dredging, filling or construction can begin in State wetlands - that is, in marshes, swamps, or submerged bottoms below the mean high water mark. Such construction includes the dredging of a channel or boat basin, constructing of a stone or timber bulkhead, or any other filling in a waterway.

10. Private Wetland Permit. Required before any dredging, filling or construction can begin in marshes or swamps that are above the mean high water mark but which are subject to periodic tidal action. Such private construction includes the dredging of a canal or boat basin, constructing bulkhead, filling to create road, or to change the marsh into buildable land.

The Water Resources Administration conducts an extensive monitoring program on the Bay. An intensive ambient surface water quality monitoring program is based on a five year cycle wherein 500-1000 stations are sampled within a particular portion of the Bay each year. This program is coordinated with an intensive monitoring program for point

source discharges, also conducted by WRA. Other WRA monitoring programs include the determination of trends in ambient surface water quality and a WRA/EPA Potomac River Consolidated sampling program (see Appendix I - Major Monitoring Programs).

The Forest Service of DNR is responsible for the operation of State forests, control of forest fires, roadside tree protection, and technical advice in the general areas of forestry and reforestation. The Forest Service provides a planning and consultant service to private owners and leasing companies with timberland adjoining the Bay to reduce erosion and runoff from logging roads and heavy cutting. On the upper reaches of the Potomac in Maryland, the Forest Service provides both consultation as well as seeds and seedlings for reclamation of strip-mined areas.

The Maryland Environmental Service of DNR is responsible for project development, design and construction, and operations and maintenance with regard to the purification and disposal of liquid and solid wastes. The Service has bonding authority to finance and construct regional treatment facilities, can charge for its services, and can enter into waste management contracts.

The Maryland Environmental Trust of DNR is a quasi-public agency responsible for conserving, stimulating, improving, and perpetuating the natural, scenic, and cultural qualities of the environment of the State. Programs of the Trust include scenic and conservation easement acquisition, environmental education, and the dissemination of information relevant to proposed and current state legislation.

The Wildlife Administration is active in the areas of wildlife and land management including waterfowl populations which inhabit the Bay area. A current project entails an annual documentation of the general extent and location of standing rooted aquatic plants, with emphasis on waterfowl preferred species. The Wildlife Administration has been conducting surveys of osprey nesting sites in the Chesapeake Bay area since 1973.

The Department of Health and Mental Hygiene administers, through federal and state grants, a comprehensive water pollution control program. The program includes regulatory activities relating to the design of sewage collection and transmission systems, control of waste from marinas and boats, and training and certification of sanitarians.

With respect to the Bay, the primary responsibility of the Department of Health and Mental Hygiene is to ensure that shellfish are safe for consumption. To fulfill this goal, the Department maintains an extensive monitoring program of shellfish growing areas in Maryland waters of the Bay. Closed shellfish waters are sampled as well as growing areas designated safe for shellfish harvesting. The Department also conducts a routine shell stock sampling of catches in harvest boats during the shellfishing season (see Appendix I - Major Monitoring Programs).

The Maryland Department of Transportation (MDOT) works with the coastal zone management program to minimize impacts of highway construction in coastal areas, especially in relation to resource protection.

The Port Administration of MDOT has broad based powers which include the protection of navigation and the acquisition of port facilities. The Port Administration has been active in the development of container port facilities in the City of Baltimore and a terminal facility at the City of Cambridge on the eastern shore of Maryland. This seaport allows refrigeration ships to carry frozen fish to packing plants situated in the city.

At the regional level, two Maryland planning councils, the Regional Planning Council (RPC) and the Tri-County Council for Southern Maryland, are active in Bay related matters. The RPC is the 208 (Section 208, PL92-500) planning agency for Maryland and is concentrating its efforts in the Loch Raven watershed which supplies the water needs for over one million people in the Baltimore area (see Appendix I - Major Monitoring Programs). RPC also is involved in a unified coastal zone planning program for the Baltimore region in coordination with the Energy and Coastal Zone Administration of DNR.

The Tri-County Council for Southern Maryland (Calvert, Charles, and St. Mary's counties) is a quasi-public planning agency concerned with economic development and related water impacts. The Council compiles water quality data on dissolved oxygen, metals, bio-chemical oxygen demand, and coliform bacteria collected by various agencies active in the Bay. Data compiled are recorded for samples collected in the Patuxent River, Wicomico River, St. Mary's River, and in the Chesapeake Bay at the mouth of the St. Mary's River. The council also

keeps a duplicate of a portion of the data file of the State of Maryland, Division of Shellfish Studies, as it relates to the area of the Bay of interest to the Council. These data are stored on punched cards and magnetic tape. The data file is continuous from 1963 to the present.

3.5 Pennsylvania

The State of Pennsylvania is situated upstream from the tidal waters of the Chesapeake Bay. Flowing southeasterly as it leaves the state, the main tributary to the Bay, the Susquehanna River, enters Maryland where it is impounded by the Conowingo Dam. A few miles downstream, the River enters the upper Chesapeake Bay at Harve de Grace, Maryland.

The Susquehanna River Basin Engineer of the Division of Water Quality (Department of Environmental Resources) has overall responsibility and authority for the Susquehanna, including planning in compliance with PL 92-500. The State of Pennsylvania recognizes that the bulk of undesirable constituents in the upper Bay are traceable to the Susquehanna. These pollutants include acid mine drainage from abandoned mines in the upper and middle reaches (iron and acidity), PCBs and nutrients from the Harrisburg area, pesticides and soil runoff in the lower reaches, and heavy metals from numerous industries and power plants along the river. The Department of Environmental Resources, in cooperation with the United States Geological Survey and the Susquehanna River Basin Commission, monitors the Susquehanna

for water quality parameters including metals, PCBs, and pesticides (see Appendix I - Major Monitoring Programs).

In addition to PL 92-500, the Department of Environmental Resources administers the Pennsylvania Clean Streams Law (Act 275), the Pennsylvania Solid Waste Management Act (Act 241), and Article 1, Section 27 of the Pennsylvania Constitution. In enforcing these statutes, the Department establishes and regulates water quality standards, reviews applications and issues permits for construction and operation of water supply and sewerage systems, provides grants for sewage facilities planning, and conducts water quality studies and investigations.

With regard for the protection of the Chesapeake Bay, the State is preparing a Comprehensive Water Quality Management Plan (COWAMP) for the Lower Susquehanna River Basin. The plan includes input from appropriate State, Regional, and local agencies.

Other State agencies provide input to the Department of Environmental Resources in matters impacting water quality and resource management. These include the Pennsylvania Fish Commission which conducts surveys of fish in the Susquehanna River Basin. The Institute for Research on Land and Water Resources situated at Pennsylvania State University has conducted a number of water quality assessments in streams tributary to the Susquehanna River. Most of these studies have taken place in headwater areas. These studies include analyses of nutrients, organic loadings, and determinations of oxygen profiles in Pine Creek, a tributary to the West Branch. Eutrophication

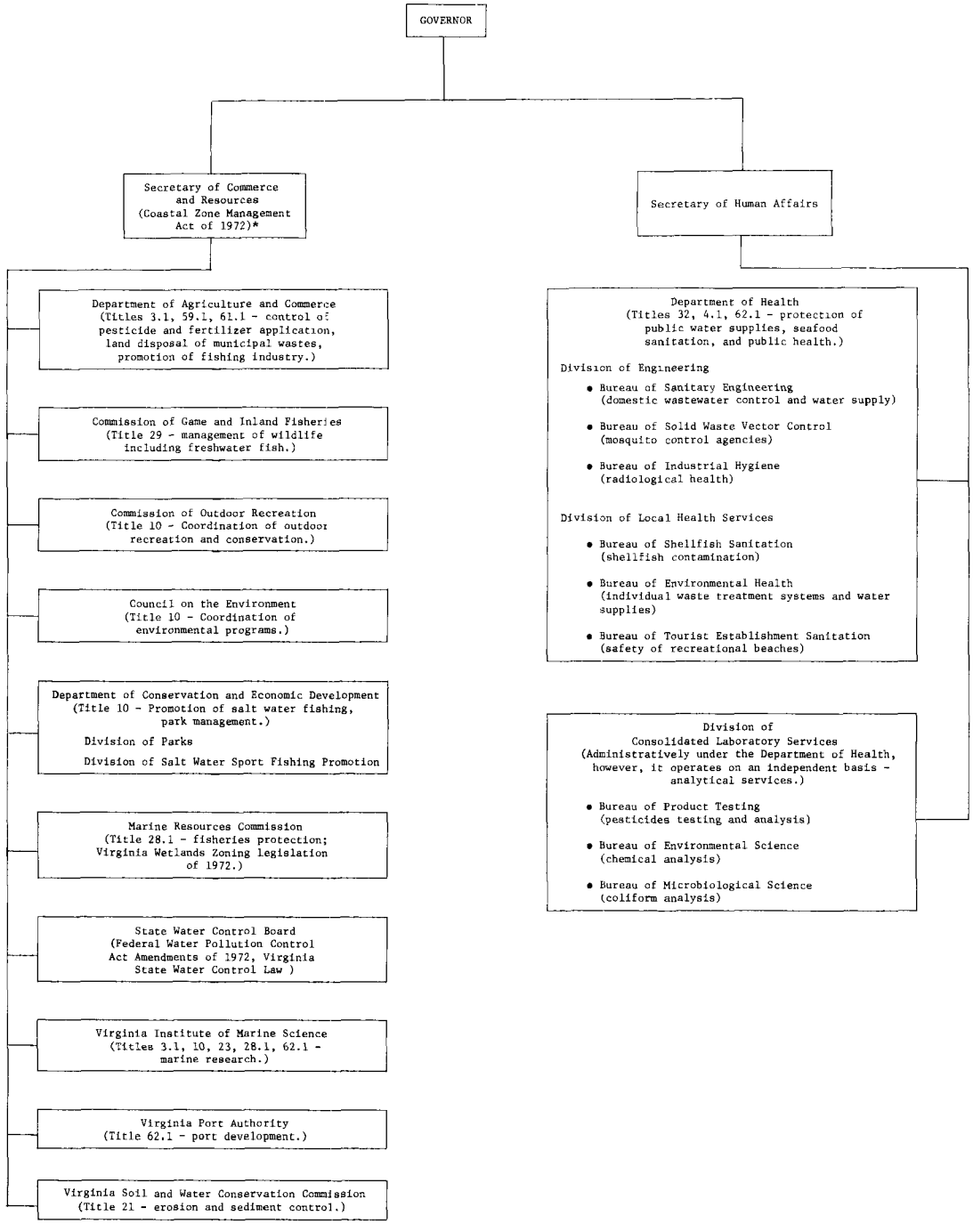
investigations have been performed on Spring Creek and studies on acid mine drainage problems also have occured in the West Branch of the Susquehanna.

3.6 Virginia

Water resources management in the Commonwealth of Virginia is largely decentralized, with program elements administered by a number of relatively independent agencies. This institutional framework has resulted from the development of laws to focus on specific problems as they have arisen. In some cases a new, independent agency has been created to administer the law. The relationship of these agencies is shown in Figure 3.2

At the beginning of the discussion of each agency, the portion of the Code of Virginia applicable to the statutory responsibility of the agency is contained within parentheses beside the agency title. Unless cited specifically, most information contained within this section was obtained during telephone conversations or personal interviews with members of the staff of the various agencies. Additional information was taken from the following publications: Council on The Environment, 1976; Laird, 1974; and Walker and Cox, 1976.

The State Water Control Board (Title 62.1, Chapter 3.1-3.4) is the State's primary water resources agency and exercises a wide range of water resource management responsibilities. One broad area of responsibility is administration of the water quality management program in compliance with PL 92-500 and state laws. This includes such



*Statutory concern or portion of the legal Code of Virginia.

FIGURE 3.2
RELATIONSHIP OF VIRGINIA AGENCIES CONCERNED WITH WATER RESOURCES IN THE CHESAPEAKE BAY BASIN

duties as establishment of water quality standards, issuance of National Pollutant Discharge Elimination System (NPDES) permits, and administration of the construction grants program for publicly owned waste treatment facilities. In addition to its water quality program, the Board is responsible for water resources policy formulation, comprehensive river basin planning (Virginia State Water Control Board, 1976; see summary in Section 6.0 - Major Studies on the Bay), designation of critical ground water areas and administration of allocation controls therein, State coordination of the National Flood Insurance Program, and administration of a dam safety program.

The State Water Control Board has maintained an extensive water quality monitoring network in Virginia waters since 1970. The monitoring entails surveillance of ambient water quality at over 570 stations within the Bay or its tributaries (see Appendix I - Major Monitoring Programs).

The Marine Resources Commission (Title 28.1, Chapters 1-8; Title 62.1, Chapters 1, 2.1, 3.1, 1b, 20) enforces laws and regulations relating to the commercial fisheries of the State's tidal waters. The commission maintains records of all of the oysters and clam planting grounds in the Commonwealth. The agency controls use of the publicly owned beds of the State's tidal waters, including operation of an extensive program of leasing shellfish grounds. It also has several responsibilities under the wetlands program, including development of guidelines for wetlands use, review of the decisions of

local wetlands boards, and administration of permit programs where local governing bodies have not adopted an ordinance dealing with wetlands zoning.

The Virginia Soil and Water Conservation Commission (Title 21, Chapter 1) exercises general supervision over State programs for soil conservation and certain water resource development projects in small watersheds. Primary responsibility for implementation of these programs has been delegated to the State's soil and water conservation districts and other political subdivisions, but the Commission provides various forms of coordination and assistance, including the exercise of regulatory authority concerning local implementation. One of the agency's functions in water resources management is exercising its authority to approve or disapprove proposed projects involving federal funding under the small watershed program. Another responsibility is the preparation of erosion and sediment control guidelines for local programs to regulate land disturbing activities, and reviewing permit decisions by soil and water conservation districts.

The Department of Agriculture and Commerce (Title 3.1, Chapters 1-6 and 9-38; Title 59.1, Chapters 12 and 14; Title 61.1, Chapters 2-7) has three main areas of concern with respect to the Bay: a) future of the fishing industry, b) effect of industrialization on the agriculture and fishing industry and c) land application of municipal waste. The Department also controls pesticides and fertilizers through the certification of applicators.

The Office of the Secretary of Commerce and Resources (Title 2-1, Chapters 26-29) has received new responsibilities as a result of the 1976 session of the General Assembly which adopted legislation that abolishes the Division of State Planning and Community Affairs. The first status report of the coastal zone management program, prepared under the Division, will be submitted to the Secretary of Commerce and Resources by September, 1976. The office works in union with the Marine Resources Commission and the Virginia Institute of Marine Science on matters related to coastal zone management. To date the Office has issued planning grants to Northern Neck, Middle Peninsula, and Accomack-Northampton planning district commissions for area-wide planning. These districts do not have on-going 208 area-wide planning efforts due to their location in non-metropolitan areas (first 208 studies centered on metropolitan areas).

A primary responsibility of the Department of Health (Title 32; Title 40.1, Chapter 1; Title 62.1, Chapters 3 and 4) within the Virginia portion of the Chesapeake Bay Watershed is the regulation of public water supplies. The Department also exercises control over certain waste disposal operations, including septic tank use and disposal of solid wastes and toxic substances, and acts in an advisory capacity to the State Water Control Board regarding large sewage treatment plants. Other relevant functions include seafood sanitation, radiation control, and mosquito control. The Board administratively encompasses Consolidated Laboratory Services, a State analytical and

testing facility serving a variety of other agencies. For practical purposes, however, this laboratory operates as an independent unit.

The Bureau of Shellfish Sanitation of the Department of Health conducts a number of sampling programs related to the water quality and shellfish populations of the Bay. These programs include shell stock monitoring, Kepone monitoring, bacteriological sampling, heavy metal monitoring, pesticide monitoring, and general water quality surveillance. Descriptions of these programs are presented in Appendix I - Major Monitoring Programs.

The Council on the Environment (Title 10, Chapter 17) is an advisory body to the Governor. Its duties include a continuing assessment of environmental conditions and problems confronting the Commonwealth, coordination and review of the State's environmental program, coordination of environmental impact analysis procedures and permit processes, and environmental education.

With respect to permits, the Council's role is to develop a uniform administrative system to facilitate the review and evaluation of proposed State facilities which require multiple permits. With respect to private interests, an applicant who requires more than two permits may request the Council to provide aid in the coordination of state review and action on the various permits.

The Virginia Port Authority (Title 62.1, Chapter 10; Title 28.1, Chapter 5) is a government corporation, chartered by the Virginia legislature to promote and develop the ports of Virginia. The ports

are Hampton Roads, Newport News, Norfolk, Portsmouth, and Richmond. The Authority owns a number of piers in the Hampton Roads area of the Bay. With respect to port facilities, the Authority seeks to secure the improvement of navigable waters within the State.

The mission of the Commission of Game and Inland Fisheries (Title 29, Chapter 2) is to preserve and propagate birds, animals, freshwater fish, and other wildlife. A primary activity of the Commission is the management of freshwater sport fish within state owned areas and, through cooperative agreements, on privately owned areas. The Commission constructs and maintains boat ramps and promotes public fishing and boating within the State. The tidewater counterpart of this Commission is the Division of Salt Water Sport Fishing Promotion of the Department of Conservation and Economic Development (Title 10). The Division collects landing statistics, publishes literature, and contributes to the general promotion of salt water sport fishing.

The Commission of Outdoor Recreation (Title 10, Chapter 2.1) coordinates state and federal funding for outdoor recreation and conservation of recreation lands. The Commission reviews environmental impact statements relating to impacts on outdoor recreation. The Commission also cooperates with utility companies to establish environmental compatibility in the siting of transmission lines.

The Virginia Institute of Marine Science (Chapters of Titles 28.1, 23, 62.1, 3.1, 10) is both an academic institution and a state agency.

It functions as the principal oceanographic or marine science center for the Commonwealth. The Institute conducts basic and applied marine related research and services as the technical advisor to coastal zone management activities in the State. The Institute provides educational opportunities through agreements with colleges and universities (see Section 4.0 - Academic Institutions).

The Code of Virginia (Title 28.1, Chapter 1) defines Tidewater Virginia as that area contained within 31 counties and 16 cities in the State. These areas generally are adjacent to tidal waters of the Chesapeake Bay or its tributaries. The Virginia Area Development Act of 1968 allowed local governments to establish planning districts to promote regional cooperation and coordination, and to provide planning assistance to local governments. Nine of these planning districts are represented by "Tidewater" Planning District Commissions because they encompass the areas designated as Tidewater, Virginia. Four of these Tidewater Commissions serve as 208 agencies for the development of area-wide water quality plans. These include the Northern Virginia Planning District Commission in Falls Church, the Rappahannock Area Development Commission (RADCO) in Fredericksburg, and a consortium between the Richmond Regional Planning District Commission and the Crater Planning District Commission in Petersburg, Virginia. Other 208 agencies in Virginia are the Fifth Planning District Commission in Roanoke and the Hampton Roads Water Quality Agency in Virginia Beach. With the exception of the Roanoke area, all 208 plans are in

the formative stage and non-point source monitoring is being initiated. The monitoring programs for these agencies are presented in Appendix I - Major Monitoring Programs.

3.7 West Virginia

West Virginia, situated to the west of the Chesapeake Bay, contains a portion of the Potomac River watershed. The State is a member of the Interstate Commission on the Potomac River Basin. Agency responsibilities, as they relate to water resources or to the Bay directly, are discussed briefly.

The Department of Natural Resources has the responsibility and authority for water quality control and management. The area of interest, with respect to the Chesapeake Bay, is the Potomac drainage basin in the eastern part of the State which includes the North and South Branch of the Potomac, the Shenandoah, and the Cacapon Rivers. The Department generally feels that any pollution originating in the West Virginia portion of the basin would represent a miniscule portion of the total pollution burden which reaches Chesapeake Bay from the Potomac. Nonetheless, the Department is committed to monitor and abate undesirable effluents in West Virginia. The principal problems are viewed as acid mine drainage from abandoned mines, soil and pesticide runoff from agriculture and deforestation, and nutrient loading. A special study within the Potomac watershed centered on acid mine drainage of the North Branch. The Department of Natural Resources currently maintains 16 monitoring stations on the upper Potomac River (see Appendix I - Major Monitoring Programs).

The Office of Federal-State Relations is responsible for water quality and resource management planning under PL 92-500. This office works closely with the Department of Natural Resources with respect to water quality planning. The Office is formulating an overall comprehensive Potomac drainage basin plan.

4.0 ACADEMIC INSTITUTIONS

4.1 Introduction

Identification of the major thrusts of investigation or research orientation is presented for those academic institutions which have a particular interest in the Chesapeake Bay. A listing of the principal academic researchers is contained in Volume II of this report. Two academic consortia, the Marine Science Consortium, and particularly the Chesapeake Research Consortium, Incorporated, have an interest in Bay research. These consortia are described in this Volume under Section 5, "Other Institutions or Agencies."

4.2 University of Delaware

The University of Delaware, in Newark, Delaware, maintains a number of marine science facilities near Lewes, Delaware. Many of the staff of the Department of Biological Sciences also serve as faculty of the College of Marine Sciences.

Most of the marine research activities of the University are centered in the Delaware Bay or in near shore coastal waters. However, several studies have been conducted in waters contiguous with the Chesapeake Bay. These investigations centered on the ecological effects of enlargement of the Chesapeake and Delaware Canal.

4.3 Johns Hopkins University

The marine research division of Johns Hopkins University is the Chesapeake Bay Institute which supports extensive facilities, including research vessels, and staff dedicated to the full breadth of oceanog-

raphy, including biology, chemistry, geology, and physics. The research emphasis is on the estuarine and coastal environment. Several staff members are engaged in deep sea oceanographic studies.

The programs of the Institute include studies of the forces that act upon water and the motions that are produced by those forces; scales of motion from small-scale, random, turbulent motions to large-scale, well-organized estuarine and oceanic flows; and from small capillary waves in laboratory tanks to large wind-induced waves.

Research interests of the staff include the sizes, shapes, origins, and structures of the Bay's tributary basins and the sediments that are filling these basins. Emphasis is placed on the sources, routes and rates of sediment transport, patterns and rates of deposition, physical and chemical characteristics of sediment, and the chemical reactions between the interstitial water of sediments and overlying water.

Members of the research staff are also concerned with organisms that inhabit the water (microscopic plants and animals, plankton, shell- and finfish). These studies include nutritional requirements of organisms, spatial and temporal distributions, evolutionary development, and behavior.

Recent investigations conducted by the Institute which relate to the Chesapeake Bay include studies of the physical and chemical hydrography of the Bay and tributary estuaries, site evaluation studies for proposed electric power plants, energy fixation and

transfer in the planktonic organisms of the Bay, the role of different nitrogenous nutrients with respect to the ecology of planktonic forms within the Bay, the biogeochemistry of trace metals (especially with regard to the mechanisms of mobilization and transfer across the sediment-water interface), and the monitoring of dredge spoil disposal operations. The Chesapeake Bay Institute also serves in an advisory capacity to city, state and Federal governments on environmental matters and in the planning of programs designed to protect the waters of the Chesapeake Bay.

From time to time the Institute has maintained stations throughout the Bay. While none of the stations are monitored continuously many or all have been sampled repeatedly for specific projects. Consequently, there is an accumulation of long-term data for specific parameters. The Institute analyzes and stores these collected data in the University computer system in Baltimore. In addition, the Institute publishes a periodic directory of the parameters in the data bank and many of them are suitable for trend analysis of the ecology of the Bay.

This Chesapeake Bay Data Bank System of the Chesapeake Bay Institute includes water chemistry and nutrient data collected by Institute personnel since 1949. Temperature, salinity, dissolved oxygen, chlorophyll, pH, orthophosphate, total phosphate, and other less commonly assayed parameters are included. The data reflect the entire Chesapeake Bay and most tributaries. The data are stored on magnetic digital tape and represent at least 7,348 retrievable stations

in the Chesapeake Bay proper and 12,937 retrievable stations in tributaries to the Bay. Several depths are sampled per station with several of the parameters measured at each depth.

The headquarters of the Chesapeake Research Consortium, Incorporated, is situated at the main campus of Johns Hopkins University in Baltimore, Maryland.

4.4 University of Maryland

The University of Maryland has contributed to Chesapeake Bay research and education since the establishment of the Chesapeake Biological Laboratory in 1924. Currently there are 119 faculty members with specific interests relating to the Chesapeake Bay. The names, addresses, specific interests, and recent publications and reports of most of these faculty members are listed in the University of Maryland Chesapeake Roster (Center for Environmental and Estuarine Studies, 1975).

At least 14 separate departments are conducting research related to the Bay at the College Park Campus. The Departments of Biological Sciences and Political Science at the Baltimore County Campus, and the Schools of Law and Medicine at the Baltimore City Campus are also conducting Bay-related investigations. Biologically oriented investigations also are conducted at the University of Maryland's Eastern Shore Campus at Princess Anne, Maryland.

The most extensive research activities related to the Chesapeake Bay and its watershed, however, are conducted by the five

laboratories of the Center for Environmental and Estuarine Studies (CEES). The Chesapeake Biological Laboratory at Solomons Island, Maryland is the largest of CEES laboratories. Estuarine research investigations generally are conducted at this laboratory or one of its field stations. Aquaculture and marine waste studies are designed and implemented at the Horn Point Environmental Laboratories at Cambridge, Maryland. Investigators at the Crisfield Laboratory in Crisfield, Maryland specialize in marine products research. Inland research activities in the Chesapeake Bay watershed are conducted by the staff of the Appalachian Environmental Laboratory and the Inland Environmental Laboratory located at Frostburg, Maryland and College Park, Maryland, respectively.

In addition, the University of Maryland is a member of the Chesapeake Research Consortium (Johns Hopkins University, Smithsonian Institution, University of Maryland, and Virginia Institute of Marine Science). The members of the University of Maryland faculty cooperate through the Consortium and in many other ways with other agencies and citizens groups in efforts to increase knowledge and enhance the uses of the Bay.

The University of Maryland also has a Cooperative Extension Service Branch which is active in Sea Grant Program Development and the administration of Marine Extension Programs. Extension agents are trained and advised on Bay-related

environmental programs. Educational programs are conducted which relate to business management for watermen; pesticide management, wetlands management, and livestock management to eliminate water pollution; consumer information on finfish and shellfish; and many other Bay-related activities.

Much of the data collected by the Chesapeake Biological Laboratory or staff of the College Park Campus of the University are archived or summarized on data sheets or are in published reports. Several of the data files are automated and a few represent continuous recordings of Bay parameters (Environmental Data Service, 1976). These automated data files include:

1. Daily temperature and salinity recorded for near surface water at the end of the Laboratory's pier on Solomons Island. Period of coverage is continuous since 1937 (5000 punched cards).

2. Data includes all fish survey work conducted by Chesapeake Biological Laboratory since December 1960. This is a master file for fishes. Collection data includes water chemistry, weather observations, fish lists, abundance, lengths, weight, and sex ratios. The data are retrievable by river code, species, station, year or date (one 1,800 foot tape reel plus 200,000 cards).

3. Analysis of Chesapeake Bay sediments for bacterial and viral components with ancillary data on water temperature, dissolved oxygen, salinity, and nutrients. The period of coverage is since January 1964 (50,000 punched cards; one magnetic tape).

4.5 Old Dominion University

Old Dominion University in Norfolk, Virginia, is an urban regional university. Founded in 1930, the University is a state-supported educational institution with approximately 10,000 students.

The Institute of Oceanography at Old Dominion University was established in 1959 as a field laboratory in the Department of Biology and became a separate unit in the School of Sciences in 1965. It initiated master's and doctoral degree programs in 1966 and 1973 respectively. There are presently seven faculty and staff devoting full time to the Institute and thirteen faculty holding adjunct or joint appointments.

The Institute occupies a 20,000 square foot building on the campus of the University with eight laboratories for biological, chemical, geological and physical oceanography. It maintains docking facilities at the Naval Amphibious Base on Little Creek in Norfolk. A 65-foot former Army T-boat has been converted by the Institute. The vessel contains oceanographic winches, sampling equipment and laboratory facilities. The research activities of the Institute include analyses for metals, organic chemicals, nutrients and sediments, and utilize underwater photographic equipment and a dive locker in coastal and estuarine studies.

Areas of Bay research are physical, chemical, geological and biological oceanography. Emphasis of the research activities is on transport, fate, and quality of sediments, chemical pollutants, statistical wave theories, invertebrates, mariculture, and larval development. Currently, the Virginia Institute of Marine Science and Old Dominion University are developing a relationship to promote cooperation in marine research activities.

4.6 United States Naval Academy

The United States Naval Academy offers a four-year program of academic, military, and professional instruction for the training and education of personnel for naval service. Completion of the program normally leads to a commission in the United States Navy or the United States Marine Corps and a bachelors degree in one of 27 fields of study including engineering, oceanography, mathematics, history, economics, and international affairs.

Research projects on the Chesapeake Bay usually are undertaken by faculty and students in oceanography as part of the curriculum in environmental pollution. Previous research activities include investigations of the nature of copper in sediments in the Bay and bioassays utilizing sediments and water from the Bay.

Current and future investigative efforts center on additional research on copper in sediments and on bioassays of different conditions of acidity or alkalinity utilizing fish from the Bay as test species. Much of this work will be directed toward the environmental impacts of iron and steel pickling wastes on the Chesapeake Bay.

4.7 University of Virginia

The University of Virginia, founded in 1819, is a state supported coeducational university in Charlottesville, Virginia and includes branches at Martinsville, Virginia (Patrick Henry); Wallops Island, Virginia (Eastern Shore); Clinch Valley College in Wise, Virginia; and several extension centers. Professional as well as Ph.D. degrees are offered.

Most research related to the Chesapeake Bay is conducted through an agreement with the Virginia Institute of Marine Science whereby the Institute serves as the Department of Marine Science for the College. Expertise of the University staff primarily is related to the ecology of wetlands adjacent to the Bay.

4.8 Virginia Institute of Marine Science

Created by the Virginia Assembly in 1940, the Virginia Institute of Marine Science (VIMS) is the principal state institution responsible for research, advisory services, and education in the marine sciences. Operating under the provisions of Chapter 9, Title 28 of the Code of Virginia, it is the mandate of the Institute:

1. To conduct studies and investigations of all phases of the commercial fishing and sport fishing industries;

2. To consider means by which fisheries resources may be conserved, developed and replenished, and to advise state agencies and private groups on such matters;

3. To conduct studies and investigations of problems pertaining to other segments of maritime economy;

4. To conduct studies and investigations of marine pollution in cooperation with the State Water Control Board and the Department of Health and make the resulting data and corrective recommendations available to the appropriate agencies;

5. To conduct hydrographic and biological studies of the Chesapeake Bay and the tributaries thereof and all the tidal waters of the Commonwealth and the contiguous waters of the Atlantic Ocean;

6. To engage in research in the marine sciences and, with proper affiliation with one or more accredited institutions of higher learning, to provide education;

7. To conduct special studies and investigations as may be requested by the Governor.

In 1970 the Governor designated the Director of the Institute to serve also as the Marine Science Advisor to the Commonwealth. In conjunction with the development of a State Coastal Zone Management System, the Governor also designated VIMS as the Coastal Zone Laboratory of the Commonwealth. VIMS receives financial support from the General Fund of Virginia; however, federal and private grants and contracts comprise over half of its annual budget.

The main campus is located on the York River at Glouster Point, Virginia. A branch site is operated at Wachapreague on the Eastern Shore. The VIMS staff, numbering over 370, includes more than 100 professional scientists and engineers, 100 technical employees, and over 80 graduate students. An additional 100 support people augment the staff during the summer months.

In fulfilling its mandate, VIMS serves as the School of Marine Science of the College of William and Mary and the Department of Marine Science of the University of Virginia. A working arrangement exists between VIMS and the community college system and the Mariners Museum. The Institute is currently building a working relationship with other academic institutions within the State and is an active member of the Chesapeake Research Consortium, Inc.

There are approximately 200 on-going projects at VIMS. Areas of special research interest and participation include: coastal zone management, outer continental shelf oil and gas development, extended

fishery jurisdiction and management, marine education and training for emerging industries, environmental benchmarks and inventories, wetlands preservation and management, environmental contaminants, environmental impact statements, aquaculture of commercially important species and advisory services and technical assistance programs. A 1972 report detailing research at VIMS currently is being revised and updated for publication in Autumn, 1976 (VIMS, 1976). VIMS also is updating its Chesapeake Bay bibliographies (adding a total of 5000 references to its bibliographies of Virginia Waters (Tennyson, et al., 1972) and Maryland Waters (Stauble and Wood, 1975) and its Virginia State Agencies Concerned With Coastal Zone Planning Management or Scientific and Engineering Activities (Laird, 1974) for Autumn release.

Archive records, many on data cards, exist for the past 5 years and are kept on the major rivers in the Commonwealth such as the James (to Richmond), York (Mattaponi-Pamunkey Branches), and Rappahannock. These data are obtained from samples collected by survey teams at about fifteen stations located upstream from the mouth of each river. The surveys are conducted once each month during slack tide. During summer, sampling occurs twice a month. These archival surveys are internally funded. Additional information on this monitoring activity is presented in Appendix I - Major Monitoring Programs.

Fisheries sampling is conducted annually in all major rivers and the Bay. VIMS collects samples to track juvenile fish migration to complement sports fisheries and commercial fishing landings data. Other monitoring work is dependent on contract work.

VIMS has an extensive information storage and retrieval system for biological data. A number of statistical and input/output programs have been adapted at VIMS for relating species to certain temporal, spatial, or chemical conditions. The master file based on a taxonomic code is maintained in the VIMS Department of Data Processing.

4.9 Virginia Polytechnic Institute and State University

Virginia Polytechnic Institute and State University (VPI) has several departments conducting educational and research activities on and adjacent to the Chesapeake Bay. At least 29 faculty members from the Departments of Agricultural Economics, Agricultural Engineering, Agronomy, Environmental and Urban Systems, Biology (the Center for Environment Studies), Civil Engineering, Forestry and Wildlife Resources, and the Virginia Water Resources Research Center have expressed research interests in the Bay or its Watershed. The Departments of Chemistry, Aerospace and Ocean Engineering, Entomology, and the Anaerobic Bacteriological Laboratory (actively involved in studies of anaerobic bacteria and their efficiency in septic tanks of the Bay's coastal plain) may provide supportive studies, although they are not presently conducting specific research on the Bay.

The majority of the research and educational programs are inland and closely associated with land-use in the Bay watershed. Many studies conducted at VPI may be applicable to Coastal Zone Management problems and to the identification and control of non-point source pollutants in the Bay drainage system. In addition, many economic,

social, and legal concerns of the commercial finfish and shellfish industry are investigated through Extension Service Programs.

The Virginia Water Resources Research Center located at the Blacksburg, Virginia campus is a Federal-State partnership agency which is attempting to find solutions to Virginia's water-resource problems. The Center has four major functions: to identify and evaluate water problems; fund and direct water-related research; provide training opportunities in research for scientists in water-related fields; and to collect and distribute information on water resources. The Center was created by the Water Resources Research Act of 1964, and receives an annual research allotment from the Office of Water Research and Technology (OWRT) in the United States Department of Interior. Additional funds for specialized projects have been obtained from the National Science Foundation, Virginia State Water Control Board, United States Department of Health, Education and Welfare, as well as from the National Oceanic and Atmospheric Administration under the Sea Grant Program. In addition to VPI, Virginia institutions which have participated in the programs sponsored by the Water Resources Center include: Virginia Military Institute; University of Richmond; University of Virginia; Virginia Commonwealth University; Washington and Lee University; the College of William and Mary; Old Dominion University; and the Virginia Institute of Marine Science.

Presently, the Center's research activities are directed toward the implementation of its Five Year Research Program which lists

eight areas of critical research needs identified through a statewide inventory of resource planners, managers and decision makers. The priority research areas are: (1) Water and Land-Use Management; (2) Non-Point Sources of Water Pollution; (3) Resource Inventory Monitoring; (4) Water Supply; (5) Waste Treatment; (6) Non-Structural Flood Damage Prevention; (7) Marine Environment; and (8) Outdoor Recreation.

Specific studies underway relate to: the deleterious effects of agricultural chemicals, contamination of surface and groundwater from swine waste lagoons, the causes and effects of turbidity in estuaries, the impact of sediments eroded from urban areas, the implications of using chlorine for disinfection, methods for reclamation of streams to serve as habitats for fish, the potential environmental hazards of fungicides, the use of biological organisms as detectors of toxic substances, the role of sediments in eutrophication, and mechanisms for watershed planning and management.

4.10 College of William and Mary

The College of William and Mary, founded in 1692, is a state supported coeducational college in Williamsburg, Virginia with branches in Newport News and Petersburg, Virginia. Professional as well as Ph.D. degrees are offered. Work related to the Chesapeake Bay primarily is carried out within an agreement with the Virginia Institute of Marine Science whereby the Institute serves as the School of Marine Science for the College. In relation to the Bay, faculty of the

college have expertise relevant to the embryology of invertebrates, reactions of invertebrates under stress, and the osprey population within the Bay area.

5.0 OTHER AGENCIES OR INSTITUTIONS

5.1 Introduction

The following is a description of the missions and activities of various interstate commissions and consortia which have an interest in applied research, pollution abatement, or resource planning within the Chesapeake Bay Basin.

5.2 Interstate Commission on the Potomac River Basin

Approved by Congress in 1940, the Interstate Commission on the Potomac River Basin (INCOPOT) was established by an agreement among the states of Maryland, Pennsylvania, West Virginia, Virginia, and the District of Columbia. The governors of each state and the President appoint three commissioners to the Commission.

The Commission lacks regulatory or enforcement powers. A concerted effort by Maryland and Virginia to establish a Potomac River Basin Compact (similar to the Susquehanna River Basin Commission and the Delaware River Basin Commission) was abandoned in June 1976 primarily due to reservations on the part of Pennsylvania and West Virginia.

The Commission is active in the coordination of data collection, evaluation, and in the dissemination of baseline water quality information. The Commission coordinates resource planning efforts and is active in public education. As part of its role as coordinator, INCOPOT, together with the Maryland Power Plant Siting Program, recently brought biologists and managers together for a comprehensive discussion in the form of a symposium on the protection and enhancement of the biological

resources of the Potomac estuary (Mason and Flynn, 1976). The Commission currently coordinates an extensive 55 station water quality monitoring network (see Appendix II - Cooperative Relationships) and is also active in the areas of erosion control and water supply. Recently, the Commission has been concentrating its efforts on the lower portion of the Potomac for the integration of a proposed estuary monitoring program to be coordinated among the states of Maryland, Virginia, the District of Columbia, and the Environmental Protection Agency. It is envisioned that the collection of data within the proposed baseline monitoring network will be carried out by the appropriate governmental agencies. The role of the Commission would be to evaluate and report the data and to promote the uniform use of sampling techniques and analytical procedures. The actual water quality testing would be conducted by the Virginia Consolidated Laboratories of the Virginia Water Control Board in Richmond, Virginia, the Maryland Water Resources Administration laboratories in Annapolis, and the laboratories of the District of Columbia, Department of Environmental Services at the Blue Plains wastewater treatment plant.

5.3 Susquehanna River Basin Commission

The Susquehanna River Basin Commission is a Federal-Interstate Compact organization in which the Federal Government is represented by a United States Commissioner (Special Assistant to the Secretary of the Interior). The state members are the Governors of Maryland, New York, and Pennsylvania (84 stat. 1509).

The Susquehanna River Basin Commission is responsible for programming, scheduling, and controlling projects and activities within the Susquehanna Basin that will develop ground and surface water supplies for municipal, industrial, and agricultural uses. The Commission has developed a comprehensive plan for the management and development of the water resources of the Susquehanna River Basin. The Commission does not regulate or enforce water quality standards (function of the Pennsylvania Department of Environmental Resources), but it does review all plans involving water use or discharge into the Susquehanna and its tributaries. The Commission cooperates fully with the Pennsylvania Department of Environmental Resources in matters related to the management of water quality.

The activities of the Commission have included the water quality assessment of specific problem areas, trend analysis throughout the basin, special heavy metal and pesticide studies, current and planned non-point source assessments, and the establishment of water supply models (Susquehanna River Basin Commission 1975, 1976, undated).

The Commission has a continuous monitoring station on the Susquehanna at Harrisburg, Pennsylvania and conducts a trend monitoring program of interstate waters at the New York-Pennsylvania border (see Appendix I - Major Monitoring Programs). Data are available from the Commission, and also are submitted to the Pennsylvania Department of Environmental Resources for inclusion in WAMIS, the Department's storage and retrieval system for water related data.

5.4 Atlantic States Marine Fisheries Commission

The Atlantic States Marine Fisheries Commission represents a compact among the Atlantic Coastal states in which each state is represented by three commissioners. One of the four regional divisions is the Chesapeake Bay Section formed by the States of Maryland and Virginia.

The Commission lacks regulatory powers except in such instances where two or more states may delegate authority to the Commission to control fisheries activities in the areas of common interest.

The purpose of the Commission is to promote coordination among the member states in regulatory activities, fisheries research, enhancement and protection of fisheries, and education with regard to conservation of fishery resources. As part of the Commission's educational objectives, it publishes brochures which characterize fishery conservation practices and ecological relationships. These are available to various agencies and institutions for distribution to interested parties.

A recent project for the Commission, conducted by the Maryland Watermen's Association, involved a series of meetings in New Jersey, Pennsylvania, Delaware, Maryland, and Virginia for the purpose of identifying fisheries problems as they relate to federal agencies. Major findings of the study were (Wieland et. al., undated):

- It is the feeling of watermen that Congress and the public do not understand the value of the seafood industry in the country. Capital backing is required to revive the industry.
- The present marketing-pricing-processing system is inadequate and needs to be revised.

- Little improvement in the pollution of fishing grounds has been observed by watermen.
- Pollution and foreign fleets are the largest threats to the mid-Atlantic fishing industry.

5.5 Potomac River Fisheries Commission

The Potomac River Fisheries Commission is a cooperative effort legalized in the form of a compact between the States of Maryland and Virginia to enhance shellfish resources of the Potomac River. The Commission works closely with the Maryland Department of Natural Resources and the Virginia Marine Resources Commission in the management of fisheries in the Potomac River. Major activities of the Commission include the surveying and reseeding of oyster beds, the regulating of shellfish, finfish, and crab harvesting, and the issuing of licenses to catch seafood from the river.

5.6 Chesapeake Research Consortium, Incorporated

The Chesapeake Research Consortium, Incorporated (CRC) is an academic association among the Johns Hopkins University, the University of Maryland, the Smithsonian Institution, and the Virginia Institute of Marine Science. Each institution selects four members to sit on the board of trustees.

The Consortium was formed as a legal consortium corporation in January 1972, and has utilized a multi-disciplinary approach to meet the comprehensive research needs for the Chesapeake Bay. Most of the research efforts of the Consortium have been funded by the Research Applied to National Needs (RANN) Program of the National Science

Foundation (NSF). These efforts related to a characterization of the biota of the Chesapeake Bay, wetlands, and the development of a Research and Management Shoreline (RAMS) Data Bank. Recent studies have included a Corps of Engineers sponsored evaluation of the impact of Tropical Storm Agnes on the Chesapeake Bay (see Section 6.0 - Major Studies on the Bay) and a literature review prepared for NSF and EPA on the effects of sewage treatment plant effluents on fish. To date, over 52 reports have been published by the Consortium.

5.7 Marine Science Consortium

Organized in 1968, the Marine Science Consortium is an association of 17 colleges and Universities. These include:

The American University
Washington, D.C.

Bloomsburg State College
Bloomsburg, Pennsylvania

California State College
California, Pennsylvania

The Catholic University of America
Washington, D.C.

Catonsville Community College
Catonsville, Maryland

Cheyney State College
Cheyney, Pennsylvania

East Stroudsburg State College
East Stroudsburg, Pennsylvania

Edinboro State College
Edinboro, Pennsylvania

Federal City College
Washington, D.C.

Indiana University of Pennsylvania
Indiana, Pennsylvania

Kutztown State College
Kutztown, Pennsylvania

Millersville State College
Millersville, Pennsylvania

Pennsylvania State University
University Park, Pennsylvania

Shippensburg State College
Shippensburg, Pennsylvania

Slippery Rock State College
Slippery Rock, Pennsylvania

West Chester State College
West Chester, Pennsylvania

West Virginia University
Morgantown, West Virginia

The Consortium maintains a research vessel in the Chesapeake Bay at Saxis, Virginia (Tangier Sound). Other vessels are located at the Consortium's laboratory on Wallops Island, Virginia. The laboratory conducts classes in marine subjects with an average enrollment of 150 students per day. The laboratory also contracts with DuPont, the City of Philadelphia, and the National Aeronautics and Space Administration to perform studies in coastal waters.

With regard to the Chesapeake Bay, the laboratory has conducted a few short term studies related to the nature of bottom sediments and biota. The laboratory has the capability to perform any kind of marine research within the areas of heavy metals analysis, suspended sediments monitoring, collection and measurement of bottom sediments, water chemistry, and marine biology.

6.0 MAJOR STUDIES ON THE BAY

6.1 Introduction

A recurring comment of various officials, scientists, and environmental organizations during this study was that the Chesapeake Bay was the most extensively investigated ecological system within their knowledge. Certainly, the amount of recorded information is extensive. In recent bibliographies on the Chesapeake Bay (Tennyson, et al, 1972; Stauble and Wood, 1975) prepared by the Virginia Institute of Marine Science, approximately 850 and 1,740 reports were cited respectively for Virginia and Maryland waters of the Bay. These works include books, periodicals, government, institutional, and academic reports, theses, and dissertations published largely in the last 100 years and deal with taxonomy, natural history, physical studies, and pollution. Literature searches conducted as part of this study revealed 376 periodical publications within the last 5 years which deal with pollution in the Bay (Biosciences Information Service, 1976). A similar search of federal documents yielded 353 reports relating to water quality within the Bay (N.T.I.S., 1976).

6.2 Major Studies

Current research activities relevant to the Bay also are extensive. Many academic researchers possess expertise and retain an interest in, or are actively involved in, research related to the Bay. A listing of these researchers and their respective areas of expertise identified during this study is presented in Volume II of this

report. A current area of major concern, and one in which studies are being initiated, is the disappearance of eel grass and other vegetation within large areas of the Bay. This phenomenon has been attributed to a number of causes including the effects of herbicides contained in storm water runoff, the changes in salinity in the upper Bay brought about by Tropical Storm Agnes, the browsing of cow nosed rays, and increases in turbidity brought about by eroded particles in suspension or algal cells. Current research in this area includes that conducted by the Smithsonian Institution's Chesapeake Bay Center for Environmental Studies where bioassay analyses of higher acquatic plants have been initiated in an effort to relate the inhibition in plant growth to herbicide contamination. Graduate research at the Virginia Institute of Marine Science (Robert J. Orth) centers around the use of remote sensing data to map the changes in vegetation and the association of vegetation disappearance with variations in winter mean temperatures for the southern portion of the Bay. The Department of Natural Resources is evaluating the impact of existing levels of rooted aquatic plants in the Bay. The U. S. Fish and Wildlife Service is monitoring the distribution and abundance of submerged vegetation at 642 stations in the Bay. The EPA Chesapeake Bay Program, through the U. S. Fish and Wildlife Service (Office of Biological Sciences), is currently funding a literature search of existing information on submerged vegetation of the Bay.

In an effort to summarize the major Bay research studies that have been performed, a list of major reports on the Bay was compiled based on recommendations by administrators and researchers interviewed during the course of this study. The list represented major studies performed since 1970 and also the broad areas of research which are of interest to the Environmental Protection Agency's Chesapeake Bay Program, namely - nutrients, toxic materials, non-point source discharges, and physical alterations. Twenty of these reports were selected for summarization by a representative of the Chesapeake Bay Program. The topics of these reports or the findings of studies described in the reports are summarized in Table 6.1 These summaries include the name of the study, the sponsoring agency, a reference to literature cited, areas of the Bay investigated, the objectives of the study, and areas of study, e.g. nutrients, toxic materials, non-point source discharges, physical alterations, and other areas.

TABLE 6.1

SUMMARY OF REPORTS RELATED TO THE WATER QUALITY OF THE CHESAPEAKE BAY

Name of Study: a. Sponsoring Agency b. Reference c. Area(s) of Bay Investigation	Objective of the Study	Areas of Investigation: Nutrients	Toxic Materials (synthetic organic chemicals and metals)	Non-Point Source Discharges	Physical Alterations	Other Areas
1. Impact of Tropical Storm Agnes on Chesapeake Bay a. Corps of Engineers b. Corps of Engineers, 1975. c. Patuxent, Potomac, Choptank, Rappahannock, York, James and Susquehanna Rivers and the open waters of the upper portion of the Bay near the mouth of the Susquehanna River (Susquehanna Flats)	To identify the effects of Tropical Storm Agnes on the Chesapeake Bay. ** To determine if changes in the bottom geometry of the Bay warrant changes in the design of the Chesapeake Bay Hydraulic Model.	Storm runoff carried large amounts of nutrients into the Bay. ** The estuary of the Patuxent River received approximately 600 and 50 metric tons respectively of dissolved nitrogen and phosphorus compounds during July 1972. ** Nutrient loading to the Bay from the Susquehanna River was estimated to be as much as 2,500 metric tons of nitrates and phosphates per day. ** Most of these compounds settled out within the Bay.	Levels of trace metals and pesticides within the Bay were affected by runoff from the storm. ** These concentrations were considered not to be hazards to public health or toxic to the Bay biota.	More sediment, over 31 million metric tons, was transported into the Chesapeake Bay by the Susquehanna River than in preceding 10 years. ** Most of suspended sediments settled out in the upper reaches of tributary estuaries. ** Storm water runoff carried large quantities of eroded soil into the Bay.	Shore erosion within the Bay, as a result of the storm was slight. ** Most erosion occurred in the upstream areas within the Bay's drainage basin. ** Scouring occurred in the James River and at the mouth of the Susquehanna River. ** Most changes were a result of the deposition of sediment. ** These changes were not sufficient to warrant changes in the design of the hydraulic model.	Owing to the inability to migrate to waters of high salinity, soft-shell clams and oysters experienced high mortality rates. ** Temporary effects were observed for finfish, blue crabs, and hard clams. ** Observations subsequent to the period of the storm indicated a rapid recovery for the soft-shell clams, but a relatively low recovery rate for oysters.

TABLE 6.1 (Continued)

Name of Study: a. Sponsoring Agency b. Reference c. Area(s) of Bay Investigation	Objective of the Study	Areas of Investigation: Nutrients	Toxic Materials (synthetic organic chemicals and metals)	Non-Point Source Discharges	Physical Alterations	Other Areas
2. Upper Bay Survey. a. Maryland Dept. of Natural Resources. b. Westinghouse Electric Corporation, 1976. c. Upper Chesapeake Bay from the Mouth of the Susquehanna River to the Mouth of the Severn River.	To determine the concentrations, distributions, sources and transport mechanisms and rates of chlorinated hydrocarbon pesticides and polychlorinated biphenyls (PCBs) in the Upper Bay. ** To determine the impact of these compounds on commercially important species. ** To determine the distribution of bacteria in sediments and suspended particles and the effects of pesticides and bacteria on oysters. ** To develop numerical models for projecting the transport, fate, and effects of contaminants.	Nutrients were not investigated.	The Susquehanna River is the major source of chlorinated hydrocarbon contaminants to the upper Chesapeake Bay. ** The primary sink of chlorinated hydrocarbon compounds is the sediments of the Bay floor. ** High concentrations of PCB's and chlordane were obtained in the suspended sediments and bottom sediment of Baltimore harbor. ** Shellfish accumulate chlorinated hydrocarbon compounds to concentrations many times higher than those in water, however, no food species were found to contain carbon compounds of pathogenic bacteria at levels in excess of regulatory or advisory limits	Significant amounts of PCB's, DDT, and chlordane enter the Chesapeake Bay by surface runoff (including runoff from storm sewers). ** Measurable amounts also enter the Bay by aerial fallout, precipitation, and groundwater discharge.	Physical alterations were not investigated.	The Susquehanna River contributes large numbers of non-human and non-estuarine bacteria to the upper Bay. ** The highest population density of zooplankton in the upper Bay was observed in late winter. Low densities were found in early summer and autumn. ** Ninety different kinds of zooplankton were found in the upper Bay.

TABLE 6.1 (Continued)

Name of Study: a. Sponsoring Agency b. Reference c. Area(s) of Bay Investigation	Objective of the Study	Areas of Investigation: Nutrients	Toxic Materials (synthetic organic chemicals and metals)	Non-Point Source Discharges	Physical Alterations	Other Areas
3. Nutrient Enrichment and Control Requirements in the Upper Chesapeake Bay. a. Environmental Protection Agency, Annapolis Field Office. b. Environmental Protection Agency, 1973. c. Upper Bay, generally between the Bay Bridge near Annapolis, Maryland to the mouth of the Susquehanna River.	To investigate trends resulting in the entrophication of the Bay. ** To delineate the major nutrient inputs to the upper Bay. ** To develop a model which determines allowable loadings of nutrients. ** To compile data to allow decisions to be made in accordance with desired objectives.	The upper Bay was determined to be entrophic as evidenced by persistent algal blooms. ** To abate the eutrophic condition during a high Susquehanna River flow (50,000 cfs), a 90 percent reduction in point source discharge to the river must be realized. ** For lower flows (10,000 or 30,000 cfs), a 70 percent reduction is required for both the Susquehanna River Basin and the Baltimore area. ** A nutrient management program for the upper Bay must include adequate control of discharge in the Baltimore area as well as in the Susquehanna River Basin. ** Inorganic nitrogen may be a rate-limiting nutrient in the upper Bay. ** Phosphorus may be made a rate-limiting nutrient if adequate controls over nutrient loadings are instituted.	Toxic materials were not investigated in this study.	The Susquehanna River is the major contribution of freshwater to the upper Chesapeake Bay and is the primary factor which influences the salinity regions and inorganic silt load within the Bay.	Physical alterations were not investigated in this study.	This study dealt primarily with nutrient enrichment within the Chesapeake Bay.

TABLE 6.1 (Continued)

Name of Study: a. Sponsoring Agency b. Reference c. Area(s) of Bay Investigation	Objective of the Study	Areas of Investigation: Nutrients	Toxic Materials (synthetic organic chemicals and metals)	Non-Point Source Discharges	Physical Alterations	Other Areas
4. Nutrient Input Study. a. Environmental Protection Agency, Annapolis Field Office. b. Environmental Protection Agency, 1972a. c. The study was confined to the following tributary watersheds: Susquehanna Patuxent Potomac Mattaponi Pamunkey Chikahominy James	To determine the magnitude extent and source of nutrient loadings to the Chesapeake Bay.	Highest nutrient Concentrations were observed in the Patuxent River, however, the nutrient loading to the Bay from the Patuxent is minor due to the higher discharges of the Susquehanna, Potomac, and James Rivers. ** The primary sources of nutrients entering the Chesapeake Bay emanate from watersheds of the James, Potomac, and Susquehanna Rivers. ** Flows from the eight tributaries investigated increase the naturally high nutrient levels in the Chesapeake Bay. ** Control of nutrient loading is essential especially from the Susquehanna River since it contributes over 50 percent of all nutrients entering the Bay.	Toxic materials were not investigated in this study.	The progressive eutrophication of the tributaries to the Chesapeake Bay, caused by nutrients in land runoff, as well as point source discharges, threatens the water quality and organisms of the Bay.	Physical alterations were not investigated in this study.	This study dealt primarily with nutrient loading to the Chesapeake Bay.

TABLE 6.1 (Continued)

		Areas of Investigation				
Name of Study: a. Sponsoring Agency b. Reference c. Area(s) of Bay Investigation	Objective of the Study	Nutrients	Toxic Materials (synthetic organic chemicals and metals)	Non-Point Source Discharges	Physical Alterations	Other Areas
5. Nutrient Transport and Accountability in the Lower Susquehanna River Basin. a. Environmental Protection Agency, Annapolis Field Office. b. Environmental Protection Agency, 1974b. c. Lower Susquehanna River Basin between Northumberland, Pennsylvania and Conowingo, Maryland.	To determine the nitrogen and phosphorus loadings entering the lower Susquehanna. ** To delineate nutrient contributions from point source discharges as opposed to non-point discharges. ** To determine a seasonal mass balance by nutrient loadings within the main stem. ** To determine the fate of nutrients in impounded areas.	Generally, all seasonal levels of nitrogen and phosphorus in the Susquehanna River were higher in the reach from Harrisburg to the Conowingo Dam than in the reach upstream from Harrisburg. ** During low flow, point source discharge accounted for 16 and 72 percent respectively, of the total nitrogen and phosphorus loading. During high flow, these decreased to 7 and 40 percent respectively. ** Impoundments act as a sink for phosphorus. ** The effectiveness of nitrogen control at point sources is questionable unless adequate controls are applied toward reducing the existing load from agricultural runoff.	Toxic materials were not investigated in this study.	The main non-point source nutrient input to the lower Susquehanna River Basin is from agricultural runoff with significant augmentation by urban storm water runoff and combined sewer overflows. ** Runoff from agricultural land (42 percent of the study area), accounted for up to 85 percent of the non-point source of phosphorus loading, 70 percent of the total kjeldahl nitrogen, and 90 percent of the nitrate non-point source loading. ** Runoff from forested land (53 percent of the study area), accounted for 10-15 percent of the non-point source phosphorus load, 25-30 percent of the total kjeldahl nitrogen load, and about 5 percent of the nitrate load from all non-point sources.	Physical alterations were not investigated in this study.	This study dealt primarily with nutrient loading to the lower Susquehanna River Basin.

TABLE 6.1 (Continued)

Name of Study: a. Sponsoring Agency b. Reference c. Area(s) of Bay Investigation	Objective of the Study	Areas of Investigation				
		Nutrients	Toxic Materials (synthetic organic chemicals and metals)	Non-Point Source Discharges	Physical Alterations	Other Areas
6. Distribution of Metals in Baltimore Harbor Sediments. a. Environmental Protection Agency, Annapolis Field Office. b. Environmental Protection Agency, 1974a. c. Baltimore Harbor	To provide a synoptic picture of the heavy metal contamination of Baltimore Harbor.	Nutrients were not investigated in this study.	Levels of all metals analyzed were 3 to 50 times greater in Baltimore Harbor than in the open Bay. ** The distribution of metals within the Harbor reflects the inputs from the surrounding industrial complex. ** The differences in the levels of metals between the Chesapeake Bay and Baltimore Harbor were not attributed to variations in sediment particle size.	Non-point source discharges were not investigated in this study.	Physical alterations were not investigated in this study.	This study dealt primarily with metal contamination within Baltimore Harbor.

TABLE 6.1 (Continued)

Name of Study: a. Sponsoring Agency b. Reference c. Area(s) of Bay Investigation	Objective of the Study	Areas of Investigation: Nutrients	Toxic Materials (synthetic organic chemicals and metals)	Non-Point Source Discharges	Physical Alterations	Other Areas
7. Chesapeake Bay Existing Conditions Study. a. Corps of Engineers, Baltimore District. b. Corps of Engineers, 1973. c. The entire Bay and its tributaries, and adjacent counties.	To provide an understanding of the existing, physical, chemical, biological, economical, and environmental conditions of the Bay.	The Susquehanna River is the largest contributor of nutrients to the Bay. ** High nutrient concentrations have contributed to the occurrence of algal blooms as late as December in the Severn and South Rivers. ** Nutrient levels in the Sandy Point area of the Bay were observed to increase over a three year period. This trend was expected to continue due to an input of nutrients from the new Sandy Point wastewater treatment plant.	Dredging operations can release heavy metals and toxic materials from bottom sediments. ** Traces of chlorinated hydrocarbon and thiophosphate pesticides were observed in the James Estuary, however, the levels were not in excess of standards. ** Analysis of sediments in the Baltimore Harbor showed excessive amounts of volatile solids, chemical oxygen demand, and oil and grease.	Upstream mine drainage probably contributes to significant amounts of iron and manganese in water below the Conowingo Dam on the Susquehanna River. ** The nutrient input to the Bay from the Susquehanna River is largely a result of runoff from fertilized agricultural areas as well as from wastewater discharges.	Erosion (caused primarily by the action of tides, storm-incured waves, and the wakes of ships) and a rising sea level cause about 450 acres of shore to be lost each year. ** Dredging and filling operations can release heavy metals and toxic substances, cause sedimentation of shellfish beds, and eliminate portions of wetlands. ** Dredging may create areas of deep water which are beneficial to young fish and create new clean, hard bottom areas suitable for shellfish growing areas.	Most of the water quality problems occur in the estuaries of the tributaries to the Bay and not in the open areas of the Bay. ** The five major rivers (Susquehanna, Potomac, Rappahanock, York, and James) provide almost 90 percent of the total fresh water flow into the Bay with about half of the total fresh water flow provided by the Susquehanna River.

TABLE 6.1 (Continued)

Name of Study: a. Sponsoring Agency b. Reference c. Area(s) of Bay Investigation	Objective of the Study	Areas of Investigation: Nutrients	Toxic Materials (synthetic organic chemicals and metals)	Non-Point Source Discharges	Physical Alterations	Other Areas
8. Water Quality Criteria and the Biota of Chesapeake Bay. a. Corps of Engineers. b. Chesapeake Research Consortium, Incorporated 1974a. c. Entire Bay, including tributary estuaries.	To characterize the ecological concepts and environmental factors affecting the Chesapeake Bay. ** To summarize the biology of the most significant organisms of the Bay. ** To describe the structure of biological communities within the Bay. ** To identify water quality standards and criteria relevant to the Bay. ** To determine the applicability of the Chesapeake Bay Hydraulic Model for biological problems.	Until the present time, the Bay has been able to withstand nutrient enrichment, however, should nutrients enter the Bay at an accelerated rate, the stability of the Bay could become threatened. ** Eelgrass communities play an important role in the cycling of nutrients within the Bay.	Although the activities of men have increased the concentrations of metals in the Chesapeake Bay, natural levels result from weathering and erosion as metals are absorbed by fine particles. ** Metals in the Susquehanna River are associated with suspended sediments and vegetation. ** Highest concentrations of metals exist at the head of the Bay where shellfish grounds are closed periodically.	An estimated amount of over 300,000 gallons of oil could be entering the Chesapeake Bay annually in urban runoff. ** The bulk of sediments within the Bay enter with tributary discharges.	The eastern floor of the Bay is sandier than the western where greater river inflow has deposited silt and clay sediments.	High concentrations of residual chlorine have been deleterious to Chesapeake Bay organisms, particularly near the Chalk Point power plant and in the James River. Areas where the potential of deleterious effects is most serious include the Potomac River and Hamptom Roads areas.

TABLE 6.1 (Continued)

Name of Study: a. Sponsoring Agency b. Reference c. Area(s) of Bay Investigation	Objective of the Study	Areas of Investigation: Nutrients	Toxic Materials (synthetic organic chemicals and metals)	Non-Point Source Discharges	Physical Alterations	Other Areas
9. The Chesapeake Bay: A study of present and future water quality and its ecological effects. a. National Commission on Water Quality. b. Virginia Institute of Marine Science, 1975. c. Entire Chesapeake Bay and its tributary estuaries.	To describe the present conditioning of water quality (temperature, salinity, nutrients, and dissolved oxygen) and quantity within the Bay. ** To project future water conditions resulting from the achievement of the requirements and goals of PL 92-500. ** To assess the present and future biological and ecological conditions within the Bay.	The major nutrients (phosphorus and nitrogen) in the Bay are derived from freshwater inflows. ** The Susquehanna River is the major source of nutrients for the upper Bay. ** The primary point source loading of nutrients to the Bay occurs upstream from the Conowingo Dam on the Susquehanna River and in the Baltimore area. ** Half of the point source loading to the Bay is concentrated in the Baltimore area, whereas more than half of the non-point source loading of nitrogen is derived from the Susquehanna River.	Toxic materials were not investigated in this study.	Marshes appear to be a dominant non-point source of phosphorus to the Bay under conditions of high flow. ** Both marshes and agricultural land appear to be significant in terms of nitrogen loading, with marshes contributing primarily organic nitrogen and agricultural land contributing mostly nitrate and nitrite nitrogen.	Physical alterations were not investigated in this study.	In Virginia waters many eelgrass beds are recovering from having been decimated recently by browsing cownosed rays. ** Rooted aquatic plants in the upper Bay are declining due to changes in salinity and turbidity induced by Tropical Storm Agnes and subsequent growths of blue-green algae.

TABLE 6.1 (Continued)

Name of Study: a. Sponsoring Agency b. Reference c. Area(s) of Bay Investigation	Objective of the Study	Areas of Investigation: Nutrients	Toxic Materials (synthetic organic chemicals and metals)	Non-Point Source Discharges	Physical Alterations	Other Areas
10. Effect of metals from sewage treatment plants on the Chesapeake Bay. a. National Science Foundation . b. Chesapeake Research Consortium, Incorporated, 1974b. c. Chesapeake Bay and its tributary estuaries .	To determine the extent to which metals from sewage treatment plants affect the Chesapeake Bay.	Nutrients were not investigated.	Sewage treatment plants probably contribute cadmium, copper, zinc, and lead to the Bay in an amount which is an order of magnitude higher than that of the fluvial supply. ** Rivers contribute more manganese, iron, and nickel to the Bay than waste water. ** In a study at one treatment plant, most metals released in the effluent were deposited within a few miles of the outfall. ** Concentrations of zinc, lead, chromium, cadmium, and copper in sediments near the outfall were as much as two orders of magnitude higher than in uncontaminated sediments. ** Such high concentrations may have a severe impact on benthic organisms. **	Non-point source discharges were not investigated in this study. (Toxic Materials *Continued*) Oysters were observed to concentrate metals,, particularly zinc, within a relatively short period of time (13 days). ** Food organisms such as oysters may accumulate metals in concentrations which exceed FDA tolerance levels for human consumption, but they may not exhibit acute or chronic effects of the metals.	Physical alterations were not investigated in this study.	Metals in sewage effluents were the only subject of this study.

TABLE 6.1 (Continued)

Name of Study: a. Sponsoring Agency b. Reference c. Area(s) of Bay Investigation	Objective of the Study	Areas of Investigation: Nutrients	Toxic Materials (synthetic organic chemicals and metals)	Non-Point Source Discharges	Physical Alterations	Other Areas
11. A Chesapeake Bay Report a. None b. Mathias, 1974 c. The entire Chesapeake Bay.	To identify potential machanisms for the management and protection of the Chesapeake Bay. ** To stimulate discussion which may lead to a consensus for a sound management policy.	Nutrients were not addressed.	Toxic materials were not addressed.	Sediment and bacteria in runoff from urban development contribute to the pollution of the Bay. ** Traditional methods of zoning may not be responsive to the abatement of this form of pollution.	The individual impact of each small, man induced physical alteration may be limited. The cumulative impact of permitted alterations may be severe. ** Reviews of applications to permit physical alterations within the Bay should be coordinated and all permits in a locality should be decided on a set date. *Other Areas* Management Problems: Enforcement powers for the protection of the Bay are not inadequate. Problems with respect to the Bay arise as a result of a lack of coordination among authorities and are also due to a failure to completely comprehend the ramifications of the decisions which are made.	Management Mechanisms: To provide a long-term planning and coordinating structure, a Title II Commission for the Chesapeake Bay should be established. This "Chesapeake Bay Commission" may be formed under the Water Resources Planning Act of 1965. * * To decrease pollution from boat discharges, existing marinas should be required to provide restroom facilities as a condition for license renewal. * * In areas within the Bay where water quality standards are not met and boat discharges can be shown to be a contributing factor, agencies should declare a moratorium on marine development or expansion. * *

TABLE 6.1 (Continued)

Name of Study: a. Sponsoring Agency b. Reference c. Area(s) of Bay Investigation	Objective of the Study	Areas of Investigation: Nutrients	Toxic Materials (synthetic organic chemicals and metals)	Non-Point Source Discharges	Physical Alterations	Other Areas
12. Maryland Water Quality 1975. a. State of Maryland. b. Maryland Department of Natural Resources and The Department of Health and Mental Hygiene, 1975. c. Maryland waters of the Chesapeake Bay and its tributaries.	To describe the water quality of all navigable waters of the state. ** To determine the extent to which these waters allow for recreation and provide for the protection and propagation of shellfish, fish and wildlife. ** To determine the extent to which the requirements and goals of Section 305(b) of PL92-500 have been achieved. ** To estimate the impact of the above actions. ** To determine the extent of pollution from non-point source discharges.	An overall decrease in eutrophication was observed in the Upper Bay in the period 1969 to 1974. ** Eutrophication has not become evident in the open waters of the lower Chesapeake Bay. ** Nutrient levels have increased significantly from 1965 to 1974 in the Chester River. ** Available data indicate a tenfold increase in phosphate within a ten year period in the Severn River.	Metals present in the sediments of Baltimore Harbor have the same distribution as the metal laden wastes which enter the harbor from the surrounding industrial complex. ** Correlation exists between the distribution of metals in the sediments of the harbor and the disruption of populations of benthic organisms.	At least 34 of 65 shellfish growing areas were closed in 1974 partly or entirely as a result of contamination by storm water runoff or other forms of non-point source discharges. ** Agricultural runoff continues to inhibit water quality in Deer Creek within the lower Susquehanna drainage basin. ** Urban land runoff is a major problem on the Patuxent River basin.	Physical alterations were not a subject of this report.	Both the upper and lower Bay area proper are suitable for water contact recreation. ** The major effect of the ten sewage treatment plants discharging directly into the Bay, is the closure of shellfish harvesting areas as buffer zones around the individual outfalls.

TABLE 6.1 (Continued)

Name of Study: a. Sponsoring Agency b. Reference c. Area(s) of Bay Investigation	Objective of the Study	Areas of Investigation: Nutrients	Toxic Materials (synthetic organic chemicals and metals)	Non-Point Source Discharges	Physical Alterations	Other Areas
13. An evaluation of the physical and chemical conditions of the Chesapeake Bay. a. Fish and Wildlife Administration, State of Maryland, and Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife, Department of the Interior. b. Schubel, J. R., 1972. c. Entire Chesapeake Bay estuarine system.	To evaluate the physical and chemical conditions of the Chesapeake Bay.	Although nutrient levels in the main body of the Bay are acceptable, man's activities have resulted in large inputs of nutrients which have produced undesirable conditions in a number of tributaries to the Bay. ** Nutrients are at undesirable levels in the upper Potomac River and Back River are near the upper limit in the upper Bay, the Patuxent, and in many smaller tributaries.	There are large natural variations in the distributions of heavy metals in the Bay. ** The above findings suggest that concentrations of metals probably have always been relatively high.	Non-point source discharges were not a subject of this report.	The Bay is rapidly filling with sediments. ** The fine grained sediments are deleterious to the ecology of the Bay. ** The sediments are introduced into the Bay by rivers, shore erosion, biological activity and by the sea.	Inputs of heated waters from power plants (as of 1972) do not pose a threat to the Chesapeake Bay. ** Man's activities have increased the frequency, duration, and extent of low oxygen zones in the upper reaches of a number of the Bay's tributaries.

TABLE 6.1 (Continued)

Name of Study: a. Sponsoring Agency b. Reference c. Area(s) of Bay Investigation	Objective of the Study	Areas of Investigation: Nutrients	Toxic Materials (synthetic organic chemicals and metals)	Non-Point Source Discharges	Physical Alterations	Other Areas
14. A Symposium on the Fate of the Chesapeake Bay. a. Washington Academy of Sciences, the American Ordnance Association, and The Maryland Department of Natural Resources. b. Washington Academy of Sciences, 1972. c. Entire Chesapeake Bay and its tributary estuaries.	To characterize the status of the Chesapeake Bay. ** To identify major threats to the Bay. ** To identify research designed to counter major threats to the Bay.	Over-enrichment does not appear to be an immediate problem in the open Bay. ** Accelerated eutrophication has occurred in tributaries to the Bay such as the Potomac River estuary and Back River. ** These tributary areas act as zones of oxidation where wastes are assimilated above the Bay, thus protecting the Bay from nutrient loading.	Pesticides have caused mortalities of crabs in local areas of the Bay in Virginia. ** Oysters, clams, and other mollusks can concentrate pesticides 50 to 70 thousand times above ambient levels. ** Chlordane may be present in softshell clams at levels injurious to these organisms. ** Generally, pesticides do not present a serious problem in the Bay but warrant continued surveillance.	Local inflows from septic field drainage contribute high levels of nutrients to small tributaries of the western shore. ** Nutrient inputs from agricultural runoff are carried to the Bay by the Susquehanna, Northeast, and Bohemia Rivers. ** Natural sediment runoff, accelerated by earth moving and construction, contributes an estimated 8 million tons of sediment per year to the Bay's tributaries.	Much channel development has been beneficial to the vitality of the Bay by providing a counter process to the accelerated filling of the Bay with sediment. ** Many spoil disposal areas have developed natural vegetative cover and thereby established new food chains, nesting habitats, and hatchery areas in the Bay. Such examples are Harve de Grace Island and an unnamed island off the mouth of Skiffes Creek in the lower James River.	Present inputs of heated water do not post a threat to the Bay. ** Man has had practically no effect on the salinity distribution within the Bay. ** Should all nutrients be removed from point source discharge in the Washington metropolitan area, nutrients within the Potomac River would remain at an undesirable level.

TABLE 6.1 (Continued)

Name of Study: a. Sponsoring Agency b. Reference c. Area(s) of Bay Investigation	Objective of the Study	Areas of Investigation: Nutrients	Toxic Materials (synthetic organic chemicals and metals)	Non-Point Source Discharges	Physical Alterations	Other Areas
15. Redesigning the Institutional Structure of the Chesapeake Bay. a. None. b. Power, 1976. c. The Chesapeake Bay basin.	To discuss alternatives to the present institutional structure for management of the Chesapeake Bay.	Nutrients were not discussed.	Toxic materials were not discussed.	Non-point source discharges were not discussed.	Physical alterations were not discussed. Other Areas Value judgments should be made by politically responsive bodies and not by administrative agencies * * A need exists for a system for decision making with respect to the Bay. * * This system can bring such value choices into focus for review by politically accountable bodies	Value choices are made by people. Scientific investigations only can depict the consequences of a decision * * Existing governmental units should be concerned with the policies and value judgments which determine competition for the resources of the Bay. * * Expectations should be lowered with respect to the actual accomplishments that can be attained by governmental activities or legislation related to Bay management. * * Scientific investigations can not provide answers as to how the Bay should be utilized. * *

TABLE 6.1 (Continued)

Name of Study: a. Sponsoring Agency b. Reference c. Area(s) of Bay Investigation	Objective of the Study	Areas of Investigation: Nutrients	Toxic Materials (synthetic organic chemicals and metals)	Non-Point Source Discharges	Physical Alterations	Other Areas
16. Virginia Water Quality Inventory. a. Virginia State Water Control Board. b. Virginia State Water Control Board, 1976. c. Virginia waters of the Chesapeake Bay and its tributaries.	To describe the water quality of the navigable waters of Virginia. ** To determine the feasibility and practicability of attaining the goals of PL 92-500.	Trends for the improvement of water quality for total phosphate, kjeldahl nitrogen and ammonia have been observed for the Chesapeake Bay. ** Nitrate and nitrite show a slight worsening trend. ** In a few areas within the Bay's basin, orthophosphate consistently showed a worsening trend.	Owing to contamination by a toxic pesticide ingredient, KEPONE, and other incidents, the lower James River has been closed for fishing and other uses.	Septic tank leachate is a major water quality problem on the eastern shore of the Chesapeake Bay.	Within the Bay, many homeowners are unable to launch boats owing to the silting of creeks and canals.	The sub-surface waters of the Great Wicomico River experience oxygen depletion in late summer rendering oyster larvae immobile. This phenomenon apparently is natural.

TABLE 6.1 (Continued)

Name of Study: a. Sponsoring Agency b. Reference c. Area(s) of Bay Investigation	Objective of the Study	Areas of Investigation: Nutrients	Toxic Materials (synthetic organic chemicals and metals)	Non-Point Source Discharges	Physical Alterations	Other Areas
17. Natural areas of the Chesapeake Bay Region. a. Smithsonian Institution. b. *Center for Natural* Areas, 1974. c. The Chesapeake Bay drainage basin between Pennsylvania and North Carolina and the fall line extending from Baltimore through Washington to Richmond.	To identify ecologically significant natural areas. ** To recommend for procurement those *judged to be* highest in terms of priority for presentation.	Nutrients were not discussed.	Toxic materials were not discussed.	Non-point source discharges were not discussed.	Physical alterations were not discussed.	Spawning fish, particularly species which are anadromous, concentrate in selected tributaries to the Bay. These fish include striped bass, herring, *hickory shad, and* American shad. ** Marshes near spawning areas serve as nurseries for fry and are considered highly important to the successful propagation of these migratory fish. ** Marshes adjacent to the Bay are intimately related to the vitality of clams and oysters. ** Marshes slow longshore currents and allow suspended sediments to settle. ** Shellfish within the Bay are sessile as adults and sensitive to siltation especially oysters which lack the siphon which allows clams to be burried by silt. **
		Other Areas The Chesapeake Bay fishery industry represents an important resource. The value of commercial catches in 1966 was about $30 million of which $5 million was attributed to the harvesting of lysters. In the same year private fishermen expended about $10 million on recreational activities. **	Other Areas Estimates indicated that pollution primarily from municipal and domestic discharges, affects 400,000 acres of finfish habitat and 42,000 acres of shellfish habitat in the Bay. ** Estimates also indicated that raw sewage discharged from ships was equivalent to the pollution loading of the Bay by the wastes of 25,000 people. **	Other Areas About 75 percent of the salt marsh habitat in the Bay area is of moderate to high value for waterfowl. ** About half of the salt marsh acreage around the Chesapeake Bay is managed specifically for waterfowl. ** More than 75 percent of the wintering population of Canadian geese which which use the Atlantic Flyway, reside in or near tidal waters of the Bay. **	

TABLE 6.1 (Continued)

Name of Study: a. Sponsoring Agency b. Reference c. Area(s) of Bay Investigation	Objective of the Study	Areas of Investigation: Nutrients	Toxic Materials (synthetic organic chemicals and metals)	Non-Point Source Discharges	Physical Alterations	Other Areas
18. Survey of Anadromous Fish Spawning Areas. a. Maryland Department of Natural Resources. b. O'Dell, Gabor, and Dintaman, 1975. c. The Potomac River and the upper Chesapeake Bay and its tributaries from the Bay bridge near Annapolis to the mouth of the Pennsylvania boundary.	To inventory anadromous fish spawning and nursery area streams. ** To assemble information useful to the improvement of stream conditions for fish propagation.	Nutrients were not discussed.	Toxic materials were not discussed.	Non-point source discharges were not discussed.	Physical alterations were not discussed.	Many problem conditions, including discharges and stream alterations which were identified were unknown to agencies responsible for the management of such conditions. ** The walking of each stream course, contributed to the first State inventory of dams and other stream blockages. **
		Other Areas Spawning was documented for one or more anadromous species for the main stem of the Potomac River along the shoreline of Maryland from the Wicomico River to Washington, D.C. **	Other Areas In the drainage area for the Potomac River six areas were identified which pose threats to the migration or spawning of anadromous fish. These problem conditions reflected impacts from refuse disposal, activities of livestock, floodplain activities, and sedimentation. These problem conditions were referred to appropriate agencies for corrective action. **	Other Areas For the Chesapeake Bay drainage area, 45 problem conditions were identified. These reflected impacts from industrial and governmental wastes, municipal wastes, storm drain discharges, urban runoff, discarded refuse, sanitary landfill violations, livestock activities, stream alterations, floodplain activities, and sedimentation. **	Except for the white perch, no spawning runs were documented for the lower Potomac River or its tributaries. ** Of 194 streams surveyed in the Upper Chesapeake Bay and drainage areas, 155 had anadromous spawning activity. ** All major tributaries on both sides of the Bay exhibited spawning activity of one or more anadromous species.	Other than previous surveys of striped bass spawning rivers, this study represented the first and only comprehensive survey of anadromous spawning streams in Maryland. ** Within the four and one-half year study, 310 streams were surveyed. ** In tributaries to the Potomac River, 43 of the 116 streams surveyed had spawning activities of one or more anadromous species. **

TABLE 6.1 (Continued)

Name of Study: a. Sponsoring Agency b. Reference c. Area(s) of Bay Investigation	Objective of the Study	Areas of Investigation: Nutrients	Toxic Materials (synthetic organic chemicals and metals)	Non-Point Source Discharges	Physical Alterations	Other Areas
19. Chesapeake Bay Waste Load Allocation Study. a. Maryland Department of Natural Resources. b. Hydroscience, Inc., 1975. c. The Chesapeake Bay from the Conowingo Dam on the Susquehanna River to the Atlantic Ocean at Cape Henry.	To compile and review data on the geomorphological hydrodynamic, and hydrologic, and nutrient characteristics of the Chesapeake Bay. ** To construct a nutrient model for the Chesapeake Bay. ** To construct a waste load allocation model for the Wicomico River.	There is an overall long-term trend of increased chlorophyll-a concentrations in the upper Bay during summer months. ** The most significant sources of nutrient loading to the Bay are from the Baltimore metropolitan area and the Susquehanna River. ** Phosphorus is the primary nutrient that is limiting algal growth in the Bay. ** About 50 percent of the total phosphorus released from the Baltimore area to the Baltimore Harbor and 10 percent of the total phosphorus in the effluent of the Back River Wastewater Treatment Plant reach the Bay. **	Toxic materials were not studied.	To control chlorophyll-a levels within acceptable limits, significant phosphorus reductions in major point source discharges in Maryland and those to the Susquehanna River will be required. ** Non-point source discharges to the Chesapeake Bay within Maryland have a relatively minor impact on the Bay.	Physical alterations were not studied.	Abatement of point source discharges of organic materials to the Chesapeake Bay would not significantly increase dissolved oxygen concentrations within the open Bay. ** The major oxygen demand in the Bay proper appears to be from oxygen demanding sediments. The origin of these sediments is unknown.
			(Nutrients Continued) The remaining phosphorus is bound and settles in the Back River within algal cells or within the Harbor and retained by algal settling and chemical precipitation. **	(Nutrients Continued) For a reduction in the concentrations of chlorophyll within the Bay, the first step in the abatement of nutrient input should be directed toward phosphorus. **	(Nutrients Continued) Chlorophyll-a levels in the upper Bay in July 1950 were less than 5µg/ℓ. Within 15–20 years the levels were averaging greater than 20µg/ℓ for stations in the open Bay.	

TABLE 6.1 (Continued)

Name of Study: a. Sponsoring Agency b. Reference c. Area(s) of Bay Investigation	Objective of the Study	Areas of Investigation: Nutrients	Toxic Materials (synthetic organic chemicals and metals)	Non-Point Source Discharges	Physical Alterations	Other Areas
20. Biota of the Chesapeake Bay. a. Corps of Engineers. b. Chesapeake Research Consortium, Incorporated, 1972. c. The entire Chesapeake Bay and its tributary estuaries.	To summarize the current state of knowledge relevant to the Bay. ** To summarize the current knowledge of sediments, eutrophication, heavy metals, and pesticides in the Bay. ** To review criteria for measuring the biological effects of environmental changes in the Bay. ** To suggest systems for the handling of data utilized in the management of a complex ecosystem.	Most scientists accept an average ratio of N:P (levels of nitrogen relative to phosphorus based on atomic weight) of phytoplankton to be 10 to 15:1. Thus as much as 15 times more N is required by cellular material than of P. ** In the Patuxent estuary observed N:P ratios in summer were less than 5:1. Thus, nitrogen appeared to be more of a limiting factor than phosphorus. ** There may be conditions where other elements, vitamins, hormones, or chelating agents may be limiting.	Available data are not sufficient to predict the biological effects of heavy metals on estuarine biota, especially for species of the lower trophic levels in the Chesapeake Bay. ** Analyses of mercury in the tissues of blue crabs, oysters, eels, white perch, catfish, and striped bass from the Bay area indicated levels not exceeding an FDA standard of 0.5 ppm.	Fragments of organic matter comprised about 26 percent of the total suspended particles entering the upper Bay from the Susquehanna River. ** During 1966 most of the input of sediments to the Bay from the Susquehanna River occurred during the spring runoff. About 90 percent of the sediments remained in the northern area of the Bay.	During an overboard spoil disposal operation in the upper Bay, turbidity was increased over a five square kilometer area. Tidal currents carried a turbid plume about 5000 meters. After 150 days, a 12 percent net loss of the deposited sediment was observed. ** In the lower Chesapeake Bay, the resettlement of dredged and spoil disposal areas by benthic organisms was a rapid process.	Blue crabs are caught in large numbers in the Bay. ** The oyster catch is of less volume but is of greater value. ** The soft clam fishery is relatively successful in Maryland. ** Although more difficult to collect the hard clams support a sizeable fishery in the lower Bay. ** Menhaden are in a slow decline but still comprise up two-thirds of the total tonnage of fish caught within the Bay.

7.0 MONITORING OF THE BAY

7.1 Introduction

During the course of this study, various sampling activities relevant to the physical, chemical, biological, or health aspects of the Chesapeake Bay and its tributaries were identified. Some of these activities involved the collection of samples over a very short period in support of a limited project. In this study, emphasis was placed on sampling efforts which required successive measurements over a prolonged period of time for the purpose of detecting change, or the lack of it.

7.2 Monitoring Activities

Within the Bay area, several agencies have established organized systems or networks for the collection of a specific kind of information. These systems include a series of points (stations) at which measurements are made at a predetermined frequency. A summary of these types of monitoring activities is presented in Appendix I - Major Monitoring Programs for 51 discrete monitoring programs. These represent primarily major monitoring programs, i.e., ones which are not short-lived or involve a localized sampling activity such as that conducted by a municipality. However, because of a special interest expressed by the Chesapeake Bay program in non-point source discharges, monitoring activities in the Chesapeake area being performed in compliance with Section 208 (PL 92-500) were included. These sampling activities, for the most part, are short-lived and relate to a portion of an area represented by a regional planning commission.

Of the 51 major existing monitoring programs identified during this study, 34 address surface water quality, 2 are concerned with point discharges, 5 with non-point discharges, 7 with the quality and volume of sediments, 22 with the kinds and abundance of aquatic organisms, and 3 with the abundance and edibility of harvested species. Of the programs, 27 sample for toxic substances (chlorinated organic compounds or metals) and 35 sample for nutrients (phosphorous or nitrogen compounds). A description of these programs is provided in Appendix I. The description identifies by name the agency conducting the monitoring and a person to contact for additional information, the name of the program and purpose of monitoring, the medium sampled and parameters analyzed, the number and general locations of sampling stations, the frequency of sampling, the duration of the monitoring program, and the form of data storage.

Of all of the states contacted, Maryland was identified as administering the most comprehensive monitoring program with respect to the Chesapeake Bay. For more than fifteen years, Maryland has had, in effect, some type of intensive ambient surface water monitoring program. Currently, Maryland utilizes two methodologies to maintain surveillance of its waters, an intensive monitoring methodology and a trend monitoring methodology.

The intensive monitoring is designed so that all waters of the State will receive detailed sampling within some reasonable time frame. Under the program, the waters have been divided into five

geographical areas. Each geographical area is considered for intensive monitoring work each year. Thus, the entire State's waters receive attention once in every five-year period. This time frame was chosen primarily to coincide with information needs for waste water discharge purposes and because water quality does not normally change significantly within a lesser time frame.

The trend monitoring program is designed to supplement the intensive monitoring program in order to allow for a continuing observation of the long-term changes occurring in surface waters. This monitoring network currently consists of 133 stations situated in Maryland waters of the Bay and its tributaries.

In addition to the regular monitoring of surface waters, Maryland has more than 40 individuals, located throughout the State, who sample municipal and industrial discharges to assure compliance with regulations specified in discharge permits and federal and state laws or regulations. In addition to sampling in response to approximately 1000 discharge permits, continuous checks for compliance with state permits and regulations are made of such areas as wetlands, sediment and erosion control, flood plain intrusion, and oil spill violations.

The monitoring programs of the State of Maryland are primarily conducted by the Environmental Health Administration of the Department of Health and Mental Hygiene and by various divisions of the

Department of Natural Resources. A total of 22 major monitoring programs were identified for the State.

In Virginia, 8 monitoring programs were identified. Of these, 5 are conducted by the Bureau of Shellfish Sanitation of the Department of Health, and one each by the Bureau of Industrial Hygiene, also of the Department of Health, the Virginia Institute of Marine Science, and the Virginia State Water Control Board. Water quality monitoring within the state is conducted by the State Water Control Board at over 570 stations throughout the Virginia portion of the Chesapeake Bay and its tributaries. This basic network has been in existence since 1970. The Water Control Board also conducts inspections to assure that sewage and industrial waste effluents are in compliance with discharge permit requirements. Extensive sampling is conducted in shellfish growing areas and other waters for metals, pesticides, coliform bacteria and kepone, by the Bureau of Shellfish Sanitation. The Virginia Institute of Marine Science sponsors a surface water monitoring program for the purpose of obtaining data collected on a regular basis and which reflect the state of water quality over a period of time. This archival program has been in existence for five years.

The monitoring activities of federal agencies include those of the Corps of Engineers (water supply), Environmental Protection Agency (water quality and the National Estuarine Monitoring Program), U.S. Fish and Wildlife Service (waterfowl and invertebrate sampling), U.S.

Geological Survey (water quality), and the National Marine Fisheries Service (menhaden sampling). The most comprehensive of these efforts is that of the Environmental Protection Agency which regularly samples for water quality at 133 stations through its consolidated Water Quality Studies in the Chesapeake Bay and Potomac River. Other monitoring programs, although not extensive in relation to the Chesapeake Bay, include those of the States of Pennsylvania and West Virginia, the District of Columbia, the Susquehanna River Basin Commission, and various regional planning commissions.

8.0 COOPERATIVE RELATIONSHIPS

During the course of this study, several interagency cooperative efforts were identified. The nature and purpose of these relationships varied according to the objective of the common effort. Most of the relationships took the form of federal/state advisory bodies wherein the participants provided guidance with respect to overall coordination and integration of a particular program. Such advisory bodies include the "Chesapeake Bay Program Policy Advisory Committee" of the Environmental Protection Agency, and the Corps of Engineers "Chesapeake Bay Study Advisory Group". Other groups, such as the "Chesapeake Bay Subcommittee" of the Interagency Committee on Marine Science and Engineering, exist primarily to promote communication and coordination among the planning and management activities of the member agencies.

A compilation of those cooperative efforts or institutional mechanisms identified as relating to the water quality of the Bay are presented in Appendix II - Cooperative Relationships. Contacts are provided for each relationship to facilitate the acquisition of additional information.

9.0 SIMILAR RESEARCH - MANAGEMENT PROGRAMS

9.1 Introduction

A major goal of the Environmental Protection Agency's Chesapeake Bay Program is to develop a water quality management program for the Bay. Attempts have been made for other, somewhat similar, bodies of water to establish an efficient approach to water quality management. Most of these efforts have been successful because the entire body of water to be managed was situated within the jurisdictional boundary of a single state. Many of the large surfaces of water which lie between states are protected through interstate compacts or commissions such as the Delaware River Basin Commission.

The following is a brief description of the nature and extent of water quality management efforts on other large marine areas. This discussion is intended only as an identification of other approaches to management or to the understanding of basic management problems. A detailed analysis is required to determine the appropriateness of applying these techniques or lessons learned to the development of a program plan for the Bay.

9.2 Long Island Sound Management Study

One of the most recent comprehensive management plans for an Atlantic estuarine system was developed by a water resources study entitled "Long Island Sound Study". The investigation was a multidisciplinary, multi-agency, three year study. The lead

agency was the New England River Basin Commission, Boston, Massachusetts. The results were published in 16 volumes (New England River Basin Commission, 1975).

In addition to making specific recommendations for solving critical problems, the study analyzed various legal and institutional arrangements for managing the implementation of their recommendations. Both short-term and long-term management plans were discussed.

This study may be particularly relevant because Long Island Sound and its drainage area extends over more than one interstate boundary; therefore, many of the legal and institutional problems may be similar to those that will be experienced in the Chesapeake Bay program.

9.3 San Francisco Bay-Delta Plans

In California the policies and goals of PL 92-500 are implemented through the State Water Resources Control Board and the nine regional Water Quality Control Boards acting in conjunction with Region IX of the EPA. It is the responsibility of the nine Regional Boards to formulate and adopt water quality control plans that protect the beneficial uses of the waterways under their jurisdiction and to comply with the State policy for water quality control.

The water quality control planning strategy consists of identifying stream segments, listing beneficial uses, defining water quality objectives, and quantifying anticipated wasteloads for each stream segment. Finally, the resultant water quality of the segment is calculated and waste discharge requirements for controllable point

sources are established accordingly. The basin planning document contains a detailed description of the control concepts, an implementation schedule, and a program for assessing compliance. The basin planning is part of an on-going process and is continuously being updated.

In dealing with contiguous water bodies, such as the San Francisco Bay/Sacramento-San Joaquin Delta, water quality management has been simplified by establishing basin, subbasin, and segment designations. For example, the Sacramento-San Joaquin Delta is subdivided into the Sacramento River, Sacramento-San Joaquin Delta, and San Joaquin River subbasins. The tributaries to the Sacramento-San Joaquin Delta were segmentized according to the definition of "segment designation", which appeared in the Federal Register (40 CFR 130.2 M).

The San Francisco Bay was subdivided in a similar manner. Wasteload allocations were calculated for different segments of the Bay and established water quality objectives were based on beneficial uses. Water quality objectives were established for the following:

bacteria
biostimulatory substances
temperature
chemical constituents
color
dissolved oxygen
pesticides
radioactivity
electrical conductivity
total dissolved solids
toxicity
floating material
oil and grease
pH
sediment
settlable material
suspended material
tastes and odors
turbidity

9.4 The Management of Great South Bay

Great South Bay located south of Long Island, New York, ranks with the Chesapeake Bay as one of the most valuable estuaries on the Atlantic coast. The Great South Bay physically is quite dissimilar to the Chesapeake Bay. The Chesapeake Bay essentially is a drowned river basin. Great South Bay, however, is a lagoon formed by barrier islands.

The drainage area of Great South Bay is small in comparison with Chesapeake Bay; therefore, non-point discharges contribute lesser quantities of pollutants. In addition, the stream flow in the small tributaries which do flow into Great South Bay consist of only 5% surface runoff. The remaining 95% consists of ground water seepage.

Further differences exist in institutional and legal aspects. Great South Bay is located within the jurisdiction of only one State; and the two major Counties (Nassau and Suffolk) cooperate fully in planning and management activities. The Coastal Zone Management Program for New York and the Regional 208 plan may become effective management plans for Great South Bay without the creation of additional agencies or commissions.

Commonality between Great South Bay and the Chesapeake Bay is that each is utilized extensively as a recreational area (passive recreation, shellfishing, and sport-finfishing). Commercial shellfishing (especially clamming) also is important to both bays.

Furthermore, both bays function as a stopover for migratory waterfowl and as a nursery area for commercially important finfishes.

Three references which discuss some aspects of marine resource management pertinent to Great South Bay, also may be useful to the Chesapeake Bay program. These references are:

- Ellis, R. H., P. B. Cheyney, J. T. Ball, and E. R. Sweeton. 1972. "Design of a management information system for coastal resources planning." Prepared by the Center for Environment and Man, Inc., Sea Grant Project GH-63, National Science Foundation, CEM-4103-460. Regional Marine Resources Council. Hartford, Connecticut,

- Ellis, R. H., P. B. Cheyney, F. A. Smith, R. M. Davis, and R. O. Brush. 1969. "The development of a procedure and knowledge requirements for marine resource planning." Prepared by the Travelers Research Corporation for the Marine Resources Council, Nassau-Suffolk Regional Planning Board, Hauppauge, New York.

- Smith, F. A., L. Ortolano, R. M. Davis, and R. O. Brush, 1970. "Fourteen selected marine resource problems of Long Island, New York." Descriptive evaluations prepared by the Travelers Research Corporation for the Marine Resources Council, Nassau-Suffolk Regional Planning Board, Hauppauge, New York, 128.

9.5 New York Bight

With respect to the establishment of a research program for the Chesapeake Bay, a similar program was developed for the New York Bight which involved an identification of basic problems within the Bight and the establishment of a program of research to understand the extent and sources of water quality problems. The research program, termed the New York Bight Marine Ecosystems Analysis (MESA) Project, is administered by the National Oceanic and Atmospheric Administration, United States Department of Commerce.

This project, established during July 1973, is a 7-year program designed to:

1. Determine the fate and effects of pollutants on the ecosystem of the New York Bight, particularly in regard to ocean dumping.
2. Quantify environmental factors involved in the location, design, and operation of major offshore facilities.
3. Identify and describe important environmental systems operating in the Bight and define their interrelationships.

The MESA program relies to a large extent on review by advisory committees which reflect governmental, industrial, academic and public concerns. These committees have met on a regular basis to review the performance of the program and to recommend future courses of action.

10.0 ACRONYMS AND INITIALISMS

AEC	Atomic Energy Commission (functions divided in 1975 between the Nuclear Regulatory Commission and the Energy Research and Development Administration)
AFO	Annapolis Field Office (of Region III, Environmental Protection Agency)
BG&E	Baltimore Gas and Electric Company
BWQMN	Baseline Water Quality Monitoring Network
CAC	Citizens Advisory Committee (with reference to the Water Resources Citizens Advisory Committee of the Metropolitan Washington Council of Governments)
CBESS	Chesapeake Bay Earth Sciences Study (a program of the Maryland Geological Survey, Maryland Department of Natural Resources)
CEES	Center for Environmental and Estuarine Studies (an organizational unit of the University of Maryland)
COWAMP	Comprehensive Water Quality Management Plan (with reference to water resources planning by the State of Pennsylvania for the Lower Susquehanna River Basin)
COG	Metropolitan Washington Council of Governments
CRC	Chesapeake Research Consortium, Incorporated
DDT	Dichlorodiphenyltrichloroethane (an insecticide)
DNR	Department of Natural Resources (of the State of Maryland)
EDBD	Environmental Data Base Directory (computerized inventory of environmental data bases, Environmental Data Service, National Oceanic and Atmospheric Administration)

EPA	Environmental Protection Agency
ERDA	Energy Research and Development Administration
FOSDIC	Film Optical Sensing Device for Input to Computers (of the National Bureau of Standards)
HRWQA	Hampton Roads Water Quality Agency
HUD	Department of Housing and Urban Development
INCOPOT	Interstate Commission on the Potomac River Basin
ICMSE	Interagency Committee on Marine Science and Engineering (formed in 1971 by the Federal Council for Science and Technology)
JHU/APL	Johns Hopkins University, Applied Physics Laboratory
MDOT	Maryland Department of Transportation
MESA	Marine Ecosystems Analysis (a program of the National Oceanic and Atmospheric Administration)
NASA	National Aeronautics and Space Administration
NASQAN	National Stream Quality Accounting Network (a data collection network of the Geological Survey, Department of Interior)
NAWDEX	National Water Data Exchange (of the Geological Survey, Department of Interior)
NMFS	National Marine Fisheries Service (National Oceanic and Atmospheric Administration); formerly--Bureau of Commercial Fisheries
NOAA	National Oceanic and Atmospheric Administration (Department of Commerce)
NODC	National Oceanographic Data Center (Environmental Data Service, National Oceanic and Atmospheric Administration)

NOS	National Ocean Survey (National Oceanic and Atmospheric Administration); formerly--Coast and Geodetic Survey
NPDES	National Pollutant Discharge Elimination System (of the Environmental Protection Agency)
NSF	National Science Foundation
NTIS	National Technical Information Service
NVPDC	Northern Virginia Planning District Commission
OASIS	Oceanic and Scientific Information System (information retrieval system, Environmental Data Service, National Oceanic and Atmospheric Administration)
OCZM	Office of Coastal Zone Management (National Oceanic and Atmospheric Administration)
OWDC	Office of Water Data Coordination (Geological Survey, Department of Interior)
OWRT	Office of Water Research and Technology (of the Department of Interior)
PCBs	Polychlorinated Biphenyls (a group of chlorinated organic chemicals)
pH	The negative logarithm of the hydrogen ion concentration in water
Ph.D.	Doctor of Philosophy
PPSP	Power Plant Siting Program (of the Maryland Department of Natural Resources)
RADCO	Rappahannock Area Development Commission (situated in Fredericksburg, Virginia)
RANN	Research Applied to National Needs (a program of the National Science Foundation)
RAMS	Research and Management Shoreline (a data bank situated at the Johns Hopkins University, Applied Physics Laboratory)

RPC	Regional Planning Council (situated in Baltimore, Maryland)
STORET	Storage and Retrieval (a data processing system utilized by federal and state agencies)
TAC	Technical Advisory Committee (with reference to the Water Resources Technical Advisory Committee of the Metropolitan Washington Council of Governments)
USGS	United States Geological Survey (Department of Interior)
VIMS	Virginia Institute of Marine Science
VPI	Virginia Polytechnic Institute and State University
WAMIS	Water Quality Management Information System (of the Pennsylvania Department of Environmental Resources)
WATSTORE	National Water Data Storage and Retrieval System (of the Geological Survey, Department of Interior)
WRA	Water Resources Administration (of the Maryland Department of Natural Resources)

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APPENDIX I

MAJOR MONITORING PROGRAMS

TABLE I.1

INDEX TO MONITORING PROGRAMS

AGENCY	PROGRAM	PAGE	PROGRAM CODE
FEDERAL			
CORPS OF ENGINEERS, Baltimore District, Washington Aqueduct Division	Routine water supply monitoring of the Potomac River	I-9	1*
ENVIRONMENTAL PROTECTION AGENCY Office of Pesticide Programs, Technical Services Division	National Estuarine Monitoring Program	I-10	1
Annapolis Field Office	Chesapeake Bay Consolidated Water Quality Study	I-11	1
	Potomac Consolidated Water Quality Study	I-12	1
U.S. FISH AND WILDLIFE SERVICE Migratory Bird Habitat Research Laboratory, Laurel, Maryland	Aquatic Vegetation Trend Monitoring	I-13	1
	Invertebrate Sampling	I-14	1
Migratory Bird Management Office, Laurel, Maryland	Waterfowl Survey	I-13	2
U.S. GEOLOGICAL SURVEY Department of the Interior	National Stream Quality Accounting Network (NASQAN)	I-15	1
NATIONAL MARINE FISHERIES SERVICE Atlantic Estuarine Fisheries Center	Menhaden Catch Sampling	I-16	1

*Program Code in parentheses at upper right of name of program.

TABLE I.1 (Continued)

AGENCY	PROGRAM	PAGE	PROGRAM CODE
STATE OF MARYLAND			
DEPARTMENT OF HEALTH AND MENTAL HYGIENE Environmental Health Administration, Bureau of Sanitary Engineering	Shellfish Sanitation Monitoring	I-17	1
	Routine Shell Stock Sampling	I-17	2
DEPARTMENT OF NATURAL RESOURCES Energy and Coastal Zone Administration Power Plant Program	Potomac Estuaries Fisheries Study	I-18	1
	Potomac Estuaries Fisheries Study	I-19	1
Fisheries Administration	Marine Animal Disease Investigations	I-20	1
	Sampling for marine fungus contamination	I-20	2
	Chesapeake Bay Bottom Study	I-21	1
Fisheries Administration, Tidewater Finfish Program	Estuarine Finfish Program	I-22	1
	Anadromous Fish/Stream Survey Program	I-23	1
Maryland Geological Survey, Coastal and Estuarine Geology Division	Chesapeake Bay Earth Sciences Study (CBESS) of the Chesapeake Bay Bottom Study	I-24	1
Power Plant Siting Program, Calvert Cliffs Nuclear Power Plant	Heavy metals (NASA)	I-25	1
	Biological Sampling (ERDA)	I-25	2
	Finfish and blue crab studies (PPSP)	I-25	3
	Cooling water quality (BG&E)	I-26	1

TABLE I.1 (Continued)

AGENCY	PROGRAM	PAGE	PROGRAM CODE
STATE OF MARYLAND (Continued)			
DEPARTMENT OF NATURAL RESOURCES (Continued) Power Plant Siting Program, Calvert Cliffs Nuclear Power Plant (Continued)	Tidal and seasonal effects on plume shape and position (PPSP)	I-26	2
	Water Chemistry (ERDA)	I-26	3
	Water Chemistry (BG&E)	I-26	4
	Biological sampling (BG&E)	I-27	1
Water Resources Administration, Water Quality Services	Chesapeake Bay and Potomac River Consolidated Water Quality Monitoring Program	I-28	1
	Intensive Ambient Surface Water Quality Monitoring Program	I-29	1
	Trend Ambient Surface Water Quality Monitoring Program	I-30	1
	Intensive Point Source Discharge Monitoring Program	I-31	1
STATE OF PENNSYLVANIA			
DEPARTMENT OF ENVIRONMENTAL RESOURCES Division of Water Quality, Bureau of Water Quality Management	Pennsylvania Water Quality Network	I-32	1
	Pennsylvania Water Quality Network - Supplemental work on the Potomac River Basin	I-33	1

TABLE I.1 (*Continued*)

AGENCY	PROGRAM	PAGE	PROGRAM CODE
STATE OF VIRGINIA			
DEPARTMENT OF HEALTH Bureau of Industrial Hygiene, Radiological Health Section	Virginia Radiological Health's Surveillance Program	I-34	1
Bureau of Shellfish Sanitation	Shell Stock Sampling Program	I-35	1
	Kepone Monitoring	I-35	2
	Bacteriological Sampling Program	I-36	1
	Heavy Metal Monitoring Program	I-37	1
	Pesticide Monitoring Program	I-38	1
INSTITUTE OF MARINE SCIENCE	Water Quality Monitoring	I-39	1
STATE WATER CONTROL BOARD	Water Quality Surveillance	I-40	1
STATE OF WEST VIRGINIA			
DEPARTMENT OF NATURAL RESOURCES Division of Water Resources	Water Quality Monitoring	I-41	1
DISTRICT OF COLUMBIA			
Bureau of Wastewater Treatment, Water Resources Management Administration	Potomac River Monitoring	I-42	1
	Anacostia River Monitoring	I-42	2

TABLE I.1 (Concluded)

AGENCY	PROGRAM	PAGE	PROGRAM CODE
REGIONAL AND LOCAL			
SUSQUEHANNA RIVER BASIN COMMISSION	Continuous Monitoring of the Susquehanna River	I-43	1
	Trend Monitoring of Interstate Waters	I-43	2
HAMPTON ROADS WATER QUALITY AGENCY (HRWQA)	Non-point source area-monitoring program	I-44	1
METROPOLITAN WASHINGTON COUNCIL OF GOVERNMENTS -- NORTHERN VIRGINIA PLANNING DISTRICT COMMISSION (NVPDC)	Occoquan/Four Mile Run Runoff Monitoring Program	I-45	1
RAPPAHANNOCK AREA DEVELOPMENT COMMISSION (RADCO)	Non-point Source Area-wide Monitoring Program	I-46	1
REGIONAL PLANNING COUNCIL	Non-point Source Area-wide Monitoring Program	I-47	1
RICHMOND-CRATER CONSORTIUM	Non-point Source Area-wide Monitoring Program	I-48	1

TABLE I.2

Nature of Materials Monitored

Surface Waters	Point Discharges	Non-Point Discharges	Sediments	Biota	Harvested Organisms
I-9(1)[nt**]	I-26(1)	I-44(1)[n]	I-14(1)	I-10(1)[t]	I-16
I-11(1)[u]	I-31(1)[n]	I-45(1)[nt]	I-24(1)[t]	I-13(1)	I-17(2)[t]
I-12(1)[n]		I-46(1)[nt]	I-25(1)[t]	I-13(2)	I-35(1)
I-15(1)[nt]		I-47(1)[n]	I-30(1)[nt]	I-14(1)	
I-17(1)		I-48(1)[nt]	I-32(1)[nt]	I-18(1)	
I-18(1)			I-33(1)[nt]	I-19(1)	
I-19(1)			I-34(1)	I-20(1)	
I-23(1)[n]				I-20(2)	
I-25(2)				I-21(1)	
I-25(3)				I-22(1)	
I-26(2)				I-23(1)[n]	
I-26(3)[n]				I-25(2)	
I-26(4)[nt]				I-25(3)	
I-27(1)				I-27(1)	
I-28(1)[n]				I-30(1)	
I-29(1)[n]				I-33(1)[nt]	
I-30(1)[n]				I-34(1)	

TABLE 1.2 (Continued)

Surface Waters	Point Discharges	Non-Point Discharges	Sediments	Biota	Harvested Organisms
I-32(1)[nt]				I-35(2)[t]	
I-33(1)[nt]				I-36(1)	
I-34(1)				I-37(1)[t]	
I-36(1)				I-38(1)[t]	
I-37(1)[t]				I-41(1)[nt]	
I-39(1)[n]					
I-40(1)[nt]					
I-41(1)[nt]					
I-42(1)[n]					
I-42(2)[n]					
I-43(1)					
I-43(2)[nt]					
I-44(1)[n]					
I-45(1)[nt]					
I-46(1)[nt]					
I-47(1)[n]					
I-48(1)[nt]					

[n] Nutrients (phosphorus or nitrogen compounds) sampled.

[t] Toxic substances (chlorinated organic compounds or metals) sampled.

** Page number within Appendix I and program code. Program code located in parentheses at upper right of name of program.

TABLE I.3

SUMMARY OF MAJOR MONITORING ACTIVITIES

a. Agency/Institution b. Contact for Additional Information	a. Name of Program b. Purpose of Monitoring	a. Medium Sampled b. Parameters Sampled	a. Number and General Location of Sampling Stations	a. Frequency of Sampling b. Duration of Monitoring Program c. Form of Data Storage
a. Corps of Engineers, Baltimore District, Washington Aqueduct Division b. Harry Ways, Chief Washington Aqueduct Division (202) 282-2753	a. Routine water supply monitoring of the Potomac River. [1] b. To maintain surveillance of the quality of potable water supplies and adjacent waters.	a. Surface waters. b. Routine water quality parameters including: pH Dissolved oxygen Salinity Nitrogen Metals Fecal Coliform Bacteria Viruses.	a. Five stations located at Great Falls and Little Falls on the Potomac River mainstream and three stations in the Potomac River estuary.	a. Daily, bi-weekly or monthly, depending upon parameters to be measured. b. Some monitoring activity has taken place over the last 110 years. Most routine monitoring has been conducted in the past 50 years. c. Tabular form and computerized into STORET.

TABLE I.3 (Continued)

a. Agency/Institution b. Contact for Additional Information	a. Name of Program b. Purpose of Monitoring	a. Medium Sampled b. Parameters Sampled	a. Number and General Location of Sampling Stations	a. Frequency of Sampling b. Duration of Monitoring Program c. Form of Data Storage
a. Environmental Protection Agency, Office of Pesticide Programs, Technical Services Division b. Philip A. Butler, Project Contact (Located at the EPA Environmental Research Laboratory, Gulf Breeze, Florida) (904) 932-5311	[1] a. National Estuarine Monitoring Program. b. Trend monitoring of heavy metals and pesticide contamination in juvenile fish.	a. Yearlings - at least two species in different food webs (i.e., carnivore and particle feeder). Fish are homogenized for purpose of analyses. b. Chlorinated pesticides; organo-phosphate pesticides; PCB's; phenoxy-herbicides; lead; cadmium; mercury.	a. Trawls are located at the mouths of major tributaries to the Bay. Sampling is performed regularly on the following rivers: Susquehanna Patuxent Patapsco Choptank Potomac Rappahannock York James and occasionally on the South, Magothy, and Elk Rivers.	a. Six month intervals. b. The program began in July 1972 and was scheduled to run until June 1976. However, final samples are still being analyzed. The program will resume in FY 1978. c. Stored on punch cards; information also is filed in an OPP data bank in Washington.

TABLE I.3 (Continued)

a. Agency/Institution b. Contact for Additional Information	a. Name of Program b. Purpose of Monitoring	a. Medium Sampled b. Parameters Sampled	a. Number and General Location of Sampling Stations	a. Frequency of Sampling b. Duration of Monitoring Program c. Form of Data Storage
a. Environmental Protection Agency, Annapolis Field Office b. Orterio Villa, Director (301) 224-2740	a. Chesapeake Bay Consolidated Water Quality Study.[1] b. Routine water quality monitoring of the Chesapeake Bay and Upper Bay tributaries.	a. Surface and subsurface water. b. Temperature; conductivity; salinity; phosphate (total, inorganic); nitrogen (total kjeldahl, ammonia, nitrite, and nitrate); dissolved oxygen; chlorphyll-a, turbidity. Note: Completeness of nitrogen and phosphate monitoring and analyses may vary.	a. 76 stations located as follows: Sassafras River (4) Elk River Basin (6) Northeast River (4) Waters of the Open Bay (near the confluence of the above rivers) (5). 57 stations are sampled approximately on a monthly schedule in waters of the Open Bay (most located in Maryland waters).	a. As indicated under number and general location of sampling stations. b. Since 1968, however, some stations added in 1974 at mouth of Potomac, or middle Bay area. c. Punch cards - transferred to STORET. Last 1-1/2 years of data is still on data sheets.

TABLE I.3 (Continued)

a. Agency/Institution b. Contact for Additional Information	a. Name of Program b. Purpose of Monitoring	a. Medium Sampled b. Parameters Sampled	a. Number and General Location of Sampling Stations	a. Frequency of Sampling b. Duration of Monitoring Program c. Form of Data Storage
a. Environmental Protection Agency, Annapolis Field Office. b. Orterio Villa, Director (301) 224-2740	a. Potomac Consolidated Water Quality Study. [1] b. Routine trend monitoring of the Potomac River.	a. Surface and subsurface water. b. Temperature; conductivity; salinity; phosphate (total, inorganic); nitrogen (total kjeldhal, ammonia, nitrite and nitrate); dissolved oxygen; chlorophyll-a, turbidity. Note: Completeness of nitrogen and phosphate monitoring and laboratory analyses may vary.	a. Approximately 27 stations in the Potomac Estuary; 30 stations located on the Potomac between the Monocacy River to the Fall line at Washington, DC.	a. Quarterly. b. Monitoring in the Estuary since 1966; other sampling stations added in 1974. c. Punch cards which are entered into the STORET system. The last 1-1/2 years of data is still in tabular form.

TABLE I.3 (Continued)

a. Agency/Institution b. Contact for Additional Information	a. Name of Program b. Purpose of Monitoring	a. Medium Sampled b. Parameters Sampled	a. Number and General Location of Sampling Stations	a. Frequency of Sampling b. Duration of Monitoring Program c. Form of Data Storage
a. U.S. Fish and Wildlife Service, Migratory Bird Habitat Research Laboratory, Laurel, Maryland b. R. Munro, Project Contact (301) 776-4880	[1] a. Aquatic Vegetation Trend Monitoring. b. To study the distribution and abundance of submerged aquatic vegetation in the Upper Chesapeake Bay.	a. Aquatic Vegetation. b. Presence or absence of vegetation by species.	a. 642 stations are randomly distributed in the shallow waters of the upper Bay.	a. Once a year. b. 1971. c. Computer tape.
a. U.S. Fish and Wildlife Service, Migratory Bird Management, Laurel, Maryland b. L. Schroeder, Project Contact (301) 776-4880	[2] a. Waterfowl Survey. b. Census all species of waterfowl throughout the U.S. after each hunting season.	a. Waterfowl count performed by species.	a. All water areas of the Bay are flown.	a. Once a year - mid-winter; also, canvas-back ducks have been censused in the Chesapeake Bay area a total of 3 times a year for the last 5 years. b. 1955. c. Tabular sheets.

TABLE I.3 (Continued)

a. Agency/Institution b. Contact for Additional Information	a. Name of Program b. Purpose of Monitoring	a. Medium Sampled b. Parameters Sampled	a. Number and General Location of Sampling Stations	a. Frequency of Sampling b. Duration of Monitoring Program c. Form of Data Storage
a. U.S. Fish and Wildlife Service, Migratory Bird and Habitat Research Laboratory, Laurel, Maryland b. Matthew C. Perry, Project Contact (301) 776-4880	a. Invertebrate Sampling.[1] b. Determine available food supply for canvasbacks.	a. Bottom sediments. b. Volume and counts of invertebrates.	a. 25 samples taken in each of 4 areas: Manokin River Choptank River Hart Island/Miller Island Potomac River.	a. Once or twice a year. b. Fall, 1972. c. Tabular form - preliminary report in preparation.

TABLE I.3 (Continued)

a. Agency/Institution b. Contact for Additional Information	a. Name of Program b. Purpose of Monitoring	a. Medium Sampled b. Parameters Sampled	a. Number and General Location of Sampling Stations	a. Frequency of Sampling b. Duration of Monitoring Program c. Form of Data Storage
a. U.S. Geological Survey, Department of the Interior b. James W. Geurin, Office of the Regional Hydrologist (703) 860-6985 For Monitoring Data Contact: Charles Showen Chief, Automated Data Section (703) 860-6879	a. National Stream Quality Accounting Network (NASQAN).[1] b. To determine baseline water quality for future assessments of changes in stream quality.	a. Surface water. b. Temperature; conductivity; turbidity; color; pH; suspended solids; dissolved solids; chloride; nitrogen; phosphorus; common ions; hardness; radiochemicals; carbon, dissolved oxygen; metals; pesticides; biochemical oxygen demand; coliform bacteria.	a. Seven stations: Susquehanna River at Danville, PA (1965)* Susquehanna River at Harrisburg, PA (1945) West Branch, Susquehanna River at Lewisburg, PA (1944) Choptank River near Greensboro, MD (1944) Potomac River at Great Falls, MD (1973) Pamunkey River near Hanover, VA (1945) James River at Cartersville, VA (1929). *Calendar year of beginning of station activity	a. Most stations are sampled at least once a month. The frequency of sampling varies with the parameter being measured. The Virginia stations are sampled weekly. b. See station list. c. Punch cards, magnetic storage, and published records.

TABLE I.3 (Continued)

a. Agency/Institution b. Contact for Additional Information	a. Name of Program b. Purpose of Monitoring	a. Medium Sampled b. Parameters Sampled	a. Number and General Location of Sampling Stations	a. Frequency of Sampling b. Duration of Monitoring Program c. Form of Data Storage
a. National Marine Fisheries Service, Atlantic Estaurine Fisheries Center b. John Reintjes, Assistant Director (919) 728-4595	a. Menhaden Catch Sampling.[1] b. To estimate population abundance and dynamics of menhaden.	a. Menhaden. b. Length; weight; age.	a. Sample catches at two plants located at Reedville, Virginia.	a. Annually - (five days a week during season). b. 1953. c. Computer cards and tape.

TABLE I.3 (Continued)

a. Agency/Institution b. Contact for Additional Information	a. Name of Program b. Purpose of Monitoring	a. Medium Sampled b. Parameters Sampled	a. Number and General Location of Sampling Stations	a. Frequency of Sampling b. Duration of Monitoring Program c. Form of Data Storage
a. Maryland Department of Health and Mental Hygiene, Environmental Health Administration, Bureau of Sanitary Engineering b. James D. Clise, Director (301) 383-2737 Or Morris L. Hennessey, Chief, Division of General Sanitation (301) 383-3126	a. Shellfish Sanitation Monitoring. [1] b. Sampling of shellfish growing areas for bacteriological contamination.	a. Surface water on a routine basis; subsurface water on an infrequent basis. b. Total coliform, fecal coliform.	a. There are approximately 2000 stations throughout the Chesapeake Bay and its tributaries.	a. About 80% of the stations are monitored on a monthly basis. "Closed" shellfish waters are sampled bi-monthly. b. and c. Bacteriological data available through early 1930's for many stations are on microfilm. The data exist on tape from 1972. In September a program will be available for providing monthly, six month, 12 month, and 18 month data summaries.
	a. Routine shell stock sampling. [2] b. To determine heavy metal, pesticide, and bacterial contamination of shell stock.	a. Shell stock (meat of oysters; hardshell or softshell clams). b. Total coliform; fecal coliform; standard plate count; PCB; BHC; chlordane; DDD; dieldrin; endrin; DDT; copper; zinc; lead; mercury; cadmium; and chromium.	a. Shell stock samples from harvest boats are collected throughout the shellfish season. There are 65 designated sections within the "open" harvest waters. Samling is conducted in productive areas only.	a. Usually once a month within productive areas. b. Since 1971. c. Tabular form.

TABLE I.3 (Continued)

a. Agency/Institution b. Contact for Additional Information	a. Name of Program b. Purpose of Monitoring	a. Medium Sampled b. Parameters Sampled	a. Number and General Location of Sampling Stations	a. Frequency of Sampling b. Duration of Monitoring Program c. Form of Data Storage
a. Maryland Department of Natural Resources, Energy and Coastal Zone Administration Power Plant Siting Program b. Myron H. Miller, Project Officer (301) 267-1261	a. Potomac Estuaries Fisheries Study. [1] b. To determine the use of the Potomac River by various fish populations in order to mitigate the impact of future power plant sitings.	a. Surface water; juveniles. b. Salinity; tidal stage; time of day; determine abundance of juveniles by species.	a. Eleven stations are sampled biweekly. (Note: Eight sonar cruises are conducted annually between Morgantown and Sheridan Point.)	a. Monitoring program conducted seasonally - as indicated on adjacent column. b. Three years; it is envisioned that the survey work will continue at a reduced level after 1976. c. Computer (cards).

TABLE I.3 (Continued)

a. Agency/Institution b. Contact for Additional Information	a. Name of Program b. Purpose of Monitoring	a. Medium Sampled b. Parameters Sampled	a. Number and General Location of Sampling Stations	a. Frequency of Sampling b. Duration of Monitoring Program c. Form of Data Storage
a. Maryland Department of Natural Resources, Energy and Coastal Zone Administration Power Plant Siting Program b. Myron H. Miller, Project Officer (301) 267-1261	[1] a. Potomac Estuaries Fisheries Study. b. To determine the use of the Potomac River by various fish populations in order to mitigate the impact of future power plant sitings.	a. Surface water; spawning stock. b. Temperature; salinity; tidal stage; identification of spawning areas and species identification.	a. Four stations are sampled weekly for twelve weeks.	a. Monitoring program conducted seasonally - as indicated on adjacent column. b. Three years; it is envisioned that the survey work will continue at a reduced level after 1976. c. Computer (cards).
		a. Surface water; fish eggs/ larvae. b. Temperature; salinity; dissolved oxygen; turbidity; total seston; chlorophyll-a, pH, ammonium ions, zoo-plankton sampling; determine abundance of eggs and location of nursery areas by species.	a. Thirty-seven stations are sampled weekly.	

TABLE I.3 (Continued)

a. Agency/Institution b. Contact for Additional Information	a. Name of Program b. Purpose of Monitoring	a. Medium Sampled b. Parameters Sampled	a. Number and General Location of Sampling Stations	a. Frequency of Sampling b. Duration of Monitoring Program c. Form of Data Storage
a. Maryland Department of Natural Resources, Fisheries Administration b. Sara V. Otto, State Lab at Oxford (301) 226-5795	a. Marine Animal Disease Investigations. [1] b. Parasite monitoring study.	a. Hard clams; soft clams; oysters; other molluscan species. b. Parasitic disease.	a. 8 infected areas are monitored routinely: Chester River, Eastern Bay; Choptank River; Little Choptank River; Monokin River; Governor's River; Potomac River; St. Marys River. Emergency sampling is done as required.	a. Three times a year. b. Since 1967. c. Tabular form; punch cards for manual retrieval.
	a. Sampling for marine fungus contamination. [2] b. To determine the level of infection in Fishing Bay.	a. Oyster. b. Dermocystidium marinum.	a. 5 to 6 stations are sampled within Fishing Bay.	a. Every 2 months. b. Since 1973. c. Tabular form; punch cards for manual retrieval.

TABLE I.3 (Continued)

a. Agency/Institution b. Contact for Additional Information	a. Name of Program b. Purpose of Monitoring	a. Medium Sampled b. Parameters Sampled	a. Number and General Location of Sampling Stations	a. Frequency of Sampling b. Duration of Monitoring Program c. Form of Data Storage
a. Maryland Department of Natural Resources, Fisheries Administration. b. Frank Oslislo (301) 267-1234	a. Chesapeake Bay Bottom Study. [1] b. Inventory of clam and oyster beds within the Chesapeake Bay and its tributaries.	a. Benthic Biota. b. Oysters, clams.	a. Over 3,500 stations located at the intersections of a 200 square yard grid pattern extending throughout the Maryland portion of the Bay.	a. One time at each station. b. One year. c. Natural Oyster Bar Charts and National Clam Bar Charts at 1:20,000 scale to be published by the Fisheries Administration.

TABLE I.3 (Continued)

a. Agency/Institution b. Contact for Additional Information	a. Name of Program b. Purpose of Monitoring	a. Medium Sampled b. Parameters Sampled	a. Number and General Location of Sampling Stations	a. Frequency of Sampling b. Duration of Monitoring Program c. Form of Data Storage
a. Maryland Department of Natural Resources, Fisheries Administration, Tidewater Finfish Program b. Benjamin M. Florence, Chief (301) 267-5361	a. Estuarine Finfish Program. [1] b. Census and inventory to establish trends and future harvests.	a. All major species in Chesapeake Bay (including striped bass, white shad, herrings - bluebacks and alewifes, white perch). b. Spawning; egg production; production of young; and harvested fish are studied - the species composition is tabulated. Parameters include abundance; age and size.	a. There are 200 Baywide monitoring points.	a. Survey work is done on an annual basis. b. Since the mid/late 1950's. c. Tabular form and some publications.

TABLE I.3 (Continued)

a. Agency/Institution b. Contact for Additional Information	a. Name of Program b. Purpose of Monitoring	a. Medium Sampled b. Parameters Sampled	a. Number and General Location of Sampling Stations	a. Frequency of Sampling b. Duration of Monitoring Program c. Form of Data Storage
a. Maryland Department of Natural Resources, Fisheries Administration, Tidewater Finfish Program b. Benjamin M. Florence, Chief (301) 267-5361	a. Anadromous Fish/Stream Survey Program.[1] b. Collect inventory information on anadromous species in all fluvial waters of the Chesapeake Bay; collect water quality information on spawning areas.	a. Anadromous fish; surface water. b. Weather data, tide; temperature, conductivity; salinity; fish population and composition by species (size, age, condition); zooplankton identification is also performed; dissolved oxygen; biochemical oxygen demand; oil and grease; specific conductance, temperature; flow; coliforms (total and fecal); salinity; solids (dissolved, suspended); turbidity; nitrate-nitrogen; total phosphate; color; residual chlorine. Stream barriers are identified.	a. Over 300 streams (with approximately 3000 monitoring sites) throughout the State of Maryland are part of the Anadromous Fish/Stream Survey Program. All principal streams and rivers on the Potomac River (Maryland side, below Washington, DC) and in the upper Chesapeake Bay (north of the Bay Bridge) were sampled from 1970-1975. Currently, the Chester River drainage basin is being surveyed.	a. Intensive survey, seasonally (annual basis). b. 8 years; water quality data available for most sampling years. c. Computer data bank designed for the Anadromous Fish Study.

TABLE I.3 (Continued)

a. Agency/Institution b. Contact for Additional Information	a. Name of Program b. Purpose of Monitoring	a. Medium Sampled b. Parameters Sampled	a. Number and General Location of Sampling Stations	a. Frequency of Sampling b. Duration of Monitoring Program c. Form of Data Storage
a. Maryland Department of Natural Resources, Maryland Geological Survey, Coastal and Estuarine Geology Division. b. Frank Oslislo (301) 267-1234	[1] a. Chesapeake Bay Earth Sciences Study (CBESS) of the Chesapeake Bay Bottom Study. b. Inventory of geologic and mineral resources of the Chesapeake Bay and its tributaries.	a. Sediments. b. Copper Cadmium Lead Zinc Chromium Grain size Bathymetric profiles Sub-bottom profiles.	a. 3000 - 3500 stations throughout Maryland portion of the Bay and tributary estuaries (except Potomac estuary).	a. One time at each station. b. To be initiated in August, 1976 and to be continued for 5 years. c. Maps at 1:20,000 to be published in the Maryland Geological Survey Report of Investigation series.

TABLE I.3 (Continued)

a. Agency/Institution b. Contact for Additional Information	a. Name of Program b. Purpose of Monitoring	a. Medium Sampled b. Parameters Sampled	a. Number and General Location of Sampling Stations	a. Frequency of Sampling b. Duration of Monitoring Program c. Form of Data Storage
a. Maryland Department of Natural Resources, Power Plant Siting Program, Calvert Cliffs nuclear power plant post-operational monitoring program. Individual participants include: Baltimore Gas and Electric Company (BG&E) Energy Research and Development Administration (ERDA) Maryland Power Plant Siting Program (PPSP) National Aeronautics and Space Administration (NASA) b. Myron Miller, Power Plant Siting Officer (301) 267-1261	[1] a. Heavy metals (NASA). b. To determine extent of heavy metal disposition.	a. Sediment. b. Heavy metals.	a. 21 stations (dredge samples collected in the open Bay).	a. Quarterly. b. One year. c. Tabular format and computer.
	[2] a. Biological sampling (ERDA). b. To determine changes in species distribution and abundance.	a. Open water at surface and near bottom. b. Phytoplankton productivity, zooplankton and macroplankton distribution and abundance.	a. 7 stations (in open Bay).	a. Monthly to biweekly. b. One year. c. Data sheets.
	[3] a. Finfish and blue crab studies (PPSP). b. To determine plant effects on the behavior and distribution of aquatic organisms.	a. Open water. b. Relative abundance per unit area, species composition, size.	a. 3 stations (discharge, intake channel, and control area).	a. Quarterly. b. One year. c. Data sheets.

TABLE I.3 (Continued)

a. Agency/Institution b. Contact for Additional Information	a. Name of Program b. Purpose of Monitoring	a. Medium Sampled b. Parameters Sampled	a. Number and General Location of Sampling Stations	a. Frequency of Sampling b. Duration of Monitoring Program c. Form of Data Storage
a. Maryland Department of Natural Resources, Power Plant Siting Program, Calvert Cliffs nuclear power plant post-operational monitoring program. Individual participants include: Baltimore Gas and Electric Company (BG&E) Energy Research and Development Administration (ERDA) Maryland Power Plant Siting Program (PPSP) National Aeronautics and Space Administration (NASA) b. Myron Miller, Power Plant Siting Officer (301) 267-1261	[1] a. Cooling water quality (BG&E). b. To determine plant-induced changes.	a. Intake and point source discharge. b. Temperature, salinity dissolved oxygen.	a. 2 (intake and discharge).	a. Continuous. b. One year. c. Tabular format and computer.
	[2] a. Tidal and seasonal effects on plume shape and position (PPSP). b. To develop a 3-dimensional map of plume; effect of plume on dissolved oxygen and salinity.	a. Surface water. b. Temperature, salinity, and dissolved oxygen.	a. 2 (outfall area and a reference station).	a. One hour intervals over 36 hour period in March. b. One Year. c. Tabular format and computer.
	[3] a. Water Chemistry (ERDA). b. Surveillance of water quality.	a. Water at surface and near bottom. b. Temperature, salinity, dissolved oxygen, turbidity, nutrients.	a. 7 stations (in open area of the Bay).	a. Monthly to biweekly. b. One year. c. Tabular format and computer.
	[4] a. Water Chemistry (BG&E). b. Surveillance of water quality.	a. Surface and 30 feet. b. Temperature, salinity, dissolved oxygen, pH, turbidity, bacteria, silica, nutrients, heavy metals, biological oxygen demand.	a. 4 stations (near shore and adjacent to the plant site).	a. Monthly. b. One year. c. Tabular format and computer.

TABLE I.3 (Continued)

a. Agency/Institution b. Contact for Additional Information	a. Name of Program b. Purpose of Monitoring	a. Medium Sampled b. Parameters Sampled	a. Number and General Location of Sampling Stations	a. Frequency of Sampling b. Duration of Monitoring Program c. Form of Data Storage
a. Maryland Department of Natural Resources, Power Plant Siting Program, Calvert Cliffs nuclear power plant post-operational monitoring program. Individual participants include: Baltimore Gas and Electric Company (BG&E) Energy Research and Development Administration (ERDA) Maryland Power Plant Siting Program (PPSP) National Aeronautics and Space Administration (NASA) b. Myron Miller, Power Plant Siting Officer (301) 267-1261	[1] a. Biological sampling (BG&E). b. To determine effects of entrainment, impingement, and discharge on aquatic organisms.	a. Open water. b. Distribution and abundance of plankton, finfish, crabs, clams, oysters, and plankton productivity.	a. Up to 20 stations around plant site including intake and outfall.	a. Daily to once per year dependent on species sampled. b. One year. c. Data sheets.

TABLE I.3 (Continued)

a. Agency/Institution b. Contact for Additional Information	a. Name of Program b. Purpose of Monitoring	a. Medium Sampled b. Parameters Sampled	a. Number and General Location of Sampling Stations	a. Frequency of Sampling b. Duration of Monitoring Program c. Form of Data Storage
a. Maryland Department of Natural Resources, Water Resources Administration, Water Quality Services b. Paul Slunt, Chief (301) 267-5238	[1] a. Chesapeake Bay and Potomac River Consolidated Water Quality Monitoring Program. b. To supplement EPA water quality monitoring activities.	a. Surface and subsurface water. b. Temperature; pH; dissolved oxygen; total organic carbon; chemical oxygen demand, nitrogen (ammonia, nitrite and nitrate, total kjeldahl); phosphates (total and ortho-); suspended solids; dissolved solids; turbidity; conductivity or salinity; sulfates; chlorophyll-a; coliforms (total and fecal).	a. 20 supplemental stations in the open waters of the Bay and at Fall Line Stations and 13 stations on the Potomac River between Washington, DC and Morgantown.	a. Monthly. b. Since 1975. c. Maryland Water Resources Administration computer system.

TABLE I.3 (Continued)

a. Agency/Institution b. Contact for Additional Information	a. Name of Program b. Purpose of Monitoring	a. Medium Sampled b. Parameters Sampled	a. Number and General Location of Sampling Stations	a. Frequency of Sampling b. Duration of Monitoring Program c. Form of Data Storage
a. Maryland Department of Natural Resources, Water Resources Administration, Water Quality Services b. Paul Slunt, Chief (301) 267-5238	[1] a. Intensive Ambient Surface Water Quality Monitoring Program. b. Intensive survey of selected surface waters to collect detailed water quality information.	a. Surface and subsurface water. b. Surface tidal samples - Field: dissolved oxygen, water temperature, conductivity, pH, secchi disk. Lab: lab pH, turbidity, nitrogen (ammonia, nitrate, nitrite, organic), phosphorus (total and ortho-), total organic carbon, chlorophyll-a, phaeophytin-a, total coliforms, fecal coliforms, BOD at selected stations and chlorides at selected stations. Subsurface tidal samples - all parameters as above (excluding field pH, secchi, and coliforms). Fresh water samples collected exclude secchi disk and chlorides but include chemical oxygen demand.	a. This intensive monitoring program is based on a five year cycle. 500-1000 stations are sampled each year. Survey work is typically concentrated on the Eastern Shore, or Western Shore, or Potomac River Basin. During 1976, intensive survey work is being performed on the Choptank River, Nanticoke River, Wicomico River, Pocomoke River, Chester River, Sassafras River, and other Eastern Shore tributaries to the Bay. Automatic monitoring is performed on 13 rivers of the Eastern Shore at 50-60 stations. Sediment-oxygen demand is determined on most rivers in the Intensive survey. Phytoplankton productivity and current meter studies are performed as needed.	a. As established by annual Intensive survey schedule. b. Since 1966. c. Maryland Water Resources computer system.

TABLE I.3 (Continued)

a. Agency/Institution b. Contact for Additional Information	a. Name of Program b. Purpose of Monitoring	a. Medium Sampled b. Parameters Sampled	a. Number and General Location of Sampling Stations	a. Frequency of Sampling b. Duration of Monitoring Program c. Form of Data Storage
a. Maryland Department of Natural Resources, Water Resources Administration, Water Quality Services b. Paul Slunt, Chief (301) 267-5238	a. Trend ambient surface water quality monitoring program.[1] b. To trace water quality conditions and trends over a period of time.	a. Surface and subsurface water. b. Performed monthly: Temperature (air and water); pH; dissolved oxygen; chemical oxygen demand; total organic carbon; nitrogen (ammonia, nitrate-nitrite, total kjeldahl); phosphates (ortho-, total); suspended solids; dissolved solids; turbidity; conductivity or salinity; sulfates, chlorophyll-a; coliforms (total and fecal - performed routinely only at land stations). Performed annually at each station in sediments; mercury; zinc; copper, chromium; cadmium; lead oil and grease; pesticides; total kjeldahl nitrogen; and chemical oxygen demand. Selective biological sampling is also performed.	a. 133 stations located as follows: Susquehanna River Basin (5) Pocomoke River (5) Wicomico River (MD, Eastern Shore) (5) Nanticoke River Basin (3) Choptank River (6) Chester River Basin (6) Sassafras River (2) Elk River (4) Northeast River (1) Ches. & Del. Canal (1) Gunpowder River Basin (8) Patapsco River (4) Severn River (1) South River (2) Patuxent River Basin (7) Potomac River Basin (46) Other tributaries (11) Maryland waters of the Open Bay (16)	a. As indicated under parameters sampled. b. Began in 1974 (gap from 7/75 - 2/76). c. Maryland Water Resources Administration computer system.

TABLE I.3 (Continued)

a. Agency/Institution b. Contact for Additional Information	a. Name of Program b. Purpose of Monitoring	a. Medium Sampled b. Parameters Sampled	a. Number and General Location of Sampling Stations	a. Frequency of Sampling b. Duration of Monitoring Program c. Form of Data Storage
a. Maryland Department of Natural Resources, Water Resources Administration, Water Quality Services b. Paul Slunt, Chief (301) 267-5238	a. Intensive Point Source Discharge Monitoring Program.[1] b. Intensive survey of municipal and industrial point source discharges.	a. Point source discharges. b. Water temperature, conductivity, dissolved oxygen, BOD, nitrogen (ammonia, nitrite, nitrate, total kjeldahl), phosphorus (total and ortho-), total organic carbon, turbidity, suspended solids, total solids, residual chlorine (if effluent is chlorinated), total coliform organisms, fecal coliform organisms, flow.	a. The number and location of stations are the same as those for the Intensive Ambient Surface Water Quality Monitoring Program.	a. As established by annual Intensive survey schedule. b. Since 1966. c. Maryland Water Resources computer system.

TABLE I.3 (Continued)

a. Agency/Institution b. Contact for Additional Information	a. Name of Program b. Purpose of Monitoring	a. Medium Sampled b. Parameters Sampled	a. Number and General Location of Sampling Stations	a. Frequency of Sampling b. Duration of Monitoring Program c. Form of Data Storage
a. Pennsylvania Department of Environmental Resources, Division of Water Quality, Bureau of Water Quality Management b. Theodore P. Clista, Susquehanna River Basin Engineer (717) 787-9637	[1] a. Pennsylvania Water Quality Network. b. Trend monitoring.	a. Surface water and sediments. b. Standard Laboratory Analysis:* pH; alkalinity/acidity; total iron; sulfate; chloride; hardness (as $CaCO_3$); calcium; magnesium; nitrogen (nitrite, nitrate, ammonia); total phosphorus; total dissolved solids; specific conductance; total organic carbon; turbidity; suspended solids; fecal coliform. c. Heavy Metal Laboratory Analysis: copper; zinc; nickel; chromium (total); cadmium; mercury; lead; aluminum; manganese; arsenic. Gross α - β radiological. Samples are collected as required. Field analyses include temperature; pH; dissolved oxygen; and appearance. *Additional parameters analyzed by the USGS: chlorophyll-a; oil and grease; total kjeldhal nitrogen; chemical oxygen demand; biochemical oxygen demand; sodium; potassium; carbonate; bicarbonate.	a. 48 stations on the main stem of the Susquehanna River basin; 38 stations on the West Branch of the Susquehanna River Basin; 32 on the North Branch of the Susquehanna River Basin. Four of the above stations are sampled and analyzed by the USGS.	a. Chemical sampling is done on a monthly or quarterly basis; biological analyses are done on a quarterly or annual basis; radiological samples, where collected, are routinely done on a quarterly basis. b. 1962. c. Computer tape - WAMIS: STORET.

TABLE I.3 (Continued)

a. Agency/Institution b. Contact for Additional Information	a. Name of Program b. Purpose of Monitoring	a. Medium Sampled b. Parameters Sampled	a. Number and General Location of Sampling Stations	a. Frequency of Sampling b. Duration of Monitoring Program c. Form of Data Storage
a. Pennsylvania Department of Environmental Resources, Division of Water Quality, Bureau of Water Quality Management b. Theodore P. Clista, Susquehanna River Basin Engineer (717) 787-9637	[1] a. Pennsylvania Water Quality Network - Supplemental work on the Potomac River Basin. b. Trend monitoring in cooperation with the Potomac River Basin Baseline Water Quality Monitoring Network.	a. Surface water and sediments. b. Temperature; turbidity; solids (total, suspended, dissolved); conductivity; total hardness; dissolved oxygen; saturation; pH; total alkalinity ($CaCO_3$); phosphorous (total, ortho); nitrogen (ammonia, nitrite, nitrate); sulfate; chloride; chemical oxygen demand; aluminum; arsenic; beryllium; boron; cadmium; chromium; copper; iron; lead; manganese; mercury; nickel; potassium; selenium; zinc; polychlorinated biphenyls; aldrin; dieldrin; toxaphene; DDT; DDD; DDE; chlordane; endrin; lindane; cyanide; gross α - β; biochemical oxygen demand; coliform (fecal, total); macroinvertebrate counts and identification.	a. A total of 3 stations are part of the BWQMN; stations are located on Rock Creek, Antietam Creek, and Conococheague Creek.	a. Samples for chemical analyses are collected monthly; biological sampling is performed every 6 weeks; macroinvertebrates are sampled after a 6-week exposure period during summer months. Radiological tests are required on an annual basis. b. The Basin network was revised in 1974. c. WAMIS; STORET.

TABLE I.3 (Continued)

a. Agency/Institution b. Contact for Additional Information	a. Name of Program b. Purpose of Monitoring	a. Medium Sampled b. Parameters Sampled	a. Number and General Location of Sampling Stations	a. Frequency of Sampling b. Duration of Monitoring Program c. Form of Data Storage
a. Virginia Department of Health, Bureau of Industrial Hygiene, Radiological Health Section b. Bruce P. Shofield, Director, Staff: Thomas Stone (804) 786-6285	a. Virginia Radiological Health's Surveillance Program. [1] b. Monitor levels of radiological activity in state waters.	a. Silt. b. Gross beta and gamma scan. --- a. Oysters and surface water. b. Gross beta and gamma scan.	a. James River (2) - sampled monthly. --- a. Elizabeth River (2) - sampled 5/year. Wicomico River at the mouth (1) - sampled 2/year. Rappahannock River at the mouth (1) - sampled 2/year. York River (1) - sampled 2/year. Hunger Creek at the mouth (Eastern Shore) (1) - sampled 2/year. James River (2) - sampled monthly for surface water only.	a. As indicated in adjacent column. b. Gross beta scans are on record for a period greater than 10 years; gamma scans have been performed for only the past 10 years. c. Early data recorded on a print-out, typed copy. Some of the gamma data is on punch cards and tape; as of 1976, data are stored on magnetic tape

TABLE I.3 (Continued)

a. Agency/Institution b. Contact for Additional Information	a. Name of Program b. Purpose of Monitoring	a. Medium Sampled b. Parameters Sampled	a. Number and General Location of Sampling Stations	a. Frequency of Sampling b. Duration of Monitoring Program c. Form of Data Storage
a. Virginia Department of Health, Bureau of Shellfish Sanitation b. Cloyde W. Wiley, Director (804) 786-7937 Or Robert Croonenberghs (804) 786-7937	[1] a. Shell stock sampling program. b. Determine the sanitation of shellfish being processed for consumption.	a. Shell stock (oysters; hard clams when harvested). b. Fecal coliforms; standard plate count.	a. Performed routinely during harvesting season. Samples are collected directly from process houses.	a. Routinely during period of operation of the processing houses, usually on a monthly basis. b. Sampling dates from the 1930's. c. Tabular form.
	[2] a. Kepone monitoring. b. Surveillance of oyster beds for Kepone contamination.	a. Oysters. b. Kepone.	a. Ten sampling areas are monitored on the James River.	a. Monthly. b. August, 1975. c. Tabular form.

TABLE I.3 (Continued)

a. Agency/Institution b. Contact for Additional Information	a. Name of Program b. Purpose of Monitoring	a. Medium Sampled b. Parameters Sampled	a. Number and General Location of Sampling Stations	a. Frequency of Sampling b. Duration of Monitoring Program c. Form of Data Storage
a. Virginia Department of Health, Bureau of Shellfish Sanitation b. Cloyde W. Wiley, Director Bureau of Shellfish Sanitation (804) 786-7937 Or Robert Croonenberghs (804) 786-7937	a. Bacteriological Sampling Program. [1] b. Surveillance of shellfish growing areas for coliform contamination.	a. Water overlying shellfish growing areas. b. Fecal coliform bacteria. Oysters also are collected for bacterial analysis on an irregular basis.	a. Stations sampled are shellfish growing areas. The number of samples collected per station is dependent upon the size of the particular growing area sampled and the state of water quality within the growing area. The number of growing areas sampled per section of the Chesapeake Bay Basin are: Potomac River Basin (10) Great Wicomico River (1) Rappahannock River Basin (17) York River Basin (7) James River Basin (6) Elizabeth River (1) Other tributary basins (34) Virginia water of the open Bay (17).	a. Monthly. b. 10 years. c. Recorded in tabular format on data sheets.

TABLE I.3 (Continued)

a. Agency/Institution b. Contact for Additional Information	a. Name of Program b. Purpose of Monitoring	a. Medium Sampled b. Parameters Sampled	a. Number and General Location of Sampling Stations	a. Frequency of Sampling b. Duration of Monitoring Program c. Form of Data Storage
a. Virginia Department of Health, Bureau of Shellfish Sanitation b. Cloyde W. Wiley, Director Bureau of Shellfish Sanitation (804) 786-7937 Or Robert Croonenberghs (804) 786-7937	a. Heavy metal monitoring program.[1] b. Surveillance of shellfish for heavy metal uptake and contamination	a. Oysters; water b. Copper, cadmium, zinc; salinity (bottom); temperature (bottom); tide.	a. Oyster collections and water quality measurements are taken at the following locations: Potomac River Basin (3) Great Wicomico River (2) Rappahannock River Basin (3) York River Basin (3) James River Basin (8) Elizabeth River (2) Other tributary basins (11) Virginia waters of the open bay (4).	a. Twice a year. b. Spring of 1974. c. Recorded in tabular format on data sheets.

TABLE I.3 (Continued)

a. Agency/Institution b. Contact for Additional Information	a. Name of Program b. Purpose of Monitoring	a. Medium Sampled b. Parameters Sampled	a. Number and General Location of Sampling Stations	a. Frequency of Sampling b. Duration of Monitoring Program c. Form of Data Storage
a. Virginia Department of Health, Bureau of Shellfish Sanitation b. Cloyde W. Wiley, Director Bureau of Shellfish Sanitation (804) 786-7937 Or Robert Croonenberghs (804) 786-7937	[1] a. Pesticide Monitoring Program. b. Surveillance of shellfish for residual pesticides.	a. Oysters. b. Chlorinated hydrocarbons (Pesticides and Polychlorinated biphenyls - PBCs).	a. The pesticide monitoring program was developed in conjunction with the heavy metals monitoring program, thus most of the pesticide stations coincide with a metals station. Areas sampled include: Potomac River Basin (2) Great Wicomico River (1) Rappahannock River Basin (2) York River Basin (2) James River Basin (4) Other tributary basins (6) Virginia waters of the open bay (1).	a. Twice a year b. Spring 1974. c. Recorded in tabular form on data sheets.

TABLE I.3 (Continued)

a. Agency/Institution b. Contact for Additional Information	a. Name of Program b. Purpose of Monitoring	a. Medium Sampled b. Parameters Sampled	a. Number and General Location of Sampling Stations	a. Frequency of Sampling b. Duration of Monitoring Program c. Form of Data Storage
a. Virginia Institute of Marine Science b. Ching Fang, Head, Department of Physical Oceanography (804) 642-2111	[1] a. Water Quality Monitoring. b. To maintain water quality archives on the major rivers in the Commonwealth of Virginia.	a. Surface and subsurface water. b. Temperature; flow rate; salinity; dissolved oxygen; nutrients; biochemical oxygen demand and coliform bacteria.	a. Sampling is performed at approximately 15 points (slack water runs) on the James (to Richmond); York (Mattaponi and Pamunkey branches); and Rappahannock. Monitoring work is conducted on other rivers, such as the Elizabeth and Nansemond, periodically - when funding is available.	a. Sampling is performed on a monthly basis for physical and hydraulic parameters. Nutrients were sampled on a quarterly basis prior to this year and bacteriological samples taken only occasionally. Nutrient sampling is being increased to a monthly basis, and bacteriological sampling is becoming more regular. b. 5 years. c. Most information is on data cards.

TABLE I.3 (Continued)

a. Agency/Institution b. Contact for Additional Information	a. Name of Program b. Purpose of Monitoring	a. Medium Sampled b. Parameters Sampled	a. Number and General Location of Sampling Stations	a. Frequency of Sampling b. Duration of Monitoring Program c. Form of Data Storage
a. Virginia State Water Control Board Bureau of Surveillance and Field Studies b. Michael A. Bellanca, Director (804) 786-1411 Or John P. Godfrey, Staff Engineer (804) 786-1411	[1] a. Water Quality Surveillance. b. Ambient Water Quality Monitoring Stations	a. Surface water. b. Temperature; dissolved oxygen; pH; fecal coliforms; phosphates (ortho-total) nitrogen, (ammonia, nitrite, nitrate, total kjeldahl) are routinely performed at all sampling stations (except at stations located on Muddy Creek and Graham Creek near Amherst, Virginia where only pesticides are measured). Additional parameters sampled: varies from station to station. These include: solids (suspended, settable, total); sulfate; total coliform, BOD_5; chlorides, salinity, conductivity; alkalinity; hardness, zinc; acidity; chromium; carbon (total, organic); chlorine residual; turbidity; chemical oxygen demand; and hexane extractables.	a. Potomac River (7) Rappahannock Riber (22) York River (6) James River (41) Elizabeth River (21) Mobjack Bay (3) Stations on other streams within the Virginia portion of the Chesapeake Bay drainage area (474).	a. Monthly, except in tidal portions where sampling is done only 8 times per year. b. Basic network has been in existence since 1970. c. Tape storage; data part of STORET system.

TABLE I.3 (Continued)

a. Agency/Institution b. Contact for Additional Information	a. Name of Program b. Purpose of Monitoring	a. Medium Sampled b. Parameters Sampled	a. Number and General Location of Sampling Stations	a. Frequency of Sampling b. Duration of Monitoring Program c. Form of Data Storage
a. West Virginia Department of Nautral Resources, Division of Water Resources b. Jackson Wolfe, Supervisor of Monitoring (304) 348-5929	[1] a. Water Quality Monitoring. b. Surveillance of surface water quality.	a. Surface water. b. Flow; appearance; solids (total, suspended, dissolved); temperature; turbidity; hardness; conductivity; PH; alkalinity; total organic carbon; orthophosphate; total phosphorus; nitrogen (ammonia, organic, nitrate, nitrite); sulfate; chloride, sodium, potassium; manganese; lead; aluminum; antimony; arsenic; cadmium; chromium; copper; iron; mercury; nickel; selenium; zinc; dissolved oxygen; saturation; biochemical oxygen demand; coliform (total, fecal). At the 4 INCOPOT stations additional analyses include: chemical oxygen demand and macroinvertebrate sampling.	a. There are a total of 16 stations maintained within the Potomac River Basin. Stations are located on the South Branch of the Potomac River, Stony River, Deakin Run, and Buffalo Creek are part of the monitoring network of the Interstate Commission on the Potomac River Basin (INCOPOT).	a. The INCOPOT stations are monitored on a monthly basis along with other stations within the River Basin. The remaining 7 stations are monitored on a quarterly basis. b. The stations located on the Shenandoah River and South Branch of the Potomac have been in operation since 1967; most stations have been operating since 1972, except for 3 stations added this year. c. Summary sheets are sent to the STORET system.

TABLE I.3 (Continued)

a. Agency/Institution b. Contact for Additional Information	a. Name of Program b. Purpose of Monitoring	a. Medium Sampled b. Parameters Sampled	a. Number and General Location of Sampling Stations	a. Frequency of Sampling b. Duration of Monitoring Program c. Form of Data Storage
a. District of Columbia, Bureau of Wastewater Treatment, Water Resources Management Administration b. Duane A. Gender, Chief Chemist, Laboratory Division (202) 629-8500	[1] a. Potomac River monitoring. b. Trend monitoring of water quality in the Potomac River.	a. Subsurface sample and 15 foot depth sample and mix. b. Temperature, dissolved oxygen, BOD_5, coliform (total, fecal), chloride, alkalinity (carbonate), total phosphorus, total kjeldahl nitrogen, nitrite - N, Nitrate - N, ammonia - N, pH.	a. 22 stations from Chain Bridge to Maryland Point until 1975. Currently, 13 stations from Chain Bridge to Wilson Bridge within the D.C. boundary.	a. Every week when possible. b. Since 1936. c. Tabular form; recent years in STORET.
	[2] a. Anacostia River monitoring. b. Trend monitoring of water quality.	a. Subsurface. b. Temperature, dissolved oxygen, BOD_5, coliform (total, fecal), chloride, alkalinity (carbonate), total phosphorus, total kjeldahl nitrogen, nitrite - N, nitrate - N, ammonia - N, pH.	a. 10 stations between Northwest Branch, Rt. 1 to Washington Channel.	a. Weekly. b. 2- 24 years. c. Tabular form.

TABLE I.3 (Continued)

a. Agency/Institution b. Contact for Additional Information	a. Name of Program b. Purpose of Monitoring	a. Medium Sampled b. Parameters Sampled	a. Number and General Location of Sampling Stations	a. Frequency of Sampling b. Duration of Monitoring Program c. Form of Data Storage
a. Susquehanna River Basin Commission b. Jerry Hollowell (717) 737-0506	[1] a. Continuous monitoring of the Susquehanna River. b. Surveillance of water quality	a. Surface water. b. pH, conductivity, dissolved oxygen, temperature.	a. 1 station on the Susquehanna River, Harrisburg, Pennsylvania.	a. Continuous. b. 1 year. c. Data computerized by USGS into STORET.
	[2] a. Trend monitoring of interstate waters. b. Surveillance of water quality.	a. Surface water b. Flow, time, weather, temperature, dissolved oxygen, pH, total organic carbon, chemical oxygen demand, total kjeldahl nitrogen, ammonia, nitrite and nitrate, total iron, total phosphorus, total dissolved solids, suspended solids, dissolved silica, chlorophyll-a, turbidity, conductivity, carbonate, bicarbonate, sulfate, chloride, fecal coliform, fecal strep.	a. 1 station on Susquehanna River near Waverly, NY. 1 station on Chemung River near Waverly, NY. 1 station on Susquehanna near Great Bend, PA.	a. Monthly. b. 1974. c. Data computerized by USGS into STORET.

TABLE I.3 (Continued)

a. Agency/Institution b. Contact for Additional Information	a. Name of Program b. Purpose of Monitoring	a. Medium Sampled b. Parameters Sampled	a. Number and General Location of Sampling Stations	a. Frequency of Sampling b. Duration of Monitoring Program c. Form of Data Storage
a. Hampton Roads Water Quality Agency (HRWQA) b. Paul Fisher, Project Administrator (804) 499-5531	[1] a. Non-point source area-monitoring program. b. To provide data for the assessment of non-point source discharges in support of the establishment of an areawide waste treatment management plan (Section 208, PL92-500).	a. Surface runoff. b. Dissolved oxygen; temperature; salinity; fecal coliform bacteria; biological oxygen demand; ultimate oxygen demand; total phosphorus; nitrogen (ammonia, nitrite, nitrate, total kjeldahl); chlorophyll-a; suspended solids; benthal oxygen demand; volume of runoff. During wet weather only fecal coliforms, ultimate oxygen demand, phosphorous, nitrogen and chlorophyll are sampled.	a. Wet weather sampling will take place at 25 sites within the study area which are to be sampled during two rain events. During each event samples will be taken every fifteen minutes for a five-hour period. Dry weather sampling will be restricted to the James, Pagan, Elizabeth, and York Rivers and the Hampton Roads area of the Bay.	a. Wet weather sampling is restricted to two rain events; dry weather sampling will be performed once. Each sampling involved an intensive phase wherein sampling is continuous over a 25 hour period and a slack water phase wherein samples are collected at slack tide at a number of sites on a river. b. 1976, studies to be completed by 15 August 1976 c. Data sheets. In addition data also will be incorporated into a predictive model.

TABLE I.3 (Continued)

a. Agency/Institution b. Contact for Additional Information	a. Name of Program b. Purpose of Monitoring	a. Medium Sampled b. Parameters Sampled	a. Number and General Location of Sampling Stations	a. Frequency of Sampling b. Duration of Monitoring Program c. Form of Data Storage
a. Metropolitan Washington Council of Governments-Northern Virginia Planning District Commission (NVPDC) b. Austan S. Librach, Director of Regional Resources Division, NVPDC (703) 573-2210	[1] a. Occoquan/Four Mile Run Runoff Monitoring Program b. To provide data for the assessment of non-point source discharges in support of the establishment of an areawide waste treatment management plan (Section 208,PL92-500).	a. Surface runoff from 19 watershed sites (9 urban, 2 construction, 7 agricultural, 1 forrested). b. Phosphorus (total, soluble, suspended, ortho-); nitrogen (ammonia, total kjeldahl, soluble kjeldahl, suspended kjeldahl, nitrite and nitrate, total organic, soluble organic, suspended organic); total suspended solids; biochemical oxygen demand; ultimate oxygen demand; chemical oxygen demand; fecal coliform bacteria; metals; flow; precipitation.	a. Twenty six watershed sites representing 17 urban areas, 7 agricultural/rural areas, and 2 construction sites. Eighteen to be located in the Occoquan River Basin and 8 in the Four Mile Run Watershed.	a. Discrete sampling by automatic samplers at six points on the runoff hydrograph during each storm event. Monitoring will occur at no less than 13 sites during each season of the year. b. June 1976 - June 1977. c. Data sheets and STORET data bank.

TABLE I.3 (Continued)

a. Agency/Institution b. Contact for Additional Information	a. Name of Program b. Purpose of Monitoring	a. Medium Sampled b. Parameters Sampled	a. Number and General Location of Sampling Stations	a. Frequency of Sampling b. Duration of Monitoring Program c. Form of Data Storage
a. Rappahannock Area Development Commission (RADCO) b. Robert S. Lowry, Project Manager (804) 371-6390	[1] a. Non-point source areawide monitoring program. b. To provide data for the assessment of non-point source discharges in support of the establishment of an areawide waste treatment management plan (Section 208,PL92-500).	a. Surface water during and ater a storm. b. Dissolved oxygen; biochemical oxygen demand; suspended solids; nitrogen (total kjeldahl, ammonia, nitrate); phosphorus; metals (iron, lead, zinc); pH; temperature; fecal coliform bacteria, chemical oxygen demand.	a. Three stations (in Fredericksburg, upstream, and downstream from the city) on the Rappahannock River; one station on Hazel Run.	a. Five replicate series of 12 samples to be taken during and after a storm and five series during dry weather. b. To be initiated in June, 1976 and completed as soon as climatic conditions permit. c. Data sheets.

TABLE I.3 (Continued)

a. Agency/Institution b. Contact for Additional Information	a. Name of Program b. Purpose of Monitoring	a. Medium Sampled b. Parameters Sampled	a. Number and General Location of Sampling Stations	a. Frequency of Sampling b. Duration of Monitoring Program c. Form of Data Storage
a. Regional Planning Council b. Thomas Smith, Project Coordinator (301) 383-5840	[1] a. Non-point source area-monitoring program. b. To provide data for the assessment of non-point source discharges in support of the eatablishment of an areawide waste treatment management plan (Section 208, PL92-500).	a. Surface waters affected by surface runoff. b. Nitrogen (total kjeldahl, nitrate, ammonia); phosphorus (ortho, total, soluble); fecal coliform bacteria; pH; temperature, dissolved oxygen; biochemical oxygen demand; suspended solids.	a. Number of stations to be determined. Initial sampling is planned for the Gunpowder River, South River, and the Patapsco River.	a. To be determined. b. To be initiated in July. c. Unknown; data to be used in a model to predict pollutant loading from urban runoff and other sources.

TABLE I.3 (Continued)

a. Agency/Institution b. Contact for Additional Information	a. Name of Program b. Purpose of Monitoring	a. Medium Sampled b. Parameters Sampled	a. Number and General Location of Sampling Stations	a. Frequency of Sampling b. Duration of Monitoring Program c. Form of Data Storage
a. Richmond-Crater Consortium b. Jerry Simonoff, Project Coordinator (804) 861-1666	[1] a. Non-point source areawide monitoring program. b. To provide data for the assessment of non-point source discharges in support of the establishment of an area-wide waste treatment management plan (Section 208,PL92-500).	a. Surface runoff. b. Dissolved oxygen; biological oxygen demand; ultimate oxygen demand; nutrients; ortho-phosphate; total phosphorus; total kjeldahl nitrogen; nitrate plus nitrate; ammonia; heavy metals; suspended solids; turbidity; fecal coliform bacteria; conductivity.	a. Three sites will be established in each of five watersheds. At least two watersheds will be drainage areas of the James River.	a. Ten samples will be collected per site on each of four storm events. b. 1976. Monitoring began in May, 1976. c. Data sheets. The data is expected to be used in a model to predict non-point source waste loads.

APPENDIX II

COOPERATIVE RELATIONSHIPS

Name of Cooperative Effort and Contact	Objective of the Cooperative Effort	Principal Agencies or Institutions and Their Respective Roles
1. Chesapeake Bay Program Policy Advisory Committee Contact: Leonard Mangiaracina Acting Director, Chesapeake Bay Program (215) 597-9872	• To provide overall policy guidance to the Environmental Protection Agency's Chesapeake Bay Program with respect to coordination and integration of Federal, interstate, and state programs.	Participants: Environmental Protection Agency Pennsylvania Department of Environmental Resources West Virginia Water Development Authority Planning Division - Corps of Engineers Susquehanna River Basin Commission State Water Control Board - Commonwealth of Virginia Water Resources Division, Department of Natural Resources and Environmental Control, State of Delaware Water Resources Management Administration, Department of Environmental Services, District of Columbia Maryland Department of Natural Resources, Water Resources Administration
2. Chesapeake Bay Study Advisory Group Contact: William E. Trieschman, Jr. Chief, Planning Division (301) 962-4710 OR	• To advise the District Engineer of the Baltimore District, Corps of Engineers on the overall management of the Chesapeake Bay Study and to coordinate interagency cooperative activities.	Advisory Group Membership: Department of Agriculture Energy Research and Development Administration Department of Commerce Federal Power Commission National Science Foundation Environmental Protection Agency Department of Health, Education and Welfare Department of Housing and Urban Development

Name of Cooperative Effort and Contact	Objective of the Cooperative Effort	Principal Agencies or Institutions and Their Respective Roles
2. continued - Alfred E. Robinson, Jr. Chief, Chesapeake Bay Study Branch (301) 962-2512		Department of the Interior Department of the Navy Smithsonian Institution Department of Transportation District of Columbia Delaware Maryland Pennsylvania Virginia
3. Chesapeake Bay Study Steering Committee Contact: Alfred E. Robinson, Jr. Chief, Chesapeake Bay Study Branch (301) 962-2512	• To provide technical guidance to the District Engineer of the Baltimore District, Corps of Engineers, on the development, implementation, and coordination of projects conducted as part of the Chesapeake Bay Study.	Steering Committee Membership: Department of the Army Energy Research and Development Administration Department of the Interior National Science Foundation Smithsonian Institution Department of Commerce District of Columbia Delaware Maryland Pennsylvania Virginia

Name of Cooperative Effort and Contact	Objective of the Cooperative Effort	Principal Agencies or Institutions and Their Respective Roles
4. Interagency Committee on Marine Science and Engineering, Chesapeake Bay Subcommittee Contact: Keith Adams Executive Secretary (202) 693-1590	• To ensure the planning and coordination of Federal activities in marine science and engineering and related matters in the Chesapeake Bay. • To overview ongoing and planned activities to uncover unnecessary duplication of effort and to identify gaps in knowledge.	Participants: Corps of Engineers Maryland Department of Natural Resources Office of Management and Budget Food and Drug Administration U.S. Geological Survey Virginia Institute of Marine Science Smithsonian Institution Environmental Protection Agency National Ocean Survey U.S. Coast Guard Department of the Navy National Aeronautics and Space Administration Energy Research and Development Administration Maryland Department of State Planning National Ocean and Atmospheric Administration
5. Power Plant Siting Advisory Committee, State of Maryland Power Plant Siting Program Contact: Myron H. Miller Project Officer (301) 267-1788	• General liaison and coordination with local and state agencies concerning the work of the Power Plant Siting Program.	Participants: Department of National Sciences Department of Economic and Community Development Department of Health and Mental Hygiene Department of State Planning Regional Planning Council Department of Agriculture Office of the Governor Local Governments (including D.C.) Consultants

Name of Cooperative Effort and Contact	Objective of the Cooperative Effort	Principal Agencies or Institutions and Their Respective Roles
6. Environmental Research Guidance Committee, State of Maryland Power Plant Siting Program Contact: Myron H. Miller Project Officer (301) 267-1788	• Coordinate monitoring efforts and permit compliance where Federal permits are involved.	Participants: Environmental Protection Agency Federal Power Commission Fish & Wildlife Service Nuclear Regulatory Commission National Aeronautics & Space Admin. U.S. Geological Survey National Oceanic & Atmospheric Admin. National Science Foundation Department of State Planning Department of Health and Mental Hygiene Department of Economics and Community Development Department of Agriculture Department of Natural Resources Consultants Power Companies
7. Interagency Advisory Committee on Water Data Contact: R. H. Langford, Chief Office of Water Data Coordination, U.S. Geological Survey (703) 860-6985	• To promote coordination in the collection, processing, and dissemination of water data.	Participants: Department of Agriculture -- Agricultural Research Service, Economic Research Service, Forest Service, Soil Conservation Service Department of Commerce -- Bureau of Census, Bureau of Domestic Commerce, National Oceanic and Atmospheric Administration, National Bureau of Standards Department of Defense -- Corps of Engineers, Naval Facilities Engineering Command

Name of Cooperative Effort and Contact	Objective of the Cooperative Effort	Principal Agencies or Institutions and Their Respective Roles
7. continued -		Department of Housing & Urban Development -- Bonneville Power Administration, Bureau of Indian Affairs, Bureau of Land Management, Bureau of Mines, Bureau of Outdoor Recreation, Bureau of Reclamation, Fish and Wildlife Service, Geological Survey, National Park Service, Office of Water Research & Technology Department of Transportation Independent Agencies -- Council on Environmental Quality, Energy Research and Development Administration, Environmental Protection Agency, Federal Power Commission, International Boundary & Water Commission, International Joint Commission, Nuclear Regulatory Commission, Tennessee Valley Authority, Water Resources Council
8. Chesapeake Bay Consolidated water Quality Study - Potomac Consolidated Water Quality Study Contact: Orterio Villa, Director EPA Annapolis Field Office (301) 224-2740	• Routine surveying of the upper Chesapeake Bay and Potomac River	Environmental Protection Agency Annapolis Field Office heads the program and receives support and supplemental data and analyses from the Maryland Department of Natural Resources, Water Resources Administration.

Name of Cooperative Effort and Contact	Objective of the Cooperative Effort	Principal Agencies or Institutions and Their Respective Roles
9. Kepone surveillance studies Contact: Orterio Villa, Director EPA Annapolis Field Office (301) 224-2740	• Monitor kepone uptake by biological organisms.	The EPA Annapolis Field Station performs tissue analyses on shellfish samples to assist the Maryland Department of Health and Mental Hygiene.
10. Oil spill surveillance Contact: Orterio Villa, Director EPA Annapolis Field Office (301) 224-2740	• Confirmation of oil spills.	EPA Annapolis Field Station assists the U.S. Coast Guard in such activities.
11. Surveillance of dredge and fill projects Contact: Orterio Villa, Director EPA Annapolis Field Office (301) 224-2740	• Analysis of dredge materials.	U.S. Army Corps of Engineers receives assistance from the EPA Annapolis Field laboratories.

Name of Cooperative Effort and Contact	Objective of the Cooperative Effort	Principal Agencies or Institutions and Their Respective Roles
12. National Estuarine Monitoring Program Contact: Phillip Butler Project Contact (904) 932-5311	• Trend monitoring of pesticides and heavy metal contamination of juvenile fish.	Environmental Protection Agency, Office of Pesticides Programs, Technical Services Division is conducting the study. The Solomons Point Laboratory (University of Maryland) and VIMS (State of Virginia) are collecting samples for the Chesapeake Bay portion of the program.
13. EPA-NMFS Cooperative Estuarine Monitoring Program (Special Study from July '76 - June '77) Contact: Phillip Butler Project Contact (904) 932-5311	• To sample 12 watersheds throughout the U.S. for 4 commercial species at the time they become market size. The study hopes to fill an information gap in the study of trace movements of pollutants from juveniles through adults. Pollutants include chlorinated pesticides, organophosphate pesticides, PCB's and phenoxyherbicides. Comparative data is being established for eatable muscle and liver.	EPA, Office of Pesticides Programs, Technical Service Division is heading laboratory work at its Gulf Breeze facilities. Joint effort with NMFS, Office of Resource Utilization. VIMS is collecting representative samples from the Chesapeake Bay in the Hampton Roads area.

Name of Cooperative Effort and Contact	Objective of the Cooperative Effort	Principal Agencies or Institutions and Their Respective Roles
14. Study of the Effectiveness of Sediment and Erosion Control Programs in the Potomac Basin Contact: William J. McCaw, III Interstate Commission on the Potomac River Basin (301) 652-5758	• To determine the changes in land use in the past 10 years, to relate such land use changes as well as current agricultural and forestry practices to any detected changes in water quality during the interim period; to assess the effectiveness of previous aid in controlling non-point source discharges from agricultural and forestry practices and determine currend needs. (Note: Last inventory performed in 1966 by the U.S.D.A.)	Interstate Commission on the Potomac River Basin is funding and managing the Study with cooperation from the following state and Federal agencies: U.S. Soil Conservation Service U.S. Agricultural Stabilization and Conservation Service U.S. Forest Service Maryland Bureau of Forestry Virginia Soil and Water Conservation Commission Maryland State Soil Conservation Committee Virginia Department of Agriculture-Statistical Reporting Service Maryland-Delaware Crop Reporting Service Pennsylvania Department of Agriculture-Crop Reporting Service West Virginia State Soil Conservation Committee West Virginia Department of Agriculture-Agricultural Statistical Reporting Service Pennsylvania Department of Environmental Resources, Bureau of Forestry Pennsylvania Department of Environmental Resources, Bureau of Soil and Water Conservation

Name of Cooperative Effort and Contact	Objective of the Cooperative Effort	Principal Agencies or Institutions and Their Respective Roles
15. Potomac River Basin Baseline Water Quality Monitoring Network (BWQMN) Contact: William T. Mason, Jr. Interstate Commission on the Potomac (301) 652-5758	• To meet the requirements of PL92-500 by providing water quality assessment data for the Potomac River Basin through the coordinated efforts of all agencies involved in monitoring activities.	Interstate Commission on the Potomac River Basin - lead agency Participating Agencies: District of Columbia -- Department of Environmental Services, Environmental Health Administration, Bureau of Wastewater Management, Water Resources Management Administration Maryland Department of Natural Resources, Water Resources Administration Pennsylvania Department of Environmental Resources Bureau of Water Quality Management Virginia State Water Control Board Bureau of Surveillance and Field Studies West Virginia Department of Natural Resources, Division of Water Resources U.S. EPA, Region III, Division of Surveillance & Analysis U.S. Geological Survey, Office of Data Coordination, Northeast Region Fairfax County Department of Public Works Hagerstown Water Department Metropolitan Washington Council of Governments Department of Health & Environmental Protection

Name of Cooperative Effort and Contact	Objective of the Cooperative Effort	Principal Agencies or Institutions and Their Respective Roles
16. Calvert Cliffs Monitoring Program Contact. Byron Miller, Project Officer Maryland Department of Natural Resources Power Plant Siting Program (301) 267-1261	• To assess the environmental effects of Calvert Cliffs nuclear power plant operations.	Baltimore Gas and Electric Company - Academy of Natural Sciences, Philadelphia (on site monitoring) National Aeronautics and Space Administration Federal City College (evaluation of the effect of plant operations on heavy metal accumulation in sediments) Energy Research and Development Administration - Chesapeake Biological Laboratory of the University of Maryland (monitoring of water quality and plankton) Nuclear Regulatory Commission (participant in several environmental studies) Maryland Department of Natural Resources, Power Plant Siting Program - Martin Marietta Corporation Environmental Technology Center (program integration)

Name of Cooperative Effort and Contact	Objective of the Cooperative Effort	Principal Agencies or Institutions and Their Respective Roles
17. Kepone Task Force Marine Resources Subcommittee, State of Virginia Contact: James B. Kenley, M.D., Commissioner Department of Health (804) 786-3561	• To coordinate and review all sampling programs and special studies related to the uptake and transport of Kepone in Virginia state waters, to set priorities for future monitoring or special studies; to advise the Governor on the status of Kepone contamination.	The Kepone Task Force is under the auspices and chairmanship of Dr. James Kenley, Health Commissioner. The Marine Resources subcommittee is chaired by Dr. Michael Bender of the Virginia Institute of Marine Sciences. Members of the task force include the: Virginia Department of Health Virginia Department of Agriculture and Commerce State Water Control Board Division of Consolidated Laboratory Services Virginia Institute of Marine Science Commissioner of Game and Inland Fisheries Marine Resources Commission Food & Drug Administration

Name of Cooperative Effort and Contact	Objective of the Cooperative Effort	Principal Agencies or Institutions and Their Respective Roles
18. Maryland's Coastal Zone Management Program, Federal Agency Contacts Contact: L. E. Zeni Administrator Maryland Energy and Coastal Zone Administration (301) 267-1788	• To exchange information among Federal and state agencies interested in coastal zone management. • To assure consistency of Maryland's program to perceived needs at the Federal level. • To develop interagency agreements to establish coordination and consultation mechanisms, to consider Federal agency goals, policies, and plans, to resolve conflict, to incorporate Federal air and water pollution contract acts into the program, and to determine the use of Federal lands with respect to the program.	Maryland has established contacts with the following: Department of Agriculture Department of Commerce -- Economic Development Administration Department of Defense -- Air Force, Navy, Army Energy Research and Development Administration General Services Administration Department of Transportation Department of Commerce -- National Marine Fisheries Service, Maritime Administration Environmental Protection Agency Federal Energy Administration Department of the Interior
19. Maryland's Coastal Zone Planning, Memorandum of Understanding/Joint Work Program Contact: L. E. Zeni Administrator Maryland Energy and Coastal Zone Administration (301) 267-1788	• To allocate HUD and NOAA/OCZM funds to support a unified work program. • To develop and coordinate all activities as required for HUD 701 land use planning and OCZM program development in the coastal zone area of the Baltimore Metropolitan Region.	Signatories: Regional Planning Council Maryland Department of Natural Resources, Energy and Coastal Zone Management Administration

Name of Cooperative Effort	Objective of the Cooperative Effort	Principal Agencies or Institutions and Their Respective Roles
20. Memorandum of Agreement between the Environmental Protection Agency and the U.S. Fish and Wildlife Service Contact: Anthony J. Donatoni Interagency Coordinator Chesapeake Bay Program (215) 597-9872	• To cooperate on matters of common concern such as research, including monitoring and field appraisal, on effects of chemical contaminants on fish and wildlife, and the establishment of water quality criteria. • To cooperate in a study relating to the ecology and values of submerged aquatic vegetation and emergent wetlands of the Chesapeake Bay.	Environmental Protection Agency, Chesapeake Bay Program U.S. Fish and Wildlife Service, Office of Biological Services A technical review committee also will include the National Marine Fisheries Service, Corps of Engineers, and the States of Maryland and Virginia.

Name of Cooperative Effort	Objective of the Cooperative Effort	Principal Agencies or Institutions and Their Respective Roles
21. Interagency agreement to continue current NSF funded research conducted by the Chesapeake Research Consortium, Inc. (CRC) Contact: Anthony J. Donatoni Interagency Coordinator Chesapeake Bay Program (215) 597-9872	• To transfer responsibility for the technical direction of a CRC continuing research project relating to the impact of pollutants from diffuse (non-point) sources on the quality of water in the Chesapeake Bay from the National Science Foundation to the Environmental Protection Agency.	National Science Foundation, Advanced Environmental Research and Technology Office Environmental Protection Agency, Chesapeake Bay Program Chesapeake Research Consortium, Incorporated.

APPENDIX III

PROBLEMS AND RECOMMENDATIONS

This section primarily contains comments concerning major problems related to the Chesapeake Bay which were made by administrators and investigators during personal interviews conducted in the course of this study. A discussion of the perspectives of citizens is also given.

In addition to the citing of commonly identified problems (enrichment of the Bay, pollution from oil spills), almost every individual held some differing viewpoint. Academic researchers presented well formulated recommendations for research investigations or management actions. Administrators were concerned with jurisdictional disputes and lack of interagency cooperation. Civic groups, polled in a survey as part of another study, were action oriented, well educated and tended to stress concern for problems receiving attention from regulatory agencies (waste discharges, oil spillage, wetland alteration).

All comments are presented as anonymous and are grouped within appropriate categories. Each comment is identified as to whether it was by a scientific investigator who conducts research on the Bay or by an administrator who is not involved in day-to-day research at the technical level.

Federal Perspectives

The following comments are concerned with institutional relationships or pollution abatement mechanisms with respect to the Bay.

- The United States Environmental Protection Agency (EPA) is a response agency and not an initiator of unmandated actions. The Agency should restrict its activity to the enforcement of existing legislation (Researcher).

- The EPA should not monitor the quality of surface waters, which is the role of the United States Geological Survey (USGS). The EPA only should monitor municipal and industrial wastewater outfalls (Administrator).

- No management solutions can be implemented before basic problems are identified. The first priority of any new research program is to identify the problems to which the program is to direct its attention (Researcher).

- There is no Bay-wide mechanism for dealing with catastrophic effects such as large spills of toxic chemicals. Contingency plans must be prepared (Administrator).

- Abatement of non-point discharges to the Bay only can be accomplished through the implementation of appropriate soil conservation practices within the watershed of the Bay (Administrator).

- Many agencies are duplicating planning efforts with respect to proposed research and monitoring activities. These efforts must be coordinated (Administrator).

- Various agencies have restricted public access to the Bay. There are not enough public lands in Virginia (Administrator).

- Fishing and boating must be promoted to retain public interest in the Bay (Administrator).

- The Environmental Protection Agency should not attempt to establish a data center. Such efforts should become a part of the NODC/NOAA system. Pass through funds should be given to NOAA to increase its coverage or to fund special data system requirements (Administrator).

- Replicate mailing lists compiled by federal agencies may be unavoidable owing to a legal restriction to the exchanging of mailing lists among federal agencies (Administrator).

- The only effective management policy for the Bay is the establishment of an interstate regulatory commission or compact. Such a unit must have strong and comprehensive regulatory powers (Administrator).

The following comments relate to problem identification or research needs with respect to the Bay.

- In the period 1950-1960 visibility was to a depth of 8 feet in certain parts of the Bay. Now in some of those places visibility is less than one foot in depth (Researcher).

- Until now, physical and chemical analyses have centered on "quick and dirty" techniques. A need exists for systematic precise analyses for all water quality parameters and pollutants including synthetic organics (Researcher).

- At present, there exists a general lack of understanding concerning the trophic levels of the Bay. These must be characterized (Administrator).

- There are disagreements as to the value of hydraulic vs. mathematical models. The Corps hydraulic model may be a step toward a mathematical model. Fewer data are needed to verify a hydraulic model than a mathematical one (Administrator).

- A grid system for determining sampling coordinates must be established (Researcher).

- Sustained programs in basic research are needed. None exist at the present time (Researcher).

- More systematic biological work is needed to determine the effects of pollution on species in the Bay (Researcher).

- A need exists to characterize the Bay in order to understand symptoms of degradation (Researcher).

- Information on hazards from flooding must be accumulated. These data are required by the Housing and Urban Development Administration (Administrator).

State and Local Perspectives

The following comments are concerned with institutional relationships or pollution abatement mechanisms with respect to the Bay.

- Increased economic returns must be made to those who make a living on the Bay and use its resources (Administrator).
- Promote and encourage consumption of seafood products (Administrator).
- A need exists for the states of Maryland and Virginia to coordinate coastal zone planning efforts (Administrator).

The following comments relate to problem identification or research needs with respect to the Bay.

- The major state water pollution abatement agencies regard the control of non-point discharges to be of utmost importance (Administrator).
- Over 90 percent of the pollution burden in the upper Bay is attributable to the Susquehanna River (Administrator).

Academic Perspectives

The following comments are concerned with institutional relationships or pollution abatement mechanisms with respect to the Bay.

- The proposed EPA Chesapeake Bay Program should channel program funds as much as possible into applied research rather than to internal staffing (Researcher).
- The proposed program should have continuity. Plans should be made for transference of data base information after the Program has terminated (Researcher).
- Present Section 208 (PL 92-500) studies should be completed in order to identify data needs before the Program is initiated (Researcher).
- Initial sampling should be concentrated in areas of the Bay adjacent to low population centers which do not warrant 208 studies. These areas require baseline data prior to induced changes with time (Researcher).

- Additional basic research regarding current measurement and tidal mixing (physical oceanography) to foster a better understanding of particulate movement in the Bay (Researcher).

- Long-term monitoring studies of biological communities are necessary. This information is desperately needed for a better understanding of castastrophic changes, such as the sudden disappearance of eel grass in parts of the Bay (Researcher).

- Historical archives should be established to monitor changes in fish populations, salinity, nutrients, and toxic materials (Researcher).

- Four "pressure points" or areas of major concern in the lower Bay (tidal waters of Virginia and Potomac are the: Upper James (Richmond to 10 miles below Hopewell), Lower James, Potomac, and areas around Newport News (Researcher).

- Physical alterations should rank 4th in priority after toxics, nutrients, and non-point sources as an area for further research (Researcher).

- Evaluate the extent and source of chlorinated hydrocarbons in Bay waters. Presently, there is a feeling that much pesticide wastes from homes and farms are entering the Bay (Administrator).

- Investigate the reason for the anaerobic condition of large subsurface areas of the Bay. Evaluate sludge depositions and compositon and its effect on oxygen levels (Researcher).

- Assess the cause of high copper levels in the sediments of the deep areas of the Bay (Researcher).

- Investigate and account for the existence of wedges of high and low salinity in the Bay near Kent Island (Researcher).

- Assess the effect of sedimentation rate on oyster production (Administrator).

- Assess the effects of heavy metals on oysters and finfish (Researcher).

- Investigate the composition and effects of oil sludges dumped from bilges (Administrator).

Citizen Perspectives

An initial indication of the citizen perspectives of the problems of the Chesapeake Bay was obtained during a recent survey of civic, environmental, and citizen organizations in the Bay area. The survey results and conclusions have been published as Bulletin 96 of the Virginia Water Resources Research Center, Virginia Polytechnic Institute and State University. (Shabman and Ashton, 1976.) Part of this survey consisted of a list of 26 response items specifically designed to examine certain types of respondent attitudes and opinions. Six items addressed the "environmentalist" orientation of the respondents; three were designed to identify the respondents' opinions of current management efforts in the Bay (specifically the Maryland and Virginia Coastal Zone Management Programs, and the United States Army Corps of Engineers' Chesapeake Bay Study Program); two items focused on proposed changes in management institutions; two were designed to identify the respondents' attitudes toward the public's role in the management of the Bay; and the remaining 13 items were specific Bay problems (as identified from an extensive review of Bay-related literature, as well as interviews with representatives of various governmental agencies and the Citizens Program for the Chesapeake Bay, Inc.). The respondents were asked to identify the relative importance of each of the 26 items.

Out of 4,561 surveys distributed, 617 completed surveys were returned. The respondents generally were of a higher socio-economic status, were better educated, were involved in public service activities to a greater degree, and displayed an "environmentalist" bias toward the Bay more than typical citizens living within Chesapeake Bay Basin.

Although the respondents did not represent the typical residents, Shabman and Ashton (1976) suggest that they were typical of the population most likely to become involved in a public-participation effort related to Bay problems.

In general, the respondents, although well educated, were not well informed about the Maryland and Virginia Coastal Zone Management Programs nor the United States Army Corps of Engineers study. The respondents did not express significant concern for the creation of a unified management agency for the entire Bay, nor did they suggest that the passage of new laws was needed. They were, however, mildly dissatisfied with present Bay-related administrative, legal, and management programs.

The ranked importance of each of the 26 items is listed in Table III-1. Table III-2 lists the priority of each of the 13 specific Bay problems from the Maryland respondent perspective and Virginia respondent perspective. Both Maryland and Virginia respondents listed the same four problems as the four highest priorities, although the exact order differed somewhat. In addition,

TABLE III.1

HOW IMPORTANT ARE THE FOLLOWING ITEMS TO THE CHESAPEAKE BAY AND ITS USERS?
(Shabman and Ashton, 1976)

	Major importance.....Not important			
	4	3	2	1
Need to improve public access to the Bay	17%	18%	31%	22%
Poor cooperation between Maryland and Virginia in Bay management	41	32	14	3
Need for continued improvement in port and shipping facilities	35	27	23	8
Preparing for the impact of off-shore oil development	72	18	4	3
Need to preserve wetlands	68	18	8	2
Dumping of bilge washings and oil from ships	78	14	4	1
Tax base threatened by proposed land use controls	13	24	31	19
Need to make better use of existing laws affecting the Bay	40	37	13	2
Siting of power plants	56	24	12	3
Conflict between profits for individuals and the health of the Bay	56	24	12	3

TABLE III.1 (Continued)

	Major importance.....Not important			
	4	3	2	1
Disposal of industrial and municipal wastes	79%	13%	3%	1%
Need to promote economic growth in Bay area	20	21	31	21
Biology of the Bay is threatened	65	21	8	2
Excessive power of federal agencies	29	23	25	12
Economic and environmental threats to commercial fishing industry	44	35	14	3
Lack of influence by citizens on government decisions about the Bay	41	33	15	3
Need more wildlife management areas	34	32	22	5
Lack of public concern about the Bay's future	55	29	9	2
Erosion of the shoreline	42	34	15	4
Need a single government agency to take leadership in dealing with the Bay's problems	32	29	17	14
Excessive costs of meeting environmental standards	24	28	23	17

TABLE III.1 (Continued)

	Major importance.....Not important			
	4	3	2	1
Need harbor and channel improvements for navigation	17%	27%	33%	14%
Too rapid population growth	37	25	23	8
Careless disposal of dredge material	53	27	11	3
Runoff of pesticides and fertilizers from agricultural land	45	29	15	5
Need new laws to improve Bay management	29	27	21	12
Others: (Specify and indicate importance below)	4	0	0	95

TABLE III.2

"HOW IMPORTANT ARE THE FOLLOWING ITEMS TO THE CHESAPEAKE BAY AND ITS USERS?"

(Shabman and Ashton, 1976)

	Maryland Rank*		Virginia Rank*	
Disposal of industrial and municipal waste	1	(1)	2	(2)
Dumping of bilge washings and oil from ships	2	(2)	1	(1)
Need to preserve wetlands	3	(3)	5	(4)
Preparing for the impact of offshore oil development	4	(4)	3	(3)
Careless disposal of dredge material	7	(5)	9	(7)
Siting of power plants	8	(6)	8	(6)
Runoff of pesticides and fertilizers from agricultural land	13	(7)	15	(9)
Erosion of the shoreline	14	(8)	13	(8)
Economic and environmental threats to commercial fishing	15	(9)	7	(5)
Too rapid population growth	14	(10)	19	(12)
Need more wildlife management growth	16	(11)	17	(11)
Need continued improvement in port and shipping facilities	17	(12)	16	(10)
Need to improve public access to the Bay	26	(13)	26	(13)

* Numbers in parentheses indicate rank of specific problem among the 13 problem items, while rank numbers not in parentheses indicate overall ranking out of all 26 items in the Question.

the four lowest priorities also were the same (again, the exact order differed). A major difference between the two states was a much higher ranking of the importance of the commercial fishing industry by Virginia respondents compared to Maryland respondents. Other specific problem items for which importance rank was significantly affected by the State of residence included: Need to preserve wetlands, siting of power plants, dumping of bilge washings and oil from ships, disposal of municipal and industrial wastes, and too rapid population growth. All five of these problem items were typically ranked higher by residents of Maryland.