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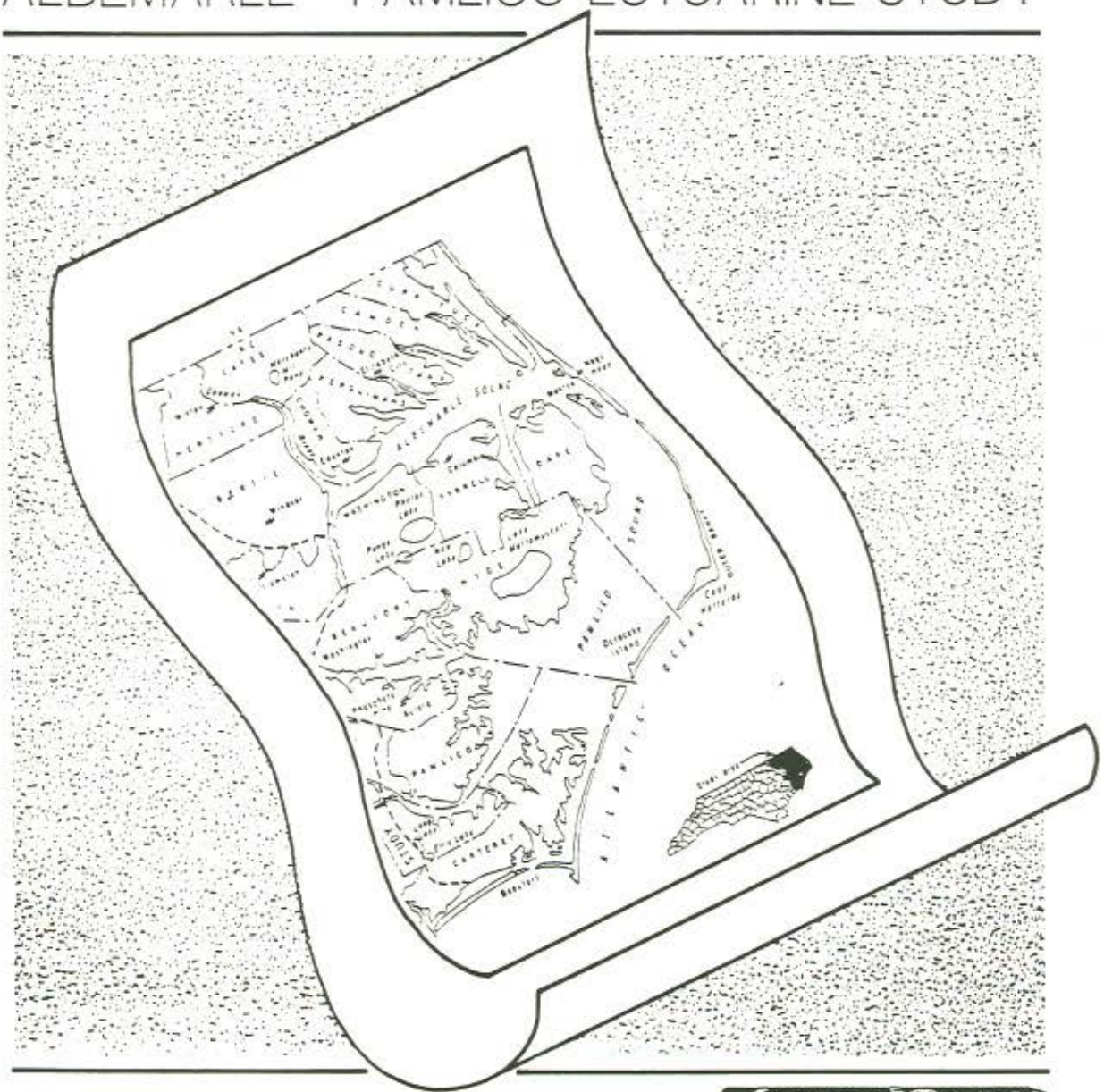
ANNUAL REPORT

ALBEMARLE - PAMLICO ESTUARINE STUDY



Funding Provided by the National Estuary Program of the United States Environmental Protection Agency and the North Carolina Department of Environment, Health, and Natural Resources

ALBEMARLE-PAMLICO

THE ALBEMARLE-PAMLICO ESTUARINE STUDY

ANNUAL REPORT

by

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MAY 1991

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I. SUMMARY

The 1990-91 year (the 4th year) has been a very busy and very productive year for the Albemarle-Pamlico Estuarine Study (APES).

New staff members have provided additional enthusiasm for the Study as it enters into the final stages of data acquisition and management plan development. In September of 1990, Randall G. Waite from the Environmental Protection Agency (EPA) Region III accepted the position of Program Director and in January of 1991 Jennifer Steel was hired as Technical Coordinator to assist with all technical aspects of the information acquisition and data management programs.

As APES enters its 5th and final funding cycle, it is moving well along the path of goals to the two key program objectives: completion of the Status and Trends Report (STR) and development of the Comprehensive Conservation Management Plan (CCMP). The draft STR is in the final stages of revision and review; the final is expected by July. Ad hoc committees are being formed to develop specific environmental objectives and begin development of the Management Plan.

As more data become available, the Center for Geographic Information and Analysis (CGIA), the information manager for APES, continues to expand its Geographic Information System, adding data layers, refining existing layers, and conducting analyses.

The Information Acquisition program has been very successful. FY 1989-90 final project reports have continued to roll in. Since January, five project reports have been completed, six are in the final stages of revision, and ten are due to be presented in draft form within the next two months. Sixteen projects funded in FY 1990-91, are all progressing nicely. Another 15 information acquisition projects will be funded in FY 1991-92. One project has been selected by the EPA for Action Plan Demonstration Project funding.

Some Information Acquisition projects represent multi-year efforts at data acquisition, hypothesis testing, or project implementation; others represent just one year of such endeavors. Topics of investigation range from shell disease in blue crabs to hydrodynamic modeling, to alternative fishing gear, to animal waste management.

The Public Participation program has also been very active reaching out to school children, local government officials, interest groups, involved citizens, and the general public. Ten public participation projects were funded in FY 1990-91 and six

will be funded in FY 1991-92. Funded projects have included the development of a "mini CCMP" -- the Citizens' Advisory Committees' Blueprint for Action, creation of fact sheets and educational posters, the development of school curricula, radio and T.V. broadcasts, and the expansion of the citizens' water quality monitoring network.

All completed and pending projects are included on the Publications list and are available through the Program and the Public Involvement Office upon request.

APES, jointly funded by the U.S. Environmental Protection Agency and the N.C. Department of Environment, Health, and Natural Resources, operated under a budget of roughly $1,760,000 in FY 1990-91 and will have a budget of roughly $1,535,000 in FY 1991-92.

II. INTRODUCTION

The Albemarle-Pamlico Estuarine Study (APES) is jointly funded by the State of North Carolina and the U.S. Environmental Protection Agency (EPA). As one of the National Estuary Programs (NEP) -- spawned by the Clean Water Act amendments of 1987 -- APES was created to improve the management of valuable, extensive, and diverse estuarine resources of northeastern North Carolina. APES combines technical information acquisition and public participation in the development of potential management alternatives in an effort to ensure the long-term productivity of the estuarine waters.

The Albemarle-Pamlico (A/P) study area is extraordinarily diverse and productive. It includes the entire watershed of Albemarle and Pamlico Sounds--except the portion of the Roanoke River watershed that lies above the Lake Gaston Dam. Thus, the A/P study area encompasses approximately 30,880 square miles in northeastern North Carolina and southeastern Virginia (Figure 1). Included are extensive uplands, tributaries, wetlands, five major rivers (the Chowan, Roanoke, Alligator, Pamlico, and Neuse), five major sounds (the Albemarle, Pamlico, Currituck, Bogue, and Core) and an extensive chain of barrier islands. The types of development and use are as varied as the environment itself. Commercial and residential development, agriculture, forestry, commercial and recreational fishing, and tourism are just a few of the activities common in the A/P region.

Although the A/P region does not display the severe problems evident in some other estuarine systems, some warning signals of environmental degradation are present. General declines in finfish fisheries have occurred since 1980. Large-scale fish kills, outbreaks of fish diseases such as "red sore" disease and ulcerative mycosis, and outbreaks of "shell disease" in blue crabs have occurred through out the region. Massive blooms of blue-green algae occur each year in some tributaries of the sounds. Once vast areas of rooted aquatic plants have disappeared from portions of Albemarle Sound, Pamlico Sound, and the Pamlico River. These and other signs are indicative of an estuarine system in distress.

APES is funding information acquisition and demonstration project efforts intended to develop better understanding of the estuarine system and management of these vital resources. Scientists are documenting the state of the system and are conducting research to determine the relationships between human activities in the A/P watershed and the health of the A/P waters. Some investigators are trying to determine the causes of the problems. Other investigators are examining the management and policy processes affecting the A/P region. Still other investigators are conducting demonstration projects that utilize

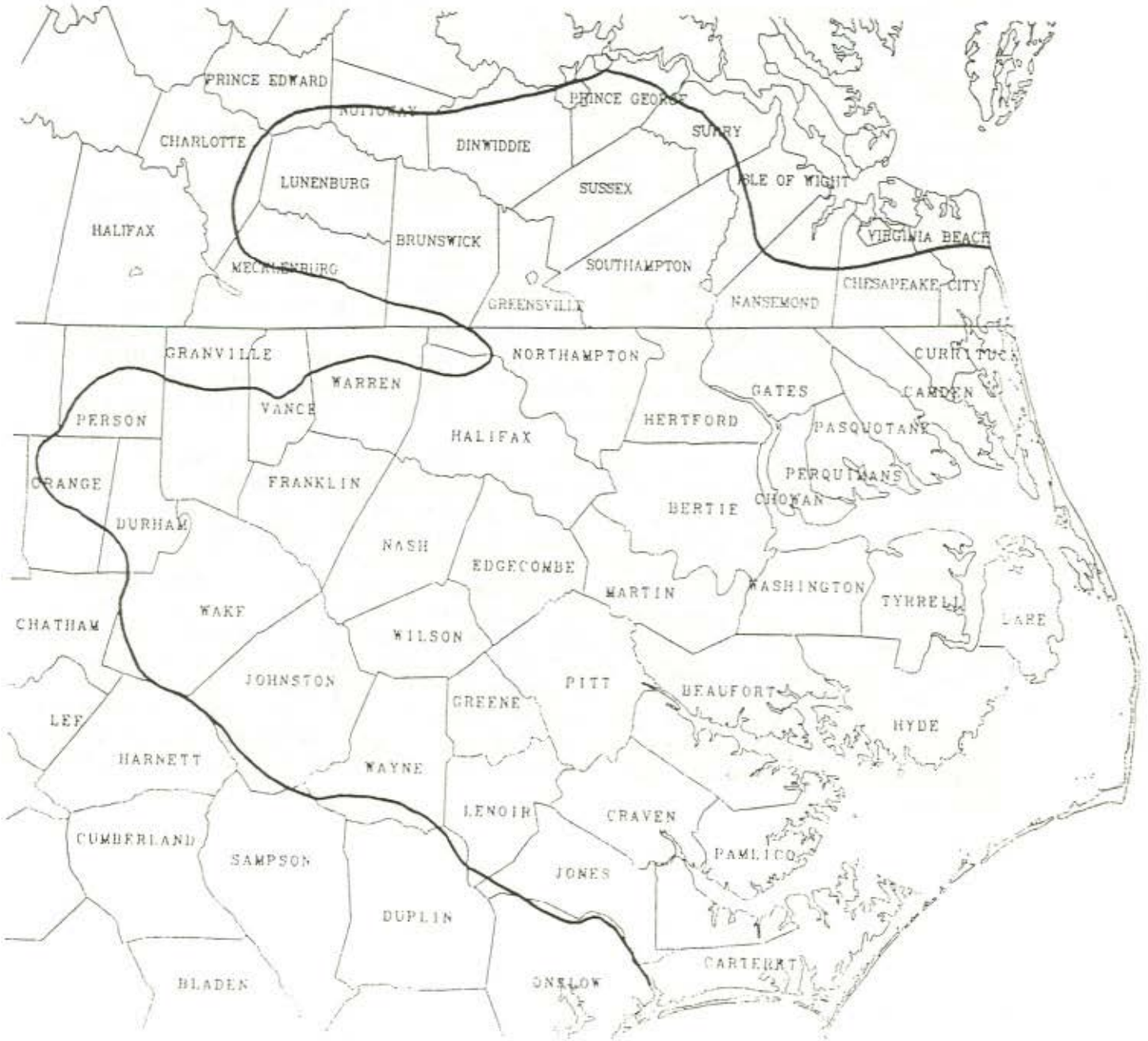
best management practices to help raise local awareness and help define viable management strategies. APES is also supporting the development of a central computerized geographic information system (Section IV) that allows geographically referenced data to be sorted, compared, and graphically displayed. Geographical, geological, biological, chemical, demographic, and sociological information can be stored in compatible data "layers", retrieved, and readily analyzed. Scientists, policy makers, and environmental managers can use the information for research and decision making. A baseline water quality monitoring program is also being carried out so that critical areas and trends can be defined and effectiveness of management actions determined.

Equally important as the investment in the acquisition of scientific information is the investment in encouraging public involvement with the Study. This vital component of APES disseminates information about the A/P Study, receives citizens' input, and develops the support needed for the implementation of the management plan. It also serves to further educate the public about how individuals can make a difference in protecting and enhancing the environment.

APES, like other NEPs, represents a unique opportunity for a partnership of scientists, resource managers, elected officials, and citizens. By working together, we can protect our natural heritage and ensure the long-term productivity of these estuaries and the many human uses they support.

FIGURE 1

ALBEMARLE - PAMLICO ESTUARINE STUDY AREA



Scale 1:1,900,000

May, 1991

Prepared by
Center for Geographic Information & Analysis
N.C. Dept. of Environment, Health & Natural Resources

Boundary and Hydrography Data Acquired
USGS Digital Line Graphs, 1:2,000,000

III. ADMINISTRATIVE BOARDS AND STAFF

The Albemarle-Pamlico Estuarine Study (APES) is made up of four administrative boards (a total of 93 members), the Policy Committee, the Technical Committee, Albemarle Citizens' Advisory Committee, and the Pamlico Citizens' Advisory Committee (Appendix 1). The Policy Committee's main responsibilities are to: establish the general goals and policies of the program; approve all substantial expenditures of funds; structure, appoint, and replace members of the three other Committees; approve and appoint program staff; approve the Workplan for the Study; evaluate the progress of the Study towards the established goals; and provide broad-based support for the program in policy and political matters. The Technical Committee provides the technical support for the program staff; reviews draft documents and make recommendations to the Policy Committee on the documents' technical merits; helps design and evaluate the information management and public participation programs of the Study; and reviews and makes recommendations to the Policy Committee regarding draft project proposals. The two Citizens' Advisory Committees provide a mechanism for structured input and valuable insight from citizens from each region into the A/P Study and assist in the dissemination of relevant information.

In September 1990, Randall G. Waite of US EPA Region III joined the APES staff as the new Program Director and in January of 1991, Jennifer Steel took the position of Technical Coordinator. She will be assisting with all aspects of the Information Acquisition Program and development of the Comprehensive Conservation Management Plan (CCMP). The APES Program Staff now consists of five full-time and one part-time employees of the NC Department of Environment, Health, and Natural Resources (EHNR) and one employee of the US EPA Region IV Office (Appendix 1). The Program Staff prepares all program documents; coordinates the grant application and award process; supports all administrative board meetings; manages all program grants and contracts; and administers the day-to-day functions of the program.

IV. PROGRAM PURPOSES AND MILESTONES

Every one of the now 17 NEP Management Conferences operates under seven purposes defined in the 1987 Clean Water Act amendments. They are to:

1. Assess trends in water quality, natural resources, and the uses of the estuary;
2. Collect, characterize, and assess data on toxicants, nutrients, and natural resources;
3. Develop relationships between pollutant loads and estuarine uses and quality;
4. Develop a comprehensive conservation management plan (CCMP);
5. Develop a plan to coordinate implementation of the CCMP;
6. Monitor the effectiveness of CCMP actions; and
7. Develop a federal consistency plan.

As part of the Designation Agreement between the State of North Carolina and the EPA, APES defined 18 goals or "milestones" to be achieved in the process of developing the CCMP by November of 1992 (Figure 2). APES plans to achieve all of these milestones and, although slightly behind schedule at the present time, is pushing forward with every intention of finishing on schedule.

Three major milestones were to be accomplished during this past year: (1) A CCMP outline, (2) a report on federal consistency, and (3) the Status and Trends Report (STR), the foundation upon which the CCMP will be developed.

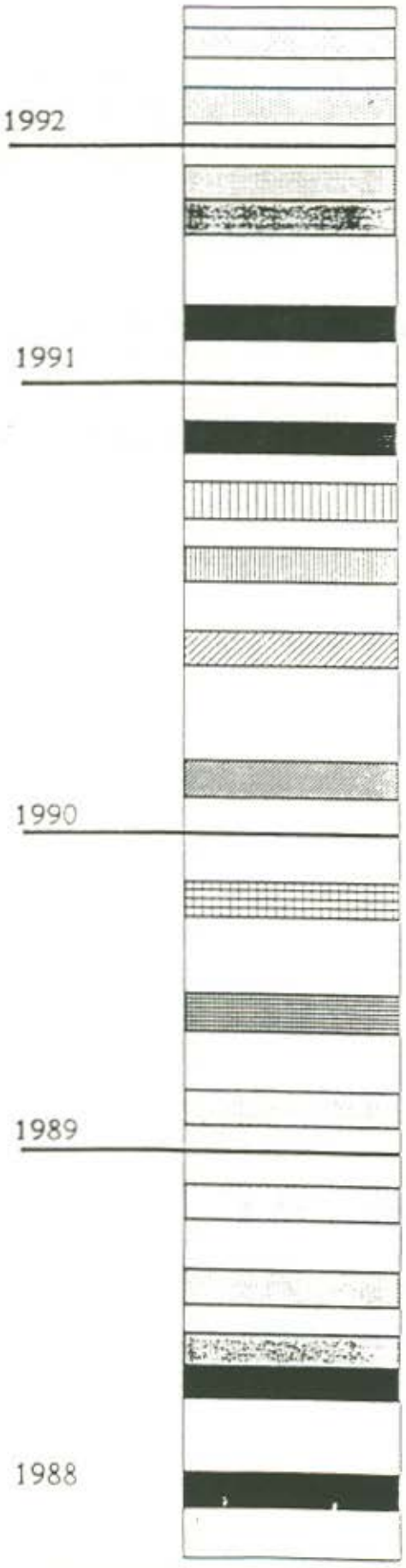
A working outline for the CCMP has been developed. Several ad hoc committees have been selected and meetings have been planned to assist in the initial stages of CCMP development. Specific environmental objectives based on the Study's Environmental Goals and on the problems defined in the STR will be finalized in workgroups of scientists and environmental managers to be held in July 1991. Scoping meetings will be held throughout the summer to develop "concepts" for each of the four Key Areas of Concern, the first stage of CCMP development. The first draft of the CCMP is expected in February of 1992 and the final is due in November of 1992.

A report on the possible strategies to be employed in satisfying the requirements of a federal consistency review procedure has been completed. Both the Coastal Zone Management Act and the State Clearinghouse offer potential means of review of federally funded projects for consistency with the intentions of the CCMP, but only coordination with the regulations of the State's Coastal Area Management Program would allow decisive intervention to be taken to uphold the findings of the CCMP.

Completion of the STR was delayed in an attempt to gain additional consensus on the document. Seven public meetings were held across the state to solicit public comment and input. Contributing authors were asked to augment, revise, and/or update the information presented. Final editing and review have been completed (Appendix 2 is the Executive Summary of the STR). The final version of the STR should be printed and available by August of 1991.

FIGURE 2

ALBEMARLE-PAMLICO ESTUARINE STUDY MILESTONES



Final CCMP (Nov.)

Institution/Financial Commitment (Aug.)

Draft CCMP (Jan.)
Federal Inconsistencies
Alternatives (Jan.)

Compliance Schedule
of Action Plan (Nov.)

Final Status/Trends Report (Oct.)

Federal Consistencies Report (Sept.)

Monitoring Long-Term
Management Effectiveness (July)

CCMP Outline Defined
(Management Strategies
& Cost Evaluation) (June)

Schedule Data
Management Activities (Feb.)

Status/Trends Scoping
(Probable Causes) (Dec.)
(Loading/Fate)

Inventory of Relevant
Federal Programs (Sept.)

Data Base Priorities (Feb.)

Priority Environmental
Concerns (Dec.)

Key Data Resources (June)

Federal Agencies
Contribution (April)
Design Baseline
Monitoring Programs (March)

Existing Monitoring Programs (Jan.)

V. EVENT SCHEDULE

The Albemarle-Pamlico Estuarine Study establishes the administrative committee's calendar one year in advance to promote better attendance, coordination, and communication among the four committees. Highlights of the 1990-91 calendar (Figure 3) include:

1. Public meetings held across North Carolina in January to review the STR,

2. The Annual Researchers' Review Workshop and the Annual Public Meeting held in Beaufort, NC in September, and

3. Two Roundtable meetings held in August 1990 and March 1991 to provide open forums for all program participants and the general public.

FIGURE 3

ALBEMARLE-PAMLICO ESTUARINE STUDY SCHEDULE-1990-91

Date	Event
September 1, 1990	Projected EPA Award of Funding
September 13, 1990	Annual Researchers Review Workshop
September 18, 1990	Technical Review Subcommittee Meeting
October 5, 1990	Annual Public Meeting
October 29/Nov 2, 1990	CAC Meeting
November 13, 1990	Technical Committee Meeting
November 27, 1990	Policy Committee Meeting
November 28, 1990	Call For Proposals Sent Out
January 11, 1991	Review Call For Proposals (submittal due date)
January 15, 1991	Status and Trends Public Meeting-Ashville
January 16, 1991	Status and Trends Public Meeting-Greensboro
January 17, 1991	Status and Trends Public Meeting-Raleigh
January 22, 1991	Status and Trends Public Meeting-Elizabeth City
January 23, 1991	Status and Trends Public Meeting-Beaufort
January 29, 1991	Status and Trends Public Meeting-Greenville
January 31, 1991	Status and Trends Public Meeting-Wilmington
February 13, 1991	PCAC & ACAC Meetings to Evaluate Specific Proposals
February 19, 1991	Technical Committee Meeting to Consider Subcommittees' Proposal Recommendations
March 5, 1991	Roundtable Meeting of All Committees
March 6, 1991	Policy Meeting to Consider Technical Committee's Proposals and Annual Budget Recommendations
March 18-30, 1991	Return Selected Proposals to Authors for Revisions
April 12, 1991	Revised Proposals to Director/Subcommittees
April 22-25, 1991	CAC Meetings
May 8, 1991	Technical Committee Meeting
May 17, 1991	Final Cooperative Agreement Packages
June 11-12, 1991	Policy Committee Meeting
July 16, 1991	Financial Planning Session
July 17, 1991	Fisheries/Human Environment Objectives Work Groups
July 18, 1991	Critical Areas Objectives Work Group
July 19, 1991	Water Quality Objectives Work Group
August 5-8, 1991	CAC Meetings
August 20, 1991	Technical Committee Meeting
August 28, 1991	Roundtable Meeting of All Committees
August 29, 1991	Policy Committee Meeting
September 2, 1991	Projected EPA Award of Funding
September 17, 1991	Technical Review Subcommittee Meeting
September 20, 1991	Annual Researchers Review Workshop
September 21, 1991	Annual Public Meeting
October 28-31, 1991	CAC Meetings
November 12, 1991	Technical Committee Meeting
November 26, 1991	Policy Committee Meeting

VI. INFORMATION MANAGEMENT

The North Carolina Center for Geographic Information and Analysis (CGIA), formerly the Land Resources Information Service, is under contract with APES to carry out the information management portion of the Study. The tremendous capabilities of their ARC/INFO-based system, its central nature, and its compatibility with many other state and federal systems make it an invaluable component of the Study and of any future resource management initiatives in North Carolina.

CGIA has completed a comprehensive assessment of the data needs of resource managers and researchers, documented those needs as data base and software specifications, and supplied recommendations for specific data layers to be developed. The data needs assessment team conducted more than 50 interviews with over 100 people from federal, state, and local government agencies and university researchers. This information was used to identify cartographic "data layers" and tabular data sets required to support the Study. Results form the data needs assessment are compiled in the Data Requirements Document. Table 1 lists the 49 most critical data layers for North Carolina and Virginia that CGIA has acquired or will attempt to acquire for the purposes of A/P Study.

CGIA completed the Functional Description Document which provides a conceptual view of the five components of the APES Data Management and Analysis System: hardware, software, data, people, and procedures. Interactions among the five components result in a set of functions that should be supported through GIS. These functions fall into five broad categories: (1) system management and maintenance, (2) data extraction and management, (3) data creation and editing, (4) data manipulation and summarization, and (5) data analysis and display. Complete descriptions of the GIS system and these five functions appear in the Functional Description Document.

CGIA compiled a Data Inventory, listing 118 computerized databases found in N.C. relating to the A/P region, and for each, a brief description, the format, the location, and the name of a contact person.

CGIA has developed a training program for APES consisting of a series of workshops designed to train people in the use of GIS.

New data and new data layers are periodically added to CGIA's GIS data base as they become available. Digitized data sets may be obtained from APES projects, other agencies, and other organizations in North Carolina and Virginia. Raw data sets may also be digitized by CGIA staff and added to the system. Expanded data base exchange and enhancement opportunities are

being actively pursued in an effort to maximize processing and analytical capabilities.

Already many data layers are complete and several others area near completion (Table 1). General soils, submerged aquatic vegetation, political boundaries, transportation corridors, and many other data layers have been loaded into the system. One critical data layer, "land use/land cover" for the entire study area, is nearly complete. Each county planner is being contacted to review the map products for accuracy. Comparison of these new maps with earlier ones produced by the U.S. Geological Survey will give an indication of land use trends over the past 15 years. The new data layer will also provide a means of more accurately estimating the loading of nutrients from nonpoint sources.

This extensive effort by APES in cooperation with other state and federal programs has resulted in one of the most comprehensive and advanced data management systems of any of the NEPs and, indeed, of any state.

Layer	Abbr	NC Reference Base	NC APES*	VA APES
State Boundary	SB	USGS - 100k	x	NC/VA
A/P Study Area Boundary	APSB	USGS - 2m	x	NC/VA
County Boundaries	CB	USGS - 100k	x	NC/VA
Sub-Basins	SBB	USGS -24k	scheduled	VA
Hydrography	HY	USGS -100k	x	NC/VA
Land Use Land Cover	LU	Landsat-TM	x	NC/VA
National Pollutant Discharge Elimination	NPD	USGS -24k	x	VA sched
Wetlands & Deep Water Habitats	NWI	USFWS - 24k	partial	VA sched
Ambient Water Quality Monitoring Sites	AWQ	USGS -24k	x	VA sched
Natural Heritage Inventory	NHI	USGS - 24k	x	VA
Natural Areas	NHNA	USGS - 24k	partial	VA sched
Surface Water Intakes	SWI	USGS - 100k	x	
Submerged Aquatic Vegetation	SAV	USGS -24k	part/sched	NC sched
Superfund Sites	SPFS	USGS - 24k	x	VA
Census Boundaries - 1970	CE70	CENSUS - 126.72k	x	
Census Boundaries - 1980	CE80	Census/Tiger '91	x	NC sched
Census Boundaries - 1990	CE90	Census/Tiger '91	x	NC sched
Coastal Reserves	CR	USGS -24k	x	
Fisheries Independent Biological Monito	BMS	USGS - 24k	x	
Oyster Cultch Plant Sites	OYSC	USGS -24k	x	
WRC Game Lands	WRC	DOT - 126.72k	x	VA 8/91
Heavy Metal & Organic Rich Muds	HM	USGS - 24k	partial	
Citizen Water Quality Monitoring Sites	CWQ	USGS - 100k	x	
Mussel Distribution	MUS	USGS - 100k	partial	
Bottom Sediment Sample Locations	BSD	Unknown	x	
Federal Land Ownership	USFP	USGS - 100k	x	VA 8/91
Fisheries Nursery Areas	NA	USGS - 24k	x	
Shellfish Evaluation/Mapping Areas	SEMA	USGS DLG - 12k	x	
Outstanding Resource Waters (Coastal)	ORW	USGS - 24k	x	
Artifical (Marine) Reefs	AR	Unknown	x	
Landfills			x	
Hazardous Waste			x	VA
CAMA Major Development Permits	CAMA	USGS - 100k	partial	
General Soils	GSL	USGS - 250k	x	NC
Roads and Trails	RDS	USGS - 100k	x	NC/VA

Layer	Abbr	NC Reference Base	NC APES*	VA APES
Railroads	RR	USGS - 100k	x	NC/VA
Pipe,Transmission Lines,&misc.	PTR	USGS - 100k	x	NC/VA
Public Water Supply Watersheds	WSD	USGS - 24k	x	
State Parks	PRK	USGS - 100k	x	VA 8/91
USGS-EHNR Stream Gages	GAGE	USGS - 24k	x	
Coastal Marinas	MAR	USGS - 24k	scheduled	NC sched
Peat Resources	PR	USGS - 24k	partial	
Anadromous Fish	AF	USGS - 24k	x	
Detailed Soils	DSL	USGS - 24k	partial	
Municipal Boundaries	MB	USGS - 100k	x	VA 8/91
Water Quality Sample Project Locations	WQS	Unknown		
Lease Blocks	LB	Coord Generated		
Geology	GEO	NCGS - 250k	x	
Military Air Space	MAS	Unknown	partial	
Fishing Water Jurisdictions	FWJ	USGS - 24k		
Elevation	EL	USGS - 24k		VA
Bathymetry	BT	Unknown		

LEGEND:

X means completed

NC or VA indicates the state agency that has or is scheduled to acquire the data layers.

VII. INFORMATION ACQUISITION

Progress to Date

The technical information acquisition portion of the Study, identified in the Study's Five-Year Work Plan, amounts to 50-60 percent of the annual budget. Many gaps remain in our understanding of the complex processes of the estuarine system. By addressing questions concerning the four Key Categories of the Study -- Critical Resource Areas, Water Quality, Fisheries, and the Human Environment -- a more complete picture of the internal workings of the estuarine system will emerge and will allow managers to make wiser decisions about the best resource management strategies to implement.

APES has cooperated with many other federal, state, and local agencies in the development of research projects and in the implementation of management strategies. Proposals have been submitted for the Coastal America Program in cooperation with US Fish and Wildife Service, Division of Coastal Management, and several other agencies. APES has participated in the activities and research efforts of the NC Stirped Bass Management Board. Projects funded by APES have yielded significant amounts of information and have been crucial elements in many larger-scale scientific and managerial undertakings.

The priority environmental concerns identified by APES are: the decline of fisheries' productivity, fish diseases and contamination, anoxia-related fish kills, changes in the distribution of sessile aquatic organisms, impairment of nursery function, eutrophication, habitat loss, and the closure of shellfish beds.

All APES projects are funded for a one-year period; annual reviews determine the merits of proposed continuation. Any continuation project must submit a new proposal during the call-for-proposals period. Continuation projects and new projects are evaluated on an equal basis, using the established review process criteria of technical merit and relevancy to the needs of the Study.

During Federal FY 1990-1991, 16 information acquisition projects were funded. Ten of the 16 projects are continuations from the previous year(s) (Table 2). Two of the projects pertained to Critical Areas, nine pertained to Water Quality, two pertained to Fisheries, and three pertained to the Human Environment. Highlights of some of these projects and other projects now completed or in the final stages of completion are presented below.

Critical Resource Areas

Project #416 Delineation of SAV in Currituck, Albemarle, and Western Pamlico Sounds (in progress)

This project is a continuation of the effort to determine the location and extent of submerged aquatic vegetation (SAV) in the A/P system. An intensive aerial photo survey has already been conducted. The results will be tabulated and digitized for entry into the State's geographic information system.

Water Quality

Project #305 Eutrophication and Nuisance Algal Blooms in the Lower Neuse River Estuary (complete)

This project defined several biologically important water quality characteristics (particularly the nitrogen limitation) of the Lower Neuse River Estuary system and, using bioassays, simulated the effects of different magnitudes of nutrient loading events on algal growth. Nuisance algal bloom potential was determined to be greatest in the lower estuary during periods of high river flow and in the middle estuary during periods of lower river flow.

Project #227 Heavy Metal Pollutants in Organic-rich Muds of the Neuse River Estuary: Their Concentration and Distribution (in progress)

The concentration and distribution of 15 select heavy metals were determined from over 200 sample sites throughout the Neuse River Estuary. Core sampling efforts focus on areas around known point source dischargers. Results indicate that significant elevation of the concentration of certain heavy metals has occurred around these point sources.

Fisheries

Project #314 Abundance and Viability of Striped Bass Eggs Spawned in the Roanoke River in 1990 (in progress)

This project is part of a cooperative effort with the Striped Bass Management Board to determine the effects of flow regulation on the dynamics of the striped bass population. Regular measurements are being taken of the densities and viabilities of the eggs spawned and the water quality and flow characteristics of the river. The results will be used in formulating a comprehensive flow management regime for the Roanoke River.

Project #434 An Examination of the Blue Crab Fishery in the Pamlico River Estuary (in progress)

This project is conducting field analyses of fishery-dependent parameters in an effort to determine the biological impacts of the crab pot and crab trawl industries in the Pamlico River Estuary. The goals of the study are to determine and achieve optimum yield for blue crabs while minimizing trawl by-catch and sustaining the yields of finfish. Preliminary field studies are underway.

The Human Environment

Project #415 Public Attitudes About Water Quality (in progress)

This is Phase II of a two-part study to determine how North Carolina and Virginia residents of the A/P Study area feel about issues regarding water quality such as health concerns, confidence in regulations and regulatory agents, and their willingness-to-pay for improved water quality. The intensive telephone survey has been developed and will be conducted in the next month.

Project #358 Federal Consistency Review for the Albemarle-Pamlico Estuarine Study (complete)

This report describes the options for incorporating the substance of the CCMP in a federal consistency review procedure. The options considered included the state Clearinghouse, the process defined in the federal Coastal Zone Management Act (CZMA), and the permit review process of Section 401 of the Clean Water Act. The study concluded that incorporation of the CCMP recommendations with the state Division of Coastal Management's coastal management program under CZMA would provide the best results.

Fiscal Year 1991-92 Proposed Projects

APES agreed to fund 15 information acquisition projects in FY 1991-92 (Table 3); final contract negotiations for these projects are nearly complete. The projects to be funded are briefly described below.

Critical Resource Areas

Project #510 Delineation of SAV in Currituck, Albemarle, and Pamlico Sounds

This project is a continuation of an effort to map the submerged aquatic vegetation (SAV) along the Outer Banks and western Sounds of North Carolina. The study combines aerial photography and ground reconnaissance to delineate and characterize SAV in Currituck, Albemarle, and western Pamlico Sounds. The third year will complete the mapping. All information will continue to be entered into North Carolina's geographic information system (GIS). SAVs are productive habitats and are often associated with fisheries nursery areas and shellfish beds. This survey will be instrumental in determining the location, extent, and trends of this valuable resource. Data could also be used to develop and support recommendations for designating new primary or secondary nursery areas.

Project #526 An Inventory and Protection Plan for Critical Natural Areas, Exemplary Wetlands, and Endangered Species

This project, a compliment to similar efforts in NC, will inventory resource critical areas in the Virginia portion of the A/P Study area. All maps will be entered into the N.C. and Virginia geographic information systems to assist natural resource managers with planning. Interstate planning and financial coordination are in full swing.

Water Quality

Project #540 Continuous Monitoring of the Open Sounds

Conducted by the U.S. Geological Survey (USGS), this project is one of three components of a comprehensive water quality monitoring program established by APES. The two other components are the Citizens' Monitoring Program (Section VIII.) and the state Division of Environmental Management's Baseline Water Quality Monitoring project (see below). The monitoring program will create a baseline of water quality information so that the effectiveness of management strategies can be determined later. This USGS project monitors salinity, temperature, and dissolved oxygen at 33 sound and tributary locations. Measurements are recorded every 15 minutes and will define the temporal and spatial variability of the parameters in the estuarine setting.

Project #509 Baseline Water Quality Monitoring

This effort by the N.C. Division of Environmental Management (DEM) is one component of the A/P Study's comprehensive water quality monitoring program. Other water quality monitoring is undertaken by USGS and volunteer citizens (see above). DEM has expanded its statewide ambient water quality program to more intensively monitor areas of highest concern within the study area. Twenty-one physical, chemical, and biological parameters are recorded monthly. Results of this baseline monitoring will be able to be used to determine the effectiveness of resource management programs.

Project #539 Hydrodynamic Modeling of Albemarle Sound

Very little is known about the hydrodynamics of the Albemarle Sound. A second year of joint funding with USGS, the U.S. Army Corps of Engineers, the N.C. Striped Bass Management Board, and APES is being used to conduct studies and create a model of this complex system. The modeling process will consist of: (1) generation of a numerical grid, (2) determination of inflows, (3) creation of input data files, (4) calibration of the model, (5) validation of the model, and (6) application of the model. The model will then be used to investigate circulation in Albemarle Sound in order to better understand striped bass reproductive patterns, nutrient budgets, water-flow characteristics, movement of sedimentary particles, and cumulative impacts.

Project #551 Developing Nutrient Loading Reduction Targets

This project will convene a workgroup of experts to refine current nutrient loading reduction targets for the Chowan, Neuse, and Tar-Pamlico Rivers. Nutrient reduction targets will also be developed for other riverine systems within the A/P study area. Results of this project should be extremely useful for the DEM basin-wide planning efforts.

Project #536 Mapping Groundwater Recharge Areas

This project will compile available information and map groundwater recharge areas within the study area. All maps will be digitized and entered into the state GIS. Since recharge areas are susceptible to pollution, this data layer will be important in the analysis of potential impacts to the estuarine system from contaminated groundwater discharge.

Fisheries

Project #537 An Examination of Alternative Fishing Devices of the Estuarine Shrimp and Crab Trawl Fisheries

Alternative fishing gear will be tested for their effectiveness in reducing finfish by-catch in the crab and shrimp trawl industries. Through the use of improved gear, destruction of non-target organisms can be minimized, while adequate harvests of target species are maintained.

Project #534 Fishing Practices Mapping and Literature Review of Environmental Impacts

Information on the location of commercial and recreational fishing areas and the effects of fishing practices is not readily available for the Albemarle-Pamlico area. Locations of current fishing practices will be mapped and entered into the geographic information system. A literature review will also be conducted to determine whether fishing practices may be affecting the natural resources of the area.

The Human Environment

Project #550 Develop Management Strategies for the A/P Study Area

APES has put forth considerable effort to develop data layers for the N.C. geographic information system (GIS). This project will integrate and analyze data from the GIS layers by way of four specific tasks: (1) preparation of watershed management profiles showing pollutants, sources, land use, nutrient budgets, etc. for each sub-basin; (2) development and analysis of future scenarios of changes in land use, population, pollutant loadings, etc; (3) development of recommendations for enhanced targeting of agricultural best management practices; and (4) assessment of critical areas at risk due to pollution. These results will play a key role in developing management strategies.

Project #543 Environmental Management Program for the Southeastern Virginia Portion of The APES Watershed

Chesapeake Bay programs in Virginia will be evaluated in terms of their potential applicability to the Virginia portion of the APES watershed where local governments are in the preliminary stages of developing management programs for the watershed. Coordination with the A/P Study program at this juncture is critical. The final product of this project will be recommendations for environmental management

programs in Virginia that are consistent with existing Virginia regulations and programs.

Project #505 Effects of Trawling on the Benthos

A literature review will be conducted regarding the effects of trawling on the benthos and summary conclusions and recommendations will be forwarded.

Project #*** Abundance and Viability of Striped Bass Eggs Spawned in the Roanoke River in 1991

R. Rulifson will continue his study on the Abundance and Viability of Striped Bass Eggs Spawned in the Roanoke River. This effort is coordinated with the NC Striped Bass Management Board study of the Roanoke River and USGS efforts in the area.

CCMP Development

Monies will be used to facilitate the CCMP development process and to hire technical services to assist in drafting the CCMP. Public meetings and the public review process will also be supported by these funds.

Sediment Toxicity

Monies will be used to fund sediment toxicity tests. Coordination with EPA laboratories and DEHNR field crews is being arranged to ensure maximum efficiency of sampling and laboratory analyses.

TABLE 2. FY 1990-91 INFORMATION ACQUISITION PROJECTS

Topic Area	NO.	Title	Researcher	Institution
Critical Areas	401	Regional Inventory of Critical Natural Areas	Roe	DEHNR/NATURAL HERITAGE PROGRAM
Critical Areas	416	Delineation of SAV in Currituck, Albemarle, Pamlico Sounds	Ferguson	NMFS
Water Quality	417	Citizen's Monitoring	Blinkoff	ECU
Water Quality	453	Point and Nonpoint Nutrient Budgets	Dodd	RTI
Water Quality	458	Management Plan for Currituck Sound Watershed: Modeling	Overton/Adams	NCSU
Water Quality	461	Evaluation of Crab Hemocyanin as an Indicator of Stress	Engel/Noga/Brouwer	NMFS/NCSU/DUKE
Water Quality	465	Continuous Monitoring of the Open Sounds	Bales	USGS
Water Quality	467	Hydrodynamic Modeling of Albemarle Sound	Bales	USGS
Water Quality	468	Determination of Flows/Flow Patterns for Pamlico	Bales	USGS
Water Quality	472	Inventory of Available Toxicant Information in the Pamlico & Neuse River Estuaries	Cunningham	RTI
Water Quality	473	Baseline Water Quality Monitoring	Tedder	DEHNR/DEM
Fisheries	434	Examination of Blue Crab Fishery	McKenna	DEHNR/DMF
Fisheries	454	Water Quality and Ulcerative Mycosis Relationship Utilizing Menhanden	Noga	NCSU
Human Env.	415	Public Attitudes Toward Different Management Strategies	Hoban/Clifford	NCSU
Human Env.	430	Evaluate Environ. Management Strategies	Bartholomew	CPN
Human Env.	452	Evaluation of Federal Programs	Duffin	RTI

DEHNR - NC Department of Environment, Health, and Natural Resources
ECU - East Carolina University
USGS - U. S. Geological Survey
NCSU - North Carolina State University
RTI - Research Triangle Institute
NMFS - National Marine Fisheries Service
DEM - Division of Environmental Management
DMF - Division of Marine Fisheries
CNP - Center for Policy Negotiations

TABLE 3

THE ALBEMARLE-PAMLICO ESTUARINE STUDY
Technical Acquisition-Projects FY 91-92

No.	Project Name	Mgmt. Conf. Purpose #	Projected Products	Date Of Delivery	Total Cost	Source Funds	Responsible Organization
509	Baseline W.Q. Program	1	Study Report	10/01/92	57,881	EPA/EHNR	DEHNR DEM
510	Delineation of SAV in Currituck, Albemarle, and Western Pamlico Sounds	1,6	Inventory Maps	09/30/92	92,717	EPA/NOAA	NOAA/NMFS
526	VA Inventory and Protection Plan	2,3	Study Report	09/30/92	83,550	EPA/EHNR/VA	VA DNH
534	Fishing Practices Mapping	2,6	Study Report	09/30/92	38,872	EPA/DMF	Research Triangle Institute
536	Ground Water Recharge Areas	1,6	Annual Report	06/30/91	21,974	EPA	Research Triangle Institute
537	Alternative Fishing Gear	3,6	Study Report	09/30/92	60,936	EPA/EHNR	DEHNR/DMF
539	Flow/Hydrodynamics in	3,6	Study Report	06/30/92	186,800	USGS/EHNR	U.S. Geological Survey
540	Continuous Monitoring	1,2	Study Report	06/30/92	252,900	EHNR/USGS	U.S. Geological Survey
543	VA Management Plan	1,6	Study Report	08/14/92	38,000	EHNR/HRPDC	Hampton Roads Planning District
550	CCMP Management Strategies/ GIS	2,4	Study Report	09/30/92	173,819	EPA/EHNR/ RTI	Research Triangle Institute

TABLE 3
CONTINUED

THE ALBEMARLE-PAMLICO ESTUARINE STUDY
Technical Acquisition-Projects FY 91-92

No.	Project Name	Mgmt. Conf. Purpose #	Projected Products	Date Of Delivery	Total Cost	Source Funds	Responsible Organization
551	Nutrient Reduction Targets	2	Study Report	12/31/91	16,439	EPA/EHNR/ RTI	Research Triangle Institute
505	Effects of trawling	1,6	Study Report	05/01/92	4,070	EPA/EHNR/ ECU	ECU
+++	Striped Bass Eggs 1991	1,6	Study Report	05/01/92	11,008	EPA/EHNR/ ECU	ECU
@@@	Sediment Toxicity	2,6	Study Report		12,557	EPA/EHNR	APES
XXX	CCMP Development	4	CCMP	11/30/92	50,000	EPA/EHNR	APES

EHNR = NC Department of Environment, Health, and Natural Resources
EPA = US Environmental Protection Agency
NOAA = National Oceanic and Atmospheric Administration
NMPS = National Marine Fisheries Service
VA = Virginia State Appropriations
VADNH = Virginia Department of Natural Heritage
DMF = NC Division of Marine Fisheries
USGS = US Geological Survey
HRPDC = Hampton Roads Planning District Commission
RTI = Research Triangle Institute

VIII. PUBLIC INVOLVEMENT

Progress to Date

The public involvement portion of the A/P Study is an extremely important long-term effort designed to inform and build public/local support for the Study. All public involvement projects are founded on the objectives of the Public Involvement Plan to: (1) provide timely information about the sounds and the progress of the Study, (2) expand educational programs that inform the public of environmental values and the importance of good management, (3) ensure that the interested public has ample opportunity to participate in the development of the CCMP, and (4) initiate a process for involving local elected officials in the Study.

Public involvement projects fall into three categories: (1) education and information (printed material, non-print media presentations, and special events), (2) public participation and hands-on activities, and (3) local government liaison programs. All of these categories were addressed in FY 1990-91 with a special emphasis on local government liaison through local outreach projects in southeastern Virginia, the Albemarle Sound region, and the Pamlico Sound region. These outreach presentations to local governments inform local leaders about the A/P Study, provide progress reports on research and pertinent information, and obtain local input concerning the Study.

Ten public involvement projects were funded in FY 90-**91** (Table 4). Several projects have been particularly effective, such as the CAC workshops for the "Bluprint For Action", award-winning radio programs, the Local Leadership Development Workshops, development of a Public Involvement Plan for southeastern Virginia, and the third APES Annual Meeting. Many other projects of this nature are undertaken by the APES staff in carrying out their daily responsibilities.

Three workshops were held for members of the Citizens' Advisory Committees to help develop an outline for and the content of the Blue Print for Action, a "mini CCMP". Panel discussions involved local leaders and representatives of several different states and open discussions involved all interested parties. The resulting document can serve as a springboard for the development of the CCMP.

Radio broadcasts dealing with pertinent Study topics were aired across the Study area. Live listener responses were incorporated on some shows and pre-produced broadcasts were distributed widely.

Local Leadership Workshops, held at four locations within

the study area, were aimed at developing management strategies to address specific "areas of concern". Participants were presented with an overview of the "areas of concern" and then divided into workgroups to develop potential solutions (final report is pending). Approximately 60-80 people attended each meeting, offering innovative and useful suggestions.

Coordination and Cooperation with the Commonwealth of Virginia continue to grow. Public involvement in natural resource conservation in southeastern Virginia is the task of the local planning district. They have been instrumental in bringing together area and local governments to discuss the A/P Study and their respective roles in the overall effort to preserve and protect our estuarine resources.

The third annual APES Public Meeting, held in October 1990 in Morehead City, was very successful. It was conducted in a new manner. Participants were treated to bag lunches which were enjoyed during "Brown Bag Seminars" dealing with four A/P funded projects.

The model estuarine/environmental health curriculum project for Pasquotank County and Elizabeth City schools is a fine example of the educational outreach being undertaken by the A/P Study. Wetlands on the grounds of eight different elementary schools (K-6) are being used as "outdoor laboratories". This non-traditional approach to teaching was so successful that the program is being reproduced and distributed to other school systems in the study area.

Fiscal Year 1991-92 Proposed Projects

Six public participation projects will be funded in FY 1991-92. Five of those six will be continuations of projects conducted in the previous year(s). Below is a description of each public participation project to be funded in FY 1991-92. Table 5 lists the projects and the principal investigators.

Project #503 Public Education Outreach in the Albemarle Sound Region

This project will present to public officials, citizens' groups, and schools specific information about the activities and goals of the A/P Study. The presentations and a series of accompanying newsnotes will be concentrated in nine Albemarle area counties and ten municipalities. Heightened awareness of pertinent environmental issues and the A/P Study's role will help develop cooperation and consensus in the development of the CCMP.

Project #524 Public Education Outreach in the Pamlico Sound Area and APES Newsletter

This is a continuation project to educate students and the general public within the Pamlico Sound area about APES and environmental issues. This year several new educational tools will be produced to further the goals of the Study including an estuarine poster, a series of newspaper articles, and a newsletter for school teachers. The project staff will also assist the A/P Study staff by producing and publishing the regular APES program newsletter.

Project #542 Public Education Outreach in Southeastern Virginia

The Hampton Roads Planning District Commission, formerly the Southeastern Virginia Planning District Commission, will be continuing their outreach effort from last year to build cooperative bridges among environmental managers, local governments, and citizens in southeastern Virginia. Their efforts include elements of public involvement, information exchange/clearinghouse, and technical studies. This project, like the other regional outreach projects (see above), aims to inform local citizens of the goals and activities of APES and to serve as a mechanism to receive the citizens' input regarding the Study.

Project #502 Model Education Curriculum

Basic environmental education is much needed in all schools. The Model Education Curriculum project is an effort by the Elizabeth City-Pasquotank County schools in eastern North Carolina to develop a curriculum for elementary school students (K-6) on estuarine habitats and environmental health.

Project #514 Citizens' Water Quality Monitoring Network

This project represents the fourth year of an A/P funding effort to develop and maintain a comprehensive citizens' water quality monitoring program that ties in closely with the monitoring efforts of USGS and DEM (see Section VI). Together they comprise the comprehensive water quality monitoring program and will help to determine the effectiveness of management strategies as they are implemented. Approximately 66 sites throughout the study area are monitored weekly by more than 80 volunteers. Baseline water quality data includes measurements of nutrients, dissolved oxygen, temperature, turbidity, pH, and salinity. Citizens have undertaken Quality Assurance and Quality Control training and have found their results to

fall within the ranges of DEM's results. All results are being compiled on a computer data base compatible with state and federal agencies.

Project #508 Public Involvement with the CCMP

This project is designed to increase citizen involvement with the development of the CCMP. Eight scoping meetings will be held in communities of the A/P watershed to solicit public comment and participation. The project coordinators will also assist the Study in arranging and conducting the fourth and fifth APES Annual Meetings in 1991 and 1992. Together, these efforts will help to build public awareness about the sounds and estuaries and about the problems they face. The efforts should also help to forge the popular support that will be necessary if the CCMP is to be truly successful and its recommendations are to be implemented.

Long-Term Citizen Invlovement

Since none of the proposals received through the Call For Proposals Public Participation Item #2 were considered to be acceptable, $10,000 has been reserved for the APES staff to develop alternatives for long-term citizen involvement. Institutional frameworks and potential funding sources for long-term involvement in planning, policy, management, and education will be analyzed and specific recommendations will be presented.

TABLE 4. FY 90-91 PUBLIC INVOLVEMENT PROJECTS

Topic Area	NO.	Title	Researcher	Institution
Public Participation	407	Assisting with Annual Meeting, 10 Fact Sheets, and reprint of Citizen's Guide	Armingeon	NCCF
Public Participation	408	8 Radio Programs	Cleary	Business Forums
Public Participation	409	Public Education Outreach in Albemarle Sound Area	Powers	AEA
Public Participation	411	Five Fact Sheets for Albemarle Sound Area	Powers	AEA
Public Participation	412	"Precious Waters" Display	Conoley	N.C. Aquarium Society
Public Participation	413	Feasibility Study for a Estuarine Resource Center	McNaught	PTRF
Public Participation	431	Public Education Outreach in S.E. Virginia	Carlock	S.E. Planning Comm.
Public Participation	439	Public TV Video	Willard	Willard Productions
Public Participation	444	Model Education Curriculum	Turnage	Elizabeth City/ Pasquotank Co. School System
Public Participation	474	Public Education Outreach in Pamlico Sound Area	Stroud	PTRF

AEC - Albemarle Environmental Council
PTRF - Pamlico Tar River Foundation
NCSU - North Carolina State University
SVPDC - Southeast Virginia Planning District Commission
NCCF - North Carolina Coastal Federation
UNC - University of North Carolina

TABLE 5

THE ALBEMARLE-PAMLICO ESTUARINE STUDY

Public Participation-Projects FY 91-92

No.	Project Name	Mgmt. Conf. Purpose #	Products Projected	Date of Delivery	Total Cost	Source Funds	Responsible Organization
502	Env. Health Education	4	Workshops	07/31/92	61,060	EPA/EHNR	Elizabeth City/Pasquotank County Schools
503	Public Education Program in the Albemarle Sound Area	4	Presentations Newsbriefs 4 Fact Sheets	09/30/92	34,314	EPA/EHNR	Albemarle Env. Association
508	Public Involvement in the CCMP	4	2 Annual Meetings 8 Scoping Meeting CCMP Recommendations	09/30/92	43,004	EPA/EHNR	N.C. Coastal Federation
514	Citizen Water Quality Monitoring	4	Study Report	09/30/92	48,958	EPA/EHNR	East Carolina University
524	Community Education Outreach Sound Area	4	Poster, Newsletters, Bulletin	09/30/92	74,850	EPA/EHNR	Pamlico-Tar River Foundation
542	VA Institutional Enhancement	4	Articles, Fact Sheets Atlantic Beach Aquarium	08/14/92	16,000	EPA/EHNR	Hampton Roads Planning District
***	CCMP/Long-Term Citizen	4	Study Report	05/30/92	10,000	EPA/EHNR	APES Staff

EPA = US Environmental Protection Agency

EHNR = NC Department of Environment, Health, and Natural Resources

IX. ACTION PLAN DEMONSTRATION PROJECTS

Supplemental funds for Action Plan Demonstration Projects have been provided by the U.S. EPA to the A/P Study in federal fiscal years 1988, 1989, and 1990. Funds are provided to estuarine programs to demonstrate management strategies that: (1) have the potential to be effective implementation measures for the entire study area, (2) have possible national application, and (3) can be incorporated into the CCMP. In the competitive process for funding, the EPA gathers project proposals from all NEPs and judges each on its individual merits, selecting only the very best. All recipients of EPA and APES priority action plan funding must provide 25% of the total project cost as "local cost share".

Funds provided in FY 1988-89 are supporting three projects. One project is implementing agricultural best management practices (BMPs) for animal waste management in the Bennett's Creek watershed, a tributary of the Chowan River in Gates County, North Carolina. This watershed has acute waste management problems resulting primarily from animal feed lots. The other two projects are efforts by the Virginia and North Carolina Divisions of Soil and Water Conservation to establish BMPs within different watersheds of the Chowan River Basin which extends into both states. Animal waste management problems have been identified by environmental agencies within both states. Virginia has been working to rectify farm waste lagoon problems and evaluating land application of the lagoon effluent as a supplemental source of fertilizer. Ninety-two contracts for the construction and operation of the cost-share BMP facilities were drawn-up between the Division of Soil and Water and local land owners and nutrient budgets were developed to direct the management of the waste products. North Carolina is investigating the effectiveness of solid-set land application of waste lagoon effluent on intensively cattle-grazed lands with different soil conditions.

Funds provided in FY 1989-90 are being utilized to build an urban stormwater detention basin to receive the runoff from 200 acres in downtown Greenville, NC. The detention basin should reduce the amount of nutrients, heavy metals, and sediments that reach the Tar River. A coordinated intensive water quality study is being funded to compliment this project (see below). This area is quite representative, geographically and culturally, of a number of small cities within the study area, and so, this project should demonstrate the BMP's widespread applicability.

In FY 1990-91, additional funds were awarded to: (1) further implement BMPs in the Bennett's Creek watershed; (2) monitor the effectiveness of the Greenville stormwater detention basin; and (3) begin a new shoreline erosion control demonstration project. This last project is intended to protect

marsh grass through the use of low-cost breakwaters. The project will site and construct several low-cost breakwaters in an effort to determine the best design and engineering for marsh protection while allowing for the passage of water and organisms. Preliminary siting, permitting, and engineering tasks have been accomplished.
Once the breakwaters are in place, marsh grass can be planted in the protected waters, thereby increasing primary nursery areas and enhancing capabilities of sediment reduction and nutrient removal by filtering the upland runoff.

One project was accepted for FY 1991-92 funding under EPA's demonstration project grants. The N.C. Division of Soil and Water will conduct a project entitled "Composting Farm Animal and Seafood Processing Residues -- Recycling Waste Management Strategies". This project will demonstrate recently proven composting procedures for carcasses and organic scraps from a broiler chicken producer, a swine operation, and a crab processing plant. Microbial monitoring and nutrient analyses will be conducted throughout the composting and land application phases of the study.

X. MONITORING

The monitoring plan of the Albemarle-Pamlico Estuarine Study was completed in October 1988 in an effort to expand the state's baseline monitoring within the study area so that long-term environmental trends and the effectiveness of management actions could be assessed. The plan was revised in January 1989 and now includes seven components.

(1) Implementation of a trained Citizens' Water Quality Monitoring Program;
(2) Continuous Monitoring of 33 open water sites by the U.S. Geological Survey;
(3) Expansion of the Division of Environmental Management's Ambient Water Quality Monitoring program from 74 to 99 sites;
(4) Maintenance of an Emergency Response Team to chronicle episodic environmental events;
(5) Completion of a Synoptic Study of Basinwide Water Quality;
(6) Survey of Fish Tissue Toxicants and Sediment Toxicants in the A/P Study area; and
(7) Measurement of Sediment Oxygen Demand in Critical Areas.

Components 1, 2, and 3 will all remain in place in an effort to establish baseline water quality data and determine the long-term effectiveness of management programs and initiatives. All data from the Ambient Water Quality Monitoring Program and the Citizens' Water Quality Monitoring are being or are soon to be entered into the state geographic information system. The results of all three monitoring efforts are being utilized by many investigators. Several fisheries researchers are using the data in their analyses. The U.S. Geological Survey is using the data in the creation of water quality and hydrodynamic models. They hope to be able to improve controlled flow regulations and wasteload allocation regulations and limits (see section VII and Figure 4).

Component 4 was satisfied by the creation of the Pamlico Emergency Response Team in June 1988 to address the increasing environmental problems seen in the Pamlico River. The Division of Environmental Management and the Division of Marine Fisheries work together to respond to calls regarding episodic events such as fish kills.

Component 5 was satisfied on June 25, 1989 with the completion of the Synoptic Survey by the Division of Environmental Management.

Components 6 and 7 have been initiated, fieldwork has been completed, and final reports are pending (see Section VII.).

FIGURE 4

MONITORING

ALBEMARLE-PAMLICO ESTUARINE STUDY
Water Quality Monitoring Stations

XI. PUBLICATIONS

Final reports continue to be printed and bound. More than 50 Study documents, final research reports, and public involvement products have been printed to date.

The Publications List (Appendix 2) includes all completed and pending Information Acquisition reports, Public Participation reviews, and other Program documents. Most of these documents are available upon request except for a few Information Acquisition reports that are out of print. Many final reports from FY 1989-90 projects are due in the next few months.

A document summarizing all APES funded projects is being compiled and should be up-to-date by August 1991.

Please contact the Program Office or the Public Participation Office to obtain a current Publications List, final reports, executive summaries, or abstracts of investigations in progress.

XII. BUDGET

Annual funding for the A/P Study comes primarily from the U.S. Environmental Protection Agency's (EPA) Office of Oceans and Coastal Protection, Division of the Office of Wetlands, Oceans, and Watersheds (OWOW) and the North Carolina Department of Environment, Health, and Natural Resources (EHNR). Additional funds are provided through various cooperative agreement grants, and by various federal and state agencies and other organizations that directly participate in the A/P Study.

The legislation which created the National Estuary Program requires a 25% non-federal cost-share. EHNR provides most of the 25% cost-share through the state appropriation. In the case of Action Plan Demonstration Projects, however, the grant recipients provide the 25% cost-share.

Table 6 shows the general breakdown of the sources of funding for each year of the Study. The current and the up-coming years are tabluated in detail.

Tables 7 and 8 show the Sources of Funding, the Actual A/P Study Budget, and a breakdown by project for Federal Fiscal Year 1990-**91**. In FY **91** the A/P Study operated under a budget of $1,760,519.

Tables 9 and 10 show the Sources of Funding, the Anticipated A/P Study Budget, and a breakdown by project for Federal Fiscal Year 1990-**91**. In FY **92** the A/P Study operated under a budget of $1,534,922.

Table 11 defines all the acronyms used within these tables.

Table 6 Funding Sources

Historical Funding Sources

Federal Fiscal Year	A/P Study Funds NC DEHNR	EPA	Other
1986-87	$ 16,000	300,000	0
1987-88	485,000	685,042	231,994
1988-89	514,177	1,625,000	422,411
1989-90	500,197	1,345,708	350,267
1990-91	497,699	1,261,469	467,773
1991-92	500,000	1,034,922	331,569

Current Funding Sources

Federal Fiscal Year 1990-91		Federal Fiscal Year 1991-92	
EPA	$ 1,261,469	EPA	$ 1,034,922
NC DEHNR	497,699	NC DEHNR	500,000
USGS	437,100	USGS	219,850
NOAA	31,078	NOAA	10,592
Other Stt Ag	121,405	Other Stt Ag	26,166
Private	23,740	Private	37,971
Virginia	2,500	Virginia	23,350
Extra for APDP	23,250	Extra for APDP	11,640

Table 7 FY 1990-91

Funding Sources for Federal Fiscal Year 1990-91

US EPA	$ 1,261,469
NC DEHNR	497,699
USGS	437,100
NOAA	31,078
Other Stt Ag	121,405
Private	23,740
Virginia	2,500
Extra for APDP	23,250

Actual APES Budget FY 1990-91

Administration			
Personnel	124,180		
Benefits	35,192		
Transportation	18,000		
Equipment	2,000		
Supplies	5,000		
Other	37,326		
Total		221,698	(12.6%)
Data Management		196,000	(11.1%)
Information Acquisition/CCMP Development		972,088	(55.2%)
Public Participation		308,949	(17.5%)
Early Action Demonstration Projects		61,784	(3.5%)
GRAND TOTAL		$ 1,760,519	(100%)

Table 8 FY 1990-91

Projects and Sources of Funding
FY 1990-91

	Project Number	A/P Funds	Other Funds	
1)	*** APES Staff	46,000	0	
	473 Tedder	43,946	0	
	434 McKenna	34,475	10,935	(DMF)
	455 Cummings	90,000	23,667	(DSW)
	430 Bartholemew	38,196	2,010	(CPN)
	401 Roe	60,000	6,750	(DFR)
	469 Stanley	50,261	36,731	(ECU)
	454 Noga	41,362	2,068	(NCSU)
	415 Hoban	53,848	2,692	(NCSU)
	458 Overton	28,691	1,436	(NCSU)
	452 Nichols	32,834	1,305	(RTI)
	453 Dodd	67,732	2,043	(RTI)
	451 Cunningham	39,965	1,477	(RTI)
	461 Engle	20,100	1,000	(NOAA)
	416 Ferguson	62,578	30,078	(NOAA)
	467 Bales	60,000	235,000	(USGS)
	468 Bales	91,300	91,300	(USGS)
	465 Bales	99,800	101,300	(USGS)
	449 Bales	11,000	11,000	(USGS)
		972,088	55,292	
2)	*** APES Staff	25,000	0	
	431 Carlock	22,500	2,500	(HRPDC)
	407 Tursi/Armingeon	35,000	0	
	408 Cleary	11,679	0	
	412 Conoley	25,000	33,500	(DOA)
	439 Willard	30,930	0	
	444 Turnage	52,430	4,000	(CE/PC)
	474 Stroud	32,700	1,800	(PTRF)
	413 McNaught	12,000	12,000	(PTRF)
	409 Powers	17,150	860	(AEA)
	411 Powers	4,875	245	(AEA)
	475 Blinkoff	39,685	3,626	(ECU)
		308,949	58,531	
3)	418 Rogers	61,784	23,250	(Private)

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1) Information Acquisition
2) Public Participation
3) Action Plan Demonstration Project

Table 9 FY 1991-92

Funding Sources for Federal Fiscal Year 1991-92

EPA	$ 1,034,922
NC DEHNR	500,000
USGS	219,850
NOAA	10,592
Other Stt Ag	26,166
Private	37,971
Virginia	23,350
Extra for APDP	11,640

Anticipated APES Budget FY 1991-92

Administration			
Personnel	157,034		
Benefits	44,307		
Transportation	15,000		
Equipment	2,000		
Supplies	5,000		
Other	51,587		
Total		275,228	(17.9%)
Data Management		186,000	(12.1%)
Information Acquisition/CCMP Development		778,089	(50.7%)
Public Participation		260,683	(17.0%)
Early Action Demonstration Projects		34,922	(2.3%)
GRAND TOTAL		$ 1,534,922	(100%)

Table 10 FY 1991-92

Projects and Sources of Funding
FY 1991-92

	Project Number	A/P Funds	Other Funds	
1)	xxx APES (CCMP)	50,000	0	
	509 Tedder	57,881	0	
	537 McKenna	44,406	16,530	(DMF)
	543 Carlock	34,200	3,800	(VA)
	526 Lipford	68,000	15,550	(VA)
	@@@ APES (sed tox)	12,557		
	505 Ambrose	4,070	0	
	536 Liddle	20,000	1,974	(RTI)
	551 McCarthy	15,000	1,439	(RTI)
	534 Cunningham	30,000	2,872	(RTI)
			6,000	(DMF)
	550 Dodd	140,000	13,819	(RTI)
	510 Ferguson	82,125	10,592	(NOAA)
	539 Bales	93,400	93,400	(USGS)
	540 Bales	126,450	126,450	(USGS)
	+++ Rulifson+	0	11,008	(SBMB)
		778,089	303,434	
2)	*** Long-term Involv.	10,000	0	
	514 Blinkoff	45,322	3,636	(ECU)
	503 Couture	32,680	1,634	(AEA)
	508 Armingeon	40,956	2,048	(NCCF)
	524 Stroud	71,100	3,750	(PTRF)
	502 Turnage	50,625	10,435	(EC/PC)
	542 Carlock	10,000	6,000	(HRPDC)
		260,683	27,503	
3)	546 Cummings	34,922	11,640	(DSW)

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1) Information Acquisition
2) Public Participation
3) Action Plan Demonstration Project

+ funded from unobligated funds from previous year's budget

Table 11

Definitions of Abbreviations Used in the Preceeding Tables

DMF	-	NC Division of Marine Fisheries
DSW	-	NC Division of Soil and Water
CPN	-	Center For Policy Negotiations
ECU	-	East Carolina University
NCSU	-	NC State University
RTI	-	Research Triangle Institute
NOAA	-	National Oceanic and Atmospheric Administration
USGS	-	US Geological Survey
HRPDC	-	Hampton Roads Planning District Commission
D0A	-	NC Department of Agriculture
EC/PC	-	Elizabeth City/Pasquotank County Schools (NC)
PTRF	-	Pamlico Tar River Foundation
AEA	-	Albemarle Environmental Association
SBMB	-	NC Striped Bass Management Board
VA	-	Virginia State Appropriations
NCCF	-	NC Coastal Federation

Note:

Other Stt Ag	=	Other State Agencies
Private	=	Private Organizations
Viriginia	=	Virginia State Appropriations
Extra APDP	=	Non-EPA monies given for Action Plan Demonstration Projects

Appendix 1

APES Program Staff

Name	Title	Organization
Randall G. Waite	Program Director	NC DEHNR
Ted Bisterfeld	Project Officer	EPA Region IV
Joan Giordano	Public Involvement Coordinator	NC DEHNR
Jennifer Steel	Technical Coordinator	NC DEHNR
Kathy Norris	Administrative Assistant	NC DEHNR
Karon Donnelley	Secretary	NC DEHNR
Ann Tyndall	Secretary (part-time)	NC DEHNR

APPENDIX 2

THE ALBEMARLE-PAMLICO ESTUARINE STUDY

POLICY COMMITTEE

LAST NAME	FIRST NAME	AGENCY	STREET	CITY	ST	ZIP	PHONE
Ashe	Dan	House Comm. on Merchant Marine	H-2-575	Washington	DC	20515	202-226-2460
Brown	Brewster	ACAC	PO Box 527	Winton	NC	27986	919-332-5921
Bryan	Don	Mayor	Town of Nags Head	Nags Head	NC	27959	919-441-5203
Carter	Derb	Southern Env. Law Center	137 E.Franklin St. Suite 404	Chapel Hill	NC	27514-3628	919-967-1450
Cobey	William W.	NC Dept. of EHNR	P. O. Box 27687	Raleigh	NC	27611-7687	919-733-4984
Costlow	John	Duke University Marine Lab.	Pivers Island	Beaufort	NC	28516-9721	919-728-2111
Cross	Ford "Bud"	NOAA/Southeast Fisheries Cntr.	Beaufort Laboratory	Beaufort	NC	28516-9722	919-728-8724
Cunningham	Ray	US EPA	345 Courtland Street, NE	Atlanta	GA	30365	404-347-4450
Gantt	L. K.	US Fish & Wildlife Service	P. O. Box 33726	Raleigh	NC	27636-3726	919-856-4520
Queen	William	Ins. of Marine & Coastal Res.	East Carolina University	Greenville	NC	27858	919-757-6779
Suermann	Lt Col Tom	US Army Corps Of Engineers	PO Box 1890	Wilmington	NC	28402	919-252-4505
John	Rushing	US ARMY CORPS OF ENGINEERS	77 Forsyth Street	Atlanta	GA	30335-6801	

ALBEMARLE-PAMLICO ESTUARINE STUDY

TECHNICAL COMMITTEE

LAST NAME	FIRST NAME	AGENCY	STREET	CITY	ST	ZIP	PHONE
Brooks	Ann	VA Council on Environment	903 9th St. Office Bldg.	Richmond	VA	23219	804-786-4500
Carl	Ernie	NC Dept. of EHNR	PO BOX 27687	RALEIGH	NC	27611-7687	919-733-4984
Cole, Jr.	William	US Fish & Wildlife Service	P. O. Box 972	Morehead City	NC	28557	919-726-7021
Copeland	B. J.	UNC Sea Grant Program	NC State Box 8605	Raleigh	NC	53-61-21	919-737-2454
Crum	Bowman	US EPA	345 Courtland Street, NE	Atlanta	GA	30365	404-347-4450
Ellis	Tom	NC Dept. of Agriculture	PO Box 27647	Raleigh	NC	51-11-00	919-733-7125
Everett	George	Div. of Environmental Mgmt.	P. O. Box 27687	Raleigh	NC	27611-7687	919-733-7015
Hamilton	Richard	Wildlife Resources Comm.	512 N. Salisbury Street	Raleigh	NC	27611	919-733-3391
Hogarth	William	Div. of Marine Fisheries	P. O. Box 769	Morehead City	NC	28516	919-726-7021
Hoss	Don	NOAA/Southeast Fisheries Ctr.	Beaufort Laboratory	Beaufort	NC	28516-9722	919-728-3595
Larkin	Ernie	Pamlico Citizens' Adv. Comm.	224 Pineview Drive ECU	Greenville	NC	27834	919-551-4212
Moreau	Dave	UNC WRRI	NC State Campus Box 7912	Raleigh	NC	27695-7912	919-737-2815
Orbach	Michael	APES Technical Committee	210 Longmeadow Road	Greenville	NC	27834	919-757-6883
Saunders	Lawrence W	Dept. Of Army Corps Of Eng.	P.O. BOX 1890	Wilmington	NC	28402-1890	919-251-4505
Sanzone	Stephanie	US EPA/OMEP	401 M Street, WH-556-F	Washington	DC	20460	202-475-7137
Schecter	Roger	Div. of Coastal Management	P.O. Box 27687	Raleigh	NC	27611-7687	919-733-2293
Settle	Cecil	US Soil Conservation Serv	4405 Bland Road, Suite 205	Raleigh	NC	27609	919-790-2909
Sides	David	Soil/Water Conservation	P. O. Box 27687	Raleigh	NC	27611-7687	919-733-2302
Stallings	John	Albemarle Citizens' Adv. Comm.	1001 Stokes Street	Windsor	NC	27983	919-794-2183
Turner	James	US Geological Survey	3916 Sunset Road	Raleigh	NC	27607	919-571-4044
Pepino	Rich	EPA Region III (3ES40)	841 Chestnut Street	Philadephia	PA	19107	215-597-1182
White	Fred	Div. of Forest Resources	P. O. Box 27687	Raleigh	NC	27611-7687	919-733-2162
Norman	Mitchell	Dept. of Game and Inland Fisheries	500 Hinton Ave.	Chesapeake	Va	23323	804-683-2871
Rushing	John	US ARMY CORPS OF ENGINEERS	77 Forsyth Street	Atalanta	GA	30335-6801	

ALBEMARLE-PAMLICO ESTUARINE STUDY

ALBEMARLE CITIZENS' ADVISORY COMMITTEE

LAST NAME	FIRST NAME	AGENCY	STREET	CITY	ST	ZIP	PHONE
Barber	Yates	ACAC At-Large	901 W. Church St.	Elizabeth City	NC	27909	919-338-3557-h
Bone	John	ACAC-TOURISM	P. O. Box 1757	Kill Devil Hill	NC	27948	919-441-8144-o
Brown	Brewster	ACAC-At Large	PO Box 527	Winton	NC	27986	919-332-5921-o
Burns	Tom	ACAC-Ag.	301 Lane Drive	Elizabeth City	NC	27909	919-246-3129-h
Daniels	Melvin	ACAC-Engin.	1618 Rochelle Drive	Elizabeth City	NC	27909	919-338-6939-h
Flowers	Don	ACAC-At Large	P. O. box 646	Hertford	NC	27944	919-426-5753-o
Fuller	J. Webb	ACAC-Pub. Off.	Box 99	Nags Head	NC	27959	919-441-5508-o
Hassell	Iredell	ACAC-At Large	P. O. Box 268	Columbia	NC	27925	919-796-2771-h
Hess	Carolyn	ACAC-Env. Group	Box 349, Holiday Island	Hertford	NC	27944	919-426-9563-h
Hinton	Phillip	ACAC-At Large	Rt. 1 Box 287-B	Sunbury	NC	27979	
Holland	Thomas	ACAC-At Large	West Sound Shore Drive	Edenton	NC	27932	919-482-4806-h
Hollowell	Joe	ACAC-Pub. Off.	202 Terry St	Edenton	NC	27932	919-482-4578-o
Howard	Alfred	ACAC-At Large	304 Pocahontas Trail	Edenton	NC	27932	919-221-4977-h
Hughes	Clyde	ACAC	POB 267	Colerain	NC	27924	
Lilly	Paul	ACAC NC Ag Ext Ser	Rt 2 Box 141	Plymouth	NC	27962	919-793-4188-o
Mansfield	Shelby	ACAC-Ag.	Box 90	Shiloh	NC	27974	919-335-0821-o
McMullan	Philip	ACAC-At Large	P.O. Box 325 Rt. 3	Hertford	NC	27944	919-335-3491 O
Meiggs	Jeanne	ACAC-Educator	P.O. Box 33	Shawboro	NC	27923	919-232-3055-h
Nixon	Murray	ACAC-Comm. Fish.	Rt. 1, Box 145	Edenton	NC	27932	919-221-4115-o
Piland	William	ACAC-Env. Group	Rt. 2, Box 93A	Gates	NC	27937	804-569-4512-o
Pratt	Terry	ACAC-Env. Group	Rt 1, Box 178A	Merry Hill	NC	27957	919-356-2267-h
Richardson	Bill	ACAC-Pub. Off.	Rt 1, Box 145	Poplar Branch	NC	27965	804-473-1600-o
Roundtree	Earl	ACAC-Ag.	Route 1, Box 203	Sunbury	NC	27979	919-465-8354-h
Smith	Sheila	ACAC-VA (At Large)	1049 Vanderploeg	Chesapeake	VA	23320	804-547-8514-h
Stallings	John	ACAC-Ag.	1001 Stokes Street	Windsor	NC	27983	919-794-2183-h
Stutts	Joe	ACAC-Industry	309 Holly Hill	Murfreesboro	NC	27885	804-569-4211-o
Watson	David	ACAC-Dev.	108 Mill Point Road	Kitty Hawk	NC	27949	919-261-8282-o
Whitley	A. B.	ACAC-Ag.	P. O. Box 10	Tarboro	NC	27886	919-823-3234-h
Williams	L. Polk	ACAC-At Large	Taylor's Beach	Camden	NC	27921	919-336-4115-h
Wright	J. A.	ACAC-Eng.	P. O. Box 573	Edenton	NC	27932	919-335-6569-o
BURGESS	MARY	(COMMUNITY OUTREACH CONTACT)	RT. 1 BOX 310	SUNBURY	NC	27979	

ALBEMARLE-PAMLICO ESTUARINE STUDY

PAMLICO CITIZENS' ADVISORY COMMITTEE

LAST NAME	FIRST NAME	AGENCY	STREET	CITY	ST	ZIP	PHONE
Barker	William		P.O. Box 52	Oriental	NC	28571	(919) 638-1901
Bellis	Vince	PCAC-At Large/Ed	1205 E Wright Rd	Greenville	NC	27834	919 758-1979-h
Brothers	Lee	PCAC	Rt. 1, Box 364-A	Aurora	NC	27806	
Burns	Beth	NC DMF	P.O. Box 1550	Manteo	NC	27954	(919) 473-5734
Buxton	Ralph	PCAC	PO Box 939	Nags Head	NC	27959	919 441-6800-o
Carpenter	Rann	PCAC-	PO Box 48	Aurora	NC	27806	919 322-4111-0
Carter	Derb	So. Env. Law CNTR	137 E.Franklin St. Suite 404	Chapel Hill	NC	27514-3628	919 967-1450-o
Carter	Ann	PCAC-At Lg/Pub.Of	1113 Front St	Beaufort	NC	28516	919 728-5501-h
Daniels	Luther	PCAC-Pub. Off.	PO Box 221	Manteo	NC	27954	919 473-5389-h
Evans	Grace	PCAC-At Large	PO Box 355	Oriental	NC	28571	919 249-1748-h
Gibbs	Sharon	PCAC-At Lg/Pub.Of	RT 1 BOX 214-C	Englehard	NC	27824	919 926-5681-h
Greene	John	PCAC-At Large	PO Box 12000	Raleigh	NC	27605	919 821-8574-0
Henries, Jr.	Etles	PCAC-At Lg	South Creek	Aurora	NC	27806	919 322-5776
Hodge	Tim	PCAC-At Large	RT 1 BOX 199B	Swanquarter	NC	27885	919 946-7725
Jackson	Bill	PCAC-At Large	509 W 15th St	Washington	NC	27889	919 946-3189-o
Larkin	Ernie	PCAC-Env. Group	224 Pineview Dr	Greenville	NC	27834	919 551-4495-o
Leach	Dick	PCAC-Dev.	Rt 5 Box 271	Washington	NC	27889	919 946-1735-o
Lyons	Roger	Weyerhaeuser	N.B. Reg. Off. P.O. Box 1391	New Bern	NC	28562	(919) 633-7472
Miller	Todd	PCAC-At Large	3223-4 HWY 58 HADNOT CREEK FM.	SWANSBORO	NC	28584	919 393-8185-o
O'neal	David	PCAC-At Large/Ag	RT 1	Squanquarter	NC	27885	919 926-5721
Quay	Thomas	PCAC-At Lg	2720 Vanderbilt Dr	Raleigh	NC	27607	919 828-9874-h
Schill	Jerry	PCAC-At Lg/Com.Fh	P.O. Box 2303 1911B Glenburnie	New Bern	NC	28561	919 633-2288-o
Sermons	Wayland		P.O. Box 69	Washington	NC	27889	(919) 946-0871
Smith	Jeffrey	PCAC-At Large	701 West Ocean Acres Dr	Kill Devil Hill	NC	27948	919 441-2525
Smith, Jr.	Edward C.	PCAC-At Large	132 Landing Circle	Grimesland	NC	27837	919 758-5183-h
Sommerkamp	Frank	PCAC-At Large	Rt 2 Box 170A	Aurora	NC	27806	919 322-5259-h
Spagnola	John	PCAC-Ed	2511-A E. 3rd St	Greenville	NC	27858	919 757-3073
Van Duyn	John	PCAC-At Large	NC Ag Ext Rt 2 BOX 141	Plymouth	NC	27962	919 793-4118
Windley	Dan	PCAC	P.O. Box 66	Aurora	NC	27806	
STROUD	TOM	COMM. OUTREACH	PTRF P.O. BOX 1854	WASHINGTON	NC	27889	

ALBEMARLE-PAMLICO ESTUARINE STUDY PUBLICATIONS LIST
SEPTEMBER 1991

(I) Information Acquisition Documents
(P) Public Participation/Program Documents

No.	Abbreviated Title	Author/Editor	Status
86-01(I)	Existing Management Programs (UNC)	Brower	Available
87-01(P)	Source Document (A/P Study)	Rader et al.	Available
87-02(P)	Five Year Workplan (A/P Study)	Rader et al.	Available
87-03(I)	Proceedings: Modeling Workshop	Stewart/Duffy (WRRI/SCI)	OUT OF PRINT
87-04(I)	Proceedings: Remote Sensing Workshop	Stewart (WRRI)	OUT OF PRINT
87-05(I)	Proceedings: Fish Disease Workshop	Stewart (WRRI)	OUT OF PRINT
87-06(P)	Citizens' Monitoring Pilot (PTRF)	Lekson	Available
88-01/02(P)	Baseline Monitoring Network	Rader/Holman et al.	Available (A/P Study)
88-03(P)	Citizen's Guidebook (NC Coastal Federation)	Kennedy	Being Updated
88-04(P)	Status Report: March 1988 (A/P Study)	Rader	OUT OF PRINT
88-05(P)*	Beaufort County Magazine (A/P Study)	Rader	Available
88-06(I)	Water Quality/Hydrology Bibliography	Bales (USGS)	OUT OF PRINT (Contact USGS)

Executive Summaries are available for all Information Acquisition documents

ALBEMARLE-PAMLICO ESTUARINE STUDY PUBLICATIONS LIST
SEPTEMBER 1991

(I) Information Acquisition Documents
(P) Public Participation/Program Documents

No.	Abbreviated Title	Author/Editor	Status
88-07(I)	Turtle Excluder Device	Pearce/Street (Mariners' Marine/DMF)	Available
88-08(P)	Project Abstracts for the Period 1987-89	Holman, et al. (A/P Study)	Available
88-09(I)	Red Tide Persistence	Tyler (Versar)	Available
88-10(I)	Submerged Aquatic Vegetation (Eastern)	Ferguson (NOAA)	OUT OF PRINT
88-11(P)*	Can Albemarle and Pamlico Be Saved?	Taylor (Wildlife of NC)	Available
88-12(I)	Obstructions to Anadromous Fish Migration	Collier/Odom (USF&WS)	Available
88-13(I)	Value of Recreational Fishing A/P Estuaries	K. Smith (NCSU)	Available
88-14(I)	Analysis of Fringe Wetlands in A/P Sounds	Brinson (ECU)	Available
89-01(P)	Progress Report for 1989	Holman (A/P Study)	Available
89-02(I)	Fish Stock Assessment	Phalen (DMF)	Available
89-03(I)	Baseline Demographic Trends	Tschetter (ECU)	OUT OF PRINT
89-04(P)	Public Involvement Plan 1989	Giordano (A/P Study)	Available
89-05(I)	Scoping of Water-Column and Bottom Sediments	Wells (UNC)	Available

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(I) Information Acquisition Documents
(P) Public Participation/Program Documents

No.	Abbreviated Title	Author/Editor	Status
89-06(I)	Heavy Metal/Mud Pollutants in Pamlico River Estuary	Riggs (ECU)	Available
89-07(P)	State and Federal Interrelated Programs To The A/P Study	Holman, et al. (A/P Study)	Available
89-08(P)	Project Abstracts For The Period 1989-1990	Holman, et al. (A/P Study)	OUT OF PRINT
89-09(I)	Evaluation of Nursery Area Data	Noble (DMF)	Available
89-10(I)	Submersed Aquatic Vegetation	Davis (ECU)	Available
89-11(I)	Water Quality Trends	Harned (USGS)	Available
89-12(P)	Where the River Meets the Sea	Okun (UNC)	Available $3.00
89-13A(I)	Albemarle-Pamlico Estuarine System: Preliminary Technical Analysis of the Status and Trends (Technical Document)	Copeland, et al. (Sea Grant)	Available (limited number)
89-13B(I)	Albemarle-Pamlico Estuarine System: Preliminary Technical Analysis of the Status and Trends (Public Document)	Copeland, et al. (Sea Grant)	Being Revised
00-00(P)	A Guide to Estuaries	Gale (PTRF)	Available $1/multi-copies
90-01(I)	Inventory of Natural Areas	Roe	Available
90-02(I)	Evaluation of Environmental Management and Resource Protection Programs in the A/P Region	Nichols (RTI)	Available

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ALBEMARLE-PAMLICO ESTUARINE STUDY PUBLICATIONS LIST
SEPTEMBER 1991

(I) Information Acquisition Documents
(P) Public Participation/Program Documents

No.	Abbreviated Title	Author/Editor	Status	C.R.
90-03(I)	Abundance and Viability of Striped Bass Eggs Spawned in the Roanoke River, N.C. in 1988	Rulifson (ECU)	Available	
90-3	Synoptic Survey (WQ)	DEM	Available	
90-04(P)	Coastal Satellite Scene	National Geographic KRS	Available ($10/copy)	
90-05(P)	Progress Report for 1990	Holman (A/P Study)	Available	
90-06(I)	Data Management and Analysis System	Siderelis	Available	
90-07(I)	Heavy Metals-Neuse River	Riggs	Final Stage	
90-08(I)	Oyster Success in Pamlico	Sutherland	Available	
90-09(I)	Effects of Water Mgmt. and Land Use Practices on Hydrology and W.Q. in the A/P Region	Skaggs NCSU	Available	
90-10(I)	A Pilot Study for Managing Multiple Use in the State's Public Trust Waters	Clark UNC Sea Grant	OUT OF PRINT	
90-11(I)	Abundance and Viability of Striped Bass Eggs Spawned in the Roanoke River, N.C. in 1989	Rulifson (ECU)	Final Stage	
90-12(I)	WQ as a Function of Discharge From The Roanoke River Reservoir During Hydropower Generation	Rulifson (ECU)	Available	
90-13(I)	Coupling Study	Pietrafesa (NCSU)	Final Stage	

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ALBEMARLE-PAMLICO ESTUARINE STUDY PUBLICATIONS LIST
SEPTEMBER 1991

(I) Information Acquisition Documents
(P) Public Participation/Program Documents

No.	Abbreviated Title	Author/Editor	Status
90-14(I)	Reduction of Nutrient Loading	Kuenzler (UNC)	Final Stage
90-15(I)	Eutrophication and Nutrients Algal Blooms	Paerl	Available
90-16(I)	Food/Feeding Larval Fishes	Rulifson (ECU)	Draft Due 8/31/91
90-17(I)	Heavy Metals...Albemarle	Riggs (ECU)	Draft Due 6/91
90-18(P)	Project Abstracts FY 89 & 90	A/P Study	Available
90-19(I)	A Comprehensive Env. Mgmt. Plan...Currituck Sound Drainage Basin	Rideout (NCSU)	Available
90-20(I)	Federal Consistency Review for the A/P Study Area	Julie Duffin (RTI)	Available
90-21(I)	Functional Description Document	Karen Siderelis (CGIA)	Available
90-22(I)	Shell Disease in Blue Crab	Noga (NCSU)	Final Stage
90-23(I)	Animal Waste Management	Lewis (VASWCS)	Available
90-24(P)	Educational Handbook For Nonpoint-Source Pollution	Hoban NCSU	Final Stage
90-25(P)	Teacher Training in WQ Issues	Okun	Available
90-26(P)	Blueprint for Action A/P Citizens Advisory Committees	Albemarle/ Pamlico CACs/ Armingeon(NCCF)	Available
90-27(I)	Public Attitudes (Phase I)	Hoban (NCSU)	Available
90-XX	Data Inventory	Siderelis	Available

*Not an A/P Study Document but material is related to the Study.
Executive Summaries are available for all Information Acquisition documents

ALBEMARLE-PAMLICO ESTUARINE STUDY PUBLICATIONS LIST
SEPTEMBER 1991

(I) Information Acquisition Documents
(P) Public Participation/Program Documents

No.	Abbreviated Title	Author/Editor	Status
90-YY	Anemic Blue Crabs (Interim Report)	Brower	Available
91-01(I)	Albemarle-Pamlico Estuarine System: Technical Analysis of the Status and Trends (Technical Document)	Copeland, et al. (Sea Grant) Steel (APES)	Draft
91-02(I)	Albemarle-Pamlico Estuarine System: Technical Analysis of the Status and Trends (Public Document)	Copeland, et al. (Sea Grant) Steel (APES)	Draft
91-03(I)	Abundance and Viability of Striped Bass Eggs Spawned in the Roanoke River, NC 1990	Rulifson (ECU)	Draft Due 8/31/90
91-00	Summary of A/P Projects	Steel	Draft
91-05	APES Fish Tissue Baseline Study 1989	Tedder	Available

*Not an A/P Study Document but material is related to the Study.

Executive Summaries are available for all Information Acquisition documents

(B:PUBLICA.LST)

EXECUTIVE SUMMARY

OF THE

STATUS AND TRENDS REPORT

OF THE

ALBEMARLE-PAMLICO ESTUARINE STUDY

AND THE

FINDINGS OF THE

ALBEMARLE-PAMLICO ESTUARINE STUDY

MANAGEMENT CONFERENCE

April 1991

This synopsis provides the judgements of the Albemarle-Pamlico Estuarine Study on the health of the Albemarle-Pamlico estuarine system, which has been under study since 1987. It is based on the best information and observations available.

INTRODUCTION

In spite of a suite of laws enacted during the 1970s, many of the nation's critical coastal ecosystems are in serious decline. Public attention has turned once again to threatened estuarine systems -- Chesapeake Bay, Narragansett Bay, Buzzards Bay, Long Island Sound, Puget Sound, and San Francisco Bay -- areas in which decades of population concentration and industrial development have resulted in the contamination of sediments, and the dramatic declines of living resources.

The Albemarle-Pamlico (A/P) estuarine system in North Carolina had become another one of these threatened systems. It is the second largest estuarine complex in North America and a key nursery area for east coast fisheries. In 1987, the A/P system was designated as an estuary of national significance and was selected to be studied, along with those mentioned above, as part of the Environmental Protection Agency's (EPA) National Estuary Program. Thus, the Albemarle-Pamlico Estuarine Study was initiated, a cooperative research and management program between EPA and the State of North Carolina's Department of Environment, Health, and Natural Resources.

The purpose of the A/P Study is to find out how serious environmental problems are in North Carolina's estuaries and how the estuaries can be preserved and managed to maintain their environmental integrity and maximize the use and pleasure people derive from them. The A/P Study's efforts are focused and guided by four committees composed of concerned citizens and people with knowledge of environmental science, management, and law. For more than three years, scientists funded by the A/P Study and other state and federal agencies have focused their research efforts on the characterization of and changes in the A/P system. This report is a compilation of the results of those studies and many previous years of estuarine research.

Any attempt to understand and rectify the problems of the A/P system must be based on an understanding of the dynamics of the system. The A/P system is made up of Albemarle Sound (including Currituck and Croatan Sounds), Pamlico Sound (including Core, Roanoke, and Bogue Sounds), with their many tributaries, marshes, swamps, and wetlands. On the western side of the system, numerous rivers discharge fresh water into the sounds. On the eastern side, a chain of barrier islands with only a few inlets in the southern portion of Pamlico Sound, hold back the Atlantic Ocean. River flow, winds, and tides are the most important forces at work in this system. These dynamic forces act to push, pull, mix, stratify, and remix the water and affect numerous physical, biological, and chemical processes such as fish recruitment, stratification of the waters, and sedimentation.

People who live near the rivers and estuaries have seen striking changes in the environment. In places along the riverbanks, submerged grasses once grew in beds so thick that it was necessary to cut paths to pass between the open river and the shore. Today, in many places, the grasses are gone and with them the young fish and shellfish that grew and were nurtured among them. Often, the river waters are turbid and dirty looking. Vast swamp area once inhabited by snakes, bears, and other wildlife, have been cleared, drained, and planted as extensive fields of soybeans, wheat, and corn. Shopping centers and condominium complexes have sprung up near fragile marshlands, once nursery areas for fish and shellfish. Shellfishing areas have disappeared or have been closed to harvests because of contamination by human waste. Fishing catches have declined. many fish and crabs suffer skin and shell diseases and so cannot be sold for human consumption. Large algae blooms occur periodically in many of the estuaries, rendering some areas unfit for swimming or fishing. Anoxic events have decimated local populations of fish and shellfish.

How people view changes in the A/P system depends on how they want to use its resources. Increasingly, conflicts are arising among the uses and the users of the estuarine resources. Boaters may think that a quiet accessible harbor is a perfect place for a marina, but people who harvest shellfish from the area may be concerned about contamination from human waste, marine fuels, and other toxicants. A recreational fisherman may be happy to pull a shrimp trawl and take home a few dozen pounds of

shrimp, but a commercial shrimper may be upset when thousands of recreational fishermen do the same thing and compete for the available resource. A farmer may want to use a small stream as a drainway to help lower the water table under one of his fields to keep his crops from drowning, but fishermen may regret the changes that the fresh water brings to a once productive primary nursery area. Commercial clammers may think that using a propeller wash to dislodge clams from the bottom is simply a more effective method of harvest, but those who understand the ecological value of submerged grasses and the harm that "clam kicking" can do, may think otherwise.

Use conflicts extend far upstream, too. Residents of inland cities and towns see "their" streams as water supplies and waste disposal resources. Coastal residents, however, expect those same streams to be clean when they reach the coast and to support wetland production, fish propagation, and other vital ecological functions.

This document summarizes the conditions and the trends that have been found in the A/P system and what is known about their causes.

CRITICAL AREAS

Submerged Aquatic Vegetation (SAV):

Status: SAV occurs in shallow low-salinity waters, in narrow bands along the eastern shores of Albemarle and Pamlico Sounds and in broad swaths across much of Core, Back, and Bogue Sounds. SAV habitat supports populations of bay scallops and numerous other species of shellfish, fish, and birds.

Trends: Scant historical observational records indicate an almost complete disappearance of SAV in the Pamlico River *and* Back Bay. In Currituck Sound major shifts in density and species assemblages have occurred; currently, SAV beds are greatly reduced in density and extent. In the western portion of Albemarle Sound significant (though unquantified) declines have also been documented. In the eastern portions of Albemarle and Pamlico Sounds, SAV appears to be quite stable.

Causes: On the western shores of the A/P system, the primary cause of the decline of SAV is believed to be related to increasing freshwater runoff, increased turbidity (from sediment-laden runoff, bottom-disturbing practices, and algal blooms), and encrustation by algae. Turbidity and encrustation effectively reduce the amount of light available to the plants for photosynthesis. On the eastern shores, decline is caused primarily by physical destruction or disturbance by dredges, boat propellers, and illegal fishing practices. If these conditions and practices continue, SAV will likely continue to decline.

Wetlands:

Status: There were an estimated 12,100 acres of tidal salt marsh (regularly flooded marsh) and 138,000 acres of non-tidal brackish marsh (irregularly flooded salt marsh) within the study area, according to a 1962 report (Wilson, 1962). The same report estimated that approximately 38,700 acres of nontidal freshwater marsh existed in the area. Significant tracts of riparian/alluvial forested wetlands ("wooded swamps and bottomlands") also exist; as of 1954 it was estimated that there were roughly 804,000 acres of these wetlands within the study area. Inland wetlands (pocosin and related wetlands and nonriverine swamps) also exist in significant numbers. Richardson (1981) estimated that as of 1979, 695,000 acres of

pocosin wetlands remained in their natural state within the North Carolina portion of the study area; an additional 808,000 acres were either partially developed or, at the time, scheduled for development.

Trends: While mapping is incomplete and historical records are inadequate, there is evidence of extensive localized reduction of ecologically important emergent wetlands and inland wetlands. Tidal salt marshes and fringe swamps are now protected by regulations and quite stable in areal extent, but it is estimated that 25-50% of wetlands that line tributaries or lie well inland have been lost to development or altered so significantly that their functioning has been severely impaired. By 1979, 33% of the state's original pocosin acreage had been drained and the native vegetation permanently removed or altered; an additional 36% were either partially altered or scheduled for development.

Causes: Regulatory changes have helped to reduce losses of coastal wetlands to residential and commercial development, and losses of all wetlands to agricultural conversion and mosquito ditching. Major losses of freshwater wetlands still occur as a result of draining or filling for silviculture and commercial or residential development.

Nursery Areas and Fisheries Habitats:

Status: The suitability of protected nursery areas for fish, seagrass beds for scallops, sands or muds for hard clams, or hard substrate for american oysters may be influenced by freshwater runoff, bottom disturbing practices, or hypoxic and anoxic conditions. A program is in place to designate and protect fisheries nursery areas from harmful fishing practices. Analysis of juvenile abundances, indicates that most of these designated areas are currently functioning satisfactorily.

Trends: Scallop habitat (SAV) has declined in areas where turbidity has increased. Clam beds appear to be generally stable, fluctuating primarily in response to climatic and hydrologic variations. Oyster beds appear to be in decline in the Pamlico and Neuse River Estuaries due in part to disease, anoxia, fresh water inflows, and harvest pressures. Access to historical anadromous spawning habitats (rivers and tributaries to the Sounds) have been blocked by dams and reservoirs and limited by roads and culverts. No long-term records exist that allow trends in the areal extent of nursery areas to be determined, but records of juvenile abundance indicate continued health of existing nursery areas--no significant population trends of any major species have been found. Records of water quality (e.g., dissolved oxygen, turbidity, and salinity), however, indicate deteriorating conditions within some nursery areas.

Causes: Nursery areas and fisheries habitats, often located in shallow creeks, embayments, and tributaries, are particularly sensitive to effects of land and water uses. Continued increases in sediment, nutrient, or pollutant laden runoff from developed land and could further reduce these areas or impair their functioning.

Barrier Island Habitat:

Status: Over the past 300 years, human impact has reduced the original extensive coverage of maritime forest, shrub, herbaceous dune growth, and soundside high marsh, to remnant quantities. However, about two-thirds of the Outer Banks is now in public ownership.

Trends: Losses of habitat, other than intertidal salt marsh, continue at a substantial rate on private lands. Acreage in public trust ownership or jurisdiction is increasing the protection of some of these habitats.

Causes: Most losses result from urbanization and related development, which includes drainage removal of vegetation, installation of hard surfaces, off-road vehicle traffic, and altering dune slopes and configuration.

WATER QUALITY

Nutrients and eutrophication:

Status: The waters of the A/P system are phosphorous-rich and relatively nitrogen-limited. Blooms of algae require concurrent inputs of nitrogen and adequate sunlight, salinity, and temperature conditions -- a fairly common occurrence during the summer-fall warm, low-flow months.

Trends: Total annual phosphorous loading into the Neuse River is estimated to have increased 60% over the past century to 1.7 million kg/yr (1985). Most of that increase has occurred within the past 40 years due primarily to the increase in sewage discharge. Total annual nitrogen loading into the Neuse River is estimated to have increased 70% over the past century to 7.8 million kg/yr (1985). After declining in the 1950s and 1960s, loading increased rapidly as population growth overtook old gains in efficiency of wastewater treatment plants. Despite the increased loadings, concentrations of nitrogen and phosphorous in the water column have, in general, declined in the recent past. However, increased concentrations of chlorophyll a (an indicator of algal abundance) may account for the declining concentration of nutrients. Throughout the Neuse River, increased concentrations of chlorophyll a and changes in the species composition have been noted; specifically, nuisance blue-green algae have increased significantly. In the Pamlico River, concentrations of chlorophyll a have increased up-river (50% in 16 years) and in middle-river segments. Trends of the frequency of algal blooms have not been able to be documented, but species composition does not appear to have changed significantly. In the Tar-Pamlico, algal blooms have been associated with fish kills. Increases in the concentration of chlorophyll a have also been noted in upper Albemarle Sound and lower Chowan and Alligator Rivers.

Causes: Point sources (such as municipal wastewater treatment plants), nonpoint sources (diffuse sources of pollutants, sediment, and nutrients such as agricultural, silvicultural, and urban runoff, and direct atmospheric deposition), and internal nutrient cycling play major roles in determining nutrient availability. Depending on the system, point sources can contribute as much as 75% of the annual nutrient inputs, while in other systems, nonpoint sources have been known to contribute up over 60% of the nutrients. Particulate deposition of atmospheric nitrogen is thought to play a large role in estuarine eutrophication; in Chesapeake Bay, a very similar system, it is estimated to contribute 10 to 20% of the annual nitrogen inputs in the upper portions of the estuaries and 30 to 50% of the annual nitrogen inputs in the lower estuaries, open sounds, and coastal waters. Along with the right climatic conditions, these nutrients can cause blooms of algae, associated hypoxic or anoxic events, changes in the food chain, and even toxic conditions.

Metals and Toxicants:

Status: Studies of the concentrations of toxic pollutants within the water column describe generally safe and reasonable levels, but studies of the estuarine sediments indicate that areas of localized but severe enrichment exist, most often associated with known point source dischargers. There is some indication that, from parts of the A/P system, concentrations of dioxin (a probable human carcinogen) found in

finfish tissues, have declined since last year, however, half of Albemarle Sound, portions of the Roanoke River, and the Chowan River still have health advisories posted for dioxin.

Trends: No long-term data base of sediment quality exists, but there is some indication of recent localized degradation due to anthropogenic loadings and disturbances. With such limited data, trends in the concentration of dioxin in sediment, water, and fish tissue are not reliable at this time. Long-term declines in concentrations of dioxin are expected, however, due to process changes in paper mills.

Causes: Municipal and industrial point source dischargers are considered to be responsible for the majority of localized degradation of the sediments. Long-term accumulation and biological and physical processes act to concentrate toxicants within the sediments, but biological effects of these toxicants are not yet known. Elevated levels of dioxin in fish tissues are primarily associated with pulp and paper mill effluents.

Freshwater Discharge and Flow Regimes:

Status: Alteration of the natural flow regimes of the tributaries to Albemarle and Pamlico Sounds can have significant effects upon the water quality and the health and distribution of flora and fauna in the receiving waters. In places, drainage ditches have reduced the salinity of receiving waters and have acted as conduits for the landward flow of brackish water. Overdraught of coastal aquifers has caused localized intrusion of brackish water. Dams have altered patterns of salinity and sedimentation, critical for the survival of many species of plants and animals. Construction and development have led to an increase of impervious surfaces, and so to an increase in stormwater runoff. The now inactive saltwater pumping station in Back Bay, Virginia caused major changes in salinity in the efforts to control the bay's habitat.

Trends: Mosquito ditching is no longer condoned and federal regulations have eliminated incentives to drain land for crop production. However, ditching associated with silvicultural practices is still exempt from 404 regions. Due to the complex hydrology of the estuarine system, precise trends of changing salinity remain unknown, but the pace of that change appears to be decreasing.

Causes: Artificial drainage of the wet interior of the study area, the pumping of groundwater, and the construction of dikes and dams may amplify natural hydrologic fluctuations.

Anoxia and hypoxia:

Status: Anoxia or hypoxia can stress or kill affected benthic and pelagic biota, however, such events are usually not wide-spread and are usually short-lived. These conditions are most common in the down-river sections of the tributaries and upper estuaries during periods of high runoff and in the up-river sections during periods of lower flow. Anoxic and hypoxic conditions can become established, broken-up, and reversed very quickly. These sporadic events seem to have little long-term impact on the health of the ecosystem as a whole.

Trends: There are no apparent trends of decreasing dissolved oxygen in the past 19 years of water quality data.

Causes: Data do not show a direct causal link between the size of the winter-spring algal blooms and the occurrence of anoxia or hypoxia. Anoxic and hypoxic conditions are usually caused by natural climatic and hydrologic conditions that result in concurrent warm temperatures (above 20 degrees

Celsius) and stratification of the estuarine waters. These events may, however, be exacerbated by algal blooms caused by cultural eutrophication.

FISHERIES

Shellfish bed closures:

Status: The Division of Environmental Health, Shellfish Sanitation Branch conducts detailed Sanitary Surveys on a continuing basis. These bacteriological, hydrological, and shoreline surveys serve as the basis on which recommendations for closures are made to the Division of Marine Fisheries. Currently, roughly 36,000 acres within the study area are closed to the harvest of shellfish. Additional areas may be closed for a few days or weeks following a heavy rainfall. Within the A/P Study area, temporary closures are usually confined to tributaries in Carteret County. An area is closed to harvest until tests indicate a return to acceptable conditions. Bogue and Core Sounds, and select areas within Pamlico Sound are significantly affected.

Trends: Closures due to point source dischargers (primarily wastewater treatment facilities) have declined with improved technology and regulations, but the area subject to temporary closures due to nonpoint source and urban stormwater runoff has increased along with increasing development, keeping the total area closed to harvest relatively constant. Within the A/P Study area, roughly 15,000 acres are now subject to temporary closures due to contaminated stormwater runoff, indicating continued localized water quality degradation.

Causes: Freshwater discharge from drainage ditches can disrupt local salinity regimes and cause the degradation of shellfish beds. Bacterial contamination from point sources, improperly sited or maintained septic systems, urban and agricultural runoff, and marinas can cause the closure of shellfish beds.

Diseases:

Status: Several new or epidemic diseases have been documented recently among the fish and shellfish of the Albemarle-Pamlico region. Outbreaks of ulcerative mycosis (UM), a fungal infection primarily affecting menhaden in the Pamlico River, have occurred biannually in epidemic proportions since its first occurrence in 1984. "Red sore" disease first occurred among a wide variety of finfish in epidemic proportions in 1975; periodic outbreaks are still reported. The occurrence of "MSX" and dermocystidium ("dermo"), diseases fatal to oysters, was first reported as a widespread problem in 1988. Shell disease in blue crabs (found primarily in the Pamlico River) causes severe and aggressive lesions, it is infectious, and is often fatal. Even when not fatal, all of these diseases can make the affected organisms unmarketable.

Trends: Prevalence of fish diseases (especially UM) in the Pamlico River has increased dramatically since 1984, yet in other areas, such as Core Sound, disease is not considered to be a real problem, and in Albemarle Sound the prevalence of disease is considerably less than in the 1970s.

Causes: Causes of fish and shellfish diseases seem to be multiple and complexly interrelated, but general degradation of water quality has been associated with outbreaks of disease. Areas with elevated levels of toxicants such as metals in the water column or sediments have been associated with outbreaks of shell

disease and UM, but no individual contaminants have been proven to be causal agents. Phytoplankton-produced toxins have been linked with increased mortality and susceptibility to diseases. Increased salinity occurring during periods of drought is believed to facilitate the spread of oyster disease. Decreased salinity has been associated with severe outbreaks of UM.

Commercial Fisheries:

Status: Dockside commercial landings data, compiled by the Division of Marine Fisheries, reflect not only stock sizes, but regulatory and market influences. In 1989 within the Albemarle-Pamlico Study area commercial fishermen landed a total (excluding menhaden) of 59.1 million pounds of fish and North Carolina fishermen as a whole landed 85.4 million pounds of estuarine-dependent fish.

Trends: In general, the total catch-per-unit-effort is decreasing despite improvements in fishing gear and methods. North Carolina's total commercial estuarine-dependent landings (including menhaden) have fluctuated 35 million pounds over the past five years from a low of 140.7 million pounds in 1987 to a high of 175.3 million pounds in 1988. Since 1988, landings have declined 14% to 151.5 million pounds.

Landings of catfish and striped bass have continued to decline since the 1970s. Landings of four other species have been in general decline since the early 1980s: river herring, American shad, croaker, and bluefish. Landings of flounder, weakfish, white perch, bay scallops, and oysters have shown a dramatic and sudden decline in the past one to three years. Coastal landings of flounder, for example, declined 60% in the past year. These declines may indicate declining stocks.

Commercial landings of hard clams, spot, and shrimp have remained fairly stable over time. Landings of blue crabs and Atlantic menhaden have continued to increase.

Causes: Specific causes of the declining landings are unknown, but several factors have been associated with the declines. Increased "effective effort" (the ability to inflict mortality) has significantly depleted some stocks. Fishermen have a greater impact on standing stocks because of the increased size and power of fishing vessels and improved electronics, fishing gear, and techniques. Alteration of riverine flow regimes has significantly reduced the habitat and reproductive success of anadromous fish. Declining water quality has been implicated in the reduced productivity of some primary nursery areas. Although trawling bycatch may negatively affect fish stocks, such an impact had not been demonstrated in the South Atlantic Region.

Recreational Fisheries:

Status: Recreational anglers compete for many of the same species as commercial fishermen and account for a significant proportion of the total catch. For some species of fish, such as bluefish, red drum, and spanish mackerel, recreational harvest probably exceeds commercial harvest. 53% of all commercial vessel licenses are issued for recreational use.

Trends: Unfortunately, no long-term recreational landings data exist, so no trends can be inferred. In general, however, the total catch-per-unit-effort is decreasing, despite increasing effective fishing effort.

Causes: North Carolina is unique in the freedom it offers recreational fishermen to use commercial gear and in the scale of the recreational fishing industry. While the total number of angler trips has remained relatively stable (or even declined slightly) over the past ten years, effective fishing effort continues to increase with improvements in gear and techniques.

THE HUMAN ENVIRONMENT

Population:

Status: According to the 1990 Census, North Carolina A/P study area counties have roughly 1,898,000 permanent residents, an increase of 16.3% since 1980. Two of North Carolina's three fastest growing counties of the 1980s are within the study area: Dare County grew 70% and Wake County grew 40.5%. Census information indicates that Virginia's A/P counties also exceeded the Virginia state-wide growth rate in the 1970s and 1980s. This relatively rapid growth of the permanent population and a concomitant growth of the recreational or seasonal population places ever-increasing demands on and creates ever-increasing conflicts over the limited and fragile resource base.

Trends: The population of the entire A/P study area is expected to reach nearly 3 million by the year 2000. The rate of growth of NC counties within the study area, while locally varied, has continued to increase. During the 1970s these counties grew at a rate below that of the statewide average, but during the 1980s, they grew 16.3%, 28% faster than the statewide average of 12.7%. This trend of growth will be reflected in increasing demands on the resources and increasing costs of maintaining the quality of the coastal environment.

Causes: The diverse resource base, healthy economy, and pleasant climate have attracted large numbers of people to the A/P area. There is a direct correlation between the growth and development of this region and the stress that is placed on the coastal environment.

Resource Utilization:

Status: The A/P study area offers opportunities for a wide variety of uses including: agriculture, tourism, residence, fishing, forestry, construction, mining, defense, retail, wholesale, and service. Each of these comprises a significant sector of the North Carolina economy. Although the A/P watershed covers about 1/3 of North Carolina, agriculture, the largest industry in the A/P area, accounts for 50% of NC's hogs, 45% of NC's cropland, and 40% of NC's chickens. Tourism is one of the state's largest industries; the A/P region accounts for 32% of the state's total tourism revenues. One-third of the state's woodlands are located within A/P counties. Degradation of drinking water supplies is not a widespread phenomenon in the A/P study area, but localized problems do exist. Livestock production, agriculture, and residential and commercial development are major industries within the Virginia portion of the A/P watershed. As in North Carolina, these practices add to the stress placed on the estuarine system.

Trends: Land in crop production has been declining since 1980, reflecting world-wide agricultural trends. Woodland acreage has also been decreasing, but pine plantation acreage increased substantially from 1973 to 1984. Swine and poultry production have been increasing as a percentage of the state total, but have not been expanding rapidly. Tourism-related industries are expanding rapidly within the A/P study area. Commercial fishing pressures, as measured by vessel licenses, have increased only slightly in the recent past. Marina development, an indicator of recreational estuarine use, has continued to increase (184% from 1970-1989). Travel and tourism are increasing within the study area (though their revenues remain a constant proportion of the statewide travel and tourism revenues). Forested land within the study area has been decreasing. Specific locations within certain aquifers suffer from salt water intrusion induced by overdraught. Surface water supplies are protected by existing water quality regulations.

Causes: Permanent and seasonal populations continue to grow throughout the A/P study area, bringing with them ever-increasing demands on the limited resource base. Continued land development, increased

domestic and municipal freshwater demands and wastewater discharges, the increasing application of fertilizer (despite the decreasing acreage of cropland), the growth of the poultry industry, the large scale hog industry, phosphate mining, forestry practices, the growth of commercial and recreational fisheries, and continued marina development have given rise to the concerns about the preservation and conservation of habitat and living resources.