Shellfish Closures in the White Oak River

White Oak River Watershed Advisory Board

Watershed Education for Communities and Officials (WECO)

SUMMARY FINDINGS REPORT- VERSION 3.0
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INTRODUCTION

The White Oak River Watershed Advisory Board was formed by the North Carolina Cooperative Extension Service in response to citizens' concerns about the water quality in the White Oak River Watershed. The Board consists of citizen stakeholders from Jones, Carteret, and Onslow Counties. Since the White Oak River Watershed spans three counties, the Advisory Board is coordinating multi-jurisdictional policy development to address the water quality of the entire White Oak River watershed.

The Board includes landowners, farmers, fisherpeople, foresters, environmentalists, businesspeople, school teachers, and scientists. They identify problems, learn about the issues, then develop solutions using consensus decision-making. Recommendations are presented to government officials.

In their first year, the Board studied the impact of the expansion of the Highway 24 Causeway. Collaborative solutions were developed by the Board and NCDOT to reduce negative impacts of Highway 24 stormwater runoff on water quality in the White Oak River. Stormwater that would have discharged into the river will be directed away from the estuary.

The Advisory Board is now in the process of examining the issues related to shellfish closures in the White Oak River. Shellfish closures have increased in the last several years, and the Board is now seeking ways to minimize the potential for future closures.

This findings document, ***Shellfish Closures in the White Oak River Watershed***, summarizes information the Board has gathered during their investigation. The information contained within represents presenters' views, and not necessarily Board Members' views. It is divided into three sections. Part One summarizes background information on water quality issues and shellfish resources in the White Oak River. Part Two summarizes the potential problem sources the Board chose to investigate that contribute to shellfish closures. Part Three will summarize the policy options investigated by the Board, and will be available later when that discussion has been completed. Each section has a similar format: the objective of the Board for the particular topic is identified, the information provided on that topic from the NC Division of Water Quality's Basinwide Plan for the watershed is summarized, and then the information presented by guest speakers is summarized.

The companion document, ***Shellfish Closures in the White Oak River Watershed: Findings Manual***, contains the complete information provided by expert presenters. The information from the ***Findings Manual*** was summarized in this summary document. The ***Findings Manual*** may be consulted for more detailed information on the topics contained within this summary document.

Shellfish Closures in the White Oak River Watershed is a working document. It will be updated and changed as the Board continues their investigation of shellfish closures in the White Oak River watershed. At the time of printing version 3.0 (May 1999), the Board is nearing the end of their investigation of possible problem sources and beginning their investigation and analysis of policy options and recommendations.

Shellfish Closures in the White Oak River

White Oak River Watershed Advisory Board
Watershed Education for Communities and Officials (WECO)

PART 1:

Background Surrounding Shellfish Closures in the White Oak River watershed

PART 1: BACKGROUND SURROUNDING SHELLFISH CLOSURES IN THE WHITE OAK RIVER WATERSHED

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1. Overview of Water Quality Issues in the White Oak River Watershed

Objective:
The Board sought to understand basic coastal water quality issues in the White Oak River watershed, which is one of 4 watershed river systems that comprise the White Oak River Basin. All four systems in the river basin are coastal systems which originate within the coastal plain and drain to estuarine waters and the Bogue Sound. Differentially, each watershed system varies in size, morphology, topography, and in the particular species distributions and water quality issues.

Speaker:
Dr. Pete Peterson, Institute of Marine Sciences, University of North Carolina at Chapel Hill, February 9, 1998

Summary of findings:
A watershed is a basic ecological unit that provides free pollution dilution services for discharges. When a watershed reaches its maximum load of pollutants, as the Neuse River has, for example, the system fails and results in problems like fish kills and algal blooms.

The four major pollution problems in North Carolina's watersheds are sediment, toxic pollutants, nutrients, and bacteria. Nutrients in the watershed originate from forests, farms, residences, and wastewater treatment plants. Nutrient problems in a watershed are cumulative, as nutrients can travel down river to cause problems. Bacteria on the other hand originate from ***local*** nonpoint source runoff. The problem is decisively local in coastal areas because bacteria do not live well in salt water. The local nature of the bacterial problem suggests that citizens have the opportunity to make a difference in their own communities.

To address bacteria and shellfish closures, Dr. Peterson recommends looking at vegetative buffers and dredging the river's mouth; pressuring the State to act on non-point source pollution; and designating the White Oak River as Use Restoration Waters (URW), a proposed classification under consideration by the Environmental Management Commission to increase protection.

2. COASTAL NUTRIENT PROCESSES AND THEIR IMPACT ON SHELLFISH RESOURCES

Objective:
The committee sought information on nutrient processes, and how they may potentially affect shellfish resources.

Basinwide Plan:
White Oak River Basinwide Water Quality Management Plan, Division of Water Quality, DENR; February, 1997 (3-4, 3-6)
The White Oak river watershed is not threatened by elevated nutrient levels, but nutrient loading estimates can still serve as a useful tool for evaluating the condition of this area. (In the basin)… nitrogen and phosphorus inputs from nonpoint source runoff from land surfaces are generally low to moderate.

Speaker:
Dr. Hans Paerl, University of North Carolina, Institute of Marine Sciences, May 18, 1998

Summary of findings:
Increased human activity changes coastal water quality by increasing nonpoint source loading of nitrogen to waters, which can impact shellfish resources. Nitrogen-stimulated algal blooms reduce oxygen levels in water as they decompose. Low dissolved oxygen levels can be compounded with stratification as dense saline water and rotting organic matter sink into lower levels in the water column. Sessile organisms such as oysters cannot escape low oxygen conditions and suffer from sickness due to stress-induced lowered immunity.

Contributors to nitrogen in the water include municipalities, forests, and animal waste from animal production.

3. SHELLFISH RESOURCES AND CLOSURES IN THE WHITE OAK RIVER

Objective:
The Board sought knowledge on the abundance and health of the shellfish resource in the White Oak River and how the resource is tracked. Board members also wanted information on the scope and causes of shellfish closures.

Basinwide Plan:
White Oak River Basinwide Water Quality Management Plan, Division of Water Quality, DENR; February, 1997 (4-17).

Problems in this subbasin appear to be related to land disturbing activities, agriculture, and large marinas. Closed shellfish areas (those areas designated as prohibited or restricted by the Division of Environmental Health) include the upper reaches of Bear Creek and Queens Creek, Parrot Creek, Dick Creek, Pettiford Bay, Broad Creek and Gales Creek. DMF considers the commercial value of shellfish in this area to be Good; the oyster resource is rated Good-Fair and primarily consumed locally, while the clam resource is rated Good and able to support a commercial fishery.

Factors affecting shellfish area closures include increased runoff due to land development, storm drains, drainage ditches and land clearing; inadequate septic systems; marinas; improperly treated wastewater discharge; and wildlife.

Speakers:
Jeff French, Shellfish Sanitation, Div. Environmental Health, Dept. of Environment and Natural Resources
J.D. Potts, Shellfish Sanitation, Div. Environmental Health, Dept. of Environment and Natural Resources

Summary of findings:
The White Oak River shellfish resources are considered productive, but threats to the health of the shellfish do exist. Threats include the oyster disease called "Dermo", hydraulic dredging, detrimental harvest practices, and stormwater run-off. Shellfish beds are managed because the presence of bacteria can cause problems to humans, but bacteria do not necessarily harm shellfish health.

Shellfish management areas are categorized according to level of pollutants. Categories include ***prohibited, conditionally approved/closed, conditionally approved,*** and ***approved***. Activities that create impervious surfaces, such as paving and roofing, facilitate closures. These activities increase sedimentation and stormwater run-off. Better stormwater management in subdivisions may provide a means for reducing shellfish area closures.

4. Bacteria, Viruses, and Shellfish Consumption

Objective:
The Board wanted information on fecal coliform bacteria, its relationship to human health, and the use of fecal indicators to protect humans from bacteria and viruses in shellfish.

Basinwide Plan:
White Oak River Basinwide Water Quality Management Plan, Division of Water Quality, DENR; February, 1997 (6-6).

Water polluted by human or animal wastes can harbor numerous pathogens that may threaten human health. This is of particular concern in waters where shellfish are harvested for human consumption. Because of the tendency of clams and oysters to concentrate material they filter from the water column, shellfish can potentially become too contaminated for safe human consumption, even when fecal coliform levels are relatively low. Therefore, while water quality may be safe enough for swimming, fishing or other forms of primary recreation, the threat to commercial and recreational shellfish harvesting is quite real and requires both corrective and preventive action.

Since routine tests for individual pathogens are not practical, fecal coliform bacteria are widely used as an indicator of the potential presence of disease-causing microorganisms. Fecal coliforms are bacteria typically associated with the intestinal tract of warm-blooded animals and their number is generally assumed to be correlated with the number of pathogens in a water sample. They enter surface waters through urban stormwater runoff and agricultural runoff. Sources include improperly designed or managed animal waste facilities, failing on-site wastewater systems, broken sewer lines, improperly treated discharges of domestic wastewater and wild animals.

It should be noted that fecal coliform contamination is not a threat to the health of shellfish populations. While other water quality problems can affect shellfish health (for instance, low oxygen levels due to eutrophic conditions or contamination of sediments by toxicants), these are currently not significant issues in the White Oak basin.

Speakers:
Dr. Nancy White, School of Design, North Carolina State University
Dr. Mark Sobsey, Dept. of Environmental Sciences and Engineering, University of North Carolina at Chapel Hill, March 16, 1998
Dr. Bill Kirby-Smith, Duke University Marine Lab, March 16, 1998

Summary of findings:
Greater amounts of bacteria in a watershed and a close proximity of the bacterial source to water increase the chance that bacteria will enter the water. Bacteria appear to attach and move more readily with sediment; so presence of sediment increases the chance of bacteria entering the water and improves conditions for longevity.

The longevity of bacteria also increases in the winter and in the presence of shade. Increased salinity promotes quicker die-off of bacteria. Time, light, and salt are the most effective factors to promote bacterial die-off. The longer bacteria are exposed on the land, the less chance they will be viable when transported to adjacent waters during a storm. Runoff through concentrated areas of wildlife, pets, or malfunctioning septic tanks near streams can increase the bacterial load in runoff. Slowing down or eliminating runoff through these areas is necessary where they are near shellfish waters.
(continued)

Fecal coliform levels are used as an indicator to protect the sanitary quality of water. The current indicator system has been successful in reducing consumption of shellfish contaminated by bacterial pathogens, such as salmonella, that are associated with gastrointestinal illness from shellfish consumption. However bacterial indicators are not adequate surrogates for the presence of human enteric viruses that can cause illness from shellfish consumption.

Enteric viruses originate from inadequate septic systems (a significant problem in coastal areas with sandy soil); municipal sewage effluent discharges; combined sewer overflows that provide waves of contamination on a regular basis during storms; stormwater run-off or by-passes; wastewater sludge and septage disposal operations; and boat waste discharges.

Enteric viruses in shellfish, their habitat waters, and in sediments can survive for months with little reduction in concentrations, particularly in lower temperatures. Unlike bacterial pathogens, viruses survive well in salt water, can be carried in water for long distances, and can survive the cooking process. Consumption of raw or cooked shellfish containing viral pathogens may cause illness. Illnesses may go unreported up to 90% of the time.

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PART 2:

Potential Problem Sources for Shellfish Closures in

the White Oak River watershed

PART 2: POTENTIAL PROBLEM SOURCES FOR SHELLFISH CLOSURES IN THE WHITE OAK RIVER WATERSHED

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1. Point Source Pollution

Objective: The Board sought information on point source pollution and its possible contribution to shellfish closures in the White Oak River watershed.

Basinwide Plan:
White Oak River Basinwide Water Quality Management Plan, Division of Water Quality, DENR; February, 1997 (3-16, 3-17, 3-18, 4-52, 4-53).

Point sources refers to discharges that enter surface waters through a pipe, ditch or other well-defined points of discharge. The term most commonly refers to discharges associated with wastewater treatment plant facilities. These include ***municipal*** (city and county) and ***industrial*** wastewater treatment plants as well as small ***domestic*** discharging treatment systems that may serve schools, commercial offices, residential subdivisions and individual homes. In addition, discharges from ***stormwater systems*** at industrial sites are now considered point source discharges and are being regulated under new urban stormwater runoff regulations being required by the U.S. Environmental Protection Agency (EPA). The primary water quality pollutants associated with point source pollution are oxygen-demanding wastes, nutrients, color and toxic substances including chlorine, ammonia and metals.

Point source discharges are not allowed in North Carolina without a permit from the state. Discharge permits are issued under the National Pollutant Discharge Elimination System (NPDES) program delegated to North Carolina from EPA… Under the NPDES permitting program, each NPDES discharger is assigned either ***major*** or ***minor*** status… For municipalities, all dischargers with a flow of greater than 1 million gallons per day (MGD) are classified as major. Most point source discharges, other than urban and industrial stormwater discharges, are continuous and do not occur only during storm events as do nonpoint sources. They generally have the most impact on a stream during low flow conditions when the percentage of stream flow composed of treated effluent is greatest. Permit limits are generally set to protect the stream during low flow conditions.

Information is collected on NPDES permitted discharges in several ways. The major method of collection is facility self-monitoring data which are submitted monthly to the DWQ by each individual permittee. NPDES facilities are required to monitor for all pollutants for which they have limits as well as other pollutants which may be present in their wastewater…Other methods of collecting point source information include effluent sampling by DWQ during inspections and special studies.

Point sources are partially responsible for impairment of estuarine waters in Queen Creek and the White Oak River. The permitted dischargers are operating efficiently.

Other source of information:
Mark McIntyre, North Carolina Division of Water Quality

Summary of findings:

The White Oak River watershed contains eight minor permitted point source dischargers, all of which have discharges under 1 million gallons per day. Facilities with fecal coliform in their effluent include Silverdale Elementary, Tabernacle Elementary, and the Towns of Swansboro and Maysville. The fecal coliform levels from these facilities are exceptionally low. Two facilities had permit violations in 1998. Swansboro failed its flow limit three times, possibly due to heavy rain, while Maysville had an ammonia problem due to a mechanical error. In general, all the permitted facilities are operating well within their permit limits.

2. STORMWATER MANAGEMENT

Objective:
The group sought information on stormwater management and the possible actions to control and manage stormwater.

Basinwide Plan:
White Oak River Basinwide Water Quality Management Plan, Division of Water Quality, DENR; February, 1997, (p. 3-22, 2-8, 2-9).

Urban land cover in the White Oak River watershed was 2% in 1987. The population in the watershed increased by 44% from 1980-1990. The populations in the three counties comprising the watershed are expected to continue increasing in the future.

Runoff from urbanized areas, as a rule, is more localized but generally more severe than agricultural runoff. The rate and volume of runoff in urban areas is much greater due to the high concentration of impervious surface areas and to storm drainage systems that rapidly transport stormwater to nearby surface waters. These drainage systems, including curb and guttered roadways, allow urban pollutants to reach surface waters quickly and with little or no filtering by vegetated areas. These affects are further exacerbated by replacement of small streams and riparian vegetation with pipes. Urban pollutants include lawn care products such as pesticides and fertilizers; automobile-related pollutants such as fuel, lubricants, abraded tire and brake linings; lawn and household wastes (often dumped in storm sewers); and fecal coliform bacteria (from animals and failing septic systems).

Many urban streams are rated as biologically poor. It is estimated that there are approximately 8 miles of freshwaters in the White Oak Basin that are thought to be impaired due to urban runoff. More importantly, urban runoff is identified as a partial contributor to the impairment of an estimated 11,183 acres of saltwaters. This represents 94% of the total impaired acreage. Urban runoff is a major issue in coastal areas where closed shellfish waters are increasing in response to coastal development (Barber et. al., 1994).

While no development threshold can be identified at present, it is apparent that closings have increased despite the management policies currently in place. The reasons for this are not clear. There are many aspects of the development process that relate to factors influencing fecal coliform export from urban areas. These aspects include size of disturbed area, length of non-vegetated stage, size of vegetated buffer, impervious level, and design of sediment or stormwater control devices.

Shellfish closures draining developed areas may be related to buffers and sediment control best management practices (BMPs) not being properly maintained or ditching/piping being installed inappropriately. Recent closings may be related in part to developments approved prior to January 1, 1988 (and thus not subject to the current stormwater regulations) but which have been gradually built out over the past few years. On the other hand, density levels allowed without stormwater BMPs may be too high or required buffers for low density development may be too small. Buffers for high density projects or the cumulative impact of the numerous small projects that are not subject to the regulations may partially relate to closures. Closures may also be related to the lack of vegetative buffers or stringent revegetation schedule during the construction phase. Most likely it is some combination of these factors, but adequate information does not exist to confirm this. DEH shoreline surveys, for example, can be suggestive, but often do not verify specific causes of contamination or identify specific aspects of stormwater management or erosion/sediment control which may need attention. Changes in DWQ's stormwater rules became effective at the end of 1995 (see Section 5.3.2). The intent of these changes was in part to address some of the above issues, including enhancing long-term enforcement and managing the cumulative effects of smaller projects. It is still too early to assess the impact of the modified rules.

Speaker:
Bill Hunt, Dept. of Biological and Agricultural Engineering, NCSU, February 9, 1998

Summary of findings:

The presence of impervious surfaces such as pavement and roofs increases the speed at which stormwater travels. This “stormwater superhighway” causes flooding and standing water, erosion, transportation of pollutants and degraded streams. Urban stormwater BMPs (Best Management Practices) provide a detour in the stormwater superhighway by slowing down the flow of water. Slowing down the flow of water allows time for bacteria to die.

3. ON-SITE WASTEWATER MANAGEMENT

Objective:
The advisory committee sought information on septic systems, and whether septic system failures factor into shellfish closures in the White Oak River watershed.

Basinwide Plan:
White Oak River Basinwide Water Quality Management Plan, Division of Water Quality, DENR; February, 1997 (pp.3-15, 3-16, 3-24).

Septic tank soil absorption systems are the most widely used method of on-site domestic wastewater disposal in North Carolina. These systems can provide safe and adequate treatment of wastewater; however, improperly placed, constructed or maintained septic systems can serve as a significant source of pathogenic bacteria and nutrients. These pollutants may enter surface waters both through or over the soil. They may also be discharged directly to surface waters through ***straight pipes*** (i.e., direct pipe connections between the septic system and surface waters). These types of discharges, if unable to be eliminated, must be permitted under the NPDES program and be capable of meeting effluent limitations specified to protect the receiving stream water quality which includes a requirement for disinfection.

The Department of Environmental Health shoreline surveys have found some contamination from septic systems (in the overall White Oak basin), but do not document widespread failures in most areas. Observations by regional DWQ staff indicate that problems with on-site systems may be more prevalent. Contamination via groundwater seepage is not readily assessed by visual inspection. Based on site investigations, surface failures usually occur after heavy rains.

Although the over all contribution of septic tank failure in the White Oak basin is unclear, there is no doubt that the potential for contamination is great given the nature of local soils, the high level of population growth along the coastline, and the reliance on on-site waste disposal in most of the basin. There are currently 18,700 septic systems in Onslow County, serving 38% of county residents, while Carteret County's 7,000 systems provide waste treatment for 56% of the population (Malcolm Pirnie, Inc. 1995). The proportion of these systems which are at least 15 years old is 50% and 40% in Onslow and Carteret Counties respectively. It is well known that many areas of these counties have either poorly drained or excessively drained soils which are not suitable for the construction of septic fields.

North Carolina regulations require a vertical separation of one foot between the bottom of an infiltration trench and the top of the seasonal high water table. Experimental evidence and field observations suggest that microorganisms can move substantial distances in saturated sandy soils and that one foot of vertical separation may not be adequate to prevent surface water contamination under such conditions (NCDEM, 1989; Cogger et al, 1988). Additionally, it has been a common practice in some areas to install drainage tile networks to lower the water table and allow the construction of drainfields in areas where they would otherwise not be permitted (Duda and Cromartie, 1982; NCDEM, 1989). Current state regulations require a 25 foot separation between septic fields and such drainage networks, but prior to 1982 the required separation was only 15 feet. There is some concern about the possible transport of fecal bacteria through the subsurface drainage network to ditches and streams during rainfall events but the extent to which this occurs is not well documented. Few local governments in the White Oak basin, or elsewhere in North Carolina, have adopted requirements for vertical separation or horizontal setbacks from surface waters that are greater than the state standards (McGuire, 1996).

Speakers:
Dr. David Lindbo, Assistant Professor and Extension Soils Specialist, North Carolina State University, June 15, 1998
Dr. A.R. Rubin, Professor and Extension Specialist, Dept. Biological and Agricultural Engineering, North Carolina State University, October 12, 1998.
Dr. Robert L. Uebler, Washington Region, NC Dept. Environmental Health, April 12, 1999

Summary of findings:

In North Carolina, a number of methods are used to treat or dispose of wastewater. Outhouses and straight pipes are still used, although neither method is environmentally sound or protective of public health. Any wastewater system must be permitted in North Carolina before construction. Permitted wastewater system options include mechanical wastewater treatment, shallow placed systems, pressure dosed surface or subsurface systems, and advanced pretreatment systems such as filters or aerobic treatment units preceding soil or land based systems. Of the 3,900 permitted discharge and non-discharge wastewater systems in North Carolina, 450 or 11.5%, are land based application systems.

Goals of on-site wastewater management include the treatment of effluent to minimize health risks and environmental health risks, and the disposal of treated effluent. All pollutants from waste management operations can affect water in a shallow water table aquifer. This water eventually becomes surface water that supports many uses.

Soil conditions and landscape position are assessed at sites before installation of a septic system. The state now requires that all sand lined trench systems (which are gravity dosed) and any conventional system with artificial drainage, if installed after summer 1991, be inspected yearly based on the issue date of the permit. Septic systems must be installed with a minimum of one foot separation between the bottom of the system and groundwater, although this distance may be inadequate in certain soils.

In order for septic systems to adequately treat the harmful components of human wastewater, including nitrogen, disease organisms, and fecal coliform, the number of houses per acre must be limited to 4 houses per acre with a maximum of 6 people per house. The potential for nitrogen contamination of groundwater emerges when more than four houses are located on an acre.

In a coastal river basin, development near a river is more suitable for septic systems than development further inland between two rivers, because there is a greater distance between the ground surface and the water table closer to the river. In the areas between two rivers, ditches are created to drain the land and enable development. The ditching allows polluted water to travel downland towards the river. Riparian buffers work to filter waste products before they reach the river, but the cost of the buffers lands on the homeowners whose systems typically are not the problem source.

In the White Oak River basin, most of the areas with poorly drained soils are currently undeveloped. However, some problem areas do exist- these areas should be targeted in their land use plans.

Septic systems need to receive regular maintenance, which includes pumping the tank every 3-7 years. Pumping of a septic tank is not required by any law. A lack of maintenance is the primary cause of septic system failure, although other causes include overloading of the system and improperly operating the system. Systems built before 1977 are more likely to fail, due to the fact that they were buried too deep for aerobic decomposition of the waste products to occur.

4. HYDROLOGY OF FORESTRY LAND USE

Objective:
The board wanted to learn about the effects that altered hydrology of forestry land use has on shellfish closures in the White Oak River watershed.

Basinwide Plan:
White Oak River Basinwide Water Quality Management Plan, Division of Water Quality, DENR; February, 1997. (pp. 2-1, 2-8, 3-22):

Forest land comprised 22% of the White Oak River watershed's land cover in 1987. A large portion of the watershed's land area is in public lands held in the Croatan National Forest and Hoffman State Forest.

Forestry, a major industry in North Carolina, can impact water quality in a number of ways. Ditching and draining of naturally forested low-lying lands in order to create pine or hardwood plantations can change the hydrology of an area and significantly increase the rate and flow of stormwater runoff. Clearing of trees through timber harvesting and construction of logging roads can produce sedimentation. Removing riparian vegetation along stream banks can cause water temperature to rise substantially, and improperly applied pesticides can result in toxicity problems. Timber harvesting occurs throughout much of the upper basin and is often done at the onset of clearing for site development.

Speakers:
Dr. Jim Gregory, Department of Forestry, NCSU, August 17, 1998
Ms. Lauren Hillman, Croatan National Forest, February 8, 1999

Summary of findings from speaker presentations:

The average rainfall in North Carolina exceeds evaporation and transpiration outputs, which are the processes that remove water from the surface and return it to the atmosphere. This excess rainfall or water available for runoff, must be managed in order to use the ground for forestry, agriculture, and even wetlands. When a forested ecosystem is changed for uses which may include agriculture and development, evaporation and transpiration is reduced, thus increasing runoff. Land drainage has been practiced in North Carolina since the 1700s to the 1980s. Wet soil areas comprise 30% of land area in North Carolina- the majority of these areas exist in the coastal plain. The majority of coastal wet soils contain altered hydrology.

The Hofmann Forest, a pine stand on drained coastal land in the White Oak River watershed, drains to the Trent, White Oak, and New Rivers. The water table in the Hofmann was lowered to increase forest productivity, and roads and drainage ditches were created for management purposes. The exact effect of the hydrologic alterations are unknown, however it is known that drainage ditches increase the flow of water. Water quality monitoring in the Hofmann shows that nitrogen, fecal coliform, and phosphorus levels are lower in watersheds uninfluenced by drainage management than in drained areas which include the portion in the White Oak River watershed. Drainage control devices in ditches, flashboard risers for example, decrease total runoff and peak flow, and reduce nitrogen and phosphorus in runoff.

Currently, the Hoffman has no drainage controls in its ditches. Researchers are creating pre-control modeling of hydrology to create a baseline for future possible management plans. It is important to develop a management program that controls outflow ***and*** allows flexible management in the forest, since high water levels may hurt root growth and inhibit harvest activities.

The Croatan National Forest also contains ditches that direct stormwater flow into the White Oak River. Although the staff are aware that the canals need to be blocked, the canals help with prescribed burnings and fire suppression by providing a fire break.

5. HYDROLOGY OF AGRICULTURAL LAND USE

Objective:
The board wanted to learn about the effects that the altered hydrology of agricultural land use has on shellfish closures in the White Oak River watershed.

Basinwide Plan:
White Oak River Basinwide Water Quality Management Plan, Division of Water Quality, DENR; February, 1997. (pp. 2-8)

Agricultural land, which includes cropland and pasture, comprised 11% of the land cover in the White Oak River watershed in 1987 (pp. 2-8).

A number of agricultural activities can impact water quality if not done properly. Land clearing and plowing render soils susceptible to erosion which in turn can cause stream sedimentation. Contour plowing, terracing and grassed waterways are several common methods used by most farmers to minimize soil loss. Maintaining a vegetated buffer between fields and streams is another excellent means of minimizing soil loss to streams although this practice is not always utilized because it may necessitate taking some land out of production. While sedimentation is the most widespread cause of stream impairment resulting from agricultural activities, it should be noted that statewide agricultural soil loss rates had dropped from 1982 to 1992 based on statistics compiled by the USDA Natural Resources Conservation Service.

Improper application of pesticides and fertilizers (including chemical fertilizers, manure and spray application of lagoon wastewater) can result in these substances being washed from fields. Field buffers would again minimize this potential problem. Improperly designed storage or disposal sites can also be a problem. Construction of drainage ditches on poorly drained soils enhances the movement of stormwater into surface waters, and channelization of natural streams destroys habitat values. In addition, use of small streams for irrigation can dewater the streams and cause localized impacts.

While, as noted above, the most widespread cause of freshwater stream impairment associated with agriculture is sedimentation, nutrients, fecal coliform bacteria, biochemical oxygen demand and pesticides are all potential concerns. Nutrient-related problems, primarily seen as excessive algal or aquatic weed growth, are not always evident in the receiving stream adjoining a farm. Rather, they may be seen in a downstream impoundment, sluggish creek or estuary many miles away.

Speaker:

Dr. Robert Evans, Department of Biological And Agricultural Engineering, NCSU, September 21, 1998.

Summary of findings:

In North Carolina, more than 50% of the agricultural land is artificially drained. Drainage methods include open ditches that encourage surface runoff and lower water levels in soils, and underground piping that encourages subsurface flow.

Fertilizer is the primary source of nutrients that flow from cropland to the waterways. Crops are not able to remove all nutrients from fertilizer. Drainage provides a pathway to transport nitrogen and phosphorus, as well as metals and bacteria. Drainage increases discharge of nitrogen by

10-20%. Drainage controls decrease discharge rates close to pre-disturbance conditions. Drainage controls also allow denitrification to occur beneath the drainage trenches.

To decrease agricultural impacts on the estuary, farmers can utilize conservation tillage, create riparian zones next to drainage ways, allow natural vegetation to return along ditches, and implement drainage control. Drainage control can yield benefits to farmers in the form of increased crop production, depending on the drainage structure used.

6. LIVESTOCK PRODUCTION

Objective:
The Board sought information on the number and types of livestock operations in the watershed.

Basinwide Plan:

White Oak River Basinwide Water Quality Management Plan, Division of Water Quality, DENR; February, 1997 (3-22, 2-13).

Concentrated animal operations can be a significant source of nutrients, biochemical oxygen demand and fecal coliform bacteria if wastes are not properly managed (see Section 5.3.1 of Chapter 5 for discussion of animal waste rules). Impacts can result from over-application of wastes to fields, from leaking lagoons and from non-permitted flows of lagoon liquids to surface waters from improper waste lagoon management. Also there are potential concerns associated with nitrate-nitrogen movement through the soil from poorly constructed lagoons and from wastes applied to the soil surface.

The White Oak drainage contains 11 registered operations with a total of approximately 14,600 swine. The increase in swine numbers from 1990 to 1994 has been dramatic in subbasin 01 (White Oak River watershed)… In the White Oak drainage area, there was a 163% increase in the number of swine during this time period, with 14,600 swine in 1996.

Other information source:
Jones County Cooperative Extension Office
Onslow County Cooperative Extension Office

Summary of Findings

According to North Carolina Cooperative Extension Service, as of March, 1999 the watershed contains six permitted swine production operations located in Jones and Onslow Counties. Of the six operations, three are wean-feeder operations, one is a finishing operation, one is a farrow-wean operation, and one is unknown. The amount of acreage required for wastewater application varies depending upon the type of operation. The total number of hogs permitted to the operations is 17,780, although the actual number of hogs on the sites may not reach permitted levels.

7. WILDLIFE

Objective:
The Board sought to determine the role wildlife may play in contributing to fecal coliform in the waters.

Sources:
Nancy White, School of Design, NCSU
Lauren Hillman, Croatan National Forest

Summary of findings:

Wildlife can become a problem for water quality when they are condensed into a small area through development activities, and when hydrology on farms and in forests has been modified, which allows for the transport of fecal coliform.

In the Croatan National Forest, wildlife is not perceived as a significant contributor to water quality problems. The population of raccoons in the Croatan is not above carrying capacity, although the beaver population is expanding.

Shellfish Closures in the White Oak River

White Oak River Watershed Advisory Board
Watershed Education for Communities and Officials (WECO)

PART 3:

POLICY INFORMATION AND ALTERNATIVES FOR PROBLEM SOURCES OF SHELLFISH CLOSURES IN THE WHITE OAK RIVER WATERSHED

Policy Information and Alternative Solutions

Part Three contains information on the regulations and programs currently governing the different possible problem sources for shellfish closures in the White Oak River. In addition to the information on existing policy are suggestions provided by speakers on possible ways to address the problem sources.

This section is currently in flux as the Board moves forward with gathering more information on possible alternatives for addressing the problem sources. As they seek information on differing alternative solutions, additional information will be added to this section.

The information in this section will provide the Board with a base of understanding from which to discuss the possible recommendations they can make to their County Commissioners in Carteret, Jones, and Onslow Counties for addressing the problem of shellfish closures in the White Oak River.

1. THE COASTAL AREA MANAGEMENT ACT (CAMA)

Objective:
The Board sought to understand tools that the CAMA program may offer to manage stormwater and reduce closures.

Speaker:
Kathy Vinson, Regional Coordinator, NC Division of Coastal Management

Summary of findings from speaker presentation:
CAMA is a state law charged with the purpose of addressing coastal development through the requirement of local Land Use Plans and the designation of Areas of Environmental concerns (AECs) in the 20 coastal counties. Local authorities possess the power to decide where development can occur providing they follow CAMA rules, make the land use planning process public, and follow the minimum guidelines set forth by CAMA. Local-elected officials ultimately determine the content of a Land Use Plan. CAMA can ***only*** enforce a Land Use Plan and local ordinances when a permit is requested within an AEC or when a project requires state or federal funding and is inconsistent with the current Land Use Plan. Otherwise, local officials enforce the Plan.

The Land Use Planning process typically takes 2 years to complete. Every county (and every municipality that chooses to create its own plan) is required to renew its plan every 5 years. Carteret and Onslow Counties are in the process of revising land use plans. Each revision of a plan requires a public meeting. Neither Carteret nor Onslow counties' plans contain much more than the minimum CAMA requirements.*

CAMA rules are being continually revised by the Coastal Resource Commission (CRC), the State Commission responsible for governing CAMA.

Interested local parties should become involved in their local governments' Land Use Planning process, as public participation is mandatory in the process. Groups may obtain certified Land Use Plans, recommend revisions to local governments, and provide input at CAMA rules hearings. Groups could also sponsor meetings with planning boards from adjoining jurisdictions about particular issues of concern.

**Note- At the time of printing Version 3.0, May 1999, the CRC has enacted a moratorium on approving any new land use plans until they investigate the effectiveness of this program.*

2. STORMWATER MANAGEMENT AND REGULATIONS

Objective:
The group sought information on stormwater management, including the possible actions to control and manage stormwater, and the regulations governing these actions.

Speakers:
Bill Hunt, Dept. of Biological and Agricultural Engineering, NCSU
Jeanette Powell, Division of Water Quality, NCDENR

Summary of findings:

State and Federal Stormwater Regulations, Jeanette Powell

Urban stormwater in North Carolina is regulated by two major programs, the State Stormwater Management Program, and the Federal NPDES Stormwater Program. The state program regulates the 20 coastal counties and areas that drain to specially regulated waters (outstanding resource waters, high quality waters, and water supply waters. In these areas, it regulates development activities where a CAMA major permit or a Sedimentation/erosion control Plan is required (disturbs 1 acre or more). Areas of low density (12-30% maximum built-upon area) are required to use passive stormwater controls, such as vegetative swales. High density areas (greater than 30% built-upon area) must use engineered stormwater treatment systems, called Best Management Practices, or BMPs. Permits for BMPs are issued for 10 years, and the issuance of a permit commits the receiver to maintaining the BMP. Inspections of BMPs are complaint-driven, as resources from the General Assembly do not fund field office staff to perform regular inspections.

The Federal phase I NPDES system regulates industrial permitted stormwater discharges and municipal permitted discharges. Currently, municipalities with greater than 100,000 people are required to obtain permits. No municipalities in the White Oak River watershed are regulated by the Federal phase I system. The proposed Phase II rules, due from the EPA in October 1999, will regulate smaller municipalities: base populations of 50,000; possibly incorporated areas near base populations; base populations of 10,000 AND with a density of 1,000 per sq. mi. (called MS4s). Municipalities will be required to implement public education and outreach, a program to eliminate illegal discharges, construction site stormwater control, post-construction stormwater management, and pollution prevention. The DWQ is responsible for developing state standards for the regulations.

Stormwater BMPs, Bill Hunt

A number of options for urban stormwater BMPs exist that range from basinwide BMPs such as a wet retention pond, to much smaller scale BMPs such as changing or reducing pavement areas. Retrofitting of existing development rarely occurs due to lack of space and monetary limitations. Money for providing incentives for implementation of BMPs is available from the State, but the incentives need to be developed before this money may be accessed.

3. HYDROLOGY OF AGRICULTURAL & FORESTRY LAND USES

Objective:
The Board sought information on how to reduce the impacts form hydrological changes due to agricultural and forestry land uses.

Speakers:
Dr. Jim Gregory, Department of Forestry, NCSU

Dr. Robert Evans, Department of Biological And Agricultural Engineering, NCSU

Summary of findings:
Forestry Land Use
Drainage control in ditches, for example flashboard risers used to increase water levels in ditches, is shown to decrease total runoff and peak flow, and reduce nitrogen and phosphorus in runoff.

Currently, the Hoffman has no drainage controls in its ditches. Researchers are creating pre-control modeling of hydrology to create a baseline for future possible management plans. It is important to develop a management program that controls outflow ***and*** allows flexible management in the forest, since high water levels may hurt root growth and inhibit harvest activities.

Agricultural Land Use
To decrease agricultural impacts on the estuary, farmers can utilize conservation tillage, create riparian zones next to drainage ways, allow natural vegetation to return along ditches, and implement drainage control. Drainage control can yield benefits to farmers, in the form of increased crop production, depending on the drainage structure used.

4. ON-SITE WASTEWATER MANAGEMENT

Objective:
The Board sought information on how to reduce the impacts from on-site wastewater management.

Speakers:
Dr. David Lindbo, Assistant Professor and Extension Soils Specialist, North Carolina State University
Dr. A.R. Rubin, Professor and Extension Specialist, Dept. Biological and Agricultural Engineering, North Carolina State University
Dr. Robert L. Uebler, Washington Region, Dept. of Environmental Health, NCDENR

Summary of findings:

Any wastewater system must be permitted in North Carolina before construction. Permitted wastewater system options include mechanical wastewater treatment, shallow placed systems, pressure dosed surface or subsurface systems, and advanced pretreatment systems such as filters or aerobic treatment units which precede soil or land based systems. Of the 3,900 permitted discharge and non-discharge wastewater systems in North Carolina, 450 or 11.5%, are land based application systems.

Land application of treated wastewater provides many benefits including; removal of pollutants; use of wastewater materials as nutrients for crop production; reduced operating costs; and ease of operation. Communities may use pasture/haylands, or woodlands to accept irrigation water. Monitoring data from community land-based wastewater systems in North Carolina show that the vegetation assimilates nutrients from the wastewater, and that nitrogen in groundwater was below state drinking water standard.

Soil conditions and landscape position are assessed at sites before installation of a septic system. The state now requires that all sand lined trench systems (which are gravity dosed) and any conventional system with artificial drainage, if installed after summer 1991, be inspected yearly based on the issue date of the permit.

To prevent septic system failures, systems should be inspected during winter (high water table) months, all systems and older sand-lined trench (SLT) systems should be inspected, water from drainage systems should by analyzed, groundwater monitoring, and additional personnel should be provided to conduct inspections. Wastewater management could change in the future with the adoption of comprehensive management based on risk assessment, in which systems are chosen based on performance standards that will pose an acceptable and manageable risk for the conditions and environment affected by the system.

A broad range of options for treating wastewater is available for communities. Permitting, operation, and maintenance are required for all systems. Recent improvements in design allow for siting in sensitive areas and difficult sites (such as near shellfish beds), and improved management. The technology exists for solving on-site wastewater treatment problems. However, the ***use***, or lack of use, of the technology may pose problems. Solutions to problems with wastewater treatment and the secondary impacts lie in local land use decisions and local management of systems.

Some specific solutions to address water quality impacts from septic systems are to: establish riparian buffers by creating incentives for landowners, or by buying land; establish a statewide surveillance system for system monitoring; require the installation of nitrogen-reduction technology when a house sells and target subsidies to aid home-buyers; and require contractor certification for installers of systems.

4. COASTAL STABILIZATION PROJECTS

Objective:
The Board sought to gain an understanding of the issues surrounding hardened structures in coastal areas.

Speaker:

Ms. Tracy Skrabel, North Carolina Coastal Federation

Summary of findings:

The current state rules under Coastal Area Management Act (CAMA) that govern the use of hardened structures may not be adequate for protecting water quality. Under these rules, hardened structures may be legally built on small creeks that serve as primary and secondary nursery areas, and are critical breeding habitat for aquatic life. The scouring action at the bottom of these structures removes vegetation . Vertical wall bulkheads cause other problems, as they restrict natural sediment movement, alter the balance between marshes and sediments, modify water circulation, and remove wetland fringe material.

Alternatives to hardened structure include setbacks, stone sills, stone groins, revetments, and stone breakwaters. The extent of construction necessary to stabilize an area depends upon a number of factors, but the treatments are considered cost-effective.