# *Managing The Albemarle-Pamlico Sounds*

**"Today's Accomplishments / Tomorrow's Challenges"**

**A Forum to Examine Implementation of the Comprehensive Conservation and Management Plan (CCMP) for the Albemarle-Pamlico Sounds Region**

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**"Today's Accomplishments / Tomorrow's Challenges"**

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# WATER QUALITY SESSION

Abstract for MANAGING THE ALBEMARLE-PAMLICO SOUNDS

The Neuse Basinwide Management Strategy: A review of the first basinwide plan as it nears renewal.
(A presentation for the Water Quality Session)

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The Neuse River Basinwide Management Plan was the completed in 1993, before the final version of the CCMP was published. As the second cycle of the Neuse Basinwide Plan approaches, the Neuse River, especially its estuary, continues to suffer water quality problems as the result of excessive pollution loading. While phosphorus loading has been estimated to have decreased by 30% in the 15 years before 1995, nitrogen loading estimates indicate an increase by 8% over that same time period. The Neuse River Nutrient Sensitive Waters Management Strategy was proposed in 1995 to develop nutrient management strategies when the 1993 Neuse Basin Management Plan was obviously not effectively alleviating the problems with water quality in the Neuse Estuary. The final version of the Neuse River NSW Management Strategy is scheduled to be presented to the Environmental Management Commission on June 12, 1997.

While the first generation of Basinwide Plans provided value by creating a previously unavailable information source which documented the condition of the basin, the second generation should be held to a higher level of expectations. In particular, a realistic, workable strategy which will result in reductions in nutrient loading and the development of basin conservation plans should be emphasized.

The Neuse River Nutrient Management Plan will play a major role in the success or failure of the second generation of the Neuse Basinwide Management Plan. Based upon the draft document, key features for the final version of the Nutrient Management Plan which hold the most promise in providing improvements to water quality include:

POINT SOURCE REDUCTIONS:

Waste water treatment plant effluent limitations should be based on 70% of the load to the estuary at full permitted flow in 1995. The proposed requirement to meet effluent concentration limits of 6 mgN/l will not result in the proposed 30% reduction in nitrogen loading given the 1995 permitted discharge volumes. Using data provided by DWQ and considering facilities responsible for more than 95% of the (end of pipe) N load, discharge at full permitted quantities at 6 mgN/l would result in a load at 136.6% of the reduced loading target.

## NONPOINT SOURCE REDUCTIONS

Riparian Buffers: Existing forested buffers need to be protected and those that are channelized need to be unchannelized. Grass vegetated buffer strips do not support nitrogen reductions in shallow groundwater, the most prevalent transport medium of nonpoint source (NPS) N in the Neuse Basin, and should not be allowed as replacements for forested buffers except under conditions where sediment is the only concern.

Animal Operations: The Neuse River supplemental classification as Nutrient Sensitive Waters should provide sufficient reason to provide regulatory controls on animal operations beyond those required in the general permit currently in place under temporary rules. Given the quantity of ammonia volatilized from hog operations, the lagoon/sprayfield waste treatment system should be phased out and replaced with an alternate waste treatment system which allows transport of nutrients in the waste out of the basin.

Nutrient Management: Nutrient management should be required of agricultural, recreational and commercial areas, including private and public land of 10 or more acres, and land receiving nutrients applied by commercial applicators.

Atmospheric Loading: A commitment needs to be made to determine sources of atmospheric N but also to examine options for immediate reductions in atmospheric deposition. Options should include control where possible, and offset where control is not possible. A vigorous program of wetland restoration and riparian buffer reforestation could provide additional nitrogen reduction to offset difficult to control sources such as atmospheric deposition. Hog and other livestock operations should be required to minimize ammonia volatilization.

Storm Water: The option for local development of storm water rules makes sense. However, the Neuse Nutrient Management Plan should include specific language which delineates the goals, criteria, and alternatives upon failure to act. Cluster development should be encouraged as it provides for cost efficient municipal services (including storm water management) and encourages reduced commuting.

Modeling Improvements: The Neuse Nutrient Management Plan should make a commitment to model improvements and provide a timetable in which these will be implemented. Specifically, the landuse export coefficients (used in Fate and Transport model) need to be improved by including within-basin landuse export data and corrections for soil type. Landuse estimates (from satellite photographs) need to be periodically updated (perhaps every 3 to 5 years).

# Development of a Water-Quality Modeling Framework for the Neuse River Estuary

Jerad D. Bales (U.S. Geological Survey, Raleigh)
and Jon Mangles (North Carolina Division of Water Quality, Raleigh)

Watershed management of nutrient inputs to coastal systems is a complex task. In many basins, nonpoint-source inputs exceed point-source loadings, but nonpoint sources are difficult to quantify. Management of nonpoint sources is even more challenging because of the effects of interannual weather variations and the cumulative effects of decisions made by numerous landowners and resource users. Compounding the challenge is the fact that nutrients released near the headwaters of a coastal basin likely do not have the same effect on coastal waters as nutrients released directly to the estuary. Despite the complexities of the natural system and the inadequacy of information, resource managers must make decisions about allowable nutrient inputs to coastal waters. Recent court decisions and pending lawsuits are accelerating the need to determine and establish total maximum daily loads (TMDLs) for receiving waters.

Decisions on acceptable nutrient inputs can be based on an experimental approach, on collection and interpretation of data, or on results from water-quality models to project the effects of proposed changes in nutrient inputs on water-quality conditions. The experimental approach--institute a change in loadings and measure the results-- is iterative, and the effects of changes in loadings and hydrologic variations are difficult to distinguish. However, this approach can be implemented quickly, meeting public demands for action, and can be a useful first step in improving water quality if it is recognized that further changes in nutrient loadings may be warranted as new information becomes available.

Data collection and interpretation is fundamental to documenting changes in estuarine water quality in response to natural variations and management actions, understanding important processes, and developing more rigorous water-quality models. Data-collection efforts need to be carefully designed and periodically reviewed, and should include significant resources for data archival, interpretation, integration of results from all data-collection efforts, and reporting. Extrapolation of findings derived from one set of conditions (climatic, hydrologic, and water-quality management) to possible future scenarios, however, is difficult without a formal set of algorithms, or a model.

Water-quality models, whether statistical, empirical, or mechanistic, have been successfully used to set discharge limits and establish TMDL's in rivers. Decision-making applications of estuarine water-quality models, however, are less routine than riverine applications. Applications of riverine water-quality models typically are made for steady low-flow conditions, but estuarine water-quality models must account for the dynamic nature of meteorological, riverine, and coastal ocean conditions on estuarine processes. Moreover, estuarine water-quality models generally do not fully represent the complexities of long-term biogeochemical cycling, nor the effects of nutrient inputs

on productivity and phytoplankton succession. Finally, the public often perceives the primary water-quality issue as the appearance of diseased or dead fish and shellfish, rather than elevated nutrient levels, which are more readily regulated and modeled. Reliable, usable, and linked hydraulic-water chemistry-fisheries models have yet to be developed.

A dynamic water-quality modeling framework is being developed by the U.S. Geological Survey, in cooperation with the North Carolina Division of Water Quality, for the Neuse River estuary. The primary application of the model is to evaluate the effects of a proposed 30-percent reduction in nitrogen loadings to the estuary on selected response variables--primarily chlorophyll *a* and dissolved oxygen concentration. The model domain extends from Oriental upstream about 63 kilometers, and includes seven embayments, or tidal creeks, along the estuary. The mainstem of the estuary is divided into 35 segments which range in length from 500 meters to 7,100 meters, and in surface width from 100 to 6,700 meters. Each segment is subdivided into as many as 10 layers, one-meter thick, depending on water depth. Hydrodynamic and water-quality conditions are assumed to vary longitudinally from segment to segment, and vertically from layer to layer. Data collected by the North Carolina Division of Water Quality, the University of North Carolina Institute of Marine Sciences, and the U.S. Geological Survey during March - October 1991 are being used to construct and test the model. More recent complete data sets are not available.

Application of this model to the Neuse River estuary exemplifies some of the difficulties associated with using results from estuarine water-quality models to make management decisions. All physical, chemical, and biological processes in the estuary need not be modeled. For example, phytoplankton respond to a variety of phenomena (for example, physical transport, stratification, sediment resuspension and light attenuation, and benthic and pelagic grazing), and phytoplankton growth results in a number of changes to the estuary (for example, depletion of inorganic nutrients, dissolved oxygen supersaturation, increased benthic oxygen demand, and changes in the form and toxicity of selected trace metals). But, modeling of estuarine response to changes in nutrient loadings requires that the key processes be identified, understood, and reasonably modeled, and that processes which are peripheral to the decision-making issues be minimized. Water-quality simulations also are typically performed by using historic meteorologic and hydrologic data, to answer such questions as, "What would dissolved-oxygen concentrations have been in the Neuse estuary in 1994 if nutrient loadings had been 30 percent lower than observed?" However, historic conditions will not be exactly repeated in the future, so it cannot be known with certainty whether future estuarine response will be the same as in the past. Further uncertainty is introduced into model predictions because the Neuse River estuary water-quality model includes more than 50 parameters, many of which cannot be directly measured, and by variability associated with data and model algorithms. However, if these, and other, limitations associated with the Neuse estuary water-quality model are recognized, the modeling framework can be an important tool in the wise management of coastal waters.

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Title: Stimulation of the Toxic Dinoflagellate, *Pfiesteria piscicida,* by Nutrient Enrichments

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The toxic dinoflagellate, *Pfiesteria piscicida*, has been implicated as a causative agent of major fish kills (affecting $10^3$ - $10^9$ fish) in estuaries and coastal waters of the southeastern United States. Transformations among an array of flagellated, amoeboid, and encysted stages in its complex life cycle are controlled by the availability of fish and other prey. This dinoflagellate requires an unidentified substance(s) commonly found in fresh fish excreta/ secreta to initiate toxin production. It is lethal to fish at low cell densities ($>$ 250 - 300 cells $mL^{-1}$), and at sublethal levels (ca. 100 - 250 cells $mL^{-1}$) it has been shown to cause ulcerative fish diseases. *P. piscicida* also has been linked to serious human health impacts. This organism is eurythermal and euryhaline, with optima for toxic activity by the most lethal stage (toxic zoospores, TZs) at $\geq$ 26°C and 15 psu, respectively. Thus far it has shown no light opti-mum, and is capable of killing fish at any time during a 24-h cycle. In warmer waters ($\geq$ 15°C) flagellated stages predominate while fish are dying, whereas toxic amoebae predominate in colder conditions.

While toxic stages are stimulated by the presence of live fish, *Pfiesteria* also consumes other microorganisms and can adopt a mixotrophic habit through retention of kleptochloroplasts from consumed algal prey. These kleptochloroplasts are actively photosynthetic for days to weeks following retention (as demonstrated by track microautoradiography with $^{14}$C-bicarbonate). We have worked to examine the effects of nutrient enrichment on nontoxic zoospores (NTZs) of *Pfiesteria* through a combination of field observations and laboratory/field experiments. In the first of an experimental series, we tested the response of NTZs to gradients of inorganic and organic P enrichment, with vs. without flagellated algal prey. A second experiment examined whether NTZs osmotrophically take up dissolved organic nitrogen ($N_o$, as radiolabeled protein hydrolysate). Experiment III tested NTZ response to gradients of inorganic P ($P_i$), organic P ($P_o$), and nitrate ($N_i$) enrichment when given nutrient-replete algae. Experiment IV assessed the influence of *Pfiesteria*'s nutritional prehistory (with kleptochloroplasts from cryptomonad prey alone in a "plant-like" mode, with nutrient-rich cryptomonads, or with nutrient-poor algal prey) on NTZ response to gradients of $P_i$, $P_o$, or $N_i$ enrichment.

In experiment V we compared NTZ and TZ response to nutrient-rich vs. nutrient-poor algal prey, to gain additional insights about *Pfiesteria*'s survival strategies between fish kills. Experiment VI has tested *Pfiesteria*'s response to characteristics of experimental containers, as one facet of an ongoing experiment to examine this dinoflagellate's seasonal response to various combinations of nutrient enrichments in natural phytoplankton communities. In other field research, we have completed an estuarine field survey to determine NTZ abundance in municipal waste discharge sites on the New River Estuary and a tidal creek system, relative to control areas without sewage influence; a more extensive study is in progress. We also assessed the influence of swine effluent discharge on TZ activity in a field setting. And, we completed an extensive characterization of the seasonal dynamics of *Pfiesteria* zoospore populations in the mesohaline Neuse Estuary, to discern relationships between zoospore densities, nutrient enrichments, and phytoplankton abundance.

Experiment I yielded greatest NTZ abundance in the higher level of $P_o$ + flagellated algal prey, with growth also stimulated by high $P_o$ alone (500 $\mu$g/L) and, less so, by high $P_i$. Experiment II documented indirect stimulation of NTZs by $P_i$ or $N_i$, mediated through algal prey densities. With aid of microautoradiography and motion analysis, we observed osmotrophic ac-

Experiment II documented indirect stimulation of NTZs by $P_i$ or $N_i$, mediated through algal prey densities. With aid of microautoradiography and motion analysis, we observed osmotrophic activity of NTZs in directly consuming dissolved organic nitrogen as protein hydrolysate. In experiment III, nutritional prehistory influenced *Pfiesteria* stimulation by enrichments in the presence of algal prey. The most "plant-like" response to inorganic nutrients ($P_i$) was shwon by NTZs that previously had been maintained with aging kleptochloroplasts but without other flagellated algal food source. *Pfiesteria* that formerly had been given nutrient-poor algal prey responded positively to enrichments, whereas little nutrient effect was shown for previously nutrient-replete NTZs.

In field research we have obtained significant differences in *Pfiesteria*'s abundance, and its response to nutrients and algal species arrays in natural phytoplankton communities, depending on container size and design. Such differences in behavior with enclosure characteristics have also been shown by various other harmful estuarine and marine algae. In our field surveys in the New River Estuary and tidal creeks, we have found significantly higher NTZ abundances near municipal wastewater discharge sites relative to control sites. NTZ densities in sewage areas were strongly positively correlated with both algal prey densities and total phosphorus concentration. We documented an apparent positive response of *Pfiesteria*'s TZs to a major swine effluent lagoon discharge, as well; in that event, a second harmful phytoplankter, *Phaeocystis*, was also stimulated. Finally, our extensive field study in the mesohaline Neuse has demonstrated a significant positive correlation between *Pfiesteria* zoospore densities and phytoplankton abundance during spring seasons that are preceeded by high-precipitation winters. Such conditions impart high nitrogen/phosphorus loading from the precipitation and runoff, which is known to support massive late winter-spring nontoxic dinoflagellate blooms. This research is analogous to previous work by other researchers which has shown that in freshwater segments of the Neuse, summer blue-green algal blooms may be expected in years that are characterized by wet winter-spring conditions and high nutrient loadings. In part the positive relationship we have established between *Pfiesteria* and late winter dinoflagellate blooms on the Neuse Estuary is attributed to the fact that these blooms include a certain species of algae we have identified as a preferred food source for *Pfiesteria,* prior to arrival of large schools of Atlantic menhaden and other fish later in the growing season.

*Pfiesteria* is an animal with both a mixotrophic (= partially photosynthetic or plant-like) habit, and with heterotrophic activity spanning prey from all trophic levels (bacteria, algae, small animals, fish, and mammalian tissues). Hence, its nutrition is complex and cannot be expected to directly parallel the linear response of algae to nutrient enrichments. Our extensive field and laboratory information has demonstrated repeatedly that *Pfiesteria*'s response to nutrient enrichments depends on **(i)** prey type and availability, **(ii)** prehistory of feeding, **(iii)** nutrient form and concentration, and **(iv)** season. These data represent a collaborative effort of twelve specialists in dinoflagellate research from five universities, interacting with our laboratory. This research summarizes eight years of experimental research in the laboratory and the field, which has been published in five peer-reviewed international science publications. The data support strong stimulation of *Pfiesteria* by organic and inorganic N and P, directly and/or indirectly as mediated by the abundance of algal prey. Further, our data indicate that *Pfiesteria* responds best to degraded water quality -- that is, conditions associated with relatively high nutrient levels (e.g., $> 100$ $\mu$g N or P/L) stimulate this dinoflagellate, so that modest nutrient reductions (e.g. $\geq$ 30% N loading reductions, and N/P co-management) and resulting declines in algal blooms would be predicted to discourage its growth and toxic outbreaks.

# Correlation of Annual Variations in Water Quality and Agricultural Practices for Subbasins of the Albemarle-Pamlico Drainage Basin, North Carolina and Virginia

Douglas A. Harned and Gerard McMahon *

To define the degree of association between agricultural practices and stream water quality annual variation in water-quality data for 66 small watersheds in the Albemarle-Pamlico drainage area in North Carolina and Virginia were correlated with annual variation in basin agricultural statistics. The data examined were collected from 1970 to 1993 by the U.S. Geological Survey, the North Carolina Department of Environment, Health, and Natural Resources, and the Virginia Department of Environmental Quality.

Annual measures of crop acreage and fertilizer sales were compiled to represent agricultural activities; however, these variables are highly intercorrelated. Principal components analysis can be used to combine several intercorrelated variables into a smaller number of synthetic variables. Analysis of annual county reports of crop acreages (1970-90) for corn, soybeans, cotton, sorgum, barley, oats, wheat, peas, tobacco, and potatoes yielded a single agricultural variable (CORNSOY) that accounted for 88 percent of the annual variance in crop acreages. The dominant variables in the CORNSOY principal component are acres of corn (loading=0.60) and acres of soybeans (0.70). A separate analysis of annual county reports (1970-88) of sales for commercial fertilizer, total fertilizer materials, total mixed fertilizer, lime, and landplaster yielded a principal component (FERT) that accounted for 98 percent of the annual variance in fertilizer sales.

Multiple regression analysis was used to test the association of each of the two agricultural principal component variables (CORNSOY and FERT) with instream water quality. Annual streamflow from a centrally located subbasin was included as a second variable in each regression to control for water-quality variations related to discharge, and a third variable accounted for trends over time that were unrelated to agricultural or streamflow characteristics.

Water-quality constituents examined included major ions, nutrients, selected metals, pH, dissolved oxygen, specific conductance, hardness, and solids concentrations. Median annual constituent values were used in the multiple regression analysis. Statistically significant (p=0.05) associations were observed for both agricultural variables for specific conductance, total nitrate, total nitrite, total ammonia, total nitrogen, total hardness, dissolved silica, dissolved solids, and non-filterable volatile solids concentrations. These correlations indicate a distinct association between water quality in the streams of the Albemarle-Pamlico drainage basin and indices measuring the amount of row crops grown and fertilizer used.

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**U.S. Geological Survey Albemarle-Pamlico
National Water-Quality Assessment Home Page:**

**http://sgi1dncrlg.er.usgs.gov/albe-html/ALBEpage.html
or
http://130.11.144.150/albe-html/ALBEpage.html**

# IMPACTS OF LAND USE AND WATER MANAGEMENT PRACTICES ON THE WATER QUALITY OF A LOWER COASTAL PLAIN WATERSHED

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Water quality problems in major rivers, lakes and estuaries of North Carolina are caused in part by nutrients and sediments from agricultural and silvicultural land uses. There is particular concern in coastal areas where these land uses are located in close proximity to recreational and environmentally sensitive waters. Most large watersheds in the North Carolina Coastal Plains are primarily composed of a mosaic of these land uses. A range of cropping, fertilization and water management practices may be used on these lands. Agricultural lands may be fertilized with inorganic fertilizers, animal wastes or a combination of both. Forested lands in these watersheds are typically a mixture of natural stands and managed plantation forests that may be fertilized during critical growth periods. Coastal watersheds may include lands with natural drainage as well as lands with various combinations of improved surface and subsurface drainage. Land with improved drainage may be managed using controlled drainage or subirrigation practices. The distribution and intensity of land uses and management practices will affect the water quality in a coastal watershed and its receiving waters.

The overall objective of this research is to determine the effects of land use, water management, variations in the application of inorganic fertilizers and animal wastes and other BMPS, and their distribution in space, on the hydrology and water quality at the watershed outlet. Simulation models will be developed to predict cumulative impacts and the reliability of the models will be tested on a large watershed. Specific objectives are:

1. To determine pollutant loading at strategic locations and the changes in water quality that occur within the drainage canal and stream network of a large watershed containing a mixture of land uses, soils, crops and BMPS.

2. To select, further develop, and validate simulation models for predicting hydrology, in-stream water quality, and pollutant loading from coastal watersheds.

3. To link in-stream water quality models with field-scale models for predicting effects of water table management and fertility practices. This will allow prediction of cumulative impacts of land uses and BMPs on water quality and pollutant loading at the outlet.

4. To analyze watershed data and apply simulation models to evaluate effects of land uses and BMPS, and their distribution within the watershed, on the hydrology and water quality at the outlet.

5. To integrate results from the watershed and simulation studies to develop recommended coastal watershed management practices for agriculture, forestry and animal waste utilization which maximizes water quality and provides acceptable yields for the producers.

Obtaining the data necessary to understand the effects of land use and BMPS on the quality of water draining from large watersheds containing forestry, several cultivated crops with different management practices, and land applied animal wastes requires a multidisciplinary, broad-based approach. The research presented herein is a cooperative project between North Carolina State University (NCSU) Weyerhaeuser Company, USDA-NRCS, USGS, USEPA, Agricultural Extension Service (AES), Water Resource Research Institute of UNC, and the North Carolina Department of Environment, Health and Natural Resources (DEHNR).

**Field Research**

We have intensively instrumented a 8100 ha watershed located in Washington County, NC. The drainage outlet on the watershed is Kendricks Creek which flows to the Albemarele Sound about 6 km downstream from the outlet. Both mineral and organic soils are present on the watershed. The mineral soils are very poorly drained Portsmouth and Cape Fear series, while the organic soils are primarily Belhaven and Pungo series, located in the southern part of the watershed. Land use consists of cropland (36%), managed forested lands (52%), unmanaged forested wetlands and riparian areas (11%) with about 1% of the area covered by buildings, lawns, roads, etc. These percentages of forested and crop lands are typical for the region.

The drainage systems on the watershed include the major types used in the Coastal Plains. The primary system for both agricultural and forested lands is a network of field ditches and canals which divide the watershed into a mosaic of regularly shaped fields and blocks of fields. Field ditches, which provide both surface and subsurface drainage, are spaced 80 to 100 m apart and range in depth from 1.0 to 1.2 m on agricultural lands and 0.6 to 1.2 m on forested lands. Some of the forested lands do not have field ditches. The field ditches drain to a network of collector and main canals, all of which eventually lead to the watershed outlet. The watershed has flashboard riser facilities for controlled drainage on about 50% of the land.

Flow measurements are being recorded and drainage waters are being sampled for water quality at 49 gauging and sampling stations within the watershed. These stations are located at drainage outlets of agricultural and forested fields (20), on the main drainage canals within the watershed (25), at the outlet of sub-watersheds comprised entirely of agricultural and forested lands (2), and at the outlets of the watershed (2). Details on the specific locations and procedures are discussed below.

Drainage water quality and pollutant loading at the field edge are being determined from measurements at the outlets of 12 agricultural fields, 7 managed forested areas and 1 natural forested wetland site. Eight of the agricultural sites are on an intensively instrumented field experiment to study the interaction of water table management and fertility practices. Losses of fertilizer nutrients and sediment via surface runoff and subsurface drain outflow are measured on a continuous basis. The hydrology and drainage water quality of a 135 ha wetland is also being continuously monitored at the field scale. Results from these two studies have already been used to modify and test process-based simulation models for predicting the hydrology and water quality at the field edge from managed agricultural land and from natural wetlands. Additional field scale gauging stations are located at the outlets of fields on which swine lagoon effluent is irrigated. These sites are located on the Tidewater Research Station (TRS) where studies are being conducted to determine impacts of irrigating lagoon effluent on quality of shallow groundwater.

Field scale measurements are being conducted at 7 sites in the drained forested area. The field sites have been selected to include mixed hardwood and plantation pine at various stages of growth. Two of the sites are on a mixed hardwood forest that is over 35 years old. The other five sites are on loblolly

pine plantations at the following ages: 3 to 4 years, 12 to 13 years, and 22 years. One of the sites will be harvested (clear cut) during the course of the study, so that the effect of harvest and regeneration will be measured. Effects of thinning and fertilization will be determined on two of the pine sites.

Gauging and sampling stations are located at 29 locations on selected canals and natural streams to determine water quality changes and pollutant transport through the canal and stream network. Equipment has been installed to continuously record canal water levels and flow rates and to automatically sample for water quality at 13 of the stations. Flow rates are manually determined and grab samples are being collected at the 16 remaining stations.

Instrumentation installed at the automatic stations include sharp crested V-notch weirs, water level recorders, automatic samplers, and microprocessors to store the data and control the samplers. Field instruments are serviced biweekly, at which time grab samples are collected to determine water quality at all stations. Temperature and dissolved oxygen are measured in the field at the time of sampling. These data should provide an accurate assessment of hydrologic and water quality conditions from the field edge through the drainage canal network, and ultimately to the receiving streams.

Intensive storm event based sampling and flow measurements are conducted at least four times per year to determine pollutant loading and in-stream water quality changes for testing prediction models. The events are 3 to 5 days in duration in each of the winter, spring, summer, and autumn seasons. Exact scheduling depends on hydrologic conditions, as determined by our continuous monitoring, and weather forecasts.

Rainfall is being measured with 8 recording rain gauges distributed on the site. Meteorological data are being continuously measured and recorded at the agricultural water management site on the TRS and at the managed forest site. Measurements at these sites will be sufficient to determine potential ET; solar radiation, wind speed, temperature, and relative humidity.

Land uses, water management practices, fertilizer applications, location and characteristics of riparian buffer areas, and detailed information on crops and cultural practices are being documented for the entire site. A geographic information system (GIS) will be used to organize the data with respect to distribution in time and space. Soil properties and other parameters needed for hydrologic and water quality modeling are being determined and included in the GIS data base.

**Model Development**

Models for predicting losses of sediment, nitrogen (N) and phosphorus (P) at the field edge will be interfaced with a model to predict the transport and fate of sediment and chemicals in drainage canals and small coastal streams. The resulting watershed-scale model will be calibrated and tested using the data discussed above.

Nitrogen losses at the field edge will be predicted using DRAINMOD-N. Sediment and P losses will be predicted with DRAINMOD/CREAMS. These models will be further tested by comparing predicted and measured water quality parameters for the field scale stations discussed above. DRAINMOD based models have already been linked with methods to describe the hydraulics in drainage channels and small streams. Thus models are available to predict N, P, and sediment loading at the field edge and to quantify flow rates, velocities, and water depth in the drainage canal-stream network. The remaining task is to link these models with a model to predict transport and fate of sediment and chemicals in the canals and streams.

Two in-stream models, DUFLOW and WASP5 have been selected for simulating the transport and fate of nutrients and sediment in drainage ditches, canals, and small streams. Each can describe standing water bodies as well as flowing streams, which is important in watersheds having water management structures for controlled drainage. They can also simulate the interaction between sediment and water,

taking into account biological processes, and predict daily average pollutant concentrations as well as extreme concentrations. The output of the DRAINMOD based models, both water quality and quantity variables, will be used as input to DUFLOW and WASP5 which will simulate the in-stream processes to predict water quality and pollutant loadings.

In-stream models will be calibrated and tested by conducting field and laboratory measurements to determine input parameters. Inputs from the field edge will be determined by on site measurements and field scale models. Model predictions for water quality at sampling stations along the drainage canal and outlet streams will then be compared to measured values. Adjustment of the input parameters may be necessary to calibrate the models. The experimental site contains several large canals, so it will be possible to calibrate models on one and test their reliability on others. Coupled field and in-stream model will finally be tested by comparing predicted and measured flows and water quality at the watershed outlet, as well as at several locations within the drainage network.

The large number of difficult to obtain input parameters required by in-stream process models and uncertainties in model predictions due to errors associated with these input parameters may limit the utility of these models. These complexities will be particularly challenging for routine analyses needed by policy makers and managers with limited time and resources. In addition to developing the complex models, we will also be developing and testing lumped parameter models for estimating the net changes of nutrient load during transport in the streams and canals. These simplified models will be developed by using sensitivity analyses to determine the relative importance of processes and parameters used in the complex models, and lumping or omitting the processes or parameters according to their importance in nutrient loading at the watershed outlet. We will develop other lumped models by assuming simple exponential decay of nutrients with time and empirically determine attenuation constants dependent on channel characteristics and seasonal conditions. The lumped parameter models will be evaluated by comparing their predictions with field measured data and with predictions of the more complex models.

Once the models are tested, they will be applied to evaluate the effects of various land uses and management practices on downstream hydrology, water quality and pollutant loading. The practices include drainage and associated water management, fertility, cultural practices, natural or planted buffers, and others. Effects of changes in land use and the distribution within the watershed will also be evaluated. The models to be used in this study are capable of predicting yields, so the effects of various alternative water management and fertilization practices on yields and profits can be analyzed. Working with our cooperators, we will develop recommendations for agricultural and forestry management practices on coastal watersheds.

# Nutrient Reductions from Agriculture in the Tar Pamlico River Basin

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The Tar Pamlico River Nutrient Management Plan for Nonpoint Sources of Pollution was developed to address water quality concerns and provide a framework for reducing nutrient loading to the river and its estuaries. The Plan requested each of the lead NPS agencies to provide an annual report on progress related to the nutrient load reduction goal of 30% of the 1991 levels. This reduction goal was equivalent to 1,215,544 pounds of nutrients originating from agricultural sources above the city of Washington and is to be achieved by December 31, 2000.

As the lead agency for agricultural nonpoint source (NPS) issues, the Division of Soil and Water Conservation (DSWC), prepared a five-year status report on the action items included in the Tar Pamlico Nutrient Management Plan for Nonpoint Sources of Pollution. Although the report was prepared by DSWC, other agricultural agencies submitted information and reviewed the draft to ensure that the report was comprehensive and representative of the North Carolina agricultural community.

The report was submitted to the Division of Water Quality (DWQ) on April 2, 1997. The DWQ compiled a draft document and included reports on NPS activities from forestry, urban stormwater, construction/mining, on-site wastewater disposal, solid waste disposal, wetland restoration, groundwater, and atmospheric deposition. The DWQ held a forum on May 2, 1997 to present the draft report to 11 non-governmental agencies representing agricultural, environmental, forestry, county, and construction interests. This draft report was included as an informational item for the Environmental Management Commission (EMC) meeting on May 8, 1997 and will be addressed in more detail by the EMC Water Quality Committee on September 10, 1997. The EMC will address the five year Tar Pamlico status report as an action item at the October 9, 1997 meeting.

## WHAT DOES THE REPORT SAY ABOUT AGRICULTURE

During the past five years, the general agricultural community has achieved significant progress in reducing nutrient loading to the Tar Pamlico River Basin. This success is due to cooperative efforts of farmers and the agencies that serve them. Local, regional, state, and federal staff of the Soil and Water Conservation Districts, the Soil and Water Conservation Commission, the Division of Soil and Water Conservation, North Carolina State University Cooperative Extension Service, North Carolina Department of Agriculture, North Carolina Farm Bureau Federation, and the United States Department of Agriculture's Natural Resources Conservation Service have provided leadership in the area of water quality. Together, these agencies have proceeded to implement best management practices which are based in science and appropriate to the agricultural systems in Eastern North Carolina.

North Carolina agencies have been at the forefront of the effort to document improvements to water quality. In 1996, a cooperative effort among agricultural agencies produced appropriate procedures for nutrient accountability due to best management practice (BMP) installation. Prior to this effort, there were no available site specific methods for nutrient accountability. The agricultural community is hopeful that these accountability measures result in continued voluntary participation in nutrient reduction efforts rather than mandatory regulations. During the coming years, the agricultural agencies will continue to refine the nutrient accountability methods based on results of appropriate research.

### Nutrient Reduction Estimates via the Nutrient Loss Evaluation Worksheet

Initial analysis of best management practices implemented in the Tar Pamlico River Basin with financial assistance from the North Carolina Agriculture Cost Share Program (NCACSP) indicates an estimated reduction of 776,848 pounds of nitrogen and 181,380 pounds of phosphorous. These estimates were based on the Nutrient Loss Evaluation Worksheet

developed by NRCS and reviewed by NCSU. This method represents the best available nutrient accounting procedures and estimates reductions of nutrients leaving the farm field edges.

During the five year period, reduction of nitrogen at the edge of farm fields was 484,586 pounds for areas above the city of Washington. This amount was compared to the 30% reduction goal and surpasses the 1996 target goal of 243,109 pounds of nutrients. It is important to recognize that the 484,586 pounds of nitrogen represents a five-year period and roughly equates to 96,917 pounds of nitrogen per year. Therefore, the NCACSP assisted BMPs resulted in reaching 40% of the goal. It is likely that a greater percent of the goal was reached due to BMPs implemented with assistance from federal sources and due to BMPs implemented by farmers without any financial assistance.

This method was not the same method used to calculate the nutrient loads contained in the Tar Pamlico Nutrient Management Plan for NPS Pollution. The next paragraph explains some concerns with the original methodology.

**Nutrient Reduction Estimates using the Export Coefficient Method**

The agricultural community has repeatedly questioned the accuracy of the export coefficient method which was developed by the Research Triangle Institute (RTI), approved by the Division of Water Quality, and used in the Tar Pamlico River Nutrient Management Plan for Nonpoint Sources of Pollution. An attempt was made to determine nutrient loading using the export coefficient method to provide comparative information between nutrient loading in 1991 and 1995. The most recent land use data (1994-1995) indicated a total of 821,724 acres of farmland in the basin and represented a shift of 335,845 acres (29%) of farmland to other land uses since 1987. Upon closer inspection of the data, it became evident that errors in the 1987 landuse data which was used for loading calculations in 1991 precluded use of the export coefficient model to complete the comparative analysis.

**Nutrient Reductions not evaluated**

Nutrient load reductions were expected from best management practices installed with funds from the United States Department of Agriculture's Farm Services Agency (FSA). Although, county, cost, and area of best management practices are reported, data on actual nutrient reductions for FSA programs were not assessed due to limited staff. In addition, farmers as the original stewards of the land, continue to implement best management practices without governmental assistance. Significant efforts were initiated to conduct farmer surveys to quantify this information, but due to limited staff the survey has been delayed.

In summary, considerable progress has been made towards reducing nutrient load to the Tar Pamlico River Basin, yet there is still the need to improve upon the success of the past five years. It is important to emphasize that the data reported in this report only represents a partial accounting of BMP implementation in the agricultural community. Additional resources are required to provide a more complete assessment of BMPs implemented in the Tar Pamlico River Basin. Program support is needed to provide additional knowledge to farmers so that they may keep abreast of advances in technology and techniques to minimize the nutrient load while maintaining profitable enterprises. As noted in the report, fulfillment of the action items would be greatly enhanced with the creation of seven positions in various agricultural agencies and special funding for nutrient management workshops ($570,000). These positions will develop cost estimates for BMP implementation required to continue to improve water quality and present that information in the 1999 annual report.

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# *Managing The Albemarle-Pamlico Sounds*

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# VITAL HABITATS SESSION

# WEYERHAEUSER COMPANY INITIATIVES TO CONSERVE VITAL HABITATS AND TO MAINTAIN NATURAL HERITAGE FEATURES OF THE ALBEMARLE-PAMLICO REGION

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Weyerhaeuser Company has used a variety of methods to conserve and protect vital fish and wildlife habitats and to maintain the natural heritage features of the Albemarle-Pamlico region since the late 1980's. These methods include natural heritage registry, conservation easements, alternative forest management systems, wildlife research studies, cooperative agreements, conservation and restoration activities and environmental education.

**Natural Heritage Registry and Conservation Easements.** Three critical natural areas identified by the Albemarle-Pamlico Estuarine Study (APES) are being protected by Weyerhaeuser through formal written agreements. Scuppernong River Swamp Forest, consisting of 460 acres in the Scuppernong River Swamp Forest Natural Area in Washington and Tyrrell counties, was listed in the North Carolina Natural Heritage Registry in 1991. Cool Springs Natural Area, containing 141 acres of longleaf pine stands and land suitable for longleaf restoration near the Neuse River in Craven County, was entered into the North Carolina Registry in 1992. A conservation easement on Walker's Millpond and Black Creek Wetlands, a 1017 acre corridor around the millpond and the creek north of the Newport River in Carteret County, was granted to North Carolina Coastal Land Trust in 1996.

**Alternative Forest Management.** About 90% of Company acreage in coastal North Carolina is planted to loblolly pine and is managed for the production of high quality southern yellow pine sawtimber. The remaining acreage includes streamside management zones, hardwood production areas and habitat reserve areas. These low-intensity management areas tend to occur as diverse-habitat corridors that provide firebreaks through our managed pine lands. A good example is the 1425 acre natural stand and planted hardwoods corridor that connects Campbell's Creek in Beaufort County to Vandemere Creek in Pamlico County.

**Wildlife Research Studies.** An important part of identifying critical habitats is to research the habitat requirements of the animal species of concern. North Carolina State University, Weyerhaeuser Company and NCASI cooperated on a study of birds and mammals in managed and unmanaged pocosins in Jones and Carteret Counties in 1991 and 1992. The University of Tennessee, North Carolina Wildlife Resources Commission and Weyerhaeuser Company cooperated in a comprehensive black bear study in the managed forest and farm lands of the Neuse-Pamlico Peninsula from 1992 to 1996. The Center for Conservation Biology at the College of William and Mary and Weyerhaeuser Company are cooperating in a study of breeding bird communities of the managed forest landscape in Washington, Beaufort and Martin Counties in 1997 and 1998.

**Cooperative Management Agreements.** Weyerhaeuser Company entered cooperative management agreements with the North Carolina Wildlife Resources Commission for black bear in 1990 and for wild turkey in 1992. The Company entered a Wild Turkey Partnership Agreement with the National Wild Turkey Federation in 1995. Croatan National Forest, Weyerhaeuser Company and U. S. Fish and Wildlife Service entered a Red-Cockaded Woodpecker Management Memorandum of Understanding in 1995.

**Conservation and Restoration Activities.** The Company is working with two tree species of regional or global concern. Most remaining longleaf pine stands are managed by natural regeneration to produce not only timber products, but also for longleaf gene conservation and to maintain the associated plant and animal community. Remaining Atlantic white-cedar groves are reserved for gene conservation of this globally threatened species. Weyerhaeuser has been a charter member of the Atlantic White-Cedar Alliance since its inception in 1988. The Company nursery business grows longleaf seedlings and white-cedar rooted cuttings for restoration and wetland mitigation projects.

**Environmental Education.** Weyerhaeuser's Cool Springs Environmental Education Center, located on a 1700 acre tract of diverse forest types at the confluence of Swift Creek and the Neuse River near New Bern, was opened to school and civic groups in 1996. Guided tours have been given to more than 2000 people during the first year of operation. US EPA wetland classification and salamander workshops have been held at Cool Springs during the first year of operation.

# Monitoring Submersed Rooted Vascular (SRV) Beds in Support of Coastal Land, Water and Fisheries Management

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Submersed rooted vascular (**SRV**) beds are a wellspring and a harbinger of healthy and productive estuaries in North Carolina. SRVs include seagrasses (eelgrass and shoal grass) which require seawater. Other species of SRVs include low salinity or fresh water grasses and forbs (wild celery, eurasian water milfoil, bushy pond weed, redhead grass, sago pondweed, horned pondweed, alligatorweed, spatterdock and bladderwort). The SRV widgeon grass is an important euryhaline species. SRV beds are an asset to: water course, water quality, fishery, and waterfowl management and coastal development. Local residents and visitors, both human and animal, exploit SRV beds. SRVs are sensitive indicators of ecosystem health and productivity.

**WATER COURSE AND WATER QUALITY** SRVs help stabilize shoals and shorelines and maintain water quality. Roots and rhizomes tap interstitial nutrients in the sediment, store food reserves, and stabilize sediments. The leaf canopy harvests light and water column nutrients, attenuates currents and waves, and enhances sedimentation. SRVs improve water quality by decreasing nutrients and turbidity.

**FISHERIES AND WATERFOWL** SRVs are very productive plants and diverse species flourish in SRV beds. SRVs create leaf surfaces for settlement and structurally complex nursery habitat and feeding grounds for myriad estuarine animals and waterfowl. Marine animals associated with SRV beds include exploited and protected species: scallops, clams, shrimp, crabs, finfish, sea turtles, ducks, and geese.

**COASTAL DEVELOPMENT** Many coastal residents and visitors seek out beds of SRV for their aesthetic, recreational and commercial value. Their abundance and distribution are indices of water quality, wildlife and overall quality of life.

**COASTAL ECOSYSTEM HEALTH** SRV beds integrate natural and anthropogenic forces of weal and wan in the coastal environment. Dredging, filling, propeller scarring and boat wakes bury or uproot SRVs. Harvest of finfish and shellfish can damage SRV dependent upon type of gear. High

and persistent currents and waves uproot SRVs. High, low or variable salinities and disease can stress or eliminate species of SRV. SRVs thrive in high quality water. Phytoplankton and macroscopic algae, including toxic or noxious species, will displace SRV in turbid, eutrophic or polluted water. Loss of SRV beds eliminates their contribution to water quality, fishery stocks and quality of life in the coastal environment. This exacerbates adverse conditions and jeopardizes recovery. SRVs in mature beds develop food reserves and foster a physical and water quality environment favorable to their own persistence. Once lost, therefore, beds of SRV are problematic and expensive to restore.

**MONITORING** It is both prudent and feasible to link monitoring objectives for SRVs, to strategies and goals for land, water, and fisheries management in coastal North Carolina. Objectives in terms of SRV abundance and distribution provide focus for water quality and fishery habitat restoration and maintenance. Monitoring SRVs measures progress and provides feedback. Successful programs of this type are ongoing for Chesapeake Bay, Tampa Bay, and Sarasota Bay. In 1995, the Beaufort NMFS laboratory completed an inventory of SRV beds from Cape Lookout north and as far inland as New Bern and Washington. Research on remote sensing continues but the initial inventory of coastal SRV beds lacks data south of Cape Lookout. It is time to complete this inventory and to initiate monitoring of change in SRV beds. This information is critical to numerous state and federal agencies and private organizations. Setting objectives and the means to achieve those objectives requires cooperation. Cooperation can advance water quality, abundance of SRV beds, and productivity of biological resources.

**STATUS AND PROGNOSIS** Coastal North Carolina contains about 200,000 acres of SRV beds. This amount exceeds the total for Chesapeake, Tampa, and Sarasota Bays. The vast majority of SRV beds in North Carolina are along the inland side of the Outer Banks. Large beds of SRV against mainland shores, on the other hand, are the exception rather than the rule. Considering qualitative historical observations and anecdotal information, major losses of SRV along mainland shores co-occurred with development and drainage of coastal uplands and wetlands. Point and non-point sources of pollution stress SRV. Altered fresh water drainage and flow patterns stress SRV. These Adverse impacts add to those from thoughtless exploitation of our estuaries and its biological resources. We are at a crossroads. Beds of SRV adjacent to the mainland may recover. SRV may continue to thrive along the Outer Banks. Will North Carolina generate the information and commitment necessary to enhance and sustain the biological resources of our coastal waters into the 21st Century?

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Title: **The North Carolina Wetlands Restoration Program**

The North Carolina Wetlands Restoration Program (NCWRP) was established by an act of the North Carolina General Assembly in 1996. This action of the General Assembly was the result of a four year cooperative effort of the Divisions of Water Quality and Coastal Management. In addition, the administration of the Department of Environment, Health and Natural Resources and several other Divisions within the Department were instrumental in the establishment of this program. The purpose of the NCWRP is to protect and improve water quality, flood prevention, fisheries, wildlife and plant habitats, and recreational opportunities through the protection and restoration of wetlands and riparian areas.

The NCWRP will accomplish this purpose by restoring wetlands functions and values throughout North Carolina which will result in a net increase in wetlands acres, functions, and values in each of the seventeen river basins. The ecological effectiveness of compensatory mitigation will be improved through the development of restoration plans which will ensure that compensatory mitigation is conducted within an ecosystem context to address identified problems. This proactive approach will provide a consistent and simplified approach to address compensatory mitigation requirements and will foster a comprehensive approach to environmental protection.

Beginning July 1, 1997, comprehensive basinwide wetlands restoration plans will be developed for each river basin in conjunction with the Basinwide Water Quality Management Plans. These plans will assess the status of the existing wetlands and riparian area resources within the basin. The plans will also identify degraded wetlands and riparian areas and prioritize these sites to ensure that restoration of the degraded areas provides a mechanism to address problems that have been identified in the Basinwide Water Quality Management Plans. The restoration plans will provide the framework for the Wetlands Restoration program, therefore it is essential that the public, local governments, state and federal agencies and others be involved in the development of these plans.

The Wetlands Restoration Fund, which is a component of the NCWRP, will provide a repository for appropriations from the General Assembly, monetary

contributions, donations of property, payments in lieu of compensatory mitigation requirement and grants. The enabling legislation for the NCWRP restricts the use of these funds to the restoration, enhancement, preservation and creation of wetlands and riparian areas in accordance with the basinwide restoration plans. In addition, this fund may be used for directly related costs of planning, monitoring and maintenance of wetlands and riparian areas. On April 10, 1996, the Environmental Management Commission adopted temporary rules that established a fee schedule for payments in lieu of compensatory mitigation requirements. The schedule is as follows:

| | |
|---|---|
| Classified surface waters | $125/linear foot of stream |
| Class WL wetlands | |
| non-riparian | $12,000/acre |
| riparian | $24,000/acre |
| Class SWL wetlands | $120,000/acre |

A Memorandum of Agreement with the United States Army Corps of Engineers (USACOE) concerning the use of the Fund to address the compensatory mitigation requirements of Section 404 permits is being developed. All agencies that are involved in the 404 permit review permit will be provided the opportunity to participate in the development of this agreement. The Memorandum of Agreement will ensure that the NCWRP will only be available after the applicant has demonstrated that the wetland impacts are unavoidable in accordance with the USACOE review procedures. Recipients of Section 404 permits will not be forced to participate in the NCWRP. However, NCWRP will provide permittees with another option to satisfy the compensatory mitigation requirements. Permittees will continue to be allowed to design and implement their own project, or they may purchase credits from private mitigation banks.

The final component of the NCWRP will be the implementation of projects in accordance with the basinwide restoration plans. Implementation of the plans will occur in several ways including the establishment of private mitigation banks in identified areas, partnerships with local governments, state and federal agencies, land trusts and other non-profit organizations, and when necessary the NCWRP will issue contracts to restore identified areas.

The Division of Water Quality is committed to implementing the NCWRP to achieve the purpose and goals outlined in the enabling legislation. Full implementation of this program will provide benefits to all citizens and regions of North Carolina.

# *A Geographic Information System for Targeting Wetland Restoration*

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The key element of the Division of Coastal Managements's (DCM) strategy for improving wetlands protection is the development of a Wetlands Conservation Plan for the North Carolina coastal area. The Wetlands Conservation Plan includes a wetland restoration component designed to target proactive wetland restoration efforts and to increase the ecological effectiveness of compensatory mitigation.

Certain considerations shaped the approach and methods used in developing a procedure for identifying and prioritizing potential wetland restoration sites. The procedure needed to fit within the context and objectives of the Wetlands Conservation Plan for the North Carolina coastal area as described above. This context, and the opportunities and limitations it imposed, had considerable influence on the specific procedure developed.

Since we are dealing with a large geographic area, it was obvious from the outset that a method was needed that could be applied to large land areas without site visits to each potential wetland restoration site. This ruled out the many site-specific functional assessment methods that have been applied in other contexts. Almost out of necessity, a Geographic Information System (GIS)-based approach was needed. That meant the procedure would have to use information available in GIS format and make use of GIS analytical techniques.

A primary consideration was that the procedure be ecologically sound and scientifically valid, based on the best information available about restoration ecology and the functions of wetlands. It needed to be based on fundamental principles of wetlands and landscape ecology rather than on arbitrary or subjective decisions. Therefore, a GIS-based, landscape-scale procedure was developed for inventorying and prioritizing candidate wetland restoration sites based on their potential ecological significance throughout a region using fundamental ecological principles to determine the specific wetland functions they might perform within their watersheds.

Finally, the procedure was to be watershed-based. This requirement was primarily because consideration of a restored wetland's potential role in its watershed is the soundest basis for determining its ecological significance, but also because the other components of the Wetlands Conservation Plan, including wetland mapping and functional assessment of existing wetlands, are based on watershed units. The watersheds being used are 5,000 to 50,000 acre hydrologic units delineated by the Natural Resource Soil Conservation Service (NRCS).

The functional assessment of wetland types and the prioritization of wetland restoration

sites is based on three major functions: water quality, hydrology, and habitat. Each of the primary functions of wetlands is actually a combination of separate more specific subfunctions. Water Quality subfunctions include the removal of nonpoint source pollutants from surface runoff and the removal of suspended or dissolved pollutants from flooding streams. Hydrology subfunctions include storage of precipitation and surface runoff, storage of floodwater from streams, and shoreline stabilization. Habitat subfunctions include providing habitat for both terrestrial species and aquatic life. The extent to which a wetland performs these different subfunctions is determined by various properties of the wetland and its surrounding landscape. These properties are called parameters in the procedure. Parameters make up the levels in the hierarchical structure that are evaluated based on fundamental ecological considerations in the scientific literature.

The wetlands mapping work has been the basis for two pilot projects. The first pilot project involved a Memorandum of Agreement (MOA) with the NCDOT which used our GIS mapping methods to identify and prioritize potential wetland restoration sites for a Bypass and Bridge compensatory wetland mitigation project in Craven County. The second project involved wetland and restoration site mapping in an upper coastal plain county (Cumberland County). The Cumberland County project demonstrated the ability and applicability of DCM's methods to map existing wetlands and potential wetland restoration sites in areas other than the lower coastal plain counties under CAMA jurisdiction.

**Wetland Restoration at Pocosin Lakes National Wildlife Refuge**

An 18,000 acre wetland restoration site is located within the Pocosin Lakes National Wildlife Refuge and is presently owned and managed by the US Fish and Wildlife Service (Service). Prior to public ownership, the area was cleared, ditched and drained for use in commercial farming and in anticipation of being mined for a peat-methanol plant. In the colonial period the demonstration site was part of the East Dismal Swamp, 20,000 acres of peat and muck swamp. The proposed peat mining fueled a long lasting environmental debate (in part based on concerns about mercury contamination of surface waters).

Ultimately proposals for peat mining were abandoned and the area was transferred to Service ownership in 1991. Although the transfer of property to federal ownership ended the likelihood of peat mining in the area, the site remained devoid of a natural community of plants and animals and the water draining from the site exceeded NC water quality standards for mercury. Further, the runoff was likely contributing to eutrophication downstream. Runoff from the designated area flows south into Clark-Mill Creek, and eventually Pungo River These surface waters are classified as nutrient sensitive as is the whole Tar-Pamlico Basin. The Tar-Pamlico River Basin Wide Water Quality Management Plan indicated that Clark Mill Creek and the upper end of the Pungo River do not attain their water use classification. Thus, there is a clear need to bring drainage waters into compliance with state standards and to reduce nitrogen loading.

Peat in the project site and surrounding area (the old East Dismal Swamp) has developed over the last 9000 years since the Wisconsin period of glaciation. Several factors contributed to its formation: low relief, high sea level, and the development of dunes along the Pungo River, which blocked drainage. Under these conditions vegetation generated organic material faster than it could decompose and a thick layer of peat was formed slowly over thousands of years. The peat retained nitrogen that had been stored by growing plants and eventually created a very large bank of nitrogen. When peatlands are ditched the water table is lowered, the peat is aerated which improves microbial activity resulting in decomposition and nutrient release. For illustrative purposes as to the magnitude of non-point pollution that could result from the decomposition of the peat layer consider the following comparison. The City of Raleigh discharges 226,000,000 liters/day (60 mgd) wastewater with a concentration limit for total nitrogen of 6.0 mg/l resulting in a nitrogen discharge of 1,364 kg/day or 497,860 kg/yr. The peat on every 640 acre section of the 18,000 acre restoratio area contains an amount of stored nitrogen equal to 75 years of the City of Raleigh's wastewater discharge.

The peat also sequestered mercury from the rain cycle, similar to the way an activated charcoal filter cleans water by accumulating contaminates. In 1996, the average concentration of mercury in rainfall at the demonstration area was 8.79 ppt (National Atmospheric Deposition Program). Total mercury occurs in the peat in concentrations of 83 ppb, approximately 9000 times the concentration in rain. Similar (within one order of magnitude) concentrations of mercury are found in peat from other bogs in North America and Denmark. Assuming a constant rate of atmospheric deposition (estimated at 9677 ng/m2 for the area by the National Atmospheric Deposition Program) and a peat depth of 2.44 meters approximately 7500 years of rainfall would have to be filtered at 100 percent efficiency to produce the amount of mercury currently found at

the demonstration site. The restoration site's peat is thought to be about 9,000 years old. Peat bogs are apparently very efficient natural filters of mercury.

Clearing and draining the peat bog for farming in the 1970's aerated the peat, causing it to decompose and release its mercury content. Subsidence from carbon loss after ditching has been estimated at 2.7 cm/yr for the first two years and 0.4 to 1.2 cm/yr thereafter. Total mercury concentrations in surface water reported for the site have been variable. The highest total mercury concentrations recorded after ditching ranged from 800 to 1100 ppt and subsequently have ranged from less than 2 to over 200 ppt in subsequent reports. The surface water quality standard for mercury is 13ppt.

In April 1995, an experiment was established in a block (0.5 x 1.0 mile) near the center of the area targeted for wetland restoration. Atlantic white cedar, pond pine, bald cypress, were planted with two tree spacings (8 ft x 8 ft, and 10 ft x 10 ft). Some plots were left unplanted to serve as controls. Plots were 2.0 acres, and there were 70 plots, totalling 140 acres. Undisturbed border areas separated plots, and riparian strips were maintained along v-ditches and canals to protect waterways. A Ghallager electric fence was installed to exclude deer.

Survival of cypress, white cedar, and pond pine was 63%, 25%, and 43%, respectively, after 2 years. Average height of bald cypress, Atlantic white cedar, and pond pine was 25, 12, and 13 inches, respectively. Deer browsing was severe despite the fence. Success with Atlantic white cedar will likely demand additional protection against deer.

Depth to water table averaged ~10 inches. Water samples were collected quarterly from seven groundwater wells, and 12 surface water sites in canals surrounding the experimental area. Total Kjeldahl N was 1.8 to 3.5 mg/liter in surface water, with nitrate and ammonia usually $\leq$ 0.01 and 0.2 mg/liter, respectively. Values for nitrate, ammonia, and TKN in filtered groundwater were $\leq$ 0.02, 0.6 to 1.6, and 2.8 to 13.6 mg/liter, respectively. In 1996, mercury concentrations in unfiltered surface water samples were 5.7 to 22 ppt. The only samples higher than the State standard of 13 ppt were taken in the winter; others were within the range of values for rainfall. Filtered groundwater contained 10 to 23 ppt , with highest readings during the winter.

In the the future, higher water levels will hopefully reduce levels of N and mercury in surface and groundwater. In addtion to the 640-acre research area, another 1330 acres have been replanted to primarily bald cypress and Atlantic white cedar. Plans are underway to restore wetland hydrology on the remaining acreage by installing a total of 14 water control structures on canals that drain the area.

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# *Managing The Albemarle-Pamlico Sounds*

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# FISHERIES SESSION

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## SUMMARY

Many persons concerned with management of the coastal fisheries of North Carolina have concluded that the existing management system is in chaos, driven by the most recent crisis. The legislatively appointed Commercial Fishing License Moratorium Steering Committee generally agreed with that assessment when it submitted its final report in November, 1996, recommending that Fishery Management Plans (FMPs) become the central focus for future management of the coastal fisheries. The goal of an FMP program would be to ensure the long-term viability of our important coastal species and fisheries. The difference between fisheries and species is important: fisheries include both fish and people. State FMPs would provide many important benefits:

- provide a central location for all relevant information, publicly available
- bring commercial and sport fishermen together as participants in FMP preparation
- provide policy statements regarding goals, objectives, and strategies
- provide facts as the basis for management decisions
- ensure consistency for resource users over time.

An FMP would apply to species, geographic areas, and/or fisheries. Plans would include background information, issue identification, goals and objectives, action options, recommendations for management actions and research, and means to measure achievement. We now have two state plans, and we are affected by more than 25 interstate and federal FMPs. The Marine Fisheries Commission (MFC) would establish priorities, a schedule, and guidelines, as well as appoint advisors for each FMP. A given draft plan would require about 4 - 6 months to prepare. The MFC would hold public meetings, revise the draft, and approve it. Any recommended rules would go through the full public notice and hearing process which can extend for 18 months or more. Other implementation steps could include monitoring, research, enhancement, and development.

Sufficient data currently exist to prepare about 12 FMPs, and information should be sufficient for three more FMPs within 2 - 3 more years.

To implement the FMP process several steps are needed:

- establishment of priorities, guidelines, and a schedule by the MFC
- organization of advisory councils by the MFC
- staff and operating funds to actually prepare FMPs
- staff and operating funds to gather data for FMPs on additional species and fisheries.

# Ecosystem Effects of Estuarine Trawling

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Commercial fishing practices affect estuarine ecosystems via their impact on the community of organisms living on or within bottom sediments (= the "benthos", "benthic community"), the inadvertent capture of non-target species of fish ("bycatch"), and the physical alteration of the habitat. The magnitude of the effects are dependent upon the: (1) physical properties of the ecosystem (habitat types, water quality, hydrography); (2) biological properties of the ecosystem (fish and benthic invertebrate community structure, and seasonal cycles of abundance); and (3) temporal and physical scale of fishing activities and the fishing methods employed. This presentation concentrates on the potential effects of trawling and similar fishing practices on the Albemarle-Pamlico estuarine ecosystem, and includes recommendations for management.

The critical physical features of the Albemarle-Pamlico estuarine complex are as follows: (1) it is a lagoonal system created by the presence of barrier islands which permit only a limited exchange with the Atlantic Ocean; (2) salinity ranges from brackish (<0.5 parts per thousand) to polyhaline (>30 parts per thousand; (3) unvegetated, fine sand sediments predominate; (4) water circulation is wind-driven; (5) basin size is large and shallow; and (6) water temperature and dissolved oxygen concentration show large seasonal variation. These features combine to make the Albemarle-Pamlico system physically rigorous, and subject to significant levels of natural disturbance in the form of temperature, dissolved oxygen, and turbidity.

Trawling can modify the living structural components of the benthos by damaging reefs of sessile organisms such as oysters. Trawling can also modify the nonliving structural aspects of the benthos through resuspension of sediment and its subsequent redeposition. These effects of trawling are in part related to the type of gear used. Dredges and trawls typically liquify the upper layers of the sediment. The extent of this liquification is dependent upon the depth of penetration of the dredge or trawl. Otter trawls and scallop dredges can penetrate muddy sediments to depths of 10 cm; shrimp trawls penetrate muddy sediments less than any of these gears.

Trawling can potentially stimulate primary productivity if nutrients stored in the sediments are released into the water column as the sediments are resuspended by the action of the trawl. Trawling could also inhibit primary productivity by reducing the depth of the euphotic zone as a result of increasing the turbidity of the water. This aspect of trawling impacts is virtually unstudied.

Trawling can act to increase secondary productivity as predators and scavengers feed on the fauna injured from fishing activity, or in some other way made vulnerable to predation. Secondary productivity could be decreased as a result of inflicting fatal injuries on benthic organisms, or by impairing foraging success of visual predators.

The shrimp fishery is the most important contributor to bycatch in North Carolina, and in the southeastern Atlantic region in general. The bycatch problem results from the large size of the fishery (number of vessels), the large areal extent of North Carolina's waters affected by the fishery, and the small, non-selective mesh size of the nets. The estimated shrimp bycatch, based on a 1:4 catch weight ratio of shrimp to fish, is about 10 times larger than the reported landed bycatch of the flynet and long haul fisheries. Approximately 80% of the annual North Carolina shrimp landings is derived from fishing estuarine waters.

Bycatch mortality of juveniles of Atlantic croaker (*Micropogonias undulatus*), red snapper (*Lutjanus campechanus*), summer flounder (*Paralichthys dentatus*), and weakfish (*Cynoscion regalis*) has been attributed as a central cause in the decline in the populations of these species in the Southeast Atlantic. However, there is no study to date which actually demonstrates a direct causal link between bycatch mortality and the population status of a particular species. Nevertheless, it is likely that the ecological consequences of bycatch are profound, pervasive, and complex. Many of the fish species vulnerable to bycatch are predators of other fish, or predators of benthic invertebrates, or are competitors with other fish for various food resources. As a result of the complexity of these trophic relationships, a reduction in the abundance of a single fish species could produce a multitude of trophic consequences, which ripple throughout the ecosystem.

Concern over the potential ecological and economic impacts of shrimp fishing bycatch has fueled research in bycatch reduction devices (BRDs) that act to exclude non-target species from the catch. Separators recently designed and tested in North Carolina reduced fish bycatch by 50-60%, and reduced the shrimp catch by 1-4%. BRDs are now required in all shrimp trawls in North Carolina. Other alternatives to reducing bycatch which are currently under investigation are modifications in net mesh size, mesh shape, and alternative net and gear designs (e.g. skimmer trawls).

Management Recommendations

Management has the option of : (1) no action; (2) banning trawling from all estuarine waters; (3) restricting trawling by gear type; (4) restricting trawling purely by habitat type (e.g., submersed grass beds, oyster reefs); (5) banning trawling from selected, multiple habitat types which would then function as spawning and recruitment sanctuaries for surrounding areas subjected to trawling; and (6) restricting trawling by season, by the number of trawling days within a season, or by the duration of trawling per day. Additional research is necessary to enable management to select the most appropriate of these alternatives, based on a combination of sociological, economic and ecological knowledge and understanding. The following lines of research are recommended:

> Determine the effects of trawling on the recruitment, growth, diversity, and population dynamics of the benthic fauna. These animals provide a critical trophic link to many commercially important fish species.

> Measure the extent of trawling-dependent habitat modification--especially with regard to short term and long term alteration of water quality (e.g.dissolved oxygen, & turbidity) and the physical character of benthos. This information is critical to understanding the importance of trawling as an agent of disturbance relative to natural sources of disturbance such as seasonal cycling of water temperature (which affects dissolved oxygen concentration), and wind-induced water movement (which affects turbidity levels).

> Continue studies on the extent of the bycatch problem in the estuarine waters of North Carolina. Such studies should include more detailed information on the spatial and temporal distribution of species likely to be affected, especially by the shrimp fishery. Age-specific estimates of bycatch for important species are required to allow bycatch related mortality rates to be estimated.

> Delineate interspecific relationships among the different fish species occupying the estuaries and inlets of North Carolina. It is essential to understand how losses of one species as a result of bycatch-related mortality will affect the abundance and distribution of other species.

> Continue to refine the effectiveness of bycatch reduction devices (BRDs).

# Status of Bycatch Research in North Carolina

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Much of the bycatch research conducted during the past few years by North Carolina Division of Marine Fisheries (NCDMF) has been funded through the Albemarle-Pamlico Estuarine Study (APES) which is part of the USEPA's National Estuary Program. The APES study culminated in the preparation of a Comprehensive Conservation Management Plan (CCMP) which addresses issues of water quality, habitat loss, education, fisheries, and the overall enhancement of the Albemarle-Pamlico watershed. The CCMP was ratified by the governor and the USEPA in 1994. The CCMP contains a fisheries plan that addresses the issue of bycatch. The goal of the CCMP's fisheries plan is:

*To restore or maintain fisheries and provide for their long-term sustainable use, both commercial and recreational.*

As part of the implementation of this plan NCDMF was asked to start a gear development program. Development of new, more efficient fishing gear that minimizes bycatch is a valuable management tool that can help North Carolina realize this goal.

Bycatch and gear development research conducted by NCDMF in recent years has encompassed many commercial fisheries including trawl, flynet, long haul seine, pound net, pot and gill net fisheries. Due to the diversity of our commercial fisheries, management is often multifaceted and complex. Many other states consider North Carolina leaders in this field of research and utilize our experience to develop and implement gear related management strategies of their own. The development of a state funded gear development program would allow more flexibility for new research that would allow NCDMF to address problems unique to North Carolina.

NCDMF has recently secured funding for a three-year pilot program financed through federal funding under the Atlantic Coastal Fisheries Cooperative Management Act (ACFCMA). The three-year ACFCMA project, which is part of an Interstate Fisheries Management Program, will develop bycatch reduction alternatives for the long haul seine, pound net and gill net fisheries. Future research plans include:

1) Bycatch monitoring of various fisheries throughout the state. This will supply valuable bycatch data for stock assessments, which are required for current and future fisheries management plans.
2) Continue state-funded shrimp trawl Bycatch Reduction Device (BRD) research.
3) Secure federal funding to continue gear development research and begin complementary survivability research.

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During its 1996 short session, the North Carolina General Assembly passed House Bill 1076, which "created within the Sea Grant College Program at the University of North Carolina, the Fishery Resource Grant Program." The Fishery Resource Grant Program, the first program of its kind in the U.S., was established in 1994 by the General Assembly. The purpose of the program is to protect and enhance the state's coastal fishery resources through individual grants in the following areas:

1) New fisheries equipment or gear;
2) Environmental pilot studies, including water quality and fisheries habitat;
3) Aquaculture or mariculture of marine dependent species; or
4) Seafood technology.

During the first two years, the program was administered by the NC Division of Marine Fisheries, which awarded 78 grants for a variety fishery enhancing projects to fishermen, processors, culturists and scientists. A basic principal of the program is that those in the fishing industry often have the best ideas for enhancing our fisheries, but do not have the financial resources to experiment with innovations. In addition, it is often difficult for the fishing public to compete in grantsmanship with academics or fisheries managers. The General Assembly made it clear that the intent of the legislation was to invest in the ideas of the fishing public through fair and competitive methods.

A discussion of the principles of operation, priorities for funding, 1997-98 schedule and summary of the 34 1997 approved applications will be discussed.

# APES and Fisheries:
# Integrated Restoration Planning

Douglas N. Rader, Ph.D.
Senior Scientist and Co-Director
North Carolina Environmental Defense Fund

The protection and restoration of estuarine-dependent marine fisheries is among the most complex of all management challenges. The re-establishment of healthy populations of such fish (and the healthy marine ecosystems in which they occur) depends not only on the development and implementation of adequately conservative fishery management programs, but also on the implementation of effective programs for the protection and enhancement of estuarine fish habitat and water quality good enough to support inshore fishery production. These three elements have historically been managed through bureaucratically distinct programs (the marine fishery, coastal landuse and water quality programs, respectively).

The Albemarle-Pamlico Estuary Study (APES) provided an excellent framework for integrated problem solving in North Carolina's estuarine-dependent fisheries. Although the APES Comprehensive Conservation and Management Plan (CCMP) -- and this conference! -- breaks fisheries, habitat and water quality back down into three management areas, all three are being addressed, and at the same time. Thus, good potential exists for comprehensive management of North Carolina's estuarine-dependent fish stocks, at the same time that the new amendments to the Magnuson-Stevens Act work to encourage expanded attention to fish habitat issues.

Even more important is the realization that North Carolina's fish stocks and fishing industry is imperiled by the declines in stocks and enhanced fishing capacity associated with the collapse of the New England groundfishery and Florida's net bans. The moratorium in the issuance of commercial fishing license which resulted, and the comprehensive fishery management recommendations which have come from the associated Moratorium Steering Committee process, allow a perfect opportunity to work with the General Assembly and the citizen boards responsible for rulemaking to protect fish, water quality and coastal lands to design a truly integrated fishery management program.

The greatest strength of the Albemarle-Pamlico Estuarine Study (APES) has been its focus on integrated problem solving. This strength is clearly reflected in the APES CCMP, where basin-by-basin restoration plans are recommended for all APES watersheds, including those most critical for marine fishery production. APES' greatest weakness remains the inability or unwillingness of responsible agencies to take this idea and implement it. The once-in-lifetime congruence of favorable political factors which currently exists provides a unique opportunity to use North Carolina's Pamlico Sound -based estuarine fishery as a national model for how to effectively manage such fisheries.

Spatiotemporal variation in postlarval recruitment of the blue crab in North Carolina: Potential "source" habitats driving the Pamlico-Albemarle fishery

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Blue crabs, like many marine organisms, exhibit annual fluctuations in population abundance. One of the goals of fisheries management is to predict population levels, which in turn necessitates knowledge of what causes fluctuations in abundance. Population variation can be explained by regulatory factors at many levels throughout the blue crab's life cycle. Much of the variability, however, can be attributed to stochastic events that occur in the early life history stages. Our study addresses the distribution patterns of these early stages, how they are related to physical processes, and how these patterns fit together in determining sound-wide population dynamics of the blue crab within the Albemarle-Pamlico system.

Mating of blue crabs occurs in late spring/early summer within the estuary. The females then move to the inlets where they release their larvae, which in turn are transported to the continental shelf. They remain on the continental shelf for approximately 30 days, developing through 4-5 larval stages. After developing into a postlarval stage, the crabs move back into the estuary, being carried by both tidal and wind-driven surface currents. They will subsequently settle into a nursery habitat where they will develop through several juvenile stages, eventually reaching an adult state after approximately 18 months.

The Albemarle-Pamlico system is unique in that it is relatively shallow and has very little tidal influence (except near the inlets). Transport of the postlarvae from offshore into the estuary is primarily due to wind-driven surface currents. Hydrodynamic models of water level heights

have been used to make predictions of postlarval transport and therefore the distribution of these early stages. The current study was undertaken to test these hydrodynamic predictions, refine models of larval transport, and identify critical nursery areas and habitats.

Blue crab postlarvae were collected throughout the Albemarle-Pamlico Sound system during peak settlement from August-October 1996. High school students assisted us in collecting daily settlement data from nine locations.

Highest abundance of blue crab postlarvae were found at the eastern inlets, whereas the inland stations received extremely low numbers. These patterns of settlement corresponded to the hydrodynamic predictions of reduced postlarval supply to Albemarle sound. Noteworthy, was an episodic settlement peak along the western shore of Pamlico Sound during Hurricane Fran, highlighting the importance of stochastic storm events. Within this western region, blue crab postlarvae utilized alternative habitats (shallow, detritus areas) in the absence of their preferred substrate, eelgrass.

These settlement patterns suggest a potential limitation of postlarval supply to large portions of the Pamlico and Albemarle Sounds, indicating that expansive seagrass beds behind the Outer Banks may serve as a "source" of crabs for the entire sound system. The dependency on an isolated region of nursery habitat has major implications to the Albemarle-Pamlico blue crab fishery. Storm events, which have different wind patterns than those typical for the season, and transport postlarvae to regions with alternative settlement and nursery habitat, may expand the nursery potential and estuarine production of juvenile blue crabs. The frequency of these storm events during the blue crab recruitment period may therefore explain much of the variation in year-class strength.

# *Managing The Albemarle-Pamlico Sounds*

**"Today's Accomplishments / Tomorrow's Challenges"**

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# STEWARDSHIP SESSION

**CLEAN WATER MANAGEMENT TRUST FUND**

Dr. David McNaught, Executive Director
Clean Water Management Trust Fund
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The Clean Water Management Trust Fund (CWMTF) was established by the North Carolina General Assembly in 1996 (Article 13A; Chapter 113 of the North Carolina General Statutes). At the end of each fiscal year, 6.5% of the unreserved credit balance in North Carolina's General Fund will go into the CWMTF; that amounted to $47.1 million in first year monies, with an additional amount of $30 million or more anticipated for 1997 - 98. The potential for this initiative is immense; it is imperative that the state of North Carolina capitalize on the opportunity.

Revenues from the CWMTF will be allocated to help finance projects that specifically address water pollution problems. The CWMTF is dedicated to the enhancement and preservation of surface water quality throughout North Carolina; in this, its prime directive, the enabling legislation is unambiguous. CWMTF will fund projects that (1) enhance or restore degraded waters, (2) protect unpolluted waters, and/or (3) contribute toward a network of riparian buffers and greenways for environmental, educational, and recreational benefits.

Nonetheless, there remains considerable latitude regarding the specific policies, processes and structures that will guide the allocations of the Fund. The 18 member, independent CWMTF Board of Trustees - - appointed by the Governor, President Pro Tem of the Senate, and Speaker of the House - - has full discretion and responsibility over the allocation of moneys from the Fund as grants. The Trustees have developed provisional criteria and guidelines which will be the basis for evaluating grant applications during the initial funding cycle. (See attachment).

Ideally, a set of wholly objective criteria could make the application and granting process equitable, predictable and relatively easy to administer. However, given the diversity, complexity and uncertainty of the causes and the potential cures for water pollution, the Trustees recognize that progress towards this goal will be gradual and incremental at best.

The provisional guidelines are designed so that CWMTF allocations will be as efficient as possible: the Trustees will favor projects which (1) deliver the "biggest bang for the buck", (2) are supported by and integrated with other local community programs, (3) are timely, (4) supplement, but do not supplant or duplicate, other water quality initiatives, and (5) do not have other sources of sufficient funding. The Trustees also recognize that throughout North Carolina the most intractable water quality problems are the result of non-point pollution; and therefore, projects that reduce, abate or avoid such pollution may offer the greatest promise. Another important point is that CWMFT is a statewide initiative. Coastal plain, CWMTF grants will be distributed in the mountain and piedmont regions as well.

North Carolina's highly regarded basinwide planning process provides and excellent framework for assessing potential CWMTF projects. These plans offer a good starting point by identifying existing or potential water quality problems. Demonstrable evidence of water quality

enhancement or protection should be available for virtually every dollar invested by the CWMTF. Moreover, CWMTF recognizes several ancillary and desirable objectives including: the protection of high quality wildlife habitat, regional integration of ecological systems and environmental education or planning. All funded projects should be monitored for anticipated, meaningful and water quality outcomes.

CWMTF is new. Potentially, it can foster the next generation of water quality protection program in North Carolina; it offers unprecedented support of non-regulatory, incentive-based actions to deal with water quality concerns. Of course, the CWMTF will not be a substitute for effective water quality regulation. Regulatory policies and programs are necessary, although insufficient, strategies for maintaining or restoring water quality. While the CWMTF cannot replace regulation, it should complement and extend the effectiveness of regulation.

CWMTF will be an innovator, stimulating "big picture" responses to water quality problems by encouraging responsible integration of complementary strategies (e.g. regulation, acquisition, easements, best management practices or technologies, etc.) Only through integrated, community-wide landscape management can specific watersheds be protected. The Trustees' goal is meaningful, long-term water quality protection, not interim or superficial environmental gains.

While innovative, the CWMTF does not seek to support "highly experimental" projects or projects that "reinvent the wheel". One shared ambition of the Trustees is that the Fund be more than merely an extension of existing programs. It is clear that in order to maintain and restore the level of water quality that North Carolinians deserve and expect, we must accomplish more than we would be able to do with traditional programs alone. This ambition is, of course, in an early stage of development and, therefore, the specifics will emerge over time through collaboration with our client base - - local governments, conservation non-profits and other State agencies. Gradually, this interaction should stimulate the evolution of even more efficient strategies to protect or restore water quality in our rivers, lakes and estuaries.

# STATUS OF
# NEUSE RIVER BASIN ENVIRONMENTAL EDUCATION STRATEGY

**Office of Environmental Education**
**Department of Environment, Health, and Natural Resources**
**December, 1996**

## RIVER BASIN AWARENESS THROUGH UTILITY BILL INSERTS

**Initiative:** One or two utility bill inserts a year for two years per participating utility will reach every home or business in the state that has electric service with information about "Your Ecological Address" and "Know Your River Basin". Other utility customers statewide will receive a number of mailings from a variety of sources such a electric membership cooperatives, local water and sewer bills and tax bills.

**Key Players:** CP&L, Duke Power, North Carolina Power, towns and cities through the League of Municipalities, counties through the Association of County Commissioners, ElectriCities, OWASA, Lower Neuse Basin Association, City of Raleigh, TJ COG (Homebuilders Association)

**STATUS:** Utility bill Inserts appeared in utility bills to over 2 million households statewide in late summer - July, August, September. The next mailing is anticipated to be April, 1997. The four mailings from the three utility companies have a cost-of-postage value alone of over $1.6 million.

## RIVER BASIN RESOURCES MADE AVAILABLE TO CITIZENS THROUGH NORTH CAROLINA LOCAL PUBLIC LIBRARIES

**Initiative:** The utility bill inserts "point" to "your local library" for more information. Local libraries will serve as one of many community resources to provide river basin information. (River basin information is also made available upon request to K-12 school media centers and to North Carolina's 120 Environmental Education Centers) The State Library Director, in cooperation with DEHNR, is placing state river basin maps, brochures entitled "Know Your Ecological Address", the *Citizens Guide to Neuse River Basin,* the *Neuse River Basin Supplement to the Teacher's Guide*, and information on availability of river basin management plans and other river basin resources in all 378 local public libraries to assist them in responding to citizen inquiries.

**Key Players:** The State Library Director in the Department of Cultural Resources, local public libraries, DEHNR, and the approximately 55 contributors to two of the publications: the *Citizens Guide to Neuse River Basin* Information and the *Neuse River Basin Supplement to the Teacher's Guide.*

**STATUS:** The State Library mailed the first "alert" and river basin resources to the 378 local public libraries in April 1996. Follow up mailings have been made including posters, river basin maps, and "Know Your Ecological Address" brochures. An Environmental Education Trust Fund being proposed will support public libraries' acquisition of quality environmental education resources.

## RIVER BASIN ENVIRONMENTAL DATA MADE ACCESSIBLE TO TEACHERS AND STUDENTS FOR CLASSROOM ACTIVITIES

**Initiative:** Environmental Data specific to the Neuse River Basin has been placed on CD-ROM in computerized mapping format (GIS). Selected teachers met for five days in June 1996 to develop accompanying classroom activity guides which have been published along with the CDs for wide distribution.

**Key Players:** 30 Science, math, social studies and language arts teachers, NCSU, Department of Public Instruction, DEHNR, Center for Geographic Information and Analysis (CGIA)

**STATUS:** Master teachers met June 24 through 28, 1996 to be trained in using the Neuse River Basin Data in GIS format and to develop classroom activity guides. CDs were pressed prior to that time. Writing, design, and publication of activity guides were completed in time for training sessions to be held at the January 23-25, 1997 Environmental Education Conference to be held at the Sheraton Imperial at the Research Triangle Park.

In addition, grant funding has been successfully sought from the US EPA in the amount of $80,000 to fund two more week long teacher training workshops the summer of 1997.

This program was selected for presentation at the 1996 national conference of the North American Association of Environmental Educators in San Francisco. North Carolina's program is a popular model and pilot for other states and countries.

## BIG SWEEP LITTER DATA COLLECTION TO BE COLLECTED AND CALCULATED BY RIVER BASINS

**Initiative:** For the first time, the North Carolina Big Sweep program included the river basin designation on each of the data collection cards compiled by approximately 12,000 volunteers at over 500 sites across the state. Volunteers not only learned the river basin in which they are working, but also acquired an understanding for how the aquatic litter in their river basin compares to others in the state.

**Key Players:** First Citizens Bank, RJ Reynolds Tobacco Company, six TV stations (WITN, WLOS, WSOC, WWAY, Fox 8), Duke Power, Glaxo Wellcome

**STATUS:** Big Sweep takes place in September each year, and publicity promoting volunteer participation in the waterway cleanup began in earnest July 1, 1996. Hurricane Fran has an impact on the Big Sweep Program, but plans are to continue the river basin awareness aspect.

## "DO YOU KNOW YOUR RIVER BASIN?" STATEWIDE PUBLIC SERVICE ANNOUNCEMENT FOR TELEVISION

**Initiative:** Four 30 second television PSAs involving children talking about their "ecological address"were produced by the Agency for Public Telecommunications -- one each for the Catawba, French Broad, Cape Fear and Neuse River Basins. The educational message refers viewers to their local library for more information.

**Key Players:** North Carolina Wildlife Federation and the DEHNR Office of Environmental Education provided funding for the initiative and the Agency for Public Telecommunications produced it for distribution to cable TV.

**STATUS:** The PSAs were distributed to TV stations in late May, 1996. In October of 1996 the PSAs were recognized by the International Television Association with its Silver Reel Award.

## DOT BRIDGE SIGNS AND RIVER BASIN BOUNDARY HIGHWAY SIGNS DENOTING THE NAME OF THE RIVER BASIN

**Initiative:** Using the Neuse River Basin as a pilot, DEHNR has worked with DOT Traffic Engineers to identify river basin boundary line crossings on interstate, primary and secondary roads, and bridge signs on interstate, primary and secondary roads to inform travelers of the river basin in which they live, work and attend school.

**Key Players:** DOT, Legislature, local governments, river basin organizations, DEHNR

**STATUS:** DOT began erection of Neuse River Basin signs at 38 locations in 12 counties in the Neuse River Basin in November 1996. Secretary Garrett, Secretary Howes, and Senator Beverly Perdue participated in a commemorative ceremony on December 18, 1996 in New Bern. This is a pilot project and is applicable to all river basins in the state.

## SOIL AND WATER CONSERVATION DISTRICT SIGNS AND PROGRAMS TO PROMOTE RIVER BASIN AWARENESS

**Initiative:** Soil and Water Conservation Districts are being encouraged to adopt the "River Friendly Farmer" recognition program and to use the award winner's sign as an educational tool to promote river basin awareness to passersby. S&WC is also considering ways to use existing "Soil & Water Conservation District" signs to indicate the river basin in each of their sign locations to raise awareness of travelers about which river basin they are driving through. In addition, efforts are underway to encourage the national theme of the nationwide Soil & Water speech, essay, and poster contests to be "Know Your Ecological Address" focusing on river basins.

**Key Players:** Soil and Water Conservation District Supervisors in 97 Counties, Soil & Water Conservation Commission, DEHNR Division of Soil & Water Conservation.

**STATUS:** Proposals are under consideration.

## STATE GOVERNMENT AGENCY MAILINGS PROMOTING RIVER BASIN AWARENESS

**Initiative:** DEHNR regulatory divisions conduct regular mailings to regulated publics which can be standardized to include river basin messages. In addition, postage meter messages can be tailored to promote river basin awareness. Divisions are planning inserts and river basin messages similar to those of the utility companies indicated above. About 30,000 pieces of mail per year could be involved from DEHNR. Other state agencies could consider similar initiatives.

**Key Players:** DEHNR

**STATUS:** Promoting river basin awareness through these avenues is under consideration.

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## RIVER BASIN RESOURCES

The following are resources available from the Office of Environmental Education, Department of Environment, Health and Natural Resources, Post Office Box 27687, Raleigh, NC 27611, 919-733-0711 World Wide Web URL http://www.ehnr.state.nc.us/EHNR/ee

Citizens Guide to Neuse River Basin Environmental Education Programs and Resources

Neuse River Basin Supplement to the Teacher's Guide to Environmental Education Programs and Resources.

River Basin map of the State

"Know Your Ecological Address" activity for Educators

Neuse River Basin Information on the World Wide Web Environmental Education Home Page.
Neuse River Basin Supplement to the Teacher's Guide,
Citizens Guide,
"Know your Ecological Address",
Statewide river basin map .

MANAGING THE ALBEMARLE-PAMLICO SOUNDS
"Environmental Education as an Environmental Management Strategy"
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Title: CAMA Land Use Planning Information Packets

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The Coastal Area Management Act requires that counties designated as "coastal" write a land use plan, while municipalities have the option of preparing a plan. Currently, all 20 coastal counties and over 70 municipalities have plans in place. The plans contain major sections on existing conditions, constraints to development including natural resources and community facilities, estimated demand (population versus community facilities and services), and policies on both development and conservation issues. The policy section of the plan deals with a community's attitude towards particular issue, such as growth impacts and infrastructure needs.

From the beginning of the land use planning program, DCM has provided technical and financial support for local land use planning. Over the past several years, numerous boards and committees have called for additional support for land use planning in coastal counties. The idea of a standard information packet to serve as an information base for the planning process was first promoted in 1993 by the Coastal Resources Advisory Council (CRAC). The need for the information packet was reiterated by the Coastal Futures Committee (CFC) in 1994. As a recommendation to improve the quality of the land use planning program, the CFC stated

> The Division of Coastal Management (DCM) should provide a standard package of background data, preferably on a geographic information system (GIS), to all local governments at the outset of a land use plan update. This could include information available from all relevant state and federal agencies, including population projections, economic and demographic trends, water quality information, land use, land cover, soils, wetland and hazard data.

Additional support for the packets was provided in the 1994 APES Comprehensive Conservation and Management Plan. The report emphasizes the importance of local and regional planning in economic development and environmental protection. Geographic data is an important tool in aiding local planning efforts. An APES management action on stewardship included the following:

> Provide to local governments affordable and accessible data from the state Geographical Information System for use in planning and public education within the region by 1996.

While geographic information distribution is primarily the responsibility of the Center for Geographic Information and Analysis, the Division has been able to meet the spirit of this management action in creating the information packets for the coastal counties and municipalities.

In 1995, the Division of Coastal Management began producing land use planning information packets. The packets contain information on issues which must be addressed in each CAMA land use plan. Each packet includes a data binder and set of 10+ maps, specifically tailored to each county or municipality. The data binder contains information on a myriad of issues, for example, demographics, natural and cultural resources, current solid waste and water supply plans submitted to the state, community facilities and building development. The planning packets are arranged in the order of the land use planning guidelines and include references to the administrative code addressing land use plan content. The table of contents and list of maps are included with the presentation summary. Please see the handout for a more thorough listing of the packet contents. The maps on the walls are examples of maps that are included in the packet.

It is the hope of the Division that these land use planning packets will supplement land use planning practices on the coastal plain. Land use plans have become increasingly more complex as the planning guidelines have asked local governments to address a greater number of issues with increased sophistication. The packets are designed to reduce the time spent in collecting data, while affording more time to be spent in formulating local policies toward resource and development issues.

Since the land use planning packets are in the third year of construction, they continue to evolve and change to meet the needs of the users. The first year packet was drastically different than the second year packet. Changes in the third year packet appear to be substantial, as well. The 1997 packets will include more complete information on shellfish resources and hazards, both technological and natural (e.g. flood plain, chemical facilities). As data sources are updated, new data sources are found, new planning issues arise and comments from the users are received, the planning packets will continue to evolve.

Attachments:
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# Watershed Education for Communities and Local Officials

by
Nancy M. White, Leon E. Danielson, and Gregory D. Jennings *

North Carolina's Albemarle-Pamlico Estuarine Study (APES) was initiated in 1987 as part of the Environmental Protection Agency's National Estuary Program to identify problems in coastal waters and develop management strategies to guide long-term protection of the region's resources. Results from the study were developed into the Comprehensive Conservation and Management Plan, or CCMP, which is divided into five action plans (water quality, vital habitats, fisheries, stewardship and implementation) with objectives and suggested management actions to address water quality problems. The APES CCMP was signed by the governor in November 1994, and many important components from that plan were folded into the basinwide program implemented by the North Carolina Division of Water Quality.

The North Carolina Division of Water Quality has noted in their basinwide plans that local communities and governments can play an important role in watershed management. However, there are logistical complications to this concept. First, technical data needed to quantify necessary watershed and water quality characteristics to support policy development is typically difficult to acquire and apply at the local level. Second, a mechanism for coordination between local governments in a watershed needs to be developed, so policies are watershed-based and multi-jurisdictional. The objective of WECO is to address these issues and empower local citizenry with the tools and mechanisms to protect water quality, support basinwide planning by supporting the development of knowledge-based policy at the local level.

The White Oak River watershed is the pilot study area for this project. The White Oak River watershed is one of four coastal river and estuarine systems which comprise the White Oak River Basinwide Water Quality Management Plan. The watershed is relatively undeveloped with wetlands comprising over at 52% of area. Only a very small portion of the watershed is urban (2%) and agriculture (11%). Despite this low-level of development, Division of Water Quality's draft basinwide management plan notes a 12% increase in shellfish closures due to fecal coliform bacterial contamination. The increase in closures are attributed to land disturbing activities associated with a 50% increase in human population in the watershed over the last ten years.

Land use is controlled by policy implementation at the local level. Decisions which determine the placement, density, and type of development can cause changes in surface hydrology, pollutant delivery and as a consequence, water quality. To attempt to offset these impacts, policy needs to be coordinated between localities in a watershed. To investigate methods to address these issues a project team was formed which involves members from the North Carolina Division of Water Quality, North Carolina Division of Coastal Management, North Carolina Division of Environmental Health - Shellfish Sanitation Branch, North Carolina Cooperative Extension, and an citizens' Advisory Board comprised of 25 citizens who are stakeholders in the White Oak River watershed.

The first task of this group was to agree upon priority water quality issues affecting the watershed. To do this, the group participated in consensus decision-making using formal facilitation and chose to address the impact of the Highway 24 causeway. As cited by the Blue Ribbon Advisory Council on Oysters (1995), there are areas on the North Carolina coast where past bridge and road construction has caused restrictions which affect flow, circulation, flushing, salinity levels. These conditions concentrate pollutants and extend the viability of fecal coliform bacteria. The group recognized the planned widening of the road as an unique opportunity to address these impacts.

Over the next 8 months, the Board reviewed technical material and historical maps, listened to the observations of long-time residents, interviewed experts, and discussed water quality goals and management strategies. The Board concluded that hydraulic alterations from the construction of the Highway 24 causeway and the Intracoastal Waterway altered circulation patterns, sediment movement, and salinity regimes resulting in a negative impact on water quality in the estuary and river. The Board concluded that these trends were affecting fish populations and shellfish habitat in the White Oak River estuary as compared to that observed many decades ago. In addition, they felt that design changes could be made to the roadway area to help mitigate these conditions.

As a consequence of these findings, the Board recommended the following;

1. To reduce freshwater inputs to the estuary and possible negative impacts of highway runoff on water quality, the Advisory Board recommends storm water runoff not be discharged and Department of Transportation (DOT) explore options to eliminate discharge into the waterways. At a minimum, discharge from Highway 24 should be directed south of the causeway. In addition, it is recommended that amelioration of the velocity, volume, and quality of that runoff be implemented, if feasible.
2. Historic maps show that prior to the 1930's the mouth of the White Oak River was open and unrestricted allowing free tidal flow. In 1932 and 1933, Department of Transportation and US Army Corps of Engineers (ACOE) projects closed approximately 80% of the mouth of the river and altered physical processes. The Advisory Board recommends that to restore salinity regimes, increase tidal circulation, and reduce sedimentation, DOT take actions to reopen the mouth of the river to the maximum extent possible. One option would be the creation of a north-south channel connecting the estuary with the sound near the current location of the Flying Bridge Restaurant on the Carteret County side of the river spanned by a bridge or connected by a culvert. Additionally, the Board recommends that DOT and ACOE access ACOE ecological restoration funds and collaborate to mitigate the impacts of this expansion and past actions.
3. All efforts to open the channel will not remain effective unless the State of North Carolina initiates an ongoing maintenance program. The Advisory Board recommends that a long-term maintenance program supporting improved circulation, reduced sedimentation and restored salinity regimes be developed and implemented.

The Board is in the process of presenting this material to their local governments to produce a collaborative, consistent, watershed-based policy. So far, this policy statement has been adopted by the Jones County commissioners, forwarded to DOT and USCOE for consideration, became part of the public record for the DOT public hearings, and a preliminary draft was included in the basinwide management plan. Review by Onslow and Carteret Counties is scheduled.

This project is developing a methodology for the protection of water quality at the local level by 1) investigating the use of GIS to link, characterize, and demonstrate watershed - specific technical water quality data; 2) researching and delivering technical material about water quality issues to the citizens, 3) facilitating the development of consensus-based management strategies and policy options; and 4) facilitating the formation and sustenance of collaborative, policymaking partnerships at the watershed level between communities, local officials and state agencies. It is the objective of this project to refine this methodology for application to other rivers and watersheds in an effort to sustain both aquatic and human environments.

# FOSTERING STEWARDSHIP -- AND SUSTAINABLE ECONOMIC DEVELOPMENT -- THROUGH ENVIRONMENTAL EDUCATION

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The mission of the Partnership for the Sounds, Inc. (PfS), is to stimulate local, sustainable, community-driven economic well-being within the Albemarle-Pamlico region through the promotion of eco/cultural tourism, environmental stewardship, and education.

PfS was chartered in 1993 as a non-profit organization. It is overseen by a Board of Directors comprised of representatives from local and state governments, businesses, education, environmental advocacy, and non-profit organizations in the Albemarle-Pamlico region. The focus area of Partnership activities includes Beaufort, Bertie, mainland Dare, Hyde, Tyrrell, and Washington counties.

The diverse groups represented by the Partnership were brought together by a common interest in developing environmental/cultural education facilities that would provide focal points for tourism in the region. With coordinated infrastructure improvements, the area could become an appealing destination to the rapidly growing ecotourism and heritage tourism markets. By helping develop that infrastructure, PfS hopes to foster an economic niche that celebrates and conserves the region's unique ecology and ways of life.

The state has appropriated capital and operating funds to the Partnership each year since 1993-94. Over $1 million has also been contributed to PfS projects by local governments, citizens, businesses, and philanthropies.

The Partnership is coordinating the development of six education-oriented sites and several other ecotourism-related projects on the Albemarle-Pamlico peninsula. Each will interpret different aspects of the regional ecosystem, and each will promote visitation to associated natural areas, historic sites, and other points of interest in the PfS area.

The six PfS sites are:

- The North Carolina Estuarium, located in Washington
- The Lake Mattamuskeet Lodge, located on the Lake Mattamuskeet National Wildlife Refuge near New Holland
- The Walter B. Jones Center for the Sounds, located in Columbia
- The Columbia Theater Cultural Resources Center, located in Columbia,
- The Roanoke/Cashie River Center, located in Windsor
- The Highway 94 Overlook, located in Tyrrell County

## The North Carolina Estuarium, Washington

Construction on the North Carolina Estuarium began in August 1996. Barring unforeseen problems or bad weather ,the facility should open to the public in November 1997. The Estuarium's focus is on North Carolina coastal estuarine systems as exemplified by the Pamlico Sound and the Tar-Pamlico River. Located on the waterfront in downtown Washington, the Estuarium will have direct access to the Pamlico River.

**Lake Mattamuskeet Lodge**

Refurbishment of the Lake Mattamuskeet Lodge has continued to the point where the facility is usable for meetings, gatherings, and short-term overnight use. Planned improvements for this year include a new heating system and hot water heater. A complete renovation plan for the Lodge was finalized with funds from an earlier appropriation; PfS continues to work closely with U.S. Fish and Wildlife Service officials in seeking federal funds to carry out the full plan. PfS will work on an exhibitry plan for the Lodge during the next year. The interpretive focus of the Lodge is the natural and human history of Lake Mattamuskeet, and the lake's role in the Atlantic Flyway for migratory waterfowl.

**Roanoke/Cashie River Visitor's Center, Windsor**

The Roanoke/Cashie River Center made excellent progress toward completion this year. A schematic site plan was developed, necessary permitting (e.g., Coastal Area Management Act) was initiated, and considerable site clean-up and preparation were performed. Renovation plans for the building that will serve as the Center are nearly finished and an exhibit scheme has been devised. A boardwalk and park area should be open to the public by the end of 1997, and the Visitor's Center should be open to the public sometime in 1998. The Roanoke/Cashie Center will focus on the vast floodplain and bottomland swamp system of the lower Roanoke basin. This system is the largest of its type east of the Mississippi River.

**Columbia Theater Cultural Resources Center**

The site for the Cultural Resources Center is the old Columbia Theater in downtown Columbia. In disrepair for many years, the building has had its physical integrity restored through Partnership funding. Complete renovation including the interior space should be completed by the Fall of 1997, and the facility should be available for public use by the end of the year. Design for the exhibitry is in preliminary stages. A grant has already been received from a private corporation for the development of a film about the history of logging in the region. The focus of the center is on human interaction with the environment on the upper Albemarle-Pamlico peninsula, especially as witnessed through the heritage of farming, fishing, and forestry.

**Walter B. Jones Center for the Sounds, Columbia**

A preliminary design scheme was completed for the Center for the Sounds through a previous appropriation. Since this facility would house the staff for the Pocosin Lakes National Wildlife Refuge and would be on USFWS land, federal funding will be necessary to complete the Center. The Partnership is working closely with USFWS to secure funding during this year's federal budget cycle. A previous appropriation was used to construct an interpretive boardwalk and outdoor classroom along the Scuppernong River in front of the Center site.

**Highway 94 Overlook, Tyrrell County**

Planned for a site just off Highway 94 as it runs between Columbia and New Holland, the overlook will serve as a link to encourage travel between facilities in Columbia and the Lake Mattamuskeet Lodge. The overlook will be a 30-foot tower that offers an excellent vista over 5 square miles of agricultural land, pocosins, and forests. Construction plans have been completed for the overlook and site preparation has begun. The tower should be operational by the end of 1997.

# *Managing The Albemarle-Pamlico Sounds*

**"Today's Accomplishments / Tomorrow's Challenges"**

* * * * * * * * * * * * * * * * * * * * *

# POSTER SESSION

# BASINWIDE PLANNING: AN IMPORTANT COMPONENT OF CCMP IMPLEMENTATION

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When the Comprehensive Conservation and Management Plan (CCMP) was adopted in November of 1994, one of its five primary goals was to "restore, maintain, or enhance water quality in the Albemarle-Pamlico (A/P) region so that it is fit for fish, wildlife and recreation." The first objective recommended to achieve that goal was to implement a comprehensive basinwide approach to water quality management. North Carolina has actively implemented the basinwide approach both in the A/P region and statewide.

Basinwide water quality management plans are being prepared for each of North Carolina's seventeen river basins and will be updated at five year intervals. Table 1, below, provides a summary of the status of basinwide planning for river basins in the A/P region. All but two of the basins in the A/P region have approved plans in place. The two remaining plans for the Chowan and Pasquotank basins will be completed by the fall of 1997. Statewide, thirteen plans have been approved by the NC Environmental Management Commission (EMC). For further information on North Carolina's basinwide program, contact either Alan Clark or Suzanne Hoover using the information above.

Table 1. Status of the Implementation of the Basinwide Program in the Albemarle/Pamlico Region (as of June, 1997).

| Basin | Date Adopted by EMC | Comments |
|---|---|---|
| Neuse | February 11, 1993 | DWQ is currently working on the five-year update for this plan. |
| Tar-Pamlico | December 7, 1994 | Five-year update to be prepared in the latter part of 1998. |
| Roanoke | September 12, 1996 | Final plans now available upon request. |
| White Oak | February 13, 1997 | It is anticipated that final plans will be available late this summer. (Note: only the eastern portion of this basin is in the A/P region.) |
| Chowan | Tentatively scheduled for presentation to EMC on September 11, 1997. | Draft plan currently under review. A public meeting will be held in Ahoskie, NC on June 16, 1997. Contact Suzanne Hoover at the number above for more details. |
| Pasquotank | same as Chowan | Draft plan currently under review. Public meetings will be held in Elizabeth City and Manteo, NC on June 16 and 17, 1997 (respectively). Contact Suzanne Hoover at the number above for more details. |

**Significant Natural Areas in the Albemarle-Pamlico Region: Protection and Priorities**

Division of Parks and Recreation
Natural Heritage Program
June 1997

In the four years since the Comprehensive Conservation and Management Plan for the APES region was developed, several high-priority natural areas have been protected through Natural Heritage Program registry, dedication, or acquisition.

Over 200,000 acres of high-priority conservation land in the APES region are protected through 126 natural area registries. A strength of the registry program is that it can be adapted to work for both public and private landowners. Registry relies on North Carolina's traditions of self-reliance and citizenship by recognizing property owners for voluntary action to safeguard the best that remains of our natural world.

While registry on public lands has been very successful, there are also abundant opportunities for private landholders to contribute to the protection of North Carolina's natural heritage. One registry, in particular, highlights the significant conservation gains that can be made when private landholders are encouraged to protect high-quality natural areas. In 1996, the Georgia-Pacific Corporation added twenty-two significant natural areas in North Carolina to the natural areas registry. Together, the Natural Heritage Program and Georgia-Pacific are developing management plans that will ensure the protection of these unique areas.

Important natural areas have come under protection through another program, the Natural Heritage Trust. Since 1993, the Natural Heritage Trust has funded the acquisition of over 8,000 acres in the Albemarle-Pamlico region by state agencies such as Wildlife Resources Commission, Division of Coastal Management, Division of Forest Resources, and Division of Parks and Recreation.

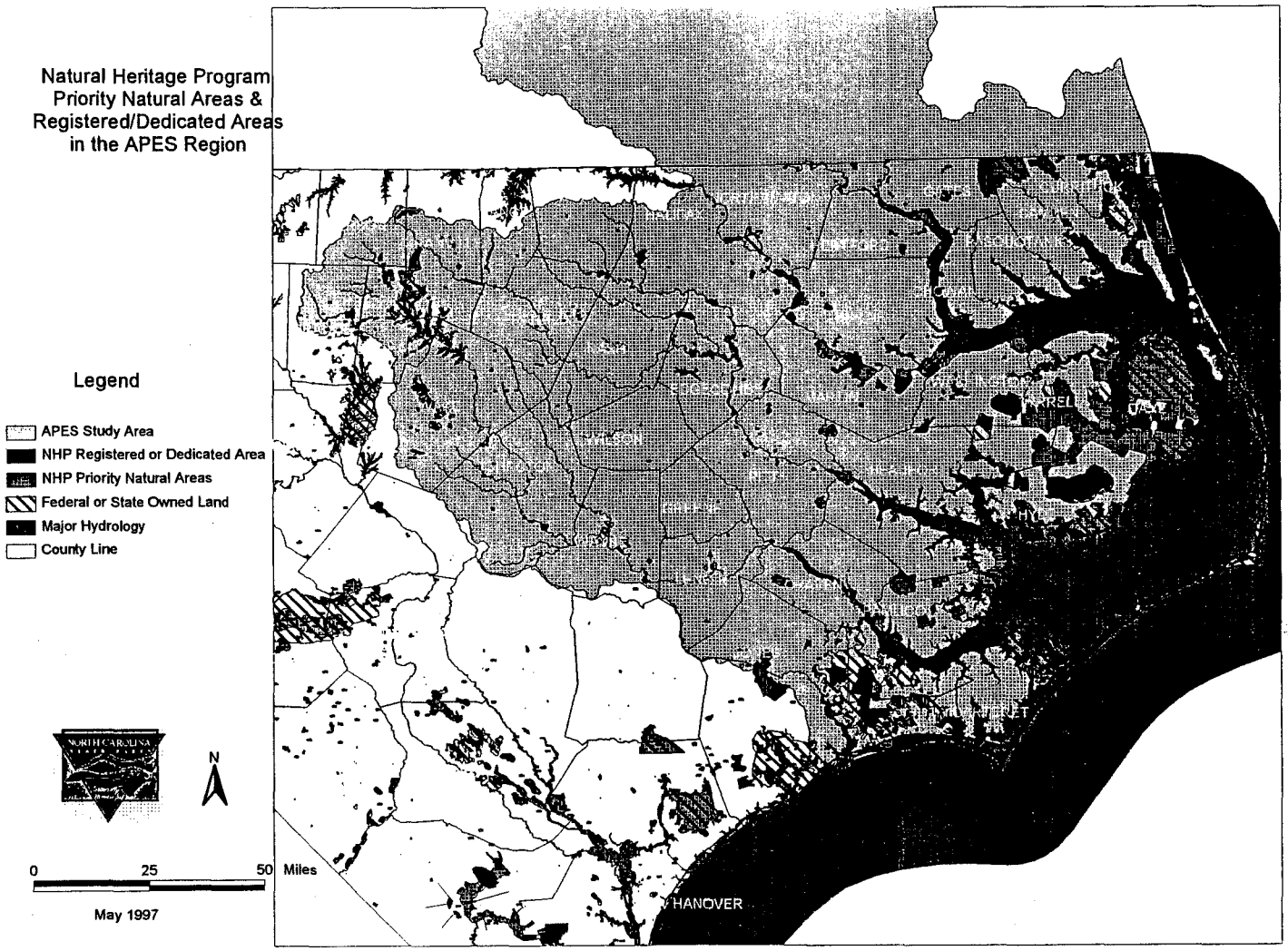
In addition, the Natural Heritage Trust has helped fund the acquisition of many of the dedicated nature preserves in the APES region. Dedication is a permanent form of protection, and it is intended to guarantee the protection of North Carolina's most exceptional natural areas. Eleven areas (encompassing over 20,000 acres) in the APES region have been dedicated as nature preserves. Some areas -- such as sections of Kitty Hawk Woods, Roanoke River, and William B. Umstead and Eno River State Parks -- are recognized and cherished by people across the state. Other areas are less well-known but serve their functions as nature preserves equally well.

To identify priorities for natural area conservation, the Natural Heritage Trust funds natural area inventories. Recognizing that sound protection is based on science, the Natural Heritage Trust has supported inventories to document the distribution of rare flora and fauna and natural communities. These inventories form the foundation for the identification of priority natural areas, those landscapes that warrant protection. Since the Comprehensive Conservation and Management Plan was developed in 1993, sixteen inventory projects have been funded in the APES region. Supplementing the natural areas inventories completed during the APES study,

these inventories have focused on special species such as peregrine falcons, diamondback terrapins, and amphibians, bats and reptiles of the lower Roanoke River basin.

Other Natural Heritage Program inventory projects that have been completed in the APES region since 1993 are inventories of the Croatan National Forest and several military installations, including Cherry Point Marine Air Corps Station, Camp Lejeune Marine Corps Base, and Dare County Air Force Range. In these large expanses of land, the Natural Heritage Program has identified a diversity of native flora and fauna as well as many rare and endangered species.

**Natural Heritage Program Priority Natural Areas and Registered/Dedicated Areas in the APES Region**



***MANAGING THE ALBEMARLE-PAMLICO SOUNDS: "Today's Accomplishments/Tomorrow's Challenges"***

Title: On-site wastewater training, management, demonstration, and research at the Vernon James Center, Plymouth, NC.

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Summary:

The land area surrounding the Albemarle and Pamlico Sounds contain extensive acreage of soils that are either provisionally suitable or unsuitable for conventional on-site wastewater systems. Despite poor soils, this area is experiencing continued growth. This growth often forces the use of alternative, innovative, and experimental wastewater technologies that are inherently more complicated than a conventional on-site system. Therefore, there is a need for advanced training of environmental health specialists, installers, operators, and CES agents in the installation and maintenance of these systems as well as the existing conventional systems. The On-Site Demonstration Facility located at the Tidewater Research Station/Vernon James Center (TRS/VJC) was established for this purpose.

Construction of the On-Site Demonstration Facility began in 1995. Currently, several systems are on display including a conventional gravity system, a low pressure pipe (LPP) system, a pressure manifold for a level site, two drip irrigation systems, a peat bio-filter treatment unit, a package plant, and several alternative trench designs. Additional demonstrations are planned and shall be installed as funding permits. The demonstration systems are sized for the soil conditions at the TRS/VJC according to NCDEHNR Laws and Rules for Sewage treatment and Disposal Systems. This allows for side by side comparison of space requirements for the various systems. Furthermore, the systems have been constructed above ground thus exposing the system components. This provides an opportunity to demonstrate the nature of the components, their operation, and maintenance requirements. The systems are demonstrated using clean water only. In order to illustrate how the systems are to be installed several cut-away trenches are utilized. The cut-away trenches illustrate the

amount of gravel within the trenches, proper placement of the distribution lines, and the amount of soil cover required.

The On-site Demonstration Facility acts as a major training area for agents, specialists, installers, and operators thus promoting the use of the most appropriate technologies for a given site. To date over 10 workshops, training sessions, or facility tours have been given at the site. The training often involves people with diverse backgrounds thus fostering a sense of cooperation. Furthermore, several of the training sessions focus on hands-on operation and maintenance. During these sessions individuals gain the knowledge and skills needed to assist in siting, designing, troubleshooting, and maintaining on-site systems.

The Facility has the potential to be a resource for interested public officials as well as individuals to in order to explain various options and illustrate the need for proper and timely maintenance and overall landuse planning. Overall this improved understanding should promote proper use and maintenance of on-site systems thus decreasing one source of non-point surface and ground water pollution. In order to accomplish the reduction in NPS and ground water pollution potential the facility will need to constantly adapt to the needs of the community and demonstrate the newest and most effective technologies that are available. Such a task can only be fully realized through continued public and private support of the Demonstration Facility.

Gill Net Selectivity of Several Estuarine Fifnish Species

The gill net fishery in North Carolina is a multi-species fishery that varies considerably by area regarding the type of netting used and species targeted. This fishery operates year around according to the seasonality of commercially marketable species. Contributions from the North Carolina gill net fishery to total harvests (all species, all gear types), during the period 1983 through 1995, ranged from 3.96% to 14.37% with a 13-year average of 9.17%. Species commonly targeted by the gill net fishery include Atlantic croaker (Micropogonias undulatus), red drum (Sciaenops ocellatus), spot (Leiostomus xanthurus), spotted seatrout (Cynoscion nebulosus), striped bass (Morone saxatilis), and weakfish (Cynoscion regalis).

Unlike most commercial finfish gears, gill nets are frequently used for part-time commercial and recreational purposes. The ubiquitous nature of this gear and its use by both commercial and recreational sectors make it difficult to estimate the quantity of gear used and the number of fishermen involved.

Effort for the commercial sector, previously unavailable, is now accessible after the initiation of a mandatory trip ticket reporting program in 1994. Gill nets were one of the most widely used commercial gear during the 1994-1995 trip ticket reporting year, comprising 22.5% of the total trips reported. Although it is a dominant gear type in the state with respect to gear units owned and number of people involved, NCDMF has only collected a limited amount of information on this gear.

The large amount of gill nets used has become increasingly controversial. Recreational hook and line fishermen contend that these nets catch and kill small finfish, contributing to declines in the stocks of some finfish species. Additionally, the public is also concerned about bycatch of birds, turtles, and marine mammals from gill net fisheries.

Bycatch, the incidental capture of non-targeted species and age groups, is a biological, economic and image problem in most commercial fisheries. While the shrimp fishery has attracted much of the attention for this problem, substantial quantities of bycatch are caught and landed by other gears such as gill nets in North Carolina. Although most bycatch from gill nets is culled at sea during the fishing operation and not documented, the bait component within the gill net fishery contributed 4.87 % (1983-1995) to the total reported from all fisheries combined.

In November 1991 the North Carolina Marine Fishery Commission (NCMFC) adopted a policy directing NCDMF to establish the goal of reducing bycatch to the absolute minimum and consciously to incorporate that goal into its actions.

Bycatch from gill nets is commonly composed of species that recreational fisheries often target and include: spot, Atlantic croaker, weakfish, red drum, spotted seatrout, and striped bass. Collectively these species contributed 14% by weight and 42% by number to the recreational harvest from 1983 to 1995 in North Carolina. Spot and Atlantic croaker respectively ranked first and third by number and fifth and eighth by weight of fish recreationally caught for the period 1983 through 1995. Average numbers and pounds harvested for these species, except striped bass, consistently ranked in the top 30% of recreationally caught finfish.

The desired reduction in mortality sought through size and creel limits are best obtained through selective gear that targets the marketable (legal) size range while significantly reducing the number of undersized fish. Development and implementation of selective gear can alleviate resource waste and reduce bycatch mortality in many North Carolina fisheries.

Primary objectives of the study were:

- To determine the mesh size selectivity in gill net fisheries for Atlantic croaker, red

drum, spot, spotted seatrout, striped bass, and weakfish.

- To determine instantaneous mortality rates under different seasonal conditions and capture modes for these same species captured by gill nets.

Sampling areas were selected where target species (Atlantic croaker, red drum, spot, spotted seatrout, striped bass, and weakfish) are commonly caught by gill nets. Sampling locations were changed as needed to reflect seasonal/areal fishing practices and to maximize the size range of fish encountered and total catch of the target species. Selection of fishing days were based on fish abundance and sampling conditions. Communication with commercial gill net fishermen and surveys of netting activity were conducted to decide times and areas of sampling. Samples were obtained in a manner to closely mirror commercial fishing practices.

An array of short nets (30 yds. long by 9 ft deep) with varying mesh sizes were set close to the shore and within the same local vicinity. Mesh size increments for gill nets were 2-3/4", 3", 3-1/4", 3-1/2", 3-3/4", 4", 4-1/4", and 4-1/2". All nets were constructed of number 6 (0.0139") diameter monofilament webbing hung on a 1 to 2 ratio. Each net was inspected for damage upon retrieval. Damage to each net was maintained below 10% of the total surface area. The gill nets were anchored perpendicular to the shoreline with all nets set within a distance of a quarter mile of each other. Nets were fished at least twice per month. Nets were set late in the afternoon and checked at sunrise (or within 4.0 hours).

The total number of each target species, including damaged individuals, were counted. Lengths of undamaged specimens were measured to the nearest millimeter (FL or TL), and weighed to the nearest 0.01 kg. Capture status, how a fish was caught, (i.e., wedged, gilled, or tangled) and fish status (alive, dead, spoiled, mutilated) were recorded. Head girth, girth at net mark, and maximum girth were measured to the nearest millimeter for wedged or gilled target species. All other marketable species were sorted to species, counted, measured to the nearest mm (FL or TL), weighed, mode of capture and fish status were recorded. Environmental conditions such as temperature (°C) and Salinity (ppt) were recorded upon retrieval of the nets on each sampling trip.

Selectivity curves were calculated for each target species and mesh size. For each target species; mean length (FL or TL), variance and coefficient of skewness were each regressed against stretched mesh size (inches) using linear regression techniques to determine relationships between mesh size and the length distribution of individuals captured by that mesh. The coefficients were fitted to a skew-normal probability density function using non-linear regression techniques. The solution to the model was response surface describing probability of capture of a size class of fish by a particular mesh size.

Instantaneous mortality was determined for each species across mesh sizes, capture mode water temperature and duration of the set. Degree of association was calculated for each individual species and capture mode across mesh sizes.

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# BYCATCH REDUCTION IN THE ESTUARINE AND NEARSHORE SHRIMP TRAWL FISHERY OF NORTH CAROLINA.

The North Carolina coastal fishing industry contributes over $500 million to the state's economy each year. The shrimp fishery represents one of North Carolina's most important fisheries with an average dockside value of $15.6 million. This fishery is dependent upon three species of shrimp, brown (Penaeus aztecus), pink (P. duorarum) and white (P. setiferus). Over 95% of the shrimp landed in North Carolina are captured by otter trawls. Due to the non-selective nature of this gear, concerns have been raised about the incidental capture of finfish and sea turtles in conjunction with this fishery.

The shrimp fishery in North Carolina is very diverse in terms of participation, vessel and gear characteristics, and physical characteristics of the areas fished. There are between 1,500 to 1,800 full-time commercial shrimpers, approximately 2,000 part-time commercial and 3,500 to 3,800 recreational shrimpers in the state. Actual fishing strategies and equipment vary with geographical location, bottom type, target species, and other factors. The purpose of this work was to:

1) develop effective Bycatch Reduction Devices (BRDs) that maximize finfish reduction and minimize shrimp losses;
2) identify and evaluate appropriate BRDs, Turtle Excluder Devices (TEDs), and TED/BRD designs for various geographic areas in North Carolina; and
3) integrate these gears into the shrimp fishery.

The methods employed during gear testing followed the research plan developed by the National Marine Fisheries Service [NMFS (1991)]. This plan identified a four phase gear development program which includes:

1) Initial design and prototype development - This work evaluates fish behavior and feasibility of prototype concepts. Fish behavior, gear instrumentation, and gear performance studies are conducted on each design using SCUBA, remote video cameras, and other techniques.

2) Proof of concept - Objectives during this phase are to evaluate prototype devices on key species, determine total finfish reduction rates, and establish shrimp catch rates. Proof of concept testing evaluates adequacy of design for safety and for problems with operational use.

3) Operational evaluation - The objective of this phase is to test TED/BRD gear combinations against a standard TED net under conditions encountered during commercial shrimping operations. TED/BRD combinations are tested on trawlers using the same TED in both the test and control net.

4) Industry evaluation - The commercial shrimping industry is responsible for fleet testing of candidate BRDs.

Sample workup for all testing (BRD, TED, and TED/BRD) complied with the methodology outlined in the sampling protocol manual for the "Evaluation of Bycatch Reduction Devices" prepared by the NMFS (September 14, 1992). On four-barrel rigs, the two outside nets were designated as experimental and control. While on double rigged boats, the experimental and control nets were either on the port or starboard side. Regardless of the vessel's configuration, experimental and control nets were switched between sides at convenient intervals, daily or after 10 tows, to minimize any variation between sides. After the completion of a tow, the total catch weights of the control and experimental nets were obtained. Shrimp were then separated from each net and a total count and weight obtained. The catch was then separated into: Crustacea [shrimp (other than Penaeus sp.), crabs and lobsters], other invertebrates, finfish, and miscellaneous (grass, wood, etc.). Total weights were obtained for each group. Finfish were then separated into 25 groups. A total count and weight were obtained for each group. Lengths were taken for selected finfish species.

The BRD designs examined included Florida fish excluders (FFEs), snake eyes with and without an accelerator funnel, large mesh funnel excluders (LMFE), PVC excluders, skylights, and different sizes of tailbags. TEDs tested were a Parrish Grid, a modified Anthony Weedless, Georgia Jumper, Mini Super Shooter, Standard Hardware, Anthony Weedless, and a Parrish Rack Back Grid. A total of 879 paired tows were examined; 581 on commercial vessels and 298 on research vessels. The breakdown of tows by gears was 357 BRD testing, 387 TED/BRD testing, 125 TED testing and 10 tailbag testing. Evaluations of the BRD designs indicate that specific FFE, PVC, and LMFE designs effectively reduce bycatch with minimum shrimp loss. The effectiveness of FFEs and PVC excluders depends on size and placement in the net. Based on the results of this study, the North Carolina Division of Marine Fisheries Director will require, by proclamation, the use of either a :

1) a Florida fish excluder measuring at least 5 ½" X 6 ½" positioned 1/8 th of the distance from the top center of the tailbag and located no more than 65% up from the tailbag tie-off ,
2) a large mesh funnel excluder, or
3) a PVC excluder measuring at least 8" in diameter and located no more than 38% up from the tailbag tie-off.

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# Farm*A*Syst and Home*A*Syst: A Well-Head Protection Program for North Carolinians

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Many activities that occur around farmsteads or homes can pollute ground water and thus contaminate drinking water. Farmstead Assessment or Farm*A*Syst is a national self-assessment tool for well-head protection. A corollary program for non-farm residents who have wells is the Homestead Assessment (Home*A*Syst) program. The national Farm*A*Syst and Home*A*Syst programs have recently been modified for North Carolina residents. The North Carolina Farm*A*Syst and Home*A*Syst programs reflect information specific to North Carolina agricultural, geological, demographic, and environmental conditions.

The Farm*A*Syst package includes seven publications, each relating to a different practice or structure that can cause drinking water contamination (water supply, fuel storage, hazardous waste, septic systems, pesticides, fertilizers, and livestock waste). Each publication contains information on a particular subject area that describes how the activities cause ground water pollution and how to protect drinking water. In addition, self-assessment questions allow the user to appraise their own practices and the risk to ground water from these practices. Home*A*Syst is a modified version of Farm*A*Syst and only includes five publications: water supply, fuel storage, hazardous waste, septic systems, and lawn care.

All publications have been reviewed by the pertinent state agencies. The materials were field tested in three counties, Johnston, Guilford, and Northampton, and changes have been made to make the information more user-friendly.

Other states who have been using Farm*A*Syst and Home*A*Syst materials have found that the effectiveness of the program increases when the information is delivered on a one-to-one basis. The North Carolina Advisory Committee for Farm*A*Syst has recommended that each county determine the most appropriate delivery mechanism for the prevailing county conditions. For example, in Northampton County, the North Carolina Cooperative Extension environmental agent will deliver the program directly to individual users. In other counties, agricultural agents may want to deliver the program at monthly meetings. Clubs composed of groups, such as homemakers, Future Farmers of America, 4-H, retired citizens, and environmentalist, may be interested in delivering the programs as community projects.

Farm*A*Syst and Home*A*Syst materials will be available for viewing during this poster session. These materials are also available through the World Wide Web at:
http://h2osparc.wq.ncsu.edu/info/farmassit/index.html (Farm*A*Syst)
and
http://h2osparc.wq.ncsu.edu/info/farmassit/homeindx.html (Home*A*Syst).

# Decision Support in the Neuse and Tar-Pamlico Basins

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As a result of the accumulated evidence of overenrichment of the Neuse and Pamlico estuaries and mounting public sentiment for restorative action, goals to reduce nutrient inputs have been established. As with any major new policy initiative, many new questions have been raised. What are the relative contributions of nutrients from various sources in the watershed? How will we monitor progress towards this goal? How can management measures be most effectively targeted? How much will this cost, and who should pay? What is the most effective and equitable approach for pursuing these goals? What benefits will accrue as progress is made, and to whom? For each of these fundamental questions, scores of additional questions are arising that require further research, new ways of sharing information, and methods for reaching common understanding and agreement.

Researchers at RTI have been working to assist the Albemarle-Pamlico Estuarine Study, the North Carolina Division of Water Quality and others as they pursue these questions. Projects that have been completed include:

- calculation of annual average nutrient (input) budgets for the entire Albemarle-Pamlico system
- subbasin-oriented profiles and databases of environmental stressors and resources
- mapping products for targeting management measures and transferring information from state databases to local agency staff
- a report endorsing more focused protection and restoration of riparian buffers
- a study of the cost-effectiveness of agricultural best management practices
- development of a simple nonpoint source loading model for the Tar-Pamlico River Basin

Currently, RTI is working on a project to better integrate environmental and economic data and models into a systematic framework. The objective of this project is to develop a decision support system that incorporates tools, data, and decision processes currently being used to manage nitrogen inputs to the Neuse River, and readily accommodates future policy needs, information, knowledge, and research results regarding the basin, river, and estuary. As currently envisioned, the system will include:

- point source loading and permit information
- export coefficient based estimates of nonpoint source loading
- a basin scale application of the Nutrient Loss Evaluation Worksheet being developed and applied by agency staff and researchers
- a simple model of atmospheric nitrogen emissions and deposition from confined animal operations
- a simple riparian buffer effectiveness model
- the pollutant routing/transport model, with enhancements, currently being used by DWQ
- point and nonpoint source nutrient reduction costing models

System architecture is being based on RTI experience developing similar systems in eastern Europe and Central Asia. The key principles for system design are:

- open, flexible, platform independent architecture
- quick turnaround in incorporating new and emerging models and data
- data-driven (rather than software-driven) design
- "ownership" of the system by the users
- a focus on the decision process
- integration of environmental and economic models (including benefits assessment as a long term goal).

RTI is also currently involved in a project to develop a map gazetteer for the Neuse and Tar-Pamlico Basins that will assist state and local agency staff in efforts to geographically target best management practices. This project is being pursued in cooperation with DWQ, DSWC, and CES staff and NCSU researchers.

**Developing a Wetland Conservation Plan for the Coastal Plain of North Carolina**

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***Vital Habitats:*** *Conserve and protect vital fish and wildlife habitats and maintain the natural heritage of the Albemarle-Pamlico region.*

***Stewardship:*** *Promote local and regional planning that protects the environment and allows for economic growth.*

While the North Carolina Coastal Management Program (NC CMP) includes a highly successful program for the protection of tidal wetlands in North Carolina, historically no emphasis has been placed on the protection or management of non-tidal, freshwater wetlands. There has existed no policy basis or regulatory mechanisms within the NC CMP to address non-tidal wetlands. The CMP's only involvement in non-tidal freshwater wetlands has been through the Division of Coastal Management's (DCM) Coastal Zone Management Act (CZMA) consistency review of 404 permit applications, with the basis for consistency review being wetlands policies stated in local land use plans. In 1992, DCM recognized these problems as well the State's inability to assess the amount, type, location, functions, and loss/gain trends of freshwater wetlands in coastal North Carolina. The Division of Coastal Management has responded to the issues of wetlands protection and management by beginning the development of a Wetland Conservation Plan for coastal North Carolina.

The Wetlands Conservation Plan (WCP) will include GIS-based inventories and maps of all the wetlands in the coastal area, a scientifically-based functional assessment of individual wetland systems' relative importance or priority for protection, methods for using the functional assessment procedure in potential wetland restoration site identification, a monitoring system to track trends and regulatory program effectiveness, an education component designed to inform business, local governments, and the public of important wetland information and issues, and policies for the protection and management of both tidal and non-tidal wetlands. Policies will be implemented through the Coastal Zone Management Act and 404 state consistency requirements for wetlands permits and other wetlands-related activities. The Plan will also provide techniques and information for improvements in the way local governments treat wetlands in their local land use plans.

Currently, the DCM has completed wetland mapping for 17 of the 20 coastal counties as defined by the Coastal Area Management Act. Of these counties, functional assessment of wetland types has been completed for Carteret County and potential restoration sites have been mapped in draft format for 2 counties. Furthermore, a functional assessment procedure has been used in a pilot project with the North Carolina Department of Transportation to identify and prioritize potential wetland restoration sites for compensatory mitigation for the New Bern Bypass project in Craven County.

# NC Center for Geographic Information and Analysis

The North Carolina Center for Geographic Information and Analysis (CGIA) is an agency of the Office of State Planning. CGIA has a mission to provide timely, cost-effective geographic information and services statewide; build and maintain the NC Corporate Geographic Database; serve as lead agency for geographic information system coordination in the state, and serve as staff to the Geographic Information Coordinating Council. Operating on a cost-recovery basis since 1977, CGIA has a strong working relationship with many state agencies, counties, municipalities, federal agencies, nonprofit organizations, educational institutions and private businesses.

CGIA offers a variety of services to diverse clients involved in making public decisions. Clients call on CGIA's Services Program for assistance in looking for patterns, informing audiences, updating plans, assessing environmental impacts, or finding a suitable site. CGIA provides access to North Carolina's Corporate Geographic Database, a strategic state resource that contains more than 60 data layers ranging from detailed soils to highways to Superfund sites to stream classifications to watersheds. Products and services include:

**Spatial analysis**--find relationships between map features or between layers of data; apply criteria to geographic data to select locations;
**Technical assistance**--develop in-house expertise by learning from our experience;
**Application development**--tailor GIS to produce custom views, maps, analysis and reports;
**Data development and enhancement**--build, maintain, verify and improve your databases;
**Custom maps and reports**--display key information at the right size and scale;
**Data distribution**--use the NC Corporate Geographic Database to get consistent, reliable data;
**System planning**--find the right configuration of GIS hardware and software;
**Image analysis**--use data from remote sensing to analyze land use and land cover.

CGIA provided geographic data management to the Albemarle-Pamlico Estuarine Study and continues to support the APES project through outreach efforts including workshop presentations and hands-on demonstrations of geographic information systems and data.

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TITLE: **A POLLUTION PREVENTION PROGRAM TO PROTECT HUMAN HEALTH AND WATER RESOURCES IN NORTHAMPTON AND BERTIE COUNTIES, NORTH CAROLINA**

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As defined by the US Environmental Protection Agency, Environmental Justice is the fair treatment of people of all races, culture and incomes with respect to the development, implementation and enforcement of environmental laws, regulations, programs and policies. Fair treatment means that no racial, ethnic or socioeconomic group should bear a disproportionate share of the negative environmental consequences resulting from the operation of industrial, municipal, and commercial enterprises and from the execution of federal, state, local and tribal policies.

The demographics of Northampton and Bertie Counties in northeastern North Carolina reflect characteristics which merit considerations on the basis of EPA's commitment to environmental justice. More than sixty percent of citizens in the two counties are of African American descent and nearly one quarter of the entire population earns less than a poverty level income.

Additionally, census data from 1990 indicated that African Americans in the two counties were three to four times more likely to live in poverty. In these communities, what relationship exists between race and socioeconomic status and the risk of exposure to environmental contamination? Furthermore, how can a unifying interest in human health and environmental protection be used to facilitate community organization for the purpose of effective management and conservation of natural resources?

The North Carolina Cooperative Extension Service set out to address these concerns with special attention devoted to the quality and safety of domestic drinking water. Working together with Northampton and Bertie Counties, Extension drafted a grant proposal entitled, "A Pollution Prevention Program to Protect Human Health and Water Resources in Northampton and Bertie Counties, North Carolina". The EPA awarded this proposal an $80,000 grant from its Environmental Justice Through Pollution Prevention initiative. Program implementation began in April, 1996.

The free sampling of domestic drinking water has been the principal service through which the Environmental Justice initiative has established itself in the community. Two different approaches to sampling have been employed. Program staff respond to requests for assistance by visiting the client's home, evaluating their well and doing an on-site nitrate screening. If appropriate, another water sample is collected for analysis in the county or state Public Health laboratory. In the first year of the program, staff conducted more than 130 home visits and evaluated 152 wells

The desire to include a broader range of tests as well as more sophisticated and accurate analytical techniques necessitated centralizing services for single day screening events. Citizens with private water supplies such a well had their sample checked for nitrate, lead and residues from the pesticides alachlor and atrazine. Citizens with a public water supply had their samples checked for lead which might be leaching from pipes or fixtures within their homes. Once lead was established as the most frequent risk in the drinking water samples analyzed, Cooperative Extension and the Northampton and Bertie County Boards of Health and Education implemented free in-school lead screening for every family with a child in elementary or middle school.

During its first year in operation, the Environmental Justice initiative conducted free analyses on water from more than 550 households including more than 350 samples for nitrate, 400 for lead and 200 for alachlor and atrazine. These screenings identified 25 wells which failed EPA Maximum Contaminant Levels (MCL) for public water supplies due to contamination from lead, nitrate, fecal bacteria, alachlor and/or the insecticide chlorpyrifos. The initiative also developed a number of projects in the areas of environmental education, sustainable agriculture, recycling, solid waste disposal and pesticide management. The initiative demonstrates the ability of government agencies and private citizens to work collaboratively to identify and address critical issues in environmental protection. Race and economic status do not have to be divisive issues, if universally shared concerns for human health and environmental well being are prioritized.

# Relating minimum soil infiltration rate to nitrate-nitrogen concentrations in shallow ground water in the Coastal Plain of the Albemarle-Pamlico drainage basin, North Carolina and Virginia

Jo Leslie Eimers and Tim Spruill, U.S. Geological Survey*

Soils vary in their ability to transmit water, and this variation affects relative amounts of ground-water nitrate contamination that may occur. The Natural Resources Conservation Service has characterized soil series by their minimum infiltration rate when thoroughly wet, and uses a classification system grading from A (well drained) to D (poorly drained). This system also allows for soils to be classified by two labels, such as A/D (well-drained in drained areas, poorly drained in undrained areas). It is in areas of well drained and moderately well-drained soils that shallow ground water is most susceptible to nitrate contamination.

Ninety shallow wells were sampled for this study; 64 wells were sampled in 1993-94 by the U.S. Geological Survey and 26 wells were sampled in 1992-1994 by the North Carolina Division of Water Quality. These wells have a median screen depth of 10 to 15 feet below land surface. Soil types at these wells were grouped into four hydrologic groups according to minimum infiltration rates-- AB, (soils ranging from deep to moderately deep, moderately well-drained soils with moderately fine to moderately coarse texture to excessively-drained sands); C (soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture), D (soils that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a clay layer at or near the surface, some organic soils, and soils that are shallow over nearly impervious material) and oD (hydrologic groups A/D, B/D, and C/D, where the first letter characterizes drained areas and the second letter characterizes undrained areas.)

For data analysis, undetected nitrate-nitrogen in samples were treated as 0 mg/L of nitrate-nitrogen. Median nitrate-nitrogen values vary among the categories: 3.90 mg/L for AB, 0.06 mg/L for C, 0.05 mg/L for oD, and 0.00 mg/L for D. Tukey's standardized range test on ranked data indicates that nitrate-nitrogen concentration in category AB is larger than nitrate-nitrogen concentration in category D at the alpha =0.05 significance level. A Kruskal-Wallace test was used to determine if nitrate concentrations differ according to soil minimum infiltration rate. This test indicates that nitrate-nitrogen differs by soil infiltration category ($p=0.0128$).

These data indicate that where a nitrogen source is present, nitrate concentrations in shallow ground water tend to be highest in areas having well-drained and moderately well-drained soils. These nitrate data also imply that other soluble chemicals that are used or generated in areas of well-drained soils could similarly contaminate shallow ground water. Data on soil-infiltration rates is now available for most Coastal Plain counties in North Carolina and Virginia at a map scale of 1:24,000. Soil maps at this scale provide an effective basis for evaluating ground-water vulnerability in the Coastal Plain of the Albemarle-Pamlico drainage basin and provide an effective basis for managing land-use activities that are likely to cause contamination.

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**Estimating a nutrient mass balance for major drainage areas of the Albemarle-Pamlico Drainage Basin**

Gerard McMahon and Michael D. Woodside, U.S. Geological Survey, Raleigh. N.C.

The source and fate of nutrients in the Albemarle-Pamlico estuary system are important water-quality concerns in North Carolina and Virginia. A calculation of a 1990 nitrogen and phosphorus mass balance for the drainage areas of eight National Stream Quality Accounting Network stations in the Albemarle-Pamlico Drainage Basin indicates the importance of atmospheric and agricultural nonpoint nutrient sources and watershed nutrient retention and processing capabilities.

Estimated nutrient contributions were calculated for atmospheric deposition (which averaged 27% of total nitrogen inputs and 22% of total phosphorus inputs); crop fertilizer (27% and 25%); animal-waste (22% and 50%, respectively); point sources (3% each); and biological nitrogen fixation (21% of total nitrogen inputs). Nutrient output estimates were made for instream fluxes and crop harvest. The difference between the sum of the nutrient input categories and the sum of the in-stream nutrient loads and crop-harvest nutrient removal was assigned to a residual category for the basin. Nutrient removal by crop harvest, as a percent of the total basin nutrient contributions, averaged 34% of total nitrogen inputs and 36% of total phosphorus inputs. Nutrients exported by instream flux averaged 15% and 10%. The residual category averaged 51% of total nitrogen inputs and 54% of total phosphorus inputs.

The highest instream nutrient load was measured in the Contentnea Creek Basin, a predominantly agricultural drainage area. Intermediate loads were observed in mixed agricultural-urban drainage areas (Dan River at Paces, Va.; Neuse River at Kinston, N.C.; and Tar River at Tarboro, N.C.); the lowest loads were measured in mixed agricultural-forested drainage areas (Blackwater River near Franklin, Va.; Meherrin River at Emporia, Va.; Nottoway River near Sebrell, Va.; and Roanoke River at Roanoke Rapids, N.C.).

The magnitude of the residual category indicates the importance of factors such as the role of wetlands and aquifers in denitrification, the high reported rates of nitrogen retention in forests, as well as uncertainty and error in estimating nutrient inputs and outputs. Additional research is needed to reduce this uncertainty, particularly regarding basin-level estimates of atmospheric and animal-waste contributions to instream nutrient loads and the natural nutrient processing capabilities of terrestrial and surface and ground-water systems. Effective and equitable management of the Albemarle-Pamlico estuary system depends on the availability of information about nutrient inputs and outputs that all involved in water quality management can agree is scientifically sound, comprehensible, and non-partisan.

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# The influence of soil drainage characteristics on triazine concentrations in the Contentnea Creek drainage basin of North Carolina, 1993-95.

Gerard McMahon and Douglas A. Harned, USGS, Raleigh, North Carolina *

The Contentea Creek Basin has been given a high priority for management action by the State of North Carolina. The basin contributes as much as 20 percent of the nonpoint-source nutrient loading to the Pamlico estuary, despite having less than 10 percent of the Pamlico Sound drainage area. There has been no systematic assessment of the occurrence and distribution in the basin's surface waters of important agricultural pesticides, such as triazine compounds. Thus, it is uncertain whether nutrient-related management efforts should be extended to include a pesticide-related component; if so, it may be more cost-effective to develop and implement an integrated management approach, rather than implementing sequential management programs at different times. As a first step in investigating potential pesticide-related water-quality concerns, the occurrence and spatial and temporal distribution of triazine herbicides in surface waters was examined at 38 watersheds located in the Contentnea Creek drainage basin during 1993-95. This investigation was conducted as part of the Albemarle-Pamlico drainage basin study of the U.S. Geological Survey's National Water-Quality Assessment Program.

Measurable concentrations of triazine herbicides occur in the surface waters of 38 subbasins of the Contentnea Creek drainage basin. Samples were analyzed by immunoassay, which detects the presence of atrazine and other triazine analogues such as propazine, prometon, and simazine. Some compounds detected by this procedure are used primarily in agriculture, whereas others, such as prometon and simazine, have non-crop uses. The greatest individual sample concentration, 2.03 ug/L, was measured in the most urbanized subbasin, Hominy Swamp near Wilson. A seasonal pattern exists in measured concentrations at the 38 stations, with the greatest triazine concentrations occurring in May and June, following the use of these herbicides in the basin.

Spatial patterns of triazine herbicides occurrence in surface waters also exist. Concentration measures for this analysis included the median and 75th-percentile concentration of all samples at each location. Triazine concentrations increase as the percentage of the basin with well-drained soils decreases, where well-drained soils are defined as soil hydrologic groups A and B.. Greater herbicide concentrations were measured along the main stem of Contentnea Creek than in other subbasins, other than those with predominantly poorly-drained soils or a high proportion of urban land use. Significant negative correlations ($p<0.05$) occur between the proportion of basin area with well-drained soils and median and 75th-percentile triazine concentrations.

Linear regression was used to better understand factors influencing the variation in instream triazine concentrations. The response variable was the log-transformed value of triazine concentration. Explanatory variables included the percentage of basin area in agriculture, the log of basin area, and the proportion of basin area in well-drained soil, raised to the third power. Two regression relations were examined, one for median concentrations and another for the 75th percentile concentrations. In each regression, the soil-drainage-characteristic variable was the only statistically significant explanatory variable. The sign of the estimated parameter indicates that the greater the percentage of well-drained soil in a basin, the lower the log will be of the triazine concentration. The R-square of the model predicting the 75th-percentile concentrations was 0.75; R-square for the median model was 0.67. This study indicates the importance of understanding and accounting for the influence of natural environmental characteristics, such as soil drainage characteristics of a watershed, when developing watershed management strategies.

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## Geologic Sources of Phosphorus in the Neuse River Basin and Implications for Management

Timothy B. Spruill *

Excessive phosphorus in freshwater aquatic systems is known to cause accelerated eutrophication. Of four major basins which drain into Albemarle-Pamlico Sounds, the Neuse Basin delivers about 44 percent of the phosphorus loading, even though it comprises only 20 percent of the drainage area. Of the two major basins that drain into the Pamlico Sound, the Neuse and the Tar-Pamlico, Contentnea Creek in the Neuse Basin delivers 20 percent of the non-point-source phosphorus loading, even though it comprises only 8% of the land area. Although the Neuse Basin has been identified as a major source of elevated nutrients to the sounds, usual sources of phosphorus to the watershed have, in the past, been identified as point, atmospheric, nitrogen fixation, animal waste, and fertilizer.

Ground- and surface-water data, simultaneously collected as part of the U.S. Geological Survey's National Water-Quality Assessment Program from 26 surface-water sites in the Albemarle-Pamlico drainage study unit during base-flow conditions in August and September 1995, indicate that a major source of phosphorus in the Neuse drainage basin, as well as other Coastal Plain streams of North Carolina, is probably of geologic origin. Concentrations of phosphorus were significantly higher in discharging ground water (median=0.23 milligrams per liter (mg/L)) than in surface water (median=0.07 mg/L). Based on historical data from the Coastal Plain, shallow ground water is typically low in phosphorus (a median of 0.01 mg/L or less), whereas deeper ground water has median concentrations of between 0.2 and 0.3 mg/L. Many of the highest phosphorus concentrations measured (most were greater than 0.5 mg/L) in discharging ground water occurred in the Contentnea Creek Basin although the maximum concentration observed occurred in Ahoskie Creek in the Chowan Basin. Current evidence from shallow wells in agricultural recharge areas of the Coastal Plain indicate that phosphorus in discharging ground water is not of anthropogenic origin. A plot of concentration versus discharge from Contentnea Creek at Hookerton indicates an inverse relationship between dissolved phosphorus and discharge, supporting the interpretation of a baseflow source of phosphorus.

Data from the NAWQA study indicate that ground water can be a significant source of phosphorus loading in Coastal Plain streams of the Albemarle-Pamlico drainage basin. Typically, ground water contributes between 30 to 70 percent of the annual stream discharge, with a median contribution of around 50 percent. Phosphorus concentrations of discharging ground water were significantly ( $p < 0.05$) and positively (Spearman rho= 0.64) correlated with the surface-water concentrations in the Albemarle-Pamlico drainage basin. Based on previous information published by the U.S. Geological Survey and new information presented in this paper, ground-water inflows contribute 60 percent or more of the phosphorus load at Contentnea Creek at Hookerton, with the remaining 10 percent from point sources and 30 percent from agriculture and precipitation. Concentrations of phosphorus in the Neuse River at several stations indicate that ground water also contributes significantly to the in-stream phosphorus load, probably on the order of 40 percent or more.

Results from this study reveal a major newly recognized source of phosphorus to Coastal Plain streams. These results reiterate the need for carefully conducted basin-wide studies and monitoring. Water quality problems of the Neuse and other Coastal Plain streams that drain to the Albemarle-Pamlico Estuarine System cannot be solved without a better understanding of the sources of nutrients and processes governing their movement and fate.

New field and analytical techniques will be necessary to provide information requisite for modeling and prediction. There is a need to assess the impact of natural phosphorus inflows to Coastal Plain streams, particularly those of the Neuse River and it's tributary streams. In addition, there is a need to examine how abundant phosphorus loading affects phytoplankton and bacterial populations, organic carbon loads to the sounds and, ultimately, nitrogen cycling; determine whether total maximum daily loads (TMDL's) can be met in reaches of the streams that exhibit elevated phosphorus concentrations; and determine whether best management practices designed to control phosphorus from agriculture or urban areas can be effective in problematic reaches of tributary streams in the Neuse and other Coastal Plain basins.

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# Trends in Surface-water Quality for the Contentnea Creek Basin, 1980-1996

Douglas A. Harned and Gerard McMahon, U.S. Geological Survey*

Temporal trends in riverine water quality for the Contentnea Creek Basin in the Albemarle-Pamlico drainage area were examined as part of the U.S. Geological Survey's National Water-Quality Assessment (NAWQA) Program. The Contentnea Creek Basin was a focus of the NAWQA study because the basin has the highest nitrogen and phosphorus instream loads of all of the large river basins in the Albemarle-Pamlico region. Available data for the study basins was evaluated for monotonically increasing or decreasing trends for selected water properties and constituents, including suspended sediment, solids, and nutrients.

The statistical test used for trend analysis was the seasonal Kendall test. The test compensates for seasonal water-quality variation, and only stations with sufficient seasonal data coverage were evaluated. Variation in water quality as a result of variation in streamflow also was accounted for in cases where streamflow data were available. The method used for streamflow adjustment involved using residual values about a smoothed data curve of the water-quality constituent related to streamflow. The method of curve smoothing used in streamflow adjustment and in presentation of data scatter-plot smoothing was Locally Weighted Scatter-Plot Smoothing (LOWESS). Although adjustments for streamflow were not possible for a few of the stations tested for trends, variation in streamflow in the Contentnea Creek is strongly seasonal; therefore, the seasonal compensation used in the seasonal Kendall trend test for non-flow adjusted concentration at least partially accounts for the seasonal variation of streamflow. A significance level of 0.05 was considered to show statistical significance of the trend test.

Water-quality data from six stations in the Contentnea Creek Basin were evaluated for trends; the stations were Contentnea Creek near Lucama, Turner Swamp near Eureka, Nahunta Swamp near Shine, Contentnea Creek at Hookerton, Little Contentnea Creek near Farmville, and Contentnea Creek at Grifton. Adjustment for streamflow was made for all stations except for Turner Swamp and Contentnea Creek at Grifton. The most extensive water-quality data were available for the Contentnea Creek at Hookerton station.

Nutrient concentrations for Contentnea Creek at Hookerton have generally declined since 1980. Total nitrogen, nitrate plus nitrite, and nitrate concentrations declined significantly, with the greatest reductions occurring from 1980 to 1992. Total ammonia and organic nitrogen concentrations, which were increasing during the 1980's, have declined since around 1990. Total phosphorus, dissolved phosphorus and orthophosphorus, which increased during the 1980's have shown a significant decline since 1988-- the first year of the legislated phosphate detergent ban. However, concentrations of these nutrients are still high enough to indicate potential for nuisance algal growth. Phosphorus concentrations, in particular, are high (median at Hookerton=0.7 mg/L total phosphorus), probably due to a geologic source.

Concentrations of magnesium, calcium, and potassium in Contentnea Creek at Hookerton have increased since 1980. These increases probably reflect the leaching of these base cations from the soil by acid precipitation. However, the pH of the stream has increased slightly since 1985 following a period of decline from 1980-85, suggesting that acidification of soil could decrease in the future.

Sodium, sulfate, turbidity, solids and dissolved-oxygen concentrations have declined since 1980 at Hookerton. Many of the trends observed for the station at Hookerton are apparent at the other stations. Solids concentrations have declined (1982-94) significantly at all of the sites. Turbidity has declined at Contentnea Creek near Lucama (1980-96) , Turner Swamp (1986-96) and Contentnea Creek at Grifton (1986-96). Dissolved-oxygen concentrations have declined at Turner Swamp (1980-96), and at Contentnea Creek at Grifton (1980-96). The declines in turbidity and solids, which probably reflect improved waste-water treatment, are particularly important to the condition of the downstream estuary. Improved clarity of the water allows greater light penetration, which may promote algal blooms, yet may have beneficial effects on other organisms with decreased silting of habitats.

These changes in the stream chemistry of Contentnea Creek and its tributaries during the past 15 years reflect changes in agricultural land management, basin development, and atmospheric inputs. Corn and tobacco acreage in the basin and the use of agricultural fertilizer and lime has declined during the last 20 years, while soybean and cotton acreage, and hog and chicken production have increased. Urban development has grown. The acidity of precipitation has decreased.

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Citizens Water Quality Monitoring Program
Institute for Coastal and Marine Resources
East Carolina University

## Background

The Citizens Water Quality Monitoring Program (CWQMP) is a network of private citizens who keep track of ambient, surface water quality in the Albemarle-Pamlico Estuary and its tributaries. The program began as an initiative by the Pamlico-Tar River Foundation and was expanded under the Albemarle-Pamlico Estuarine Study to gather essential data and focus additional public attention on the quality of the fragile water resources of the estuary. Additional activities are described in the accompanying figure.

Participants in the CWQMP primarily monitor the "vital signs" of the estuary. Specifically, volunteers monitor dissolved oxygen, pH, salinity, temperature and turbidity to gauge the general health or quality of the waters in the estuary. Using basic, but quite accurate water quality kits, citizen volunteers analyze water samples, observe qualitative factors such as weather conditions and other visual indicators, and record their results. Occasionally, program volunteers gather water samples and forward them to a laboratory to analyze samples for specific pollutants such as bacteria and nutrients. All data collected are forwarded to the program office where staff organize the information and put the data into report form for citizen and government agency use. Often, these monitoring efforts serve as useful supplements to existing governmental activities.

The CWQMP focuses on three areas:

1. *Baseline & Trend Monitoring*
2. *Targeted Monitoring & Surveys*
3. *Water Quality Education*

Regional environmental groups help the CWQMP to:

- → *identify projects,*
- → *recruit volunteers, and*
- → *serve as advocates for the data.*

The program office of the CWQMP provides:

- * *financial support,*
- * *equipment,*
- * *training,*
- * *data management, and*

## What is Water Quality Monitoring and Why is it Needed?

Water quality monitoring is the repetitive measurement or observation of a waterbody over time. We measure water quality repetitively to detect changes and trends in water conditions that occur due to natural events or pollution. Often, one or two years of data will not show trends in water quality and will not pinpoint sources of pollution. Therefore, monitoring is a long term effort. Carefully obtained, quality assured, objective monitoring is very valuable to develop information about a waterbody's baseline conditions. Trained analysts use this data to identify trends and changes in the

system's water quality. By not relying on subjective information, monitoring can provide more objective, quantified measures of the past.

## What is the Albemarle-Pamlico Estuary and Why Should We Monitor It?

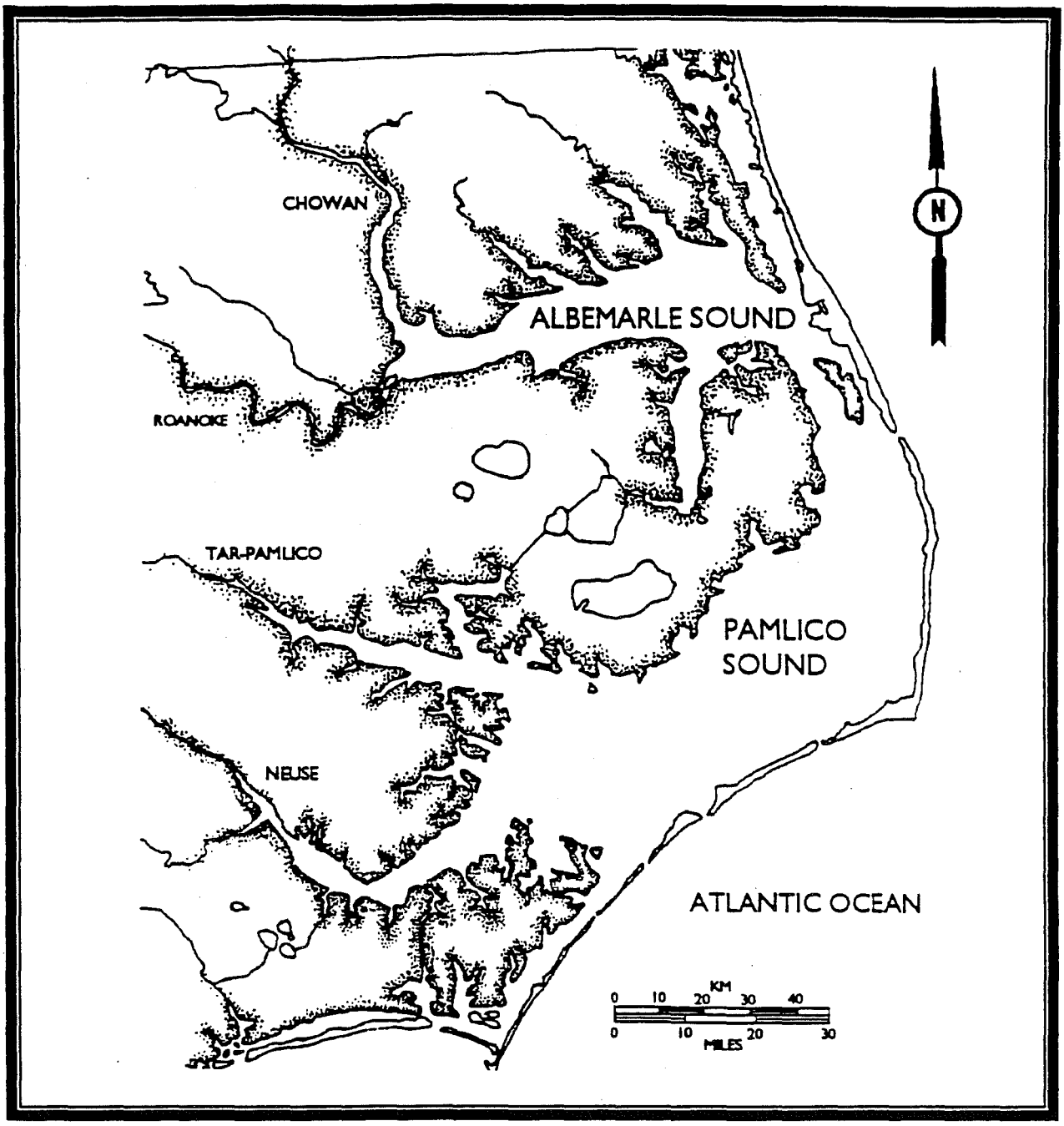
The Albemarle-Pamlico Estuary is one of North Carolina's most important natural resource treasures. Seven sounds make up an estuary that is home to a wide diversity of unique habitats and wildlife. Historically, the estuary has also supported many important northeastern North Carolina industries such as commercial fishing, seafood, recreation and tourism. Not only do we extract resources from the estuary but we also depend on its aesthetic and cultural viability to attract interest and investment in the region.

We monitor water quality in the estuary to determine its state of health and what is impacting it. In fact, the need to monitor has become more urgent. The 1993 Albemarle-Pamlico Estuarine Study comprehensive plan determined that the estuary is degraded to the point that it no longer *fully* supports the uses on which North Carolinians depend. The plan reported that . . .

- ☹ eight percent of the freshwater rivers and streams in the estuary region do not fully support fish propagation, shellfish harvesting or recreation; 34 percent of the estuary partially supports these uses while 32 percent of the estuary is threatened;
- ☹ approximately 26,600 acres of prime shellfish habitat are closed because of pollution;
- ☹ unsafe levels of mercury and dioxin have been found in the tissues of fish in some areas;
- ☹ disease epidemics have been reported for finfish, blue crabs and oysters; and
- ☹ throughout the region, wetland draining and filling activities have contributed to the destruction of vital fish, plant and wildlife habitats.
  (1993, APES Plan Summary).

## Why Should Private Citizens Participate in Water Quality Monitoring?

*First*, we need your help. The estuary is a large and diverse region and is too big to adequately monitor with government agency resources (See Map next page). The estuary has a 30,000 square mile watershed with more than 9,299 miles of freshwater rivers and streams and 1.8 million acres of brackish estuarine waters. The watershed also contains five major river basins and seven sounds and is the second largest estuary in the United States, second only to Chesapeake Bay. Because the estuary is so large and the impacts are so diverse, the assistance




*The Albemarle-Pamlico Estuary*

of *everyone* is needed to monitor the estuary. The wide expanse of waters that makes up the estuary is often more accessible to local citizens who live near it. *Citizens* help allows us to "fill the gaps" left open by limited government resources.

*Second*, as a citizen of northeastern North Carolina, you need to know what is happening in your estuary and to be involved in the policy process. Water quality monitoring allows you to observe water conditions firsthand and to learn more about the interactions of water measures and the changes that occur due to natural events and pollution. The new knowledge you gain through water quality monitoring will also help you as an informed citizen and as an advocate for a clean environment.

# *Managing The Albemarle-Pamlico Sounds*

**"Today's Accomplishments / Tomorrow's Challenges"**

* * * * * * * * * * * * * * * * * * * * *

## IMPLEMENTATION
## of the
## COMPREHENSIVE CONSERVATION & MANAGEMENT PLAN
## ALBEMARLE-PAMLICO ESTUARINE STUDY

**DRAFT**
**SUMMARY REPORT**
**1997 Edition**

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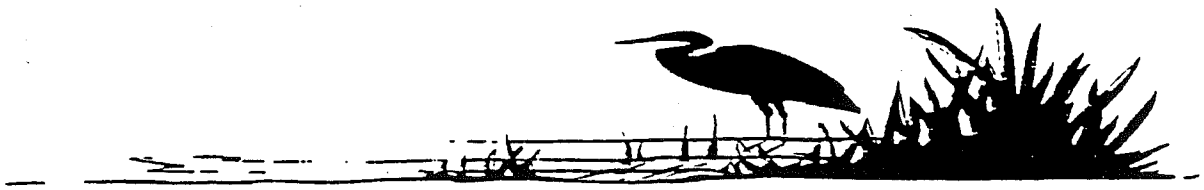
**1997 Edition**


This document has been prepared based on communication with state and federal agencies, and other groups having involvement with CCMP management actions. We are currently seeking public input prior to finalizing this edition. Please send any comments you may have by July 15, 1997 to: Guy Stefanski, NC Division of Water Quality, Water Quality Section, Planning Branch, P.O. Box 29535, Raleigh, NC 27626. Or call (919) 733-5083 extension 585.



# FORWARD

The Albemarle-Pamlico Estuarine Study, a part of the US Environmental Protection Agency's National Estuary Program, culminated in the preparation of a Comprehensive Conservation and Management Plan (CCMP). The CCMP, intended as a practical, cost-effective, and equitable approach to restoring, enhancing, and protecting the valuable resources of the Albemarle-Pamlico watershed, was ratified by the Governor of North Carolina and the US EPA in November of 1994.

Implementation of the CCMP is being administered through the Division of Water Quality (DWQ) within the NC Department of Environment, Health and Natural Resources (DEHNR). Much progress has been made in implementing several key objectives of the CCMP. This report (revised from the August 1996 edition) was prepared by staff of the DWQ. It summarizes the status of each of the 49 management actions contained in the CCMP water quality, vital habitats, fisheries, stewardship and implementation plans. The information contained in this report was derived from a variety of methods including staff's most current knowledge of ongoing CCMP activities, brief interviews with individuals within and outside of the DEHNR, and consultation with groups having involvement with CCMP management actions.

Included among those providing input are:

State agencies
Division of Water Quality
Division of Coastal Management
Division of Soil & Water Conservation
Division of Marine Fisheries
Division of Forest Resources
Division of Parks & Recreation
Division of Water Resources
Division of Land Resources
Wildlife Resources Commission
Division of Environmental Health
Division of Epidemiology
Office of Waste Reduction
Office of Environmental Education
Division of Community Assistance
Center for Geographic Information & Analysis

Federal agencies
US Fish & Wildlife Service
US Soil Conservation Service
US Environmental Protection Agency

Others
The Nature Conservancy
The NC Coastal Land Trust
The Conservation Fund
Partnership for the Sounds
Neuse River Basin Regional Council
Albemarle-Pamlico Citizens' Water Quality Monitoring Program

The goals, objectives, management actions, and explanations in this summary are taken directly from the CCMP. As further progress is made in implementing the CCMP's management actions, this summary will be updated accordingly.

# IMPLEMENTATION
# of the
# COMPREHENSIVE CONSERVATION & MANAGEMENT PLAN
## ALBEMARLE-PAMLICO ESTUARINE STUDY

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## STEWARDSHIP PLAN *(continued)*



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## I. WATER QUALITY PLAN

*GOAL: Restore, maintain or enhance water quality in the Albemarle-Pamlico region so that it is fit for fish, wildlife and recreation.*

### OBJECTIVE A: IMPLEMENT A COMPREHENSIVE BASINWIDE APPROACH TO WATER QUALITY MANAGEMENT

***Management Action 1: Develop and begin implementing basinwide plans to protect and restore water quality in each basin according to the schedule established by the Division of Environmental Management's Water Quality Section. The plans would include provisions for basinwide wetland protection and restoration.***

**Explanation:** Basinwide plans are comprehensive, targeted strategies for managing water quality. They assess the cumulative impact of individual projects on water quality within a basin. They can identify and manage pollutants in a way that protects water quality while accommodating economic growth. Basinwide protection and restoration also can help assess and preserve wetlands functions.

**STATUS:** *(1) The Division of Water Quality (DWQ) continues to develop basinwide water quality management plans according to schedule. Basinwide plans have been completed for thirteen of the seventeen river basins in North Carolina, including the Neuse, Tar-Pamlico, Roanoke and White Oak rivers in the Albemarle-Pamlico (A/P) region. Draft plans for the Chowan and Pasquotank rivers are currently being circulated for public review. Public meetings on those plans are scheduled for June 16 and 17, 1997. A draft of the second Neuse River Basin Plan is scheduled to be prepared by the fall of 1997 and approved in February 1998.*

*(2) DWQ is currently incorporating wetland protection initiatives and targeting sites for wetland restoration, whenever wetland inventories are available, into the*

*basinwide water quality management plans. This initiative began with the Roanoke River Basin Plan (September 1996) and will be incorporated in all future plans. This effort will be greatly enhanced as the Wetlands Restoration Program becomes fully staffed and operational (See Status section in Vital Habitats Plan, Objective A, Management Action 1 and Objective C, Management Action 4.)*

***Management Action 2: Establish total maximum daily loads (TMDLs) and associated control strategies for all impaired streams in the Albemarle-Pamlico region by 1999.***

**Explanation:** Total maximum daily loads estimate the amount of pollution that can safely enter a body of water. To determine limits to these daily loads, current and projected levels of pollution must be considered in relation to what the system can absorb. Proper use of TMDLs will allow development of management strategies to ensure long-term sustainable growth that does not harm the state's water resources.

**STATUS:** *(1) Section 303(d) of the Clean Water Act requires states to identify impaired waters and develop TMDLs to bring them into compliance with water quality standards. If states fail to meet this obligation, the law requires the US Environmental Protection Agency (EPA) to develop the TMDLs. The EPA and several states have been embroiled for years in a controversy over TMDLs. As of April 1997, EPA estimates that environmentalists have filed 26 lawsuits or notices of intent to sue over the failure to develop impaired water lists and/or TMDLs. Although the Division of Water Quality (DWQ) has submitted to EPA the 1996 Section 303(d) list of impaired waters, an environmental group in North Carolina has filed a lawsuit against EPA for failure to follow proper procedures in developing the 303(d) list and for not implementing the appropriate TMDLs.*

*(2) The Division of Water Quality uses TMDLs as a strategy for establishing water quality based controls on point and nonpoint sources of a given pollutant identified as contributing to a waterbody's impairment. TMDLs have been developed for both relatively small streams as well as for larger segments of a river system. TMDLs for smaller streams may serve as important elements in a TMDL covering a larger portion of the basin. Nesting of TMDLs in this fashion constitutes a flexible yet comprehensive management approach that allows for specific strategies to be developed for smaller problem areas and yet offers the means to address the large scale problems as well.*

*(3) In the Neuse River Basin, interim total nitrogen targets for the estuary have been developed and draft rules to implement the TMDLs have been taken to public hearing. A BOD strategy has also been developed on the mainstem and several*

*other management strategies were outlined in the 1993 Neuse River Basinwide Management Plan.*

*(4) TMDLs are completed each time the DWQ performs a Waste Load Allocation for a NPDES permit. There are approximately 2000 of these completed at this time. TMDLs for waterbodies in the A/P region have been completed in several cases. Examples include:*

- *Total Nitrogen (TN) and Total Phosphorus (TP) in the Tar River Estuary and Chowan River*
- *TN target in the Neuse River Estuary (draft)*
- *BOD5 targets in many stream reaches including the Neuse, Roanoke, and Tar-Pamlico rivers*
- *TP control in the Falls Lake watershed*
- *TN and TP control in the New River watershed*
- *BOD strategies for the Neuse,Tar-Pamlico and Roanoke rivers, along with associated tributaries in these basins*

*(5) Outstanding Resource Waters (ORW), High Quality Waters (HQW) and reservoirs with water supply protection are considered as having a general TMDL.*

*(6) The basinwide water quality management plans developed by the Division of Water Quality, contains information on specific and general TMDLs located in each respective river basin.*

***Management Action 3: Renew all discharge permits in a river basin simultaneously by 1999.***

**Explanation:** Renewing permits simultaneously allows the Division of Water Quality (DWQ) to consider the total impact from all dischargers when determining how much pollution each may release into the basin.

**STATUS:** *DWQ's scheduled basinwide plans allow for synchronous renewal of discharge permits within respective river basins of the state. This is part of the basinwide management process. Under this approach, a basinwide NPDES permitting cycle was established in 1990. By 1999, all NPDES permit renewals in the Albemarle-Pamlico region will be handled in this manner.*

***Management Action 4: Consider the potential for long-term growth and its impacts when determining how a basin's assimilative capacity will be used.***

**Explanation:** Assimilative capacity is the ability of a river basin to safely absorb pollutants. Basinwide planning should ensure that this capacity is used in a way that sustains long-term growth. However, planning for long-term growth also must consider how secondary impacts such as runoff from new roads will affect water quality.

**SUPPORTING INFORMATION:** Integrating point and nonpoint source pollution controls and determining the amount and location of the remaining assimilative capacity in a basin are key long-term objectives of basinwide management. The information can be used for a number of purposes including determining if and where new or expanded municipal or industrial wastewater treatment facilities can be allowed; setting the recommended treatment level at these facilities; and identifying where point and nonpoint source pollution controls must be implemented to restore capacity and maintain water quality standards.

Wasteload allocations (WLAs) are performed by DWQ using models of varying scope and complexity, depending on the type of waste of interest and the characteristics of the receiving waters. DWQ uses models to determine the fate and transport of pollutants, reduction goals for point and nonpoint sources of environmental contaminants, and to derive effluent limits for NPDES permits. For new dischargers or for expanding dischargers, DWQ utilizes models to determine the existing assimilative capacity for that waterbody.

**STATUS:** *DWQ has taken steps to limit the impacts of long-term growth on its rivers. On the Neuse River, and several other major rivers, the Division has placed limits on the amount of wastes that can be discharged. For oxygen-demanding substances, dischargers on some streams have been prohibited from expanding, have been required to reduce loading, or, for proposed dischargers, have been prevented from discharging any waste at that location. For nutrients, a similar cap has been established in the Tar-Pamlico River Basin and is being developed for the Neuse River Basin. In the Tar-Pamlico Basin (and proposed in the Neuse), increases at one facility must be offset by a decrease at another facility or by a substantially larger decrease from a nonpoint source activity. The impacts of growth are clearly being considered in these areas.*

***Management Action 5:* Improve the scientific models for understanding the estuarine system, the effects of human activities on the system and the viability of alternative management strategies.**

**Explanation:** Scientists use models to understand how systems work. Models for the Albemarle-Pamlico's river basins have been developed, but further refinement and calibration are needed to determine how much pollution can be safely released into the estuary (i.e., total maximum daily loads). This would allow regulators to focus on the most critical sources of pollution, thereby reducing the cost of regulation, monitoring and enforcement. Increased knowledge gained from models will help planners manage water resources to allow for future growth.

**STATUS:** *DWQ is working to enhance scientific modeling capabilities in the Neuse River Basin. Emphasis is to develop and apply the estuary model, the fate and transport model, and the watershed model for nonpoint source load estimation.*

*The goal of the current Neuse River Basin modeling efforts is to provide tools to assist with efforts to determine appropriate and effective nitrogen control measures that will protect water quality in the Neuse River Estuary. To achieve this goal, three major modeling efforts are underway. Land Use Models will be used with point source discharge data to estimate total nitrogen loading to the river basin. A Fate and Transport Model will then be used to estimate how much of the total nitrogen load will arrive at the Estuary. And finally, a Nutrient Response Model will be used to predict how changes in nitrogen loading will impact water quality. Progress to date on each of these efforts is discussed below.*

***Fate and Transport Model*** *- A preliminary nitrogen transport model has been completed and a computer demonstration of its functionality is available. However, it is important to note that exact delivered loads predicted by the model are based upon limited data and several untested assumptions. At present, the model represents DWQ's best predictions of nitrogen transport, but future work on nitrogen loading and loss rates will increase confidence in model results.*

*DWQ has developed a study plan to obtain nitrogen decay data in the Neuse River Basin. This study should be completed during 1997.*

***Estuary Response Model*** *- A preliminary Estuary Response Model for the Neuse River Basin has been completed in conjunction with work by the US Geological Survey. Ongoing efforts are in progress through the next two years to collect more data and to further enhance that model.*

***Nonpoint Source Models*** *- Export Coefficient Models have been used to predict nonpoint source loading in the Neuse River Basin. This is the simplest type of land use model, but given the huge scale of the entire basin, it is the only practical model available at this time. Results from this model will be significantly improved upon receipt of new land use coverage from the NC Center for Geographic and Information Analysis.*

*Significant improvements in land use models for the entire Neuse Basin will result upon the completion of ongoing field work by researchers at NC State University. DWQ is actively assisting these and other research efforts. However, it will likely be two years before direct benefits are returned.*

***Management Action 6: Continue long-term, comprehensive monitoring of water quality in the APES system, collecting data to assess general system health and target regional problems.***

**Explanation:** On a system-wide basis, water quality monitoring allows managers to assess the effectiveness of management strategies. In addition, monitoring data may be used to develop scientific models or other methods of evaluating water quality on a smaller scale. Continued monitoring also would assess long-term trends.

**STATUS:** *(1) DWQ is seeking to expand water quality monitoring efforts in the Neuse River Basin. A gaged monitoring station has been installed at Fort Barnwell on the Neuse mainstem. This station will enable DWQ to obtain more accurate nutrient loading information to the estuary. Daily water quality monitoring has been conducted at Kinston and Fort Barnwell. Frequent nutrient monitoring has also been conducted on Contentnea Creek and the Trent River.*

*(2) A new gaged monitoring station was established near Greenville in the spring of 1997 to obtain better nutrient loading information to the Tar-Pamlico River Estuary.*

*(3) The Lower Neuse Basin Association is a unique voluntary association of industrial and municipal point source dischargers in the lower Neuse River Basin. The Association has worked with DWQ to design and implement a water quality monitoring program in the Neuse which complements DWQ's monitoring efforts.*

*(4) DWQ has also benefitted from data collected by the US Geological Survey under that agency's water quality sampling program -- National Water Quality Assessment Program (NAWQA).*

## OBJECTIVE B: REDUCE SEDIMENTS, NUTRIENTS AND TOXICANTS FROM NONPOINT SOURCES.

***Management Action 1: For each river basin, develop and implement a plan to control nonpoint source pollution as part of the basinwide management plans.***

**Explanation:** Plans would address all nonpoint sources of pollution in each basin, targeting the most critical areas for controls. These plans would identify the nonpoint source pollution problems specific to each basin. Implementation would vary according to each basin's needs. Plans also would include strategies to control nonpoint source pollution in accordance with the total maximum daily loads (TMDLs) established for each basin. Possible measures include targeted funds for implementation of BMPs, buffer strips along waterways, and continued use of BMPs for highway construction.

**STATUS:** *(1) The Division of Water Quality and the Environmental Management Commission are in the process of revising the Nutrient Sensitive Waters (NSW) Management Strategy for the Neuse River Basin. The revised NSW Management Strategy is a comprehensive nutrient control plan for the Neuse River Basin which is currently in the formal rule-making process. Six public workshops to solicit public input on the proposal, prior to formal rule-making, were held in May 1996. In addition, DWQ produced several public information documents on the proposal during the summer of 1996 (see below). Four public hearings were held in November 1996, following incorporation of comments gathered during the public workshops in May. Rule proposals were tailored for nitrogen removal and included requirements for wastewater discharges, urban stormwater, nutrient management and the establishment and maintenance of vegetated riparian areas. The Environmental Management Commission is scheduled to consider adoption of the rules in June 1997.*

*Descriptions and justifications of the proposed NSW management measures along with draft rule language, a fiscal analysis of the proposed rule alternatives and their economic effects on all affected parties, and predicted reductions in nutrient loading have been presented in the following documents, respectively:*

- *Draft Neuse River Nutrient Sensitive Waters (NSW) Management Strategy Concept Paper and General Summary documents.*
- *Draft Neuse River Nutrient Sensitive Waters (NSW) Management Strategy Fiscal Analysis.*
- *Draft Neuse River Nutrient Sensitive Waters (NSW) Management Strategy Accountability Issues document.*

*(2) Nonpoint Source (NPS) Teams have been created for the following river basins in the A/P region: 1) Upper, Middle and Lower Neuse River, 2) Chowan River, 3) Pasqoutank River, and 4) White Oak River. The teams consist of representatives of federal, state, and local governments and interest groups responsible for nonpoint source pollution control. Primary objectives of these groups include:*

- *Coordinating efforts to address nonpoint source pollution issues between various stakeholders.*
- *Assessing the effectiveness of existing nonpoint source pollution management initiatives in their area.*
- *Developing local strategies for targeting and implementing best management practices and restoration efforts where they will address the most pressing nonpoint source pollution issues.*
- *Providing local knowledge of nonpoint source pollution issues and priorities for inclusion in DWQ's Basinwide Management Plan for their river basin.*

*(3) The interagency Nonpoint Source Workgroup met to review and rank project proposals for FY 98 funding from EPA under Section 319 of the Clean Water Act. The workgroup consists of 15 federal and state nonpoint source pollution (NPS) agencies. Seven projects out of 20 submitted project proposals will be submitted to EPA for funding. In addition, proposals submitted by NPS Teams in the Chowan, Pasquotank and White Oak river basins are being considered for funding.*

*(4) The Division of Water Quality is proposing a Use Restoration Waters (URW) supplemental classification to restore the designated uses of selected impaired waters. The URW supplemental classification would be applied to a waterbody in addition to its existing primary classification. The goal of the URW supplemental classification is to target and coordinate various sources of technical and financial assistance toward selected impaired watersheds in order to improve water quality and restore designated uses. In March 1997, the Environmental Management Commission (EMC) gave DWQ permission to begin the rule-making process to establish URW as a supplemental classification. The proposed rule-making would only establish the supplemental classification for URW. Any watershed-specific strategies proposed for adoption would be required to go through separate, individual rule-making proceedings at a later date. Public hearings are scheduled on July 8, 1997 in three locations. The hearings will allow individuals to voice their concerns or support prior to the EMC making a decision on the proposal. The strategies developed under the URW supplemental classification could include:*

- *source reduction and pollution prevention measures through education and site planning,*
- *best management practices for nonpoint source pollution,*

- *streamside restoration efforts,*
- *additional wastewater treatment requirements, and*
- *other waste management requirements.*

*(5) DWQ has drafted a management plan to reduce nonpoint source nutrient loading in the Tar-Pamlico River Basin. A status report was presented to the Environmental Management Commission in May 1997, and public hearings, regarding the plan, are scheduled for July 1997.*

***Management Action 2: Expand funding to implement nonpoint source pollution controls, particularly agricultural best management practices through the N.C. Agriculture Cost Share Program, and also to develop a broader Water Quality Cost Share Program. Expand the cost share programs to include wetlands restoration. Increase cost share funds to problem areas.***

**Explanation:** Economic incentives and technical assistance have been effective in promoting nonpoint source pollution controls in agriculture. Under this initiative, the Agriculture Cost Share Program would expand and a new Water Quality Cost Share Program, modeled after the one for agriculture, would be created. Cost-sharing would give farmers, marina owners, forestry operations and individual land owners greater incentive to reduce nonpoint source pollution.

**STATUS:** *(1) In 1996, the NC General Assembly increased the amount of money available to farmers under the North Carolina Agriculture Cost Share Program (NCACSP) by $1,750,000 for the Neuse River Basin and an additional $5,750,000 for the remaining river basins of the state. The NCACSP is administered by the Division of Soil and Water Conservation.*

*(2) The Division of Soil and Water Conservation (DSWC) and Soil & Water Conservation Districts will target funding and technical assistance to priority areas identified through the basinwide nonpoint source control plans. DSWC has hired additional personnel to provide technical assistance to farmers in implementing best management practices (BMPs) to control runoff.*

*(3) The Tar-Pamlico Basin Coordinator position, with the DSWC, was extended through funding provided by the Tar-Pamlico Basin Association and EPA. This position provides technical assistance and guidance in targeting and tracking the implementation of agricultural best management practices in the basin, including those funded through nutrient trading with point source dischargers.*

*(4) The Clean Water Management Trust Fund (CWMTF) was established by the NC General Assembly in 1996 (Article 13A; Chapter 113 of the North Carolina General Statutes). At the end of each fiscal year, 6.5% of the unreserved credit balance in the North Carolina's General Fund will go into the CWMTF; that amounted to $47.1 million in the first year monies, with an additional amount of $30 million or more anticipated for 1997-98. A portion of the first year's funding ($9.2 million) was set aside by the General Assembly for establishment of the Wetlands Restoration Program in the Division of Water Quality (See Status section of the Vital Habitats Plan, Objective A, Management Action 1).*

*Revenues from the CWMTF will be allocated to help finance projects that specifically address water pollution problems. The CWMTF is dedicated to the enhancement and preservation of surface water quality throughout the state. It will fund projects that (1) enhance or restore degraded waters, (2) protect unpolluted waters, and/or (3) contribute toward a network of riparian buffers and greenways for environmental, educational and recreational benefits.*

***Management Action 3: Continue to research and develop alternative septic systems and new best management practices to reduce nonpoint source pollution.***

**Explanation:** Alternative septic systems will help protect the environment and support long-term growth by providing effective waste treatment for eastern North Carolina. BMPs improve septic system performance and reduce costly repairs. Developing and demonstrating additional BMPs for other sources of pollution, such as runoff from agricultural lands, urban lands, and highways, would provide proactive, cost-effective means to reduce nonpoint source pollution.

**STATUS:** *(1) The NC General Assembly has funded a second research/demonstration/education facility in Plymouth (first facility located in Chatham County) at the Vernon James Research & Extension Center that is operated by NC State University's Soil Science Department in cooperation with the Division of Environmental Health's On-Site Wastewater Section and local health departments. These facilities are used to demonstrate various on-site wastewater technologies and to train environmental health specialists, on-site wastewater system operators, system installers, designers and other interested parties.*

*(2) While operation and maintenance using certified operators is now in place for all but the simplest septic tank systems, efforts (law and rules) are underway to enhance improved management practices for conventional septic tank systems through the use of filtered effluent and access risers. (See Senate Bill 477).*

*(3) The On-Site Wastewater Section has published a comprehensive guidance manual that is available at low costs to all interested parties.*

*(4) Rules have been adopted by the Commission for Health Services to allow aerobic treatment units [15A NCAC 18A. 1957(c)] and approval of innovative and experimental systems [15A NCAC 18A.1969 ].*

*(5) The On-Site Wastewater Section is currently in the process of employing an on-site wastewater/NPS coordinator for the development, review and education of on-site technologies related to best management practices (BMPs).*

*(6) A project entitled, "Nutrient loading from septic tanks", is being considered for Section 319 funding for FY 98. This project will involve an inventory of a Neuse River watershed and a demonstration of advanced on-site wastewater technologies.*

*(7) DWQ is seeking funds to conduct an aerial infra-red survey of failing on-site wastewater disposal systems. This will help identify areas where program resources should be targeted to help correct these potential sources of nutrients.*

*(8) As part of the revised NSW Management Strategy for the Neuse River Basin, DWQ is considering the mandatory protection of existing riparian forests along perennial streams, lakes, and estuaries.*

*(9) Best management practices for urban, agricultural, and forestry settings have been evaluated for their cost-effectiveness in controlling nutrients. Much emphasis is placed on nutrient management planning and controlled drainage as important BMPs used to control nutrients in the Neuse River Basin. The Division of Soil & Water Conservation promotes the recycling of on-farm nutrients like animal waste versus importing more nutrients into the basin via commercial fertilizers.*

*(10) A full time position to address on-site wastewater issues has been provided through Section 319 funding to the Division of Environmental Health. This position, intended to be filled in 1997, will help to develop demonstration projects in the Tar-Pamlico River Basin.*

*(11) Several projects have been funded to improve knowledge of the effectiveness of various traditional and innovative BMPs in improving water quality:*

- *<u>Impacts of Riparian Buffers on Nutrient Transport to Streams by Groundwater Flow</u> (FY 1997) by the DWQ Groundwater Section in cooperation with NC State University. This project will feature a minimum of 60 monitoring wells at four*

*sites (two sites with riparian buffers and two without riparian buffers, one each with moderately to well-drained soils, and moderately to poorly-drained soils). The monitoring wells and stream gages will be sampled monthly for water quality and hydrologic parameters. Comparisons will be made of groundwater travel paths, fate of nitrogen in groundwater, and flow characteristics to streams with and without riparian buffers.*

*- Riparian Buffer and Controlled Drainage BMPs to Reduce the Impacts of Animal Production on Water Quality (FY 1997) by NC State University. Some of the BMPs that this project will investigate include:*

- *mature forest buffers*
- *planted forest buffers (25 and 50 feet wide)*
- *deep rooted grass buffers, natural vegetation buffer*
- *controlled drainage without buffer*
- *controlled drainage with buffer (2 locations)*
- *controlled drainage with forest buffer.*

*These BMPs will be integrated into four water control structures and nine combinations of buffers (total length approximately 8,000 feet). Additionally, there will be instream water quality monitoring, shallow ground water quality monitoring in riparian buffers, and monitoring of phosphorus and sediment removal efficiency.*

*- Trenched Level Spreaders Project (FY 1996) by the Cooperative Extension Service. This project will attempt to demonstrate the use of trenched level spreaders to produce sheet flow and improve the efficiency of buffers. If effective, trenched level spreaders will enhance the effectiveness of forested filter zones (FFZ) in cleaning agricultural runoff. A fact sheet will be produced to describe level spreaders, their function, implementation, construction, and water quality benefits. The research site is located in Wayne County.*

*- Lower Neuse Tributaries Watershed Project (FY 1997) by the NC Cooperative Extension Service. This project will include the establishment of an urban runoff demonstration in the River Bend community. Some aspects of this project will include vegetative buffers to intercept sediment and nutrients from lawns and gardens, golf courses, and parks. Surface water quality will be closely monitored. The project will also involve implementing nutrient management planning on cropland, pasture land, and silvicultural land totaling 2500 acres.*

*- Basinwide NPS Planning and Management (FY 1997) by NC State University, in cooperation with the NC Division of Soil and Water Conservation. This project includes two components related to the Neuse River Basin:*

- *Analysis of current and needed BMPs to reduce nutrient runoff from farms. Research will be conducted on the various crop and livestock commodities in the basin to assess current use of BMPs and needs on a farm-by-farm basis. The BMPs that will be evaluated include nutrient management, water table control, and riparian buffers. The researchers will also evaluate a computer program for its usefulness in estimating current nutrient reductions and needs as well as for its compatibility with the NRCS FOCS computer reporting system.*
- *Analysis of current fertilizer use on non-agricultural lands and potential water quality impacts. This includes residential areas, golf courses, commercial properties, and other turf and landscape areas. Project results will support basinwide estimation of resource allocations to meet nutrient reduction goals.*

*- Storm Drain Stenciling and Project HERO (Help the Environment by Recycling Oil) (FY 1996) by the NC Cooperative Extension Service. This project seeks to reduce sediment, nutrients, pesticides, and toxic materials to water resources. The Storm Drain Stenciling aspect utilizes volunteers who paint messages on storm drains. These messages convey that pollutants washed or dumped into the drains go directly to rivers, creeks, lakes, and coastal waters (an extension of a successful 1994 pilot project). Project HERO will be piloted in 19 counties as an educational program. Two of the counties will have a collection program for used oil and filters.*

*- Farm*A*Syst project (FY 1995) by the Cooperative Extension Service. This project primarily targets the farming community. The program consists of a series of fact sheets that inform farmers about the contamination risks of particular pollutant sources, such as pesticide storage areas and livestock waste. Farm*A*Syst will be modified further into Home*A*Syst in order to reach the non-farm community. Johnston County (in the Neuse River basin) is being considered as one of the Home*A*Syst sites.*

*- NPS Water Quality Modeling (FY 1996 and 1997) by NC State University. This project will develop and apply watershed scale models for nitrogen loading. To develop this model, data will be collected from an existing instrumented site located near Washington County, NC. Once a model is developed and tested, it will be applied throughout the lower coastal plain of the Neuse River Basin to evaluate the effects of various land uses and management strategies on nitrogen loading. Although a variety of models show promise for evaluating*

*nutrient loads, this project is unique in that it will test a linkage between the field-scale nitrogen model DRAINMOD-N and the Dutch instream model DUFLOW.*

*- Geocoding the North Carolina Agriculture Cost Share Program Data for the Neuse River Basin (FY 1997) by the NC Division of Soil and Water Conservation. This project will address several points on the Agriculture Action Plan by digitizing BMP location data into ARC/INFO GIS (geographic information systems). ACSP BMP data from 1987 to 1997 will be entered first, followed by non-ACSP BMP data that have been made available to the Natural Resources Conservation Service (NRCS). Maps featuring BMP activity will be produced by hydraulic unit area. These maps may also be used to target future BMP efforts in the basin.*

***Management Action 4: Strengthen current enforcement to detect and correct ground and surface water quality violations from nonpoint sources.***

**Explanation:** Although current enforcement authority exists, nonpoint sources of water quality violations are difficult to identify because they are varied and often widespread. The Division of Water Quality's (DWQ's) Water Quality and Groundwater Sections would strengthen enforcement to ensure that these violations are identified and corrected.

**STATUS:** *(1) The NC General Assembly (summer 1996) approved eighteen new positions to enhance annual inspection, permitting and compliance of animal waste management facilities.*

*(2) For animal operations statewide, a new permitting strategy is being implemented in order to ensure that the larger facilities remain in compliance and that the problem facilities both achieve and maintain compliance with all water quality regulations. This strategy includes the use of a three-tiered permitting strategy consisting of individual permits, general permits as well as the current deemed permitted status.*

*Senate Bill 1217, ratified in June 1996 by the NC General Assembly, establishes the statutory basis for a tiered permitting program for animal waste management systems. The ratified bill is quite detailed and contains the following major components:*

*•Permits are required for animal operations with > 250 swine, > 100 cattle, > 75 horses, > 1,000 sheep, >30,000 birds (liquid system). DWQ has*

*developed general permits for swine, cattle and poultry (liquid system).*

- *Permits to be issued on a phased-in priority basis by Department within five years, beginning January 1, 1997. Priority to be given to largest operations first.*
- *Dry poultry operations with > 30,000 birds are required to develop animal waste management plans and retain records on site for three years. Plan to include nutrient testing of waste within 60 days of application, annual soil testing, nitrogen as limiting nutrient for land application, monitoring of zinc and copper in soils and alternative crop sites if zinc and copper levels excessive; record keeping for waste application (dates, rates, locations). Must be compliant with testing and record keeping requirements by January 1, 1998.*

*Provisions were also included for:*

- *design storm for waste management system,*
- *permit review and approval period,*
- *required components of animal waste management plan,*
- *evaluation and encouragement of alternative and innovative animal waste management technologies,*
- *annual review of animal operations by technical specialists,*
- *violations requiring immediate notification by state or local employee,*
- *yearly inspections of animal operations by DWQ,*
- *establishment of fee schedule based on steady state live weight,*
- *addition of two animal agriculture industry representatives to Water Pollution Control System Operators Certification Commission,*
- *certified operator requirements, certification, training, examination, fees, continuing education requirements and revocation or suspension of certificate,*
- *siting requirements for swine houses, lagoons and land areas onto which waste is applied at swine farms,*
- *civil action provisions against swine farmers,*
- *required written notice for new operations,*
- *addition of specific BMPs into Agricultural Cost Share Program.*

*(3) The Division of Water Quality and the Division of Soil and Water Conservation (DSWC) have worked together to develop a single form to be used by the staff of both agencies to document inspections and operational reviews of animal operations. Both agencies are now required by law to visit all animal operations once per year. DSWC performs site evaluations and DWQ conducts compliance inspections. The results from these visits are maintained on a database shared by both agencies.*

*(4) The Division of Water Quality is also undertaking the task to verify the information on file for the 4,000 plus operations which are either currently registered or certified. All operations were sent a letter and asked to verify information such as address, phone number, number of animals, etc. This letter also informed farmers about operator training and certification requirements, permitting requirements, annual fees and other recent legislation.*

***Management Action 5:* Strengthen implementation of forestry best management practices through training, education, technical assistance and enforcement.**

**Explanation:** Proper use of forestry best management practices is critical for water quality protection in the APES region. Additional professional foresters would provide needed outreach and technical assistance to forestry operators and landowners regarding implementation of BMPs. Enhanced enforcement would ensure proper use of forestry BMPs and help to eliminate improper forestry practices. Participation by loggers and landowners in education programs, such as the Professional Loggers Program, is vital to the expanding goals of the forest products industry. Forestry workshops create an opportunity for landowners to learn about forestry management and the use of acceptable forestry BMPs.

**STATUS:** *(1) The Division of Forest Resources (DFR) has received limited funding on a temporary basis to hire BMP foresters statewide. (Funding expired on June 30, 1996). The temporary positions have been utilized in training, education, technical assistance, and enforcement. The need to hire five permanent full time professional foresters (one for each district in the Albemarle-Pamlico region -- as identified in the CCMP) still exists.*

*(2) The DFR has also established a statewide inspection /compliance program to monitor for BMP implementation. BMP compliance checks are continuously done by DFR. According to a limited sampling of sites in a preliminary survey in 1992, DFR found that overall compliance was approximately 85%. The Division also completed a survey of 196 harvested sites statewide in 1995 and found overall BMP compliance increased to 92%. In 1996, 200 timber harvest sites and 23 site preparation sites across North Carolina were evaluated for forest practice guidelines (FPG) and BMP implementation and effectiveness. Overall compliance at those sites was 95%. Use of BMPs was significantly higher on sites where a professional forester or technician was involved in the timber operation.*

*(3) The DFR, the Forestry Association and the Cooperative Forest Extension Service have fully implemented the education workshops (outlined in critical*

*step 3, page 52 of the CCMP) which promote the use of environmentally sound forestry practices. The improvement in the use of BMPs could be attributed to increased education of the forest resources community. As educational efforts by the DFR, other government agencies and private companies continue, compliance with forestry BMPs should increase even more in the future.*

***Management Action 6: Enhance stormwater runoff control by strengthening existing regulations and developing new ones, if needed, by 1995. Improve enforcement to ensure that stormwater management systems are properly installed and regularly maintained.***

**Explanation:** At present, the North Carolina Stormwater Management Program targets priority areas and high risk pollutant sources. Additional benefits from this program may be realized by evaluating expansion of the areas of coverage to target more -- or potentially all -- waters. Under this initiative, various regulating agencies would coordinate their efforts to protect all state waters. The Division of Water Quality (DWQ) would dedicate more staff time to monitoring the installation, operation and maintenance of stormwater systems. A critical part of enforcement would be providing education and technical assistance to private land owners, industries, municipalities and others required to comply with these regulations.

**STATUS:** *As part of the revised NSW Management Strategy being considered for the Neuse River Basin, the following are recommended proposals (Please note that the final recommendations and adopted rules may differ) :*

*(1) Mandatory management of urban stormwater runoff is proposed for new developments which require a sedimentation and erosion control plan within those areas of the basin not already under a mandatory stormwater control program. The affected new development would have an option of meeting low density or high density development requirements. Low Density development would be limited in the amount of built-upon area allowed and would utilize natural drainage features as opposed to conveyance systems. The high density option would require the use of engineered control structures (e.g., wet detention ponds, artificial wetlands, bioretention, infiltration, and sand filters) to control the pollutants in stormwater runoff in accordance with existing requirements stipulated in 15A NCAC 2H .1000.*

*(2) The Environmental Management Commission is also considering an alternative stormwater management proposal which offers local governments the option of developing a collective stormwater management program for local implementation. However, if a local government chooses not to*

*implement the appropriate stormwater management controls within three years following the adoption of the rule, then the state will implement stormwater management controls. The state would implement a program utilizing a low density option and a high density option with stormwater controls.*

*(3) An illegal discharge elimination program has also been proposed for certain municipalities in the Neuse River Basin. Under the strategy, all municipalities having a population of 5,000 or greater would be required to begin the process of adopting a plan to address illegal discharges. Draft plans would be submitted within two years of the effective date of the proposed rule for approval by DWQ. The plan would be implemented within five years after the effective date of the rule. At the end of the five year time period local governments would submit to DWQ a report that addresses the local implementation programs progress in removing existing illegal discharges, prevention of additional illegal discharges and an on-going inspection program of the storm drainage system to ensure prevention and continued removal of illegal discharges.*

*(4) DWQ is also encouraging local governments, industries, commercial activities and the general public to develop and become involved in voluntary programs for urban stormwater management; such as (1) education/outreach activities, (2) land use planning, (3) source reduction/pollution prevention activities, (4) storm drain stenciling, and (5) the review of local ordinances for stormwater quality improvements.*

***Management Action 7: Implement an inter-agency state policy that addresses marina siting and integrates best management practices through permitting and better public education.***

**Explanation:** There is no consensus on the cumulative impact of marinas on the estuary or on how to manage marina development. A state marinas policy would coordinate agencies concerned with regulating and planning for marinas. It would address such issues as public trust rights and siting, and would integrate new best management practices. New BMPs include designing marinas to contain oil spills and pollution, minimizing the impact of turbulence from boating outside marinas, and controlling pollution from fish wastes and boat cleansers. A marinas policy, along with the appropriate regulations, would be a guide for local government planning. Public education, particularly boater education, plays an integral role in encouraging best management practices.

**STATUS:** *(1) The current permitting process allows for inter-agency coordination for the review of new marina permits. However, there has been no formal organization of an inter-agency marinas policy committee to address the cumulative impacts of marina sittings in the coastal zone as referred to by this management action.*

*(2) The Division of Coastal Management (DCM) has geo-located all marina and dockage facilities throughout the coastal area. GIS information include size, number of wet and dry slips, services, and support facilities. In addition to this information being made available to local governments for land use planning purposes, staff are using it to assess cumulative and secondary impacts of proposed new marinas and additions. DCM has also worked to develop a coordinated North Carolina State Environmental Policy Act (NC SEPA) review and public trust lease review for all marinas with the Division of Water Quality, the Division of Marine Fisheries, the Wildlife Resources Commission and other state agencies.*

*(3) To strengthen marina BMPs, DCM (via grants received in 1992 from The Clean Vessel Act) provides funding to marina operators to install pump-out stations at their facilities. Since 1995, 53 marinas have been equipped with pump-out stations -- 27 of these marinas are located in the Albemarle-Pamlico region. This initiative is ongoing through 1997. For further information, refer to the Stewardship Plan, Objective A, Management Action 3.*

## OBJECTIVE C: REDUCE POLLUTION FROM POINT SOURCES, SUCH AS WASTEWATER TREATMENT FACILITIES AND INDUSTRY.

***Management Action 1: Promote pollution prevention planning and alternatives to discharge, where feasible, for all point sources to reduce the volume and toxicity of discharges.***

**Explanation:** Environmental problems surface when inadequately controlled or treated wastewater is discharged into the system. Pollution prevention programs are a proactive measure aimed at reducing waste at its source. These programs make treatment more efficient, reduce pollutants in the waste stream, and lower cleanup costs for industry and government. When appropriate, alternatives to discharge should be encouraged.

**STATUS:** *(1) There is increased coordination between the Division of Pollution Prevention and Environmental Assistance (DPPEA) and DWQ's Pretreatment Program to help reduce/improve inputs and operating costs from*

*point source dischargers. DPPEA provides nonregulatory multi-media pollution prevention technical assistance to industries and municipalities; while the Pretreatment Program works to protect municipal or publicly owned wastewater treatment works (POTW) and their receiving waters from potential impacts of industrial users. Pollution prevention is voluntary, but all dischargers (industrial and municipal) are encouraged to use pollution prevention strategies to minimize pollution at their facilities, especially those with compliance problems. All of the state's major municipal dischargers, and most of the minor municipal dischargers, utilize pretreatment programs. Annual pretreatment audits and compliance inspections conducted by the Pretreatment Program consider whether or not a facility has incorporated pollution prevention at their site. DPPEA is working through the Pretreatment Program to educate local government POTW staff on pollution prevention and to increase referrals from local governments.*

*(2) DWQ regional inspectors are increasingly referring facilities with compliance problems to DPPEA for technical assistance.*

*(3) Pollution prevention is also a major component of DWQ's Stormwater Permitting Program. All applicants for stormwater NPDES permits must develop and maintain a Stormwater Pollution Prevention Plan to minimize pollutants introduced to stormwater.*

*(4) FUTURE ACTIVITIES: DPPEA and DWQ are coordinating efforts to identify other opportunities to integrate pollution prevention into permitting, inspections, compliance and enforcement activities. This includes development of standard language to be included in notices of violations (NOVs) that encourage facilities to use pollution prevention strategies to address the non-compliance and identifying opportunities to include Supplemental Environmental Projects for pollution prevention as part of enforcement settlements.*

***Management Action 2: Expand and strengthen enforcement of National Pollutant Discharge Elimination System (NPDES) permits. Increase site inspections and review of self-monitoring data to improve facility compliance by 1995.***

**Explanation:** Increasing the staff of the Division of Water Quality's (DWQ) Compliance Group would allow for more frequent site inspections and would enhance enforcement. More frequent inspections would improve communication between the Division and dischargers, and would help prevent some violations before they occur. Stronger enforcement would dampen incentives for dischargers to violate their permits.

**STATUS:** *(1) During 1995, much of the Division of Water Quality's Compliance Group staff were needed to inspect animal waste operations throughout the state. Therefore, inspections at discharge facilities were less and the number of cases brought against NPDES permitees for discharge limit violations was about 50% less than what occurred during 1994. Five new positions were created by the 1995 General Assembly for inspections of animal operations to help alleviate this situation.*

*(2) The 1996 session of the NC General Assembly provided 18 new inspector positions for DWQ. The addition of these positions will, to a degree, ease the drain on resources caused by the increased animal waste compliance activities. As these new staff members take on the animal waste compliance functions, other staff will redirect their activities toward NPDES activities. Water Quality Section shortfalls have required that a number of vacant positions be temporarily frozen, including some involved with NPDES compliance. It is hoped that through possible appropriations and revisions to the Permit Fee Schedule, this shortfall can be alleviated. DWQ does expect to fulfill the EPA inspection requirements by inspecting all major non-municipalities, as well as all major and minor municipalities in 1997.*

## OBJECTIVE D: REDUCE THE RISK OF TOXIC CONTAMINATION TO AQUATIC LIFE AND HUMAN HEALTH.

***Management Action 1: Increase efforts to assess and monitor the extent of estuarine sediment contamination, fish and shellfish tissue contamination, water quality violations, and to identify the causes and sources of these problems.***

**Explanation:** Several areas within the Albemarle-Pamlico region have been identified as exceeding levels of concern for toxicity in water, sediment and fish tissue. Any additional contaminated sites should be identified. Existing contaminated sites would be evaluated to determine the extent of the problem and its impact on aquatic life, wildlife and human health. Management actions should focus on reducing or eliminating further contamination in areas of concern.

**STATUS:** *(1) The US Environmental Protection Agency (USEPA) and National Oceanic and Atmospheric Administration (NOAA) continue efforts to develop protocols for the collection, analyses, and criteria for sediment toxicity. These protocols, once they are approved, would be useful in assisting states implement a sediment toxicity program. Currently, DWQ's Environmental Sciences Branch has no such program to collect and analyze for sediment*

*toxicity. DWQ will consider sediment testing if and when effective and reliable methods and ecological interpretations can be established.*

*(2) DWQ's Intensive Survey Group continues to monitor for water quality at those sites identified as being most contaminated.*

*(3) DWQ's Biological Assessment Group continues to monitor and analyze for chemical contaminants in fish tissues. Much of the analyses of fish tissues focuses on metals and dioxins. The Group conducts basin assessments of fish tissue contamination according to the schedule established by the Basinwide Management Program. When necessary, special studies are conducted in problem areas that have been identified as having elevated toxicity concentrations in the sediments.*

***Management Action 2: Continue to issue fish advisories as necessary to protect public health. Improve communication and education about the risks associated with eating contaminated fish and shellfish.***

**Explanation:** Regional fish advisories alert the public to the potential health hazards of eating contaminated fish. The Environmental Epidemiology Section (EES) would continue to review fish tissue analyses and issue advisories as necessary. Public outreach and education should stress the risks associated with eating contaminated seafood to the general population and sensitive populations (e.g., women of child-bearing age and children).

**STATUS:** *(1) When analysis of fish tissues result in levels exceeding FDA or EPA screening levels, DWQ's Biological Assessment Group notifies the Division of Epidemiology's Occupational and Environmental Epidemiology Section (OEES). The OEES reviews the fish tissue analysis and issues a fish consumption advisory as necessary. Currently, fish consumption advisories for dioxin are in effect for several water bodies in eastern North Carolina, including Welch Creek near Plymouth and the Chowan River from the Virginia line to Albemarle Sound. The entire Lumber River Basin and Phelps Lake in the Pasquotank River Basin are under a fish consumption advisory due to mercury contamination.*

*(2) According to DWQ's Roanoke River Basinwide Management Plan, the source of dioxin has been eliminated at the Weyerhaeuser pulp and paper mill on Welch Creek. A gradual recovery of the system is anticipated. Likewise, according to the draft Chowan Basinwide Management Plan, the source of dioxin in Virginia (Union Camp plant) has been eliminated, and dioxin levels in fish tissues are decreasing.*

*The source of mercury in the Lumber River and Phelps Lake is unknown at this time. It is known, however, that elevated levels of mercury in fish tissues occur widely in black water streams in other states from Maine to Florida.*

***Management Action 3: Remediate toxic contamination where necessary and feasible.***

**Explanation:** Considerable efforts should be made to remedy contamination that is an immediate threat to human health and aquatic life. The Division of Water Quality (DWQ) would proceed with sediment cleanup only where necessary and where remediation activities would not cause further damage to ecological communities.

**STATUS:** *Currently, no remedial action has occurred involving the removal of contaminated sediment. Known contaminated sediment sites are being monitored.*

## OBJECTIVE E: EVALUATE INDICATORS OF ENVIRONMENTAL STRESS IN THE ESTUARY AND DEVELOP NEW TECHNIQUES TO BETTER ASSESS WATER QUALITY DEGRADATION.

***Management Action 1: Continue to track and evaluate indicators of environmental stress, including algal blooms, fish kills, and fish and shellfish diseases.***

**Explanation:** Biological assessments are useful in evaluating the integrity of the estuarine system. Traditional biological indicators such as algal blooms and fish kills can signify water quality problems that chemical and toxicological monitoring may have missed or underestimated.

**STATUS:** *(1) In 1991, scientists at NC State University discovered a new, toxic dinoflagellate (Pfiesteria piscicida) that affects a wide array of finfish and shellfish and has been identified as the causative agent of several major fish kills in the Neuse and Pamlico estuaries. Research continues in efforts to learn more about the seasonal dynamics of this organism, its overall role in finfish/shellfish kills, its potential human health effects and its possible stimulation by nutrient enrichment .*

*(2) In May 1997, Governor Hunt announced the formation of a "rapid-response team" capable of traveling to the scene of most fish kills within 20 minutes to check for the presence of Pfiesteria. The rapid-response team will be based in*

*New Bern, much closer to the site of the majority of the state's fish kills, which typically occur most often in late summer and early fall -- and are caused by various types of river pollution. The team will include four permanent members, but also employ officials from various state agencies as needed. The team will cost $280,292, and begin work on June 1, 1997. Existing state money will be reallocated for the project. In addition to emergency responses, the team will also conduct regular water quality monitoring on the Neuse and other rivers.*

*(3) In 1996, the DWQ, in consultation with Wildlife Resources Commission biologists and Division of Marine Fisheries personnel, instituted a new fish kill investigation procedure to be used by the DWQ Regional Offices and other agencies to collect and track information on fish kills throughout the state. Fish kill data is recorded on a standardized form and is sent to DWQ where the data is compiled and reviewed. The procedure also requires the notification of appropriate state officials and scientists associated with the investigation of such events. Fish kill investigation forms and supplemental information can be managed (summarized, sorted, etc.) and retrieved for use in reporting to concerned parties. Fish kill data is also reviewed as part of the DWQ efforts to monitor water quality trends across the state.*

*(4) The Division of Coastal Management is using available indicators of environmental quality in its identification of portions of the coast at highest risk to cumulative impacts of development. Current, site-specific indicators are critical to the success of this project.*

***Management Action 2: Improve the techniques for evaluating the overall environmental health of estuarine waters.***

**Explanation:** The sensitivity and diversity of organisms inhabiting an area can be an indication of the system's overall environmental health. Further research is needed to target these "indicator species" in the estuary. Once found, these organisms could be used to monitor the general state of the system and indicate areas that warrant further attention.

**STATUS:** *DWQ's Environmental Sciences Branch has been working on the development of estuarine biological criteria in an effort to find and evaluate indicators of water quality degradation in estuarine waters using macroinvertebrate community analysis. Various approaches have been tested to see which combination of methods and analysis best separates areas of different water quality. Currently, evaluation of macroinvertebrates communities, using an estuarine biotic index, total taxa, amphipod and caridian shrimp taxa, collected in multiple habitats with a dip net, appear to give the*

*most consistent separation of sites with varying water qualities. Efforts continue to develop estuarine biological criteria based on these approaches.*

***Management Action 3: Develop and adopt better indicators of shellfish contamination as soon as possible.***

**Explanation:** The presence of fecal coliform bacteria currently is used to detect sewage contamination in shellfish beds. This practice has been criticized, however, and the National Oceanic and Atmospheric Administration's (NOAA) National Indicator Study is investigating better indicator tests. These tests, which assess both bacterial and viral contamination, better indicate the health risk from eating contaminated shellfish. They also would establish more reliable criteria for closing shellfish areas or re-opening previously closed areas.

**STATUS:** *Due to a lack of federal funding, efforts by NOAA's National Indicator Study to develop better indicators of shellfish contamination have been put on hold. Even if this program should receive future funding, it would take several more years of scientific research to develop the necessary indicators.*

## II. VITAL HABITATS PLAN

*GOAL: Conserve and protect vital fish and wildlife habitats and maintain the natural heritage of the Albemarle-Pamlico region.*

### OBJECTIVE A: PROMOTE REGIONAL PLANNING TO PROTECT AND RESTORE THE NATURAL HERITAGE OF THE APES REGION.

***Management Action 1: Develop ecosystem protection and restoration plans (basinwide ecosystem plans) for each river basin in the region. Individual basinwide ecosystem plans will be completed and implemented according to the schedule established for basinwide water quality management plans. (See Objective A in the Water Quality Plan.) Plans should establish coordinated priorities for protecting habitats and critical areas in each basin, and should target areas most vital to the survival of wildlife and fisheries and the protection of natural heritage.***

**Explanation:** Protecting vital habitats involves a great number of agencies and organizations. The coordination of their efforts with strategies that target management at the most critical areas would be best accomplished through basinwide ecosystem

planning. Planning on a river basin level encompasses important ecological habitats that do not correspond to local jurisdictional boundaries. Restoration plans for river basins would provide a means for assessing the sources and causes of habitat damage and enable the appropriate agencies and organizations to coordinate priorities within the entire basin.

**STATUS:** *(1) The Division of Coastal Management (DCM) took some initial steps toward developing ecosystem protection and restoration plans for each of the river basins in coastal region of NC. The project was postponed in 1997 due to staff limitations and a shift in priorities. The objective of this project was to develop a process for natural resources conservation planning at the landscape level. These plans would incorporate information on many topics including identified critical areas, important wildlife and fisheries habitats, existing conservation lands, and local land use planning. If the project resumes, the plans would be used to guide conservation efforts toward the highest conservation priorities. These plans would supplement basinwide water quality plans being developed by DWQ by identifying areas which, if maintained or restored, will enhance water quality.*

*(2) The North Carolina Natural Heritage Program (NCNHP) of the Division of Parks and Recreation has identified priority natural areas for protection in each county of the Albemarle-Pamlico region. In addition, NCNHP, is seeking funds to support the development of plans that document the terrestrial and aquatic conservation priorities for each river basin. The Tar River Basin will serve as the pilot project if funds are found.*

*(3) During the 1996 session of the North Carolina General Assembly, legislation was ratified that established the Wetlands Restoration Program within the Division of Water Quality. Staff of the Wetlands Restoration Program will be developing Basinwide Wetlands Restoration Plans for each of the 17 major river basins in North Carolina. These plans will establish goals and objectives for management, restoration and protection of the wetland resources within each basin. The plans will also prioritize the protection efforts for existing wetlands and potential sites for wetlands restoration and enhancement based on the needs of each basin. This program received $9.2 million for wetlands mitigation.*

*(4) The Coastal Resources Commission revised its state guidelines for local land use planning in the coastal area (15A NCAC 7B) to include new provisions for planning on a small watershed level. Beginning in 1995, DCM began providing technical assistance to local governments for addressing those guidelines. Funding is also now available for the first time from DCM for local*

*governments to address land use planning issues on a regional basis. Eligible activities include regional projects designed to enhance basinwide water quality protection. The first grants for regional planning projects were awarded to local governments in May 1996 and are to be completed during the fall of 1997.*

*(5) The Division of Water Resources (DWR) is coordinating the North Carolina Rivers Assessment (NCRA) which is an evaluation and inventory of some of the important riverine resources of the major rivers and streams across the state. A broad-based coalition of groups, including citizens, municipalities, utilities, agricultural interests, conservation groups, industries and recreationists as well as state and federal agencies, who use and appreciate rivers are participating in the assessment. The NCRA is being conducted in partnership with the National Park Service, and its objectives are to:*

- *Increase public awareness of rivers and their many values.*
- *Evaluate North Carolina rivers using consistent resource-specific criteria.*
- *Develop a GIS database for the storage, management and reporting of river-related resource data.*
- *Increase coordination between local, state, tribal, and federal agencies and organizations which affect or have interests in the state's river resources.*
- *Establish a process for the ongoing evaluation and assessment of the state's river resources.*

*A statewide workshop and seven regional public workshops were held to receive input on the focus areas and scope of the assessment. Over 400 citizens participated in these workshops. As a result, nine riverine resource categories to be evaluated were determined. These include economic uses, ecosystem health, fisheries, history and culture, recreation, scenery, water quality, water supply and wildlife. River corridor volunteer assessment teams will be established in each of the 17 major river basins to facilitate collection of NCRA data.*

*(6) The Conservation Fund is developing the "Albemarle-Pamlico Bioregional Greenway Plan" . The Plan is a proposed network of conservation and heritage corridors that link parks, wildlife refuges, education centers, historic sites, and recreational facilities in the 30,000 square mile Albemarle-Pamlico estuarine region. Since 1994, The Conservation Fund, in partnership with numerous state, regional, and local agencies and citizens, has been designing a network of greenways that define a "green infrastructure" for a sustainable economic development program focusing on nature-based tourism, environmental education, stewardship, and associated economic development opportunities. The Conservation Fund utilized GIS mapping technology to facilitate the*

*identification of this network of corridors with assistance from the NC Center for Geographic Information and Analysis (CGIA) and numerous conservation professionals.*

***Management Action 2: Develop and maintain accurate maps and records of wetlands, fisheries habitats, federal and state endangered species and their habitats, natural areas, and natural communities.***

**Explanation:** Accurate maps of natural areas are essential to the development of basinwide ecosystem plans. They allow for more accurate analysis of protection and enhancement priorities for various habitat types. A biological inventory of the region was part of the Albemarle-Pamlico Study and additional detailed inventory and monitoring projects would be completed for individual counties and for the most significant natural areas. This information would be kept current and accurate. Up-to-date, readily available biological inventories, maps, and data would provide local governments, planners, land managers, and private citizens with the information they need to protect habitats.

**STATUS:** *(1) The Division of Marine Fisheries (DMF) has mapped shellfish substrate and resource abundance for portions of the North Carolina coast. Mapping has been completed for the area from Snow's Cut to the Newport River, the South River, and areas around Roanoke Sound (including Shallowbag Bay) south to Oregon Inlet. Currently, DMF is mapping the Cape Fear River area near Sunny Point and areas of Core Sound.*

*(2) The Division of Parks and Recreation's Natural Heritage Program continues to maintain databases and GIS database layers of rare species occurrences and ecologically significant areas (Natural Heritage Priority Areas). These layers are statewide in scope. In addition to on-going statewide work, detailed natural community and rare species inventories were conducted at several important sites in the Albemarle-Pamlico region. These sites are the lower Roanoke River, Dare County Air Force Bombing Range, the Dismal Swamp State Natural Area and the Croatan National Forest. These site specific inventories supplement the county level natural area inventories that were conducted as part of the Albemarle-Pamlico Estuarine Study.*

*(3) The US Fish and Wildlife Service has completed the National Wetland Inventory (NWI) maps for the Albemarle-Pamlico region. These data layers have been digitized and are being maintained by the Center for Geographic Information and Analysis (CGIA). The Division of Soil and Water Conservation can provide copies of NWI maps upon request.*

*(4) The US Soil Conservation Service has completed and digitized soil survey maps for 33 of the 36 counties located in the Albemarle-Pamlico region. Soil survey maps for Wayne, Halifax, and Pamlico counties are scheduled for completion during the summer of 1997. Hard copies of these maps are available at the Natural Resources Conservation Service's field office in each county. Digital versions of these maps are being archived and distributed through the NC Center for Geographic Information and Analysis (CGIA).*

*(5) The Division of Coastal Management (DCM) has developed a methodology for mapping wetlands in eastern North Carolina, based on the National Wetland Inventory and soils information, combined with the APES LandSAT land cover layer. These maps show the extent and distribution of both freshwater and estuarine wetlands. Wetlands mapping is complete for 19 of the 20 counties in the CAMA area. In support of this work, DCM has extended the APES LandSAT land cover layer to include the entire NC coastal area and is supporting a current project to update that land cover information with more recent imagery. The land cover update project will include an analysis of the change that has occurred between the two sets of satellite imagery.*

*(6) DWQ is developing a computer tracking system to track permitted wetland activities that can be used to evaluate compliance with 401 Water Quality Certification conditions required to protect water quality. This data base will be interactive with the Army Corps of Engineers, the US EPA, and DWQ's regional field offices. This will enhance DWQ's ability to assess impacts of wetland fill activities.*

*(7) The Center for Geographic Information & Analysis (CGIA) is currently developing a land cover map of the state that would aid in protecting wetlands. As of March 1997, a preliminary state-wide land cover data file has been completed and is available through CGIA. A final version will be available by August 1997. As part of this initiative, DWQ completed a field check of forty quadrants to evaluate the accuracy of the land cover maps in delineating wetlands.*

***Management Action 3: Expand programs to identify wetlands on a regional scale and to evaluate and rank wetland function.***

**Explanation:** An accurate identification and evaluation of wetlands, in advance of proposed activities that disturb wetlands, improves our ability to protect the most critical wetlands and to make wetlands permitting more predictable for developers and local governments. An Advanced Identification (ADID) program is a multi-agency

effort that tests a variety of methods to evaluate wetlands. Under this program, wetlands regulations would not be expanded. Instead, the wetlands permitting process would become more efficient.

**STATUS:** *(1) The Division of Water Quality will be developing a wetland function assessment methodology in the mountains and the Piedmont to prioritize wetlands for the protection of water quality, similar in scope to the Division of Coastal Management's wetland functional assessment. This initiative will be funded by an EPA-State Wetland Program Development Grant (pending availability of funds).*

*(2) The Division of Coastal Management has completed wetland mapping for all of the coastal counties under CAMA jurisdiction, with the exception of Pasquotank County, which is scheduled for completion during the summer of 1997. In addition, Cumberland County, which is located in the upper coastal plain, and not under CAMA jurisdiction, has been successfully mapped by utilizing slight modifications of existing methodologies.*

## OBJECTIVE B: PROMOTE THE RESPONSIBLE STEWARDSHIP, PROTECTION, AND CONSERVATION OF VALUABLE NATURAL AREAS IN THE APES REGION.

***Management Action 1: Bring areas identified as having the highest priority for protection into public ownership and/or management. Expand funding for public acquisition of park lands, gamelands, coastal reserves, and other natural areas.***

**Explanation:** Natural areas that are most vital to maintaining the region's natural heritage have been identified. Further priorities will be determined through basinwide ecosystem planning. Where possible, voluntary acquisition is an important tool for protecting these areas. In addition to preserving rare species and natural communities, public areas that are managed by different agencies can serve a variety of purposes such as recreation, education, or hunting.

**STATUS:** *(1) The Natural Heritage Trust Fund has provided grants to the Division of Coastal Management, the Division of Parks and Recreation, the NC Wildlife Resources Commission, the NC Department of Cultural Resources, and the NC Department of Agriculture for acquisition of 14 significant natural areas in the Albemarle-Pamlico region. Acquisitions include lands at: Buxton Woods Coastal Reserve, Kitty Hawk Woods Coastal Reserve, Jockey's Ridge State Park, Run Hill State Natural Area, Occoneechee Mountain State Natural Area,*

*Eno River State Park, Historic Leigh Farm Park, Bentonville State Historic Site, Roanoke River Wetlands Game Land, North River Game Land, Clemmons Educational State Forest, Walter B. Jones 4-H Environmental Educational Center, William B. Umstead State Park, and Bull Neck Swamp.*

*In addition to the lands that the Division of Parks and Recreation has purchased at Run Hill -- one of two active dunes remaining on the North Carolina coast -- and along the Eno River as additions to Eno River State Park, land acquisition projects have been initiated for additions to Pettigrew, Medoc Mountain, and Goose Creek State Parks.*

*(2) The Division of Coastal Management (DCM) completed the acquisition of maritime forest natural areas on Hatteras Island. A total of 825 acres at Buxton Woods is now preserved as part of the North Carolina Coastal Reserve system. A formal dedication ceremony was held May 19, 1997. The Division's latest efforts in maritime forest protection have been in Kitty Hawk Woods. A total of 350 acres were purchased and combined with an existing 462-acre conservation easement to establish the Kitty Hawk Woods Coastal Reserve. The Division anticipates purchasing an additional 220 acres in Kitty Hawk within the next 18 months. The acquisition of these vital habitats will enhance the education and research goals of the NC Coastal Reserve and associated National Estuarine Research Reserve program.*

*(3) DCM hired a new site manager for the northernmost sites in the NC Coastal Reserve system (Currituck Banks, Kitty Hawk Woods, and Buxton Woods). That person is working with researchers and educators to promote stewardship, protection, and conservation of estuaries, maritime forests and other natural areas.*

*(4) As of May 1997, The Nature Conservancy (TNC) has acquired 379,137 acres of vital habitats throughout the state -- of which 253,684 of these acres (67%) are located in the Albemarle-Pamlico region. Many of the sites are managed and protected by TNC in agreements or partnerships with other agencies/organizations, such as the US Fish & Wildlife Service, NC Division of Coastal Management, NC Wildlife Resources Commission, NC State Parks, NC Department of Transportation, and Georgia Pacific Corporation.*

*(5) The NC Coastal Land Trust works with interested riparian land owners, one by one, on individual projects to protect natural areas on the state's coastal rivers. In October 1995, the Trust was awarded a $55,000 two-year grant from The Mary Whiting Ewing Foundation, Inc., in support of the Trust's "Rivers to the Coast Project", which is a conservation easement initiative for the protection*

*of significant privately-held conservation lands along the Cape Fear, Neuse, and North/North Landing river corridors. This grant will be used to increase the number of acres of significant riparian habitat and plant and animal communities for protection along the rivers. With funding from the National Fish & Wildlife Foundation and the World Wildlife Fund, the Trust conducted workshops in Carteret and Cumberland counties regarding conservation easements, tax incentives, and ways to capitalize on protected properties through limited development and forestry.*

*The North Carolina Wetlands Conservation Plans will identify priority wetlands protection, restoration and enhancement needs in each of the 17 river basins in North Carolina.*

***Management Action 2: Provide incentives and technical assistance for the protection of privately owned vital habitats.***

**Explanation:** High-priority natural areas that are not brought into public ownership can be targeted for private conservation. Efforts would be expanded to inform private land owners of the ecological values of their land, to advise them on appropriate management strategies, and to help them explore options for voluntary protection. Where possible, conservation organizations could acquire vital habitats in order to consolidate management and protection efforts.

**STATUS:** *(1) The Natural Heritage Program (NHP) has entered into a Memorandum of Understanding with Georgia-Pacific and The Nature Conservancy to inventory 25 significant natural areas on GP lands and to develop management criteria which protect or enhance the habitats of rare species or high quality natural communities. Three percent of these sites are in the Albemarle-Pamlico region. The NHP, in cooperation with the Division of Forest Resources and the Environmental Protection Agency, is working to identify specific rare wetland types that should be protected from conversion to pine plantations. Of the nine types initially identified, eight occur in the Albemarle-Pamlico region.*

*(2) The Division of Coastal Management began in FY 95-96 providing comprehensive information packages to local governments for updating their land use plan. That information includes a current map and GIS data layer of natural heritage sites from the Natural Heritage Program inventory. The Coastal Resources Commission's revised land use planning guidelines (15A NCAC 7B) ask local governments to identify fragile areas that could be damaged or destroyed by inappropriate development and list the types of land uses it feels are appropriate in each of those areas.*

*(3) DWQ has produced a catalog, "Wetlands Protection: A Catalog for Wetland Managers", to increase the public's awareness of wetland conservation programs that are available to assist them in protecting vital habitats.*

*(4) DWQ has also developed "A Field Guide to North Carolina Wetlands" to assist wetland managers in identifying and protecting the values and functions of their wetland resources.*

*See STATUS for Objective B, Management Action 1 above for related information regarding this topic.*

## OBJECTIVE C: MAINTAIN, RESTORE, AND ENHANCE VITAL HABITAT FUNCTIONS TO ENSURE THE SURVIVAL OF WILDLIFE AND FISHERIES.

***Management Action 1: Enhance the ability of state and federal agencies to enforce existing wetlands regulations by 1995.***

**Explanation:** Strengthening enforcement of current wetlands regulations and ensuring compliance with the existing permitting process are essential to minimizing inappropriate development in wetlands areas. Aerial monitoring would be expanded to increase coverage and ensure efficient enforcement. Enhanced enforcement would prevent some actors from gaining an unfair advantage through their failure to comply with wetlands regulations.

**STATUS:** *(1) The 401 computer tracking system, currently being developed by DWQ, will help to identify significant wetland changes and can be used to evaluate and revise permitting and monitoring activities.*

*(2) DWQ has requested additional funds to increase staff to enhance the 401 Water Quality Certification Program. The Environmental Management Commission has adopted rules, effective October 1, 1996, which will enhance the ability of the DWQ to take enforcement actions against individuals that fill or alter wetlands without the appropriate certifications and permits.*

***Management Action 2: Strengthen regulatory programs to protect vital fisheries habitats, which include submerged aquatic vegetation, shellfish beds, and spawning areas by 1995.***

**Explanation:** Vital fisheries habitats are threatened by water quality degradation, physical destruction and the cumulative impacts of development in the region.

Protecting areas in which aquatic organisms breed, live, and feed is essential to the successful propagation of many finfish and shellfish species. Increased protection for vital fisheries habitats will help maintain healthy fish populations for abundant commercial and recreational harvests.

**STATUS:** *(1) By rule, the Marine Fisheries Commission (MFC) has included a definition for areas to be designated as critical habitat. These areas include fish nursery areas, beds of SAV, shellfish producing areas, anadromous fish spawning grounds, and anadromous fish nursery areas. Once these areas are identified and delineated by the Division of Marine Fisheries and Wildlife Resources Commission, appropriate use standards could then be applied by the various regulatory commissions. For example, the MFC could decide to restrict certain fishing practices in or near designated spawning areas or SAV beds. The Environmental Management Commission could consider specific water quality protection measures for vital fisheries habitats, such as designating these areas as High Quality Waters.*

*(2) The Environmental Management Commission has adopted rules, effective October 1, 1996, that establish classifications for wetlands, define wetlands that will be classified, designate uses for wetlands, establish narrative standards to protect the designated uses of wetlands, and provide greater detail on the procedures used to review requests for 401 Water Quality Certifications.*

*(3) The Division of Coastal Management (DCM) has identified several areas, or habitat types, within the coastal zone that are deemed important for the protection of vital fisheries resources, and are therefore afforded protection under the special use standards of the rules of the Coastal Resources Commission (CRC). These areas, known as Areas of Environmental Concern (AECs), include estuarine waters, estuarine shorelines and coastal wetlands. Furthermore, several AEC components (primary nursery areas, outstanding resource waters, submerged aquatic vegetation beds, and open shellfish waters) receive an increased level of protection in the rules of the CRC. DCM uses the CRC use standards to ensure that fisheries resources are not adversely impacted by development projects located within AECs. Additionally, proposed projects which do not meet certain criteria must undergo a coordinated state and federal review (which includes the Division of Marine Fisheries, Division of Water Quality, Wildlife Resources Commission, and National Marine Fisheries Service) before final action may be taken on a permit application.*

***Management Action 3*: Enhance existing efforts to restore the functions and values of degraded wetlands and vital fisheries habitats. Develop and begin implementing an expanded program to restore wetlands.**

**Explanation:** Natural areas that have been slightly or moderately damaged may be restored by means such as replanting vegetation, repairing hydrological systems and improving water quality. Expanding restoration will increase the region's acreage of valuable, functioning vital habitats. Research and development of successful restoration techniques will ensure that these efforts are cost-effective.

**STATUS:** *(1) During the 1996 session of the North Carolina General Assembly, legislation was ratified that established the Wetlands Restoration Program. The legislation provided $500,000 to support the staff of the program and appropriated an additional $9,200,000 that will be used for restoration and protection of wetlands and riparian areas. This program will develop Basinwide Wetlands Restoration Plans for each of the 17 river basins in North Carolina. During the development of these plans, the existing wetland and riparian area resources in each basin will be evaluated. This evaluation, in conjunction with other information, such as nonpoint sources of pollution, flood control needs and habitat needs, will be used to prioritize protection, restoration and enhancement efforts throughout each basin. The goal of these plans is to ensure that the funds used to protect existing wetlands and to restore and enhance degraded areas are used so that the greatest environmental benefit is achieved.*

*(2) A research project, funded by the Albemarle-Pamlico Estuarine Study in 1989, identified certain dams, culverts, stream channelizations, and artificial drainages as obstructing the migration of anadromous fish. With funding from the federal Coastal America Program, a multi-agency effort, coordinated by the Division of Water Quality and Division of Water Resources, is underway to remove two dams located in Wayne County of the Neuse River Basin. Removal of these dams will restore approximately 75 miles of the Neuse River's main stem and an additional 925 miles of tributaries and streams for anadromous fish migration.*

*(3) The US Fish & Wildlife Service (USFWS) is working to restore habitats in the Pocosin Lakes National Wildlife Refuge. Having received the necessary funding, the USFWS intends to restore the hydrology and vegetation to an entire 18,000 acre tract of land (formerly known as the "Old Peat Methanol Associates Property) located south of Lake Phelps and east of Pungo Lake. To date, hydrology and vegetation has been restored to a 640 acre site. The area was planted with Atlantic white cedar, bald cypress, and pond pine. Also, in*

*1996, the USFWS planted an additional 510 acres with bald cypress in an area adjacent to this site. The hydrology will also be restored at this site. The water quality in the drainage canal exiting the site has improved in terms of mercury levels, with further improvements expected in the near future. Additionally, plans by the USFWS to restore the natural fire regime to large wetland acreages in the Alligator River National Wildlife Refuge is underway. Plans are being drafted.*

***Management Action 4: Establish by 1995 a consistent and effective mitigation program to compensate for unavoidable permitted wetlands losses.***

**Explanation:** Mitigation compensates for the loss of smaller, fragmented wetlands with the acquisition, enhancement or restoration of larger, contiguous wetlands. A practical and coordinated system of mitigating wetlands damage, that is permitted only after all efforts to avoid and minimize alteration of wetlands have been considered, would ensure the greatest possible long-term benefit to vital habitats. Mitigation banking is a mechanism that allows land developers to alter wetlands in exchange for financial contributions toward the acquisition, enhancement, restoration, or creation of wetlands with similar value. This practice would be evaluated for expanded use in the region.

**STATUS:** *(1) The Wetlands Restoration Program will draw upon the resources of the Divisions of Water Quality, Coastal Management, Soil and Water Conservation and Wildlife Resources Commission, federal agencies, local governments, non-profit organizations and the general public in the development of the Basinwide Wetlands Restoration Plans. The plans will locate and prioritize potential restoration sites in each basin using a GIS-based mapping method referenced in Objective A, Management Action 2. These plans will provide a mechanism that will ensure that all wetlands restoration activities, including compensatory mitigation, will be conducted consistent with the goals and objectives of the Basinwide Wetlands Restoration Plans.*

*(2) The Basinwide Wetlands Restoration Plans would be based on information contained within DWQ, DCM, and other resource agency databases and managed initially through DCM's existing GIS facilities and procedures. While DCM is currently utilizing said procedures for applications in the coastal area (mapping and functional ratings of wetland types and potential wetland restoration sites), some modifications would be made for applications in the piedmont and mountain areas of the state. The Wetlands Restoration Program would then plan, implement, and monitor compensatory mitigation to address water quality needs, preferably within the same small watershed (NRCS 14-*

*digit). The guidelines would ensure that compensatory mitigation is performed in an ecologically-sensitive manner and will replace lost wetland functions.*

*(3) In addition to providing a plan for restoration efforts and conducting restoration, enhancement and preservation activities, the Wetlands Restoration Program will also provide an option for complying with compensatory mitigation requirements associated with 404 permits and 401 water quality certifications. Applicants will be able to pay a per acre fee that has been established by the Environmental Management Commission in lieu of performing their own mitigation project. This option is only available after the Army Corps of Engineers and DWQ have determined that the wetlands impacts have been minimized to the maximum extent practicable. The fees paid by applicants will be used to implement restoration projects that provide water quality benefits, fisheries and wildlife habitat and recreational opportunities in accordance with the Basinwide Wetlands Restoration Plans.*

## III. FISHERIES PLAN

*GOAL: Restore or maintain fisheries and provide for their long-term, sustainable use, both commercial and recreational.*

**OBJECTIVE A: CONTROL OVER-FISHING BY DEVELOPING AND IMPLEMENTING FISHERY MANAGEMENT PLANS FOR ALL IMPORTANT ESTUARINE SPECIES.**

***Management Action 1: Develop and implement management plans for fisheries that are important to recreational and commercial fishing interests. These plans would include recovery objectives for severely depleted stocks by 1999.***

**Explanation:** State fishery management plans will allow the Marine Fisheries Commission (MFC) and Wildlife Resources Commission (WRC) to identify and maintain healthy stocks of important commercial and recreational fish. The plans will enhance depleted and declining stocks and restore economically important species for future harvest.

**STATUS:** *The pending Fisheries Reform Act will accelerate the process, calling for the completion of Fisheries Management Plans on commercially and recreationally significant species. Plans must be reviewed and revised every* three years.

***Management Action 2: Modify the existing marine fisheries license structure to improve data collection with respect to landings, demographics and fishing effort, and to generate increased revenues for fisheries management.***

**Explanation:** A license system that enhances fisheries data collection is critical to developing and implementing state fishery management plans. The data collected is necessary for additional research on how regulations impact the fisheries. License revenues can support fisheries research, habitat restoration and other management improvements.

> **STATUS:** *Substantial work by the Moratorium Steering Committee -- ranging from proposed modifications of membership to the Marine Fisheries Commission, to proposed licensing categories, to law enforcement and habitat protection--have been targeted. For example, new licensing categories, including the following, have been proposed: individual licenses (three types); a shellfish harvest license; a gear license; and a coastal mariculture license; others include fish dealer licenses; commercial fishing pier licenses; and fishing tournament licenses. On August 1 and 2, 1996, the Moratorium Steering Committee voted on their preliminary findings and held 19 public meetings between August 19th and September 25th to seek public input. After the public meetings, the Moratorium Steering Committee presented their recommendations to the Legislature. The pending Fisheries Reform Act includes the majority of the Moratorium Steering Committee license proposals with the notable exception of a saltwater license.*

**OBJECTIVE B: PROMOTE THE USE OF BEST FISHING PRACTICES THAT REDUCE BYCATCH AND IMPACTS ON FISHERIES HABITATS.**

***Management Action 1: Continue and expand the development of bycatch reduction gear and practices, and require their use as practicality is demonstrated. Aim to reduce inside trawl, long haul seine, pound net, and gill net bycatch by at least 50 percent by 1995.***

**Explanation**: Minimizing non-targeted harvests will preserve the diversity of fish populations and support the long-term use of fisheries resources. Implementing efficient and effective measures to reduce bycatch eventually may result in lower costs to commercial fishermen.

> **STATUS:** *(1) Bycatch reduction devices (BRDs) have been required in the shrimp fishery since 1992. In order to comply with the Atlantic States Marine Fisheries Commission (ASMFC) Weakfish Management Plan, a reduction of 50% of the weakfish in shrimp trawl bycatch must be obtained. With support*

*from a Marfin Grant (awarded by the NMFS), the NC Division of Marine Fisheries (DMF), working with fishermen, have experimented with many different BRD designs aboard Division vessels and commercial shrimp trawlers. These tests yielded three designs which met the ASMFC's criteria for weakfish reduction; the Florida Fish Excluder, the large mesh extended funnel excluder, and the large mesh funnel excluder. During April 1996, DMF conducted a series of workshops to discuss upcoming changes in the requirements for BRDs used in shrimp trawls. Effective July 1, 1997, only these devices will satisfy the requirement for BRDs in shrimp trawls.*

*(2) Additionally, under the Atlantic Coastal Fisheries Cooperative Management Act (ACFMA), bycatch reduction devices, such as culling panels in long haul seines and pound nets, are being tested.*

***Management Action 2: Institute a cost share program for best fishing practices for commercial fishing gear by 1995.***

**Explanation:** A cost share program would help alleviate the financial burden and encourage commercial fishermen to implement best fishing practices.

**STATUS:** *(1) Created by the NC General Assembly in 1994, the Fisheries Resource Grant Program, a $1 million grant program, is touted as a way to help fishermen design new gear and studies to ease overfishing, to improve fisheries habitat and to diversify the fishing industry. Four types of projects addressing the following areas may be funded ($1,000,000/yr.): (1) new fishing equipment and techniques to reduce bycatch and fishing impacts; (2) assessments of fishing industry trends: (3) environmental studies targeted toward reducing adverse environmental impacts of fishing techniques, restoring fishery habitat, and understanding environmental controls of fish and shellfish abundance; and (4) other fishery issues that will enhance NC's coastal fisheries.*

*In 1995, the NC Marine Fisheries Commission selected 38 projects that received $905,521 research money under this fishery resource grant program. In 1996, 109 applications were received. Many of the grants awarded through the Grant Program require some form of cost share by the recipient. As of July 1, 1996, this grant program is being administered by the North Carolina Sea Grant program. In 1997, 86 grant applications were received and 32 were funded.*

*(2) The Division of Marine Fisheries received funding from the NC General Assembly in FY '94/'95 and again in FY '95/'96 to enhance enforcement and fisheries management efforts.*

# IV. STEWARDSHIP PLAN

*GOAL: Promote responsible stewardship of the natural resources of the Albemarle-Pamlico region.*

## OBJECTIVE A: PROMOTE LOCAL AND REGIONAL PLANNING THAT PROTECTS THE ENVIRONMENT AND ALLOWS FOR ECONOMIC GROWTH

***Management Action 1: Support local planning by providing funding and economic incentives to local governments to integrate environmental and economic planning by 1999.***

**Explanation:** Local planning gives governments the opportunity to direct their own growth and enables private investors and local citizens to make informed decisions. Comprehensive planning also promotes economic development and environmental protection that are compatible. Financial assistance to local communities would encourage land and water uses that have the least impact on natural resources while promoting sound economic growth, included increased opportunities for nature-based tourism.

**STATUS:** *(1) There has been no action to date with regard to implementation of the recommendation to hire six new staff members (planners) within the Department of Commerce (DOC). This recommendation requires introduction of legislation to fund the effort. There is no indication from the Division of Community Assistance (DCA) within the DOC that progress has been made toward implementation of this management action.*

*(2) Two projects funded by the APES CCMP implementation grant, "Environmental & Economic Planning Handbook" (due September 1997) and "Open Space Design Guidebook, Albemarle-Pamlico Estuarine Region" are intended to assist local governments and citizens with local and regional planning efforts. The "Open Space Design Guidebook, Albemarle-Pamlico Estuarine Region" was selected by the NC American Planning Association (NCAPA) as the 1997 award winner in the category Large Community Outstanding Planning Award-Comprehensive Planning.*

***Management Action 2: Provide to local governments affordable and accessible data from the state Geographic Information System (GIS) for use in planning and public education within the region by 1996.***

**Explanation:** Local comprehensive plans influence private and public development and management decisions, and should be supported with accurate and timely geographic information. Increasing the availability of state GIS data to local governments will help in environmental and economic planning.

**STATUS:** *(1) The North Carolina Center for Geographic Information and Analysis (CGIA) was instrumental in assisting the development of significant coastal digital geographic data sets during the 1987-1994 Albemarle-Pamlico Estuarine Study (APES). Through a Memorandum of Agreement, CGIA was designated as the APES Data Management Center and was the official repository for GIS data sets. Approximately 60 digital data sets are now being distributed as part of the North Carolina Corporate Geographic Database (CGDB), which is "on-line," physically distributed and supported by the North Carolina Information Highway.*

*(2) Many of the data layers are maintained by the source agency and are updated on a regular basis. Other layers are updated on an irregular basis (and some not at all) as money permits. All data layers are available through CGIA. Recent additions to the CGDB that have significant APES and coastal area interest include:*

*Digital Orthophotography Quarter Quadrangles for APES and CAMA counties. This is 1993 aerial photography at 1:12,000 scale in which displacements caused by the camera and terrain have been removed. The digital processing of the photography was a joint cost share involving numerous state and federal agencies. It is available "on-line" through CGIA, or as CDs of individual counties (source: USGS).*

*Water Distribution Systems and Sanitary Sewer Systems: Phase 2 (APES area) of a statewide inventory is now in progress. Preliminary data has been received for more than six APES counties. The project is funded by the NC Rural Economic Development Center, NC Department of Commerce, Division of Community Assistance, the Northeast Partnership, North Carolina's Southeast, and the Lower Cape Fear Water and Sewer Authority (source: NC Rural Economic Development Center).*

*Land Cover-Thematic Mapper, 1994-1995. The preliminary classified statewide inventory is now available. The final classification scheme will be available beginning in August 1997. (source: LandSat Thematic Mapper).*

*Advanced Wetland Identification project. This project is identifying and functionally assessing wetlands in CAMA counties based on numerous factors. It also is identifying and functionally assessing wetland restoration sites. As sites are completed, the data will be released to the CGDB (source: NC DEHNR, Division of Coastal Management).*

*Hurricane Storm Surge Inundation Areas, 1993 data. Dare and Carteret counties data will be released in June 1997; the remaining coastal counties have been authorized for development in cooperation with the NC Division of Emergency Management. Data for New Hanover, Brunswick, Pender and Onslow counties were released in the summer of 1996 (source: US Army Corps of Engineers).*

*(3) In support of APES data, access to the CGDB across high-speed communication line (T-1, Wide Area Network) has been authorized for the Division of Marine Fisheries (Morehead City, NC) and NOAA Coastal Service Center (Charleston, SC). These locations were added to existing access agreements with the Division of Coastal Management, Department of Transportation, Department of Environment , Health and Natural Resources and various departments at NC State University.*

*(4) The NC Geographic Data Clearinghouse has launched a new spatial, temporal and keyword search capability that allows custom geographic data searches on the Internet. The Clearinghouse indexes all data sets in the Corporate Geographic Database and from local government sources and links to comprehensive metadata (data about the data) on each set.*

*(5) CGIA conducted presentations and GIS demonstrations and workshops in the following venues:*

*(a) Participated in quarterly video teleconferenced meetings and demonstrations organized by the Geographic Information Coordinating Council standing committees: the Affiliated GIS Users Group, geared to local governments and universities, and the Federal Interagency Group. Each teleconference included Wilmington and Greenville state university facilities. The State Government GIS Users Committee meetings in Raleigh generally draw participants from state government regional offices in Morehead City.*

*(b) Participated in the October 1996 NC State Fair "Cyberspace Exhibit." Organized by the Department of Agriculture, the exhibit included two continuous hands-on GIS demonstrations where participants zoomed into their county to view CGDB data, learned about their river basin, and received local demographic information.*

*(c) The DEHNR Office of Environmental Education in cooperation with the Department of Public Instruction, NC State University's College of Education SCI-LINK/GLOBE-NET project, NC State University Computer Graphic Center and CGIA conducted a GIS teacher training workshop in July 1996. The week-long workshop used thematic and environmental data from the CGDB for the Neuse River Basin to support curriculum objectives and classroom adoption of GIS into interdisciplinary instruction.*

*(d) The largest outreach effort was a series of workshops held at three coastal locations on December 4, 5, and 6, 1996. These APES workshops provided an opportunity to disseminate information about data sets of coastal relevance to governmental agencies and planning organizations. All county and municipal governments located within the eight river basins that flow to the coast were invited, mirroring the state's river basin planning initiatives.*

*Invitations to the three coastal workshops were determined by location within the eight river basins that empty into an estuary or coastal waters:*

**Dec. 4, 1996 - Cape Fear and Lumber River Basins (9 counties)*
**Dec. 5, 1996 - Neuse, Tar-Pamlico, & White Oak River Basins (20 counties)*
**Dec. 6, 1996 - Chowan, Roanoke, & Pasquotank River Basins (18 counties)*

*Invited participants included:*

*City, town and county officials and elected representatives*
*Staff from lead regional organizations (COGs)*
*Staff from Cherry Point, Camp Lejeune, and Fort Bragg military bases*
*Staff from regional economic development commissions*
*Environmental and conservation groups*
*River basin advisory committees*
*Chambers of Commerce*
*Soil and Water Conservation Districts and District Conservationists*
*Natural Resource Conservation District management*

*The largest number of participants in each session represented city and county government:*

| | |
|---|---|
| *Wilmington* | *40 of 50 registrants* |
| *Morehead City* | *72 of 90 registrants* |
| *Plymouth* | *40 of 63 registrants* |

*There was a sizable contingent from the environmental health sector, soil and water conservation districts, and the military (at the Morehead City meeting). Lead regional organizations, the Department of Commerce, Division of Community Assistance and several environmental groups (Neuse River Foundation, Coastal Federation, Nature Conservancy) were also in attendance.*

*Presentations featured actual GIS applications that analyzed data to assist decision-makers as well as real-world local government experiences with this technology. Discussion identified particular GIS data layers that were still needed, including topography, elevation data, floodplain characteristics, intensive livestock operations, detailed surface water, detailed groundwater, water use plans, water supply systems, traffic counts, military zones (noise), Atlantic white cedar stands and land use.*

*The workshop panel discussions generated a volume of requests for the two APES/CGIA-produced GIS videos that were targeted for local government officials and agencies:*

*A Coastal County in 2010 A.D. with Geographic Information Systems - In this overview of GIS, county commissioners, planners and government agencies learn how GIS technology can help resolve land-use issues in sensitive coastal areas. Suitability analysis and predictive analysis capabilities are featured using GIS displays. (1990-15 minutes)*

*GIS - Develop the Future - This dramatization shows a developer working closely with local government officials and state regulatory agencies on a marina/residential project. GIS, through the NC CGIA network, is the common link used in the planning and permitting process. Siting and potential environmental problems are resolved through GIS and agency/developer cooperation. (1992-13 minutes) CGIA ordered the video reproduction of 100 copies of a combined tape with both programs. Tapes were mailed to all requesters in early January 1997.*

*(6) In 1995, the Division of Coastal Management (DCM) began providing comprehensive information packages to local governments to support local land use plan updates. These packets include a GIS-derived map series and accompanying tabular information, covering demographic, natural resource, environmental quality and infrastructure information. Updated information packets will be provided each year in the future to coastal counties and municipalities that are updating their land us plans. DCM is also working with coastal jurisdictions that have a geographic information system, to provide them GIS data from the NC Corporate Database.*

**Management Action 3: Implement a comprehensive, coordinated and proactive approach to managing the state's public trust waters by 1996.**

**Explanation**: North Carolina holds the waters, the lands beneath them and the resources living in them in trust for its citizens. The state has the authority and responsibility to preserve their natural value as a part of our common heritage. Several state agencies are responsible for the stewardship of this public trust. As the region's population continues to grow, public use of the sounds and waterways will increase as well. Greater conflicts are likely between various groups, including those who use the resources of public trust areas for profit. Therefore, closer coordination is necessary between the agencies that manage these resources. Public trust policy should be proactive and should consider issues related to future population growth, including public access and compensation for uses of public trust resources.

**STATUS:** *(1) Recognizing that the discharge of sewage from recreational and commercial vessels can have adverse impacts on local water quality, the Division of Coastal Management (DCM) initiated an assessment of marine sewage pump out facilities along the NC coast in 1992. DCM completed an inventory of services available to boaters coast wide and publicized their locations through a popular guide. This inventory showed a lack of pump out facilities to adequately serve boaters in the coastal area, particularly in the Albemarle-Pamlico region. The Division also posted standardized signs at all marina with pump out facilities to increase their visibility.*

*(2) In 1994, DCM established the NC Marine Sewage Pump out and Dump Station Grant Program (NC Pump out Program). The goal of the program is to make pump out and dump stations readily available and significantly more convenient for recreational boaters and marina operators in coastal NC. Financial assistance is provided in the form of matching grants for the installation of new pump out and dump stations and/or the renovation of existing facilities for public use.*

*Matching funds are available to marinas (private, commercial and municipal), gas/service docks, fish house/seafood dealers and other boat docking facilities in the 20 coastal counties. The NC Pump out Program provides 75% of the project costs, up to $10,000, with the grant recipient providing the remainder. Local governments may receive 90% of the project costs (up to $10,000). As an incentive to marinas to offer pump out/dump station service at no charge to recreational boaters, DCM provides 85% of the project costs if the service is offered free rather than charging the allowed $5.00 fee.*

*To fund the NC Pump out Program, DCM received a total of $404,250 in federal funds through the 1992 Clean Vessel Act. The US Fish & Wildlife Service administers the federal program and provides matching funds to states. The majority (97%) of the NC Pump out Program's matching funds comes from the marinas. The guidelines for the grant program were developed by an interagency advisory committee comprised of representatives from the NC Divisions of Coastal Management, Environmental Health (Shellfish Sanitation Branch),Water Quality, Marine Fisheries, NC Sea Grant and the NC Marine Trades Program. In the first two years, the program awarded $152,921 in financial assistance to 25 marinas, three local government docking facilities (Columbia, Carolina Beach and Edenton) and the Wanchese Seafood Industrial Park. Of the 29 grants, 15 are for services located in the Albemarle-Pamlico area with five new facilities being installed in counties which previously had no pump out or dump stations services. An educational poster and brochure have also been produced. DCM has received $147,000 from the USFWS to continue the program and expects to fund 10 to 15 additional pump out facilities in 1997.*

***Management Action 4: Provide support to organizations that promote nature-based tourism and environmental education as a way of fostering environmentally sound economic development in the region.***

**Explanation:** The mission of the recently formed Partnership for the Sounds is to promote economic development through environmental conservation, education and nature-based tourism. The Partnership seeks to educate people who come to the Albemarle-Pamlico region to enjoy its natural environment. The more people know about the ecological balance of a region where they vacation or earn a living, the more invested they will be in the stewardship of its resources.

**Revised Explanation:** The mission of the Partnership for the Sounds, Inc. (PfS) is to stimulate local, sustainable, community-driven economic well-being within the Albemarle-Pamlico region through the promotion of eco/cultural tourism, environmental stewardship, and education.

PfS was chartered in 1993 as a non-profit organization. It is overseen by a Board of Directors comprised of representatives from local governments, non-profit organizations, businesses, and industries in the Albemarle-Pamlico region. The focus area of Partnership activities includes Beaufort, Bertie, mainland Dare, Hyde, Tyrrell, and Washington counties.

The diverse groups represented by the Partnership were brought together by a common interest in developing environmental/cultural education facilities that would provide focal points for tourism in the region. With coordinated infrastructure improvement, the area could become an appealing destination to the rapidly growing ecotourism and heritage tourism markets. By helping develop that infrastructure, PfS hopes to foster an economic niche that celebrates and conserves the region's unique ecology and ways of life.

**STATUS:** *(1) The NC General Assembly has appropriated funds to the Partnership each year since 1993-'94. Capital funding has been provided for the construction or renovation of PfS educational facilities, and a recurring line item has helped cover staffing and administrative costs.*

*The Partnerships coordinating the development of six education-oriented sites and several other ecotourism-related projects on the Albemarle-Pamlico peninsula. Each will interpret different aspects of the ecosystem that encompasses the region, and each will promote visitation to the other facilities, associated natural areas and historic sites, and other points of interest in the five-county PfS area.*

***The six PfS sites are:***

**The North Carolina Estuarium, located in Washington*
**The Lake Mattamuskeet Lodge, located on the Lake Mattamuskeet National Wildlife Refuge near New Holland*
**The Walter B. Jones Center for the Sounds, located in Columbia*
**The Columbia Theater Cultural Resources Center, located in Columbia*
**The Roanoke/Cashie River Center, located in Windsor*
**The Highway 94 Overlook, located in Tyrrell County*

***The North Carolina Estuarium, Washington***

*Construction on the North Carolina Estuarium began in August, 1996. Barring unforeseen problems or bad weather, the facility should open to the public in November, 1997. The Estuarium's focus is on North Carolina coastal estuarine systems as exemplified by the Pamlico Sound and the Tar-Pamlico River. Located on the waterfront in downtown Washington, the Estuarium will have direct access to the Pamlico River.*

***Lake Matamuskeet Lodge***

*Refurbishment of the Lake Mattamuskeet Lodge has continued to the point where the facility is usable for meetings, gatherings, and short-term overnight use. Planned improvements for this year include a new heating system and hot water heater. A complete renovation plan for the Lodge was finalized with funds from an earlier appropriation; PfS continues to work closely with US Fish and Wildlife Service officials in seeking federal funds to carry out the full plan. PfS will work on an exhibitry plan for the Lodge during the next year. The interpretive focus of the Lodge is the natural and human history of Lake Mattamuskeet, and the lake's role in the Atlantic Flyway for migratory waterfowl.*

***Roanoke/Cashie River Visitor's Center, Windsor***

*The Roanoke/Cashie River Center made excellent progress toward completion this year. A schematic site plan was developed, necessary permitting (e.g., Coastal Area Management Act) was finalized, and considerable site clean-up and preparation were performed with the aid of prison laborers. Renovation plans for the building that will serve as the Center are nearly finished and an exhibit scheme has been devised. A boardwalk and park area should be open sometime in 1998. The Roanoke/Cashie Center will focus on the vast floodplain and bottomland swamp system of the lower Roanoke basin. This system is the largest of its type east of the Mississippi River.*

***Columbia Theater Cultural Resources Center***

*The site for the Cultural Resources Center is the old Columbia Theater in downtown Columbia. In disrepair for many years, the building has had its physical integrity restored through Partnership funding and oversight. Complete renovation, including the interior space, should be completed by the Fall of 1997, and the facility should be available for public use by the end of the year. Design for the exhibitry is in the preliminary stage. A grant has already been received from a private corporation for the development of a film about the history of logging in the region. The focus of the center is on human interaction with the environment on the upper Albemarle-Pamlico peninsula, especially as witnessed through the heritage of farming, fishing, and forestry.*

***Walter B. Jones Center for the Sounds, Columbia***

*A preliminary design scheme was completed for the Center for the Sounds through a previous appropriation. Since this facility would house the staff for the Pocosin Lakes National Wildlife Refuge and would be on US Fish and Wildlife Service land, federal funding will be necessary to complete the Center. The Partnership is working closely with the US Fish and Wildlife Service to secure funding during this year's federal budget cycle. A previous appropriation went to construct an interpretive boardwalk and outdoor classroom along the Scuppernong River in front*

*of the Center site.*

***Highway 94 Overlook, Tyrrell County***
*Planned for a site just off Highway 94 as it runs between Columbia and New Holland, the overlook will serve as a "linkage" to encourage byways travel between facilities in Columbia and the Lake Mattamuskeet Lodge. The overlook will be a 30-foot tower that offers an excellent vista over 5 square miles of agricultural land, pocosins, and forests. Construction plans have been completed for the overlook and site preparation has begun. The tower should be operational by the end of 1997.*

*(2) In 1996, The Division of Coastal Management (DCM) hired a new site manager for the northernmost sites in the NC Coastal Reserve system (Currituck Banks, Kitty Hawk Woods and Buxton Woods). That person is working with PfS, NC Aquariums, and other education centers to promote research and education activities on maritime forests and other barrier island ecosystems.*

*(3) In May 1996, DCM awarded $9,600 to the City of Washington for the Partnership for the Sounds to hold a nature-based tourism conference. Other participating local governments in the conference were Hyde County, Town of Columbia and Town of Windsor.*

*(4) The Conservation Fund, a private conservation organization, working with PfS, the Natural Heritage Program of the Division of Parks and Recreation, the Wildlife Resources Commission, the Conservation Trust of North Carolina, and North Carolina State University developed a planning map for the conservation of greenways in the Albemarle-Pamlico region.*

## OBJECTIVE B: INCREASE PUBLIC UNDERSTANDING OF ENVIRONMENTAL ISSUES AND CITIZEN INVOLVEMENT IN ENVIRONMENTAL POLICY MAKING.

***Management Action 1:* Expand and coordinate education projects about the Albemarle-Pamlico estuary, focusing on both environmental and economic issues.**

**Explanation**: The future security of the estuary depends on whether people who live, work and vacation there understand its environmental challenges. These education efforts must be innovative, must include adults as well as children, and must take place outside of traditional school settings as well as in the classroom.

**STATUS:** *(1) The development and publishing of the Teacher's Guide to Environmental Education Programs and Resources and its companion document, the Neuse River Basin Supplement to the Teachers' Guide have occurred. The original Teachers' Guide focuses on environmental education resources available within the NC Department of Environment, Health and Natural Resources and lists a variety of environmental education resources external to the DEHNR.*

*The supplement to the teacher's guide expands this information to include resources available from non-profit groups, colleges and universities, and other groups that have environmental education information specifically relating to the Neuse River.*

***(2) Citizen's Guide to Neuse River Basin Environmental Education Programs and Resources***

*A Citizen's Guide to Neuse River Basin Environmental Education Programs and Resources has been published and placed in all public libraries and other repositories in the state. Unlike the Supplement to the Teachers' Guide, which is specifically intended for educators, the Citizen's Guide targets all stakeholders in the Neuse River Basin. It identifies 150 environmental education programs and resources of the Neuse River Basin and includes a color map of the Neuse River Basin, a section on "What You Can Do," and is indexed by program, organization, audience, program type and counties served.*

***(3) "Know Your Ecological Address"***

*The activity, "Know Your Ecological Address", developed by Dr. Denis DuBay of the Office of Environmental Education, encourages all citizens to know which river basin they live in (including knowledge of soil types, air shed, flora and fauna, etc) is available to the public through public libraries and from the Office of Environmental Education. In conjunction with this project, four 30 second television public service announcements (PSAs) involving children talking about their "ecological address" were produced by the Agency or Public Telecommunications -- one each for the Catawba, French Broad, Cape Fear and Neuse River Basins. The educational message refers viewers to their local library for more information. The PSAs were distributed to TV stations in late May, 1996. In October of 1996 the PSAs were recognized by the International Television Association with its Silver Reel Award.*

*The "Know Your Ecological Address" and the "Know Your River Basin" campaigns were further communicated to the public through utility bill inserts. Key players include CP&L, Duke Power, NC Power, and ElectiCities. Utility inserts appeared in*

*utility bills to over 2 million households statewide in late summer, 1996 and will be again inserted once or twice per year for two years, per participating utility.*

***(4) River Basin Environmental Data***

*Environmental data specific to the Neuse River Basin has been placed on CD-ROM in computerized mapping format (GIS). Selected teachers met for five days in June 1996 to develop accompanying classroom activity guides which have been published along with the CDs for wide distribution. Thirty science, math, social studies and language arts teachers, NCSU, Department of Public Instruction, DEHNR, Center for Geographic Information and Analysis were participants. Writing, design and publication of activity guides were developed and used at training sessions during the Environmental Education Conference held at the Research Triangle Park in January 1997.*

*Additionally, using the Neuse River Basin as a pilot, DEHNR has worked with the Center for Geographic Information and Analysis (CGIA) to identify river basin boundary line crossings on interstate, primary and secondary roads; and with the NC Department of Transportation (DOT) to place bridge signs on interstate, primary and secondary roads. This helps to inform travelers of the river basin within which they live, work and attend school. DOT erected Neuse River Basin signs at 38 locations in 12 counties in the Neuse River Basin in November 1996. This is a pilot project and is applicable to all river basins in the state.*

***(5) Love a Tree Program***

*The "Love a Tree" program has been developed and was distributed to 6,000 classrooms and other youth organizations in 1996. This program, sponsored by International Paper Company, includes classroom kits with supplies for 30 students including 12 classroom activities correlated to the North Carolina Competency Based Curriculum, a Cherry Bark acorn planting exercise for each student, and the "Know Your Ecological Address" activity. North Carolina served as the pilot for this program which is expected to go nationwide next year. This program was presented at the North American Association of Environmental Educators' annual meeting in November of 1996.*

*In February 1997, more than 875 educators received 6,700 "Love A Tree" kits. The kits were distributed to 63 environmental education centers which served as pick-up points for educators.*

***(6) Guide to Environmental Education Centers***

*A second edition of The Guide to Environmental Education Centers in North Carolina, which describes environmental education centers across the state, has been developed and published.*

*As a result of the work on The Guide to Environmental Education Centers, the Office of Environmental Education facilitated the organization of a state association of environmental education centers that helps promote each other, helps support each others work, prevents duplication of services, and increases service to the citizens of the state. An organizational meeting was held February 21, 1996. The Association has organized and consists of 133 members. A slate of officers was elected at the 1997 North Carolina Environmental Education Conference held in January.*

*(7) Creation of a World Wide Web (WWW) home page for the NC Office of Environmental Education has been implemented. In addition, the Teachers' Guide to Environmental Education Programs and Resources, its companion document, the Neuse River Basin Supplement, and the Citizens' Guide to Neuse River Basin Environmental Education Programs and Resources can be found at the site (World Wide Web URL-http://www.ehnr.state.nc.us/EHNR/ee).*

*(8) The Office of Environmental Education, has developed for informational purposes, a "Green Sheet" which lists, among other things, resources available free upon request, and contact information needed for obtaining additional information on specific activities.*

*(9) Additionally, an environmental education newspaper supplement reaching 200,000 households, was inserted into the News and Observer newspaper on April 20, 1997 (Environmental Education month), helping to bring environmental awareness into North Carolina homes and businesses.*

*(10) The Office of Environmental Education worked with the Center for Geographic Information and Analysis (CGIA) to produce and distribute 8"X10" maps of the Neuse and Tar-Pamlico river basins as well as 20"X40" maps of North Carolina,delineating all 17 river basins located in the state. The GIS data pertaining to the Neuse River basin was incorporated into a teacher training workshop held June 24-28,1996. At the workshop, master teachers crafted age-appropriate activities thus moving GIS applications into North Carolina classrooms. Two more GIS teacher training workshops are planned for the summer of 1997 focusing on river basins and hazardous waste.*

***(11) Division of Water Quality Initiatives***

*Products promoting education and outreach in the region are in various stages of completion. Examples are educational bookmarks relating to each of the five river basins in the Albemarle-Pamlico region; a series of river basin posters containing descriptive/educational information; and an activity entitled "Soundland" (available summer 1997) which illustrates for high school students and adults the functions and characteristics of the Albemarle-Pamlico estuarine system. It provides background on the ecology, fisheries, land forms and geography of the region. It asks participants to make decisions that affect both the physical and human environments of a real, but unnamed, part of the area. The decisions they make will have a cumulative effect on those environments. It is intended that this activity be used in conjunction with the publication A Guide to Estuaries (APES 1989), but may be undertaken without this publication.*

***Management Action 2: Increase opportunities for citizens to communicate with members of environmental agencies and policy-making commissions.***

**Explanation**: Citizens are more likely to support environmental protection and be involved in decision making when they feel governments and regulatory agencies are working with them as equal partners. Increased opportunities for public participation and education will promote citizen involvement in environmental policy making.

**STATUS:** *(1) The first of five river basin regional councils, The Neuse River Basin Regional Council (NRBRC) has been formed. The membership consists of stakeholders and local government representatives for all the counties within the Neuse River Basin. The purpose of the Regional Councils is to advise and consult with local, state, and federal governments, as well as the general public and different interest groups within the basin, on the implementation of environmental management programs in the river basins. The NRBRC is staffed by the Division of Water Quality (DWQ) - Water Quality Section, Basinwide Assessment Unit, Public Coordinator/Implementation Group. The NRBRC has met 11 times to date (November 1995 through May 1997).*

*(2) Additionally, there is scattered involvement with Environmental Advisory Boards (Councils) at the local government level throughout the Albemarle-Pamlico estuarine region. An example is the group working in Greenville (Pitt County). They have been addressed at their meetings by personnel from the DWQ.*

*(3) Further fulfillment of this management action occurs with each of the public meetings held during the preliminary stages of Basinwide Water Quality*

*Management Plan writing. These plans, which will be created for all seventeen river basins throughout North Carolina, are scheduled at various times to coincide with NPDES permit renewal. A concerted effort has been made to involve stakeholders in this planning process through workshops and public meetings.*

***Management Action 3: Enhance and heighten local public involvement in issues affecting the estuary.***

**Explanation:** Public involvement in local policy processes can be promoted through Environmental Advisory Boards. These boards would not have a regulatory role. Instead, they would provide credible information and insight to local governments on the environmental issues surrounding projects such as landfill and roadway siting, water supply and sewage discharge, land use planning and stormwater control.

**STATUS:** *See paragraph 2, Management Action 2, Objective B.*

***Management Action 4: Expand involvement in the Citizens' Water Quality Monitoring Program (CWQMP) and make the program more interactive with regulatory agencies.***

**Explanation:** Citizen monitoring gauges the estuary's health and it an important education tool. In the Albemarle-Pamlico region, the CWQMP has served both purposes. The CWQMP would continue and broaden efforts to provide accurate data to water quality management agencies, thereby expanding their ability to track potential problems.

**STATUS:** *The CWQMP continues to grow in numbers of volunteer participants, sites monitored, and parameters measured. Among those requesting CWQMP data are numerous state and federal agencies, local governments, non-profit organizations, colleges and universities, and private sector groups.*

*The Division of Water Quality (DWQ) has utilized the CWQMP data and recognizes the potential benefits of expanding the volunteer monitoring program into other areas of the state. Funding ($50,000) has been made available to the DWQ to initiate this effort and the CWQMP was institutionalized within the DWQ. Training and certification sessions have occurred and a newsletter was produced. Over 70 citizen monitors have been trained, monitoring equipment has been distributed and data has been received by the DWQ. However, the General Assembly failed to allocate additional funds to support this program at the level which was requested. The DWQ intends to seek other methods to continue this program.*

***Management Action 5: Create a citizen ombudsman position within the Department of Environment, Health and Natural Resources (DEHNR).***

**Explanation:** A citizen ombudsman is an independent advocate for citizen concerns within a government agency. An ombudsman would respond to and track these concerns, and would serve as the public's "eyes and ears" with regard to activities of DEHNR divisions.

**STATUS:** *There has been no movement toward establishing this position.*

## OBJECTIVE C: ENSURE THAT STUDENTS, PARTICULARLY IN GRADES K-5, ARE EXPOSED TO SCIENCE AND ENVIRONMENTAL EDUCATION.

***Management Action 1: Support the development of a comprehensive environmental science and education curriculum.***

**Explanation:** The Department of Environment, Health and Natural Resources (DEHNR) will expand the operation of the Office of Environmental Education (OEE) to establish an ongoing liaison between the Department of Public Instruction (DPI) and OEE. DPI must address a variety of concerns in developing curriculum. However, OEE would provide assistance as needed in targeting environmental education components.

**STATUS:** *(1) The Office of Environmental Education has established a positive working relationship with the NC Department of Public Instruction. All environmental education curriculum offered by DEHNR, including Project Estuary, Sound Ideas, Aquatic WILD, Project WET, Project Learning Tree, Project WILD (Wildlife in Learning Design), and NC State Park Environmental Education Learning Experiences (EELEs) have been or are being correlated to the North Carolina Competency based curriculum for science, math, social studies, and language arts. The correlation is being offered free on diskette to all NC school teachers including public, private, and home schoolers. This was updated in 1996 and is anticipated to be updated again in 1997.*

*(2) The Office of Environmental Education has developed and is administering the North Carolina Environmental Education Certification Program for educators working with youth and adults both in the school setting and outside the school setting. The Certification Program is cosponsored by the Environmental Educators of North Carolina. The Certification Review Committee, composed of representatives of DEHNR, Environmental Educators of North Carolina, the NC*

***Management Action 2: Assess the health of the Albemarle-Pamlico Estuary and the success of CCMP recommendations in protecting the environment.***

**Explanation:** Assessing the success of the implementation of the CCMP also requires monitoring the environment and a thorough evaluation of the results. The CCMP must be flexible to adapt to natural conditions. Data gathered on the state of water quality, habitats, and fisheries may be used to adjust strategies as necessary.

**STATUS:** *Assessing the health of the estuary is an on-going and ever-changing undertaking. The document entitled "Comprehensive Conservation and Management Plan Summary Report" offers the most up-to-date and comprehensive summary of the changes taking place in the Albemarle-Pamlico Sounds region.*