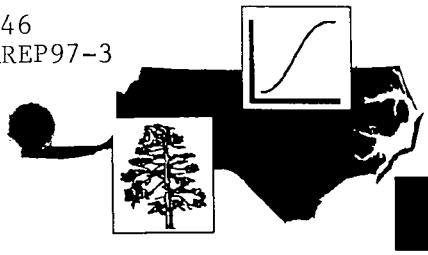
RESOURCE ECONOMICS AND POLICY

(North Carolina State University, Dept. of Agricultural and Resource Economics)



Resource Economics and Policy

Applied Resource Economics and Policy Group
Department of Agricultural & Resource Economics

AGRITOURISM OPPORTUNITIES FOR NORTH CAROLINA

Taking advantage of North Carolina's growth in tourism and its agricultural heritage, agritourism represents a potentially profitable addition to the farm business. This fact sheet describes farm-based tourism options, examines the benefits and drawbacks of agritourism, and identifies sources of information for the person who is considering an agritourism operation.

What Is Agritourism?

An agritourism business is a farm enterprise operated for the enjoyment and education of the public that may also generate additional farm income by promoting farm products.

Farm-related tourism in America can be traced to the early 1900s when families visited relatives in an effort to escape the heat of the city summer. A similar rationale brings people to the country today, as an escape for the family to a slower, less stressful environment. But with the decline in family farms it is unusual for anyone in the city to have rural relatives with whom they can stay – only 1.9% of Americans lived on farms in 1992, compared with 40% in 1900. This has led to an increase in agritourism vacations.

In North Carolina, agritourism already exists in a wide range of on-farm recreation and hospitality businesses. Examples of the activities offered by these businesses include farm tours, farm bed and breakfasts, wineries, petting zoos, fee hunting, fee fishing, farm vacations, horseback riding, and camping. Many of these enterprises are tied to farm retail operations such as a roadside stand, pick-your-own-operation, or craft shop. The possibilities for agriculture-related tourism opportunities is limited only by the imagination, and have included such things as pig races, corn mazes, and Halloween pumpkin patches.

The Market for Agritourism

For North Carolina's farmers, diversification has always been a good management strategy for maintaining incomes in the face of declining profits from specific farm enterprises. While the state's 50,000 farmers grow over 80 different

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commodities, one option for diversification that they may not have considered is tourism.

Tourism is the world's largest industry with an estimated $3.4 trillion in annual revenues. The 1996 North Carolina Travel Study estimated that business travel and recreational tourists expenditures totaled $9.8 billion statewide. A 1993 survey by the Travel Industry Association of America ranked rural destinations third among the eight most popular vacations, ahead of state parks and theme parks. One particular strength of rural areas lies in their attractiveness to travelers, especially families with children interested in learning about a region's heritage – its history, people, and natural resources.

North Carolina's heritage is tied to agriculture. Cotton, tobacco, and livestock have been the lifeblood of the state's economy since colonial days. Despite rapid increases in other economic sectors, agriculture is still the state's number one industry and North Carolina ranks third nationally in terms of net farm income.

Agritourism and Community Economic Development

Agritourism businesses can yield significant benefits to the community in which they operate. Other recreational and hospitality businesses in the area – restaurants, retail stores, hotels and the like – profit from the increased traffic of tourists. For this reason, county and regional development groups may do well to incorporate agritourism into their community economic development plans.

In addition, some agritourism ventures, such as the development of a farm-related museum, a petting zoo, or tours of farms and agribusinesses, require broader community participation. The support of local businesses, chambers of commerce, and tourism development boards usually leads to better coordination and increases the likelihood of success for these agritourism businesses.

Starting an Agritourism Business: Pros and Cons

For rural communities trying to diversify their economies, agritourism offers a clean alternative that requires very little capital outlay for infrastructure. But under what circumstances does a tourism-based business make sense for a specific farm family?

Agritourism offers a number of potential advantages. Agritourism enterprises create employment opportunities for family members and supplement the family's income. In addition, family members have the opportunity to make new friends and forge stronger links to the community. One of the most rewarding aspects of agritourism for many farmers is the opportunity to provide the public a better understanding of what agriculture is really about.

On the other hand, the potential disadvantages of an agritourism enterprise must also be considered. These may include interference with the main farm operations, loss of privacy, extra responsibilities, the possible need to hire additional labor, modest financial returns, and the high liability risk.

Developing a successful new farm enterprise requires thorough market research and business planning. Each individual situation is unique. Farmers are not encouraged to start enterprises that are inappropriate for them, or that have limited markets already served by existing operators.

What Does It Take to Start an Successful Agritourism Business?

An important first step in evaluating a new business opportunity is to first examine the goals and the philosophies of the whole farm family before making any decisions. Some agritourism enterprises are not entered into for the purpose of profit. They are seen by the farm family as an exciting opportunity to meet new people, share their farm-life with others, and to provide a little

extra spending money. The family must be careful not to intermix or misinterpret profit and the non-profit objectives.

Along with establishing goals, prospective agritourism entrepreneurs need to do some market research and financial budgeting. Whether a farmer chooses to start an agricultural bed and breakfast, host day visits to the farm or enter into a more creative enterprise, the key is to understand the options available and choose an enterprise that is suited to that particular farm and family. This requires careful consideration of a host of management issues that will affect the success of an agritourism enterprise: social skills, site considerations, insurance, labor and regulations. Very careful consideration needs to be given to each of these factors before venturing into an agritourism business.

Social skills are probably the most important of these factors. Entrepreneurs involved in agritourism need to be "people" persons – they should enjoy having people in their homes, they need to be open to questions and they need to have the ability to "sell" themselves and their farm over the phone. They also need to be flexible – work may be interrupted and this can't be perceived by the guests as an annoyance.

Site involves the location of the farm as well as the nature of the farm itself. It is necessary that the farm be accessible to a sufficiently large visitor population; for obvious reasons, city people are more interested than country people in visiting a farm. Also most agritourism visits tend to occur on the weekend, so being a short drive away from an urban center is an asset. The farm itself needs to be attractive, clean and free of odor. Although this may conflict with reality, visitors do not want to be bothered by manure and fodder.

Liability insurance needs to be obtained prior to initiating an agritourism business. A farmer may be held legally responsible for any person on his or her property and liability insurance can protect the farm and its assets. This can be added to the existing farm owner's policy or through writing a general liability policy. It is safest to assume that any new operation would not be covered by an existing policy; a qualified insurance agent, as well as an attorney, should be consulted to guarantee full protection.

Labor will be greatly affected by the new agritourism business. Farmers will need to decide who will be the primary manager of the new enterprise, and whether family labor will be enough to handle the increased responsibilities or if regular farm employees will need to devote time to the new venture. Children can be a fabulous resource in this area, assuming that they are mature enough and interested enough to participate.

Local, state and federal regulations affect everything from the restrooms needed to signage and zoning requirements. Since agritourism is a relatively new industry, it is not always clear what agency is responsible for each aspect of the enterprise.

The additional resources listed below can help cut through the confusion.

The key to establishing a successful agritourism business is understanding the available options and choosing an enterprise that is suitable to the individual situation. For more information contact your Cooperative Extension Office and refer to the following resources.

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Acknowledgments

Thanks are expressed to the following reviewers of an earlier draft of this fact sheet: Gene Brothers, Department of Parks, Recreation, and Tourism Management, NCSU; and Steve Smutko, Department of Agricultural and Resource Economics, NCSU.

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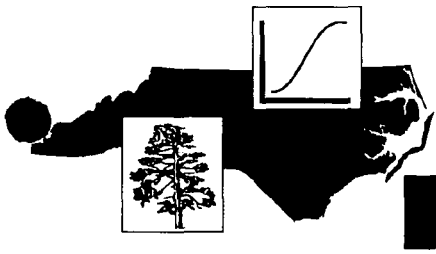
AREP97-3—October 1997



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MEASURING PROGRESS TOWARD SUSTAINABILITY: THE ENVIRONMENTAL YARDSTICK

Environmental Indicators

The main purpose of environmental monitoring is to represent in a simple, understandable way, complex environmental systems with the goal to develop effective and efficient policy options and to measure progress toward the desired environmental objectives. This report focuses on the description and evaluation of the Environmental Yardstick approach developed in the Netherlands. Particular attention is paid to its adaptability for United States agricultural and environmental policy making. Another European monitoring tool, the AMOEBA approach, is presented and discussed in a companion report.[1]

Effective and efficient political decisions depend on reliable information. This is true for environmental matters as well as for every other field of political action. The close relationships and dependencies between economies and ecology are well known and best described by the concept of sustainability. Until recently, environmental monitoring played only a minor role compared to economic monitoring, especially with regard to its importance for political decision making.

The absence of recognized environmental indicators is the primary reason for the secondary role of environmental monitoring. Although substantial amounts of data, both economic and ecological, are generated each period, established indicators that serve as inputs for political decisions and actions exist only for economic data (i.e., rate of employment, GNP [Gross National Product], and the inflation rate). A comparable set of indices for the ecological context is missing so far. Currently available ecological information often is of a qualitative and specialized nature. Moreover, these data generally are fragmented, so they do not provide an overall view of the ecological situation.

When attempting to measure progress toward sustainability,

[1]Wefering, F.M. and M.C. Marra, and L.E. Danielson 1997. Measuring Progress Toward Sustainability: The Amoeba Approach. AREP97-1, NCSU, Raleigh, NC.

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adequate economic and ecological information, according to the Dutch ecologist ten Brink, must:

A. give an indication of whether or not an environmental goal can be reached,

B. provide sufficient information about the entire system of interest,

C. be of a quantitative nature,

D. be understandable for nonscientists, and

E. include parameters that are usable in the long run.

There is a demand for environmental, as well as economic, indicators that satisfy these criteria.

Sustainability Indicators: Functions and Standards

In the following, we first present an overview of the purposes of environmental indicators. Secondly, we introduce additional features of sustainability indicators which go beyond the purposes of general environmental indicators and the requirements they must meet.

The German Experts' Council for Environmental Questions, Der Rat von Sachverständigen für Umweltfragen, listed the purposes of environmental indicators as follows:

1. Description of the environmental situation
2. Diagnosis of existing environmental problems
3. Prediction of environmental trends
4. Setting goals for the quality of the environment
5. Information for the public
6. Facilitation of political decision making
7. Test of strategies for environmental protection
8. Success control for environmental protection policies

Sustainability indicators, in contrast to common environmental indicators, not only describe the situation of the environment and the burden on it, they also show what environmental burden the ecosystem is able to withstand in the long run without affecting its basic recuperative capacity. Economic activities that unavoidably cause burdens on the environment will only be tolerated as long as they do not detract from the operating ability of the natural capital stock in the long run.

According to Braat, *sustainability* indicators should satisfy the following additional requirements:

9. Existence of reference values and sustainability thresholds
10. Adequate representation of reversible and manageable processes

The existence of reference values and sustainability thresholds is the most important requirement for sustainability indicators. The formulation of reference values presumes that a reference situation exists or can at least be constructed. As a reference for a damaged ecosystem, it is possible to utilize an ecosystem that can be found somewhere else and that is largely uninfluenced by human activities. Ten Brink refers to such an ecosystem as the geographical reference situation. Other possibilities are the reconstruction of a past environmental situation or a quantitative description, based on scientific criteria, of an environmental situation to be achieved. Furthermore, sustainability thresholds whose passing endangers the sustainability of an environmental situation can serve as reference.

The concept of sustainability combines not only the needs of future and present generations but also the interdependencies of economic activities and ecological status as well. Although widely accepted all over the world as a concept, the goal of sustainable development has a noteworthy weakness - the difficulty of measuring sustainability. Is a political decision sustainable? Is it more sustainable than the alternatives? Is the way a firm produces, a farmer grows, or a citizen behaves sustainable? Or is it at least more sustainable than the alternatives? A sustainability indicator should tell us if, and to what degree, we are making progress toward the goal of sustainability.

The Environmental Yardstick

Introduction

In the Netherlands, it has been a policy goal to reduce the physical amount of pesticides used in agriculture.[2] Such a reduction, however, does not necessarily imply fewer environmental im-

[2]Multi-Year Crop Protection Plan by the Dutch Government (1991).

pacts. In fact, Reus shows that dosages of pesticides and impacts on the environment are not significantly correlated. Farmers lack information about the environmental impacts of pesticides and fertilizers they use. In order to provide that information in a useful way for farmers and to allow a responsible and more sustainable agriculture, the Center for Agriculture & Environment (CLM) in Utrecht developed an environmental yardstick for pesticides - a tool for farmers to measure the environmental impacts of their farming practices, with the hope that this knowledge would contribute to changes in pesticide use behavior.

Construction of the Indicator

The yardstick gives information about the following three effects:

- leaching into ground water,
- risk to water organisms and
- risk to soil organisms

(Reus and Pak)

Environmental Impact Points (EIPs) of individual pesticides are assigned to each of these. If considered important for a particular crop or pesticide, the yardstick can include additional effects such as measures of food safety. They are calculated by computer models that predict the leaching of pesticides into ground water, soil and surface water and their biodegradation. To calculate EIPs, the following formula is used:

EIP = (PEC / ES) * 100

where PEC = predicted environmental concentration, and

ES = the environmental standard (the maximum concentration allowed by current regulation).

Methodology

To measure the environmental impacts of pesticides, methods derived from the pesticide registration procedure of the Dutch government are used. Reference points of the yardstick according to proposed Dutch environmental standards are set at 100. Actual scores below 100 are considered to be acceptable. EIPs are assigned for a standard application of 1 kg/ha. For dosages differing from the standard application, the number of EIPs should be multiplied by the actual dosage measured in kg/ha.

How are EIPs measured? The conditions determining risks to humans and to the environment are complicated. The environmental impacts of pesticides depend on (Figure 1.):

" properties of the chemical, such as rate of biodegradation, mobility in the environment and toxicity to non-target organisms; application factors, like application rate and method of application; environmental conditions, like soil properties, climate, etc. "

(Reus and Pak)

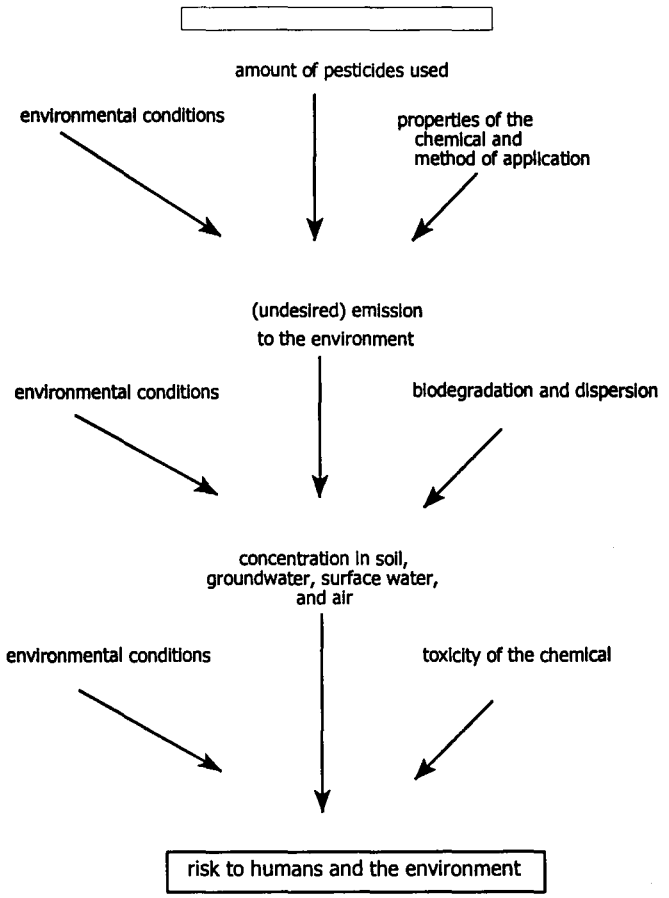
For each of the three environmental effects covered in the yardstick approach - leaching into ground water, effects on water organisms and effects on soil organisms - a variety of variables have to be taken into account to calculate EIPs.[3]

The Environmental Yardstick in Practice

The yardstick is used to compare different pesticides (figure 2). The farmer decides which of the three environmental effects is most significant for his conditions. He can select the pesticide with the lowest EIP for the most important environmental effect. That is, the pesticide which puts the least environmental pressure on his farm. It is also possible to compare the environmental effects of the use of pesticides in a certain crop. As figure 3 shows, a farmer can calculate the EIP scores for each application during the season. Afterward, the scores are added to get a rough estimation of the total environmental effect. Dutch agricultural consultants (equivalent to Cooperative Extension in the United States) encourage farmers to keep records of their scores and to compare them with their own scores from previous years as well as with those of other farmers. This practice leads farmers towards a more environmentally sound (sustainable) crop protection regime. In fact, yardsticks have become widely used by Dutch farmers. They have achieved voluntary reductions of 70% and more in environ-

[3]For a more technical description of the calculation procedure, see Reus and Pak, pp.251-53.

Figure 1. Factors determining the enviromental impact of pesticides



mental impacts since they started to apply yardsticks. Water companies who supply drinking water to towns and cities have begun to pay farmers a bonus for achieving specific percentage reductions in their pesticide impact scores or for specific levels of reduction in nutrient loss.

It also is interesting to note that the Dutch Department of Agriculture gives eco-labels to biologically grown products based on the EIPs of the product. Eco-labeling requires a permanent evaluation and control system. The standards to receive an eco-label have a progressive character in order to provide incentives for quality improvement in the sustainability of the production system. Standards are set by the responsible environmental agency. Moreover, the chemical industry is cooperating by increasing research funding to improve evaluation methods on the one hand and pesticides with regard to reductions in EIPs on the other.

Evaluation of the Yardstick as a Sustainability Indicator

Existence of Reference Values

The most important requirement to judge the degree of sustainability is the existence of reference values. Sustainability indicators should be able to do more than merely describe the current situation. They should enable an evaluation of a current situation with respect to the sustainable reference system chosen by policymakers and scientists.

The environmental yardstick for pesticides uses certain standards (set by policymakers) that are primarily based on toxicity data (for example LC_{50}).[4] These acceptable concentration standards

[4] LC_{50} is a lethal concentration that kills half of the test population within a certain amount of time, for example 96 hours.

Figure 2. **Comparison of the environmental impact of several insecticides**

Pesticide (a.i.)	Recommended Dose (kg a.i./ha)	Pollution Points at the Recommended Dose Rate		
		Water Organisms	Soil Organisms	Groundwater
acephate	0.1	0.1	0	0.8
azinphos-methyl	0.3	1100	190	0
cypermethrin	0.03	13000	28000	0
deltamethrin	0.0075	52	0.2	0
dimehoate	0.4	0.6	63	40
parathion	0.5	2500	158	0
propoxur	0.5	182	275	10000

Figure 3. **Example of a Dutch farmer's EIP's for potato pest control**

Pesticide (a.i.)	Recommended Dose (kg a.i./ha)	Pollution Points at the Recommended Dose Rate		
		Water Organisms	Soil Organisms	Groundwater
maneb	1.5	2500	1500	15
maneb	1.5	2500	1500	15
mancozeb/ cymoxanil	2.5	18	0	24
mancozeb/ cymoxanil	2.5	18	0	24
mancozeb/ cymoxanil	2.5	18	0	24
maneb/fentin	1.1	2800	820	8
maneb/fentin	1.1	2800	820	8
metribuzin	0.5	980	60	260
pirimicarb	0.3	110	230	0
propoxur	0.5	182	275	10000
Total	14		5202	10378

are a crucial factor in calculating EIPs (EIP = 100 x predicted environmental concentration / acceptable concentration). Thus, EIP values smaller or equal to 100 indicate that concentrations are at or below reference values for this indicator.

Scientific Exactness

An indicator should be scientifically based to be used for policy and it should also provide useful information for nonscientists. It should be noted that indicators are a compromise among scientific exactness, the demand for condensed and understandable information and constraints (Verbruggen and Kuik). In order to satisfy the requirements of scientific exactness, an indicator should represent adequately the system it describes.

The environmental yardstick relies on data submitted by the pesticide industry. In order to introduce pesticides to the market, the Dutch mandate all technical data about the pesticide be made available by the industry. Data then are validated by an independent governmental research institute and are made available in pesticide fact sheets. Since the industry is required by law to provide accurate data, there is no reason to doubt the scientific exactness of this indicator. Rather, the more accepted the yardstick becomes, the higher the incentive for the pesticide industry to make their products less harmful.

Clarity

The effectiveness of an indicator depends to a large extent on its clarity. Therefore, three different target groups whose attitudes toward clarity differ must be considered:

a) scientists are primarily interested in statistically utilizable and possibly raw (uncondensed) data,

b) political decision-makers requires some condensation of the data as well as setting it into relation to political goals and criteria, and

c) individual users (the public) tend to prefer unambiguous statements and a condensation of the data to one value (for example, an index number). (Braat)

The calculation of EIPs in the environmental yardstick approach does not appear difficult once a farmer knows how to include his/her particular farming conditions.

Analysis and Description of the Environmental Situation

The environmental yardstick can be used to describe the current impact of farmers' pesticide application. Matching their particular farming conditions, their dosages, and data about the pesticides they want to use, they can calculate the index of environmental impact. The value of the yardstick begins as soon as they compare different EIP values for different pesticides or even if they compare values and underlying conditions with other farmers. It is still their decision which pesticide to use, but the environmental yardstick enables them to be aware of and consider environmental, as well as economic, impacts in a more quantitative way.

Setting Goals for the Quality of the Environment

In the concept of sustainability, goals like the observance of the management rules, sustainable yields in agriculture or a sustainable stock of a certain species play a major role. It is therefore necessary to include such goals in an indicator of sustainability. However, a chosen environmental goal does not have to be the same as a sustainable reference value. The goal behind the environmental yardstick approach is simply to enable farmers to evaluate the environmental impact of their pesticide application. The sustainable goal is defined as a target number of environmental impact points per pesticide application or per growing season not to be exceeded.

The Environmental Yardstick's Adaptability for Use in the United States

The environmental yardstick tells a success story. First applied in the Netherlands in 1994, it is today used by individual farmers, farmers' study groups, and by the extension service in training courses for farmers and in agricultural schools. The yardstick also made its way across the Atlantic within this short period of time. The

Dutch Centre for Agriculture and Environment (CLM) and the United States Institute for Agriculture and Trade Policy (IATP) already have initiated demonstration projects using the yardstick in the context of nutrient balance in Minnesota, Wisconsin, and New York.

To apply the yardstick successfully, the toxicity, leaching potential, half-life and other data for a pesticide must be available. In order to effectively calculate the predicted environmental concentration (PEC) and EIPS, soil types and growing conditions of the particular region need to be evaluated as well as the relationship between the soil type and pesticide. This information is becoming more available in the United States as a result of various, ambitious research and modeling projects begun in the last few years. An example of this is the Herrings Marsh Run watershed demonstration and research project in Duplin County, North Carolina. Researchers associated with this project have begun to model and understand how pesticides and nutrients affect water quality in the soils and growing conditions of the coastal plain. The advantage of this approach to pesticide impact reduction is that it is a way to achieve the goals through voluntary means without reducing the farmer's choice set. Farmers are simply provided more information about the environmental impacts of the set of possible pesticides. This approach seems to change, at least in part, an externality or off-site impact to one that is more internal to the pest control decision and decision maker. The method seems well suited for adoption in the United States and follows well the current philosophy of providing carrots, rather than sticks, in the regulation of United States agricultural producers. It seems then that this technique shows promise as one applicable to most United States situations fairly soon. It can be adapted for nutrient applications as well. In some areas, this use could be much more important environmentally than its application to pesticide use. This is particularly true where livestock operations are relatively concentrated, such as in parts of Iowa or the southern coastal plain of North Carolina. It will be interesting to see whether introduction of this indicator to farmers in the United States results in the same degree of adoption and pesticide use reduction as has been seen in the Netherlands.

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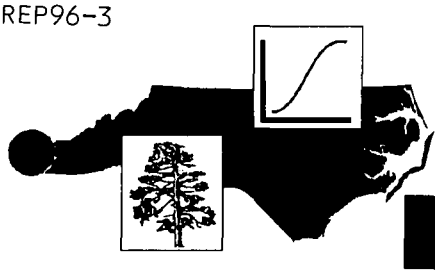
AREP97—1 October 1997



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Municipal Solid Waste Composting: Does It Make Economic Sense?

Currently there is widespread interest on the part of local governments in incorporating municipal solid waste composting into their integrated solid waste management systems. However, there is little information on the costs of MSW composting and how those costs compare with the costs of alternative forms of waste disposal (especially traditional land disposal). This fact sheet begins to fill this information gap by reporting the results of a survey of 19 MSW composting facilities around the United States. Results indicate that MSW composting generally costs around $50 per ton, and that very few facilities receive any revenues from the sale of compost to offset operating costs. Additional economic analysis indicates that, at present, MSW composting cannot be justified on financial grounds where landfill costs are relatively low (as they are in North Carolina).

Municipal solid waste composting is an alternative to the disposal of garbage in sanitary landfills. Municipal solid waste (MSW) composting facilities are currently operational in more than a dozen locations throughout the United States, and many communities are currently exploring the possibility of incorporating MSW composting into their integrated solid waste management systems. The growing interest in MSW composting has been stimulated by a desire to minimize the amount of garbage entering landfills — either as a way of meeting state waste diversion requirements or as a way of extending landfill life.

Communities contemplating establishment of an MSW composting facility need to weigh several factors, including the environmental consequences of landfills versus composting, the relative political and social costs of siting landfills and composting facilities, and the economic implications of the alternatives. In this fact sheet, information is presented on the costs of MSW composting and how those costs compare with the costs of land disposal in sanitary landfills. Following a brief overview of MSW composting technologies, the results of a survey of 19 MSW composting facilities around the United States are reported. Cost information collected in the survey and actual landfill cost data from one North Carolina county are then used to compare

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the cost of MSW composting versus the cost of land disposal. This analysis indicates that even accounting for the beneficial effects of delaying construction of a new landfill, a solid waste management system that includes MSW composting costs significantly more than a solid waste management system without MSW composting.

MSW COMPOSTING TECHNOLOGIES

The Composting Process

Composting is a controlled biological process that uses natural aerobic processes to increase the rate of biological decomposition of organic materials. It is carried out by successive microbial populations that break down organic materials into carbon dioxide, water, minerals, and stabilized organic matter. Carbon dioxide and water are released into the atmosphere, while minerals and organic matter are converted into a potentially reusable soil-like material called compost. The loss of water and carbon dioxide typically reduces the volume of remaining material by 25% to 60%. Compost can be used as a soil amendment in a variety of agricultural, horticultural or landscaping applications.

Composting is most commonly confined to municipal yardwaste operations that use leaves, grass clippings, and other yard trimmings as a feedstock. The number of yardwaste composting facilities throughout the country has grown tremendously over the past five years because state regulations have increasingly banned yard trimmings from landfills. MSW composting processes all of the biodegradable components of the wastestream that decompose readily – paper, food waste, and wood in addition to yard trimmings. On average, these materials account for 55-70% (by weight) of a community's solid waste. The significant volume reductions associated with composting and the possible uses of compost make MSW composting attractive as a potential means of diverting waste from landfills. On the other hand, MSW composting requires considerable pre-sorting of the incoming waste and screening of the finished product to remove uncompostable materials such as glass, metal, and plastic – activities that tend to be relatively costly.

Composting Technologies

The two basic processes used in large scale composting are windrow-based technologies and in-vessel technologies. In *windrow* systems, waste is brought to a central open air facility and formed into windrows that are three to five feet high.[1] The windrows are turned periodically to maintain a stable temperature and rate of decomposition, and water is added as needed to maintain an appropriate moisture content. After a desired level of decomposition is reached, the composted product is ready for assembly and distribution to end-users. A somewhat more sophisticated alternative to the simple *windrow* system is the *aerated windrow system.* Aerated windrow systems replace manual turning of windrows with a network of pipes that force air into the windrows.

In-vessel systems employ considerably more sophisticated proprietary technologies. These technologies offer a highly controlled, enclosed environment for effecting the biological decomposition needed to produce a high-quality product. In-vessel systems tend to be considerably more capital intensive than windrow technologies, however, requiring a larger initial investment. In addition, the greater technical complexity of these systems usually requires a workforce that is more highly trained (but fewer in number) for operating the composting facility.

THE SURVEY OF MSW COMPOSTING FACILITIES

A telephone survey of MSW composting facilities operating in various parts of the country was conducted in the spring of 1995. Nineteen facilities were contacted, and facility managers were asked a number of questions regarding the specific composting technology employed (windrow, in-vessel, etc.); operational details (process time, percent volume reduction, annual throughput); costs (both debt

[1]Windrow formation may be preceded by shredding the incoming product to reduce particle size at the outset of the composting process.

Table 1. Overview of MSW composting facilities surveyed

Location	Type of system	Age (years)	Volume (tons/day)	Process Time (months)	Volume reduction
<u>Publicly owned and operated facilities</u>					
Columbia Co., WI	in-vessel	2	67-80	2.5	40%
Lakeside, AZ	in-vessel	4	10-12	3.0	n/a
Martin/Fairbault Co., MN	in-vessel	4	100	3.0	50%
Mackinac Island, MI	aerated windrow	3	200-400	2.0	45%
Portage, WI	aerated windrow	9	16	3.0	50%
Sumter Co., FL	aerated windrow	7	50-55	2.0	n/a
Wright Co., MN	aerated windrow	n/a	175	4.0	60%
Buena Vista, IA	windrow	5	35-40	4.0	25-50%
Fillmore Co., MN	windrow	8	11	3.0	70%
Lake of the Woods, MN	windrow	6	1.5	1.0	50%
<u>Publicly owned and privately operated facilities</u>					
Sevier Co., TN	in-vessel	3	150	1.5	60%
Mora, MN	windrow	4	200-250	6.0[a]	50% [a]
<u>Privately owned and privately operated facilities</u>					
Baltimore, MD	in-vessel	2	500-600	1.5	n/a
St. Cloud, MN	in-vessel	7	65	2.0	60%
Whatcom Co., WA	in-vessel	4	100	2.0	50%
Pembroke Pines, FL[b]	aerated windrow	4	550	1.5	50%
Montgomery Co., KS	windrow	9	50-60	2.0	60%

a. The Mora facility also processes some compost for 12 months with volume reduction of 60%.
b. The Pembroke Pines facility is not currently operational.

service and operating/maintenance costs); and disposition of the finished product (uses and users, revenues from sales, and quality control systems to assure product consistency). Respondents were also queried as to any problems that had been experienced since start-up and ways in which problems were dealt with. Of the nineteen facilities contacted, three have shut down. One facility (Escambia Co., FL) was closed due to liability and cost problems, one (New Castle, DE) was forced to shut down due to odor problems, and one (Pembroke Pines, FL) has shut down temporarily due to technological problems.

Table 1 provides an overview of 17 of the MSW composting facilities surveyed.[2] Of the seventeen facilities listed, ten are publicly owned and operated, five are privately owned and operated, and two are publicly owned but operated by private firms. About 40% use in-vessel technologies, with the balance relying on less sophisticated windrow systems. Annual throughput varies considerably, although publicly operated facilities tend to handle smaller volumes of waste. With one exception, process time ranges from one to four months and volume reduction ranges from 25% to 70%.

[2]We include information for the Pembroke Pines facility, even though it is not currently operating.

Table 2. Disposition of final product at MSW composting facilities surveyed

Location	How product is used
Publicly owned and operated facilities	
Columbia Co., WI	Agriculture
Lakeside, AZ	Landscaping
Martin/Fairbault Co., MN	Agriculture, landscaping, nurseries
Mackinac Island, MI	Landscaping, landfill cover
Portage, WI	Agriculture, landscaping
Sumter Co., FL	Landscaping, roadside fill dirt
Wright Co., MN	Agriculture, landscaping, roads, nurseries, landfill cover
Buena Vista, IA	Landfill cover
Fillmore Co., MN	Agriculture, landscaping
Lake of the Woods, MN	Soil conditioner for closed landfill
Publicly owned and privately operated facilities	
Sevier Co., TN	Agriculture, landscaping, nurseries
Mora, MN	Landscaping, nurseries
Privately owned and privately operated facilities	
Baltimore, MD	Agriculture
St. Cloud, MN	Agriculture
Whatcom Co., WA	Nurseries
Pembroke Pines, FL	Agriculture, nurseries
Montgomery Co., KS	Landfill cover

Compost Uses

Table 2 indicates the uses of finished product from the facilities surveyed. Over half the facilities listed farmers and/or landscapers as the primary users of the compost that is produced. Six facilities contract with nurseries for disposal of some of their compost, and in five cases compost is used as landfill cover. Somewhat surprisingly, only two facilities provide compost for use as roadside fill dirt. In general, most compost was given away at no charge.

Costs of MSW Composting

Only nine of the facilities contacted provided sufficient cost information to allow computation of average costs on a per-ton basis. In the case of privately-operated facilities, most firms informed us this was proprietary information they were reluctant to divulge. Public composting facilities were considerably more forthright about their costs; however, in several cases the requisite data (particularly data on operating and maintenance costs) was simply unknown by the facility manager.

Annual debt service costs were, in most cases, provided by survey respondents. Where debt service information was unavailable, these costs were computed as 10% of initial capital investment (comparable to principal and interest payments on a bond financed at 8% over a 20-year period). In the case of the Sevier County facility, the reported initial capital cost of $6.5 million included a significant subsidy on the part of the vendor of the composting technology (Bedminster Corp.). Presently, a comparable system would cost twice that amount, and hence we computed "unsubsidized" annual debt payments based on the price that a prospective pur-

Table 3. Costs of selected MSW composting facilities

Location	Type of system[a]	Average Volume (ton/day)	Debt service ($/ton)	O&M costs ($/ton)	Revenue ($/ton)	Net cost ($/ton)
Sevier Co., TN						
- reported	I-V	150	$13	$23	$1	$35
- unsubsidized[b]	I-V	150	$26	$23	$1	$48
Columbia Co., WI	I-V	74	$14	$29	none	$43
Baltimore, MD	I-V	550	$27	$24	none	$51
Martin/Fairbault Co., MN	I-V	100	$28	$51	none	$79
Portage, WI	AW	16	$26	$24	none	$50
Wright Co., MN	AW	175	$28	$23	none	$51
Sumter Co., FL	AW	53	$22	$52	$20	$54
Fillmore Co., MN	W	11	$41	$240	none	$281
Lake of the Woods, MN	W	1.5	$176	$1,795	none	$1,971
Weighted average[c]			***$26***	***$28***	***$1***	***$53***

a. I-V = in-vessel; AW = aerated windrow; W = windrow

b. "Unsubsidized" estimate assumes an initial capital cost of $13 million (as opposed to the reported value of $6.5 million).

c. These are mean costs (weighted by tons processed), excluding the Fillmore County and Lake of the Woods facilities, and using the unsubsidized estimate for the Sevier County facility.

chaser would have to pay for establishing a similar facility. Finally, annual debt service costs and annual operation and maintenance (O&M) costs were divided by the number of tons of annual throughput to arrive at a cost per ton.

Table 3 lists the per-ton costs for the nine facilities that supplied cost information. There it will be observed that for six of the nine facilities, net costs lie clustered around $50 per ton (ranging from $43 to $54). One facility had costs of $79 per ton, and two other facilities – both of which handle relatively small amounts of material annually – had extremely large per-ton costs. In only one case were significant revenues from compost sales reported.

Problems

Respondents generally reported being pleased with how well their facilities were operating. Two problems – odor and residual plastics in the final product – were identified by a number of individu-

als questioned. Three respondents cited odor as a continuing problem, and an additional four had had odor problems that were remedied by installation of bio-filters. Residual plastics were cited as problematic at seven facilities. In most of these cases, this has led to greater emphasis on pre-sorting of feed stock prior to composting.

Summary

In summary, our survey indicates that MSW composting facilities generally involve costs around $50 per ton, although we did uncover some cases of extremely large operating costs for a couple of facilities handling relatively small amounts of trash. The great bulk of facilities contacted receive no revenues for the compost they produce; rather, they generally give the finished product away to farmers, landscapers, nurseries, and landfills. We found little evidence of any particular cost advantage related to public versus private operation. Respondents generally appeared to be satisfied with the operational aspects of their facilities. Odor and residual plastics were identified as the primary areas of concern, but most operations had developed mechanisms for dealing with these problems.

MSW COMPOSTING VERSUS LANDFILLS

The survey results presented above indicate that communities contemplating MSW composting as part of their integrated solid waste management system should expect composting to cost in the area of $50 per ton. In North Carolina, this is above what it costs nearly all municipalities and counties to dispose of waste in sanitary landfills. However, as mentioned in the introduction, one of the benefits of municipal solid waste composting is that it extends the life of landfills by diverting waste. A key economic question that arises in assessing the desirability of establishing a MSW composting facility, then, is whether or not the economic benefits of extending landfill life exceed the additional cost of processing waste through composting.

To address this question, Table 4 compares the cost of landfilling all waste generated within a county with a hypothetical scenario in which 50% of the county's waste is landfilled and 50% is processed at a MSW composting facility. To do so, we utilize 1995 landfill cost data from Rowan County, North Carolina. Rowan County owns and operates a sanitary landfill that currently handles approximately 100,000 tons of garbage per year at a cost of just under $24.00 per ton. Total costs are made up of three roughly equal components: (a) Operating and maintenance (O&M) costs; (b) debt service on the capital outlay for construction; and (c) contributions to a reserve fund for environmental monitoring. Note that contributions to the reserve fund are fixed costs that accrue regardless of the amount of waste handled; a reduction in the amount landfilled therefore increases the *per ton* cost of this cost item. Debt service is also a fixed cost; however, extending the life of the landfill effectively draws out the period of time over which initial capital outlays are paid off and hence will lower the size of the total annual principle and interest payment (although not necessarily on a per ton basis). Finally, variable costs will fall in direct proportion to the reduction in waste landfilled and so remain constant on a per ton basis.

Rowan County is currently planning to develop a new cell (at a cost of $3 million) that will take 7 years to fill up at current waste generation rates. The first column in Table 4 provides the costs for the "landfill everything" scenario. These cost figures assume that (a) the $3 million capital outlay is financed over the seven years it will take to fill the cell up, at an interest rate of 5%; (b) the current amount set aside annually for environmental monitoring remains constant; and (c) current per ton variable costs remain constant. Given these assumptions, the total annual cost of solid waste management would be $2.2 million (or $21.28 per ton of waste handled).

The remaining columns of Table 4 present the costs of solid waste management assuming that half

Table 4. Comparison of annual waste management costs with and without MSW composting

		Landfill + MSW Composting		
	Landfill Only	Landfill Cost	Compost Cost	Total Cost
Fixed Cost[a]	$1,357,213	$1,141,826	$1,053,670	$2,195,496
Variable Cost[b]	$885,465	$442,733	$1,580,505	$2,023,238
Total Cost	$2,242,678	$1,584,558	$2,634,175	$4,218,733
Tons of garbage	105,367	52,684	52,684	105,367
Fixed cost per ton	$12.88	$21.67	$20.00	$20.84
Variable cost per ton	$8.40	$8.40	$30.00	$19.20
Total cost per ton	$21.28	$30.08	$50.00	$40.04

a. Fixed cost for the landfill includes contribution to a reserve fund for environmental monitoring. Fixed finance costs for the landfill are computed assuming a $3 million loan at 5% interest paid out over 7 years in the "Landfill Only" scenario, and over 14 years in the "Landfill + MSW Composting" scenario. Fixed costs for MSW composting are assumed to be $20 per ton of waste handled.

b. Variable costs for the landfill are assumed to be $8.40 per ton of waste handled. Variable costs for MSW composting are assumed to be $30 per ton handled.

of the waste generated within the county is landfilled and half is processed at a MSW composting facility. Here, we take the variable and fixed costs of MSW composting to be equal to the averages derived from the results of our survey of composting facilities presented earlier ($30 and $20 per ton, respectively).

Diverting half of the county's waste to a MSW composting facility entails processing half the county's waste steam at a per ton cost that is more than twice the cost of landfilling. There is some cost saving in extending the life of the landfill by lengthening the period over which debt needs to be paid off. This cost saving only partially offsets the greater cost involved in composting, however.[3] The overall impact of diverting half of the county's waste to a MSW composting facility is an 88% increase in the county's annual solid waste management bill – from $2.2 million ($21.28 per ton) to $4.2 million ($40.04 per ton).

From a financial perspective, it is clearly not possible to justify construction of a MSW composting facility for the specific case of Rowan County, even when the value of extending a landfill's life is taken into account. Further analysis indicates that only if landfill costs were more than double those of Rowan County ($59.00 per ton) would processing waste at a MSW composting facility become economically feasible. Disposal costs are currently much lower than this at most, if not all, landfills in North Carolina. We conclude that only if landfill costs were to rise considerably – or markets for compost were to develop such that revenues from compost sales grew enough to substantially offset

[3]In fact, the per ton cost of landfilling actually *rises*, due to the fact that while fixed costs drop by 15% the amount of trash over which these fixed costs are spread falls by 50%.

the higher costs of composting – would MSW composting become an economical component of a community's integrated solid waste management strategy.

DOES MSW COMPOSTING MAKE SENSE?

From an economic perspective, communities contemplating MSW composting as a component of their overall solid waste management system should proceed with great caution. It is clear that, at present, MSW composting cannot be justified on financial grounds where landfill costs are relatively low (as in North Carolina).

It is conceivable that there are other factors that might justify the larger costs of MSW composting in some locations. One such factor is the strength of state-mandated waste diversion requirements. Where these mandates are binding – and to the extent that other, cheaper alternatives such as yard waste composting do not divert sufficiently large volumes from landfills – MSW might be rendered more attractive (although no less costly).

A second possible reason sometimes offered as to why some communities might want to explore MSW composting has to do with the difficulty of siting a new landfill. According to this argument, if a community perceives MSW composting to be more environmentally "friendly" and/or less damaging to local property values than land disposal, it may be easier to site an MSW composting facility than a new landfill. This contention is probably no longer true for most if not all communities, however, given recent well-publicized negative public reaction to MSW composting facilities in various locations across the country due to odor problems and cost overruns.

Acknowledgements

Thanks is expressed to the following reviewers of an earlier draft of this fact sheet: James Shelton, Department of Soil Science, NCSU, and Charles Safley, Department of Agricultural and Resource Economics, NCSU. Wesley Nimon provided able research assistance.

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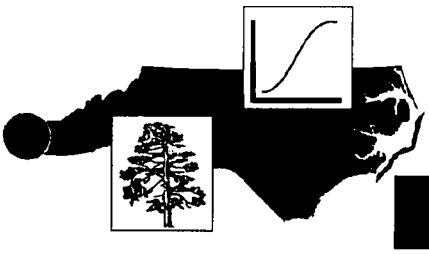
AREP96—3 October 1996



Resource Economics and Policy

Applied Resource Economics and Policy Group
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Wetlands Mitigation Banking Systems: A Means of Compensating for Wetlands Impacts

Balancing economic development with the protection and conservation of the nation's wetland resources has become an important issue in natural resource policy. Section 404 of the Clean Water Act and Section 401 Water Quality Certification regulations in each state designate allowable uses of wetlands. The North Carolina General Assembly has passed legislation regarding wetlands mitigation banking systems. Additional legislation is possible. The North Carolina Environmental Management Commission, in furtherance of their regulations for protecting the state's water resouirces, passed new rules (effective September 1, 1996) regarding wetlands uses. Federal and state regulations also designate which wetland uses (impacts that alter wetlands) must be mitigated through the replacement of the functions and values lost due to wetland impacts. Mitigation is usually required to be of the same wetland type as the wetland that is harmed, and to be in close proximity to the wetland that is impacted. Regulations require a minimum compensation ratio of one-to-one, although the ratio is often higher. The compensation ratio is the number of wetland acres that must be replaced to the number of wetland acres that are impacted. Wetlands mitigation banking systems have arisen as a means to satisfy the mitigation requirements of federal and state regulations. Mitigation banks represent large areas of replacement wetlands which are assigned credits corresponding to the amount of wetland function and value created, enhanced, or restored through the bank's construction. Mitigation banks can offer benefits over on-site mitigation such as cost-effectiveness, greater ecological value, and the ability to provide mitigation in advance of impacts.

INTRODUCTION

In the last twenty years, a transition in federal and state policy concerning the regulation of our nation's wetlands has occurred. The national policy regarding wetlands and their use has moved from a position which promoted 'wetland conversion' (the alteration of wetlands for agricultural, development and other purposes) to a policy that seeks to balance economic development with the conservation and

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preservation of a natural resource deemed to be an important part of our nation's environment. This paper will provide an overview of wetlands and their regulation, as well as an introduction to the concept of wetland mitigation banking systems. Additionally, this paper will look at the state of wetland legislation and mitigation banking in North Carolina.

WHAT ARE WETLANDS?

The US Army Corps of Engineers and the North Carolina Environmental Management Commission's Wetlands and 401 Certification Procedures describe wetlands as areas that are covered or saturated by surface or ground water on a sufficiently frequent basis and for a sufficient length of time so as to support, and under normal conditions do support, a goodly amount of vegetation that is typically adapted for life in saturated soil conditions. Swamps, bogs, pocosins, hardwood bottomlands, Carolina Bays, and saltwater marshes are types of wetlands that one might encounter in North Carolina. Many wetlands function as a means of flood control, erosion control, water cleansing, and water storage, as well as serving to provide many recreational and commercial opportunities like fishing and hunting. In conjunction with plants that live in wet soil conditions, wetland supports various types of aquatic and land-based wildlife. For example, a saltwater marsh often supports fish, shellfish, and birds. In addition to plants and animals that live in the water, a swamp might provide habitat for deer, bear, and foxes.

WETLAND POLICY AND REGULATION

United States wetland policy has been evolving over about the last 140 years. From the mid 1800's until around the 1970's, wetland policy encouraged the conversion (draining/filling to remove wetland characteristics) of wetlands for a variety of purposes including agricultural production, bioculture and development. During this period, policy tools such as cost-sharing, tax incentives, and farm commodity programs were used to promote the conversion of wetlands.

From the 1940's through the 1970's, wetland policy was somewhat conflicting. The policy contained measures to promote the conversion of wetlands while at the same time some aspects of the policy began to promote the protection of wetland. A turn toward a more comprehensive policy of wetland protection began in the 1970's (Danielson and Leitch 1994).

There are basically two major categories of regulations that apply to wetlands: federal regulations and state regulations. Additionally, local units of government may have wetlands rules and regulations.

Federal Regulations

The main federal regulations concerning wetlands are contained in Section 404 provisions of the Clean Water Act of 1972. These Section 404 provisions establish a procedure for regulating the discharge of dredged or fill material into waters of the United States, including wetlands. These apply to activities undertaken to convert wetlands into land suitable for purposes such as development projects, dam construction, highway construction, and agriculture. Section 404 is designed to prevent impacts (alterations) to wetland when there is a practical alternative which is less damaging to the wetland or when an impact will seriously alter the ecological functions of the nation's waters.

Anyone who wants to undertake an activity which will impact a wetland must determine if application for a permit to do so is needed. Whether a permit for impacting a wetland is needed is based upon such things as the nature of the development project and the number of wetland acres that will be affected by the project. The US Army Corps of Engineers has main oversight of Section 404 regulations and administers permitting. In the individual permitting process, the permit applicant must go through a sequence of steps. First, the applicant must try to *avoid* adversely impacting the wetland.

Second, the applicant must show that they tried to *minimize* any adverse impacts to the wetland. And lastly, the applicant may be required to take steps to *compensate* for any unavoidable impacts to the wetland caused by their project. This third step, compensation, is where wetland mitigation banking comes into play. In essence, this sequencing process for individual permit applications means that if a permit applicant has shown the adverse wetland impacts caused by the proposed project are unavoidable and have been minimized, then the permit applicant may be required to take steps to 'replace' or mitigate the wetland function(s) and ecological values lost due to the adverse impacts of the permitted project. Wetland mitigation is discussed in more detail in the next section, 'Wetland Mitigation.'

Although most projects affecting wetlands must be permitted, there are exceptions. Some on-going activities such as farming, ranching, and forestry are in some cases exempted from these regulations. Additionally, some activities which have limited impacts to wetlands are considered to be covered under general permits (as opposed to individual permits). These general permits cover certain activities such as minor road crossing construction, and can be issued on a national, regional, or statewide basis. For example, a particular activity not deemed to require an individual permit (judged to have minimal impacts to wetlands), could be granted a general permit which allows the activity to take place anywhere in the country, anywhere within a specific region of the country, or anywhere within a particular state. The 'Federal Guidance for the Establishment, Use and Operation of Mitigation Banks' advises that the use of mitigation banks is preferred when compensatory mitigation is required for impacts to minor aquatic resources such as those authorized under general permits (US Army Corps of Engineers 1995).

Another type of general permit is the Nationwide 26 permit. This permit allows impacts to certain types of freshwater wetlands anywhere in the nation. It also authorizes impacts of less than one-third acre, and has a maximum fill of three acres, and provides that impacts between one-third and one acre require notification of the Corps of Engineers. The Corps of Engineers then may allow the impacts to be covered by this general permit or require the project to apply for an individual permit.

In addition to the Corps of Engineers, the Environmental Protection Agency, US Fish and Wildlife Service and other federal agencies may be involved in the permitting process.

State Regulations

The Clean Water Act requires that any activity seeking a federal permit for discharges into waters (including wetland) must have certification from the state in which the impact will take place. This state certification falls under Section 401 Certification rules and requires that in order to be granted a federal Section 404 permit, an activity must have certification that it meets state water quality regulations. Each state develops its own water quality standards and regulations, in consultation with federal agencies such as the Environmental Protection Agency, which best suit the particular water quality issues within the state.

North Carolina's Wetlands Rules and 401 Certification Procedures provide specific rules for management of the state's water quality. For instance, these rules provide for three broad classifications of state waters, including wetlands (Table 1).

- The Freshwater Classifications are divided into eight classes which describe the uses for which the particular class of waters is protected. For example, Class C waters are freshwaters protected for secondary recreation, fishing, aquatic life and wildlife; these are the minimum uses for which freshwaters are protected. Freshwater wetlands have their own class, designated as Class WL.
- The Tidal Salt Water Classifications are subdivided into four classifications which describe the uses for which the waters are protected. As in the Freshwater Classifications,

Table 1. North Carolina Wetland Classifications
(Wetlands and 401 Certification Procedures, North Carolina Environmental Management Commission 1996)

Freshwater	Class WL	Defined as areas that are inundated or saturated by an accumulation of surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions, excluding those designated as Class SWL.
Tidal Salt Water	Class SWL	Waters that meet the definition of coastal wetlands as defined by NCGS 113-229(n)(3), and which are landward of the mean high water line, and wetlands contiguous to estuarine waters as defined by NCGS 113A-113(b)(2).
Supplemental	UWL (unique wetland)	Wetlands of exceptional state or national ecological significance which require special protection to maintain existing uses. These wetlands could include those that have been documented to the satisfaction of the Commission as habitat essential for the conservation of state or federally listed threatened or endangered species.

wetlands in this group have their own classification designated as Class SWL.

- The Supplemental Classifications group contains six classifications made up of particularly sensitive waters. Wetlands in this group are designated as Unique Wetlands (UWL) and consist of wetlands of exceptional state or national ecological significance which call for special protection to preserve existing uses.

The North Carolina Environmental Management Commission's policy is to maintain, protect, and enhance water quality in the state. The Commission utilizes the Wetlands Rules and 401 Certification Procedures to determine the best use of the state's waters.

WETLANDS MITIGATION

Restoration, Creation, Enhancement

The third step in the Section 404 permitting process, the mitigation of wetland functions and ecological values, may be achieved through the restoration, enhancement or in some cases preservation of an existing wetland or creation of a new wetland. This process is designed to replace the functions and values of the wetland that was affected or altered by the permitted development project. Restoration typically refers to the process of restoring a former wetland back to its original wetland state. A good example would be prior converted cropland (a wetland that had been drained/filled to create farmland) which is taken out of agricultural production and restored to its wetland state. This is usually the easiest way to produce a wetland since it is less complicated to take land that has previously exhibited wetland characteristics (such as proper water flows and vegetation) and restore wetland function. Creation refers to taking upland, which has at no recent point in history been a wetland, and constructing the necessary water flows (hydrology), planting the proper vegetation and developing other wetland functions so that a new, self-sustaining wetland comes into existence. Enhancement involves taking an existing wetland and improving the functions already in place or

developing additional wetland functions at the site. Preservation entails protecting the functions and ecological values of an existing wetland. Preservation is not usually allowed as compensation for adverse impacts to wetlands in the permitting process since it does not further the national goal of 'No Net Loss' of wetlands. 'No Net Loss' refers to replacing impacted wetlands so that there is no net loss in national wetland acreage. As a mitigation tool, preservation only 'protects' an existing wetland, and thus does not 'replace' a destroyed or impacted wetland, thereby resulting in a net loss of wetland acreage.

In-kind, On-site Mitigation

Mitigation of impacts has historically been achieved through on-site mitigation. On-site mitigation refers to the restoration, creation, or enhancement activities undertaken by the permit holder on the same site where the permitted impact occurs. This is pursuant to federal policy, which prefers that mitigation be in-kind (i.e., replace the same type of wetland that is impacted) and in as close proximity to the impact as possible. This is designed to assure the mitigation is as close to a 'replacement' of the impacted wetland as possible. For example, if a permit holder impacts a freshwater wetland in Falls Lake watershed, mitigating that impact by restoring a saltwater marsh in the Lower Cape Fear watershed would replace wetland acreage, but would not replace the particular functions and ecological value associated with the freshwater wetland in Falls Lake watershed.

In recent years, the concept of allowing mitigation to take place off-site, or in a different geographical location than the impact site, has begun to develop. This concept will be examined in the 'Wetland Mitigation Banking' section.

Compensation Ratios

If the Section 404 permit requires compensation for adverse impacts caused by the permitted project, the type of mitigation undertaken to satisfy the compensation requirements of the permit can have an affect on the number of wetland acres required to be restored, created or enhanced. The number of acres restored, created or enhanced for each acre of wetlands impacted is known as the compensation ratio. For example, if the compensation ratio is 2:1, then two acres of wetlands must be restored, created or enhanced for every one acre of wetland that was impacted by the permitted development project. In general, the minimum ratio of restoration or creation acceptable by regulators is 1:1. However, this ratio is often higher, sometimes as high as 10:1. Since restoration is usually favored by regulators, the ratio of restored to impacted acres may be 2:1 for a restoration project. But if the permit applicant wanted to use enhancement for mitigation instead of restoration, the ratio may be increased to 3:1 or 4:1. As preservation is the least favored method of mitigation, ratios for this type of mitigation are sometimes 10:1 or higher.

Wetland Mitigation Rules in North Carolina

Table 2 shows the general rules for determining what type of Section 401 Water Quality Certification requirements a proposed impact to freshwater wetlands (Class WL) in North Carolina may need to meet.

The heading 'Distance From Surface Water' refers to how far the impacted wetland is from surface water. The remaining headings refer to the size of the wetland acreage that will be impacted. 'Notification' means whether the North Carolina Division of Water Quality (Under the Department of Environment, Health, and Natural Resources) must be made aware of the proposed impact to a wetland. 'Review' refers to whether the proposed impact must be reviewed by the Division of Water Quality and what possible sequencing action could be required on part of the person or entity undertaking the impacting activity. 'Mitigation' refers to whether replacement will be required for the lost functions and values of the impacted wetlands. The NC 401

Table 2. NC 401 Water Quality Certification Review Requirements for Class WL (freshwater wetlands) (North Carolina Environmental Management Commission, Wetlands and 401 Certification Procedures 1996)				
Distance From Surface Water	Wetland Acres Impacted			
	Less than or equal to 1/3 acre	Greater than 1/3 acre to 1 acre	Greater than 1 acre to 3 acres	Greater than 3 acres
0 to 50 feet	Notification=No Review=No Mitigation=No	Notification=Yes Review=Minimization Mitigation=No	Notification=Yes Review=Minimization Mitigation=Yes (4:1)[1]	Notification=Yes Review=No Practical Alternative & Minimization Mitigation=Yes (4:1)
greater than 50 to 150 feet	Notification=No Review=No Mitigation=No	Notification=Yes Review=No Mitigation=No	Notification=Yes Review=Minimization Mitigation=Yes (4:1)	Notification=Yes Review=No Practical Alternative & Minimization Mitigation=Yes (4:1)
greater than 150 to 1000 feet	Notification=No Review=No Mitigation=No	Notification=Yes Review=No Mitigation=No	Notification=Yes Review=No Mitigation=Yes (2:1)	Notification=Yes Review=No Practical Alternative & Minimization Mitigation=Yes (2:1)
greater than 1000 feet	Notification=No Review=No Mitigation=No	Notification=Yes Review=No Mitigation=No	Notification=Yes Review=No Mitigation=Yes (1:1)	Notification=Yes Review=No Practical Alternative & Minimization Mitigation=Yes (1:1)

[1] Ratio applies to restoration. The ratio for other types of mitigation is determined by multiplying these ratios by 1.5 for creation, 2 for enhancement, and 5 for preservation.

Certification Program will accept mitigation provided as part of a federal Section 404 permit unless the State finds that the Section 404 mitigation would not replace existing uses lost to the impact. Normally, a minimum of 1:1 restoration or creation is needed. The numbers in parentheses following 'Mitigation' denote the compensation ratio required.

In general, the North Carolina Section 401 Water Quality Certification rules for wetland impacts call for varying degrees of avoidance, minimization and compensation depending on the size of the acreage impacted and the proximity of the impacts to surface water. To summarize, the closer a wetlands impact is to surface water and the larger the acreage of the impacted wetland, the greater the requirements for avoiding, minimizing, and compensating for such impacts.

Example: A person, business, or government agency wants to undertake construction on a site which is classified as a wetland. In doing so, 2 acres of wetlands will be impacted. As part of permission to go ahead with the construction, the permit (from the Corps of Engineers and the state) for the project requires that 4 acres of wetlands must be restored to replace the 2 acres lost to the construction project (that is, a compensation ratio of 2:1). Instead of restoring a wetland at the site of the construction impacts, the permit applicant could obtain the number of credits (that would be equivalent to the 4 acres required to be replaced) of restored wetlands to serve as compensation for the 2 acres impacted. How these credits may be obtained will be discussed in the 'Types of Wetland Mitigation Systems' section.

WETLAND MITIGATION BANKING

Wetland mitigation banking is a system where permit holders who are required to complete compensatory mitigation for adverse impacts to wetlands can acquire credits from a mitigation 'bank' to satisfy their mitigation requirements. Permit holder refers to the person or entity undertaking a development project which will impact a wetland, requiring permitting and mitigation. Basically, a mitigation bank represents a large restored or created wetland. Enhancement and preservation of wetlands are allowed if the majority of the site consists of restoration and creation. This large 'replacement' wetland is developed according to regulatory guidelines, and is assigned a certain number of credits. These credits correspond to the functions and ecological values that were restored or created above what may have already been in existence at the mitigation bank site before the creation, enhancement or restoration activities. Subject to regulatory approval, the number of credits necessary to satisfy the compensation ratio requirements of a permit holder's Section 404 (and Section 401 water quality certification) permit are debited against the mitigation bank (that is, credits are 'subtracted' from the number of credits in the mitigation bank). These wetland mitigation bank credits usually are used as an alternative to the normal 'on-site' mitigation.

The wetland impact permit requirements will specify whether mitigation bank credits may be used for compensation and what type (as in category of wetland) of wetland mitigation credits must be used. Wetlands mitigation banking has many potential benefits, including:

- Potentially more cost-effective compensatory mitigation
- Larger wetland sites better provide some wetland function and ecological value over smaller, isolated, on-site mitigation projects
- Mitigation in advance of impacts which helps assure mitigation is successful

Table 3. Types of Wetlands Mitigation Systems	
Single-User Bank	Developed by person(s) or entity for their exclusive use
Public-Commercial Bank	Developed by government, quasi-government or non-profit organizations; offers credits for sale to the public
Private Mitigation Bank	Developed by non-governmental person(s) or entity; offers credits for sale to public or government as a for profit enterprise
Fee-based System	Receives monetary contributions into wetlands trust fund as satisfaction of mitigation requirements
Statewide Mitigation Bank	State supervised repository for all mitigation credits within a state; allows free market sale and trade of credits
Hybrid Mitigation System	Combination for profit, non-profit bank; sells credits, uses percentage of proceeds to under take further mitigation projects

- Larger mitigation sites means fewer on-site mitigation projects to be reviewed thereby reducing permit processing time and increasing effectiveness of regulatory agencies.

Overall, wetlands mitigation banking can be a useful tool for those who must fulfill regulatory requirements in order to proceed with construction or development projects located in wetlands (US Army Corps of Engineers 1995).

Types of Wetlands Mitigation Systems

The different types of wetland mitigation systems may be broadly divided into four classes: single-user banks, public 'commercial' banks, private commercial banks, and systems that combine aspects of different wetland mitigation methods (Table 3).

Single-User Banks

This type of wetlands mitigation bank is created for use by a single person or entity needing to compensate for wetland impacts. The most common example of this type of bank is a mitigation bank created by a state department of transportation (DOT). Since state DOTs are almost continually undertaking highway construction projects, they often impact wetlands in the course of these construction projects. In many cases, this means they must provide replacement wetlands for the wetlands they impact during the course of their highway projects. Therefore, many DOTs have found it helpful to create their own wetland mitigation banks. In doing so, the DOT creates an account of wetland credits that may be drawn upon as needed. In this way, the DOT may be able to withdraw credits from their own bank each time they undertake a highway project that requires them to replace wetlands. Use of credits from a single-user bank is subject to approval by the appropriate regulatory agencies such as the Corps of Engineers. The fact that many of the impacts created by a DOT are small and isolated makes the creation of a mitigation bank well suited for this type of mitigation requirement.

Public Commercial Banks

A public commercial mitigation bank is a bank created by a government, quasi-government,

or not-for-profit organization that offers mitigation credits for sale to the public. The credits are usually sold to help offset the costs of the bank's construction and development. The credits are neither produced nor sold in order to make a profit, but rather to provide an alternative for those needing to compensate for wetland impacts.

Private or Entrepreneurial Mitigation Banks

While not as common as the previous types of mitigation programs, a private market for mitigation credits is developing. In a private mitigation credit market, entrepreneurs purchase suitable land and then complete a restoration or enhancement project to an existing wetland or produce a new wetland through creation. If this new wetland meets regulatory requirements regarding the mitigation bank's plan, organization, construction, and ecological function, the new wetland bank is assigned a certain number of credits available for mitigation purposes. The developer of the private bank may then offer the credits for sale to permit holders who may use them to satisfy the mitigation requirements of their permits. The use of private mitigation credits by a permit holder must be approved by the appropriate regulatory agencies.

Other Wetlands Mitigation Systems

In addition to the types of mitigation banks mentioned above, there are other systems in existence designed to provide alternatives to on-site mitigation for permit holders subject to compensatory mitigation requirements. These systems combine components of various mitigation systems in an effort to provide a means for permit holders to meet the mitigation requirements of their federal and state permits for impacts to wetlands.

- Fee-based System

While similar to a mitigation bank, the fee-based mitigation system is not actually a true mitigation bank in the sense that it does not produce mitigation credits for use by permit holders. This system takes monetary contributions from permit holders into a fund used to create, restore, enhance, or preserve wetlands. Instead of undertaking a mitigation project to replace wetlands they impact, the permit holder would make a contribution to this fund. This contribution serves to fulfill the compensatory mitigation requirements of the permit holder. The contribution amount is usually based on the projected cost of the mitigation necessary to fulfill the permit holder's mitigation requirements. A trust fund program is usually administered by the US Army Corps of Engineers (COE) and the money contributed by the permit holders is often held in trust by a not-for-profit conservation organization. The COE then uses the funds in the trust to undertake wetland projects to replace the wetlands impacted by the permit holders. One possible drawback of this system is that the replacement wetlands are not completed in advance of the impacts to wetlands.

- A Not-for-Profit Wetlands Mitigation Bank

The Delta Environmental Land Trust Association (DELTA) mitigation bank combines aspects of private for-profit banks with the trust fund system. DELTA was created to help restore bottomland hardwood wetlands to the Delta region of Mississippi. This system proposes to take donations from private landowners of land suitable for restoration purposes, restore the land to its wetland state and sell credits from these new wetlands to permit holders. The proceeds from the sale of credits will be used to cover wetland restoration costs, with a mandatory twenty-five percent of proceeds set aside to undertake additional restoration of wetlands in the region. The additional wetlands restored with proceeds from the sale of credits from the original mitigation bank will not be sold as credits or used for mitigation purposes. This program will also be similar to a public commercial bank, in that it offers wetland mitigation credits for sale, but is not intended as a for-profit enterprise (DELTA 1994).

- A State-Wide Wetlands Mitigation Bank

Minnesota has created a state-supervised wetland mitigation bank. This system covers all types of wetland mitigation in the state, be they private commercial banks, single-user banks, or public commercial banks. All wetland mitigation credits produced in the state are deposited in this state bank. In this way, state regulators can keep an accounting of wetland mitigation activities in the state. The state bank allows free sale and trade of mitigation credits, subject only to the normal federal and state regulatory oversight.

WETLAND MITIGATION BANKING IN NORTH CAROLINA

Existing North Carolina Wetland Mitigation Banks

Like many other state Departments of Transportation, the North Carolina Department of Transportation (NCDOT) has undertaken the development of wetland mitigation banks. These banks are used to meet the regulatory requirements associated with the wetland impacts that occur as part of the Department's highway projects.

The Company Swamp Mitigation Bank was created by the North Carolina Department of Transportation to compensate for unavoidable wetland impacts occurring from NCDOT highway projects near the Roanoke River. Company Swamp is a preservation bank and consists of 1031 acres located in Bertie County, North Carolina (Pfeifer 1995). The bank may be used to compensate for impacts outside the 'watershed' in which the bank is located. On average the impact sites that use this bank for compensation have been 100 miles from the bank site. The bank may only be used for in-kind replacement of bottomland hardwood habitat.

The North Carolina Department of Transportation Pridgen Flats Mitigation Site is a single-user bank created to compensate for unavoidable losses to pocosin-type wetland habitat occurring from highway construction projects. The bank is 127.3 acres of a 348.2 acre tract located in Sampson County, North Carolina (Pfeifer 1995). The size of the bank may be enlarged pending the determination of the extent of wetland acreage on the tract. Pridgen Flats may be used to compensate for losses to pocosin-type habitat occurring anywhere in the coastal plain of North Carolina. The bank was created through the restoration of prior converted cropland to pocosin. The use of this bank for compensation is required to be in-kind replacement of pocosin (ELI 1994).

At this time, there are no operational private wetland mitigation banks located in North Carolina. There are numerous private companies in North Carolina that provide mitigation services such as environmental impact surveys, wetland delineation, as well as wetland creation, restoration, and enhancement on a project-specific basis. But there are no banks that have been created expressly to produce and sell wetland mitigation credits on a for-profit basis. However, with the advent of proposed legislation outlining rules and regulations for promoting wetlands mitigation banking in North Carolina, the private sector is showing interest in the potential market for wetland mitigation banking in North Carolina.

Wetlands Mitigation Legislation: North Carolina

In 1995, North Carolina House Bill 886 was introduced to establish a statewide program for the acquisition, restoration, enhancement and creation of wetland and riparian resources. The purpose of the program is to restore wetland functions and values across the state, to replace critical functions lost through wetland conversion and through current and future permitted impacts. This program will be implemented within the context of basinwide planning initiatives, which seek to protect and enhance water quality, flood prevention, fisheries, wildlife habitat, and recreation. Under the statewide program, a Wetlands Mitigation Bank is to be created to provide a repository for monetary contributions. These funds are to be used to promote projects for the restoration, enhancement, preservation or creation of

wetlands in North Carolina (General Assembly of North Carolina 1995).

SUMMARY

As a result of federal and state policies and regulations, wetland mitigation banking systems are emerging as mechanisms to facilitate the fulfillment of federal and state regulations regarding wetland mitigation and the development of our nation's wetlands. The various types of mitigation systems as described here are designed to provide an alternative to traditional on-site wetland mitigation. These methods of satisfying wetlands impact permits have the potential to balance economic development goals with federal and state environmental policies.

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Acknowledgements

Comments on an earlier draft by Robert Evans and Fred Cubbage, North Carolina State University; John Dorney, NC DEHNR (DWQ); and Jay A. Leitch, North Dakota State University are appreciated.

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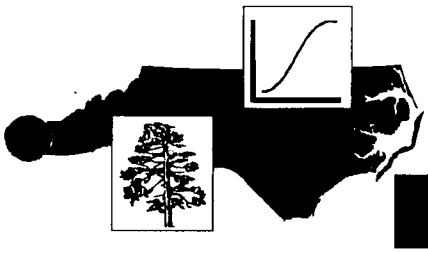
AREP96—2 November 1996



Resource Economics and Policy

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Finding the "Best of the Best" in Water Quality BMP's: The Economists' Viewpoint

Why do we have a problem with water pollution? Sometimes when economic activity occurs, not all of the costs of the activity are borne by those engaged in and receiving the benefits of it. In other words, some external costs are not taken into account. This causes more of the economic activity and less investment in pollution prevention to take place than is socially optimal. Because those engaged in the activity that results in water pollution receive no incentive to change their behavior from market signals, some sort of intervention may be called for to reduce the economic activity to the socially desirable level. One example of this type of intervention has come to be called watershed management.[1]

The purpose of this report is to describe important economic criteria to consider when making agricultural watershed management policy. We hope it is helpful to policymakers at all levels of government and also to concerned citizens.

Watershed Management Policymaking

The goal of watershed management is to improve or maintain water quality within the watershed to achieve the socially optimal level of water quality. Many tools are available to watershed managers to help achieve this goal. Some can be described as "carrots" and others as "sticks." Sticks consist of rules which, if violated, result in a penalty for the violator, such as a fine or loss of privileges. Conversely, carrots are incentives offered for changes in behavior, such as USDA cost-sharing programs. Before an analysis of which policy instruments will be most effective in achieving the water quality improvement goal in a particular watershed or region, attention must be given to the set of alternatives available to those who must change behavior to achieve the goal.

The most effective method of water quality improvement from an environmental standpoint would be to *ban*

[1]The mere existence of an externality does not mean intervention will lead to a more desirable allocation of resources. If the costs of the intervention outweigh the benefits, then intervention should not be implemented.

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economic activity. This method generally is not considered because of its excessive cost (in terms of goods and services foregone). This option may make sense in some sensitive environmental areas if the cost of water quality degradation includes loss of a unique environmental asset, but in general this is not a serious option. This option does serve to illustrate the simple principle that the set of options should be the "best" (most efficient) set according to economic, as well as environmental, criteria. The cost of achieving water quality goals must be balanced with the benefits. That is, the "best" option should be expected to achieve the greatest environmental benefit *per dollar spent* or achieve a target level of benefit *at least cost.*

From the policymaker's viewpoint, total cost should be the sum of private and public costs associated with the option. This concept is often forgotten when public resources are spent to promote a particular mechanism for changing behavior. Moreover, an option *must be considered feasible and reasonable from the standpoint of the person whose behavior is being modified.*

To allow efficient utilization of public resources, economic analysis is also needed to rule out options that have little chance of success. In addition, economic evaluation of possible options will give policymakers some idea of the level of subsidy required for effective implementation of those options likely to improve water quality.

The ideal from an economic viewpoint would be to present all the relevant cost and benefit information to each contributor to the pollution and, given a watershed-wide pollution reduction goal, shares of the reduction could be allocated to each. Allowing flexibility in the choice of pollution control methods and/or trading of shares insures that the reduction can be achieved at the least total cost (i.e. that the "best" methods will be employed to achieve the goal). This approach has been adopted in some areas, most notably in the case of industrial air pollution abatement. One drawback to this strategy in the case of nonpoint source pollution is that monitoring and enforcement are costly.

BEST MANAGEMENT PRACTICES

A series of land and water controls, "best management practices" (BMPs) are being used to address nonpoint source runoff. The concept of promoting and/or requiring "Best Management Practices" has been applied so widely probably because identification of adopters (and non-adopters) and, thus, enforcement of the rules, is not so costly. For example, it is easy to spot whether a farmer practices conservation tillage or has a large enough spray field so that animal waste can be field applied with minimal nutrient loss to ground and surface waters (although, as we've seen recently in North Carolina, the cost of inspecting every farm in a short time period can be significant). BMPs have been developed for most nonpoint sources of pollution, including farms, forestry enterprises and residential property. The following sections focus on agricultural BMPs, although the principles suggested would apply to the other BMPs, as well.

Farmer Incentives

Voluntary farmer adoption of a particular BMP depends on whether or not its use will maintain farm profitability or, at the very least, will not decrease profitability by a significant amount. If BMP adoption is too costly in terms of forgone profit, farmers will not change their behavior without some additional incentive to do so.

A potential adopter often may not have all the relevant information to assess whether or not a BMP will be profitable. In the absence of information, they may be reluctant to change behavior. Economic analyses can provide a basis for BMP selection and implementation.

Measuring the Benefits

The cost of measuring environmental improvement due to BMP implementation can be quite high; field edge monitoring and test wells are often re-

quired. However, BMP effects on water quality can differ substantially depending on site-specific factors such as soil type, slope, operator experience or crop planted. Where BMP effects are site-specific, accurate measurement may be quite costly. In other cases, however, benefits can be estimated experimentally and applied to a wide area. An example would be the benefits of a lagoon expansion that would lower the probability of an accidental spill. Some effects can be estimated with the aid of a model of the relevant physical and biological processes. Again, there must be a weighing of the benefits of accuracy against the costs of monitoring.

Measuring the Costs

In many instances, the farm level costs of BMP implementation are easier to measure than the benefits. For example, the costs of purchasing or leasing more land for spray fields and installing the irrigation equipment can be obtained by surveying realtors and equipment dealers.

Some BMPs require more management time than others. For managers with high opportunity costs of their time (i.e., the return to time spent in other activities is large), management-intensive BMPs will hold a relative disadvantage. This cost is important to include, but is often ignored in the estimation of BMP costs because it is more difficult to measure than other input costs. Imposing management-intensive BMPs on these managers may result in a misallocation of resources. Conversely, BMPs that require a certain level of management skill, may result in a misallocation or failure when imposed on poor managers.

Estimates of implementation costs will allow improved decisionmaking both at the regulatory level and the farm level. If a BMP is not feasible for a certain group or a certain area, then it will not pay to direct public resources into promoting it there. If cost sharing incentives are contemplated to entice adoption, they should be sufficient to result in enough adoption to achieve the water quality goal without "overspending" on the program. Adoption costs are, therefore, valuable tools to use in tailoring the level of cost sharing to the situation. At the farm level, BMP cost and benefit estimates will aid the producer in making better adoption decisions.

THE BEST OF THE BEST

Finding the "Best of the Best": The Big Picture

The search for the "best of the best" can be characterized as an optimization process. The purpose of this characterization is to define specific criteria for identifying the "best of the best". First, a state or regional social optimization process determines how much pollution is acceptable and how much private and public cost should be incurred to prevent additional pollution. The optimization process also determines agriculture's share of pollution reduction/prevention. In this context, the optimization facing the agricultural community is to maximize private and public wealth subject to achieving the desired pollution reduction and a host of other constraints.

Finding the "Best of the Best": The Challenge to Agriculture

Maximization of private and public wealth implies maximizing farm profits, income of the non-farm community, property values, and investment in the community. Many constraints or external conditions limit the optimization process. The acceptable level of pollution or the degree of pollution reduction is one constraint. The external funds available for cost-share, enforcement, government overhead, and education are another constraint. The current technology in agricultural production and in pollution prevention are limiting factors. Another external factor is the resource base of farms in the region, including soil types, topography, condition of riparian areas, and proximity to sensitive waters. A socioeconomic constraint is the current farm structure including the distribution of farms by size, by geographic dispersion, by enterprise mix, and by financial status. An important

external factor may be the human resource base of farmers and supporting businesses in the region (knowledge, skill, education). A deceptively simple condition of the optimization facing the agricultural community is that *the marginal benefit of each Best Management Practice implemented must equal or exceed the marginal cost of that practice.*

Finding the "Best of the Best": Selection Criteria

Criteria for identifying the "Best of the Best" can be derived from the marginal condition for optimization stated above. Researchers, educators, policymakers, and individuals strive to specify the costs and benefits of each practice taking into account the many external factors listed above. Several specific criteria are listed below.

a) No other feasible practice would allow a farmer to achieve greater profits over time while achieving the same degree of environmental protection.

b) No other allocation of the budgeted public funds across cost share, enforcement, and education would achieve greater environmental benefits.

c) No other allocation of budgeted public funds across regions (e.g., subbasins, highly sensitive waterways) would achieve greater environmental benefits.

d) No other allocation of funds across farm sizes, enterprises (e.g., dairy, row crops, hogs, poultry), or farms by financial status would achieve greater environmental benefits.

e) No other allocation of funds or set of practices would provide greater community wealth /income over time while maintaining the same degree of environmental protection.

If we assume diminishing marginal benefits to spending (for example, the marginal benefit of eliminating the last few ppm of nitrogen from a waterway is less than the marginal benefit of eliminating the first few ppm), then the above allocations will be achieved when *the marginal benefit per dollar is equal across all choices.*

This is true whether the allocation is across different uses of public funds or farmer choices of pollution abatement strategies. The list of criteria above is just an example and may be expanded. Even this short list illustrates the need for a great deal of specific information.

Finding the "Best of the Best": Information Needs

In order to apply the criteria listed above, very specific information is required.

Criterion a) requires knowledge of the cost of each BMP in a farm specific setting. Research and educational efforts can provide reasonable estimates of the range of direct investment and typical operating costs for many BMPs. The farmer and consulting experts will have to determine actual farm specific costs. Indirect costs and benefits of each BMP may be more difficult to estimate. For example, the change in field operations costs due to buffer strips depends heavily on the size and shape of the field, the size of the field machinery, and the location of the buffered areas. When costs and benefits are difficult to estimate, educators can provide a list of factors to consider and methods of calculation. Criterion a) also requires that educators and researchers provide a clear estimate of the expected environmental benefits of each BMP. Environmental benefits should be listed for each potential pollutant affected. Environmental benefits should also be listed in terms of both expected values and risk reduction, where appropriate. For example, enlarging a dairy waste lagoon may not provide much benefit in average years, but can prevent a catastrophic event that occurs rarely.

Criterion b) requires information on the expected expenditures of public funds on cost share, education, enforcement, and government overhead

for each BMP. The effectiveness of each BMP may depend on the level of expenditure in one or more of these categories. Information on the number of cost share projects and the level of cost share proposed is also required.

Criterion c) requires specific information on which waterways would benefit most from pollution reduction. The word "benefit" implies not only a physical measurement but also a social valuation. For example, cleanup of a waterway that is "used" by or affects a large number of people may yield greater social benefits than a similarly polluted waterway that is not "used" by many people. Criterion c) also requires information on the effectiveness of each BMP in correcting pollution problems along specific waterways.

Criterion d) requires information on the source of pollution affecting specific waterways and on the ability of specific types of farms to adopt BMPs. For example, which enterprises (row crops, hogs, poultry, . . .) are causing most of the pollution along a specific waterway? Are there specific sizes of farms with that enterprise that create most of the problem? Does the financial condition of some of those farms make cost share more effective when targeted to those farms. Again, specific information on the effectiveness of BMPs for the type of farms being targeted is required.

Criterion e) requires information about the effects of BMPs on community income and wealth. Where BMPs address a local problem as well as a regional water quality problem, community wealth may be increased. Where BMPs reduce economic activity, they may decrease community income. Alternatively, where BMPs create need for a new service or create a new product, they may enhance community income and wealth.

Implications of the Search for the "Best of the Best"

The criteria and information needs identified above have implications for the selection and implementation of BMPs.

1) *Flexibility is important.* The site specific nature of much of the information required makes it highly unlikely that the "best" BMP (or set of BMPs) can be identified by anyone unfamiliar with the site. A research, education, cost share and regulatory program that emphasizes a menu of BMPs and a flexible process for local identification of the "best" seems most likely to be effective.

2) A major effort to prioritize geographic locations in terms of where installation of BMPs is most likely to have the greatest water quality benefit is recommended.

3) A major effort to prioritize farm sizes, enterprises, and practices in terms of likely efficacy of BMPs for optimal allocation of public funds is also recommended.

4) More work is needed to identify the farm specific determinants of cost, feasibility, and effectiveness of each BMP. Much of the work to date seems limited to estimates of the direct investment and operating cost of BMPs with limited consideration of indirect costs or benefits.

5) New efforts are required to assess the implications of each BMP for community wealth and income. Community costs and benefits should be included in any new evaluation of BMPs.

6) The same criteria used to evaluate existing BMPs can be used to prioritize research into new pollution prevention technology. While funds for pollution prevention research are increasing, they remain limited. The "best of the best" criteria can be used to determine the potential value of proposed technologies. High cost technologies or technologies that address only a small portion of the potential for pollution reduction may receive a lower priority. Easily managed technologies that control potential pollutants effectively at low cost (or even

at a profit) on the types of farms being targeted may receive a high priority.

7) The "best of the best" criteria can be used in designing educational programs and regulatory/ monitoring/enforcement programs as well.

Summary

Economists' perspective on Best Management Practices can be summarized as the search for maximum social benefit at minimum social cost. Collaboration between economists, other scientists, and policymakers, coupled with regulatory flexibility, holds promise for finding the "best of the best".

Regardless of whether the search is being conducted by policymakers or farmers, finding the "best of the best" involves weighing the costs and benefits of each option from their viewpoint. The information provided through economic analysis of available options will allow more efficient decisions to be made and increase the likelihood that the chosen option is the "best of the best."

Acknowledgements

Thanks is expressed to Jennifer Platt, Department of Agricultural and Resource Economics, NCSU, who reviewed an earlier draft.

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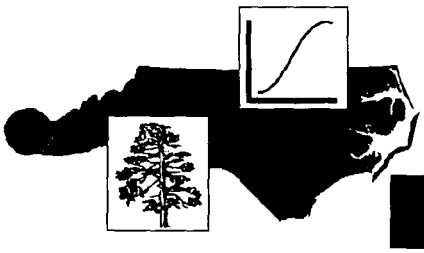
AREP96—1 October 1996



Resource Economics and Policy

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Small Water System Waivers for Monitoring of Pesticides, Synthetic Organic Chemicals and PCB's

The Safe Drinking Water Act requires public water systems to monitor for a variety of potential contaminants. The monitoring tests can be expensive and may represent a significant cost to owners of small water systems. The Public Water Supply Section of the North Carolina Division of Environmental Health recently announced that a monitoring waiver has been approved for small public groundwater systems. The waiver is for required monitoring of certain pesticides, synthetic organic chemicals and PCBs. The information provided on the following pages is designed to answer some of the common questions regarding monitoring requirements and monitoring waivers.

Background

In July of 1994, the Public Water Supply Section of the North Carolina Division of Environmental Health announced a susceptibility waiver process for the monitoring of pesticides, synthetic organic chemicals (SOCs), and PCBs. The monitoring requirements result from the Safe Drinking Water Act amendments enacted by Congress in 1986. Under these amendments, Congress directed the Environmental Protection Agency (EPA) to develop regulations for 83 contaminants that may be found in drinking water. EPA is required to regulate more than 200 contaminants by the year 2000.

Who is subject to the monitoring requirements?

Monitoring requirements for pesticides/SOCs/PCBs began the first quarter of 1994 for schools and health care facilities and for community systems serving populations between 3,300 and 101 persons. Community groundwater systems serving less than 101 persons, or non-

Community Water Systems: Public water systems which serve 15 or more service connections or which regularly serve at least 25 year-round residents. Examples may include subdivisions, mobile home parks and apartment complexes that provide their own drinking water.

Non-Transient, Non-Community Water Systems: Public water systems that are not community water systems and that regularly serve at least 25 *of the same persons* more than 6 months per year. Examples may include industries, day-care centers, schools and health care facilities that provide their own drinking water.

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transient, non-community systems are required to begin monitoring for these contaminants the first quarter of 1995.

What are the monitoring requirements?

Affected systems must test for required pesticides/ SOCs/PCBs for four consecutive quarters in the first year of monitoring. Systems obtaining a waiver will be required to monitor less often, depending on the requirements of the individual waiver.

Who is eligible for the waiver?

The monitoring waiver is available to small public groundwater systems serving fewer than 3,301 people.

How do I get a waiver?

In order to qualify for a waiver, applicants must provide monitoring results to the Division of Environmental Health and must submit a completed susceptibility waiver application form.

How many monitoring samples do I have to submit?

If the system draws water from more than one source and the sources are combined before distribution, the system is only required to obtain one representative sample during each monitoring period. However, if the water from individual wells is not combined before distribution, a sample must be taken from each well within the system. All samples should be taken after any treatment has occurred.

Where can I get my samples tested?

There are currently five labs fully certified by the State of North Carolina to run tests for pesticides/ SOCs. The addresses and phone numbers of these labs are shown in Table 1.

Can I continue working with my current lab, even though they aren't certified to run these tests?

It may be possible for your current lab to subcontract with one of the certified labs to get your testing done. If you prefer this option, contact your current lab to see if this can be arranged.

What's required on the waiver application form?

The waiver application form is comprised of three primary sections. Section A requires applicants to provide the location code for each well in the system and a description of the well location.

Aqua Tech Env. Labs, Inc. 936 N. Horner Blvd. Sanford, NC 27331-0488 Ph.# (919) 776-5999 1-800-522-2832	**Environmental Health Labs** 110 S. Hill Street South Bend, IN 46617 Ph.# (219) 233-4777
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Oxford Laboratories 1316 S. Fifth Street Wilmington, NC 28401 Ph.# (910) 763-9793	

Table 1. Certified Labs

Section B provides a list of potential sources of groundwater contamination. The applicant is required to identify which potential sources, if any, are within the zone of influence of each well. If the zone of influence of each well within the water system has not been identified, a 1,000 foot radius around the wellhead may be substituted. Table 2 provides a list of potential sources of contamination that are included in the waiver application form.

Section C requests information concerning the vulnerability of the well to existing or potential sources of groundwater contamination within the zone of influence of each well. The questions asked in Section C are shown in Table 3. Responses to these questions must be provided for each well in the system.

What type of waiver will I get?

The waiver obtained by an individual system, if any, depends on the monitoring results and the information provided on the waiver application. Figure 1 presents a flow chart summarizing the types of waivers that may be granted depending on the responses given to the questions in Section C of the application form.

How long will it take to receive a waiver?

Depending on the lab, it will likely take about four weeks to get test results back. In addition, it is expected to take about 60 days for the Public Water Supply Section to process the waiver application if all information provided is complete. If the information provided is

incomplete or requires verification, processing the waiver will take longer.

Chemical bulk storage site
Chemical manufacturer
Electroplating business
Foundry
Grain (bulk) storage site
Landfill/dump
Metal finishing shop
Military base/depot
Paper mill
Pesticide manufacturer
Pesticide mixing area
Pesticide spill (known)
Pesticide storage facility
Plastics manufac./molding
Polyester manufacturer
Smelting plant
Superfund site
Textile manufacturer
Unused/improperly abandoned well
Waste disposal site
Wood-preserving facility

Table 2. Potential Contamination Sources Listed in Section B.

When should I schedule monitoring tests?

Because of the length of time required to get test results and to process the waiver, it is recommended that water systems schedule sampling as soon as possible to avoid having to take another quarterly sample if the monitoring waiver is granted.

Should I continue monitoring until I receive my waiver?

It is very important to continue sampling each entry point under the regular monitoring schedule until a waiver is received. Water systems should schedule sampling with their lab for four consecutive quarters with an option to drop additional quarterly tests when a waiver is received. If your system does qualify for a waiver, you should notify your laboratory so that it can schedule analysis for other customers.

How much will the laboratory testing cost?

Testing costs will vary depending on the lab used. The cost of testing for pesticides/SOCs/PCBs is expected to range from $900.00 to $1500.00 for each quarterly sample.

Is there any way to reduce monitoring costs?

The monitoring waiver will provide substantial cost reduction for those systems that qualify. However, even with a waiver, all water systems will be required to conduct sample testing at least once every three years, and possibly more often depending on the terms of the waiver. For those systems that do not receive a waiver, they must monitor quarterly for the first year, and at least annually for the following three years for each entry point into the system. For systems with more than one well and individual distribution systems for each well, it may be cost effective to combine water sources before distribution so that the number of samples required for testing is decreased. Another option, where available, is to hook up to an existing nearby water system and purchase water from this source rather than continue operating the existing groundwater system.

Summary

Public water systems are required to monitor for a variety of potential contaminants. These monitoring tests can be expensive and may represent a significant cost to owners of small water systems. The monitoring waivers offer an opportunity to decrease monitoring costs while assuring the continued availability of safe drinking water for the citizens of North Carolina.

This document provides only a brief discussion of monitoring requirements and waivers for pesticides, SOCs and PCBs. For more detailed information, contact Mr. Hornlean Chen of the Public Water Supply Section of the Division of Environmental Health at (919) 715-3222, or the appropriate regional office shown below.

Regional Office	Telephone Number
Black Mountain	(704) 669-3361
Fayetteville	(910) 486-1191
Mooresville	(704) 663-1699
Raleigh	(919) 571-4700
Washington	(919) 946-6481
Wilmington	(910) 395-3900
Winston-Salem	(910) 771-4600

1.	Are there point sources or non-point sources in the zone of influence for this well?
2.	Does well fail to meet the requirements of Section .0402 (a) through (d) Water Supply Wells in the "Rules Governing Public Water Systems"?
3.	Is there transport of any pesticides, SOCs, PCBs, in the zone of influence? (If yes, attach description.)
4.	Is there environmental persistence of any pesticides, SOCs, PCBs in the zone of influence?
5.	Are any PCBs used in the production, storage, or distribution of water (i.e., PCBs used in pumps, transformers, etc.)?
6.	If the use of the pesticides, SOCs, PCBs or accidental spillage in the zone of influence of the well did occur, is the depth of the well, type of soil and integrity of the well such that there would be contamination of the well water? (Attach copy of water system approval letter if approved.)
7.	Are the previous pesticides/SOCs/PCBs results from this well above the detection limit for any regulated contaminant? (Attach copy of most recent results.)
8.	Are the most recent nitrate levels at the water supply source in excess of 5 milligrams per liter (mg/l)? (Attach copy of most recent results.)

Table 3. Vulnerability Questions Listed in Section C.

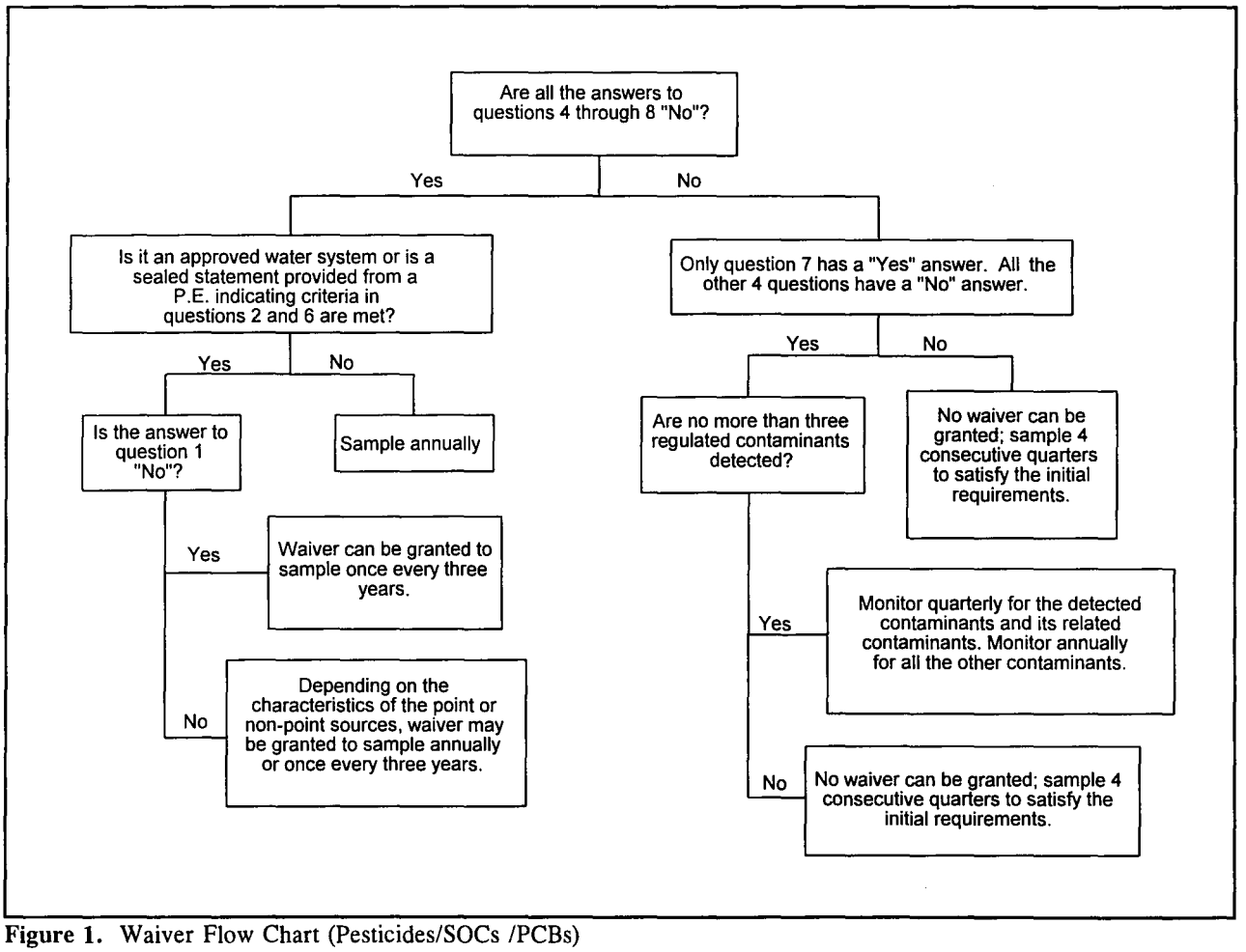
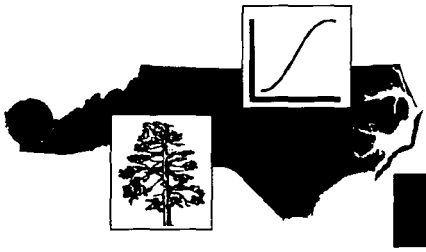


Figure 1. Waiver Flow Chart (Pesticides/SOCs /PCBs)

Prepared by Vernon N. Cox and Leon E. Danielson
Agricultural and Resource Economics
Applied Resource Economics and Policy Group
AREP95—1 March 1995



Resource Economics and Policy

Applied Resource Economics and Policy Group
Department of Agricultural & Resource Economics

Small Water System Waivers for Monitoring of Pesticides, Synthetic Organic Chemicals and PCB's

The Safe Drinking Water Act requires public water systems to monitor for a variety of potential contaminants. The monitoring tests can be expensive and may represent a significant cost to owners of small water systems. The Public Water Supply Section of the North Carolina Division of Environmental Health recently announced that a monitoring waiver has been approved for small public groundwater systems. The waiver is for required monitoring of certain pesticides, synthetic organic chemicals and PCBs. The information provided on the following pages is designed to answer some of the common questions regarding monitoring requirements and monitoring waivers.

Background

In July of 1994, the Public Water Supply Section of the North Carolina Division of Environmental Health announced a susceptibility waiver process for the monitoring of pesticides, synthetic organic chemicals (SOCs), and PCBs. The monitoring requirements result from the Safe Drinking Water Act amendments enacted by Congress in 1986. Under these amendments, Congress directed the Environmental Protection Agency (EPA) to develop regulations for 83 contaminants that may be found in drinking water. EPA is required to regulate more than 200 contaminants by the year 2000.

Who is subject to the monitoring requirements?

Monitoring requirements for pesticides/SOCs/PCBs began the first quarter of 1994 for schools and health care facilities and for community systems serving populations between 3,300 and 101 persons. Community groundwater systems serving less than 101 persons, or non-

Community Water Systems: Public water systems which serve 15 or more service connections or which regularly serve at least 25 year-round residents. Examples may include subdivisions, mobile home parks and apartment complexes that provide their own drinking water.

Non-Transient, Non-Community Water Systems: Public water systems that are not community water systems and that regularly serve at least 25 *of the same persons* more than 6 months per year. Examples may include industries, day-care centers, schools and health care facilities that provide their own drinking water.

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transient, non-community systems are required to begin monitoring for these contaminants the first quarter of 1995.

What are the monitoring requirements?

Affected systems must test for required pesticides/ SOCs/PCBs for four consecutive quarters in the first year of monitoring. Systems obtaining a waiver will be required to monitor less often, depending on the requirements of the individual waiver.

Who is eligible for the waiver?

The monitoring waiver is available to small public groundwater systems serving fewer than 3,301 people.

How do I get a waiver?

In order to qualify for a waiver, applicants must provide monitoring results to the Division of Environmental Health and must submit a completed susceptibility waiver application form.

How many monitoring samples do I have to submit?

If the system draws water from more than one source and the sources are combined before distribution, the system is only required to obtain one representative sample during each monitoring period. However, if the water from individual wells is not combined before distribution, a sample must be taken from each well within the system. All samples should be taken after any treatment has occurred.

Where can I get my samples tested?

There are currently five labs fully certified by the State of North Carolina to run tests for pesticides/ SOCs. The addresses and phone numbers of these labs are shown in Table 1.

Can I continue working with my current lab, even though they aren't certified to run these tests?

It may be possible for your current lab to subcontract with one of the certified labs to get your testing done. If you prefer this option, contact your current lab to see if this can be arranged.

What's required on the waiver application form?

The waiver application form is comprised of three primary sections. Section A requires applicants to provide the location code for each well in the system and a description of the well location.

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Section C requests information concerning the vulnerability of the well to existing or potential sources of groundwater contamination within the zone of influence of each well. The questions asked in Section C are shown in Table 3. Responses to these questions must be provided for each well in the system.

What type of waiver will I get?

The waiver obtained by an individual system, if any, depends on the monitoring results and the information provided on the waiver application. Figure 1 presents a flow chart summarizing the types of waivers that may be granted depending on the responses given to the questions in Section C of the application form.

How long will it take to receive a waiver?

Depending on the lab, it will likely take about four weeks to get test results back. In addition, it is expected to take about 60 days for the Public Water Supply Section to process the waiver application if all information provided is complete. If the information provided is

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Chemical manufacturer
Electroplating business
Foundry
Grain (bulk) storage site
Landfill/dump
Metal finishing shop
Military base/depot
Paper mill
Pesticide manufacturer
Pesticide mixing area
Pesticide spill (known)
Pesticide storage facility
Plastics manufac./molding
Polyester manufacturer
Smelting plant
Superfund site
Textile manufacturer
Unused/improperly abandoned well
Waste disposal site
Wood-preserving facility

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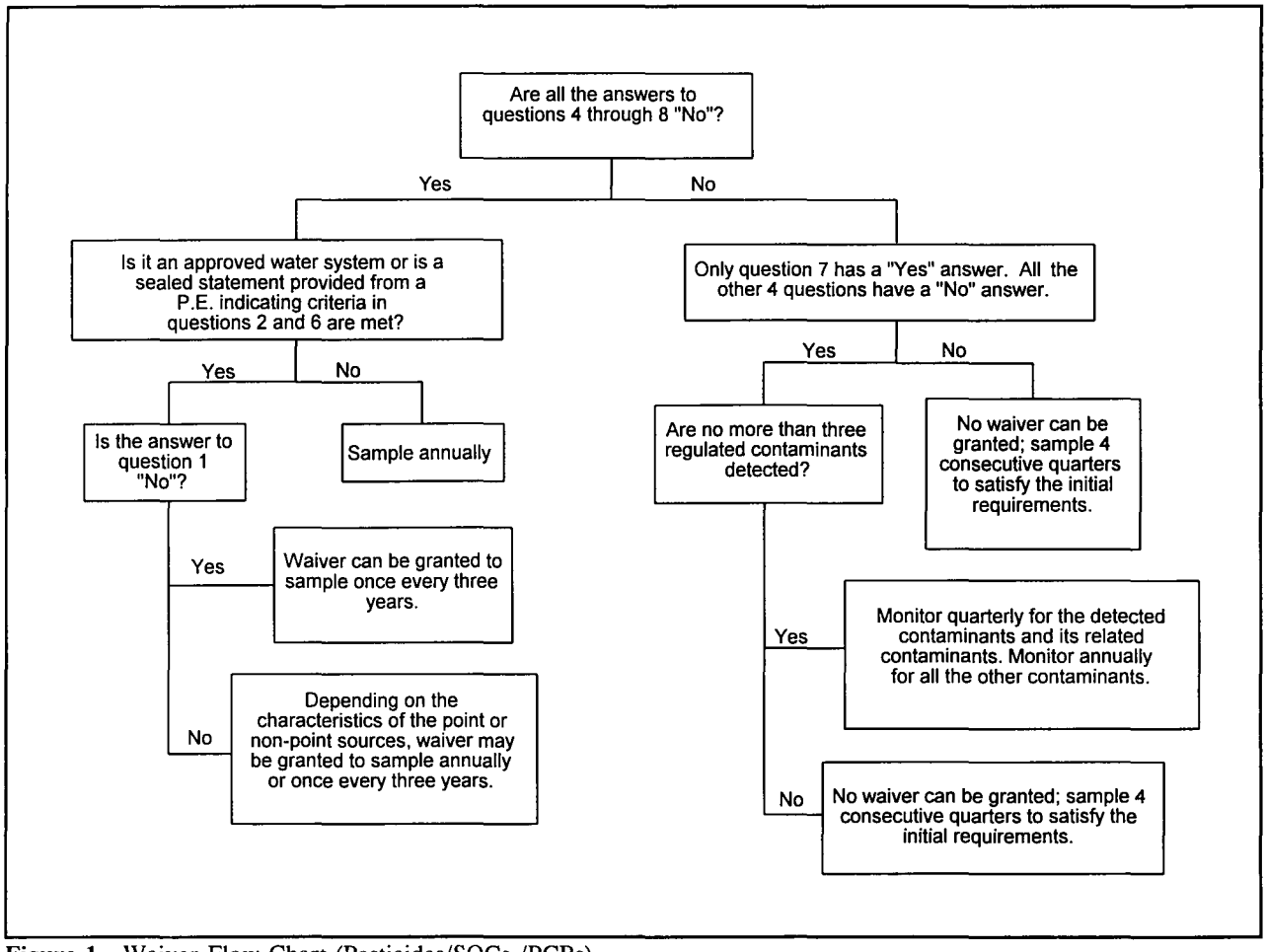

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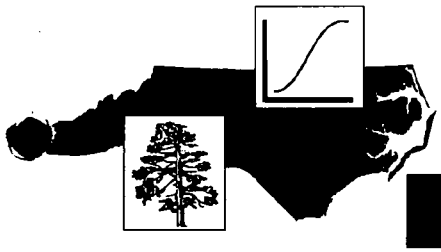

Resource Economics and Policy

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Department of Agricultural & Resource Economics

Glossary of Water Quality Terms and Acronym List

This publication provides brief definitions of technical and regulatory terms often used when discussing surface water quality issues. It also contains descriptions of relevant federal and state legislation, agencies and programs, and provides a list of commonly used water quality acronyms. This publication is intended to serve as an educational guide only. For more detailed information, please contact the appropriate state or federal agency.

Technical and Regulatory Terms

Aerobic: in the presence of, or requiring, oxygen.

Algal Bloom: a large, visible mass of algae found in bodies of water such as lakes or estuaries. Blooms occur most often during warm weather, but may also occur at other times of the year. Color ranges from green to red.

Anaerobic: in the absence of oxygen.

Aquifer: an underground geological formation or group of formations containing usable amounts of groundwater that can supply wells and springs.

Assimilative Capacity: the amount of pollutants that a water body may absorb while maintaining corresponding water quality standards, including protection of aquatic life and human health.

Background Level: amount of a substance expected to occur naturally in the environment.

Bacteria: microscopic one-celled organisms which live everywhere and perform a variety of functions. While decomposing organic matter in water, bacteria can greatly reduce the amount of oxygen in the water. (See Fecal Coliform)

Baseflow: the amount of water in a stream that results from groundwater discharge.

Best Management Practice (BMP): a structural or nonstructural method, activity, maintenance procedure, or other management practice used singularly or in combination to reduce nonpoint source inputs to receiving waters in order to achieve water quality protection goals. Examples include animal waste management systems, conservation tillage systems, vegetated filter strips, etc.

Best Usage: the most appropriate uses of a body of water as designated by the Environmental Managemental Commission given the characteristics of the water body and surrounding area. Best uses may include use for public water supplies; protection and propagation of fish, shellfish, and wildlife; recreation in and on the water; as well as uses for agriculture, industry, and navigation.

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Biological Oxygen Demand (BOD): the amount of oxygen required by aerobic biological processes to break down the organic matter in water. BOD is a measure of the pollutional strength of biodegradeable waste on dissolved oxygen in water.

Chemical Oxygen Demand (COD): the amount of oxygen utilized in the chemical reactions that occur in water as a result of the addition of wastes. COD is a measure of the pollutional strength of chemical waste on dissolved oxygen in water.

Classifications: all surface waters in North Carolina are assigned a classification by the EMC. These fall into two categories: freshwater classifications and saltwater classifications. Waters may also be assigned one or more supplemental classifications. Water classifications are based on best usage of those waters, and each classification is assigned water quality standards. (See also Freshwater Classifications, Saltwater Classifications, and Supplemental Water Classifications.)

Dissolved Oxygen (DO): oxygen dissolved in water and readily available to fish and other aquatic organisms.

Ecoregion: an area of relatively homogeneous environmental conditions, usually defined by elevation, geology, and soil type. Examples include mountains, piedmont, coastal plain, sandhills and slate belt.

Ecosystem: a community of animals and plants and the physical environment in which they live.

Effluent: wastewater, treated or untreated, that flows out of a treatment plant, sewer, or industrial outfall. Generally refers to wastes discharged into surface waters.

Environment: the sum of all the external conditions that may act upon a living organism or community to influence its development or existence.

Erosion: wearing away of rock or soil by the gradual detachment of soil or rock fragments by water, wind, ice, and other mechanical and chemical forces.

Estuary: coastal waters situated between rivers and nearshore ocean waters, where tidal action and river flow mix fresh and saltwater. Such areas include bays, sounds, mouths of rivers, salt marshes, and lagoons.

Eutrophication: degradation of water quality due to enrichment by nutrients, primarily nitrogen (N) and phosphorus (P), which results in excessive plant (principally algae) growth and decay. Low dissolved oxygen in the water is a common consequence.

Fecal Coliform: bacteria found in the intestinal tracts of warm-blooded animals. The presence of high numbers of fecal coliform bacteria in a water body can indicate the recent release of untreated sewage and/or the presence of animal feces. These organisms may also indicate the presence of pathogens that are harmful to humans.

Filter Strip: strip or area of vegetation often situated at the edge of a field or along a waterway that is used for removing sediment, organic matter, and other pollutants from stormwater runoff.

Frequency of Storm: anticipated number of years between storms of equal intensity and/or total rainfall volume. For example, a 25-year 24-hour storm is the volume of rainfall that could be expected to occur during a 24-hour period once every 25 years on average.

Freshwater: all waters that would have a chloride ion content of less than 500 parts per million under natural conditions.

Freshwater Classifications: (See also Classifications)

Class C: freshwaters protected for secondary recreation, fishing, and propagation and survival of aquatic life; all freshwaters are classified to protect these uses at a minimum.

Class B: freshwaters protected for primary recreation, which includes swimming on a frequent or organized basis, and all Class C uses.

Class WS-I: waters protected as water supplies which are essentially in natural and undeveloped watersheds.

Class WS-II: waters protected as water supplies which are generally in predominantly undeveloped watersheds.

Class WS-III: waters protected as water supplies which are generally in low to moderately developed watersheds.

Class-IV: waters protected as water supplies which are generally in moderately to highly developed watersheds.

Class-V: waters protected as water supplies which are generally upstream of and draining to Class-IV waters.

Geographic Information System (GIS): a computerized database system containing information on natural resources and other factors that can be analyzed and displayed in spatial or map format.

Grey Water: wastewater other than sewage, such as sink or washing machine drainage.

Groundwater: underground water stored in aquifers. Groundwater is created by rain which soaks into the ground and flows down until it collects above an impervious zone.

Heavy Metals: those metals that have high specific gravity and high atomic mass, such as lead, cadmium, zinc, copper, silver, and mercury. In sufficient concentra-

tions, these metals are toxic to humans and aquatic life.

Hydrologic Cycle: the movement of water in and on the earth and atmosphere through processes such as precipitation, infiltration, runoff, and evaporation.

Judicial Order by Consent (JOC): an administrative order issued by an administrative law judge which in some way modifies limitations of an NPDES permit by consent of both parties and provides interim limitations and conditions.

LC50: The concentration of a toxicant or percentage dilution of an effluent that is predicted to be lethal to 50% of a test population of organisms.

Loading: amount of a substance entering the environment (soil, water, or air).

Municipal Discharge: discharge of effluent from wastewater treatment plants operated by municipalities or public sewerage authorities; may include wastewater from households, commercial establishments, and industries.

Nitrogen: an element essential to the growth and development of plants; occurs in manure and chemical fertilizer and, in excess, can cause waters to become polluted by promoting excessive growth of algae and other aquatic plants.

Nonpoint Source Pollution: sources of water pollution not associated with a distinct discharge source; includes rainwater, erosion, runoff from roads, farms, and parking lots, and seepage from soil-based wastewater disposal systems.

Oxygen Demand: chemical and biological oxygen demand (COD and BOD) are measures of the oxygen consumed when a substance degrades. Materials such as food waste and dead plant or animal tissue use up dissolved oxygen in the water when decomposed through chemical or biological processes.

Pathogen: disease-causing biological agent such as a bacterium, virus, or fungus.

Performance Standard: a limitation on the emission or discharge of a pollutant that may be expressed as an emission or discharge standard or as a requirement for specific operating procedures.

pH: numerical measure of hydrogen ion activity with a scale of 0 to 14. Neutral is pH 7; values below 7 are acid, and values above 7 are alkaline. Waters that are too acid or alkaline can be unfit for animal or plant life.

Phosphorous (P): an element essential to the growth and development of plants; occurs in manure and chemical fertilizer and, in excess, can cause waters to become polluted by promoting excessive growth of algae and other aquatic plants.

Point Source Pollution: a specific discharge that is traceable to a distinct source (pipe, ditch, container, well, etc.) such as those from wastewater treatment plants or industrial facilities.

Pollutant: a contaminant that adversely alters the physical, chemical, or biological properties of the environment. The term includes toxic metals, carcinogens, pathogens, oxygen-demanding materials, heat, and all other harmful substances, contaminants, or impurities.

Potable Water: water that is safe and palatable for human consumption.

Publicly Owned Treatment Works (POTW): wastewater treatment facilities owned by the state or a unit of local government; usually designed to treat domestic wastewaters, but may also treat a significant amount of industrial waste.

Receiving Water: body of water that receives runoff or wastewater discharges; may be a river, stream, lake, estuary, or groundwater.

Riparian: of, on, or pertaining to, the banks of a stream, river, or lake.

River Basin: the land area drained by a river and its tributaries. There are 17 major river basins in North Carolina.

Runoff: rainfall or other precipitation that is not absorbed by the soil, but drains off the land into streams, rivers, and other receiving waters.

Salinity: quality of water based on its salt content; seawater contains approximately 18,000 parts per million of salt.

Saltwater Classifications: (See also Classifications)

Class SA: suitable for commercial shellfishing and all other tidal saltwater uses.

Class SB: saltwaters protected for primary recreation, which includes swimming on a frequent or organized basis, and all Class SC uses.

Class SC: saltwaters protected for secondary recreation, fishing, and propagation and survival of aquatic life; all saltwaters are classified to protect these uses at a minimum.

Sediment: particles of mud, sand, clay, silt, and organic matter transported and deposited by water.

Septic Tank: an underground sewage disposal tank, generally installed to treat the wastewaters from an individual home, in which a continuous flow of waste mate-

rial is decomposed by anaerobic (in the absence of oxygen) bacteria.

7Q10 Flow: the lowest average stream flow that would be expected to occur for 7 consecutive days once in 10 years.

Sewage: the waste and wastewater produced by residential and commercial sources and discharged into sewers.

Sludge: heavy, slimy residue remaining from the treatment of municipal and industrial water and wastewater.

Solubility: amount of a substance that will dissolve in a given amount of another substance, typically water.

Special Order by Consent (SOC): an administrative order entered by the Environmental Management Commission and an NPDES discharger which in some way modifies limitations of an NPDES permit by consent of both parties and provides interim limitations and conditions.

Stormwater: water that is generated by rainfall and is often routed into drain systems in urban areas to prevent flooding.

Supplemental Water Classifications: (See also Classifications)

HQW: High Quality Waters: waters with quality higher than state water quality standards.

NSW: Nutrient Sensitive Waters: waters subject to excessive growth of microscopic and macroscopic vegetation that need additional nutrient management. In general, management strategies for point and nonpoint source pollution control are designed to prevent any increase in nutrients over background levels.

ORW: Outstanding Resource Waters: unique waters of exceptional state or national recreational or ecological significance that require special protection to maintain existing uses.

Sw: Swamp Waters: waters with low velocities and other natural characteristics that differ from other surface waters.

Tr: Trout Waters: freshwaters protected for natural trout propagation and survival of stocked trout.

Tidal Saltwater: tidal waters that generally have a natural chloride ion content in excess of 500 parts per million; includes all waters assigned S classifications by the Environmental Management Commission (see Saltwater Classifications).

Total Dissolved Solids (TDS): the total amount, in milligrams, of solid material dissolved in one liter of water.

Total Maximum Daily Load (TMDL): the total waste (pollutant) loading from point and nonpoint sources that a water body can assimilate while still maintaining its water quality classification and standards.

Total Suspended Solids (TSS): concentration of all substances suspended in water (solids remaining after filtering of a water sample).

Tributary: a stream or river that flows into a larger stream or river.

Turbidity: a cloudy condition in water caused by suspended silt or organic matter.

Wastewater Treatment Plant (WWTP): facility that uses a combination of physical, chemical, and biological processes to treat wastewater (and sometimes runoff) from domestic and/or industrial sources.

Water Quality Criteria: levels of water quality expected to render a body of water suitable for its designated use. Criteria are based on specific levels of pollutants that would make the water harmful if used for drinking, swimming, fish production, or industrial uses.

Water Quality Standards: ambient standards for water bodies adopted by the EMC and approved by the EPA that prescribe the use of the water body and establish the water quality criteria that must be met to protect designated uses. Water quality standards may apply to dissolved oxygen, heavy metals, pH, and other water constituents.

Watershed: a geographic area in which water, sediment, and dissolved materials drain to a common outlet such as a point on a larger stream, a lake, an underlying aquifer, an estuary, or an ocean.

Wetlands: areas inundated or saturated by surface or groundwater at a frequency and duration to support and that, under normal circumstances, do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Coastal wetlands extend back from estuaries and include salt marshes, tidal basins, marshes, and mangrove swamps. Inland freshwater wetlands consist of swamps, marshes, and bogs.

Legislation, Agencies and Programs

Agricultural Cost Share Program: a state program designed to accelerate the implementation of best man-

agement practices (BMP's) on agricultural operations to reduce the input of agricultural nonpoint source pollution into waters of the state. This program, administered by the North Carolina Division of Soil and Water Conservation, reimburses farmers for up to 75 percent of the installation cost of approved BMP's and also provides incentive payments for management changes that improve water quality.

Agricultural Stabilization and Conservation Service (ASCS): a federal organization whose mission is to promote the wise use of agricultural land and water resources in partnership with farmers and ranchers. ASCS works in cooperation with other federal and state agencies and organizations to implement voluntary conservation programs.

Clean Water Act (CWA): federal legislation administered by the U.S. EPA that serves as the primary means of protecting and regulating the surface water quality of the United States. The goal of this legislation is to eliminate the discharge of contaminants into United States waters and to achieve a level of water quality capable of supporting propagation of fish and wildlife and water-based recreation.

Coastal Area Management Act (CAMA): state legislation that requires local land use plans to be developed and adopted by individual counties and municipalities in North Carolina's twenty-county coastal area. Land use plans must be in accordance with standards adopted by the North Carolina Coastal Resources Commission.

Coastal Nonpoint Pollution Control Program (Section 6217): the portion of the Coastal Zone Act Reauthorization Amendments (CZARA) that requires states with approved coastal zone management programs to develop Nonpoint Pollution Control Programs. These coastal nonpoint programs will build on existing coastal management and nonpoint source pollution programs designed to reduce and prevent coastal water quality problems.

Coastal Resources Commission (CRC): the body responsible for administering the North Carolina Coastal Area Management Act (CAMA).

Coastal Zone Act Reauthorization Amendments (CZARA): Legislation enacted by Congress in 1990 to reauthorize the Coastal Zone Management Act. The CZARA includes requirements for states with approved coastal zone management programs to develop coastal nonpoint pollution control programs.

Coastal Zone Management Act (CZMA): a federal program designed to encourage environmentally responsible development through long-range planning and the establishment of clear, enforceable standards for growth and land use in coastal areas.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), also known as the "Superfund" legislation: authorizes EPA to clean up sites contaminated by disposal of hazardous substances.

Cooperative Extension Service (CES): an educational organization supported by federal, state, and county governments. CES programs fall into the general areas of agriculture and natural resources, home economics, 4-H and youth, and community and rural development. The North Carolina CES is operated through the state's Land Grant universities: North Carolina State University and North Carolina A&T State University.

Department of Environment, Health and Natural Resources (DEHNR): the state government agency with primary responsibility for the stewardship of the state's natural resources and management of its health programs. The department is divided into divisions that carry out these responsibilities through education, technical assistance, and regulation.

Division of Coastal Management (DCM): a division of DEHNR that provides staff support to the Coastal Resources Commission and the Coastal Resources Advisory Council which are responsible for carrying out the provisions of the North Carolina Coastal Area Management Act (CAMA).

Division of Environmental Health (DEH): the division of DEHNR responsible for administering eight programs in North Carolina in the following areas: food and lodging sanitation, institutional sanitation, milk sanitation, on-site sewage, shellfish sanitation, public water supply plans review, coastal mosquito management, and sleep products sanitation.

Division of Environmental Management (DEM): the division of DEHNR responsible for comprehensive planning, management, and regulation of the state's air, surface water, and groundwater resources. The division issues permits to control sources of pollution, monitors compliance at permitted facilities, evaluates environmental quality, pursues enforcement actions for violations of environmental regulations, and serves as staff for the EMC.

Division of Forest Resources (DFR): the division of DEHNR that has the lead role in managing, developing, and protecting the forest resources of the state.

Division of Land Resources (DLR): the division of DEHNR whose purpose is to protect and conserve the state's land, minerals, and related resources through the effective implementation and management of

programs related to sedimentation pollution control, mine land reclamation, dam safety, land records management, geodetic survey, resources inventory and analysis, and mineral resources conservation and development.

Division of Marine Fisheries (DMF): the division of DEHNR that is responsible for stewardship of the marine and estuarine resources of North Carolina.

Division of Parks and Recreation (DPR): the division of DEHNR that manages the state park system which includes state parks, state natural areas, state recreation areas, state trails, state lakes, and natural and scenic rivers.

Division of Soil and Water Conservation: the division of DEHNR that administers a comprehensive statewide program for conserving the state's soil and water resources, including the Agricultural Cost Share Program. It serves as staff for the North Carolina Soil and Water Conservation Commission and assists local Soil and Water Conservation Districts.

Division of Water Resources (DWR): the division of DEHNR that manages programs for instream flow, interbasin transfers, water supply needs, water conservation, navigation, stream clearance, flood control, beach protection, aquatic weed control, hydroelectric power, and recreational uses of water.

Emergency Planning and Community Right-to-Know Act (EPCRA), also known as Title II of the 1986 "Superfund" Amendments and Reauthorization Act (SARA): Requires certain manufacturers to submit annual reports documenting the amount of toxic chemicals their facilities release into the environment. EPA supplies this information to government officials and the public. Requires every community in the United States to be part of a comprehensive emergency plan.

Environmental Management Commission (EMC): responsible for adopting rules to be followed in the protection, preservation, and enhancement of the water and air resources of the state.

Federal Insecticide, Fungicide and Rodenticide Act (FIFRA): makes EPA responsible for regulating the manufacture, distribution, and use of pesticides in the United States. EPA provides North Carolina with support and oversight in enforcement of pesticide regulations and programs to train and certify pesticide applicators.

Marine Fisheries Commission (MFC): responsible for adopting rules to be followed in the management, protection, preservation, and enhancement of the marine and estuarine resources of the state, including commercial and sports fisheries resources.

National Environmental Policy Act (NEPA): federal legislation that requires federal agencies to prepare environmental statements for federal or federally assisted projects having an impact on the environment.

National Oceanic and Atmospheric Administration (NOAA): a federal agency whose fundamental objectives are to observe, describe and predict the natural variability of the global earth system and to identify any changes in the earth system caused by human activity. NOAA administers the Coastal Zone Management Program in cooperation with EPA and other state and federal agencies in accordance with the Coastal Zone Management Act (CZMA) of 1972, as amended.

National Pollution Discharge Elimination System (NPDES): federal regulations that regulate discharge of wastewater to surface waters such as streams, rivers, lakes, and estuaries. An NPDES permit is required for any project involving the construction, alteration, and/or operation of any sewer system, treatment works, or disposal system and for construction of certain stormwater runoff structures which would result in a discharge into surface waters.

North Carolina Environmental Policy Act (NCEPA): requires the preparation of an Environmental Assessment or Environmental Impact Statement for any activity that involves the expenditure of public monies or that requires state approval or that may significantly affect the quality of the environment.

Resource Conservation and Recovery Act (RCRA): federal legislation related to hazardous waste (Subtitle C); solid, non-hazardous waste (Subtitle D); and the recovery and use of recycled materials and energy (Subtitle F).

Safe Drinking Water Act (SDWA): legislation to insure safe drinking water. Passed by Congress in 1974 and amended in 1986, it directs the EPA to establish and enforce water quality standards to protect public health.

Section 404 Permit: Section 404 of the Clean Water Act requires that a permit be obtained from the U.S. Army Corps of Engineers prior to undertaking any activity that will result in the discharge of dredged or fill materials into waters of the United States, including wetlands.

Sedimentation Pollution Control Act: applies to any land-disturbing activity that uncovers one or more contiguous acres of land. Its purpose is to protect the state's streams and lands from degradation caused by land disturbances that erode sediments. All agricultural and mining activities are officially exempt from these

regulations (although mining activities are covered under the Mining Act). Forestry activities must utilize accepted Best Management Practices to qualify for an exempt status.

Soil and Water Conservation Commission (SWCC): responsible for adopting rules to be followed in the development and implementation of the state's soil and water conservation program.

Soil and Water Conservation District: a sub-unit of state government responsible for the local soil and water conservation programs.

Soil Conservation Service (SCS): an agency of the U.S. Department of Agriculture whose mission is to provide national leadership in the conservation and wise use of soil, water and related resources through a balanced cooperative program that protects, restores, and improves those resources.

Superfund Amendments and Reauthorization Act (SARA): enacted in 1986, these amendments provided for a five-year extension to CERCLA.

United States Army Corps of Engineers (COE): the federal government's largest water resources development agency. The Corps is responsible for construction and maintenance of inland waterway, port, and dam projects throughout the country. It also has primary responsibility for administering the permit program established in Section 404 of the Clean Water Act.

United States Environmental Protection Agency (EPA): created in 1970 to facilitate effective governmental coordination of actions that occur on behalf of the environment. The agency's mission is to safeguard the health and welfare of the American people by protecting the environment and improving environmental quality. EPA is responsible for implementing most of the federal laws relating to protection of water and air quality.

United States Fish and Wildlife Service (USFWS): an agency of the U.S. Department of Interior whose mission is to conserve, protect, and enhance the nation's fish and wildlife and their habitats for the continuing benefit of the American people. The agency is responsible for migratory birds, endangered species, certain marine mammals, inland sports fisheries, and specific fishery and wildlife research activities.

United States Geological Survey (USGS): an agency of the U.S. Department of Interior that operates hydrologic data networks and conducts a variety of water-resources studies to support the resource assessment, evaluation, planning, conservation, and protection programs of federal, state and local agencies.

Water Quality Certification: required by the Environmental Management Commission for any activity that may discharge fill into waters or wetlands and that requires a federal permit. The certification indicates that the discharge will not result in a violation of the state's water quality standards.

Water Supply Watershed Protection Act (WSWPA): state legislation enacted to limit growth and land disturbance in North Carolina's water supply watersheds in order to maintain the quality of surface drinking water supplies. Counties and municipalities with water supply watersheds in their land-use jurisdictions are required to develop watershed protection plans and ordinances that meet or exceed state guidelines.

List of Acronyms

ASCS	Agricultural Stabilization and Conservation Service
BMP	Best Management Practice
BOD	Biological Oxygen Demand
CAMA	Coastal Area Management Act
COD	Chemical Oxygen Demand
CRC	Coastal Resources Commission
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
CZARA	Coastal Zone Act Reauthorization Amendments
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CES	Cooperative Extension Service
COE	Corps of Engineers
DCM	Division of Coastal Management
DEH	Division of Environmental Health
DEHNR	Department of Environment, Health and Natural Resources

DEM	Division of Environmental Management
DFR	Division of Forest Resources
DLR	Division of Land Resources
DMF	Division of Marine Fisheries
DO	Dissolved Oxygen
DPR	Division of Parks and Recreation
DWR	Division of Water Resources
EPA	Environmental Protection Agency
EPCRA	Emergency Planning and Community Right to Know Act
EMC	Environmental Management Commission
FIFRA	Federal Insecticide, Fungicide and Rodenticide Act
GIS	Geographic Information System
HQW	High Quality Waters
JOC	Judicial Order by Consent
MFC	Marine Fisheries Commission
NCEPA	North Carolina Environmental Policy Act
NEPA	National Environmental Policy Act
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollution Discharge Elimination System
NSW	Nutrient Sensitive Waters
ORW	Outstanding Resource Waters
POTW	Publicly Owned Treatment Works
RCRA	Resource Conservation and Recovery Act
SARA	Superfund Amendments and Reauthorization Act
SCS	Soil Conservation Service
SDWA	Safe Drinking Water Act
SOC	Special Order by Consent
Sw	Swamp Waters
SWCC	Soil and Water Conservation Commission
TDS	Total Dissolved Solids
TMDL	Total Maximum Daily Load
TSS	Total Suspended Solids
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WWTP	Wastewater Treatment Plant
WSWPA	Water Supply Watershed Protection Act

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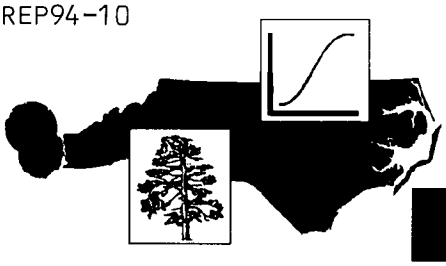
AREP94—11—July 1994



Resource Economics and Policy

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Agriculture and the Coastal Nonpoint Pollution Control Program

Water pollution is a significant problem in many coastal areas. In an effort to protect and enhance coastal water quality, Congress enacted section 6217 of the Coastal Zone Act Reauthorization Amendments (CZARA). Section 6217 requires states with federally approved coastal zone management programs to develop Coastal Nonpoint Pollution Control Programs. Section 6217 presents a change in philosophy in dealing with pollution from agriculture. Rather than rely primarily on education and voluntary cooperation, section 6217 requires states to adopt enforceable policies and mechanisms that will insure the adoption of required management measures. This fact sheet provides a brief overview of the program and its requirements for agricultural operations. It also discusses some of the options for insuring that the program's requirements are implemented.

What is the Coastal Nonpoint Pollution Program?

In 1990, Congress enacted the Coastal Zone Act Reauthorization Amendments (CZARA). The purpose of these amendments was to enhance the effectiveness of the existing Coastal Zone Management Act by expanding the ability of state Coastal Zone Management Programs to address environmental problems. Section 6217 of these amendments requires each state with an approved Coastal Zone Management Program to develop and implement a Coastal Nonpoint Pollution Control Program. The purpose of the program is to implement management measures to reduce nonpoint source (NPS) pollution caused by stormwater runoff.

States are not expected to develop stand-alone programs. Coastal Nonpoint programs are to be developed and implemented through changes to existing state nonpoint source and coastal zone management programs. Two federal agencies, the U.S. Environmental Protection Agency (EPA) and the National Oceanic and Atmospheric Administration (NOAA), have joint responsibility for guiding development of the state's program and issuing final program approval.

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What is Nonpoint Source Pollution?

The two general categories of water pollution are point source and nonpoint source pollution. *Point source pollution* is traceable to a distinct source (pipe, ditch, container, well, etc.) such as a wastewater treatment plant or an industrial facility. *Nonpoint source pollution* is pollutant transport to surface and groundwater caused by rainfall or snowmelt moving over and through the ground. Unlike point sources, nonpoint sources are diffuse in nature and occur at random intervals depending on rainfall events. As a result, NPS pollution is often difficult to identify and control. Common types of nonpoint source pollution and their sources are shown in Table 1.

NPS Pollution in North Carolina's Coastal Rivers

There are approximately 18,152 stream miles in North Carolina's eight major coastal river basins. In its 1992 Water Quality Progress Report, DEM estimated that 26% of these stream miles partially support and 6% do not support their designated uses. Designated uses, which vary for different waters bodies, may include use as public water supplies, protection and propogation of fish, shellfish and wildlife, swimming, fishing, boating, etc. Nonpoint source pollution is identified as a major source of pollution for 78% of the impaired stream mileage, equivalent to 25% of the total stream mileage. As shown in Figure 1, agriculture is identified as a major cause of water quality impairment in over 53% of impaired river miles. Other sources of water quality impairment include point source dischargers, as well as urban, construction, hydromodification, land disposal and forestry activities.

Responsible State Agencies

Section 6217 requires that the Coastal NPS Program be coordinated with existing coastal zone management and water quality programs. In North Carolina, the Division of Coastal Management (DCM) is responsible for administering the state's coastal management program, while the Division of Environmental Management (DEM) has primary responsibility for implementing the state's water quality programs. As a result, the Coastal NPS program is being developed jointly by DCM and DEM in cooperation with other state and local agencies with water quality and other natural resource responsibilities.

Geographic Area Affected by Coastal NPS Program

DCM and DEM are conducting a coastal land use analysis to determine which land uses contribute significant NPS pollution to coastal waters and which ones may contribute significantly in the future. Results of this study will be used to establish the boundaries of the

Sediment	Nutrients (Fertilizers, Grease, Organic Matter	Acids & Salts	Heavy Metals (Lead, Mercury, Zinc)	Toxic Chemicals (Pesticides, Organic, Inorganic Compounds)	Pathogens (Bacteria, Viruses)
• Construction Sites	• Croplands	• Irrigated Lands	• Mining Operations	• Croplands	• Domestic Sewage
• Mining Operations	• Nurseries, Orchards	• Mining Operations	• Vehicle Emissions	• Nurseries, Orchards	• Livestock Waste
• Croplands	• Livestock Operations	• Urban Runoff, Roads, Parking Lots	• Urban Runoff, Roads, Parking Lots	• Building Sites	• Landfills
• Logging Operations	• Gardens, Lawns, Forests	• Landfills	• Landfills	• Gardens, Lawns	• Urban Runoff
• Streambank Erosion	• Petroleum Storage Areas			• Landfills	
• Shoreline Erosion					
• Grazed Woodland	• Landfills				

Table 1. Nonpoint Source Pollutants and Major Sources.

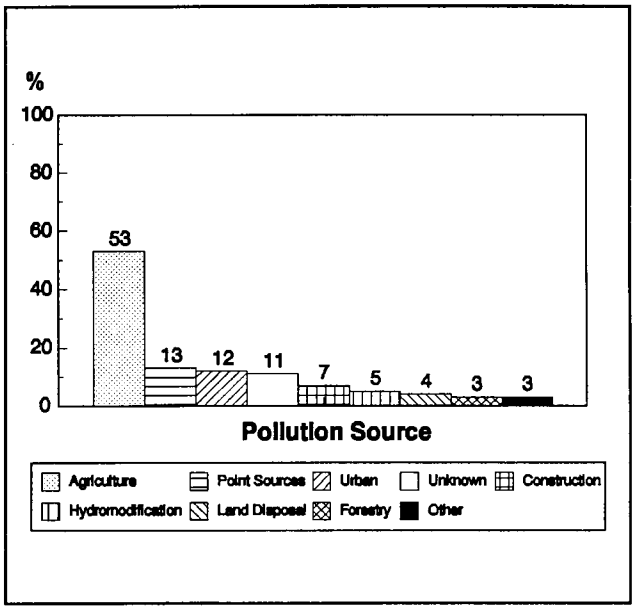

Figure 1. Major Pollution Sources as a Percent of Impaired River Miles in North Carolina's Eight Major Coastal River Basins.

Coastal NPS program. It is likely that the area affected by the Coastal NPS program will extend beyond the twenty coastal counties that are under the jurisdiction of the state's existing coastal management program.

Nonpoint Sources Affected

A broad range of nonpoint pollutant sources have been identified by NOAA and EPA to be targeted by the Coastal NPS program. These sources are:

- Urban and Developed Areas
- Agriculture
- Forestry
- Marinas and Recreational Boating, and;
- Hydromodification (includes dam construction, channelization, channel modification, and streambank and shoreline erosion)

Because of the importance of wetlands and riparian areas in reducing nonpoint source pollution, measures to protect and restore these resources must also be included in a state's Coastal NPS Program.

The strategy for controlling NPS pollution from these sources is to use technology based "management measures" to reduce and prevent pollution of coastal waters. Management measures are defined as economically achievable measures that reflect the best available technology for reducing pollutants. A document published by EPA entitled "Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters" provides a detailed list of management measures that are to be included in a state's Coastal NPS Program. In addition, the guidance suggests a variety of practices that will achieve the level of control specified in each management measure. In general, the practices suggested for agriculture are similar to the Best Management Practices (BMPs) already being promoted through the North Carolina Agriculture Cost Share Program and/or by the Soil Conservation Service.

Schedule for Program Development and Implementation

States are required to submit their Coastal NPS Programs to NOAA and EPA for approval by July 1995. The management measures for addressing significant sources of pollution must be implemented within three years after final Federal approval. If the level of protection provided by these management measures is not expected to be adequate for the protection of designated uses of coastal waters, or if it does not enable coastal waters to meet water quality standards, states will be required to implement additional management measures for land uses and critical areas adjacent to impaired or threatened coastal waters. These additional management measures must be implemented within eight years after final Federal program approval.

If a state fails to submit an approvable program by July 1995, NOAA and EPA will reduce Federal grant dollars otherwise available to the state under the coastal zone management and nonpoint source management programs. The penalties will begin in Fiscal Year 1996 with a 10% reduction in funding under both programs, increasing to 15% in FY 1997, 20% in FY 1998 and 30% in FY 1999 and each fiscal year thereafter.

Management Measures for Agriculture Sources

The following agricultural sources of pollution are identified by EPA and are to be targeted in the states Coastal NPS Program:

1. Sedimentation and Erosion: In its most recent Water Quality Progress Report, DEM identified sedimentation as the most widespread cause of water quality impairment in North Carolina. The goal of this management measure is to minimize the delivery of sediment from agricultural lands to receiving waters. Land owners have a choice of two approaches: (a) prevent erosion by applying the erosion component of the U.S. Department of Agriculture's Conservation Management System through such practices as conservation tillage, strip cropping, contour farming and terracing, or (b) install a combination of practices, such as field borders, filter strips, and terraces, designed to remove settleable solids and associated pollutants in runoff before being deposited into local rivers and streams.

2. Confined Animal Facilities: Runoff, wastewater, or manure entering surface waters from confined animal facilities can cause significant water quality impairment. Different management requirements apply to this pollution source, depending on the size of the facility. All new confined animal facilities, and existing facilities of the size limits shown in Table 2, must be designed and implemented so as to collect solids, reduce contaminant concentrations, and reduce runoff to minimize the discharge of contaminants from a 25-year, 24-hour frequency storm. Existing facilities smaller than those in Table 2 are not subject to the requirements of this management measure.

	Head
Beef Feedlots	50-299
Stables (horses)	100-199
Dairies	20-69
Layers/Broilers	5,000-14,999
Turkeys	5,000-13,750
Swine	100-199

Table 2 Facility sizes required to control wastewater and runoff.

Facilities larger than those shown in Table 2 are required to store wastewater and runoff in storage structures. These structures must be designed to control discharges resulting from a 25-year, 24-hour frequency storm. All affected facilities are required to use appropriate waste disposal systems designed to utilize the livestock wastewater, while minimizing the impact to surface and ground water.

North Carolina already has rules in place for properly managing and utilizing animal wastes from livestock operations. The rules, commonly referred to as the .0200 Rules, apply to new, expanded or existing feedlots with animal waste management systems designed to serve more than or equal to the following animal populations: 100 head of cattle, 75 horses, 250 swine, 1,000 sheep, or 30,000 birds if a liquid waste system is used. These operations are deemed permitted if a signed registration and certified waste management plan is submitted to Division of Environmental Management (DEM). All facilities, regardless of size, are required to prevent the discharge of animal waste to surface waters by runoff, drift or direct discharge. Operations failing to comply with these rules may face civil penalties and/or be required to obtain an individual nondischarge permit from DEM.

While North Carolina's existing rules generally comply with the federal requirements discussed above, there are differences that will have to be resolved. Unlike the federal requirements, North Carolina's nondischarge rules do *not* require existing facilities above threshold population sizes to upgrade their waste management facilities. In addition, the .0200 Rules do not apply to new facilities below threshold numbers, whereas the federal requirements would apply to all new facilities. A final difference between state and federal rules applies to dry poultry litter systems. The federal regulations apply to all types of poultry operations, including dry litter systems. The .0200 Rules do not require operators of dry litter systems to register and submit a waste management plan for their operation. Existing state rules only require that operators stockpiling litter maintain a 100 foot setback from perennial waters and must keep records of waste applications. All waste applications must be made at agronomic rates.

3. Nutrient Management: The goal of this measure is to minimize nutrient movement as a result of stormwater runoff and nutrient leaching through the root zone. Nutrient management is pollution prevention achieved by developing a nutrient budget for the crop, applying nutrients at the proper time, applying only the types and amounts of nutrients necessary to produce the crop, and applying at times and using methods that minimize loss to receiving waters.

4. Pesticide Management: This measure is designed to minimize water quality problems by reducing pesticide use, improving the timing and efficiency of application, preventing backflow of pesticides into water supplies, and improving calibration of pesticide spray equipment. Pesticide management includes the use of integrated pest management (IPM) strategies. IPM strategies include evaluating current pest problems in relation to the cropping history of the field and previous pest control measures used, and applying pesticides only when an economic benefit to the producer will be achieved. When pesticides are applied, consideration should also be given to their environmental impacts such as persistence, toxicity, and leaching potential.

5. Livestock Grazing: The purpose of implementing this management measure is to protect sensitive areas such as stream banks, wetlands, estuaries, ponds, lake shores and riparian zones by restricting livestock access to these areas. Application of this management measure will reduce the physical disturbance to sensitive areas and reduce the discharge of sediment, animal waste, nutrients, and chemicals to surface waters.

6. Irrigation Management: This measure promotes an efficient irrigation system that delivers necessary quantities of water yet reduces nonpoint pollution to surface and ground waters. To achieve this, the measure calls for uniform application of water based upon accurate measurement of crop water needs and the volume of irrigation water applied. When chemicals are applied through irrigation, a backflow prevention system is required to prevent contamination of water sources.

Enforcement Authority

In addition to the program requirements discussed in the previous sections, the state must also provide detailed information on how it will insure implementation of the management measures. The state's Coastal NPS Program must identify enforceable policies and mechanisms to insure that each management measure is implemented. These policies and mechanisms may include state and local regulatory controls, as well as non-regulatory incentive programs backed by enforceable state authority. DCM is currently reviewing North Carolina's existing approach to controlling NPS pollution to determine where the state's existing statutes and regulations are adequate to meet the enforcement requirement.

The state's Coastal NPS Program will likely employ a broad range of approaches to insure that enforceable policies and mechanisms are in place. Selection of particular policies will likely depend on the characteristics of individual pollution sources being considered, as well as existing programs and authorities. Examples of regulatory and non-regulatory enforcement approaches that may be used to comply with this requirement are discussed below.

Regulatory Approaches

North Carolina already has a number of statutes and regulations in place designed to protect surface waters from nonpoint source pollution. However, in some cases, such as North Carolina's Sedimentation Pollution Control Act, agriculture is specifically exempt from the statute requirements. In other cases, the existing state regulations may not adequately conform to the management measures required for the Coastal NPS program. If North Carolina's existing laws and regulations are not adequate, there are a variety of options available to insure that enforceable policies and mechanisms are in place. A few are discussed below.

- Statutory Requirements: The state legislature may adopt laws that require or prohibit activities in certain areas as a way to implement some of the management measures. Laws may also be adopted directing the appropriate state commission to enact regulations to insure that adequate enforcement mechanisms are in place.

- Rulemaking Authority: In North Carolina, state commissions and boards are often responsible for developing and enforcing regulations necessary to carry out laws enacted by the General Assembly. Boards and commissions play important policymaking roles because they formulate regulations (quasi-legislative function) and because they have authority to hear cases (quasi-judicial function). The primary state authority responsible for protecting water resources is the Environmental Management Commission (EMC). The EMC is responsible for enacting and enforcing rules and regulations

designed to protect the air and water resources of the state. The Coastal Resources Commission is responsible for administering North Carolina's Coastal Area Management Act. Other state authorities that may be involved in implementing or enforcing components of the Coastal NPS program include the Soil and Water Conservation Commission, the Sedimentation Control Commission and the North Carolina Pesticide Board.

There are a variety of options available to these state regulatory groups to enforce the requirements of a Coastal NPS Program. Some or all of the alternatives below could be used in North Carolina's program.

- Develop new nonpoint source regulations: One alternative may be to adopt entirely new regulations that require specific management measures be used in the coastal nonpoint management area. While this may be necessary for some management measures, it is unlikely that a total restructuring of the state's exisiting approach to controlling NPS pollution will occur. Most components of the state's Coastal NPS program will likely be developed through existing NPS programs. However, because of the requirement for enforceable policies and mechanisms, significant changes may occur in the regulation of agricultural NPS pollution.

- Increase present monitoring activities: Where existing regulations are considered adequate, it may only be necessary to increase present monitoring activities to document that the regulations are being followed.

- Make regulatory exemptions for agriculture contingent upon compliance: Where agricultural activities are exempt from existing regulations, future exemptions could be made contingent upon the implementation of approved management practices. The forestry industry currently operates under this type of exemption with regard to the Sedimentation Pollution Control Act (SPCA). In 1989 amendments were made to the SPCA that require site-disturbing forestry activities to be conducted in accordance with approved management practices. Forestry operations found in violation of these requirements may be fined and required to submit a sedimentation control plan to the North Carolina Division of Land Resources.

- Adopt a permitting system for agricultural operations: One regulatory approach to implementing agricultural management measures is through the use of individual and general permits. As described by EPA, a state could issue general permits for specific source categories. These permits would describe management measures that must be adopted by all entities that meet a particular definition. For example, a general permit could require farmers to adopt management measures applicable to various parts of their operation such as pesticide management, nutrient management, etc. Farmers would then choose site specific management practices designed to satisfy the requirements of the general permit. If producers did not comply with the terms of the general permit they could be subject to enforcement actions such as fines and/or be required to apply for an individual permit containing more detailed management, reporting, and inspection requirements.

- Adopt "sunset" provisions for voluntary nonpoint programs: A more flexible approach than a permitting system may be to back up new or existing educational or incentive based NPS programs with sunset provisions. Under such provisions, a target number of producers or a target number of acres would implement the desired management measures. If the target levels were not met, the state would enforce more stringent, mandatory requirements for implementing the management measures.

As discussed earlier, all management measures must be backed by state-level enforceable policies and mechanisms. Enforcement of regulatory requirements may include cease and desist orders, administrative orders, fines, or in certain cases, criminal penalties. Enforcement may be triggered when inspections or monitoring programs indicate that operators are not complying with the regulatory requirements.

Non-regulatory Approaches

In addition to the use of regulatory authority, states are encouraged to use voluntary, nonregulatory ap-

proaches to encourage adoption of management measures. A general discussion of some of the non-regulatory approaches are presented below.

■ Economic Incentives: Economic incentives can be used by states to promote or discourage certain practices. One option is to provide cost share funds, as presently used in North Carolina's Agricultural Cost Share Program, to defray a part of the cost of adopting management measures. Other incentives could include tax credits, deductions, rebates or low interest loans designed to subsidize the cost of adopting desired management practices.

Another alternative is to require producers to fully comply with all management measures as a condition for receiving cost-share funds. For example, a farmer receiving cost-share funds for constructing an animal waste lagoon could be required to implement other management measures, such as pesticide or nutrient management, in order to qualify for state agricultural cost-share funds for the lagoon.

■ Economic Disincentives: States may also adopt disencentive programs designed to discourge certain activities or the use of certain products. For example, taxes could be imposed on manufacturers or retailers of fertilizers or certain pesticides in order to raise their costs and discourage use.

■ Market-Oriented Incentive Strategies: EPA and NOAA are encouraging states to develop market-oriented approaches for implementing required management measures. One option is to achieve loading reductions through a pollution trading program. Trading programs seek to achieve the most efficient means of pollution reduction by taking advantage of differences in control costs for dischargers. Dischargers with high control costs can pay those with lower control costs to reduce their pollution discharge more than required. The discharger with higher control costs can then take credit for the decrease in pollutant loading by the other discharger and thereby achieve the overall goal at lower cost.

In 1989 North Carolina established a nutrient trading program in the Tar-Pamlico River Basin. Under the program agreement, point source dischargers can achieve their nutrient discharge reduction goals by reducing their own discharge levels or by paying funds into the state's agricultural cost share program. These funds are used to pay for the implementation of BMPs to reduce nutrient loading from agricultural sources.

■ Education Programs: The North Carolina Department of Agriculture, Cooperative Extension Service, Soil Conservation Service, Agricultural Stabilization and Conservation Service and various other federal and state agencies provide a variety of educational and technical assistance programs designed to promote agricultural practices that are environmentally sound and economically feasible. These organizations will likely play a crucial role in promoting compliance with required management measures for agriculture.

Opportunities for Public Participation

For program approval, states must provide opportunities for public participation in all aspects of program development and implementation. As part of the public involvement process, DCM will sponsor a series of public meetings at various locations in the state's coastal area. These meetings will provide the public with an opportunity to comment on the state's approach to developing its coastal NPS program.

Summary

Nonpoint source pollution has been identified as a major contributor to surface water pollution in the nation's coastal areas, including North Carolina's. It has become apparent that in order to maintain and ultimately improve surface water quality in coastal areas, it will be necessary to place greater emphasis on the control of nonpoint source pollution. The requirements of section 6217 of the CZARA indicate that federal, state, and local governments must take a more active role in insuring that nonpoint control technology is adopted.

Like much of North Carolina's existing approach to NPS control, section 6217 is based on the adoption of BMP's to control various sources of nonpoint pollution. However, section 6217 presents a change in philosophy in dealing with many nonpoint sources of pollution, particularly agriculture. Rather than rely primarily on education and voluntary cooperation, section 6217 requires states to adopt enforceable policies and mechanisms that will insure the adoption of required technology and practices.

In order to comply with the provisions of section 6217, North Carolina may have to alter its approach to controlling agricultural nonpoint source pollution. Individuals who wish to have input into the development of the Coastal Nonpoint Program should send comments to: Coastal Nonpoint Coordinator, NC Division of Coastal Management, PO Box 27687, Raleigh, NC 27611-7687. Upon request, interested individuals can also be placed on a mailing list that will provide information on scheduled public meetings and other program activities.

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Acknowledgements

Thanks is expressed to the following reviewers of earlier drafts of this fact sheet: Drs. Frank Humenik and Greg Jennings, Department of Biological and Agricultural Engineering, NCSU; Lisa Huff, Coastal Nonpoint Source Coordinator, DEHNR, Division of Coastal Management; Jennifer Platt, DEHNR, Division of Coastal Management.

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AREP94—10 November 1994

Resource Economics and Policy

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The Cost of County Recycling Programs in North Carolina

A recent survey of recycling costs in 11 North Carolina counties indicates that in many counties recycling is more costly than landfilling, but that in others recycling programs may be relatively cost effective. Countywide curbside programs and other specialized programs are identified as particularly expensive ways of diverting waste from landfills. These findings highlight an important tradeoff between meeting state waste diversion goals and local budgetary constraints.

Recycling is becoming an increasingly important component of local solid waste management systems in North Carolina. This is due, in large part, to changes in the rules and regulations governing solid waste disposal, including recent EPA regulations requiring the imminent closure or upgrading of many landfills and state laws mandating a 25-percent reduction in solid waste entering landfills. It is also due to growing awareness among citizens and public policymakers that there are physical, environmental, and financial limitations on the ability of local communities to dispose of solid waste in traditional ways (i.e., by burying the problem).

There appears to be widespread confusion (and many misconceptions) regarding the costs and benefits of recycling. Some individuals think that recycling is a profitable activity; others think that the costs of recycling are extremely high relative to alternative forms of solid waste disposal. While most knowledgeable observers would argue that the truth lies somewhere in between, the detailed information needed to assess the economics of recycling is often not readily available.

To begin to bridge this information gap, this bulletin presents the key findings of a survey of 11 county recycling coordinators conducted between June and August of 1993. The survey sought to develop as complete an accounting as possible of all costs related to the collection, processing, and disposal of commonly recycled materials — including indirect costs (overhead), fixed (depreciation) costs of capital items, direct labor and equipment costs, and the

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costs of contracted services. Recycled materials included in the survey were aluminum, old newspaper (ONP), old corrugated cardboard (OCC), glass, plastic (HDPE and PET), steel and tin cans, and mixed paper. Composting and tire recycling were explicitly excluded from analysis. In addition to the cost data, information was gathered on quantities collected and sales revenues.

Survey Results

Table 1 provides background information on the kinds of recycling programs operated in the 11 counties surveyed.[1] In eight of these, the county takes responsibility for collecting recyclables solely in unincorporated areas and small municipalities for which there is no curbside pickup. The other three counties assume responsibility for all recycling activities within the county.

In most of the surveyed counties, convenience centers handling both recyclables and non-recyclable garbage or drop-off sites, exclusively devoted to collection of recyclables, are the major collection source for recyclables. Several of these counties operate additional programs such as mixed paper drives, office paper programs, local government office recycling programs, school recycling programs, and commercial recycling programs. Two counties have instituted countywide curbside programs as the primary collection mechanism for recyclables.

Counties differ considerably in the degree to which they contract with private companies to undertake specific activities. All counties use private haulers – in some cases within the county (from convenience centers or drop-off sites to processing centers), but more commonly to transport recyclables to final markets. In most counties (7 of 11), this is the extent of contracted activity. The three counties with materials recovery facilities (MRFs) contract with private firms to operate these facilities. All but one of the other counties did their own processing, which included sorting, separating, and assembly of recyclables in preparation for shipment to final markets. Two counties contract with private firms to handle all collection activities (countywide curbside pickup in one case, operation of convenience centers in the other). Two other counties use private companies for collection in selected programs within the county.

Considerable variability is evident in both the quantities recycled and costs of recycling across counties. Quantities ranged from a low of 297 tons per year to over 11,000 tons per year. Per-ton recycling costs (net of revenues from sales) are shown in the last column in Table 1. These ranged from just over $40 to over $300, with roughly half the counties having recycling costs in excess of $100 per ton. By way of comparison, landfill tipping fees in all counties surveyed were between $18 and $31 per ton, while median trash collection costs in the state are approximately $50 per ton.[2] It appears, then, that in many of the counties surveyed recycling is more costly than land disposal (in some cases much more costly), but that in others recycling programs may be relatively cost effective.

Figure 1 depicts the costs of different kinds of recycling programs – convenience centers, drop-off sites, curbside pickup, and other programs such as government office paper and school recycling programs. Some rather striking differences exist between the costs of different types of recycling programs. Costs ranged from $40 to $85 per ton for the five convenience center programs in the surveyed counties. The per ton costs of drop-off programs was somewhat higher, with a range of $48 to $120.

[1]Several of the respondents requested anonymity, and hence the names of the counties are not listed.

[2]Data collected by the North Carolina League of Municipalities found that 75 percent of municipalities in their survey paid between $20 and $80 per ton for trash collection. Costs varied by type and frequency of pickup, equipment used, and other factors.

Table 1. Overview of county recycling programs surveyed.

County	Types of programs	Contracted Activities	Materials collected [a]	Net Cost per Ton
A	Convenience centers.	Hauling	Aluminum, ONP, OCC, glass, mixed paper, steel cans, plastics, white goods.	$52.46
B	Drop-off, gov't recycling program.	Hauling	Aluminum, ONP, OCC, glass, mixed paper, steel cans, plastics, white goods.	151.38
C	Convenience centers, school recycling program.	Hauling	Aluminum, ONP, glass, steel cans, plastics.	323.16
D	Countywide curbside, convenience centers, MRF.	All	Aluminum, ONP, OCC, glass, steel cans, plastics, mixed paper, office paper, white goods.	240.35
E	Drop-off, curbside, mixed paper, commercial, multi-family, government.	Hauling; collection (curbside programs).	Aluminum, ONP, OCC, glass, mixed paper, steel cans, plastics, white goods, glossy paper, office paper.	85.67
F	Countywide curbside.	Hauling	Aluminum, ONP, OCC, glass, steel cans, plastics.	176.00
G	Convenience centers, MRF.	All	Aluminum, ONP, OCC, glass, mixed paper, steel cans, plastics, white goods.	40.35
H	Drop-off.	Hauling	Aluminum, ONP, OCC, glass, mixed paper, steel cans, plastics, white goods.	100.72
I	Drop-off, office paper program ("OPP"), MRF.	Hauling, processing, collection (OPP)	Aluminum, ONP, OCC, glass, mixed paper, steel cans, plastics, white goods.	119.37
J	Convenience centers.	Hauling	Aluminum, ONP, OCC, glass, mixed paper, steel cans, plastics, white goods.	80.31
K	Convenience centers.	Hauling	Aluminum, ONP, OCC, glass, mixed paper, steel cans, plastics, white goods.	85.84

[a] ONP = old newspaper; OCC = old corrugated cardboard.

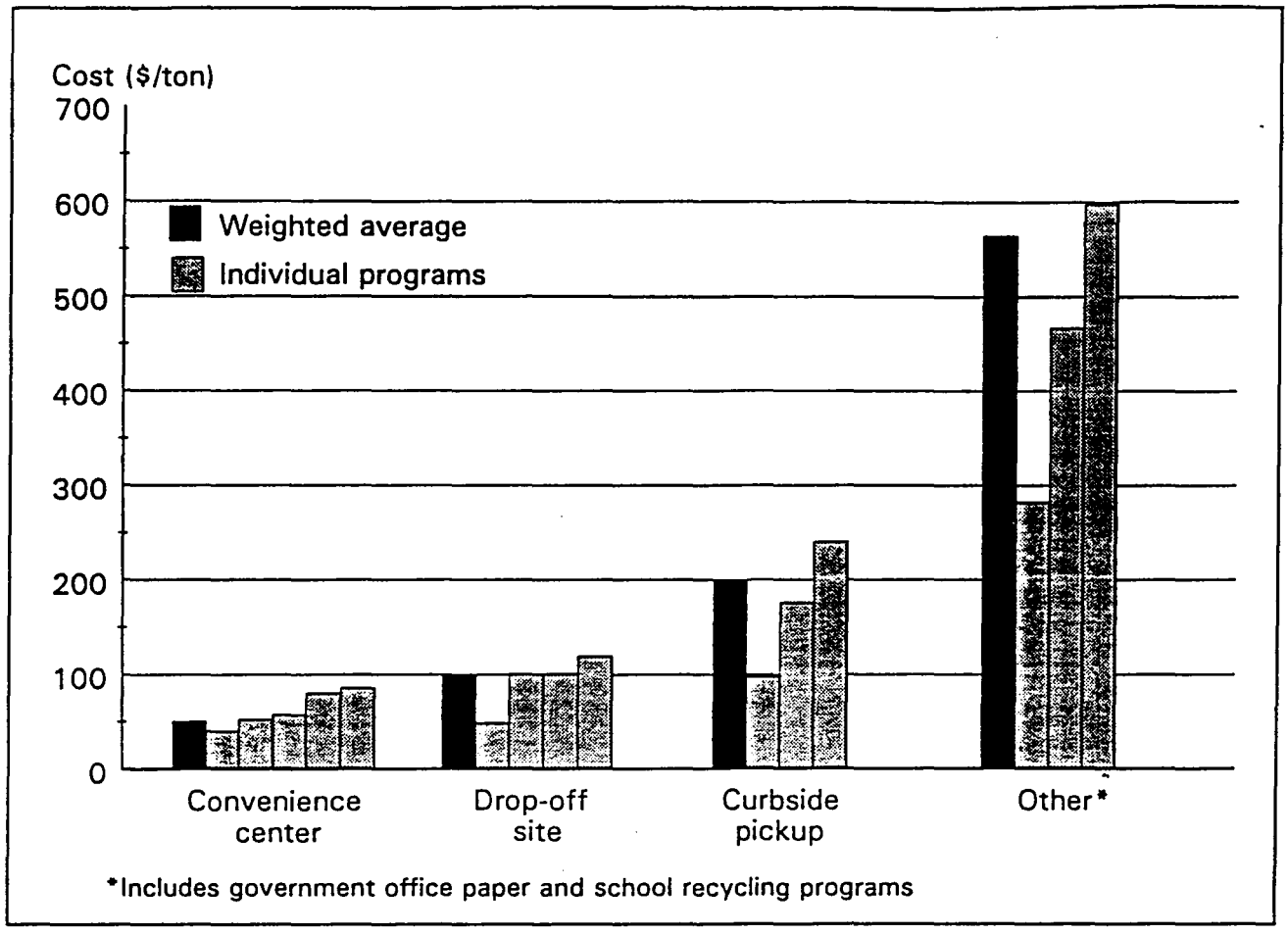

Figure 1. Net cost per ton of various types of recycling programs.

Three of the counties surveyed operate curbside programs. In two of these, curbside pickup has been implemented on a countywide basis — that is, in rural areas as well as municipalities. For these two counties, the costs of recycling are high relative to counties operating drop-off or convenience center-based programs. This is hardly surprising since curbside pickup involves considerably greater labor and equipment usage, particularly in rural areas characterized by low population densities. By the same token, it is likely that the proportion of solid waste recycled in these counties is higher than it would have been had these counties relied on alternative collection systems (e.g., drop-off sites). The other county that operates a curbside program does so only in the county's three main municipalities. Per-ton costs of that curbside program are considerably lower than those in the two counties in which countywide service is offered (but much higher than the drop-off program that is also operated within the county).

Finally, Figure 1 highlights several very costly programs that are run by three of the surveyed counties in conjunction with other recycling activities. The most costly of these is a school recycling program consisting of several "igloo" containers for aluminum cans, glass, and plastic located at each of 50 public schools countywide. The high cost of operating this program is due to the fact that the schools are widely dispersed around a fairly large county, and the per ton cost of hauling the relatively small amounts of recyclables from

each site to a central processing facility are consequently quite high.[3] The other two relatively high-cost programs highlighted in Figure 1 collect office paper from local government offices. However, these programs exist because there is demand for them on the part of the individuals they service and because it is felt that they "send the right message" — that local government is doing its part to encourage recycling.

Discussion

Recent state and federal regulations governing solid waste disposal, combined with increased environmental consciousness on the part of citizens and policymakers, have motivated direct local government involvement in recycling. Local officials must make important decisions on the kinds of recycling programs to operate and the kinds of educational activities to promote public participation. In the process, these officials must balance the need to meet waste diversion requirements against the cost of operating recycling programs.

Two main findings that emerge from the survey results presented above clarify the nature of the economic tradeoffs involved in local solid waste management. First, in many cases recycling costs are large relative to landfilling costs. Of course, landfill costs (and tipping fees) have risen considerably throughout the state in the recent past, and this trend is likely to continue in the future as the costs of siting, permitting, and constructing landfills continue to escalate. There is, therefore, considerable future benefit (in the form of avoided future costs) of conserving landfill space through waste diversion today. In addition, many proponents of recycling argue that continuing improvements in extraction and utilization technologies for recyclables, coupled with prospective market development activities, will increase future demand for recycled material, thereby raising revenues and lowering the net cost of recycling. These arguments support the notion that recycling programs, while expensive in the short-run, may prove to be economical in the long run. Nonetheless, the fact remains that currently and for some time to come, recycling will be a relatively expensive component of many solid waste management systems.

A second conclusion that emerges from the survey results is that there is considerable variability in recycling costs, both among counties and between different programs within counties. Differences in participation rates, population densities, public education efforts, and a host of other factors contribute to cross-county differences in recycling costs. Considerably more information than was collected in this survey would be needed to begin to explain these cross-county differences.

Substantial differences in costs per ton across different types of programs were also noted. Not surprisingly, the per ton costs of the curbside programs in the sample were more expensive than the per-ton costs of drop-off sites and convenience centers. This result typifies an important trade-off facing solid waste planners: increasing the quantity of waste diverted from landfills via recycling will come at the expense of increases in average recycling costs. The fundamental reason for this is that getting individuals to recycle a greater share of their everyday waste will require increasing amounts of public effort, either by making recycling more convenient (e.g., by instituting curbside programs) or through greater educational and promotional activities. At the same time, a few cases were noted in which counties operate several kinds of recycling programs, some of which are extremely expensive while contributing relatively little to total quantities recycled. It would thus appear that for some counties there may be scope for lowering overall recycling costs by eliminating such high-cost, low-volume programs.

[3]The county recycling coordinator was fully aware of the program's high cost but noted that it is popular because it is viewed as an educational investment that encourages recycling among school children.

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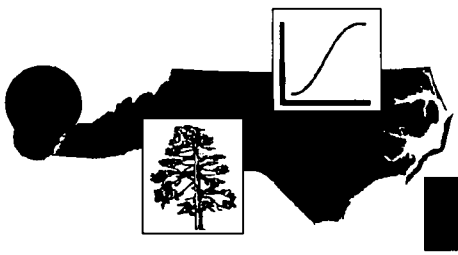
AREP94–8–July 1994



Resource Economics and Policy

Applied Resource Economics and Policy Group
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The Role of Strategic Planning in Community Decision Making on Environmental Issues

Communities throughout North Carolina currently face a number of critical issues related to the use and protection of natural resources. These range from siting and construction of new solid waste management facilities to the enactment of land use ordinances aimed at groundwater protection. In many instances, decisions have to be made because of state or federal regulations requiring local governments to take actions to protect the quality of the natural resource base; in other cases, expanding environmental consciousness is causing citizens and local government officials to take steps to improve or protect the quality of water, air, and land resources.

The process whereby environmentally related decisions are made can be a contentious and divisive one. Often, actions that protect scarce natural resources have effects that are perceived by some segments of the community to have negative economic repercussions. A case in point is new watershed management rules promoted as a part of the Water Supply Watershed Protection Act (HB156). These rules limit the extent and type of development allowable on certain critical areas adjacent to water supply sources, and hence are expected to affect some landowners and developers in negative ways.

Strategic planning is a mechanism through which the residents of a community can be brought together in an attempt to reconcile a variety of viewpoints regarding environmental decision-making. It is distinguished from other methods of public decision making in two key ways. First, instead of concentrating the responsibility for formulating and implementing policies in the hands of a few persons, strategic planning stresses the need to bring citizens from as wide a cross-section of the community as possible into the policy-making process. Second, it is an on-going process that stresses the

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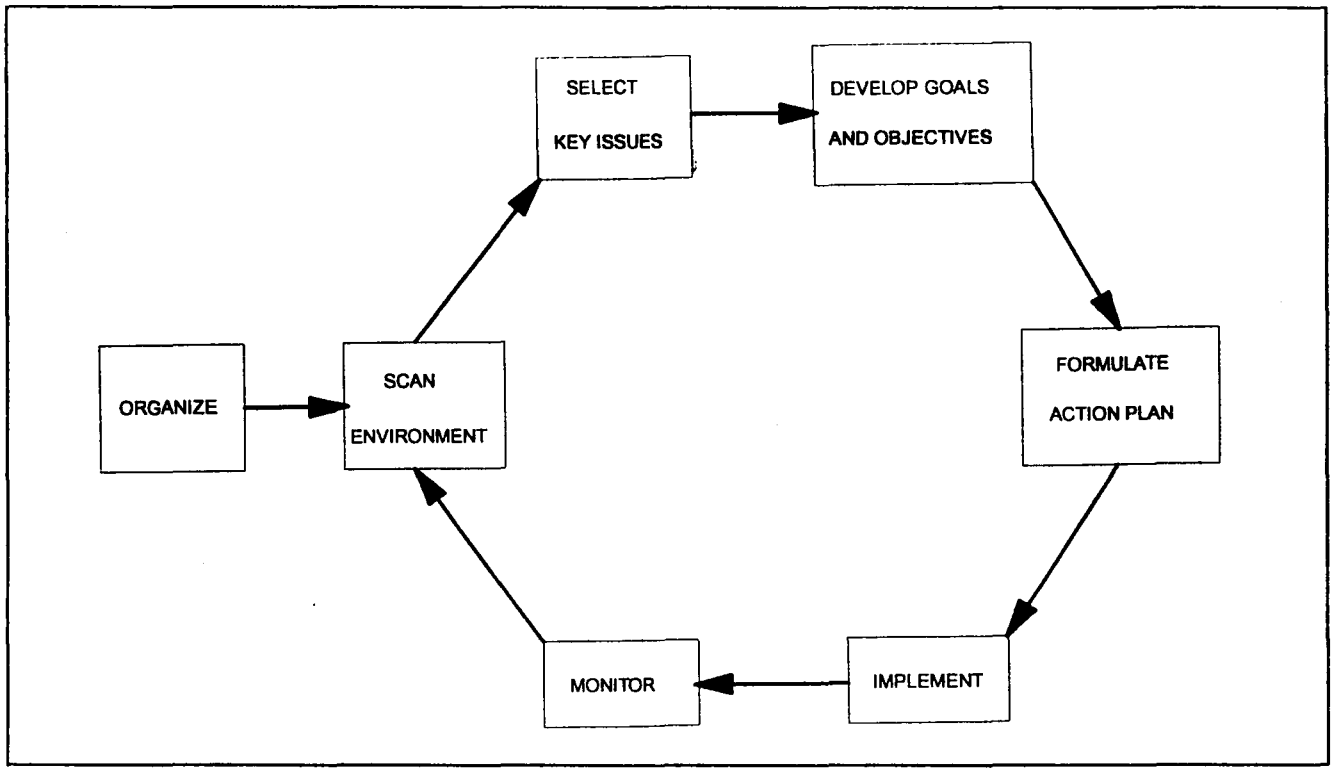

Figure 1. The Strategic Planning Process.

importance of continually monitoring the progress toward agreed-upon goals and objectives. In this factsheet we will describe the strategic planning process and its potential role in community decision-making on environmental issues.

What is Strategic Planning?

Strategic planning is an orderly planning process that allows people in counties and towns to identify and address pressing issues in their communities. This planning method answers three related questions:

- Where is our community today?
- What do we want our community to be like in the future?
- How can we most effectively get from here to there?

How is Strategic Planning Conducted?

The first step in the strategic planning process is to form a *planning committee* which will then rally participation from the entire community (see Figures 1 and 2). It is important for local government to take an active role in sponsoring the planning process, as such support is critical for ensuring that plans translate into actions. In addition, the planning committee should to the greatest possible degree reflect the diversity of viewpoints and interests within the community. Thus, the committee should contain representatives of local government, local development groups, the chamber of commerce, banks, utilities, agriculture, civic organizations, environmental organizations, and the like. Ideally, it should reflect the community's population composition (age, gender, and race) as well.

- Organize and form planning committee
- Conduct environmental scan
- Select limited set of issues
- Form study teams
- Develop action plans
- Implement action plans
- Monitor progress

Figure 2. Steps in the Strategic Planning Process.

The next step of the strategic planning process is to assemble the relevant information necessary for participants to make sound decisions. This phase, commonly referred to as an *environmental scan*, provides the necessary intelligence on the community's internal resources for attacking problems as well as the external economic and policy environment within which the community exists.

The next phase of the strategic planning process is to select a *limited set of issues* on which to concentrate. This can be accomplished by establishing task forces to hold organized, structured discussions around central themes — e.g., technical environmental considerations, public finance issues, and economic impacts.

Once a set of issues have been identified, *study teams* examine each issue. Composed of a range of citizens from the community, each team conducts its own analysis before recommending desired outcomes or actions (goals) and measures of those outcomes (objectives) to the planning committee. Once goals and objectives have been formed, strategies — in the form of *action plans* — must be developed for carrying them out. An action plan lists the specific steps to be taken, assigns responsibility to specific individuals or groups for carrying out those steps, and assures that tasks are completed according to a detailed timetable that can be evaluated along the way. A well-designed action plan aids the *implementation* process by ensuring complete understanding of the various tasks and the time required to perform them. Consequently, implementation should follow the action plan closely.

To be successful, strategic planning requires continuous *monitoring*. Regular progress updates provide an early warning system that will alert the planning committee when actions are not proceeding according to plan. Monitoring should also track expenditures and allocation of resources. Finally, continual monitoring will supply local government sponsors of the strategic planning process with the information necessary to assess the progress toward meeting the goals and objectives adopted by the community.

Strategic Planning in Practice: The Gaston County Experience

Faced with increasing citizen concerns about environmental quality in Gaston County, the Board of County Commissioners appointed a broad-based citizen advisory group, the Quality of Natural Resources Commission (QNRC), to serve as the planning committee for a countywide environmental strategic planning effort. Established in 1988, the QNRC consists of more than 50 members representing the county's municipalities, businesses, industries, environmental organizations, county boards and agencies, and citizens at large. Its mission is to examine the state of natural resources in Gaston County, review environmental concerns, and make recommendations to the Board of Commissioners on how to improve the environment.

With the assistance of the NC Cooperative Extension Service, the QNRC evaluated surface water, groundwater and air quality in the county. The assessment provided county leaders with a current picture of air and water quality in the county. The QNRC also commissioned a countywide community survey to learn about the concerns of county residents toward environmental quality and their willingness to clean up the environment.

Based on the information they gained from the

environmental assessment and community survey, the QNRC then began the process of exploring policy alternatives for improving air and water quality. Dividing into three resource committees: air, surface water, and groundwater, the members worked through the structured process described earlier in this bulletin to develop policy recommendations. The policy process consisted of seven steps (Figure 3). These were:

1. Identify and clarify issues — review information from the environmental assessment and community survey, related studies and documents, and presentations by experts in the field.
2. Reach a group consensus on the issues — group members agreed on an issue, or a set of issues to begin to work on.
3. Set goals — members identified the goals they wished to strive for through policy action. Goals should be refined to the point they are specific, attainable, and measurable.
4. Formulate program guidelines — this step was meant to provide bounds within which future policies were to be centered. Guidelines are based on concepts of efficiency, equity, and feasibility.
5. Select targets — the realm of policy alternatives was further narrowed to enhance policy effectiveness and feasibility. Policies were targeted at either pollutants, activity sources, or location.
6. Identify implementation measures and their consequences — the mechanisms available for achieving policy goals were discussed and evaluated.
7. Formulate recommendations

- Identify and clarify issues
- Reach a consensus on the issues
- Set goals
- Formulate program guidelines
- Select targets
- Identify implementation measures and their consequences
- Formulate recommendations

Figure 3. Using the public policy process to develop and implement action plans.

The QNRC has used this process for several policy issues including watershed protection, industrial wastewater discharge, and air pollution. The process is ongoing. The QNRC continues to monitor its air and water quality and is currently updating the county environmental assessment.

Conclusion

Communities commonly confront difficult public policy decisions regarding issues of environmental quality and the use of natural resources. Resolving these kinds of issues is a difficult task requiring considerable effort and creativity on the part of local citizens. Strategic planning provides an organizational structure for focusing that effort and creativity in productive ways. As the Gaston County example indicates, strategic planning can be a fruitful way for communities to organize public debate over environmental issues and to develop innovative methods of coming to closure over them.

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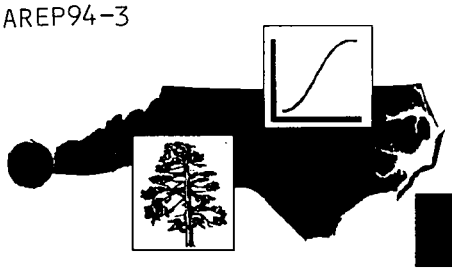
AREP94—4—April 1994



Resource Economics and Policy

Applied Resource Economics and Policy Group
Department of Agricultural & Resource Economics

Wetland Regulations in North Carolina

Wetlands perform a variety of valuable functions. They improve water quality, recharge groundwater, provide flood control, and support a wide variety of fish, wildlife, and plants. Federal and state governments have written a number of laws and regulations designed to protect wetlands. Because of the complexity of these laws and regulations and the number of different agencies involved in enforcement, complying with these regulations can be complicated. This fact sheet summarizes the major regulations related to protection of wetland resources in North Carolina.

Wetlands and Policy

The U.S. Fish and Wildlife Service (FWS) estimates that when Europeans first arrived in North America, wetlands occupied more than 220 million acres in the area that now comprises the lower 48 states. By 1980, wetlands occupied about 104 million acres. The FWS estimates the current rate of wetland loss to be about 290,000 acres per year.

For approximately 200 years, the Federal Government and many states, including North Carolina, approved of and assisted in wetland destruction as a way to improve public health and encourage economic development. For the first 70 years of the twentieth century, the U.S. Department of Agriculture offered direct financial and technical assistance to farmers for wetland drainage. Many of these direct incentives for wetland destruction ended during the 1970's. In 1977, President Carter issued Executive Order 11990 which required agencies of the Federal Government to "minimize the destruction, loss or degradation of wetlands" and to "avoid direct and indirect support of new construction in wetlands wherever there is a practicable alternative." This change in federal policy has led to a number of regulations which affect the use of wetlands in the United States and North Carolina.

What are Wetlands?

In order to implement the wetland regulations, it is first necessary to reach an adequate definition of wetland characteristics so that regulated areas can be identified. The Army Corps of Engineers, the U.S.

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Environmental Protection Agency (EPA) and the Soil Conservation Service (SCS) use wetland definitions that are conceptually the same. In general, wetlands are identified as lands having all three of the following attributes:

- at least periodically, the land supports wetland vegetation typically adapted for life in saturated soil conditions;
- the substrate is predominantly undrained hydric soil (i.e., soil that is saturated or flooded long enough to produce the anaerobic conditions that wetland vegetation requires); and
- the substrate is saturated or covered by shallow water at some time during the growing season of each year.

Much of the controversy surrounding wetlands in recent years has focused on the proper definition and identification of wetlands. Wetlands regulated under sections 404 and 401 of the Clean Water Act are currently identified using technical criteria in the 1987 U.S. Army Corps of Engineers Wetland Delineation Manual. In 1989, a revised multi-agency manual was developed as a replacement for the 1987 version. However, these revisions led to considerable confusion and controversy.

As a result, another revision of the delineation manual was developed in 1991, but, because it generated additional controversy, it was not adopted. During Congressional review of the 1991 manual, Congress barred the Corps from implementing the 1989 manual. As a result, the 1987 manual continues to be used for wetland delineation. Congress also appropriated funding for the National Academy of Sciences to study wetlands science issues. The results of this study should provide additional information necessary to develop a revised delineation manual. The study is to be completed in 1994.

Why Are Wetlands Important?

Historically, wetlands have been considered unimportant, even worthless. At best, they were considered useful only when filled or drained. However, during the last twenty to thirty years, scientists and policy makers have become more aware of the value of wetlands to landowners and the general public. These wetland values may include:

- water storage, including limiting the effects of floods and droughts;
- water purification;
- shoreline stabilization;
- habitat for waterfowl and other animals, and plants;
- erosion protection;
- production of fish and shellfish;
- food production;
- timber production;
- education and research;
- recreation; and
- open space and aesthetic values.

Increased awareness of the value of wetlands has resulted in a number of regulations and programs designed to protect wetlands and the benefits they provide.

Major Wetland Regulations and Their Enforcement

Table 1 provides an outline of the wetland regulations discussed in this fact sheet. Each category is discussed below.

Section 404 Permits

Section 404 of the Clean Water Act of 1972 provides the primary legislative authority behind federal efforts to regulate the use of wetlands. Section 404 requires that a permit be obtained from the U.S. Army Corps of Engineers prior to undertaking any activity that will result in the discharge of dredged or fill materials into waters of the United States, including wetlands.

Corps regulations state that the discharge of dredged material includes the addition of material to specified discharge sites located in waters of the United States and the runoff or overflow from a contained land or water disposal area. Fill material includes any material used primarily for replacing

Table 1. State and Federal Legislation Affecting Wetlands		
Legislation	**Responsible Agency**	**Regulated Activity**
Section 404 Clean Water Act (1972)	US. Army Corps of Engineers	Discharge of dredged or fill materials into waters of the United States
Section 401 Clean Water Act (1972)	NC Division of Environmental Management	Discharge of pollutants in surface waters of the state
NC Coastal Area Management Act (1974)	Division of Coastal Management	Development in designated "Areas of Environmental Concern"
State Dredge and Fill Act (1969)	Division of Coastal Management	Filling or dredging in estuarine waters, tidelands, marshlands, and state-owned lakes
Title XIV: 1990 Food, Agriculture, Conservation and Trade Act (Swampbuster)	Agricultural Stabilization and Conservation Service	Conversion of wetlands for the purpose of agricultural production

an aquatic area with dry land or changing the bottom elevation of a body of water.

Upon receiving a permit application, the Corps determines the type of permit needed, if any. If an individual permit is required, a public notice is prepared containing information on the nature and magnitude of the project to evaluate the probable impact on the public interest. Copies of the notice are sent for review and comment to each federal and state resource agency, local agencies, and the public.

The federal resource agencies notified upon receipt of a 404 permit application are the U.S. Environmental Protection Agency (EPA), the National Marine Fisheries Service (NMFS), and the U.S. Fish and Wildlife Service. The Corps is required to consult with these agencies and to give full consideration to their comments and recommendations. In addition, the Department of the Army, the EPA, and the Departments of Agriculture, Commerce, Interior, and Transportation have established interagency agreements under which these agencies can comment on permit applications. Of all the federal agencies and departments mentioned above, EPA is the only federal agency which has authority to prohibit issuance of a 404 permit. Any agency may, however, request higher level review within the Department of the Army if the agency disagrees with the permit decision made by the Corps.

The Corps and EPA currently operate the Section 404 program under a 1990 Memorandum of Agreement which states that activities that require a 404 permit should be avoided when possible; when they cannot be avoided, impacts should be minimized; and, after all possible minimization is achieved, compensatory mitigation is required to offset the remaining unavoidable impacts. The Memorandum directs that mitigated wetlands be replaced on a one-to-one functional basis. This is usually implemented as a 2:1 acreage replacement. When mitigation is chosen as a condition for a 404 permit, it normally involves the construction of new wetlands or the restoration of existing wetlands that have previously been degraded. The decision to issue or deny a 404 permit is made by the Corps District Engineer who serves as project manager for the application.

Corps regulations also allow the issuance of general permits which cover wetlands activities that

the Corps has determined are substantially similar in nature and that cause only minimal individual and cumulative environmental impacts. Thirty-six general permits have been issued nationwide. The Corps of Engineers' Wilmington District has issued thirteen regional permits for use in North Carolina. General permits have been issued for activities such as:

- Fish and wildlife harvesting;
- Survey activities;
- Minor road crossings;
- Modifications of existing marinas;
- Maintenance dredging of existing basins;
- Boat ramps with no discharge to wetlands; and
- Cleanup of hazardous and toxic waste.

The most frequently used general permit is Nationwide Permit 26 which applies to wetland fills less than ten acres in size. To qualify for this permit, a project must meet one of the following criteria: (1) the wetland must be located adjacent to a stream above headwaters; or (2) the wetlands are isolated, which is defined as being hydrologically separated from surface waters.

A number of activities which qualify for a general permit require notification to the Corps of Engineers before the activity begins. If there is any uncertainty regarding whether an activity qualifies for a general permit or whether notification of the Corps is required, it is advisable to contact the Corps of Engineers to verify the status of the activity prior to undertaking the project.

The following activities are exempt from Section 404 regulatory requirements.

- normal agriculture, silviculture (forestry), or ranching activities such as plowing, seeding, cultivating, minor drainage, and harvesting for the production of food, fiber, and forest products;[1]
- maintenance or emergency reconstruction of certain serviceable structures, including dikes, dams, breakwaters, causeways, or bridge abutments;
- construction or maintenance of farm or stock ponds, or irrigation ditches, or the maintenance of drainage ditches;
- construction or maintenance of farm or forest roads, or temporary roads for moving mining equipment;
- construction of temporary sediment basins on a construction site which does not include placement of fill material into waters of the United States; and
- Congressionally approved projects for which an environmental impact statement has been filed.

The Corps of Engineers should be contacted to determine if a specific project is exempt from Section 404 requirements.

Section 401 Water Quality Certification

The North Carolina Division of Environmental Management (DEM) administers 401 Water Quality Certifications as required under Section 401 of the Clean Water Act. A Water Quality Certification *must* be obtained for any activity that discharges pollutants into surface waters and requires a federal permit or license. The 401 certification indicates that the discharged pollutant will not violate state water quality standards. Activities requiring an individual or nationwide Section 404 permit from the Corps of Engineers also require a Section 401 Water Quality Permit.

North Carolina's Section 401 permit requirements have been developed to comply with the state's water quality antidegradation policy which requires that beneficial existing uses of state waters, including wetlands, may not be removed. In order to comply with this policy, the state may not grant a 401 water quality certification if significant existing wetland uses will be removed, unless no practicable alternative exists.

As with the Section 404 permits, there are also general and individual 401 water quality certifica-

[1]To qualify for this exemption, the farming, silviculture or ranching activities must be part of an established (i.e ongoing) operation. Activities which bring an area into farming, silviculture or ranching use are not part of an established operation.

tions. General certifications have been issued for those activities that are similar in nature and have been determined to have minimal impact on water quality. Individual certifications are required for all other activities that do not qualify for a general certification.

DEM has issued 22 general certifications encompassing 34 categories of activities. Of these, 23 certification categories correspond to the 404 nationwide permit categories defined by the Corps of Engineers. DEM did not issue general 401 certification for three of the nationwide permits (hydropower projects, cranberry production and surface coal mining); these activities must obtain individual certification. Projects not eligible for general certification must obtain an individual certification from DEM.

Coastal Area Management Act

The North Carolina Coastal Area Management Act (CAMA) of 1974 applies to all 20 counties on the coast of North Carolina (Figure 1). The purpose of CAMA is to control development pressure within North Carolina's coastal region in order to protect those attributes that make it economically, aesthetically and ecologically rich. As required by CAMA, the Coastal Resources Commission has identified four "areas of environmental concern" (AEC's) within these counties in which uncontrolled development might cause irreversible damage to property, public health, and the natural environment. The four AEC's are:

- the estuarine system;
- the ocean system;
- public fresh water supplies; and
- natural and cultural resource areas.

Most wetlands affected by CAMA permit requirements are included in the estuarine system AEC. The estuarine system is the coast's broad network of brackish sounds, marshes, and surrounding shorelines.

Except for exempted activities, any development that occurs within the areas of environmental concern must obtain a CAMA permit. Exempted activities include:

- agricultural or forestry production that does not involve the excavation or filling of estuarine or navigable waters or coastal marshland;
- agricultural or forestry ditches equal to or less than 6 feet wide by 4 feet deep; and
- the construction of an accessory building usually found with an existing structure, if no filling is involved.

There are two categories of CAMA permits. These categories are identified as "major" or "minor" development permits. A major development permit must be obtained if the project involves any of the following:

- alteration of more than 20 acres of land and/or water within an AEC;
- construction of one or more buildings covering a ground area greater than 60,000 square feet on a single parcel of land;
- excavation or drilling for natural resources on land in an AEC or under water; or
- another state or federal permit, license, or authorization (such as for dredging and filling, sedimentation control, wastewater discharge, or mining).

Development projects in an AEC which meet none of the conditions listed above must obtain a minor development permit. The minor permit is administered by the local government where the project is located using standards developed by the Coastal Resources Commission.

General permits have been issued by the Coastal Resources Commission for activities within AECs which are likely to pose little or no threat to the environment. Activities for which general permits have been issued include:

- construction of private piers, docks, and boathouses;
- construction and maintenance of boat ramps along the estuarine shoreline;
- maintenance dredging of channels, canals, boat basins, and ditches that does not involve the removal of more than 1,000 cubic yards of material.

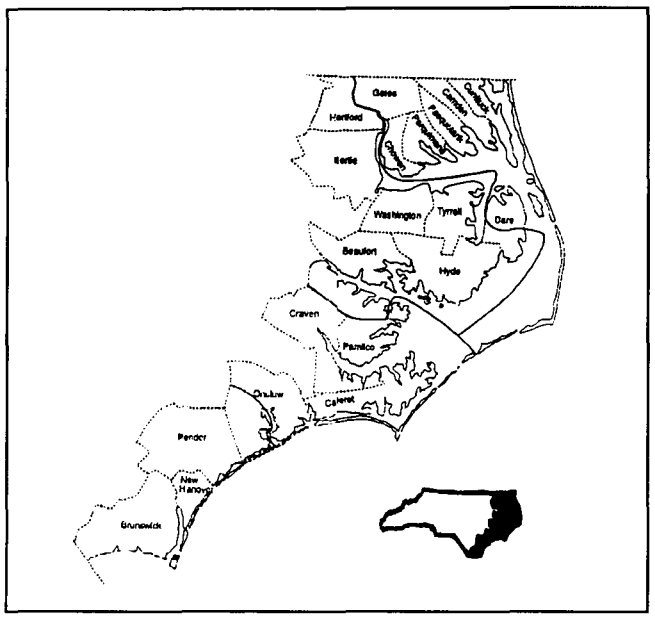

Figure 1. North Carolina's 20 coastal counties covered by the Coastal Area Management Act.

- moving sand from above the mean high water line on ocean beaches to create protective dunes.

A representative from the Division of Coastal Management determines whether a particular project qualifies for a general permit. Any project requiring a general permit must comply with a set of general and specific conditions for development. These include:

- no wetland alteration;
- no impacts on adjoining property; and
- no unreasonable interference with navigation.

Compliance with all local regulations and land use plans is also a requirement for a general permit. Any activity that is covered by a general permit issued by the Army Corps of Engineers under Section 404 of the Clean Water Act is also certified as being consistent with the North Carolina Coastal Management Program.

In addition to the permitting program described above, DCM also reviews CAMA-region projects requiring federal permits or authorization for consistency with the state Coastal Management Program. Under the U.S. Coastal Zone Management Act of 1972, federal agencies may not issue a permit for any project found to be inconsistent with the state's CAMA program. This includes projects requiring a Section 404 permit.

State Dredge and Fill Permit

The Dredge and Fill Act of 1969, as amended, requires a state dredge and fill permit for any project that involves filling or dredging in estuarine waters, tidelands, marshlands, or state-owned lakes. State dredge and fill permits are issued through the consolidated review process for applications for a CAMA major development permit. Unless the Corps of Engineers chooses to conduct a separate review, all projects which receive a state dredge and fill permit are automatically issued a Section 404 permit for the project. The State Dredge and Fill Act is administered through the Division of Coastal Management.

Title XIV: 1990 Food, Agriculture, Conservation and Trade Act (Swampbuster)

Title XIV of the 1990 Food, Agriculture, Conservation and Trade Act (the 1990 Farm Bill), extended 1985 Farm Bill legislation designed to discourage the conversion of wetlands for the purpose of agricultural production. Under these "Swampbuster" rules, after December 23, 1985, any producer who converts a wetland for the purpose of producing an agricultural commodity or to make possible the production of an agricultural commodity is not eligible to receive USDA farm-program benefits on any of the land being farmed.

A graduated payment reduction for first-time, unintentional violations ranging from $750 to $10,000 in lost USDA benefits is to be enforced for the first violation in a 10-year period. Disturbed wetlands must be restored to wetland status in order to regain eligibility for USDA program benefits. The Agricultural Stabilization and Conservation Service (ASCS) is responsible for administering the Swampbuster program. The USDA Soil Conservation Service (SCS) provides technical support in identifying wetlands.

Recent Developments

On August 24, 1993 the Clinton Administration announced a comprehensive package of initiatives designed to reform Federal wetlands policy.

The initiatives were developed by an Interagency Working Group on Federal Wetlands Policy. The group was chaired by the White House Office on Environmental Policy and included representatives from the EPA, the Army Corps of Engineers, the Office of Management and Budget, and the Departments of Agriculture, Commerce, Energy, Interior, Justice, and Transportation. In the process of developing the policy initiatives, a broad range of wetland stakeholders were allowed to present their views to the group. Among those offering evidence were a bipartisan group of eight members of the U.S. Congress, representatives of state and local governments, environmentalists, the development community, agricultural interests, scientists, and others.

The initiatives developed by the working group include regulatory reforms and non-regulatory policy approaches. Portions of the package involve immediate administrative actions. Other components of the initiative involve legislative recommendations for Congress to consider during the upcoming reauthorization of the Clean Water Act.

The reform package adopted by the working group includes the following initiatives:

- Within one year the Corps will establish an administrative appeals process for the Section 404 program. Applicants will be required to utilize the administrative appeals process prior to initiating judicial action.
- The Corps will establish deadlines for reaching permit decisions. The regulations will generally require the Corps to reach permit decisions within 90 days from the day of issuance of the public notice.
- Mitigation banking is supported in appropriate circumstances as a means of compensating for authorized wetland impacts. The initiative encourages Congress to endorse the use of wetland banking as a compensatory mitigation option under the Section 404 program.
- The Corps, EPA, SCS, and FWS will all use the same procedure to delineate wetlands. The agencies will revise the SCS Food Security Act Manual to eliminate inconsistencies between its wetland delineation procedures manual and those of the Corps of Engineers 1987 wetlands delineation manual.
- Wetland delineations conducted by the SCS will represent the final government position on the extent of Swampbuster and Clean Water Act jurisdiction on agricultural lands.
- The Corps of Engineers and EPA have issued a final rulemaking that solidifies the Corps' previous policy that activities occurring on wetlands converted to cropland on or before December 23, 1985 are not subject to Section 404 regulations.
- The USDA's Wetlands Reserve Program is promoted as a valuable tool for assisting farmers who wish to restore wetlands on their property. Congress is encouraged to provide future funding for this program.
- State and local governments should have an increased role in Federal wetland protection and restoration efforts. Congress is encouraged to include provisions in the Clean Water Act that will provide incentives to state and local governments to include wetlands protection in an overall watershed planning approach.

This package of reforms is designed to provide a comprehensive approach to Federal wetlands policy, while maintaining protection of wetland resources. The Clinton Administration plans to work closely with Congress to promote implementation of these initiatives. In addition, the Administration will establish an ongoing interagency working group, to be chaired by the Office on Environmental Policy, to monitor the implementation of these initiatives.

Summary

Wetland regulations can be complicated. This is only a brief discussion of the major regulations. Individuals considering activities that may impact wetlands should contact the appropriate agency (see next page) to determine which regulations, if any, may be applicable in a particular situation.

Section 404 Permit

Wilmington District Engineer
Corps of Engineers, Dept. of the Army
P.O. Box 1890
Wilmington, NC 28402-1890
(910) 251-4511

Water Quality Certification

Water Quality Planning
Division of Environmental Management
NC DEHNR
P.O. Box 29535
Raleigh, NC 27626-0535
(919) 733-5083

CAMA Development Permit and State Dredge and Fill Permit

Division of Coastal Management
NC DEHNR
P.O. Box 27687
225 N. McDowell St.
Raleigh, NC 27611-7687
(919) 733-2293

Title XIV: 1990 FACTA

(Swampbuster)
Agricultural Stabilization and Conservation Service (ASCS)
County Offices

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Acknowledgements

Thanks is expressed to the following reviewers of earlier drafts of this fact sheet: Ken Jolly, Raleigh Regulatory Field Office Manager, U.S. Army Corps of Engineers; Ron Ferrell, Environmental Specialist, DEHNR, Division of Environmental Management, Water Quality Section, Wetlands and Technical Review Group; and Dr. Frank Humenik, Department of Biological and Agricultural Engineering, NCSU.

Prepared by

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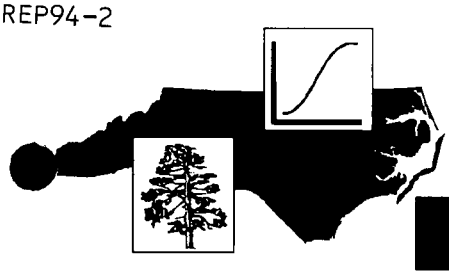
AREP94—3—July 1994



Resource Economics and Policy

Applied Resource Economics and Policy Group
Department of Agricultural & Resource Economics

Water Law in North Carolina

North Carolina is fortunate to have numerous and substantial water resources. In recent years, however, there has been increasing pressure on North Carolina's water supplies. Growing urban areas need large amounts of water, agricultural irrigation has increased, industrial development creates new demands, and there is strong demand for recreational uses of water. These often competing interests and the keen private and public interest in environmental protection have caused water law to become a topic of increased prominence. This paper surveys some of the major principles of water law in North Carolina.

I. Riparian Rights

Riparian rights are the rights of landowners to use water that is on or adjacent to their property. Landowners have riparian rights only if their land touches some body of water. There is no right to go over the property of others to take water, even if that intervening property is only a narrow strip such as a road or railroad. Landowners have rights in the groundwater underneath their property that are similar to surface water riparian rights.

Reasonable Use

The guiding principle of riparian rights in North Carolina (and most other eastern states) is "reasonable use." Owners of property adjacent to a natural body of water have the right to make reasonable use of the water. (Such property owners are referred to generally in this paper as "riparian owners" although the correct technical term for owners of property adjacent to ocean or estuarine waters is "littoral owners.") Similar reasonable use rights also apply to groundwater.

"Reasonable use" means that each riparian owner can take, use, and discharge surface water so long as that use does not excessively diminish the quality or quantity of the water that flows to other riparian owners. All of the riparian landowners have equal riparian rights, and no one owner can unreasonably interfere with the reasonable uses of the others. A riparian owner who uses so much

North Carolina
Cooperative Extension Service
NORTH CAROLINA STATE UNIVERSITY
COLLEGE OF AGRICULTURE & LIFE SCIENCES

water that it impairs the reasonable uses of the other owners or who pollutes the water can be sued by the adversely affected owners for damages and an injunction to stop the infringing use. All customary household uses are presumptively reasonable. Agricultural and industrial uses are only reasonable if they do not cause unreasonable adverse effects for other riparian owners.

The reasonable use doctrine as applied to groundwater allows a landowner to withdraw groundwater for any use on the property, including manufacturing uses and agricultural irrigation. The courts have applied the reasonable use rule more liberally to groundwater than to surface water, and any use of groundwater on the property is presumed reasonable. The groundwater user is only liable to affected neighbors (e.g. those whose wells go dry) if the water was wasted or used for some purpose off the property. A property owner who causes contamination of groundwater will be liable to affected neighbors in the same manner as a polluter of surface water who is liable to other riparian owners.

Most riparian use issues concern the effects on downstream owners. However, damage can also be done to upstream riparian owners by building a dam or otherwise obstructing the natural water flow so that flooding occurs on upstream land. In such cases, the upstream owner has a cause of action for trespass against the downstream owner.

If the body of water is man-made, a canal or reservoir for example, the customary riparian rights may not apply, and the uses by littoral owners can be limited. For instance, an owner of property on a lake formed by a hydro-electric dam or on a man-made canal may have no riparian right to withdraw water or build a dock. On the other hand, landowners who build ponds on their own property would continue to have riparian rights in that water.

Land Ownership Issues

Private and State Ownership

Questions often arise concerning the ownership of the submerged lands under rivers and lakes and the tidal lands of the oceans, sounds and estuaries. Under North Carolina law, all land under saltwater bodies, lands subject to the ebb and flow of the tide, and land under water that is subject to the influx of saltwater is owned by the State "in trust" for the public. Such lands cannot be privately owned, with the exception of certain limited grants and sales of these lands that the State has made in the past. The same rule of State ownership applies to lands underlying fresh water bodies that have an outlet to the ocean and would be potentially navigable by historical sea vessels.[1] In all of the above cases, private property boundaries extend only to the high water line or the mean high tide line of the water body.

When the State owns submerged lands, the owner of land adjacent to the water body still has riparian rights of access to and use of the water and bottoms (using water for irrigation or building a dock, for example). Those rights are limited, however, by the requirements of navigation and by the rights of the public to use the publicly-owned navigable waters and tidal lands. Other regulations also may apply, including the requirement to obtain a permit before building docks or piers in coastal waters.

Submerged lands that do not fall into the above categories, which would include most land under streams, smaller rivers, and lakes, can be privately owned. When a private property boundary is described in the deed as the course or "thread" of a stream, the property line is considered to run down the middle of the stream. The property line will shift as the stream slowly changes course. Gradual erosion from one side and gradual accretion on the other will respectively reduce and increase the amount of land held by the adjacent owners. If a flood or other unusual event causes a stream to change course suddenly and dramatically, the property boundary does not move and will be established at the center of the old stream bed.

[1]This test of navigability by historical sea vessels is not precise. Any disputes about title to submerged lands that turn on this issue of navigability must ultimately be resolved by the courts on a case-by-case basis.

Public Use Rights

Although riparian owners have certain rights to use water, they do not actually own the water itself. All surface and ground waters are legally "waters of the State." The water, plus the fish and other aquatic life belongs to the State. (There is an exception for fish in private ponds if the fish cannot escape to or enter from public fishing waters.) Even when all of the submerged land under a water body belongs to private owners, the State owns the water, although the riparian owners continue to enjoy their riparian rights. If the body of water that lies over privately owned submerged land can be navigated by any craft such as a canoe or a raft, then the public has a permanent right to use the water surface for all purposes of recreation and commerce, including fishing, whitewater canoeing, etc. It is not clearly settled whether the public's right to use such water bodies includes the right to wade on the privately owned stream bed for fishing or other recreation. When a stream is so small that it is no longer navigable by smaller craft such as a canoe, there is clearly no public right to wade, fish, or otherwise use or enter upon the stream. Similarly, there is no public use right for man-made ponds on private property.

On water bodies over submerged lands owned by the State (historically navigable waters and tidal waters) the public has a clear right to navigation, fishing, and other recreation on the water, as well as the right to use the foreshore — the area between the low and high water lines.

There is no public right to travel over private property to obtain access to streams, lakes, tidal areas or other waters that the public has a right to use. Likewise, the public cannot generally trespass on private property on the banks of a stream, river or lake. Under traditional riparian law, the public had no right to use the dry sand above the high tide mark on coastal beaches. By custom, however, the public has long been allowed to use the dry sand between the dunes and ocean in North Carolina and many other states. With increasing development and public use of beaches, conflicts have sometimes arisen when property owners have tried to exclude the public from the dry sand. In states other than North Carolina, the courts and legislatures have used various legal approaches to grant the public a formal right to use the dry sand portion of beaches when private property owners have sought to prevent such use. The issue has never been fully tested in North Carolina, but it is likely that the public does have a legal right to make reasonable use of the dry beach between the dunes and the ocean.

Water Runoff

Surface drainage (i.e. storm water runoff) creates water law issues. The laws of nature dictate that storm water will run downhill, and a property owner has no right to complain about natural runoff from property at a higher elevation. The higher landowner has the right to make reasonable use of the land, which may necessarily cause some changes in the runoff. If the higher landowner unreasonably diverts the flow of runoff, increases the flow, or contaminates the runoff in a way that causes material damage to the lower landowner, then the lower landowner can bring an action for an injunction and damages.

II. STATUTORY WATER LAW ISSUES

The above concepts of water law and riparian rights are mostly traditional legal doctrines. Like other property rights, riparian rights are not absolute and numerous federal, state and local statutes, regulations, and ordinances may limit or modify the rights. For instance, some regulations restrict high capacity uses of surface and ground water. Most importantly, there are numerous regulations

designed to control or prevent water pollution. A detailed summary of all laws relating to water use and water quality is beyond the scope of this paper. A general overview of the applicable laws is set forth below.

Surface Water Pollution

Point Sources

"Point sources" of water pollution generally are clearly established points of wastewater discharge into the surface waters. The most common point sources are the outfalls from industrial plants and from public wastewater treatment facilities. The federal Clean Water Act requires that all point source dischargers obtain permits. North Carolina has authority delegated from the EPA to administer the state's permit program. The permits establish the levels of contaminants that the point source is allowed to discharge. What is permissible depends upon numerous factors. Relatively strict limits are placed on certain toxic substances based upon the best available technology for eliminating those contaminants. Somewhat less stringent technology-based discharge limits are placed on other contaminants. Permit requirements can be further tightened depending upon the classification of appropriate uses for the receiving water body and its ambient quality.

Nonpoint Sources

"Nonpoint sources" are all of the man-made sources of water contamination that are not point sources. These nonpoint sources are widely diverse and often difficult to identify as specific sources of water quality problems. They include, among others, storm water runoff from roads and urban areas, soil erosion from development, logging and agricultural activities, leaks or overflows from private septic systems, irrigation backflows, and pesticide and fertilizer runoff from agricultural and domestic uses and other uses like golf courses.

Nonpoint sources are mostly small and dispersed and, therefore, are more difficult to regulate than point sources. The control of nonpoint sources, however, may be the most cost-effective means for further improving water quality. There are now a few mandatory regulations and more numerous voluntary programs aimed at controlling nonpoint sources. Additional regulation of nonpoint sources can be expected, and agriculture will be one focus for future nonpoint source control programs.

Contamination of surface waters by sediment is currently regulated primarily by the Sedimentation Pollution Control Act which requires approved erosion control plans for any land-disturbing activities that will uncover more than one acre. Timber production and harvest activities are exempt if they are conducted using established best management practices. Agricultural production also is exempt from this law, but the prevention of agricultural erosion and runoff through the adoption of best management practices is encouraged by the Agricultural Cost Share program, the U.S. Soil Conservation Service, and other state and federal programs and agencies.

In late 1992, North Carolina adopted new regulations intended to prevent livestock wastes from entering surface waters. Under the regulations, any operation confining 100 head of cattle, 75 horses, 250 swine, 1000 sheep, etc. must file and implement a certified animal waste management plan. The plans require buffer strips, proper land application of wastes, and other best management practices to protect water quality.

Special attention has been focused on nonpoint sources in watersheds that supply public drinking water. North Carolina law requires local governments to adopt ordinances limiting the density of development and/or requiring engineered storm water controls in water supply watersheds. The law also places additional restrictions on agricultural practices, point source discharges and other activities in these watersheds.

Groundwater Pollution

Over half of North Carolina's population obtains its drinking water from groundwater. One of the main sources of groundwater contamination

is leaking underground storage tanks (USTs). New and existing commercial USTs must be registered, include devices both to prevent and detect leaks, and comply with substantial testing and reporting regulations. Tanks for home heating oil and farm fuel and heating oil tanks under 1100 gallons are not regulated as commercial tanks. If any UST has leaked, even a non-commercial tank, then the owner is responsible for removing or repairing the tank and cleaning up the contamination.

North Carolina has established public trust funds to help owners pay for the cleanup of leaks. For non-commercial tanks, the state may pay for the full cost of environmental cleanup, but not the actual removal of the tank.

Wells are often the conduit for contaminants to reach the groundwater. For example, chemicals or other contaminants that are stored or mixed near a wellhead are far more likely to travel down the well pipe than to leach through the soil to the groundwater. The State regulates well drillers and requires drillers to register all new wells. The State also has established technical standards for the construction of wells. Local governments are now being encouraged to adopt wellhead protection ordinances that would take further steps to insure that wells are protected from potential sources of groundwater contamination. North Carolina also prohibits the disposal of wastes through injection wells.

Numerous other environmental regulations that are not directly focused on water quality are nevertheless intended to prevent water contamination and other environmental problems. For example, regulations concerning the disposal of solid waste and hazardous waste are intended in substantial part to prevent leaking of waste contaminants to groundwater.

Wetlands Regulations

Environmental regulation of wetlands has been controversial. In the past 30 years, the perception of wetlands has changed from that of useless areas to be drained and filled to that of critical ecological resources which are valuable in their own right and deserving of preservation. This relatively rapid change has disrupted the expectations of private property owners. In addition, many wetlands occur in coastal areas where development pressures have been strong. The controversy is fueled further by the regulatory difficulty of defining and determining the boundaries of wetlands.

The U.S. Army Corps of Engineers is the federal agency with primary responsibility for regulating wetlands, although the EPA, Soil Conservation Service, U.S. Fish & Wildlife Service, and the individual states have their own roles and some veto power over Corps decisions. The federal definition of "wetland" uses criteria that focus on the types of vegetation and soils and the level of the water table. It is clear that a wetland can be much more than a marsh or swamp. Land that is saturated with water for as little as seven days during the growing season may be classified as a wetland if it supports vegetation typically associated with saturated soils or otherwise performs the functions characteristic of wetlands.

The Clean Water Act requires permits for the filling or dredging of wetlands. Filling and dredging have been interpreted broadly to include virtually any soil-disturbing activity in a wetland. The Corps of Engineers is the permitting authority. It has issued some blanket permits for small activities deemed not to have substantial potential for harm to water quality. Normal farming and forestry activities do not require permits, but this exemption does not extend to activities designed to drain or convert a wetland to a different use. There is substantial debate and litigation over what activities are "normal" and therefore exempt from permitting. The 1985 Farm Bill included the "Swampbuster" provision that limits or denies federal agricultural benefits to anyone damaging a wetland for agricultural production.

The procedures for regulating wetlands may be streamlined somewhat with the reauthorization of

the Clean Water Act and passage of a new farm bill by Congress in 1994 and 1995. Although the final form of any legislation is unpredictable, it is unlikely that the substance of wetlands regulations will change dramatically.

In addition to federal regulation, most states, including North Carolina, either have or are developing their own regulatory programs for wetlands. North Carolina has some wetlands statutes in place and is developing a program to classify wetlands. The classification system is intended to ensure against water degradation through the State's review and approval or denial of Corps of Engineers permits.

Limits on Water Use

Any withdrawal of 1,000,000 gallons per day (gpd) or more of surface or ground water requires registration with the North Carolina Environmental Management Commission (EMC). The same registration requirement applies for any transfer of 1,000,000 gpd from one river basin to another. The North Carolina General Assembly also has recently adopted a policy against substantial new interbasin water transfers. For use of groundwater, the construction of a well or well system with a design capacity of 100,000 gpd or greater requires an EMC permit.

The EMC has the authority to designate "capacity use areas" in locations where it appears that surface water or groundwater is or may be overused. In capacity use areas, permits are required for users of more than 100,000 gallons of water per day and other use restrictions may apply. There is currently only one designated capacity use area in North Carolina. It is located primarily in Beaufort County near the coast in the vicinity of the Texasgulf, Inc. phosphate mining facility, which has been a large user of groundwater.

III. Conclusion

This paper is intended to provide an overview of water law in North Carolina and to make individuals aware of legal issues that may affect them. It is not a comprehensive statement of the law, and it is not a substitute for the advice of an attorney. Anyone with questions or concerns about specific legal issues or involved in a legal dispute should consult an attorney. Questions about water quality regulations may also be directed to any regional office of the North Carolina Division of Environmental Management.

Thanks is expressed to Walter Clark, Ocean and Coastal Law Specialist, UNC Sea Grant Program, who reviewed an earlier draft of this fact sheet.

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AREP94—2—July 1994

Resource Economics and Policy

Applied Resource Economics and Policy Group
Department of Agricultural & Resource Economics

The Tar-Pamlico River Basin Nutrient Trading Program

Introduction

In 1989, the Environmental Management Commission (EMC) classified the Tar-Pamlico River Basin as Nutrient Sensitive Waters (NSW). This classification was prompted by excessive sediment and nutrient loadings which cause algal blooms and low dissolved oxygen. The eutrophication problem and outbreaks of fish disease threatened the Pamlico River estuary's valuable fisheries.

When a body of water is designated as NSW, the North Carolina Division of Environmental Management (DEM) must develop and implement a special nutrient management strategy — called a NSW Implementation Strategy. Historically, regulators have developed nutrient management strategies that place more stringent limitations on point source discharges of nutrients, usually total nitrogen and total phosphorous, and increase funding for agricultural best management practices (BMPs) which control nonpoint source pollution. Point source pollutants are those that can be traced to a precise source such as a pipe. Nonpoint source pollution comes from diffuse sources such as urban and agricultural runoff, and thus it is difficult to trace such pollutants to a precise source.

The Tar-Pamlico NSW Implementation Strategy sets up a nutrient trading program that is unique in North Carolina. The trading program sets basin-wide goals on nutrient load reductions for point source discharge but gives dischargers the flexibility to invest in the most cost-effective controls. For example, a municipal wastewater treatment plant could help fund grassed waterways on croplands instead of installing expensive, high-tech controls at the plant.

The Tar-Pamlico River Basin

The Tar-Pamlico River Basin has a drainage area of 4,498 square miles in 17 counties in the eastern North Carolina Piedmont, and inner and outer Coastal Plain regions (see Figure 1). It is the fourth largest river basin in the state. It contains 2,308 miles of freshwater streams and 148 active permitted surface water (fresh and salt water) dischargers. Seven dischargers are major municipals, twelve are minor municipals, two are major industrial, and 127 are nonmunicipal. Eighteen of these dischargers are categorized as major

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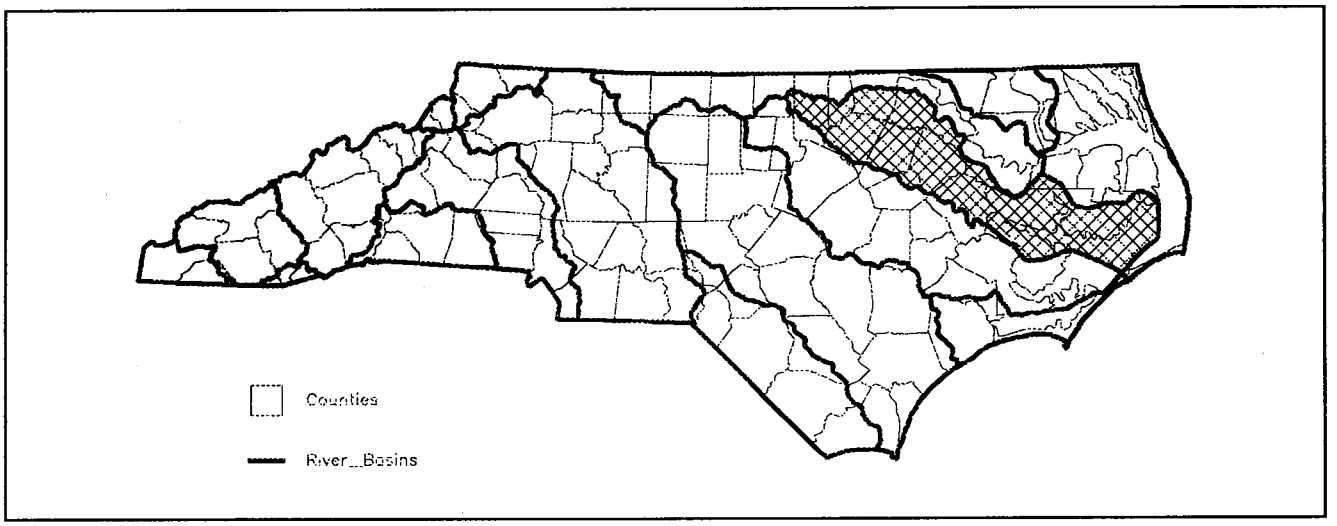


Figure 1. The shaded area is the Tar-Pamlico River Basin

dischargers (with a flow greater than 0.5 million gallons per day). Most of the major dischargers are publicly owned treatment works. The river basin also contains 634,400 acres of salt water.
Three major sources of nitrogen and phosphorous loadings in the Tar-Pamlico system are (1) nonpoint source runoff from farming and forestry operations, (2) nonpoint runoff from urban areas, and (3) point source dischargers, including a large phosphate mining operation near the terminus of the Pamlico River.

Sources of Nitrogen(N) and Phosphorus (P) in the Tar-Pamlico System

Source	Est. % N	Est.% P
Point Sources	28	8
Agriculture and Livestock	44	44
Forestry	5	9
Urban Areas	3	2
Wetlands	2	4
Water (atmos-pheric deposition	32	17

The Concept of Pollution Trading

The Tar-Pamlico nutrient trading strategy is similar to other pollution trading programs that have been the focus of increased attention over the past few years. Trading programs seek to achieve environmental goals in the most cost-effective manner possible through the use of market forces. In essence, a regulator sets a ceiling on the amount of pollution allowed for a whole group of polluters within a "bubble" and issues permits to individual polluters within that bubble for their share of the total amount. Polluters can then buy or sell pollution discharge allocations so that those who can clean up cheaply can do so and then make money by selling spare pollution credits to those for whom cleaning up would be more expensive.

By allowing polluters to buy or sell pollution allocations among themselves, the program lets market forces produce a cost-effective outcome. The most cost-effective methods of control, whether point or nonpoint, will be used to reduce pollution, resulting in a lower total cost for pollution control. Trading programs take advantage of the differences in pollution control costs between various polluters and provide incentives for some polluters to "overcontrol" their discharges or emissions through the ability to sell their extra pollution allocation.

Point/nonpoint source trading is this bubble concept applied to watershed management. The "bubble" in this case is the river basin, and point/nonpoint source trading has come to mean granting publicly owned treatment works and industrial point sources the option of bringing agricultural and urban nonpoint sources under control rather than simply requiring further controls at point sources. The regulator continues to focus on the more easily identified and managed point sources, but allows them more flexibility to pursue lower cost control options.

The Tar-Pamlico NSW Implementation Strategy

Background to the Strategy

In 1988, the Pamlico-Tar River Foundation, a citizens group based in Washington, NC, petitioned the EMC to classify the Tar-Pamlico River Basin as NSW. In response to this petition, the Division of Environmental Management (DEM) developed a set of recommendations. These recommendations were the subject of a public comment and hearing process conducted by the EMC during the summer of 1989. The recommendations of DEM proved unsatisfactory to several environmental groups such as the North Carolina Environmental Defense Fund and the Pamlico-Tar River Foundation. The recommendations were criticized for including neither a specific numeric nutrient reduction target nor a goal of reducing nutrient pollution from point sources. DEM had recommended a policy of no increases in point source loadings. Also, a more aggressive, targeted approach to nonpoint source pollution was called for.

Point source dischargers who had plans to expand their facilities by 1995 were alarmed by the projected costs of complying with the proposed numerical effluent limitations. They argued that meeting the proposed effluent limits on total nitrogen and total phosphorous would cause serious economic hardship to the public served by these dischargers because some facilities do not have the capability to remove nitrogen and phosphorous from their discharges and would face expensive upgrades. The dischargers also pointed out that the proposed strategy seemed to affect point source dischargers much more than nonpoint source dischargers when nonpoint source loadings are more significant contributors to the nutrient problem. Dischargers also argued that a long-term nutrient strategy for the basin required a more complete understanding of the relationship between nutrient loadings and estuarine water quality. In light of these criticisms, DEM agreed to consider an alternative plan for nutrient reduction in the Tar-Pamlico River Basin proposed by the environmentalists and dischargers.

The EMC approved the alternative nutrient trading option plan in December, 1989. Given the short time span over which the new strategy was developed and the many complex issues involved, the parties soon identified a number of details of the plan that required further attention. Negotiations over the next two years produced a revised strategy approved by the EMC in February, 1992.

Administrative Details

The Tar-Pamlico NSW Implementation Strategy is comprised of two phases: Phase I, 1990 to 1994, and Phase II, post 1994. As part of the nutrient management strategy, a coalition of dischargers called the Tar-Pamlico Basin Association (the Association) agreed to fund the creation of an estuarine computer model that would facilitate the development of a long-term nutrient reduction strategy for the basin. The Association allocated approximately $400,000 toward this project. Upon completion of the computer model, but in any case no later than mid-1994, the parties to the approved management strategy (DEM, Environmental Defense Fund, Pamlico-Tar River Foundation, and the Association) will begin development of Phase II of the NSW Implementation Strategy. The purpose of the estuarine computer model is to better define the relationship between nutrient loadings and estuarine water quality.

Results of the model will be used to develop refined nutrient reductions for Phase II of the strategy.

The Association has thirteen members. Twelve are publicly owned treatment works (municipal dischargers) and one is an industry. No new members can be added to the Association during Phase I. Association membership may be reopened in Phase II to include other parties.

Given the projected 1994 flows for Association members and assuming no nutrient reduction from pre-strategy concentrations, it was estimated that by the end of 1994 the Association's annual total phosphorus and total nitrogen nutrient loading would reach approximately 625,000 kg/yr. The nutrient reduction targets called for a reduction of 180,000 kg/yr total nitrogen and 20,000 kg/yr total phosphorous in Association loadings from the levels that would result if flow increased as projected and no new nutrient controls were required. The total nutrient reduction of 200,000 kg/yr is to be achieved by a series of stepped down annual nutrient loading limits for the Association. Association loadings for 1991 were reduced by 100,000 kg/yr and reduced 25,000 kg/yr for the following four years. The nutrient reduction trading program allows a discharger to treat its effluent to meet the nutrient reduction goals or trade to remove an equivalent amount of nutrients from agricultural runoff through the NC Agricultural Cost Share Program (NCACSP).

The NCACSP is administered through the Division of Soil and Water Conservation (DSWC), located within the NC Department of Environment, Health, and Natural Resources. The Association agreed to contribute a one-time payment of $150,000 to fund additional DSWC personnel to assist in BMP review and identification. These funds were to design and establish the nutrient-reduction trading system, including targeting and documenting existing BMPs and similar activities in the basin.

In order to establish a point/nonpoint trading system, an appropriate trading ratio must be determined. The trading ratio is the amount of nonpoint source control that a point source discharger must undertake to create a credit for a given unit of point source discharge. Under the Tar-Pamlico strategy, an Association member pays $56 per kg of excess nutrient discharges to the nonpoint source control fund administered by the NCACSP. This figure is based on the average nonpoint source control costs in a neighboring watershed which had sufficient cost and nutrient reduction data and includes a safety factor of 3:1 for cropland BMPs and 2:1 for confined animal operations. The safety factors are included to account for the fact that nonpoint source loadings are less predictable over time and space because they result from storms and thus are more random than point source loadings and are less reliably controlled than point source controls. All BMP credits have a useful life of ten years unless cost share program contracts with the nonpoint sources provide for a longer period. If the nutrient reduction goal for the Association were met entirely through the funding of agricultural BMPs, it was estimated that $11.2 million would be needed for nonpoint source improvements (200,000 kg × $56 per kg = $11.2 million).

In order to ensure the availability of funds for the agricultural BMP implementation necessary to test the viability of point/nonpoint trading, the Association agreed to make a yearly minimum payment to the NCACSP. The total minimum payment during Phase I (1990-1994) is $500,000. Of this amount, $350,000 is currently being allocated in the Chicod Creek Watershed for agricultural NPS controls.

As part of the agreement, the Association conducted an engineering evaluation of its existing wastewater treatment plants. The evaluations were necessary to optimize pollutant removal capabilities by point source dischargers. The evaluations were completed in 1991 and the facilities took steps to implement operational and minor capital improvements recommended by the consultants. As a result of such improvements, the Association was

about 13 percent below its allocation for 1991 and 15 percent below in 1992. Despite increasing discharge volume, the Association is expected to meet the declining nutrient targets in 1993 and 1994. To date, no point/nonpoint trades have occurred.

If a localized water quality problem arises, DEM may require individual point sources to remove nutrients. Also, if a discharger agrees to bring nutrient removal facilities into operation and the Association receives credit toward its allowable annual nutrient loading, but the facility does not meet its projected nutrient removal level, the DEM may add nutrient limits to the facility's discharge permit. The Association must then pay for the projected pollution credits plus a penalty charge of 10 percent.

Existing non-Association dischargers that reach a rate higher than 0.5 million gallons per day will receive stringent effluent permit limitations. Less stringent permit limitations may be obtained if offset by nutrient-reduction trading at a rate of $62/kg/yr. All new dischargers will be subject to the stringent nutrient limits and will not be able to participate in the nutrient trading program. If the terms of the agreement are violated, all existing dischargers (Association and non-Association dischargers) must meet the stringent nutrient limits.

Conclusion

The use of market forces to protect the environment has been championed by economists for the past 25 years. Only recently, however, has the broader policy community begun to regard market instruments favorably. The Tar-Pamlico NSW Implementation Plan has become the focus of increased attention because it represents one of the few attempts to apply market forces to the problem of water pollution. The nutrient trading program has also generated attention because it incorporates a basinwide management approach to water quality control by implementing a nutrient reduction strategy that accounts for both point and nonpoint sources of pollution for the entire watershed. Since nutrient control opportunities are assessed on a basinwide basis, BMP funds are targeted to the most serious nonpoint problems (rather than being allocated on an ad hoc basis), and installation and performance are tracked. By combining the benefits of a basinwide approach to pollution control with market-based incentives which drive down total program costs, point/nonpoint nutrient trading programs have the potential to make the development and attainment of water quality goals a reality.

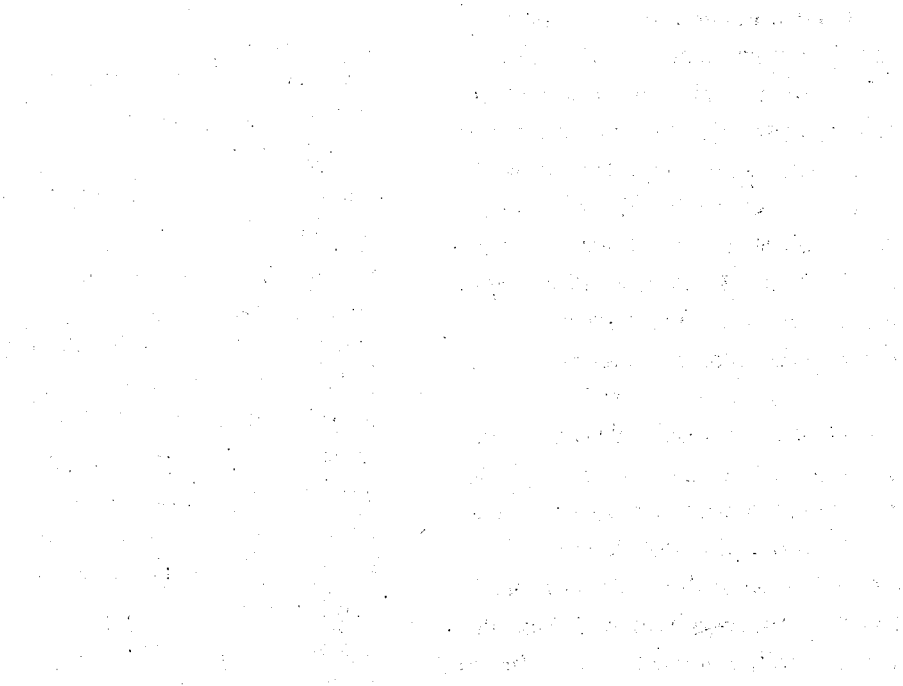
List of Resources

Dodd, R.C. and G. McMahon. *Watershed Planning in the A/P Study Area-Phase I: Annual Average Nutrient Budgets.* Research Triangle Institute. RTP, NC. 1992.

Pamlico-Tar River Foundation Bulletin. Vol. 11, No. 3, Spring 1992. Washington, NC.

The Tar-Pamlico River Basin Nutrient Sensitive Water Designation and Nutrient Management Strategy. Report 89-07. DEHNR-DEM-Water Quality Section. Raleigh. April 1989.

Tar-Pamlico NSW Implementation Strategy. Adopted by the Environmental Management Commission on December 14, 1989; revised February 13, 1992. Raleigh.



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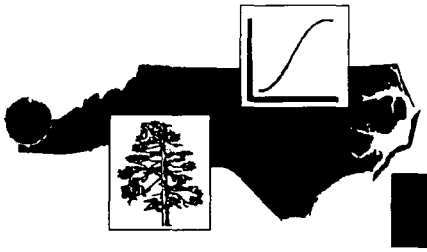

Resource Economics and Policy

Applied Resource Economics and Policy Group
Department of Agricultural & Resource Economics

Evaluating County Policy Alternatives to Meet Air Quality Standards: A Case Study

Under terms of the 1970 federal Clean Air Act, the U.S. Environmental Protection Agency (EPA) sets standards for various air pollutants. In 1990 amendments to the Clean Air Act set a timetable for attaining air quality standards. Ozone, a pollutant which develops from the interaction of sunlight and emissions from vehicles and industry, is one of the pollutants regulated by the Clean Air Act.

Air Quality Standards

In 1991, seven counties in North Carolina failed to meet the EPA standards for ozone. Gaston and Mecklenburg Counties were among these "nonattainment" areas. The amount of ozone pollution found in the air on hot, sunny days exceeded national ambient air quality standards. The EPA now classifies the Gaston-Mecklenburg Metropolitan Area as a "moderate" ozone nonattainment area. Under this classification, both counties have until 1996 to reduce emissions of volatile organic compounds (VOCs) — important ingredients in the formation of ozone -- to 85 percent of 1990 levels.

Emissions of VOCs can be reduced by regulating vehicle emissions, gasoline filling stations, industrial processes, and various other activities. The following actions to reduce ozone levels are required by federal and state law in nonattainment areas:

- initiate a vehicle emission inspection program to reduce pollutants from automobiles;
- install vapor controls at gasoline filling stations and storage tank facilities;
- alter some industrial processes or facilities;
- offset any increases in VOC emissions from any new or expanding industries in the county by reductions in emissions from existing sources.

If target ozone levels are not reached by 1996, stricter regulatory measures will be imposed. More businesses and industries would be subject to regulatory requirements, stricter and more expensive vehicle emission inspections would be required, and greater VOC offsets would be required

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to allow industrial growth. Under extreme circumstances, transportation control measures such as roadway alterations and trip reduction ordinances would have to be carried out. Implementing such stringent additional requirements would be financially burdensome for both the private and public sectors.

The Gaston County Policy Evaluation Process

In 1991, when Gaston County was classified as a non-attainment area, the Quality of Natural Resources Commission (QNRC)had been operating for three years. This broad-based citizens group recommends to the Board of County Commissioners policies, procedures, regulations and changes in laws to protect the environment.

Faced with the need to achieve at least a 15-percent reduction in ozone levels within four years, the QNRC saw the need to respond quickly to ensure that an effective program was put into place. Its Air Quality, Education/Policy, and Executive Committees met regularly from May to October 1992 to identify and evaluate policy alternatives for reducing air pollution in Gaston County. Generally, the steps followed were:

1. reach a consensus on the issues to be addressed;
2. set goals and objectives;
3. formulate program guidelines; and
4. identify and evaluate policy alternatives.

Throughout the process, committee members sought information regarding the Clean Air Act, implementation of local air pollution programs, potential fee revenues generated by a local program, and other topics, from the North Carolina Cooperative Extension Service and the North Carolina Division of Environmental Management.

The QNRC Air Quality Committee investigated the program that the North Carolina Division of Environmental Management currently has in place to control air pollution emissions in the county. The committee also investigated Mecklenburg County's program, one of three local programs in the state that administers state air quality statutes by reference in a local ordinance.

Defining the Problem

Reaching consensus on the air quality issues to be addressed was the first step in a process designed to guide QNRC members toward specific policy recommendations. Issue identification is a fundamental step: solutions cannot be reached if people cannot agree on the problem.

The QNRC initially developed a list of nine issues related to air pollution control. It was the consensus of the group that the primary issue was to identify and evaluate alternatives for administering the provisions of the 1990 Clean Air Act Amendments in Gaston County. All issues were restated as goals or guidelines to provide policy direction and emphasis.

Goals are broadly defined targets for policy action. Guidelines add further direction to the policy program by providing boundaries within which future policies will be centered. By defining policy goals and guidelines, committee members were able to reach agreement on the overall direction of the air quality program. Once the policy alternatives were identified, they could be evaluated in reference to these goals and guidelines.

Setting Priorities

Ranking the goals and guidelines provided another method for evaluating policy alternatives. A policy alternative that seems likely to achieve high priority goals and remain consistent with high priority guidelines should receive greater consideration for policy recommendation. The goals and guidelines and their rankings are listed in Table 1.

Table 1. Policy Alternatives in Relation to Air Quality Goals (G) and Guidelines (g)

Rank	Goal or Guideline	S	L	R
1	Improve air quality in Gaston County (G)	—	O	O
2	Protect air quality while minimizing economic impact to the community (g)	—	+	—
3	Increase public awareness through education on air quality issues (G)	—	+	O
4	Maintain local flexibility in implementing Clean Air Act regulations (g)	—	+	O
4	Speed up the permit application process (G)	—	+	+
5	Minimize program costs in reducing air emissions (g)	+	—	O
5	Develop local expertise in interpreting and administering regulatory provisions (G)	—	+	O
6	Keep air pollution control permit fee revenues in the county (G)	—	+	—
7	Provide incentives to reduce emission levels (g)	—	+	O
8	Maintain local control of air pollution permitting (G)	—	+	O
9	Achieve a single-point interpretation of air pollution control regulations (G)	—	+	O
10	Provide incentives to stimulate growth while reducing emissions	Not ranked		
11	Exceed emission reduction requirements specified in the Clean Air Act (G)	—	+	—
11	Reduce exposure to civil liability (g)	+	—	—

Alternative S = State Program
Alternative L = Local Program
Alternative R = Regional Program

Scale	
+	Good
O	Fair
—	Poor

Reaching a consensus on the rankings was important since the potential to achieve goals and meet guidelines was one of the criteria used in evaluating policy alternatives. The first attempt to rank issues provided no clear indication of their relative importance to the committee members. A second ranking was made after committee members spent several weeks becoming better informed

about air pollution. Still, clear consensus was reached only on the top three priorities. Rankings for the remaining 11 were rather evenly distributed, resulting in several equal rankings and making it difficult to discern priorities. In light of this, the policy alternatives identified through the next step were evaluated with respect to the top three goals and guidelines only.

Three Policy Alternatives

Air pollution control programs depend on a permit process. A facility that emits sufficient quantities of one or more regulated pollutants must obtain a permit to operate. This allows the permitting authority to monitor facility emissions against a set of maximum emission standards, enforce standards, and assess and collect fees.

When faced with a mandate to reduce air pollution levels, the QNRC discovered that counties have three choices:

A State Alternative. Continue to have the state Division of Environmental Management implement control programs in the county and administer the permit program. This does not preclude the county from adopting other local measures to enhance the potential of meeting the 1996 deadline.

A Local Alternative. Establish, by local ordinance, a county air pollution control program. The county assumes permitting, monitoring, inspection, and enforcement authority from the state through adopting by reference the state air pollution control requirements.

A Regional Alternative. Where appropriate, participate in or develop regional air pollution control programs. This would involve establishing a regional air pollution control board with proportional representation based on the population of each participating jurisdiction. The regional board would develop and administer a local air pollution control program through adopting by reference state standards as described above.

Each of these policy alternatives was evaluated for its potential to meet the three top priority goals and guidelines (Table 1). The values of the three-point scale (+, O, —) are relative. In other words, the alternatives were evaluated on how well each achieved a particular criterion *in relation* to the others. As shown in Table 1, it was felt that a Local program could better achieve the goals and guidelines than either of the other two alternatives, i.e., this alternative scored more pluses (+) than did the other two. The Regional program ranked second, and the State program ranked third. Focusing on the top three issues and applying numeric values to the +, O, — scale and the goal/guideline rankings, a numeric goal-achievement score was calculated for each alternative. Using only the top three issues on which committee members had reached consensus, the following goal-achievement scores were calculated:

Figure 1. Goal Achievement

Alternative	Score
State Program	0
Local Program	9
Regional Program	4

When considering potential to achieve the top three goals/guidelines, the local program alternative again ranked highest followed by the regional and state program alternatives in that order.

The policy alternatives were also evaluated based on their potential to meet several operational criteria. These rankings were determined by a vote of the committee members. Table 2 shows the other criteria that committee members felt were important in evaluating the alternatives.

Since these criteria were not ranked as were the goal/guideline criteria, a criteria-achievement

score was not calculated. This does not imply that these criteria were considered of lesser importance. In fact, committee members placed a high priority on the criterion, "Maintain local autonomy." This criterion refers to the ability of Gaston County policy makers to influence decisions regarding air quality control in the county. Committee members felt that a local program would provide the greatest amount of local autonomy. With regard to the state alternative, the committee believed that state agency staff and decision makers would be indifferent to Gaston County and would treat Gaston County businesses and industries no differently than those in other locations. Local autonomy was considered to be weakest with the regional program alternative. Because statutory requirements set per capita representation on regional authorities, a Gaston-Mecklenburg regional authority of seven members would contain five members representing Mecklenburg County and two representing Gaston County. A firm conviction of the committee members was that such a representational structure would leave Gaston County with little influence over local decisions regarding air pollution control.

Table 2. Policy Alternatives in Relation to External Criteria

External Criteria	S	L	R
Maintain local autonomy	o	+	—
Maintain single point of contact	—	+	o
Speed up permit process	—	+	+
Improve response rate	—	+	o
Improve compliance through local familiarity	—	+	o
Negotiate new source trade-offs	—	+	o

S = State, L = Local, R = Regional Program

Scale: + Good, o Fair, — Poor

Guided by the goal/guideline comparisons shown in Table 1, and the external criteria comparisons shown in Table 2, the committee members voted for their first, second and third choices among the policy alternatives. Voting results are shown in Table 3.

The first choice of the committee members was to recommend that the county adopt and implement a local air pollution control program. The second preference was to maintain the state pollution control program. No consensus was reached on the third preference. Even though the goal/guideline comparison indicated that the regional program alternative might have more potential to achieve the high priority goals and guidelines, the local autonomy criterion carried significant weight. As a result, the regional program was the least preferred alternative.

Table 3. Votes by Preference Alternative

	Preference Choices		
	1st	2nd	3rd
State Program	2	9	6
Local Program	11	1	4
Regional Program	2	5	5

From Process to Policy

In the final stages of its decision-making process, the QNRC held a series of seminars and a community round-table discussion with business leaders and local officials to gain some feedback on the decision to recommend a local air pollution control program. Based on these discussions, and negotiations with state and federal authorities, a program was to be drafted and a final recommendation made. As of this time, the program details were still under debate.

By following a deliberate and well-defined process, the QNRC reached the decision to recommend that the county develop and administer a local air pollution control program. QNRC members identified the goals that any air pollution control program — whether local, regional, or state — should meet, specified program guidelines, and used those and other criteria to evaluate the policy alternatives available to them. A decision as important as that of embarking on a local air pollution control program is likely to be controversial. However, as the decision reaches the political arena, the QNRC will be better prepared to defend its choice of policy alternatives.

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AREP93—3—October 1993

Resource Economics and Policy

Applied Resource Economics and Policy Group
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Protecting Local Groundwater Resources

Many North Carolina communities rely on groundwater for public water supplies for large municipal systems, as well as community systems serving small subdivisions, mobile home parks, schools, and churches. This makes protecting groundwater an important local issue.

The foundation of a groundwater protection program is the delineation of protection areas surrounding public water supply wells where groundwater recharge will likely become the source of drinking water. Within these protected areas, good management can reduce the threat of contaminants entering the well recharge areas and polluting public water supplies.

Planning for Protection

Protection of groundwater resources requires good planning and concerted effort. Because groundwater contamination is often irreversible, taking steps to protect groundwater by preventing contamination is usually more effective and less costly than remediation.

Planning for groundwater protection occurs in response to threats to the groundwater

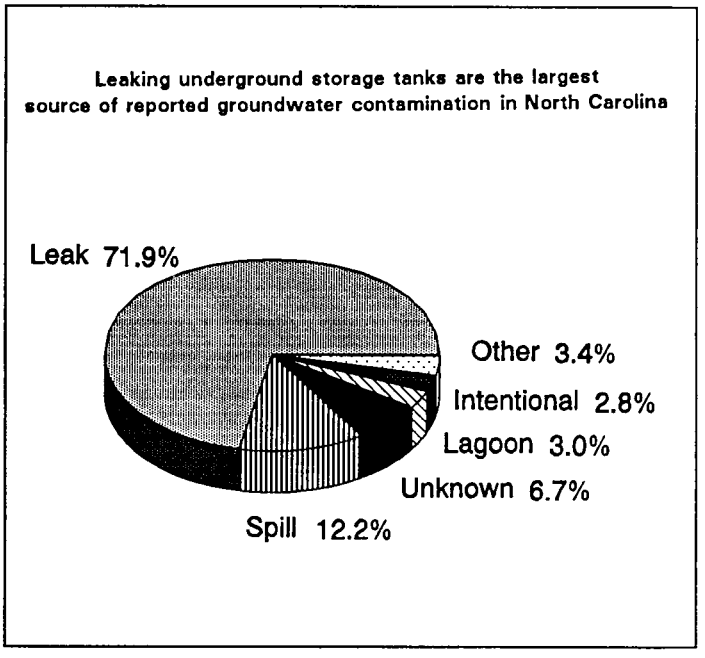

Figure 1. Sources of Groundwater Contamination in North Carolina.

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resource. The greatest threats to groundwater resources are created by human activity. Groundwater resources can be disrupted by contamination and by altering groundwater levels.

Contamination

Common contaminants consist of bacteria, minerals, and inorganic or organic chemicals that are present in the aquifer or introduced to it at the ground surface. Landfills, waste lagoons, and leaking underground storage tanks are the most common sources of contamination from industrial sources. The use of farm fertilizers, pesticides, and animal-waste lagoons can cause local contamination of shallow aquifers. Septic disposal systems, and improper storage, use or disposal of household and lawn chemicals are the most common contamination sources from domestic land uses.

Altered Groundwater Levels

Water quantity problems can stem from reduced groundwater levels as well as artificially increased levels. Reduced recharge occurs when water that would otherwise filter into the aquifer is diverted to surface water bodies or taken out of the groundwater recharge basin. One of the most significant causes of recharge problems is the increase in impermeable surfaces, such as build-

Sources of Hydrogeologic Data

Information concerning general aquifer characteristics can be found in the following publications and maps:

Basic Elements of Ground-Water Hydrology with Reference to Conditions in North Carolina. Ralph C. Heath. 1980. USGS Water Resources Investigations Open File Report 80-44.

Ground Water of the Piedmont and Blue Ridge Provinces in the Southeastern United States. H. E. LeGrand. 1967. USGS Circular 538.

Groundwater Resources of the Southern Pines Area; A Supplement to the Sandhills Capacity Use Study. 1980. NC Office of Water Resources.

Hydrologic Framework of the North Carolina Coastal Plain Aquifer System. M. D. Winner, Jr. and R. W. Coble. 1989. USGS Open File Report 87-690.

Hydrogeologic Unit Map of the Piedmont and Blue Ridge of North Carolina. Charles C. Daniel, III and Robert A. Payne. 1990. USGS Water Resources Investigations Report 90-4035.

Water Resources of Northeast North Carolina. H. B. Wilder, T. M. Robison, and K. L. Lindskov. 1978. USGS Water Resources Investigations Report 77-81.

Simulation of Ground-Water Flow in the Coastal Plain Aquifer System of North Carolina. G. L. Giese, J. L. Eimers, and R. W. Coble. 1990. USGS Open File Report 90-372.

Sources of Information on Groundwater Use

Information on community water supply wells is maintained by the Department of Environment, Health and Natural Resources, Division of Environmental Health, Public Water Supply Section. Information on each well system includes number of connections, population served, data on well site, well, pump, treatment, monitoring results, and contaminant violations. Some data are computerized and can be easily accessed through the Public Water Supply Section's computer, however, most information is kept on paper files in the Section's office in Raleigh.

Figure 2. Sources of Groundwater Information.

ings, other structures, and pavement in recharge areas. Withdrawals from the aquifer that are not returned also lower the groundwater table. This has been a problem in the Castle Hayne and Cretaceous aquifers in eastern North Carolina. Problems of artificially increased groundwater levels can stem from an increased rate of groundwater recharge (from surface water irrigation), or a disruption in groundwater discharge. Common effects of elevated groundwater levels include mineralized soils in irrigated areas and property damage from basement flooding.

Developing a Local Database

Effective protection measures require information about the groundwater resource and usage, human activities, and land uses that can have an impact on the resource and its use.

Hydrogeologic Data

Groundwater resources underlying the community must be identified and described in map format. Size, yield, and direction of flow must also be assessed. Determining the rate and direction of groundwater flow is important for identifying recharge areas and delineating areas needing protection. Water quality data is also a necessary component of the local database since it provides information for identifying existing and potential management problems.

Groundwater Use Data

Effective planning requires data on quantities,

What is Hazardous?

Defining and assessing pollution hazards requires a knowledge of what is potentially hazardous and what is not. Limiting the storage and handling of hazardous substances in the vicinity of public water supply systems is one method of protecting groundwater supplies. However, selecting those materials which should be regulated is no easy task. One source of information is the federal government. Substances that are deemed potentially hazardous if allowed to escape into the environment have been defined in several federal laws that regulate their storage and use. Lists of these substances can be found in the following laws:

1. The federal Clean Water Act (CWA) Section 311 contains a list of about 300 substances. The CWA list is printed in the Federal Register, Volume 54, August 14, 1989, p.33482.

2. Superfund Amendments and Reauthorization Act of 1986, Title III, (SARA) Section 302. This list contains 366 chemicals included in EPA's List of Extremely Hazardous Substances. The SARA list can be found in the Federal Register, Volume 52, April 22, 1987, p.13378.

3. The Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) lists 721 chemicals as hazardous substances. This list can be found in 40 CFR Part 302, Table 302.4.

4. Other listings are contained in Section 3001 of the Solid Waste Disposal Act at 42 U.S.C. 6921, and Section 2606 of the Toxic Substances Control Act.

These lists contain many overlapping entries. The US EPA has developed a consolidated "List of Lists" including SARA Section 302 substances and CERCLA substances. This list may be obtained by calling the EPA Title III Hotline: 1-800-535-0202. The CERCLA list of hazardous substances includes hazardous wastes identified in the Resource Conservation and Recovery Act (RCRA) which includes both specific chemicals and waste streams. The substances covered by Section 311 of the CWA include oil and other petroleum products.

Figure 3. Defining Hazardous Substances.

withdrawal locations, and specific uses of groundwater. Community wells must be mapped and their rates of withdrawal documented. Location and other characteristics of private wells must also be documented to understand overall use of the local aquifers. Data should be gathered on types of usage — e.g. residential, industrial, agricultural irrigation, — in order to establish management priorities.

Land Use Data

Existing and proposed land uses can be mapped along with hydrogeologic and water use data to obtain a clear picture of the relationship between land use and existing and potential groundwater problems. This information helps identify sources of contamination and potential threats to groundwater.

Analytical Techniques for Developing Groundwater Protection Plans

Once a local groundwater database has been established, a variety of analytical techniques can be employed to develop groundwater protection plans.

Identification of Sensitive Areas

A sensitive area is an area that can be easily polluted or an area that once polluted will pose a substantive risk to water consumers. Sensitive groundwater protection areas are those that are within a public supply well's "zone of contribution" — the area surrounding the well that directly contributes water to a pumping well. These areas are referred to as wellhead protection areas. Sensitive areas can also include recharge areas which, although quite distant from the well, recharge underground water supplies within a time frame considered relevant. An alternative to identifying sensitive areas is to classify the aquifer according to use such as public drinking water supply, irrigation, or waste assimilation.

Groundwater Modeling

Modeling techniques can be used to predict movement of contaminants in the aquifer, estimate the effects of land use changes in recharge areas, and predict development effects on groundwater quality. Models can provide the water resource manager with the information necessary to determine residential densities compatible with groundwater quality objectives.

Ranking Existing and Potential Threats

Groundwater managers must assess existing and potential pollution hazards to identify management priorities. The risks that an activity poses depend on the hazards inherent in the particular activity, where it occurs, and how many people might be affected by it.

Establish Goals and Objectives

Community goals and objectives related to groundwater protection must be identified before management options can be selected. The community must define what needs to be protected and how much protection it can afford. Protection can extend to the entire aquifer within jurisdictional boundaries, to important recharge areas, or to areas surrounding public supply wells. The hydrologic regime, sources and kinds of threats to the aquifer, and water use in the community are the parameters from which such a determination is made.

The question of how much protection is needed or desired will depend again on the characteristics

Figure 4. Protection of Sensitive Areas: Wellhead Protection Area.

of the resource and its use and abuse, as well as other community goals. Some groundwater protection strategies will limit the types and amount of urban development relative to the groundwater supply. It may be necessary to forgo future industrial development in a particular area if protection goals are to be achieved. Decisions must be made as to how groundwater protection goals and economic development goals can be integrated.

Prevention Options: Control of Contamination Sources

Groundwater protection measures can be directed toward two fronts: (1) control of the sources of contamination, or (2) protection of sensitive areas through land use planning measures. Although this discussion focuses on the latter set of alternatives, it is worthwhile to discuss the options available for controlling groundwater pollution at the source. Communities may choose to adopt source controls for several reasons. It is often the case that a pollution problem is the impetus for a community to begin groundwater protection measures. An existing land use, such as a landfill in a groundwater recharge area, is one example of such incompatibility. Source control techniques are necessary when development has occurred that can potentially threaten groundwater supplies.

It may not be technically possible for a community to delineate sensitive areas. The underlying hydrogeologic formations may be so complex that a community may not have the resources to map the aquifer accurately or a highly permeable geologic formation may underlie the entire community. This is the case with the surficial aquifer in

A number of commonly used land use controls, source controls, and other management methods can be effectively applied by local governments for protecting underground drinking water supplies. These management tools have been compiled by the US EPA in a publication entitled *Wellhead Protection Programs: Tools for Local Governments*.

- **Zoning ordinances:** Direct land development and regulate land uses.
- **Subdivision ordinances:** Protect land divided for development.
- **Site plan reviews:** Help ensure compliance with development plan.
- **Design standards:** Prevent groundwater contamination by setting design and construction standards
- **Operating standards:** Help regulate potentially hazardous practices.
- **Source prohibitions:** Prohibit development or materials that threaten groundwater.
- **Purchase of property:** Ensures control of land uses in areas to be protected.
- **Public education:** Builds support for groundwater protection activities.
- **Groundwater monitoring:** Helps assess groundwater quality.
- **Household hazardous waste collection:** Reduces threats to groundwater from hazardous waste disposal.
- **Water conservation:** Reduces contamination from salt water intrusion.

Source: U.S. EPA. 1989. *Wellhead Protection Programs: Tools for Local Governments.* EPA 440/6-89-002. Washington D.C.: Office of Groundwater Protection, U.S. Environmental Protection Agency.

Figure 5. Management Tools for Groundwater Protection.

the Sand Hill region of North Carolina. Under these circumstances, source controls would be an appropriate means of groundwater protection. Three types of source control measures are discussed below.

Design Standards

Design standards are used to regulate the design and construction of new structures, infrastructure items such as parking lot runoff collection systems, and hazardous material storage systems.

Operating Standards

Operating standards are procedures to prevent or limit pollution. They usually take the form of agricultural or industrial Best Management Practices (BMPs). BMPs generally define a set of standard operating procedures that can be used in a particular industry or agricultural activity to limit the threat of groundwater contamination through accidental spillage, over application, or misuse of hazardous substances.

Source Prohibitions

These measures involve prohibiting the storage or use of dangerous materials in sensitive areas. Source prohibition regulations generally take the form of either prohibitions against certain kinds of activities that typically require the use of specific hazardous substances, or restrictions on the use of the substances themselves.

Prevention Options: Guiding Land Use in Sensitive Areas

Protection of sensitive areas by guiding land use and development provides the best opportunity for groundwater protection. These programs are particularly useful if the sensitive areas are largely undeveloped. Protection can be proactive and comprehensive, providing a mechanism to guide local growth and development so that it is compatible with groundwater protection objectives. The earlier a groundwater protection plan is adopted and implemented, the lower will be the economic costs of protection, since fewer incompatible activities will be affected.

Sensitive area protection programs rely heavily on land use controls, particularly zoning and subdivision ordinances. But other non-regulatory alternatives such as land purchase, monitoring, and education can supplement these programs. In fact, the most effective groundwater protection programs integrate land use controls with other techniques to formulate a comprehensive response to groundwater contamination and misuse.

To enhance their effectiveness, land use controls should be tailored to: (1) area hydrologic conditions; (2) well characteristics (where applied to wellhead areas); (3) associated development alternatives; and, (4) existing local, state and federal programs. Hydrologic conditions will affect the type and extent of land use controls that are most appropriate for a given community. For example, the spatial requirements of land use controls in a community underlain by an unconsolidated aquifer formation may follow a simple elliptical pattern or even a circular pattern around the zone of influence of a community well field.

In the case of wellhead and well field protection programs, well characteristics are important. Similar to hydrologic conditions, well characteristics, such as topographic location and average pumping rate, will affect the spatial application of land use controls.

Associated development goals will affect the intensity as well as the selection of land use control alternatives. Communities may wish to substitute source controls for land use options in areas where land uses are potentially incompatible with groundwater protection objectives rather than forego the activity altogether.

Local land use alternatives must be evaluated in terms of their compatibility with existing local, state, and federal programs for groundwater and surface water protection. Many activities that are potentially damaging to the environment are currently regulated under state and federal rules and regulations regarding source controls. Land use controls should be developed to complement existing programs.

The two most commonly employed land use planning tools for groundwater protection are zoning and subdivision ordinances.

Zoning

Zoning consists of dividing a municipality into land use districts and applying regulations uniformly within each district. Zoning both defines what kind of general land use can occur within a given district and specifies a set of applicable regulations for that district.

Zoning has been used as a tool to protect groundwater resources in a number of ways. It is best used as a method for directing future growth in ways that are compatible with development objectives (groundwater protection being one of them). It is not an effective method of altering land uses once they are established.

If a sensitive area is not yet zoned and undeveloped, the most direct approach would be to zone the area for some compatible use such as low-density residential with limited septic system use, or open space.

Several zoning techniques are available for protecting groundwater in a variety of circumstances. These include large-lot zoning, conditional zoning, floating zones, incentive zoning, overlay zoning, and planned unit developments.

Subdivision Regulation

Subdivision ordinances apply to a parcel of land that is to be divided for resale and future development. Subdivision regulations attempt to ensure that the subdivided lands appropriately relate to their surroundings. They contain provisions on the location and construction of roadways, storm and sanitary sewers, open spaces, and public areas within the subdivision.

Subdivision regulations are particularly suitable for groundwater protection planning. Location and amount of open space, storm sewer design, amount and location of pavement and other impermeable surfaces, are all items relevant to groundwater protection that can be managed through subdivision ordinances. Source control regulations can be combined with subdivision ordinances to provide additional protection. However, like zoning ordinances, subdivision regulations are most useful for controlling future development, and have little application in previously developed areas.

Zoning and subdivision ordinances are only the most common tools for groundwater protection; there are a host of other regulatory and nonregulatory alternatives available. By integrating source controls with land use controls and nonregulatory protection measures, groundwater protection planning can be both effective and workable.

List of Resources

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U.S. EPA. 1989. *Wellhead Protection Programs: Tools for Local Governments.* EPA 440/6-89-002. Washington D.C.: Office of Groundwater Protection, U.S. Environmental Protection Agency.

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AREP93—4—October 1993

Resource Economics and Policy

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North Carolina's Basinwide Approach to Water Quality Management

The Water Quality Section of the North Carolina Division of Environmental Management (NCDEM) has initiated a basinwide approach to state water quality management. The overall goal of basinwide management is to develop consistent and effective long range water quality management strategies that protect the quality and intended uses of North Carolina's surface waters while accommodating population increases and economic growth.

Introduction

Basinwide management is not a new regulatory program but rather a new watershed-based organizational vehicle for managing pollution control. Under this plan, the state is divided into seventeen major river basins (see map, page 2). For each river basin, water quality problems are identified and appropriate management strategies developed. The plan features basinwide permitting of pollution dischargers, integration of existing point and nonpoint source control programs, and preparation of a basinwide management plan report.

Motivation for Planning

Like many other states, North Carolina is faced with a number of critical water quality management issues brought on by an increase in the number and size of wastewater treatment plants, population growth, changes in land use, and emergence of nonpoint source pollution as a significant cause of water quality degradation. The NCDEM found its traditional approach of evaluating one stream and one discharger at a time to be inadequate in addressing these issues. Instead, it needed an approach that allowed for the interactive and cumulative water quality impacts from multiple dischargers and nonpoint sources.

The management plan also arose out of the NCDEM's interpretation of several sections of the federal Clean Water Act. The most explicit of these sections, section 303(e), requires each state to develop an areawide planning process for all navigable waters in the state and to address a broad range of water quality issues. Sections 303(d) and 319 provide general support for the basinwide approach. Section 303(d) requires states to define total maximum daily loads (the quantity of a pollutant that a water body can receive while maintaining its assigned water quality)

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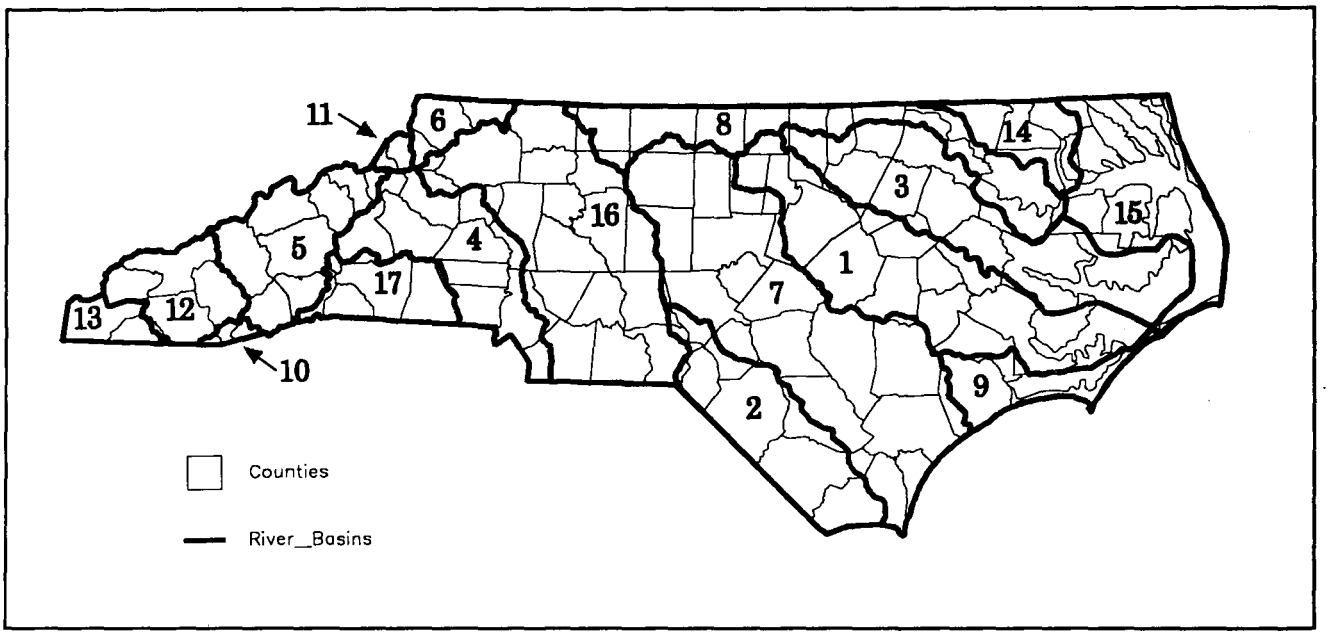

North Carolina River Basins

1	Neuse	7	Cape Fear	13	Hiwassee
2	Lumber	8	Roanoke	14	Chowan
3	Tar-Pamlico	9	White Oak	15	Pasquotank
4	Catawba	10	Savannah	16	Yadkin
5	French Broad	11	Watauga	17	Broad
6	New	12	Little Tenn.		

and associated pollution load allocations for point and nonpoint sources in order to ensure the attainment of water quality standards within all surface waters. Section 319 (Nonpoint Source Management Program) directly calls for a watershed management program. Thus, North Carolina's basinwide management and planning approach is consistent with the stated goals, objectives, and guidance of the federal Clean Water Act.

Implementation of the Plan

A basinwide management plan report will be prepared for each basin. Its purpose is to communicate to policy makers, the regulated community, and the general public, the state's rationale, approaches, and long-term strategies for each basin. Preparation of a basinwide management plan is a five year process. In general, this process involves the following five major phases of development:

- collecting pertinent water quality and related information,
- analyzing the information and targeting problem areas,
- developing management strategies,
- circulating a draft plan for public review and comment, and
- finalizing the plan.

Permitting activities and associated routine support activities such as field sampling, modeling, wasteload allocation calculations, etc. have already been rescheduled by major river basin. All pollution discharge permit renewals within a basin will occur after completion of the final basin plan so the information contained in the plan is available for permit renewal decisions. Table 1 shows the

Table 1. Proposed Basin-Wide Planning Schedule

Basin	In-house Draft Ready for Staff Review	EMC /WQS Approval for Public Meetings	Public Meetings	Final Plan Receives EMC Approval	Permits Issued
Lumber	7/93	11/93	12/93	6/94	11/94
Tar-Pamlico	9/93	2/94	3/94	8/94	1/95
Catawba	12/93	5/94	6/94	11/94	4/95
Fr. Broad	4/94	9/94	11/94	4/95	8/95
Cape Fear	9/94	2/95	3/95	8/95	1/96
Roanoke	7.95	12/95	2/96	7/96	1/97
White Oak	1/96	6/96	8/96	1/97	6/97
Savannah	4/96	11/96	12/96	4/97	8/97
Watauga	5/96	10/96	11/96	4/97	8/97
Little Tenn.	6/96	11/96	12/96	5/97	10/97
Hiwassee	7/96	11/96	12/96	5/97	12/97
Chowan	8/96	2/97	3/97	8/97	1/98
Pasquotank	8/96	2/97	3/97	8/97	1/98
Neuse	11/96	5/97	6/97	11/97	4/98
Yadkin	2/97	6/97	7/97	1/98	7/98
Broad	7/97	12/97	1/98	6/98	11/98
Lumber	6.98	11/98	12/98	6/99	11/99
(5-year cyle repeats					

EMC: Environmental Management Commission
WQS: Water Quality Section
Note: All dates are tenative except permit issuance.

planning schedule for each basin. The plans will be evaluated on the basis of follow-up water quality monitoring. They will be updated at five-year intervals. Each basinwide management plan report will have seven major sections:

1. *Introduction.* Provides a non-technical description of the purpose of the plan, including the benefits of the plan, the major steps taken to prepare the plan, and an implementation schedule. Summarizes how the basinwide approach will be administered within the NCDEM Water Quality Section. Describes federal and state legislative mandates for basinwide planning.

2. *General Basin Description.* Describes the physical and geographic features of the basin, including land use, population, and growth trends. Summarizes North Carolina's water

quality classifications and lists the classifications found within the basin.

3. *Overview of Existing Pollutant Sources.* Describes the causes and sources of surface water degradation within the basin. Defines and locates point source dischargers and describes nonpoint sources of pollution within the basin.

4. *Water Quality Status in Basin.* Reviews and interprets data generated by NCDEM on water quality and biological communities to assess current conditions and the status of surface waters by subbasin. Describes the ambient monitoring system and summarizes use support ratings for those surface waters that have been monitored or evaluated. Outlines the methods used for determining water quality "use support" ratings and lists the water quality use support ratings for the basin.

5. *Existing Point and Nonpoint Source Pollution Control Programs.* Summarizes point and nonpoint source pollution management tools and strategies available for addressing priority concerns and issues. Describes how point and nonpoint source pollution controls can be integrated through the concept of total maximum daily loads.

6. *Priority Water Quality Issues and Recommended Control Strategies.* Water quality issues identified in previous sections of the report are evaluated and prioritized based on factors such as their severity and the sensitivity or importance of affected waters and biological resources.

7. *Implementation, Enforcement, and Monitoring Plans.* Outlines plans for implementing and enforcing the basinwide management program as well as future ambient and effluent monitoring. Implementation and enforcement activities are described separately for point and nonpoint pollution sources.

The basinwide management plan for the Neuse River basin is the first plan to be completed and provides a foundation for future basinwide plans.

Primary Projected Benefits of the Plan

Improved Efficiency

The basinwide approach enhances administrative efficiency because state and regional staff activities, such as travel and field sampling, are focused on particular river basins in a scheduled manner. Public notices and public hearings are aggregated within each basin, increasing public awareness of and participation in the planning process. Wasteload allocation analyses will be conducted more efficiently because multiple dischargers within a given river basin are considered simultaneously through the synchronization of the waste discharge permitting schedule for all dischargers by basin. As a result of the increased efficiency, greater monitoring coverage, and/or more sophisticated water quality assessments may be achieved for a given level of funding and resource allocation.

Improved Effectiveness

The basinwide approach is more consistent with basic ecological principles of watershed management. Linkages between aquatic and terrestrial systems are addressed (e.g., contributions from nonpoint sources) and all inputs to aquatic systems and potential interactive and cumulative effects are considered.

Basinwide management will encourage the integration of existing water quality program components (for example, chemical-specific monitoring and regulations, bioassessments, water quality modeling, and compliance and enforcement activities) into a comprehensive, balanced, water quality management program, taking full advantage of each type of information and approach. Finally, the development of basinwide strategies will formalize the process of long-range planning and add several new and innovative approaches, such as agency banking and pollution trading, to water quality assessment and management.

Better Consistency and Equitability

The basinwide plan provides a focus for management decisions. By defining the program's long-term goals and approaches to water quality protection, these plans will encourage more consistent decision making. Consistency, together with greater attention to long-range planning, in turn, will promote a more equitable distribution of assimilative capacity among potential users, explicitly addressing the trade-offs among pollutant sources (point and nonpoint), and allowances for future growth. In addition, the availability of basinwide management plan reports, presented in a consistent format, will allow policy makers and the general public to more easily understand and evaluate the background, methods, and rationale for management decisions, thereby creating a more stable foundation for future planning.

Long-Term Management Strategies

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 assimilative capacity of a waterbody refers to the total pollutant loadings from point, nonpoint, and atmospheric sources that the waterbody can receive while still maintaining its assigned water quality.

The US Environmental Protection Agency has developed a strategy to help integrate point and nonpoint source pollution assessment and control. Total Maximum Daily Loads (TMDLs) is a tool for establishing water quality-based controls on point and nonpoint sources of a given pollutant identified as contributing to impairment of a water body. In North Carolina, the concept of TMDLs is applied primarily to the control of nutrients and biochemical oxygen-demanding wastes. Once the TMDL of a particular pollutant has been estimated, the remaining assimilative capacity (if any) will be determined relative to current point and nonpoint source pollutant loadings. Wasteload allocations, specialized treatment requirements, or minimum technology requirements for individual point sources that will achieve the goals and objectives of basinwide management strategies will be recommended. For nonpoint sources, best management practice approaches will be recommended.

As the ability to quantify and predict the impacts of point and nonpoint source pollution becomes more sophisticated, the basinwide approach will make more innovative management strategies possible such as:

Agency banking: holding assimilative capacity in reserve by NCDEM for future growth and development in the basin.

Pollution trading: trading of waste loading and stream assimilative capacity among permitted dischargers, or between point and nonpoint sources.

Industrial recruitment mapping: providing specific recommendations on the types of industry and land development best suited to the basin's long-term water quality goals and also an individual basin's ability to assimilate a particular type or quantity of discharge or nonpoint source pollutant.

Consolidation of wastewater dischargers: combining several dischargers into one facility.

NCDEM Responsibilities

Although the basic structure and major responsibilities within the Water Quality Section of NCDEM will remain unchanged, implementation of the basinwide approach to water quality management requires some modification of and additions to the existing tasks for each branch and regional office. Several ongoing efforts within the Water Quality Section support a basinwide management approach. These efforts include improved data base management, incorporation of geographic information systems, implementation of long-term intensive and ambient monitoring schedules, large-scale model development, and water quality indexing.

The basinwide management plan provides the NCDEM with a watershed-based approach to state water quality management. It does not eliminate any water quality issues that existed before implementation of the plan but it does provide the state

with the tools for taking significant steps toward addressing these issues. The basinwide approach provides a means for reducing the numerous water quality issues into units defined both geographically (by river basin) and temporally (by the five-year permit review/renewal and basin plan update intervals). Integrating point and nonpoint source pollution controls by river basin allows for closer evaluation of water quality status, identification of impaired waters, and development of appropriate management strategies within each basin. The waste discharge permit rescheduling provides structure to the state's water quality program which enables program activities to be conducted in a more effective, efficient, and consistent manner. Updating the plan every five years offers a convenient and realistic time frame for measuring the progress of pollutant reduction standards. No new governmental organizations will be created. The structure of the NCDEM Water Quality Section and the responsibilities of the individual branches will remain largely unchanged for basinwide planning. There will, however, be increased emphasis on the coordination of activities and the integration of information among the branch and regional offices.

List of Resources

Creager, C.S. and J.P. Baker, 1991, *North Carolina's Basinwide Approach to Water Quality Management: Program Description.* Final Report/August 1991, Second Printing, June, 1992, NC Division of Environmental Management, Report No. 91-08, 54pp.

Neuse River Basinwide Water Quality Management Plan, NC Dept. of Environment, Health, and Natural Resources, Division of Environmental Management, Water Quality Section, March 1993.

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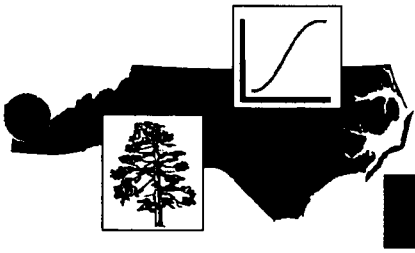
AREP93—2—October 1993



Resource Economics and Policy

Applied Resource Economics and Policy Group
Department of Agricultural & Resource Economics

Environmental Assessments

Finding ways to conserve and manage natural resources is increasingly important at every level of government. Maintaining or improving the quality of the natural resource base, while at the same time using these resources to increase income and enhance quality of life, will require better public policies and better management practices.

Environmental Assessments Put County Planning on a Sound Basis

With competing demands for natural resources, county governments are taking on new responsibilities for wise management. Many decisions made by local governments have either direct or indirect effects on natural resources, but the full consequences of these decisions are seldom recognized in advance. Increased use of a resource for one purpose may preclude or diminish other potential uses or benefits. For example, areas of scenic beauty attract development and stimulate economic growth, yet the resulting development may damage the very resource which first attracted it.

How can counties and cities anticipate consequences of resource use? Better public policy and better management of natural resources both depend on better information. Inventories of natural resources provide the detailed information necessary for making wise decisions. Such environmental assessments are best done at the county or local level where policies are most closely linked with site specific decisions.

An environmental assessment provides information on the current condition of the county's natural resources which will help determine the likely effect of various policy alternatives. When local governments identify current or potential pollution problems, debates over the effect of present and future economic growth on natural resources can be based on information rather than speculation.

Bringing information together in the form of an environmental assessment is a feasible task. The procedure followed in Gaston County is an example of how one county carried out a natural resource assessment as a basis for making policy and management decisions.

The Gaston County Example

Gaston County conducted an environmental assessment as part of an effort to improve surface water, protect groundwater and meet air quality standards (Levi, et al. 1990; 1992).

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Some of Gaston County's streams and rivers are unsuitable for drinking water and swimming and no longer provide habitat for fish and wildlife. Urban waste, toxic chemicals, and runoff from urban and agricultural sources contribute to the problems. Groundwater resources are threatened by leaking underground storage tanks, hazardous waste sites, and solid waste landfills. In addition, air pollution levels in Gaston County have exceeded EPA standards for ozone and are approaching standards for carbon monoxide and particulates.

Citizen Involvement

In 1988, Gaston County commissioners appointed a fifty-member citizen group to advise them on ways to solve water and air quality problems. This group, now called the Quality of Natural Resources Commission (QNRC), received an allocation of county funds and was asked to develop recommendations for policies to improve or protect water and air quality.

The first task was to assess the state of the county's natural resources. Under a contract with the North Carolina State University Cooperative Extension Service, the QNRC evaluated surface water, groundwater, and air quality in the county and conducted a public attitude survey. In Gaston County, assessments of the quality of surface and ground water were organized by the six regional watersheds in the county. Table 1 lists the types of information collected for this assessment and the sources where such information may be obtained.

Surface Water Quality

For surface water assessments, reports and data were collected from the Division of Environmental Management, NC Department of Environment, Health, and Natural Resources (DEHNR). These included:

- The State of North Carolina Water Quality Assessment (Section 305(b) Report) and The North Carolina Non-Point Source Assessment (Section 319 Report)
- Biological (Benthic Macroinvertebrate) reports on water quality,
- Fixed station water chemistry monitoring data, and
- National Pollutant Discharge Elimination System (NPDES) permits.

Additional information was collected from other sources on:

- allocation of water supply intakes,
- agricultural crop and animal operations,
- land use, and
- complaint and general background information.

Results were reported on maps for each watershed showing: land use and surface water quality data; NPDES permit information; water monitoring data; and nonpoint source loading estimates by land use type and pollutant.

This study resulted in three categories of information:

1. It identified several sources as important contributors to surface water

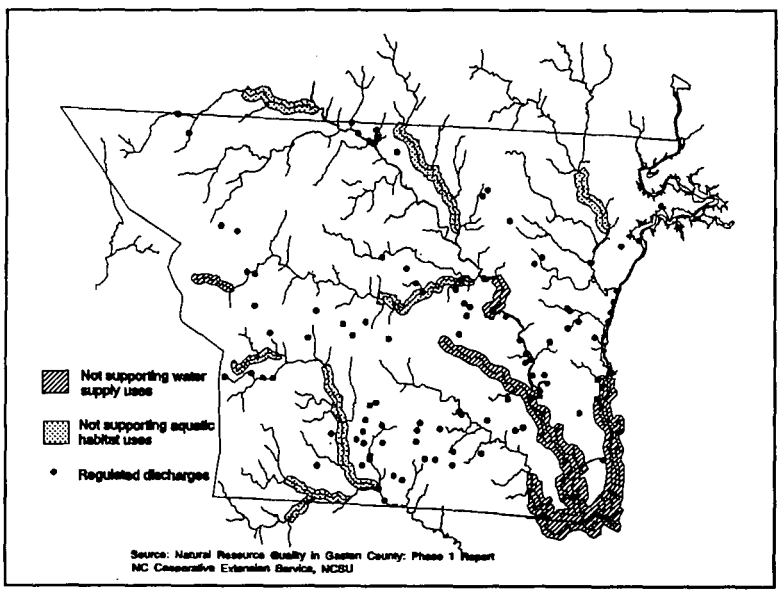

Figure 1. Information collected through an environmental assessment process shows stream mileage not suitable for water supply or aquatic habitat (shaded area) in relationship to permitted point source discharges.

pollution as well as the varying importance of each source for each watershed.

2. It showed that many waters in the county fully supported their designated uses. Areas where capacity to assimilate pollutants had been reached under summer low flow conditions were also identified. Further development in these areas is limited unless existing facilities reduce discharge.

3. Finally, it found that nonpoint sources of pollution such as agriculture and run-off from urban and suburban development, although difficult to quantify, contribute significantly to lowered water quality in parts of most watersheds.

Groundwater Quality

Assessing the potential for groundwater pollution required collection of various kinds of information from several sources:

- Data on the potential for groundwater pollution based on soil and geological conditions were digitized and assembled as a county map using hand-drawn DRASTIC maps provided by the Mooresville regional office of the Division of Environmental Management. (DRASTIC is a standardized system for evaluating groundwater pollution potential based on environmental factors).
- The Gaston County Department of Planning provided land use maps.
- The Soil Conservation Service provided data on animal operations.

Various divisions within the NC DEHNR provided information on:

- mining operations,
- CERCLA (superfund) sites, landfills, RCRA (hazardous waste) sites,
- non-discharge permits,
- underground storage tanks, and
- groundwater contamination.

The study identified potential major sources of groundwater pollution and showed that the highest potential for groundwater pollution is along rivers and major streams. It also brought to light the scarcity of data on groundwater quality in Gaston County. Little or no monitoring has been conducted near hazardous waste sites, underground storage tanks, and other possible pollutant sources in areas where groundwater has a high potential for contamination. The situation is probably similar in most counties in North Carolina.

Air Quality

Air quality was also assessed through the collection of a variety of measures from several sources:

- NC DEHNR and the South Carolina Department of Health and Environmental Control provided point source chemical emission data.
- Mobile source (vehicle) emissions were also obtained from DEHNR.
- Traffic data were gathered from the NC Department of Transportation
- Meteorological data came from the National Climatic Data Center in Asheville.

Information from these sources was used to estimate the concentration of primary pollutants and ozone, a secondary pollutant, in the ambient air over Gaston County. This was done using the Industrial Source Complex Model recommended by the U.S. Environmental Protection Agency. The rate of hydrocarbon compound emissions from natural sources was also estimated by modifying a model developed for the study of forest emissions. Finally, monitoring data from the adjacent counties of Gaston, Lincoln, and Mecklenburg counties were collected.

The air quality assessment had several findings:

1. Major contributors to air pollution in Gaston County were identified.

2. Despite the fact that ozone is the most widespread and serious pollutant produced in North Carolina, Gaston County does not monitor ozone. From information on ozone levels in neighboring counties, the study concluded that the county would be declared a non-attainment area by the EPA. (This did subsequently occur in 1992.)

3. The only primary pollutant currently measured in Gaston County is Total Suspended Particulates (TSP). Even though TSP concentration has been below the national standard, the level is increasing and may be exceeding the standard in some areas of the county.

4. Modeling indicates that carbon monoxide (CO) concentration in parts of Gastonia may be above EPA standards, but not high enough to qualify as violations. Also, the concentrations of sulfur dioxide and nitrogen oxides are increasing, but still within the acceptable range.

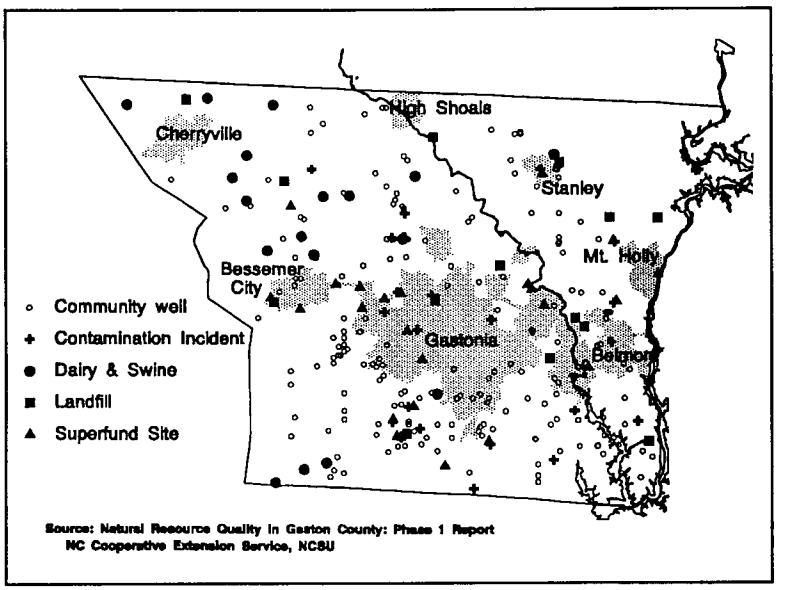

Figure 2. Potential sources of groundwater contamination include "Superfund" hazardous waste sites, livestock operations, contamination incidents, and landfills. Sources not mapped here include underground storage tanks, land application of waste and septic systems.

Public Attitude Survey

In order to understand the environmental concerns of Gaston County residents, personal interviews and focus group discussions were conducted with 15 county opinion leaders. In addition, 500 responses to a county-wide telephone survey were collected. These efforts identified water pollution and toxic wastes as the subjects of greatest concern. Questions were also asked to identify sources of environmental information, willingness to pay to prevent or clean up pollution, and target audiences for improved environmental educational efforts.

Creating Policy Information from Technical Data

There is an important difference between data and information. Data are just numbers which usually require explanation to be useful. It is only when the numbers are put in context and explained, that they become useful and understandable information. It is also important to have information made available in a timely fashion.

This can be accomplished through mapping, graphical presentation of the data, and statistical analysis. Once an assessment has been completed and the data integrated into understandable forms, the county will have a scientific basis for policy decisions and educational programs.

In Gaston County, identifying data sources for both air and water quality and transferring the data to maps was a time-consuming task. The assembly of mapped data for resource assessment and the subsequent manipulation of that data to create information of use to the QNRC and policymakers constituted a significant portion of the environmental assessment in this county.

A computerized mapping system (in this case a Geographic Information System or GIS) brought all the maps into a common scale and format. It was also used for many of the assessment tasks including delineation of watershed groups, calculation of acreage of ground and surface water pollution impact, and the geographic registration of air quality modeling results.

Use of the GIS system also ensured that the data developed for the environmental assessment project could be transferred to the Gaston County computer mapping system. The final GIS effort was focused on the development of high

quality paper maps for use in communicating the results of the assessment.

Consequences of the Environmental Assessment

The environmental assessment process in Gaston County led County Commissioners to fund two new positions: one for a Cooperative Extension Service agent specializing in natural resource issues, the other for a county staff hydrogeologist.

On the basis of the information provided by the environmental assessment, the Gaston County QNRC has analyzed several policy issues and made recommendations to the County Commissioners. Gaston County has also been awarded several grants, including an EPA grant to monitor surface water quality and a USDA Water Quality Incentive Program grant. More applications for grant funding have been submitted, including a proposal to control nonpoint pollution through implementation of a best management plan. In addition to grants, Gaston County has won public recognition in the form of state and regional awards for its environmental efforts.

Two other North Carolina counties, Surry and Stanly, have since conducted similar water quality assessments to serve as the basis for future public policy actions.

Table 1. Environmental Information Available from Government Agencies

Soils, Hydrogeology, Climate

Division of Environmental Management, Ground Water Section (919-733-3221): Reports and Maps of hydrogeologic information may be available from state or regional offices. DRASTIC maps showing areas of varying ground water contamination potential based on environmental variables are available for some counties. Special publications contain information on hydrogeologic conditions.

Soil and Water Conservation District Offices: Soil Surveys containing information on soils and climate.

US Geological Survey (919-856-4791): Special reports of geologic investigations at various sites.

Land Use

County Planning Departments Reports and Maps of land uses, including township maps, zoning maps, etc. These show categories of land use such as municipal, service, residential, agricultural, and undeveloped.

Soil and Water Conservation District: Land use maps of agricultural areas based on aerial photographs are available in many counties.

Public Water Supplies

Division of Environmental Health, Public Water Supply Section (919-733-2321): Computer Printout lists type of water source, location, and number and types of users. Does not include water quality monitoring data. Paper Files for each public water supply for which the state has jurisdiction include monitoring data and "Public Well Survey Sheet" containing information on well depth, age, construction, etc.

County Health Departments: Information on well protection, monitoring, complaints, etc.

Private Wells

County Health Departments: Paper Files list well user, location, and information about well construction for some wells. Well water quality data may also be available for some wells.

Table 1. Environmental Information Available from Government Agencies

Water Quality Data

DEM Ground Water Section (919-733-3221) and Water Quality Section (919-733-5083): Reports list monitoring results (examples: North Carolina 305(b) Water Quality Assessment Report, Non-point Source Assessment Report, special monitoring project reports).

EPA STORET (800-424-9067): Computer Printout or Electronic File available from EPA database retrieval, which includes all state monitoring data updated semi-annually.

USGS (919-856-4791): Data from special monitoring studies is published periodically.

Pollution Incident Management Database

DEM Ground Water Section (919-733-8488): Computer Printout and Paper Files describe reported ground water contamination incidents relating to UST, landfills, CERCLA, RCRA, etc. Does not include all incidents of ground water contamination. Records list location, source, contaminant type, date, and amount released.

Superfund (CERCLA) Sites

Division of Solid Waste Management, Superfund Section (919-733-2801): Computer Printout lists Federal and State Superfund sites including name, address, location, site assessments. Paper Files available for viewing. Preliminary site assessment and site investigation reports on file for some sites.

County engineer: Additional information on individual sites may be available.

Hazardous Waste Facilities

Division of Solid Waste Management, Hazardous Waste Section (919-733-2178): Computer Printout lists facilities which generate, store, or handle hazardous waste includes name, address, activity (generator, transporter, disposer, storer, or treator), and RCRA number. Small quantity generators are indicated.

Toxic Release Inventory

Division of Emergency Management (919-733-3283): Paper Files list facilities required to report manufacture, processing, importing, or use of toxic chemicals on EPA Form R, Toxic Chemical Release Inventory Reporting Form as listed in the Emergency Planning and Community Right-to-Know Act, Title III of SARA (Superfund Amendments and Reauthorization Act of 1986). Includes name, address, latitude/longitude, type and location of discharge, chemical name, chemical use, and quantity released.

EPA's Toxic Release Inventory (TRI) Database Hotline (800-638-8480):Information on release incidents.

Hazardous Materials Emergencies

County Emergency Management Office: Computer Printout lists hazardous material emergencies occurring in a county and remedial actions.

NPDES (National Pollutant Discharge Elimination System) Permits

Division of Environmental Management, Water Quality Section (919-733-7015) (and regional DEM offices): Computer Printout by county lists information on NPDES permits for direct discharge systems including facility name, permit number, and issue date, expiration date, latitude/longitude locations, monitoring data, and violations of permitted levels available upon request for a fee. Paper Files of all permit holders and monitoring results available for viewing and manual transfer of information. Maps available as part of the Basin Modeling effort which show dischargers located in a particular watershed area. DEM regional offices may have the same information.

Table 1. Environmental Information Available from Government Agencies

Non-Discharge Permits

Division of Environmental Management, Water Quality Section (919-733-5083): Computer Printout by county lists information on non-discharge permits for sludge application to land, spray irrigation of wastewater, etc. including facility name, permit number, issue date, expiration date, and type of non-discharge activity. DEM regional offices may have information on reported problems with permitted non-discharge activities.

Solid Waste Facilities (Landfills)

Division of Solid Waste Management, Solid Waste Section, (919-733-0692): Paper Files on open, closed, and proposed landfills for which a permit exists or is being processed. Include monitoring data if available. Information on closed landfills which are also CERCLA sites may be available from Division of Solid Waste Management, Superfund Section.

Septic Systems

Division of Solid Waste Management, Solid Waste Section, (919-733-0692): Paper Files on permitted municipal, industrial, and large systems regulated by the state.

County Health Departments: Records of septic systems in use.

Underground Storage Tanks

Division of Environmental Management, Ground Water Section (919-733-3221): Computer Printout lists registered tanks (mostly used to store petroleum products) greater than 1,100 gallon capacity. Includes street address, size, product stored.

Mining Operations

Division of Land Resources, Land Quality Section (919-733-4574): Computer Printout and DOT Map by county of permitted mining operations lists name, address, location, commodity, permit numbers. Latitude/longitude available for active operations.

Pesticides

Food and Drug Protection Division, Pesticide Section (919-733-3556): Paper Files describe violations of pesticide use restrictions, licensing rules, spills, illegal duping, etc. Estimates of pesticide use may be available from Extension, ASCS, SCS, or Soil and Water Conservation District.

Animal Waste Storage and Application

Division of Soil and Water Conservation, District Programs Section (919-733-2302): Paper Files on animal waste storage and application facilities which have been designed and implemented with assistance from District Office. Additional information may be available from local Soil and Water Conservation District, SCS, ASCS, and Extension.

List of Resources

Jennings, Gregory D. *Water Quality Assessment of Stanly County. Final Report.* North Carolina Cooperative Extension Service, N.C. State University. Raleigh. 38 pp. 1993.

Jennings, Gregory D. *Water Quality Assessment of Surry County. Final Report.* North Carolina Cooperative Extension Service, N.C. State University. Raleigh. 39 pp. 1993.

Levi, Michael, Leon E. Danielson, et al. *Natural Resource Quality in Gaston County, Phase I: Characterization of Air, Surface Water, and Groundwater Quality. Final Report.* North Carolina Cooperative Extension Service, N.C. State University. Raleigh. 170 pp. 1990.

Levi, Michael, Leon E. Danielson, et al. *Natural Resource Quality in Gaston County, Phase II: Implementation of Natural Resource Education and Policy Development Programs. Final Report.* North Carolina Cooperative Extension Service, N.C. State University. Raleigh. 143 pp. 1992.

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AREP93—1—October 1993