The North Carolina Geographer
Vol. 4, Winter 1995

PROTECTING UNDERGROUND WATER SUPPLIES: A COUNTY-WIDE WELLHEAD PROTECTION PROGRAM

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Introduction

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In North Carolina concern about ground water pollution is resulting from an increase in contamination incidents and is leading to a major effort for its control

Many North Carolina citizens rely on ground water for their drinking water. In fact, 55% of all North Carolinians and 97% of rural citizens receive their drinking water from underground. In the past, most people assumed that ground water resources would always be free of harmful chemicals. As contamination incidents continue to rise, however, many people are beginning to realize the importance of preventing ground water contamination. Once ground water becomes contaminated, it is often difficult and costly to remediate. The increase in concern about the health risks associated with ground water pollution have led to the enactment of federal and state laws regulating the use, storage and transport of hazardous substances, as well as establishing human exposure limits. The goal of these laws is to protect ground water quality, however, enforcement often takes the form of penalties after a contamination incident has occurred. Major sources of ground water pollution come from underground storage tanks, chemical spills, landfills, abandoned dumps, and pesticide and fertilizer applications (Figure 1) (McLaughlin, et. al, 1994). A relatively new approach to protecting ground water supplies is through a wellhead protection program. The purpose of this report is to provide a general overview of the federal and state government's role in wellhead protection and highlight a North Carolina County (Gaston County) in the process of developing a county-wide wellhead protection program.

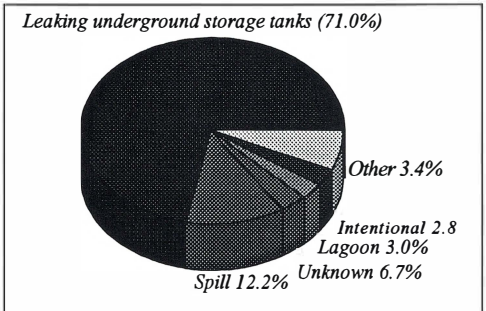

Figure 1. Sources of Ground Water Contamination in North Carolina

Background

A wellhead protection area, as defined by the Federal Safe Drinking Water Act, is "the surface and subsurface area surrounding a well or wellfield, supplying a public water system through which contaminants are likely to move toward and reach such well or wellfield (US EPA, 1991)." Once identified, these areas can be protected from contamination by sources above and below the ground to prevent degradation of underground water supplies. Well head protection may be broadly defined as a program that reduces the threat to the quality of potable ground water by identifying and managing recharge areas to specific wells or wellfields. The program consists of two basic components: (1) identification of the wellhead protection area; and (2) management approaches that can be undertaken to reduce the threat of land-based contaminants entering well recharge areas and polluting public water supplies. Protection measures may range from simple practices involving basic housekeeping procedures at local businesses and industries, to extensive and comprehensive land use planning and restrictions.

A wellhead protection program also includes several other components. A plan must be developed that details the roles of specific agencies and organizations in protecting public water supplies. Public participation is required before a program will be approved by the state. The citizens of the community should be involved in deciding what to protect and how much protection is needed. An inventory of all potential sources of contamination within delineated wellhead protection areas also must be made. Finally, in the event that a community well becomes contaminated, contingency plans must be in place to ensure an adequate supply of clean water to the residents affected (EPA, 1991).

In Gaston County, citizens are involved in identifying wellhead areas, whose protection and management will aid in removing possibilities of pollution

Over the past four years, Gaston County, North Carolinahas explored options for protecting its public community water supply wells. Gaston County, located in the southwestern Piedmont of the state includes fifteen municipalities with a total population of 180,000. The eastern half of the county is becoming increasingly urbanized. While the western is not as densely developed, it supports a variety of commercial and industrial activities. Groundwater provides drinking water to over 90,000 (50%) County residents. More than 200 public community water supply wells in the county's rural areas provide over 30,000 Gaston County residents with about 3 million gallons of groundwater per day (Thompson, 1994). In addition, over 50 public non-community wells supply water to schools, churches, businesses and parks throughout the county. Public community wells are defined as those that supply water to at least 15 water supply connections or 25 people on a regular basis.

Water drawn from Gaston County's aquifers is generally of good quality (Levi, et al., 1990). However, groundwater is susceptible to pollution from many activities on or below the land surface. Land disposal of wastes, storage and/or use of hazardous substances for industry and agriculture, poorly designed and failing septic systems, accidental spills, and leaking underground storage tanks, are all sources of groundwater pollution. Since North Carolina began keeping records in 1982, there have been over 50 incidents of groundwater contamination in the County, 35 of these having been caused by leaking underground storage tanks. Since 1988, four public wells have been contaminated by chemical substances — three public community wells, and one non-community well. These contamination incidents affected 240 households connected to those wells. An additional 134 nearby homes connected to private wells and one elementary school were also contaminated. Costs to connect affected households to alternate water supplies exceeded $2 million (Thompson, 1994).

Federal Requirements

Wellhead protection originated from the federal Safe Drinking Water Act Amendments of 1986. The goal of the program was to encourage all states to develop a methodology for preventing public water supply contamination, recognizing that remediating groundwater contamination is proving costly and sometimes impossible (EPA, 1995). The EPA is charged with providing oversight and technical and financial assistance to states that are developing wellhead protection programs. So the Safe Drinking Water Act requires that all states develop a program, however, EPA does not have authority under this program to reprimand states that choose not to implement it. States that do develop a wellhead protection program, however, are required to address the public water supply wells issue. The following states have approved protection programs by EPA Region IV: Kentucky, Tennessee, North Carolina, South Carolina, Georgia, Alabama and Mississippi. The only state within Region IV that does not have an approved program is Florida (EPA, 1995).

States have authority over water allocation and therefore have historically been responsible for ground water management. Recognizing that all states differ in state water laws and hydrogeology, the federal wellhead protection program is designed to integrate existing state water protection regulations and programs. Therefore, broad federal guidelines are set for designing a program.

North Carolina's Wellhead Protection Program

The North Carolina Wellhead Protection Program (NCWPP) is part of the national strategy to prevent groundwater contamination of public community wells. This complements the state's ongoing programs to reduce the potential for groundwater pollution. And, although it is the state's re-

The state has provided a basic water pollution regulatory program that counties are then able to enhance in the context of their particular needs

sponsibility to develop standards, local communities are the primary beneficiaries of clean water supplies. Moreover, local governments possess the legal mechanisms — such as land use and subdivision regulations — to implement specific protection objectives. The NCWPP is designed to provide local governments with the ability to broaden the protection already provided by the state through its regulatory programs, as well as to protect public water supplies from currently unregulated contamination sources. Two state agencies are responsible: the Groundwater Section of the Division of Environmental Management and the Public Water Supply Section of the Division of Environmental Health, both within the Department of Environment, Health, and Natural Resources. As the lead agency, the Groundwater Section is responsible for establishing the state criteria and for developing an approval process for local governments wishing to implement their own wellhead protection programs. The Public Water Supply Section has responsibility for developing and enforcing public water supply rules (Smutko, 1994). The state program consists of six basic components:

1. Identifying a wellhead protection area. In 1987, the United States Environmental Protection Agency (EPA) defined five criteria for delineating a wellhead protection area. These include: 1) distance, 2) drawdown, 3) time of travel, 4) flow boundaries, and 5) assimilative capacity (US EPA, 1991). Since aquifer characteristics vary greatly across the country, the EPA has given states the authority to determine appropriate methods for delineating wellhead protection areas (WPAs). North Carolina has adopted well drawdown criterion for defining WPAs in each of the three physiographic regions of the state. The size of an area is determined by the recharge needed to sustain the permitted well yield (Heath, 1991). Communities may choose from one of two delineation methodologies: the calculated fixed radius or simplified variable shape. Figure 2 shows an example of the simplified variable shape method.

Figure 2. Wellhead Protection Area Using Simplified Variable Shape Method

2. Non-regulatory or regulatory management approaches to reduce the threat of contaminants entering well recharge areas and polluting public water supplies. Wellhead protection measures may range from targeted education measures, the use of best management practices (BMPs) to prevent pollution at local businesses and industries, and site design standards for facilities that handle hazardous substances, to prohibitions of specified substances within WHPAs, or a number of other options.

3. Clarification of the roles that specific agencies and organization will play in protecting public water supplies.

4. Public participation in developing and implementing the program.

5. An inventory of all potential sources of contamination within delineated wellhead protection areas.

6. Contingency plans to ensure an adequate supply of clean water to the residents affected (Smutko, 1994).

Gaston County Wellhead Protection Program

The lead organization for developing a wellhead protection program in Gaston County is the Quality of Natural Resources Commission (QNRC). The QNRC is an organization of 54 volunteer members appointed by the Board of County Commissioners. Members represent municipalities, county government, business / industry, developers, physicians, environmental organizations, retired citizens, among others. QNRC's purpose is to advise the County Commissioners on environmental issues and policy options, evaluate the quality of the county's natural resources, and provide educational programs to county citizens.

Gaston County adopted the simplified variable shape method for delineating wellhead protection areas around public community wells. This method determines the size, shape and location of the protection area with respect to the well yield. The resulting shape is an ellipse oriented in the direction of groundwater movement with a 2:1 ratio between the long and short axes (Figure 2). In Piedmont and Mountain regions this method is recommended for aquifers where groundwater moves through fractures in bedrock (Heath, 1991). The variable shaped method requires knowledge of average daily pumping rates, average recharge rates, direction of bedrock foliation and transmissivity. In sizing the ellipses the basic assumption is that recharge equals well yield.

Researchers at the University of North Carolina at Charlotte (Forsythe, et. al, 1995), who mapped Gaston County's wellhead protection areas also chose to include land use (impervious cover), geology and soil type as parameters for determining the size of each area. This has resulted in a more accurate estimate of each well's contributing area. While applying the delineation methodology at the county level, researchers discovered that the

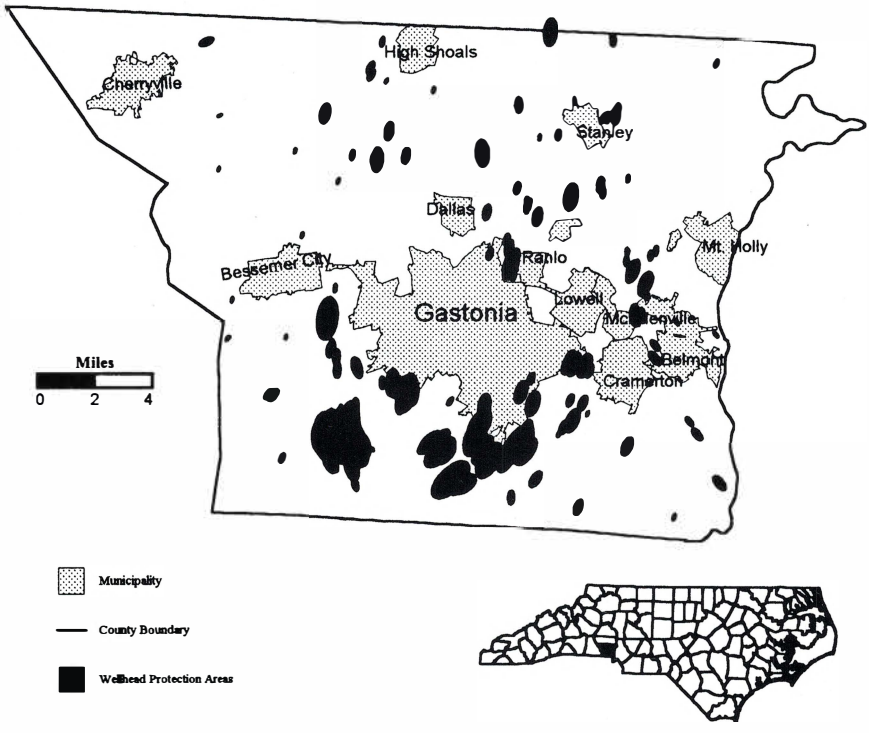

Figure 3. Wellhead Protection Areas, Gaston County
Sources: Wellhead protection areas were developed under contract with UNC at Charlotte, Department of Geography and Earth Science. Map was produced by the Gaston County Cooperative Extension Service.

close proximity of wells to one another resulted in substantial sizing errors because of well competition for recharge. To accommodate the effects of too closely spaced wells, they developed a Geographic Information System (GIS) based algorithm. This, along with impervious cover, created larger wellhead protection areas than the state's method alone (Figure 3)

Selection of Management Alternatives

One of four QNRC working committees, the QNRC Water Committee, met monthly for nearly two years developing the necessary policy components for a successful county-wide wellhead protection program. This Committee is comprised of a broad cross section of county-wide representation (see Figure 4). Its deliberations placed strong emphasis on education and non-regulatory controls. Examples include household hazardous waste collection days, direct mailings to potential contamination sources and water users, conservation easements, signs, and community workshops.

Water Committee Representation	
County Public Works Director	City of Cherryville
Community Well Owner	City of Bessemer City
Gastonia Public Utilities Director	Schiele Museum
Soil & Water Conservation Board	Well Drillers
Business Sector	Riverbend Community School System
EDC Representative	Leadership Gaston
Junior League	Medical Association
Crowders Mountain Community	County Planning Board
Audubon Society	Home Builders
Board of Health	**Technical Support**
Environmental Health Director	Cooperative Extension Service
	County Health Department
	University of North Carolina at Charlotte
	Rural Water Association

Figure 4. QNRC Water Committee Representation

Rather than establish a new regulatory program to protect community water supplies, the QNRC elected to focus existing programs to new purposes. A concern of the group was the presence of manufacturing and commercial facilities that handle large quantities of hazardous materials within a wellhead protection area. The 1993 revisions of the state building code specify that hazardous substances be used and stored in such a way that, while reducing the risk of employee exposure and fire hazard from these materials, their escape into the environment is also prevented (11 NCAC 8.024 with specific reference to 408.3, Special Hazardous Materials). The QNRC recommended that the County use existing site plan review and building inspection programs to ensure that new and expanding facilities handling hazardous substances conform to the most current revisions of the State and County Building Codes.

In addition, the QNRC recommended that before approval is granted for a new public community well, an inventory of sites using hazardous substances be taken within the projected wellhead protection area.In cases where facilities with hazardous substances on site exist, facility owners would be advised of the placement of the new well and given information on voluntary pollution prevention measures. If the County were to determine that existing facilities pose a significant risk to users of the new well system, the QNRC recommended that the well be monitored for contaminants on a quarterly schedule. The policy recommendations have been forwarded to Board of County Commissioners for final approval.

Summary

It is hoped that Gaston County's wellhead protection program, unique for the state, will encourage other counties to follow

In summary, a wellhead protection program provides a flexible method for preventing ground water contamination in areas supplying drinking water through a community well system. The federal Safe Drinking Water Act Amendments of 1986 requires that all states develop a wellhead protection program. However, general requirements allow states to tailor their programs to reflect the hydrogeology and ground water issues of their state (US

EPA. 1994). North Carolina has taken a state wide non-regulatory approach, leaving local governments and communities with the ability to create their own programs with guidance from the state.

Gaston County is unique in North Carolina, addressing wellhead protection issues for the entire county. Most programs are developed for a single municipality or community well system. The outcome of this program will benefit many other counties, in North Carolina and the nation, as they begin to address county-wide wellhead protection.

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