THE INTERAGENCY STUDY OF THE IMPACT OF PESTICIDE USE ON GROUND WATER IN NORTH CAROLINA

Prepared for The North Carolina Pesticide Board

Prepared by
The Interagency Work Group:

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Carl Bailey, Agency Project Coordinator, DEHNR
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Bill Williams, Agency Project Coordinator, DEHNR
Alan York, Pesticide Advisory Committee, NCSU

Sponsoring Agencies:
N.C. Department of Agriculture
N.C. Department of Environment, Health, and Natural Resources

March 4, 1997

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TABLE OF CONTENTS

	Page
Acknowledgments	2
Disclaimer	2
List of Figures	4
List of Tables	5
List of Appendices	6
Executive Summary	7
Introduction	9
Materials & Methods	10
Selection of Target Pesticides	10
Selection of Phase I Well Sites in the Ambient Ground Water Network	10
Selection of Phase II Well Sites in Vulnerable Pesticide Use Areas	10
Monitoring Well Site Questionnaires	12
Pre-Site Monitoring Well Questionnaire	12
Pre-Construction or Existing Monitoring Well Site Questionnaire	12
Pesticide Use Survey Form	12
Monitoring Well Construction	12
Sample Collection and Shipment	12
Sample Collection	13
Measuring In-Situ Field Parameters	13
Purging the Monitoring Well and Collecting Ground Water Samples	13
Collecting Field Blanks	14
Sample Shipment	14
Drinking Water Well Sampling	14
Laboratory Analytical Methods	14
Division of Water Quality Laboratory	14
Department of Agriculture Laboratory	15
State Laboratory of Public Health	15
Development of Health-Based Guidance Levels for Pesticides in Drinking Water	15
Notification of Cooperator Landowner Results from Monitoring Well Samples	16
Results and Discussion	17
Phase I	17
Phase II	17
Previously Registered Pesticides Detected in Ground Water	18
Registered Pesticides Detected In Ground Water	21
Summary of Results	27
Conclusions	29
Additional Studies	30
References	31
Glossary	34

LIST OF FIGURES

Page

Figure 1 - Locations of ambient monitoring wells sampled in phase I 36

Figure 2 - Plot of the depths of sampled ambient monitoring wells 37

Figure 3 - Number of cooperator monitoring wells in each county in phase II 38

Figure 4 - Ground water vulnerability predicted using the Pesticide DRASTIC method for Halifax County, North Carolina 39

Figure 5 - Locations of cooperator monitoring wells sampled in phase II 40

Figure 6 - Diagram of cooperator monitoring well construction details 41

Figure 7 - Locations of detected pesticides or metabolites in monitoring wells 42

LIST OF TABLES

Page

Table 1 - The 31 primary target pesticides, their leaching potential ratings, and the number of monitoring wells with nearby pesticide use 43

Table 2 - List of laboratory analytes and their target quantitation limit in parts per billion for the Division of Water Quality Laboratory 44

Table 3 - List of laboratory analytes and their limit of detection in parts per billion for the NCDA Laboratory 46

Table 4 - Counties, number of cooperator monitoring wells, and type of monitoring sites 48

Table 5 - Sampling dates, chemicals detected and concentrations, well construction description, and measured water levels in ambient and cooperator monitoring wells 49

Table 6 - Target pesticides, pesticide leaching potential rating, soil series, soil leaching potential index, and DRASTIC parameters for ambient and cooperator monitoring wells 55

Table 7 - Summary of laboratory analyses of ground water samples collected from monitoring wells 63

Table 8 - Sampling dates and laboratory analytical data for ground water samples collected from domestic wells after two detections of the same pesticide in an ambient or cooperator monitoring well 64

Table 9 - Health-based guidance levels, ground water quality standards, health advisory levels, and maximum contamination levels for detected chemicals 66

Table 10 - Site and soil data, Pesticide DRASTIC rating or aquifer, chemical reported and concentrations, > 50% of GWQS or IMAC, screen and water level data for all monitoring wells with detections of pesticides from nonpoint sources 67

Table 11 - Summary of laboratory analyses of ground water samples collected from domestic wells 70

LIST OF APPENDICES

Page

A - Soil Facts - Protecting Groundwater in North Carolina: A Pesticide and Soil Ranking System 71

B - Summary of North Carolina's Hydrogeologic System 77

c - Pre-Site Monitoring Well Questionnaire 81

D - Pre-Construction or Existing Monitoring Well Site Questionnaire 82

E - Cooperator's Pesticide Use Survey Form 84

F - NC DEHNR Groundwater Section Monitor Well Log 85

G - Groundwater Field/Lab Form 86

H - NCDA Constable Laboratory - Pesticide Residue Section, Standard Operating Procedures (SOP) IGWS-1, IGWS-2, and IGWS-3 87

I - Notification letter for no detection 97

J - Notification letter for a detection 98

K - Evaluating Pesticide Movement in North Carolina Soils 99

EXECUTIVE SUMMARY

The North Carolina Departments of Agriculture (NCDA) and Environment, Health, and Natural Resources (DEHNR) conducted a cooperative study under the direction of the North Carolina Pesticide Board. The purpose of this statewide study was to determine if the labeled uses of pesticide products were impacting the ground water resources in North Carolina. Thirty-one widely used pesticides, previously identified by the U. S. Environmental Protection Agency (U. S. EPA, 1987) as potential contaminants of ground water, were selected as primary targets for the study.

In phase I of the study, 55 wells in the DEHNR Groundwater Section ambient monitoring network, representing the major drinking water aquifers of the state, were sampled at least twice and analyzed for pesticides.

In phase II of the study, 97 shallow cooperator monitoring wells were installed and subsequently sampled at least twice in 36 counties across the state. Sites for the cooperator monitoring wells were chosen based on an evaluation of the vulnerability of ground water to risk of contamination from the use of pesticides. Where possible, the areas of highest risk were intentionally selected for this study. Monitoring wells were located adjacent to and downgradient from areas where pesticides were reported to have been applied (within 300 feet) during the previous five years. They were constructed so that the shallowest ground water could be collected for analyses. The objective of these siting criteria was to use a scientific method for determining monitoring well locations so that the results from the study could be used as an early indication of the potential for problems associated with pesticides leaching into ground water. Results cannot be interpreted as representing the quality of ground water near pesticide use areas statewide because study methods targeted areas of highly vulnerable ground water. The cooperator monitoring locations included 79 crop sites and 18 other sites used for electrical substations, golf courses, highway right-of-ways, mosquito abatement areas, and residential termite control sites.

Wells were sampled in two rounds, approximately six months apart. If a chemical was detected in any well, a follow-up sample was collected from the same well and analyzed for the same chemical and any additional chemicals that the methods would detect. If a chemical was detected twice in ground water during sampling events on two separate dates, the closest domestic wells were sampled and analyzed for the detected chemical(s) and any additional chemicals that the methods would detect. The owners of the domestic wells were notified by the DEHNR Division of Epidemiology of the laboratory results, the health significance of detections, and the options available to them if a health risk was determined.

The analytical methods that were used by NCDA and DEHNR/Division of Water Quality (DWQ) laboratories analyzed ground water samples for more than 140 pesticides and other chemicals. The laboratories employed some of the same analytical procedures used by the EPA in their 1988 to 1990 National Pesticide Survey of drinking water wells.

Data collected show that 26 pesticides or metabolites of pesticides were detected in 33 of the 152 monitoring wells sampled in both phases of the study. Of these pesticides, the following 10 have been canceled by the EPA and are no longer used in North Carolina: DDD, DDE, DDT, dibromochloropropane (DBCP), 1,2-dichloropropane, dinoseb, endrin ketone, methylene chloride, mirex, and 2,4,5-T. Two of these chemicals (DBCP and methylene chloride) were found in excess of health-based guidance levels or North Carolina ground water quality standards at one location each.

The remaining 16 chemicals detected are either registered pesticides or metabolites of registered pesticides: acifluorfen, atrazine, BHC-alpha, BHC-delta, DCPA, dichlorprop, hexazinone, metribuzin, metribuzin DA, norflurazon, pentachlorophenol, prometon, simazine, tebuthiuron, triazine de-alkylated ethyl, and triazine dealkylated isopropyl. Four of these chemicals (BHC-alpha, BHC-delta, dichlorprop, and simazine) were found in excess of health-based guidance levels or North Carolina ground water quality standards at one location each, except for BHC-alpha which was found in excess of its health-based guidance level at three locations.

Twenty-two of the 26 chemicals detected in the study have moderate to very high leaching potential ratings. Other pesticides with similar or higher leaching potentials, which were used at these same sites, were not detected. The remaining four detected chemicals, which have very low to low leaching potentials, are persistent pesticides (or their metabolites) whose registrations have been canceled by the EPA.

In the ambient monitoring well phase of the study, seven of 55 wells had pesticide residues detected in at least one water sample collected from each of them. In a shallow ambient well located in the Sand Hills region, hexazinone was found during two sampling events at a concentration below a health-based guidance level. All other detections

were single event occurrences in this phase of the study, including a detection of BHC-alpha at a concentration in excess of its health-based guidance level. Forty-eight of the 55 wells had no pesticide residues detected in water samples collected from them.

In the cooperator monitoring well phase of the study, 26 of 97 wells had pesticide residues detected in at least one water sample collected from each of them. Nine wells had detections of pesticides that exceeded 50 percent, of North Carolina ground water quality standards or health-based guidance levels. Six of these nine wells had levels which exceeded standards or guidance levels. The remaining detections ranged from less than 1 to 50 percent of North Carolina standards or guidance levels. Seventy-one of the 97 wells had no pesticide residues detected in water samples collected from them.

Seventeen cooperator monitoring wells had multiple detections of one or more pesticides. Six of these 17 wells had pesticide concentrations greater than 50 percent of their ground water quality standards or health-based guidance levels, which could trigger the development of pesticide specific State Management Plans. One of the following five pesticides was detected in these six wells: atrazine, UHC-alpha, dibromochloropropane, 1,2-dichloropropane, and simazine. Simazine was detected at least twice in ground water at four of 20 sites where applications were reported to have occurred within 300 feet of the monitoring wells within five years before sampling. At one of these sites, the simazine concentration in ground water exceeded the North Carolina ground water quality standard (interim maximum allowable concentration). Atrazine was detected at least twice in ground water at two of 22 sites where applications were reported to have occurred within 300 feet of the monitoring wells within five years before sampling. Neither of these atrazine detections exceeded the North Carolina standard (interim maximum allowable concentration). At another location, dibromochloropropane exceeded the ground water quality standard. At an additional location, 1,2-dichloropropane exceeded 50 percent of the ground water quality standard. BHC-alpha exceeded a health-based guidance level at a different location. Fourteen of the 17 sites with detections were in locations where soils have high to very high leaching potential indices. Only one currently registered pesticide, simazine, was found in a location where the soil had a low leaching potential index.

E'orty-six domestic drinking water supplies, which were near the 18 monitoring wells with multiple detections of one or more pesticides were sampled during the study. Eight of these supplies were found to contain pesticide or nonpesticide residues. The 11 pesticides, all of which have moderate to very high leaching potential ratings, were alachlor, atrazine, bentazon, 2,4-D, DCPA, 1,2-dichloroethane, 1,2-dichloropropane, lindane, prometon, simazine, and 2,4,5-TP. Five domestic wells contained at least one pesticide (alachlor, 1,2-dichloropropane, or simazine) in excess of health-based guidance levels. Thirty-eight of the 46 domestic drinking water supplies had no pesticide residues detected in samples collected from them.

Some of the pesticides or metabolites most frequently detected in ground water monitoring wells in this study were in the triazine family of pesticides: atrazine (two wells); hexazinone (two wells); metribuzin (one well); a metabolite, metribuzin DA (one well); prometon (two wells); simazine (five wells); and two metabolites, triazine dealkylated ethyl (four wells) and triazine dealkylated isopropyl (two wells). These results suggest that some of the triazine pesticides should be considered for State Management Plan actions, ranging from intensive applicator education up to and including the adoption of rules prescribing use restrictions of these chemicals in the more vulnerable areas of the state.

Nine of the pesticides and pesticide metabolites detected in shallow cooperator monitoring wells are no longer registered for use in the state. These results indicate that some canceled pesticides and pesticide metabolites persist in ground water for many years and can be a potential health concern for users of shallow domestic wells. Domestic water supply wells can be subject to contamination from many sources. Poor well construction or damaged well components can provide a direct pathway for contamination to enter a well at the soil surface or subsurface. Many domestic wells have been constructed so that the water supply is drawn from the shallowest aquifer, which is the most vulnerable to contamination from surface activities. The results from the sampling of domestic wells in this study indicate that there is the potential for contamination of these wells if they are withdrawing shallow ground water and are close to pesticide use areas.

In the 26 cooperator monitoring wells with pesticide detections, the depth to ground water was less than 25 feet and in the majority of these wells, 10 feet or less. Depth to water will be a factor considered in the development of required pesticide specific State Management Plans.

INTRODUCTION

The purpose of this statewide study, which was directed by the N.C. Pesticide Board from 1990 to 1995, was to determine if the labeled uses of pesticide products were impacting the ground water resources of North Carolina. Thirty-one pesticides, previously identified as potential contaminants of ground water in the United States (U.S. EPA, 1987), were selected as primary targets for the study (Table 1-p. 43). Water samples were analyzed by the North Carolina Department of Agriculture and the Department of Environment, Health, and Natural Resources/ Division of Water Quality laboratories which employed many of the same analytical procedures utilized by the EPA in their National Pesticide Survey of ground water (U.S. EPA, 1990b). The seven laboratory analytical methods initially utilized by the Division of Water Quality, Department of Environment, Health, and Natural Resources and the North Carolina Department of Agriculture analyzed ground water samples for more than 140 pesticides and other chemicals (Tables 2-p. 44 and 3-p. 46). Additional analytical methods were added by the laboratories in July 1994. The results from this study will provide the North Carolina Pesticide Board with the scientific basis for determining whether pesticide specific State Management Plans, separate from those required by the EPA, are needed to protect the health, safety, and environment of the people of North Carolina.

The plan for this study was developed and implemented by the Interagency Work Group consisting of staff from the Department of Agriculture and the Department of Environment, Health, and Natural Resources. At the time of its development, the group surveyed pesticide and ground water monitoring activities conducted in North Carolina. Although a number of studies of pesticides in ground water have been conducted, and several others have been initiated since this study began, all prior studies were limited either to a particular geographic area or to a small group of pesticides. Thus, the work group determined that a *comprehensive statewide study was needed to ascertain whether primary pesticide leachers used in the state were impacting ground water resources* (Interagency Working Committee on Ground Water Monitoring, 1988). The Interagency Study of the Impact of Pesticide Use on Ground Water in North Carolina was designed in response to this need.

Because the study could not examine every site at which pesticides were used, monitoring in the first phase focused on the major aquifers of the state. The second phase concentrated on hydrogeologically vulnerable areas.

During phase I of the study, ground water samples were collected and analyzed for pesticides from existing Groundwater Section Ambient Monitoring Network wells. The network wells are located throughout the state in the major aquifers that serve as principal sources of ground water used for domestic and municipal drinking water supplies (Figurel-p. 36 and 2-p. 37). Monitoring ground water from these wells provided information about the occurrence of pesticides in the major drinking water aquifers of North Carolina.

In phase II of the study, ground water samples were collected and analyzed from 97 new shallow monitoring wells installed in 36 counties (Figure 3-p. 38 and Table 5-p. 49). These wells were located on cooperating landowners' property where pesticides were used and the shallow ground water was moderately to highly susceptible to contamination. These monitoring locations included 79 crop sites and 18 other sites, which represent electrical substations, golf courses, highway right-of-ways, mosquito abatement areas, and residential termite control sites (Table 6-p. 55).

The detection of the same pesticide more than once in a well was given more significance than a pesticide that was detected only once. This was done because the laboratory analytical methods were capable of detecting many chemicals at sub-parts-per-billion levels and water samples could have become contaminated at the wellhead during collection or shipment to the laboratory. Nevertheless, the lack of a detection in a repeat sample did not disprove the earlier detection because ground water is a dynamic system, which is both spatially and temporally variable.

The study protocol stated that whenever a chemical was detected at least twice in the same well, the closest domestic drinking water wells around that site were to be tested for that chemical.

Selection of Target Pesticides

Thirty-one pesticides were identified as targets for analyses in the Interagency Pesticide Ground Water Study (Table l-p. 43). Twenty-nine of these pesticides were ranked among the top 10 in terms of use within a category (fungicides, herbicides, insecticides, and nematicides) on each of 25 major North Carolina crops in 1987, according to estimates by Cooperative Extension Service Specialists at North Carolina State University (personal communications, 1987). These 29 pesticides were also found on the EPA's February 4, 1987, list of chemicals that are likely to be found in ground water (U.S. EPA, 1987). Even though they have low leaching potentials, carbaryl, chlorothalonil, and trifluralin were also included in the study because they were on the EPA's list of chemicals found in ground water (Humburg et al., 1989; McLaughlin et al., 1994; Weber, 1995). The Interagency Pesticide Ground Water Study work group also decided to add chlordane and heptachlor to the state's target list because of their once widespread use around structures for termite control and their detections in other ground water studies (Robbins, 1988; Cape Cod, 1987). Neither has a high leaching potential due to their high sorption onto soil (U.S. EPA, 1986a; U.S. EPA, 1986b).

Selection of Phase I Well Sites in the Ambient Ground Water Network

In phase I of the study, water samples were collected and analyzed from 55 wells selected from the extensive North Carolina ambient ground water monitoring network (Figure1-p. 36 and Table 6-p. 55). The Groundwater Section and the U.S. Geological Survey (USGS) constructed this network in order to monitor the water quality and quantity in the state's aquifers.

From 1965 through 1987, the statewide ambient network consisted of 611 research station wells managed and monitored by the Groundwater Section. Since 1987, only a portion of this network has been actively monitored for water levels by both the Groundwater Section and the USGS. Extensive historical information on both water level and water quality exists for most of the wells in this network. The wells selected for pesticide sampling have a wide distribution throughout the state and include aquifers in the Coastal Plain, Piedmont, and Mountain regions. The aquifers have varying thicknesses, well yields, and water quality. In the Coastal Plain region, underlying sediments create a layered system of aquifers separated by confining zones of less permeable sediments. In the Piedmont and Mountain regions, the aquifer system is composed of saprolite (or residuum) overlying bedrock. The pore space in the saprolite and the fractures in the bedrock contain the ground water. Where the aquifers yield sufficient potable water, they are used as sources of drinking water. Additional information on the aquifer systems of the state is provided in Appendix B.

An effort was made to select wells that are representative of the state's important aquifers. A greater density of wells were selected in the eastern part of the state because more aquifers exist in the Coastal Plain.

Selection of Phase II Well Sites in Vulnerable Pesticide Use Areas

In phase II of the study, cooperator monitoring wells were installed in locations where pesticides were reported to have been used in the last five years and where shallow ground water was susceptible to contamination. Ground water samples were collected from each of these wells and analyzed for at least 140 different chemicals. As opposed to the ambient network wells which represent regional aquifer conditions, the cooperator wells were intentionally located in sites believed to be susceptible to ground water contamination from routine, labeled pesticide use. Several evaluations were conducted in order to locate areas of the state at maximum risk from pesticide contamination.

First, an evaluation was made at the statewide level using agricultural data from the N.C. Agricultural Statistics (1985), U.S. Bureau of Census (1982), and acreage estimates by North Carolina State University Cooperative Extension Service Specialists (personal communications, 1987). The three counties with the largest planted acreages of each of 25 major North Carolina crops were selected from this information. This process resulted in a list of 39 counties designated to have cooperator monitoring wells. In some of these counties, however, cooperators were not found. Thus, more wells were installed in counties that already had cooperator monitoring wells. The final count

resulted in 36 counties having at least one monitoring well (Table 4-p. 48 and Figure 3-p. 38).

Second, in order to identify suitable areas to locate monitoring wells, each county was evaluated for ground water vulnerability to pesticide contamination using the U.S. EPA DRASTIC method (Aller et al., 1987). The name DRASTIC is an acronym derived from seven hydrogeologic parameters: D - Depth to Water, R - Net Recharge, A- Aquifer Media, S - Soil Media, T- Topography, I - Impact of the Vadose (Unsaturated) Zone Media, and C- Hydraulic Conductivity. This standardized method was designed to be used on a regional scale in many different hydrogeologic settings. Although there were other methods available to evaluate hydrogeologic vulnerability, the DRASTIC method is the only nationally recognized, standardized method. DRASTIC analysis was conducted by creating layers for each of the seven parameters. Each of these parameters was rated according to its contribution to ground water vulnerability. Each DRASTIC factor was assigned a relative weight ranging from one to five. The result was a county Pesticide DRASTIC vulnerability map showing regions of theoretical vulnerability to ground water contamination. A Pesticide DRASTIC map for Halifax County is shown in Figure 4-p. 39.

Third, local agents of the USDA Natural Resources Conservation Service (NRCS), Soil and Water Conservation Districts, and/or N.C. Cooperative Extension Service (NCCES) assisted Pesticide Study personnel in locating farms growing the target crop(s) in the most vulnerable areas indicated on the county DRASTIC maps. Pesticide Study staff held regional meetings (three to four counties at a time) with representatives of the above three agencies during which the purpose of the study was presented and the assistance of the county representatives was sought in order to identify potential cooperators. The county Cooperative Extension Service agents contacted the Pesticide Study staff when they identified potential cooperators. In the final evaluation step, Pesticide Study staff and county representatives visited the farm(s). The study staff discussed the project with the potential cooperator. They were informed that the purpose of the study was to determine, through ground water sample analyses, if the ground water had become contaminated below areas where pesticides had been applied in accordance with pesticide labeling. It was also explained that if a pesticide or metabolite was detected in ground water, the landowner or operator would not have any regulatory action taken against them by the N.C. Pesticide Board provided the pesticide had been used in accordance with its labeling. If the potential participant agreed to cooperate and have a monitoring well installed in some location, the farmer and study staff visited one or more target crop fields. Because the DRASTIC maps were created on a regional scale and thus were not suitable for site specific hydrogeologic evaluation, each potential field was evaluated separately based on the following hydrologic criteria: soils, landscape position and slope, depth to ground water, and surface and ground water flow paths. Also included in the site evaluation were the accessibility for well installation and sampling, proximity to man-made structures, and fields managed by other farmers. Any potential point sources of contamination were avoided as much as possible. In addition, in order to participate in the study, the cooperator must have used some of the target pesticides on the target crop and verified that potential point sources of pesticides were absent within 300 feet of the proposed monitoring well site. The cooperator was requested to provide a five-year history of the pesticide use within 300 feet of the proposed monitoring well site. The final site selection was based on areas with the most vulnerable hydrogeologic characteristics and the least possibility of contamination from sources other than the labeled use of pesticides on crops. Each well was sited downgradient from the target pesticide use area and as close to it as possible. Eighty-one sites were selected for the counties and crop types listed in Table 4-p. 48.

In addition to the wells on crop sites, 19 wells were installed at noncrop sites where pesticides were used. These sites included electrical substations, golf courses, highway right-of-ways, mosquito abatement areas, and residential termite control sites. The selection process for these wells was similar to that used for the crop locations.

Monitoring Well Site Questionnaires

Monitoring well site questionnaires were used in both monitoring phases to assess the history of pesticide use and other land use practices at each ground water monitoring location. Each form is discussed below.

Pre-Site Monitoring Well Questionnaire

Once each cooperator monitoring well site was identified, individuals who owned or operated land within 300 feet of the well were asked a series of questions to determine if the site met the final criteria of the study. The Pre-Site Monitoring Well Questionnaire (Appendix C) was used to determine if any of the target pesticides were used and if any potential point sources of contamination existed within 300 feet of the monitoring well site.

Pre-Construction or Existing Monitoring Well Site Questionnaire

The Pre-Construction or Existing Monitoring Well Site Questionnaire (Appendix D) was used to determine pesticide use for the previous five years on cropland and noncropland within 300 feet of the monitoring well, the number of active wells within 1000 feet of the monitoring well, and the presence of any body of water within 300 feet of the monitoring well.

Pesticide Use Survey Form

The Cooperator's Pesticide Use Survey form (Appendix E) was used to record pesticide applications within 300 feet of the monitoring well site. The form also indicated whether rainfall had occurred after each pesticide application.

Monitoring Well Construction

After a new cooperator monitoring well site was selected, the well was installed by the Groundwater Section's Pesticide Study staff and Technical Services Unit drill crew. Wells were constructed following both the Groundwater Section's well construction regulations (N.C. Environmental Management Commission, 1992) and the well construction quality assurance/quality control (QA/QC) procedures in the U.S. EPA Region IV SOP Manual (U.S. EPA, 1991).

Each cooperator monitoring well was drilled using a CME 55[1] or CME 75[1] drill rig with hollow stem augers. A continuous sampler rode just ahead of the lead auger, enabling the geologist or field technician to log relatively undisturbed soil and sediment samples in five-foot intervals. Through interpretation of the well logs, an attempt was made to place the top of the screen at or just above the seasonal high water table. The bottom of the screen was positioned so as to be a minimum of three feet below the water table year round. All cooperator monitoring wells were constructed using two-inch stainless steel screen and riser pipe.

Written records of each well were completed during installation by both the geologist (or technician) and by the well driller. A sample geologist's log is included in Appendix F. The well's stratigraphy, total depth, screened interval, depth of filter pack, bentonite seal, grout, water level after drilling, and any other information pertinent to the drilling and well installation process were all recorded in the field.

Upon completion of each well, a steel cover with a locking cap was cemented over the top of the riser pipe. Most covers were 1.5 feet above the ground. If requested by the cooperator, a grade-level locking cover was used to minimize obstruction. A state map showing the approximate locations of installed wells is included in Figure 5-p. 40.

A diagram of a typical completed well is shown in Figure 6-p. 41. The two-inch stainless steel screen and riser were centered in the well annulus. Filter-pack sand extended from the total depth of the well to two feet above the top of the screen while the bentonite seal extended from above the filter pack to approximately 1.5 feet below grade. Concrete grout sealed the top of the well and held the locking cover. After well construction was completed, a warning label was attached, and the well cover was locked with a padlock.

Sample Collection and Shipment

A hydrogeologist and hydrogeological technician assigned to the study from each of the seven DWQ regions conducted most of the sampling in phase I. A central office hydrogeological technician, assisted by a hydrogeologist or technician from the regional office, conducted the sampling in phase II and the latter part of phase I. Sample collectors were trained in U.S. EPA and DWQ Groundwater Section QA/QC techniques for ground water measurements and sample collection (U.S. EPA, 1991; NC DEHNR, 1990).

[1] Central Mine Equipment Co., 4215 Rider Trail North, Earth City, MO 63045.

Sample Collection

A "sampling event," as defined for this study, involved measuring water level, temperature, and electrical conductivity in the well, collecting field blanks, purging the well, and collecting ground water samples. A sampling event for a single well sometimes took an entire day.

Wells were sampled in two rounds, approximately six months apart. If a chemical was detected in any well, a follow-up sample was collected from the same well and analyzed for the same chemical and any additional chemicals that the methods would detect.

Extensive precautionary measures were used to reduce the risk of contaminating samples (due to sampling technique) during the sampling event. Personnel wore clean, disposable latex gloves throughout sampling operations. Gloves were changed if they came in contact with any unclean surface. All equipment was cleaned following established QA/QC protocols before and after contact with the monitoring well and ground water sample.

Measuring In-Situ Field Parameters

Before sampling a well, four measurements were taken with a YSI 3000 mete?. First, the probe was lowered to the bottom of the well to measure total depth. Second, the probe was raised to the top of the water level in the well to measure depth to water, temperature, and electrical conductivity. Depth measurements were recorded to the nearest 0.1 foot in a field notebook. All data were later transferred to the Groundwater Field/Lab Form (Appendix G). Field parameters were measured during all phase II monitoring well sampling; however, these in-situ field parameters were not taken during phase I sampling of ambient network wells because of the unavailability of the YSI meter.

Purging the Monitoring Well and Collecting Ground Water Samples

Every well was purged of standing water before sampling. The volume of purged water was dependent on the characteristics of the individual well. Most of the time, wells were purged a minimum of three well volumes, determined by the following equation:

$$V3 = 3 \times (0.041 \times D^2 \times h)$$

where: V3 = amount of water in three well volumes in gallons,
D = well diameter in inches, and
h = height of the water column in the well in feet.

The "three volume" purging technique was developed by the EPA as a method to ensure that the water in the well is representative of ground water quality.

Wells were purged with a pump or bailer depending on the size and depth of the well. Deep wells, four inches in diameter or larger, were purged with a four-inch submersible pump; deep wells smaller than four inches in diameter were purged with a two-inch submersible pump. Shallow wells were purged using hand bailers, Waterra® handpumps[3], or submersible pumps. The same equipment was used to purge and sample each well.

During the first four sampling events of phase II, the Waterra® pump was used to purge (three well volumes) and collect the samples. This sampling method was later abandoned because the surging action of the pump created considerable aeration and siltation of the sample. In order to purge and collect all subsequent samples from cooperator monitoring wells, a Grundfos Redi-Flo2® two-inch submersible pump[4] was used. After plastic tubing was attached to the pump outlet, the pump was lowered two to three feet into the water table. The wells were purged at a low flow rate (not exceeding two to three gallons per minute) so as not to disturb the well's filter pack, and the outflow was monitored for temperature and conductivity. When temperature and conductivity stabilized, purging was assumed to be complete. If the well was particularly productive or the top of the screened interval was below water level, purging was continued until at least three volumes had been purged in order to ensure that representative formation water entered the well.

Once purging was complete, the sample bottles were filled. For the ambient network wells and the first four wells of phase II, six bottles were filled: four 4-liter and two 40-ml sample bottles. For the rest of the cooperator monitoring wells, eight bottles were filled: four 4-liter and four 40-ml sample bottles.

Immediately after the four-liter sample bottles were filled, samples were collected in 40-ml bottles using the lowest flow rates possible so as not to overflow the bottle but allow for a slight meniscus at the top before capping. These bottles were tapped to remove air bubbles, and the caps were carefully tightened to exclude air in the bottles. The bottles were shaken for one minute to mix the buffer with the water sample.

A Groundwater Field/Lab Form was completed for each well (Appendix G). Before leaving the site, the pump and YSI meter were thoroughly cleaned

[2] YSI Incorporated, Yellow Springs, OH 45387.
[3] Waterra USA, 7282 Augusta Dr., Boulder, CO 80301.
[4] Grundfos Pumps Corp., 2555 Clovis Ave., Clovis, CA93612.

following established QA/QC protocols, and the tubing and any other disposable equipment were discarded. Finally, before departing the sampling site, the well cover was locked.

Collecting Field Blanks

Field blanks are samples of laboratory water that were pumped through clean sampling equipment in the field before monitoring well purging and sampling. Blanks ensure the cleanliness of sampling equipment and the effectiveness of field QA/QC procedures.

Field blanks were collected and handled in the field in the same manner as monitoring well samples. When a bailer was used to collect the sample, the laboratory grade water was poured into the bailer and then into the sample bottle(s). When a pump was used to collect the samples, the laboratory grade water was poured into a PVC tube with a closed end and then pumped through a short length of plastic tubing into the sampling vessel(s).

In addition to field blanks collected during follow-up sampling events, field blanks were also collected periodically to ensure the effectiveness of field and laboratory QA/QC. The blank sample bottles were handled and shipped along with the bottles containing samples from monitoring wells and analyzed by both the NCDA and DWQ laboratories. When collected with follow-up samples, blanks were analyzed only for the pesticide(s) detected in the previous sample.

Sample Shipment

After monitoring well samples and field blanks were collected and labeled, coolers containing the sample bottles were filled with ice and sealed with tape. The ice level remained just below the caps of the sample bottles before delivery. From the field site, samples were transported to Raleigh laboratories by one of two methods: 1) delivery to the nearest DEHNR regional office for shipment to Raleigh by state courier or 2) delivery directly to the laboratories by Groundwater Section staff. The sampling vehicle was always locked when samples were inside to ensure security.

When samples were shipped via the state courier, the coolers were addressed to the DWQ Lab with the Groundwater Field/Lab Forms enclosed inside or taped on the outside of the coolers. Once the DWQ Lab received the coolers, staff notified the NCDA Lab to retrieve the sample bottles to be analyzed by the NCDA. Direct shipment of samples was delivered to the DWQ Laboratory by 4:00 p.m. on Wednesday of any particular week.

Drinking Water Well Sampling

The study protocol stated that whenever a chemical was detected at least twice in the same well, the closest domestic drinking wells around that site were to be tested for that chemical. A state industrial hygiene consultant andlor a designated representative conducted the sampling of residential wells, and the DEHNR State Laboratory of Public Health conducted the analyses. Results, including a toxicological risk assessment, were reported to the well owners and the local health department. When domestic wells contained chemical concentrations in excess of health-based guidance levels, the pesticide registrants were notified so that they could provide technical assistance or offer funds to cover the construction of a new well.

Laboratory Analytical Methods

The analyses of monitoring well samples were conducted by laboratories of the NCDA and the DWQ, DEHNR. These two laboratories utilized different analytical methods so that the workload could be shared and more chemicals could be analyzed. If both labs detected the same chemical, the higher concentration was reported.

The State Laboratory of Public Health analyzed water samples from domestic water supplies for pesticides or pesticide metabolites that were detected twice in nearby monitoring wells and additional chemicals that the methods would detect.

Division of Water Quality Laboratory

The DWQ laboratory used the following five methods for the determination of pesticide concentrations via capillary column gas chromatography (GC): 1) nitrogen pesticides with an electrolytic conductivity and nitrogen-phosphorus detectors (U.S. EPA, 1989b (Method 507)), 2) organophosphate pesticides with a flame photometric detector (U.S. EPA, 1990a (Method 8141A)), 3) chlorinated pesticides with an electron capture detector (U.S. EPA, 1989c (Method 508)), 4) chlorinated acid pesticides with an electron capture detector (U.S. EPA, 1989d (Method 515.1 and Method

625 for extraction of acid herbicides)), and 5) volatile organic compounds with an electrolytic conductivity detector in series with a photoionization detector (began utilizing this method in July 1994) (U.S. EPA, 1984a (Method 601) and U.S. EPA, 1984b (Method 602)). A list of all compounds analyzed by the DWQ laboratory is found in Table 2-p. 44.

Laboratory QA/QC was performed by daily injection of all method analyte standards and by utilization of surrogates, spikes, duplicates, and blanks with each analytical method. When a compound was detected, it was confirmed on a chromatographic column of different polarity.

Analytes and surrogates were quantitated using calibration curves with the compound quantitated falling between the lowest and highest point of the curve. If the compound quantitated fell below the target quantitation limit (TQL), a single point quantitation was made and the result labeled as an estimate. TQL is the concentration of an analyte in a sample, which can be reliably measured and quantitated by a given method.

No attempt was made to quantitate peaks not clearly separable from the background noise level. Furthermore, for peaks clearly distinguishable from background noise, amounts reported at or above the TQL were also estimated if interfering peaks from the sample extract did not allow clean chromatography in the area of the target analyte.

Department of Agriculture Laboratory

Throughout the study, the NCDA laboratory used three analytical methods for the detection of various pesticide residues by high performance liquid chromatography (HPLC) with an ultraviolet detector, residues of N-methylcarbamate and N-methylcarbamoyloxime pesticides by HPLC with post column derivatization, and residues of ethylene thiourea and some triazines by GC with a nitrogen-phosphorus detector. In July 1994, a fourth analytical method using GC with electron capture detection was added to detect residues of five volatile organic compounds.

For confirmation of detects or upon request, the NCDA laboratory has used several other pesticide screening methods and pesticide specific analytical methods including HPLC with photo diode array detection, GC with electrolytic conductivity detection, GC with mass spectrometer detection, and other specialized techniques.

Specific details on laboratory procedures, including information on receiving and storing samples, data dissemination and evaluation, and references for the EPA and Association of Official Analytical Chemists (AOAC) approved methods, are included in Appendix H, U.S. EPA, 1989e, and U.S. EPA, 1992. A list of all compounds analyzed by the NCDA laboratory is found in Table 3-p. 46.

State Laboratory of Public Health

The North Carolina State Laboratory of Public Health (DEHNR Division of Laboratory Services) used standard EPA methods for the analyses of pesticides and volatile organic compounds. Chlorinated pesticides were analyzed by capillary GC with an electron capture detector (U.S. EPA, 1989c (Method 508)). Pesticides containing nitrogen and phosphorous were analyzed by GC with a nitrogen-phosphorus detector (U.S. EPA, 1989b (Method 507)). When possible, identification and quantitation were confirmed by liquid-solid extraction and capillary GC/mass spectrometry with an ion trap detector (U.S. EPA, 1988 (Method 525)).

Volatile organic compounds were analyzed by purge and trap capillary GC with photoionization and electrolytic conductivity detectors in series (U.S. EPA, 1989f (Method 502.2)). Confirmation was made by capillary GC/mass spectrometry (U.S. EPA, 1989g (Method 524.2)).

Laboratory QA/QC included surrogates, spikes, duplicates, and blanks for each analytical method.

Development of Health-Based Guidance Levels for Pesticides in Drinking Water

The Division of Epidemiology, DEHNR, was responsible for assessing the human health risk of any pesticide contamination found in a domestic well during the study. Through the use of the EPA established MCLs (maximum contaminant levels), HALs (health advisory levels), and health-based guidance levels derived from toxicity information, the Division's toxicologists made risk assessments for any North Carolina citizen consuming water found contaminated in this study.

Notification of Cooperator Landowner Results from Monitoring Well Samples

Once the analytical results of the water samples were received by the central project coordinator, a letter was written to the cooperator, detailing the results and any future sampling planned for the specific well. (Sample notification form letters for no detection and a detection are shown in Appendices I and J, respectively.)

RESULTS AND DISCUSSION

Table 5-p. 49 is a summary of the sampling dates, chemicals detected with their respective concentrations, well construction details, and measured water levels in ambient and cooperator monitoring wells. In phase I of the study, the 55 ambient monitoring wells ranged in depth from 12 to 726 feet with a median of 130 feet (Figure 2-p. 37). In phase II, the top of well screens ranged from 2.5 to 38 feet below land surface with a median of 9 feet for 97 of the cooperator monitoring wells (excluding wells G121, G129, and G155). Water levels were recorded for eight of the ambient wells. For the cooperator monitoring wells, water levels ranged from 0.1 to 35.6 feet below land surface with a median of 4.3 feet (excluding G121, G129, and G155). Table 6-p. 55 is a summary of the target pesticides and their pesticide leaching potential ratings[5], together with the soil series, soil leaching potential indices, and DRASTIC parameters for all cooperator well sites. The pesticide leaching potential rating is determined by the persistence of the pesticide in the environment, the rate of application, the fraction of the pesticide reaching the soil during application, and the retention of the pesticide by soil organic particles (McLaughlin et al., 1994; Appendix A; Weber, 1990 and 1991; Warren and Weber, 1994; Appendix K; Warren et al., 1995). The study's analytical methods screened for pesticides with leaching potential ratings that ranged from very low to very high. The soil series recorded in the table is the series which was mapped in the county soil survey at the well site. Of the ambient monitoring wells, the only soil series recorded was for well G47 in Scotland County. The soil leaching potential index (0 to 100) is determined by three soil properties that affect pesticide leaching: organic matter, texture, and pH (McLaughlin et al., 1994; Appendix A; Weber, 1990 and 1991; Warren and Weber, 1994; Appendix K; and Warren et al., 1995). The soil leaching potential indices for the cooperator monitoring wells ranged from 10 to 95 with a median of 70 (excluding wells G93, G94, G121, G129, and G155). DRASTIC parameters were only determined for the cooperator well sites. Theoretical values with shallow wells can range from 46 to 256. The Pesticide DRASTIC values in the study ranged from 132 to 224 with a median of 190 (excluding wells G93, G94, G121, G129, and G155). Table 10-p. 67 summarizes the well, site, and pesticide information for each monitoring well with detections of pesticides. Figure 7-p. 42 is a state map which shows the approximate locations of monitoring wells with detections of pesticides. Table 11-p. 70 is a summary of laboratory analyses of ground water samples collected from domestic wells, which are near monitoring wells that each had a chemical detected twice in them.

[5] Weber, J. B. 1995 and 1996. Personal communications.

Phase I

In phase I of the study, nine of the 55 wells had at least one sample testing positive for a pesticide (Table 7-p. 63). The detection of the same pesticide more than once in a well was given more significance than a pesticide that was detected only once due to possible sample contamination. As an example of sample contamination related to sampling technique, merphos, which was detected in one water sample from well G45, is believed to have leached from a cotton rope used to drop a bailer into the well on September 30, 1991. Part of the rope was submerged in the well water during sampling. An analysis of unused cotton rope tested positive for merphos. Nylon cord was used thereafter on the bailer. Subsequent samples collected from the well did not contain any merphos.

Two pesticides were detected twice in two of these wells in separate sampling events. Hexazinone was detected twice in well G47. Well G46 tested positive for malathion, but the contamination was determined to be a point source. A water level recorder mounted inside a metal box attached to the top of the well had been sprayed with a 2 percent solution of malathion to control wasps. Four domestic wells were sampled near G46 and tested negative. At least two, and as many as four, sampling events were conducted on all 55 wells. An additional well, G29, was sampled only once and was then abandoned at the request of the landowner.

Phase II

In phase II, 100 cooperator monitoring wells were installed in 36 counties. These wells were sited downgradient from or within 81 crop sites and 19 other sites (Table 6-p. '55). Lab analyses were performed on ground water samples collected from 97 of the wells (Table 5-p. 49). At least two, and as many as four, sampling events were conducted for each of these 97 wells. Twenty-six wells had at least one sample with a detection (Table 7-p. 63). Fifteen different pesticides were detected at least twice in one or more of 17 wells. Nine of these pesticides or metabolites are currently registered for use as pesticides in North Carolina.

Three cooperator wells did not have ground water samples collected from them due to an insufficient water supply at each location. Well G121 in Union County was sited downgradient from a

soybean field. The drilling log for this well indicated that weathered bedrock had been encountered at a depth of 17 feet which prohibited further drilling. Following purging, the well did not produce a sufficient amount of ground water for a sample to be collected and thus was subsequently abandoned. Well G129 in Rowan County was sited downgradient from a corn field. The drilling log for this well indicated that weathered bedrock was encountered at a depth of 13 feet and that the formation material at a depth of 27 feet prohibited further drilling. Following purging, the well did not produce a sufficient amount of ground water for a sample to be collected. Well G155 in Iredell County was sited adjacent to an electrical substation on top of a hill overlooking a river. The estimated difference in elevation from the well location to the river was 170 feet. The drilling log for this well indicated that weathered bedrock prevented further auger drilling beyond a depth of 73 feet. The well did not produce a sufficient amount of ground water suitable for a sample (high siltation).

In July 1994, each of the laboratories added an analytical method to determine if some previously registered fumigant pesticides, dibromochloropropane, 1,2-dichloropropane, and ethylene dibromide, were present in monitoring wells. Ground water samples from 43 cooperator monitoring wells were analyzed at least two times, and samples from 22 wells were analyzed one time by these additional analytical methods. Dibromochloropropane was detected twice in well G116, and 1,2-dichloropropane was detected twice in well G122.

Previously Registered Pesticides Detected In Ground Water

Ten pesticides or their metabolites that are no longer registered for use in North Carolina were detected in monitoring wells: dibromochloropropane (DBCP), 1,2-dichloropropane, DDD, DDE, DDT, dinoseb, endrin ketone, methylene chloride, mirex, and 2,4,5-T (Table 5-p. 49 and Table 10-p. 67). None of these pesticides were reported to have been used five years before sampling. Dibromochloropropane was detected twice in monitoring well G116 at concentrations which exceeded the N.C. ground water quality standard (Table 9-p. 66).

The closest domestic drinking water wells were also sampled and analyzed to determine if pesticides or metabolites were present in ground water near monitoring wells in which the same pesticides or metabolites were detected on two different sampling events in ground water (Table 8-p. 64). Two domestic wells near G122 contained a pesticide (1,2-dichloropropane) at concentrations which exceeded its health-based guidance level.

DDD, DDE, and DDT

Well G35 was screened from a depth of 10 to 15 feet in the Surficial Sand aquifer of Jones County. This well was sampled three times during the study. The insecticide DDT, which has a very low leaching potential, was detected once at 0.02 part per billion (ppb). This is below the health-based guidance level of 0.10 ppb. DDT products were canceled by the EPA in 1972. Before the first sample collection on July 15, 1991, a corn field located within 300 feet of G35 received recommended rates of atrazine and alachlor in 1987 and 1989. Atrazine has a moderate to high leaching potential and alachlor, a moderate leaching potential. No residues of either pesticide were detected in any of the water samples collected from G35.

Well G52, which was screened from a depth of 14 to 24 feet, was located in Chowan County on a Seabrook soil series having a very high leaching potential. Watermelons were grown 20 feet from this well. Three water samples were collected from the well. DDT was detected once at 0.02 ppb, which is below the health-based guidance level. Before the first sample collection on June 22, 1992, alachlor (1.2 pounds per acre), metolachlor (0.83 pound per acre), aldicarb (1.4 pounds per acre), and chlorothalonil (1.13 pounds per acre) were applied to peanuts within 300 feet of the well. Alachlor was applied in 1988, while the other three pesticides were applied in 1991. In addition, carbofuran was applied at 0.5 pound per acre in 1992 to watermelons. Except for chlorothalonil, which has a low leaching potential, these four pesticides have moderate or high leaching potentials. No residues of any of these pesticides were detected in water samples collected from the well.

Well G59 in Beaufort County was four feet from a soybean field and was screened from a depth of 8.5 to 13.5 feet. The soil series at this location is Bayboro, which has a very low leaching potential. Ground water contained DDD in the first two of three samples collected from the well. The higher concentration detected was 0.06 ppb, which is less than the health-based guidance level of 0.14 ppb. DDD is a metabolite of DDT and has a very low leaching potential. DDD was also once marketed as an insecticide with the common name TDE. DDD

product registrations were canceled in 1971. In 1992, 2,4-D, which has a moderate leaching potential, was used in the adjacent field before the first sample collection on December 1, 1992, but it was not detected. In 1991, metolachlor, atrazine, and alachlor were used, but they were not detected. These pesticides have a moderate, moderate to high, and moderate leaching potential, respectively. Because DDD is very persistent in the environment, it is possible that it is present in the ground water from use that occurred many years ago.

Three domestic wells were sampled near G59 (Table 8-p. 64). Well G59-DW1, a 100-feet deep, drilled well, is located approximately 0.23 mile northwest of the monitoring well. Well G59-DW2, a 150-feet deep, drilled well, is located approximately 0.40 mile west. Well G59-DW3, a shallow bored well, is located approximately 0.28 mile southwest. No pesticides were detected in these three domestic wells.

Well G60 in Beaufort County was screened from a depth of 4 to 14 feet and was 10 feet from a wheat field. The soil series at G60 is Leaf, which has a low leaching potential. DDD was detected once at 0.05 ppb. This is less that the health-based guidance level. Before the first sample collection on December 1, 1992, acifluorfen at 0.75 pound per acre and alachlor at 1 pound per acre were used on soybeans, and 2,4-D was used at 0.18 pound per acre on wheat. Disulfoton was used at 3 pounds per acre on tobacco and metolachlor at 4 pounds per acre on corn. Diuron was used in 1990 through 1992 at 4 pounds per acre, and hexazinone was used in 1989 at 2.7 pounds per acre on a nearby railroad track. The leaching potentials of these pesticides are as follows: acifluorfen-moderate; alachlor-moderate; 2,4-D-moderate; disulfoton-moderate; diuron-moderate to high; metolachlor-moderate; hexazinone-high. None of these pesticides were detected in any of the three samples collected.

Well G73 in Bertie County was 70 feet from a peanut field and was screened from a depth of 3 to 8 feet. The soil series at this location is Tarboro, which has a very high leaching potential. DDE was found in the first, third, and fourth samples collected from the well. The concentrations ranged from 0.01 to 0.05 ppb. These are less than the health-based guidance level of 0.10 ppb. DDE is a metabolite of DDT and has a very low leaching potential. Refer to section on Registered Pesticides Detected In Ground Water for additional information on detections in well G73.

Three domestic wells were sampled near G73 (Table 8-p. 64). All were negative for DDE.

Dibromochloropropane

Well G116 in Moore County was within the pesticide treatment area of a grape vineyard and was screened from a depth of 18 to 23 feet. The soil series at this location is Lakeland, which has a very high leaching potential. Dibromochloropropane, which has a very high leaching potential, was detected in the second and third of four samples collected from the well. The higher concentration was 0.5 ppb, which is above the health-based guidance level and the N.C. ground water quality standard of 0.025 ppb. The farmer had used the pesticide many years ago in a different field that was upgradient from the well. Its use was canceled by the EPA in the 1970s. Simazine, which has a moderate to high leaching potential, was last used in this field in 1993 at two pounds per acre before the first sample collection on March 8, 1994, but it was not detected in ground water.

Two domestic wells were sampled near G116 (Table 8-p. 64). Well G116-DW1, a hand-dug well approximately 35 feet deep, is located approximately 0.28 mile west of G116. Well G116-DW2, a 60-feet deep, drilled well, is located approximately 0.25 mile southwest of G116. No pesticides were detected in these two domestic wells.

1,2-dichloropropane

Well G122 in Montgomery County was 22 feet from a peach orchard and was screened from a depth of 13 to 23 feet. The soil series at this location is Norfolk, which has a high leaching potential. The pesticide, 1,2-dichloropropane, was detected in the first two of three samples collected from the well. The higher concentration was 0.37 ppb. This level is less than the health-based guidance level of 0.51 ppb and the N.C. ground water quality standard of 0.56 ppb. Registration for 1,2-dichloropropane, which has a very high leaching potential, was discontinued before 1984. Although simazine was the target at this site, being last used in this peach orchard in 1993 at a rate of one pound per acre before the first sample collection on August 8, 1994, it was not detected.

Four domestic wells were sampled near G122 (Table 8-p. 64). Well G122-DW1, a drilled well with an estimated depth of 80 feet, is located approximately 0.38 mile east of the monitoring well. Well G122-DW2, a 70-feet deep, drilled well, is located 0.25 mile east of the monitoring well. Well G122-DW3, a 60-feet deep, drilled well, is located 0.25 mile southeast of the monitoring well. Well

G122-DW4, an SO-feet deep, drilled well, is located 0.5 mile southeast of the monitoring well. On the first sampling date, no chemicals were detected in G122-DW3 and G122-DW4. However, 1,2-dichloropropane was detected in G122-DW1 at 2.5 ppb and in well G122-DW2 at 5.5 ppb. On the second sampling date, 1,2-dichloropropane was detected at 2 ppb and 1,2,3-trichloropropane at less than 1 ppb in G122-DW1. In well G122-DW2, 1,2-dichloropropane was found at 5.6 ppb, 1,3-dichloropropane at less than 1 ppb, acetone at 23.7 ppb, and 1,2,3-trichloropropane at 1.5 ppb. Chloroform and 1,2-dichloroethane were detected at less than 1 ppb in G122-DW3. All of these detections exceeded health standards (Table 9-p. 66), and the residents were therefore advised not to drink the water. G122-DW4 had no pesticide detections.

Dinoseb

Well G70 in Halifax County was two feet from a cotton field and was screened from a depth of 6 to 11 feet. The soil series at this location is Gritney, which has a low leaching potential. Dinoseb was found in the first two of three samples collected from the well. The higher concentration was 1.4 ppb, which is less than the health-based guidance level of 7 ppb. The registration of dinoseb, which has a moderate leaching potential, was canceled by the EPA in 1986. Aldicarb, which has a high leaching potential, was last used in 1992 at 0.45 pound per acre before the first sample collection on March 31, 1993, but it was not detected. Methomyl was last used in 1989 at 0.23 pound per acre. Acifluorfen was last used during the same year at 0.25 pound per acre. Although both methomyl and acifluorfen have moderate leaching potentials, neither was detected.

Three domestic wells were sampled near G70 (Table 8-p. 64). Well G70-DW1, a 35-feet deep, bored well, is located 0.25 mile southwest of the monitoring well. Well G70-DW2, a 55-feet deep, drilled well, is located 0.13 mile south of the monitoring well. No pesticides were detected in either well. Well G70-DW3, a shallow bored well, is located approximately 0.23 mile south of the monitoring well. Well G70-DW3 tested positive for alachlor at 0.6 ppb, which exceeds the health-based guidance level of 0.4 ppb. This well is located within an agricultural field and had been used to fill spray equipment. The detection of the alachlor could be due to a point source contamination from the filling of spray equipment. Domestic use of well G70-DW3 has been discontinued by the owner.

Endrin Ketone

Wells G95 and G96 in Robeson County contained endrin ketone, which has a low leaching potential, in four samples collected from each well. Endrin ketone is a metabolite of endrin, a pesticide whose registration was canceled gradually by the EPA from 1979 to 1985. The highest concentration of endrin ketone detected in G95 was 0.34 ppb and in G96 was 0.15 ppb. The health-based guidance level developed by a state toxicologist in the DEHNR is 2.1 ppb.

Well G95 was screened from a depth of 14 to 19 feet and was six feet from a soybean field. The soil series at G95 is Cainhoy, which has a very high leaching potential. Refer to section on Registered Pesticides Detected in Ground Water for additional information on detections in G95.

Well G96 was screened from a depth of 13 to 18 feet and was six feet from a flue-cured tobacco field. The soil series is Norfolk, which has a high leaching potential. Refer to section on Registered Pesticides Detected in Ground Water for additional information on detections in G96.

Methylene Chloride

Well G119 in Moore County was eight feet from a sweet corn field and screened from a depth of 23 to 33 feet. The soil series at G119 is Candor, which has a very high leaching potential. Methylene chloride was detected in one sample at 120 ppb. This is in excess of the North Carolina ground water quality standard of 5 ppb. This chemical, which has a high leaching potential, was once contained in some pesticides registered for use as insecticides and repellents. Methylene chloride is presently used as a solvent in paint strippers and metal cleaners, and as a propellant in some aerosols. Refer to section on Registered Pesticides Detected in Ground Water for additional information on detections in G119.

Mirex

Well G130, which was screened from a depth of 12 to 22 feet, was located in Rowan County on an Enon soil series having a moderate leaching potential. The well was two feet from a tomato field. Three water samples were collected from the well. One contained the insecticide mirex at 0.06 ppb, which is below the health-based guidance level of 1.4 ppb. Mirex, which has a moderate leaching potential, was canceled by the EPA in 1976. Before the first sample collection on August 15, 1994,

chlorothalonil was used on tomatoes at 1.5 pounds per acre in 1993. In addition, in 1989 diazinon was applied to tomatoes at 0.5 pound per acre and metribuzin at 0.75 pound per acre. The leaching potentials of these pesticides are as follows: diazinon-moderate, metribuzin-moderate, and chlorothalonil-low. None of these three pesticides were detected in any of the samples collected.

2,4,5-T

Well G28 was screened from a depth of 122 to 132 feet in the Peedee aquifer of Pitt County. This well was sampled three times during the study. The herbicide 2,4,5-T, which has a high leaching potential, was detected once at 0.02 ppb. This concentration is well below the health-based guidance level of 70 ppb. Products containing 2,4,5-T were canceled by the EPA before 1984. During the five years before the first sample collection on June 17, 1991, no pesticides were reported to have been used within 300 feet of this well.

In Lenoir County, well G34, screened from a depth of 480 to 490 feet in the Upper Cape Fear aquifer, was sampled four times during the study. The herbicide 2,4,5-T was detected once at 0.07 ppb. This is less than the health-based guidance level of 70 ppb. Refer to section on Registered Pesticides Detected In Ground Water for additional information on detections in G34.

Registered Pesticides Detected In Ground Water

The following 16 currently registered pesticides or metabolites were detected in monitoring wells: acifluorfen, atrazine, BHC-alpha, BHC-delta, dichlorprop, DCPA, hexazinone, metribuzin, metribuzin DA, norflurazon, pentachlorophenol, prometon, simazine, tebuthiuron, and two triazine metabolites, triazine dealkylated ethyl and triazine dealkylated isopropyl (Table 5-p. 49 and Table 10-p. 67). Six monitoring wells, G18, G90, G119, G123, G125, and G147, had pesticide detections, which exceeded either health-based guidance levels or ground water quality standards. Two of these six wells had multiple detections of either BHC-alpha or simazine.

The closest domestic drinking water wells were also sampled and analyzed to determine if pesticides or metabolites were present in ground water near monitoring wells in which the same pesticides or metabolites were detected on two different sampling events in ground water (Table 8-p. 64). Three domestic wells near G70, G73, and G125 contained pesticides (alachlor or simazine) at concentrations which exceeded health-based guidance levels.

Acifluorfen

Acifluorfen, which has a moderate leaching potential, was used within 300 feet of 16 cooperator monitoring wells five years before sampling. It was detected at two of these sites, wells G95 and G96. Well G95 in Robeson County was sampled four times. (See "Previously Registered Pesticide Detected in Ground Water" for a full site description). Acifluorfen, which has a moderate leaching potential, was detected once at 0.1 ppb. It was used as a spot treatment in 1994 at label rates. The health-based guidance level for acifluorfen is 1 ppb. Near G95, trifluralin was last used in 1993 at one pound per acre and metribuzin at 0.38 pound per acre before the first sample collection on February 21, 1994, but they were not detected. In 1992, aldicarb was used at 1.5 pounds per acre and methomyl at 0.45 pound per acre but were not detected. In 1991, disulfoton was used at 0.5 pound per acre and metolachlor at 2 pounds per acre but were not detected. The leaching potentials of these pesticides are as follows: aldicarb-high; disulfoton-moderate; methomyl-moderate; metolachlor-moderate; metribuzin-moderate; trifluralin-low.

Well G96 in Robeson County was sampled four times. (See "Previously Registered Pesticide Detected in Ground Water" for a full site description). Acifluorfen was detected once at 0.4 ppb and DCPA, which has a high leaching potential, once at 0.02 ppb. The health-based guidance level for acifluorfen is 1 ppb and for DCPA is 70 ppb. Acifluorfen was used as a spot treatment in 1994 at label rates. We have no record that DCPA was used during the six years before the water sample was collected. Aldicarb was applied at 1.5 pounds per acre in 1993 before the first sample collection on February 22, 1994. In 1992, disulfoton was used at 0.5 pound per acre, metolachlor at 2 pounds per acre, and metribuzin at 0.32 pound per acre, but none of these pesticides were detected. In 1991, methomyl was used at 0.9 pound per acre, but it was not detected.

Only one domestic well was sampled near G95 and G96 (Table 8-p. 64) because this area is now supplied by county water, and only one currently used domestic well was located in reasonable proximity to the monitoring wells. Well G95-G96-DW1, a shallow, hand-driven well, is located 0.4 mile

northwest of the monitoring wells. It is adjacent to an agricultural field. No pesticides were detected in the water sample collected from this well.

Atrazine and Triazine Dealkylated Isopropyl

In the five years before sampling, atrazine applications were reported to have occurred within 300 feet of monitoring wells at 26 sites. All 26 sites had monitoring wells less than 35 feet deep. Atrazine, which has a moderate to high leaching potential, was detected twice in ground water at two of these sites, G69 in Halifax County and G73 in Bertie County (Table 5-p. 49).

Well G69, which was one foot from a sweet corn field, was sampled only two times because it was destroyed by some type of field equipment. The well was screened from a depth of 6 to 11 feet. The soil series at this location is State, which has a high leaching potential (Table 6-p. 55). Atrazine concentrations of 2.5 and 2.1 ppb were detected in these samples, which were greater than 50% of the N.C. interim maximum allowable concentration of 3 ppb. Triazine dealkylated isopropyl was detected in the second sample at 0.8 ppb. Both of these chemicals have moderate to high leaching potentials. Before the first sample collection, on April 12, 1993, atrazine and alachlor were last used on sweet corn in 1991 at 2 pounds each per acre. In 1993, atrazine was used on April 19, which was after the first sampling event, at 1.5 pounds per acre in combination with metolachlor at 1.5 pounds per acre. Neither alachlor nor metolachlor was detected. Both of these chemicals have moderate leaching potentials.

Two domestic wells were sampled near G69 (Table 8-p. 64). Because the rural area near this monitoring well is now served by the Halifax County Water System, no domestic wells nearby are utilized as sources of drinking water. Well G69-DW1, located 0.25 mile east of the monitoring well, is a deep, large-capacity, drilled well used only for cooling water for a prison cannery, Well G69-DW2 is a 60-feet deep, drilled well, approximately 1 mile east on a neighboring farm. No pesticides were detected in these samples collected from either well.

Well G73 was sampled four times during the study. (See "Previously Registered Pesticides Detected in Ground Water" for full site description.) Atrazine was detected all four times, and triazine dealkylated isopropyl was detected three times. The maximum atrazine and triazine dealkylated isopropyl concentrations were 1 and 1.4 ppb, respectively. Before the first sample collection on April 13, 1993, atrazine was last used on corn in 1992 at 2 pounds per acre in combination with alachlor at 1 pound per acre. Some other pesticides used were alachlor on peanuts at 3 pounds per acre; in different years, metolachlor on peanuts twice per season at 3 pounds per acre per application; aldicarb on peanuts at 1.05 pounds per acre; and norflurazon on cotton at 0.8 pound per acre. Aldicarb has a high leaching potential. Norflurazon has a moderate leaching potential. Alachlor, aldicarb, metolachlor, and norflurazon were not detected.

Three domestic wells were sampled near G73 (Table 8-p. 64). Well G73-DW1, a bored well of unknown depth, is located approximately 0.28 mile northeast of the monitoring well. Well G73-DW2, a bored well of unknown depth, is located approximately 0.5 mile southeast of the monitoring well. Well G73-DW3, a six-feet deep well, is located 1.5 miles north of the monitoring well. No pesticides were detected in either G73-DW1 or DW3. Well G73-DW2, which was within 100 feet of a corn field on an adjacent farm, tested positive for atrazine at 0.2 ppb and alachlor at 9.2 ppb on the first sampling date. On the second sampling date, atrazine was detected at 0.3 ppb and alachlor at 5 ppb. Because both samples contained alachlor in excess of standards, the owner of this well was advised not to consume the water.

BHC-alpha and BHC-delta

BHC-alpha, which has a moderate leaching potential and is an isomer of lindane, was detected in ground water at three sites, G18 in Duplin County, G90 in Sampson County, and G123 in Montgomery County BHC-delta, which has a moderate leaching potential and is also an isomer of lindane, was detected in well G119 in Moore County. There is no record of lindane being used within 300 feet of these wells during the five years before sampling. Three sites in the study are known to have had lindane applications within five years before sampling, but no lindane, BHC-alpha, or BHC-delta detections occurred at those sites.

In Duplin County, well G18, which was screened from a depth of 83 to 98 feet in the Peedee aquifer, was sampled three times during the study. BHC-alpha was detected once at 0.02 ppb. This is in excess of the health-based guidance level of 0.0056 ppb for combined concentrations of BHC-alpha, BHC-delta, and BHC-gamma. No pesticides were reported to have been used within 300 feet of the well within five years before the sampling events.

Well G90, which was screened from a depth of 11 to 21 feet, was located in Sampson County on a Lynchburg soil series having a moderate leaching potential. The well was eight feet from a cucumber field. Three water samples were collected from the well. One sample contained BHC-alpha at a concentration of 0.01 ppb. This is in excess of the health-based guidance level. Although well G90 is within 300 feet of a location which had applications of atrazine (1.34 pounds per acre to corn in 1989), metolachlor (1.67 pounds per acre to corn in 1989), carbaryl (0.06 pound per acre to cucumbers in 1993), 2,4-D (0.35 pound per acre to wheat in 1990), and methomyl (0.45 pound per acre to cucumbers in 1993), no residues of any of these pesticides were detected. Except for carbaryl, which has a low leaching potential, these four pesticides have moderate or high leaching potentials.

Well G119 was sampled three times during the study. BHC-delta was detected once at 0.02 ppb. This exceeds the health-based guidance level. Before the first sample collection on March 8, 1994, aldicarb was used at 1.5 pounds per acre and methomyl at 0.5 pound per acre in 1993 on tobacco. In 1989, 1991, and 1992, atrazine was used each year at 1 pound per acre, and metolachlor was used each year at 1.2 pounds per acre on sweet corn. Methomyl was also used on sweet corn at 0.6 pound per acre four times in 1989, three times in 1991, and once in 1993. Carbaryl was used twice at 1 pound per acre, and chlorothalonil was used twice at 1.5 pounds per acre in 1990 on watermelons. The leaching potentials of these pesticides are as follows: atrazine-moderate to high; aldicarb-high; carbaryl-low; chlorothalonil-low; methomyl-moderate; metolachlor-moderate. None of these pesticides were detected in any of the three samples collected.

Well G123, which was screened from a depth of 18 to 28 feet, was 20 feet from a soybean field. The soil series at this location is Norfolk, which has a high leaching potential. Well G123 contained BHC-alpha at 0.01 ppb on two sampling dates. This is greater than the health-based guidance level. Trifluralin was used in 1993 before the first sample collection on August 8, 1994, but it was not detected.

Three domestic wells were sampled near G123 (Table 8-p. 64), but no pesticides were detected. Well G123-DW1, a 75-feet deep, drilled well, is located approximately 0.08 mile south of the monitoring well. Well G123-DW2, an 85-feet deep, drilled well, is located approximately 0.13 mile southwest of the monitoring well. Well G123-DW3, an 85-feet deep, drilled well, is located approximately 0.28 mile northwest of the monitoring well.

DCPA

DCPA, which has a high leaching potential, was detected once at 0.02 ppb in well G96 in Robeson County. The health-based guidance level for DCPA is 70 ppb. We have no record that DCPA was used here within six years before initiation of sampling events. DCPA was used within 300 feet of two monitoring wells five years before sampling, but none was detected at these sites. Refer to "Previously Registered Pesticides Detected in Ground Water" for a full site description.

Dichlorprop

Dichlorprop, which has a moderate leaching potential, was detected once in well G147 at 2.2 ppb. This is greater than the health-based guidance level of zero ppb. This well was screened from a depth of four to nine feet in Buncombe County in a Hayesville soil series, which has a high leaching potential. The well was two feet from a hay field. We have no record of dichlorprop use five years before the collection of water samples from this or any other monitoring well. Before the first sample collection on November 1, 1994, carbofuran, which has a high leaching potential, was applied in 1993 and 1994 to alfalfa at labeled rates. No residues of carbofuran were detected in any of the samples.

Hexazinone

In the five years before sampling, hexazinone applications were reported to have occurred within 300 feet of monitoring wells at seven sites. Hexazinone, which has a high leaching potential, was detected multiple times in ground water at two of these sites, G47 in Scotland County and G105 in Sampson County (Table 5-p. 49).

Well G47, which was screened from a depth of 31 to 36 feet in a Lakeland soil series (very high leaching potential), was sampled four times. The first and third samples collected contained hexazinone at 1.5 and 5.2 ppb, respectively. The hexazinone health-based guidance level is 231 ppb. Before the first sample collection on October 30, 1991, hexazinone was applied at two pounds per acre in 1989 to a forest site within 25 feet of the well.

Only one domestic well was sampled near G47 (Table 8-p. 64). Well G47-DW1, a 60-feet deep, drilled well, is located about one mile west of the monitoring well. No pesticides were detected in this domestic well.

Well G105, which was screened from a depth of 14.5 to 19.5 feet, was within the pesticide

treatment site of a forest. The soil series at this location is Cainhoy, which has a very high leaching potential (Table 6-p. 55). Concentrations of hexazinone were detected during four sampling events. The concentrations ranged from 0.74 to 34 ppb. The health-based guidance level for hexazinone is 231 ppb. Before the first sample collection on December 7, 1993, hexazinone was applied at 2.5 pounds per acre in 1992.

Two domestic wells were sampled near G105 (Table 8-p. 64). Well G105-DW1, a drilled well, is located about 0.28 mile southwest of the monitoring well. Well G105-DW2, a drilled well, is located about 0.25 mile west of the monitoring well. No pesticides were detected in either of these domestic wells.

Metribuzin and Metribuzin DA

Metribuzin and metribuzin DA, which have moderate leaching potentials, were detected once at wells G12 and G117, respectively. We have no record of metribuzin use within 300 feet of these wells five years before sampling events. Metribuzin was used within 300 feet of 13 monitoring wells five years before sampling, but none was detected at these sites. In Carteret County, well G12, which was screened from a depth of 181 to 191 feet in the Castle Hayne aquifer, was sampled four times during the study. Metribuzin, which has a moderate leaching potential, was detected once at 4.5 ppb. This is less than its health-based guidance level of 91 ppb. No pesticides were reported to have been used within 300 feet of the well within five years before the sampling events.

Well G117, which was screened from a depth of 12.5 to 17.5 feet, was located in Moore County on an Ailey soil series, which has a high leaching potential. Part of a golf course receiving pesticide applications was six feet from the well. Three water samples were collected from the well. One contained metribuzin DA (a metabolite of metribuzin), which has a moderate leaching potential, at 1.6 ppb. This concentration is well below its health-based guidance level of 91 ppb. We have no record of metribuzin being used five years before the collection of the water samples. Before the first sample collection on March 7, 1994, chlorothalonil was applied at 15 pounds per acre to turf in 1994 and carbaryl at 5.5 pounds per acre to turf in 1993. Both of these pesticides have a low leaching potential. No residues of either pesticide were detected in any of the samples collected.

Norflurazon

Norflurazon, which has a moderate leaching potential, was detected twice in ground water at one of two sites (G138) where applications were reported to have occurred within 300 feet of the monitoring wells within five years before sampling. Well G138 in Lincoln County was 10 feet from an apple orchard and was screened from a depth of 12 to 17 feet. The soil series at this location is Pacolet, which has a high leaching potential (Table 6-p. 55). Measurable amounts of the herbicide were found in four water samples collected from the well. The concentrations ranged from 1.5 to 5.3 ppb. These levels are well below the norflurazon health-based guidance level of 280 ppb. Before the first sample collection on September 19, 1994, norflurazon was last used on the apple orchard in 1992 at 3.5 pounds per acre in a tank mix with simazine at 3.5 pounds per acre. Simazine, which has a moderate to high leaching potential, was also detected in the last three samples collected from this well. The simazine concentrations ranged from 0.62 to 2.0 ppb. These levels are below the N.C. interim maximum allowable concentration for simazine of 3.5 ppb. One sample exceeded 50% of the N.C. interim maximum allowable concentration for simazine, which could trigger the development of a pesticide specific State Management Plan. Although an application of 2,4-D, which has a moderate leaching potential, had occurred yearly at 1.7 pounds per acre, this herbicide was not detected in samples collected from this well.

Two domestic wells were sampled near G138 (Table 8-p. 64). Well G138-DW1, a drilled well, is located about 0.57 mile east of the monitoring well and within 15 feet of an orchard. Well G138-DW2, a drilled well, is located about 0.57 mile south of the monitoring well and within 60 feet of the orchard. No pesticides were detected in either well.

Pentachlorophenol

Pentachlorophenol, which has a high leaching potential, was detected in wells G13 and G34. We have no record of any pentachlorophenol use within 300 feet of any monitoring well within five years before any sampling event. Well G13 was screened from a depth of 555 to 565 feet in the Upper Cape Fear aquifer of Gates County. This well was sampled three times during the study. Pentachlorophenol, a pesticide used as a wood preservative, was detected once at 0.01 ppb. This is less than the health-based guidance level of 0.29 ppb. During the five years before the sampling events, no pesticides were reported to have been used within 300 feet of this well.

Well G34 in Lenior County was sampled four times. (See "Previously Registered Pesticides

Detected in Ground Water" for a full site description). Pentachlorophenol was detected once at 0.1 ppb, which is less than the health-based guidance level. No pesticides were reported to have been used within 300 feet of the well within five years before the sampling events.

Prometon

Prometon, which has a high to very high leaching potential, was detected twice in ground water at two sites, G97 in Robeson County and G114 in Duplin County, even though no one had any knowledge of its use within 300 feet of either monitoring well. Prometon was used within 300 feet of four ambient monitoring wells five years before sampling, but none was detected at these sites.

Well G97, which was screened from a depth of 8 to 13 feet in a Goldsboro soil series, (high leaching potential), was located in a site where corn was grown. In the first two of three sampling events, prometon was detected at 6.2 and 2.0 ppb. The health-based guidance level is 105 ppb for prometon. The nearest prometon use site was approximately 990 feet from the well. The herbicide was used twice approximately two and three years before the sampling events. Before the first sample collection on February 14, 1994, alachlor was used at 1.5 pounds per acre in 1993. Before the second sample collection on August 3, 1994, metolachlor was used at 2.25 pounds per acre in 1994 within eight feet of the well. Although both of these pesticides have moderate leaching potentials, neither was detected in samples collected from the well.

Three domestic wells were sampled near G97 (Table 8-p. 64). On the first sampling date, the G97-DW1 sample represents a combination of water from two interconnected wells, a drilled well, 95-feet deep (DW1) and a shallow well, 30-feet deep (DW2). Both are located about 0.28 mile south of the monitoring well. This sample tested positive for prometon at 0.22 ppb, 2,4-D at 0.40 ppb, 2,4,5-TP at 0.10 ppb, DCPA at 0.50 ppb, bentazon at 0.30 ppb, and atrazine at less than 1 ppb. Although all findings are below health-based guidance levels, the owner of this well was advised not to consume the water. Follow-up samples were collected independently from each of the two wells and from a third well (DW-3), which is 46-feet deep and located approximately 0.28 mile north of the monitoring well. No pesticides were detected in any of these samples.

Well G114, which was screened from a depth of 4.5 to 19.5 feet in a Lakeland soil series (very high leaching potential), was 15 feet from an electrical substation. Prometon was detected in three of four sampling events at concentrations ranging from 0.14 to 3.5 ppb. During all four sampling events, this well also contained tebuthiuron, which has a very high leaching potential. Concentrations of tebuthiuron ranged from 85 to 123 ppb. These amounts are less than the health-based guidance level of 490 ppb. Before the first sampling event, tebuthiuron was used at the electrical substation at 7.5 pounds per acre in 1993. In 1993, alachlor was used on a soybean field less than 300 feet from the monitoring well but was not detected.

Two domestic wells were sampled near G114 (Table 8-p. 64). Well G114-DW1 is located 0.06 mile southwest of the monitoring well. Well G114-DW2 is located about 0.08 mile southeast of the monitoring well. No pesticides were detected in either of these wells.

Simazine and Triazine Dealkylated Ethyl

In the five years before sampling, simazine, (moderate to high leaching potential), applications were reported to have occurred within 300 feet of 20 monitoring wells. Simazine was detected in ground water at five of these sites, G125 in Moore County, G138 in Lincoln County (see discussion under "Norflurazon"), and G135, G137, and G153 in Ashe County.

Well G125, which was screened from a depth of 10 to 20 feet in a Candor soil series (very high leaching potential), was located on a golf course. Four samples collected from this well contained simazine at 1.1 to 7.4 ppb. A metabolite, triazine dealkylated ethyl, was also detected in three samples, ranging in concentration from 0.69 to 2.2 ppb. It has a moderate to high leaching potential. The detection of simazine at 7.4 ppb could trigger the development of pesticide specific State Management Plans because simazine exceeded its N.C. interim maximum allowable concentration of 3.5 ppb. Before the first sample collection on August 9, 1994, simazine was reported to have been last used on the golf course in 1993 at one pound per acre.

Six domestic wells were sampled near G125 (Table 8-p. 64). Well G125-DW1, a 70-feet deep, drilled well, is located 0.25 mile southwest of the monitoring well. Well G125-DW2, a 28-feet deep, bored well, is located about 0.57 mile south of G125. Well G125-DW3, a 100-feet deep, drilled well, is located 0.25 mile west of G125. Well G125-DW4, a 35-feet deep, bored well, is located 0.85 mile

southeast of G125. Well G125-DW5, a 200-feet deep, drilled well, is located 0.38 mile north of G125. Well G125-DW6, a 32-feet deep, bored well, is located 0.7 mile south of G125. No pesticides were detected in wells DW1, DW3, DW4, DW5, and DW6. Well G125-DW2 tested positive for simazine at 1.0 ppb. Second and third samples from this well contained 1.0 and 4.1 ppb simazine, respectively. The owner was advised not to consume the water because it exceeded the health-based guidance level.

Well G135, which was screened from a depth of 5 to 15 feet in a Toxaway soil series (low leaching potential), was within a Christmas tree plantation. The well was reported to have been flooded in January 1995 after the first sample was collected. The second and third samples collected in April and May 1995 contained 1.2 and 1.0 ppb of simazine, respectively. Triazine dealkylated ethyl was detected once at 1.0 ppb in the second sample. In 1991, simazine was applied at three pounds per acre near the well.

'Iwo domestic wells were sampled near G135 (Table 8-p. 64). Well G135-DW1, an approximately 80-feet deep, drilled well, is located 0.15 mile northwest of the monitoring well. Well G135-DW2, a 350-feet deep, drilled well, is located 0.10 mile west of the monitoring well. Well DW1 tested positive for lindane at 0.15 ppb. No pesticides were detected in well DW2.

Well G137 in Ashe County was screened from a depth of 34 to 44 feet and was within a Christmas tree plantation. The soil series at G137 is Chandler, which has a moderate leaching potential. Simazine was detected at 0.33 ppb in one of the three samples. This is less than the health-based guidance level. A metabolite, triazine dealkylated ethyl, was detected in the same sample at 0.53 ppb. Before the first sample collection on November 15, 1994, simazine was used in 1989 at a rate of 2.8 pounds per acre. In 1993, disulfoton was used once at 7 pounds per acre. The leaching potential for disulfoton is moderate. Disulfoton was not detected in any of the samples.

Well G153, which was screened from a depth of 9 to 19 feet in a Watauga soil series (high leaching potential), was 30 feet from a Christmas tree plantation. Measurable amounts of simazine and triazine dealkylated ethyl were found in two of four samples collected from this well (the first and third). Simazine was detected at 0.9 and 0.54 ppb. Triazine dealkylated ethyl was detected at 2 and 0.39 ppb. Before the first sample collection on November 15, 1994, simazine was last used in the Christmas tree plantation in 1993 at three pounds per acre. Although disulfoton, which has a moderate leaching potential, was used at a rate of three pounds per acre in the spring of 1994, none was detected.

Two domestic wells and one spring box near G153 (Table S-p. 64) were found to be free of pesticides. Well G153-DW1 is 62-feet deep and located about 0.11 mile southwest of the monitoring well. Well G153-DW2 is of unknown depth and located about 0.02 mile west of the monitoring well. Spring box G153-SB is located about 400 feet southeast of the monitoring well.

Tebuthiuron

Tebuthiuron, which has a very high leaching potential, was detected in ground water at three of four monitoring sites where this pesticide was known to have been used within 300 feet of these wells during the five years before the study: G113, G114 (see discussion under "Prometon"), and G154.

Well G113 in Sampson County was screened from a depth of 9 to 19 feet and was 25 feet from an electrical substation. The soil series at G113 is Wagram, which has a very high leaching potential. Tebuthiuron was detected once at 1.3 ppb. This level is less than the health-based guidance level of 490 ppb. Before the first sample collection on December 13, 1993, tebuthiuron had been used at labeled rates twice a year to control vegetation at the electrical substation.

Well G154, which was screened from a depth of 13 to 23 feet in a Cecil soil series (high leaching potential), was 25 feet from an electrical substation. Tebuthiuron was detected during all four sampling events. The concentrations ranged from 3.2 to 7.3 ppb. These are well below the health-based guidance level. Before the first sample collection on September 20, 1994, tebuthiuron was used at the electrical substation at 1.6 pounds per acre in the spring of 1994. Trifluralin, which has a low leaching potential, was last used on the same site in 1993 at 4 pounds per acre, but it was not detected. Because the nearest wells are miles away from the public utility application site, no domestic wells were sampled.

SUMMARY OF RESULTS

Thirty-one widely used pesticides were the primary targets in the study. The analytical methods that were used by NCDA and DEHNR/Division of Water Quality (DWQ) laboratories analyzed ground water samples for more than 140 pesticides and other chemicals. The laboratories employed some of the same analytical procedures used by the EPA in their National Pesticide Survey of drinking water wells.

Sites for the 97 cooperator monitoring wells were chosen based on an evaluation of the vulnerability of ground water to contamination from the use of pesticides and where possible the areas of highest risk were intentionally selected for this study. Monitoring wells were located adjacent to and downgradient from areas where pesticides were reported to have been applied within 300 feet during the previous five years. Results cannot be interpreted as representing the quality of ground water statewide because study methods targeted areas of high ground water vulnerability.

The detection of the same pesticide more than once in a well was given more significance than a pesticide that was detected only once. This was done because the laboratory analytical methods were capable of detecting many chemicals at sub-parts-per-billion levels and water samples could have become contaminated at the wellhead during collection or shipment to the laboratory. Nevertheless, the lack of a detection in a repeat sample did not disprove the earlier detection because ground water is a dynamic system, which is both spatially and temporally variable.

Data collected show that 26 pesticides or metabolites of pesticides were detected in 33 of the 152 monitoring wells sampled in both phases of the study. Of these pesticides, the following 10 have been canceled by the EPA and are no longer used in North Carolina: DDD, DDE, DDT, dibromochloropropane (DBCP), 1,2-dichloropropane, dinoseb, endrin ketone, methylene chloride, mirex, and 2,4,5-T. Two of these chemicals (DBCP and methylene chloride) were found in excess of health-based guidance levels or North Carolina ground water quality standards at one location each.

The remaining 16 chemicals detected are either registered pesticides or metabolites of registered pesticides: acifluorfen, atrazine, BHC-alpha, BHC-delta, DCPA, dichlorprop, hexazinone, metribuzin, metribuzin DA, norflurazon, pentachlorophenol, prometon, simazine, tebuthiuron, triazine dealkylated ethyl, and triazine dealkylated isopropyl. Four of these chemicals (BHC-alpha, BHC-delta, dichlorprop, and simazine) were found in excess of health-based guidance levels or North Carolina ground water quality standards at one location each, except for BHC-alpha which was found in excess of its health-based guidance level at three locations.

Twenty-two of the 26 chemicals detected in the study have moderate to very high leaching potential ratings. Other pesticides with similar or higher leaching potentials, which were used at these same sites, were not detected. The remaining four detected chemicals, which have very low to low leaching potentials, are persistent pesticides (or their metabolites) whose registrations have been canceled by the EPA.

In the ambient monitoring well phase of the study, seven of 55 wells had pesticide residues detected in at least one water sample collected from each of them. In a shallow ambient well located in the Sand Hills region, hexazinone was found during two sampling events at a concentration below a health-based guidance level. All other detections were single event occurrences in this phase of the study, including a detection of BHC-alpha at a concentration in excess of its health-based guidance level. Forty-eight of the 55 wells had no pesticide residues detected in water samples collected from them.

In the cooperator monitoring well phase of the study, 26 of 97 wells had pesticide residues detected in at least one water sample collected from each of them. Nine wells had detections of pesticides that exceeded 50 percent of North Carolina ground water quality standards or health-based guidance levels. Six of these nine wells had levels which exceeded standards or guidance levels. The remaining detections ranged from less than 1 to 50 percent of North Carolina standards or guidance levels. Seventy-one of the 97 wells had no pesticide residues detected in water samples collected from them.

Seventeen cooperator monitoring wells had multiple detections of one or more pesticides. Six of these 17 wells had pesticide concentrations greater than 50 percent of their ground water quality standards or health-based guidance levels, which could trigger the development of pesticide specific State Management Plans. One of the following five pesticides was detected in these six wells: atrazine, BHC-alpha, dibromochloropropane, 1,2-dichloropropane, and simazine. Simazine was detected at least twice in ground water at four of 20 sites where applications were reported to have occurred within 300 feet of the monitoring wells within five years

before sampling. At one of these sites, the simazine concentration exceeded the North Carolina ground water quality standard (interim maximum allowable concentration). Atrazine was detected at least twice in ground water at two of 22 sites where applications were reported to have occurred within 300 feet of the monitoring wells within five years before sampling. Neither of these atrazine detections exceeded the North Carolina standard (interim maximum allowable concentration). At another location, dibromochloropropane exceeded the ground water quality standard. At an additional location, 1,2-dichloropropane exceeded 50 percent of the ground water quality standard. BHC-alpha exceeded a health-based guidance level at a different location. Fourteen of the 17 sites with detections were in locations where soils have high to very high leaching potential indices. Only one currently registered pesticide, simazine, was found in a location where the soil had a low leaching potential index.

Forty-six domestic drinking water supplies, which were near the 18 monitoring wells with multiple detections of one or more pesticides, were sampled during the study. Eight of these supplies were found to contain pesticide or nonpesticide residues. The 11 pesticides, all of which have moderate to very high leaching potential ratings, were alachlor, atrazine, bentazon, 2,4-D, DCPA, 1,2-dichloroethane, 1,2-dichloropropane, lindane, prometon, simazine, and 2,4,5-TP. Five domestic wells contained at least one pesticide (alachlor, 1,2-dichloropropane, or simazine) in excess of health-based guidance levels. Thirty-eight of the 46 domestic drinking water supplies had no pesticide residues detected in samples collected from them.

CONCLUSIONS

The purpose of this statewide study, which was directed by the N. C. Pesticide Board, was to determine if the labeled uses of pesticide products were impacting the ground water resources in North Carolina. The focus of the study was on primary pesticide leachers identified by the EPA that are used in the state. The study methodology provided for an evaluation of pesticide occurrence in the aquifers of the state which are widely used by domestic and municipal water suppliers (phase I ambient wells) and in shallow ground water at locations where pesticides were used and the ground water is at maximum risk from pesticide contamination (phase II cooperator wells). There was no attempt made to select ambient monitoring wells near areas where pesticides were known to have been applied. Additionally, the study protocol stated that whenever the same chemical was detected twice during two separate sampling events in a monitoring well, the closest domestic drinking water wells around that site were to be tested.

Seven of 55 ambient monitoring wells sampled in this study had detections of pesticides. The only ambient well with two detections of the same pesticide was a well in a shallow, sandy aquifer. In order to determine the significance of these detections, one should evaluate them in relation to the current North Carolina ground water quality standards or the health-based guidance levels if no ground water quality standard exists. In the ambient wells representing the major drinking water aquifers of North Carolina, pesticide detections ranged from less than 1 to 34 percent of standards or guidance levels, the exception being one well with a detection of a pesticide (BHC-alpha) in excess of a standard.

Twenty-six of 97 cooperator monitoring wells sampled in this study were found to contain pesticides or their metabolites. An evaluation of the concentrations of these pesticide detections in relation to North Carolina ground water quality standards or health-based guidance levels shows that nine wells had detections of pesticides that exceeded 50 percent of standards or guidance levels and six of these nine wells exceeded standards or guidance levels. The remaining detections ranged from less than 1 to 50 percent of standards or guidance levels. These results indicate that there is a potential for ground water contamination to occur from the use of pesticides throughout the state.

Some of the pesticides or metabolites most frequently detected in ground water monitoring wells in this study were in the triazine family of pesticides: atrazine (two wells); hexazinone (two wells); metribuzin (one well); a metabolite, metribuzin DA (one well); prometon (two wells); simazine (five wells); and two metabolites, triazine dealkylated ethyl (four wells) and triazine dealkylated isopropyl (two wells). Other studies in the Mountain region of the state associated with Christmas tree production have found the occurrence of some of these pesticides in ground water monitoring wells and domestic wells (Interagency Work Group, 1996;McLaughlin, 1996). These results suggest that some of the triazine pesticides should be considered for State Management Plan actions, ranging from intensive applicator education up to and including the adoption of rules prescribing use restrictions of these pesticides in the more vulnerable areas of the state.

Other pesticides that were found were two of the isomers of lindane, BHC-alpha and BHC-delta (four wells), and tebuthiuron (three wells). The health-based guidance level for BHC-alpha and BHC-delta is very low (0.0056 ppb), such that even a minute concentration in ground water will exceed standards. The EPA is considering State Management Plan requirements for lindane.

Nine of the pesticides and pesticide metabolites detected in shallow cooperator monitoring wells are no longer registered for use in the state. These results indicate that some canceled pesticides and pesticide metabolites persist in ground water for many years and can be a potential health concern for users of shallow domestic wells.

In the 26 cooperator monitoring wells with pesticide detections, the depth to ground water was less than 25 feet and in the majority of these wells, 10 feet or less. Depth to water will be a factor considered in the development of required pesticide specific State Management Plans.

Forty-six domestic drinking water supplies, which were near the 18 monitoring wells with multiple detections of one or more pesticides, were sampled during the study. Eight of these supplies were found to contain pesticides or nonpesticide residues. Five of these domestic wells contained at least one pesticide in excess of health-based guidance levels. Domestic water supply wells can be subject to contamination from many sources. Poor well construction or damaged well components can provide a direct pathway for contamination to enter a well at the soil surface or subsurface. Many domestic wells have been constructed so that the water supply is the shallowest aquifer, which is the most vulnerable to contamination from surface activities. The results from the sampling of domestic wells in this study indicate that there is the potential for contamination of these wells if they are withdrawing shallow ground water and are close to pesticide use areas.

ADDITIONAL STUDIES

The Departments of Agriculture and Environment, Health, and Natural Resources have forged an effective working relationship, which has culminated in the completion of this study. Results indicate that more in-depth work must be conducted in North Carolina in order to minimize the environmental impact of pesticide use through the development and implementation of Pesticides and Ground Water State Management Plans. The two Departments have committed additional resources to study in more detail the effect of pesticide use on ground water resources at some of the locations where atrazine, hexazinone, norflurazon, and simazine have been used. Additional monitoring wells have been constructed, so that the influence of soil series, landscape position, and hydrogeology on the occurrence of pesticides or metabolites in ground water can be characterized.

The EPA will soon be requiring that state specific Pesticides and Ground Water State Management Plans be adopted in order to protect ground water resources from significant contamination. One component of State Management Plans is vulnerability assessment of locations where the identified pesticides are used. The intense monitoring scheme employed in this study will allow the state to learn more about which factors are most important in predicting where ground water is likely to become contaminated by the labeled use of pesticides. The North Carolina Pesticide Board can use this information in defining specific locations or conditions requiring additional rules in order to safeguard the ground water resources of the state.

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GLOSSARY

Ambient monitoring well - a well constructed and managed by the Groundwater Section or the USGS in order to monitor the water quality and quantity in the state's aquifers.

Analyte - one of the chemicals that the study's analytical methods were chosen or designed to identify.

Aquifer - any water-bearing layer of rock or unconsolidated sediments which will yield water in a usable quantity to a well or spring.

Bailing/Bailer - a method of collecting water from a ground water well using an open container of the same diameter as the well; the bailer is lowered into the well and water flows in and the bailer is brought back up to the surface.

Contamination - the introduction into water of chemicals in a concentration that makes the water unfit for its best intended use.

Cooperator monitoring well - a well installed with permission of a landowner for the purposes of determining if pesticides are in shallow ground waters located in areas designated vulnerable by the criteria established for the N.C. Interagency Study.

DEHNR - N.C. Department of Environment, Health, and Natural Resources.

DWQ - Division of Water Quality, DEHNR.

DRASTIC - a standardized system for evaluating ground water pollution vulnerability using hydrogeologic settings (Theoretical values with shallow wells can range from 46 to 256).

EPA's list of chemicals found in ground water - a list of 69 analytes identified by the EPA as ones to target in ground water studies.

Estimated detection - an approximate concentration for a pesticide or analyte which is below the TQL, and therefore, not precisely quantifiable.

Ground water quality standards - the maximum allowable concentrations resulting from any discharge of a substance to the land or waters of the state, which may be tolerated without creating a threat to human health or which would otherwise render the ground water unsuitable for its intended best usage; established in accordance with regulations in Title 15A North Carolina Administrative Code 2L .0200.

HAL - health advisory level. The maximum concentration of a substance in water that may safely be consumed over a specific time period as identified by the EPA.

Health-based guidance level - lowest of the concentrations derived using the following six criteria:

1) Systemic threshold concentration calculated as follows:
   [Reference Dose (mg/kg/day) x 70 kg (adult body weight) x Relative Source Contribution (0.10 for inorganics; 0.20 for organics)]/[2 liters/day (avg. water consumption)];
2) Concentration which corresponds to an incremental lifetime cancer risk of 1 x 10^{-6};
3) Taste threshold limit value;
4) Odor threshold limit value;
5) Maximum contaminant level; or
6) National secondary drinking water standard.

Interim maximum allowable concentration - a temporary numerical standard established by the Director of the Division of Water Quality, DEHNR, for a substance after review of submitted toxicological and epidemiological data, study results, and calculations necessary to establish a standard in accordance with regulations in Title 15A North Carolina Administrative Code 2L .0200.

Limit of detection - the lowest observable peak response for an analyte above the background noise, three times the system noise in a matrix. This is normally calculated from a blank matrix in the retention window of the peak of interest.

MCL - maximum contaminant level. The maximum permissible level of a contaminant in water that is delivered to any user of a public water system (established by the Safe Drinking Water Act (SDWA)).

Metabolite - the product of the chemical or biological breakdown of a complex compound into simpler ones.

Monitoring well - any well constructed for the primary purpose of obtaining samples of ground water for testing or for the observation or measurement of ground water levels.

NCCES - North Carolina Cooperative Extension Service.

NCDA - North Carolina Department of Agriculture.

Part(s) per billion - equal to microgram(s) per liter.

Pesticide leaching potential - ranking of the leaching potential of a pesticide based on the persistence of the pesticide in the environment, the rate of application, the fraction of the pesticide reaching the soil during application, and the retention of the pesticide by soil organic particles (index values from 0 to 100; Appendix A).

Point source ground water contamination - a single, localized source of contamination; typically, such sources produce well-defined contaminant plumes.

QA/QC - quality assurance and quality control - a system of procedures, checks, audits, and corrective actions to ensure that all study design and performance activities are of the highest achievable quality.

Research station - a location at which the Groundwater Section has installed one or more wells, generally screened at different depths, in order to monitor ground water characteristics such as water quality, water level, and transmissivity.

Shallow monitoring well - a well constructed in order to sample the shallowest ground water located in the saturated zone just below the water table.

Soil leaching potential - ranking of the leaching potential of a soil for organic chemicals based on the organic matter, texture, and pH of the soil profile (index values from 0 to 100; Appendix A).

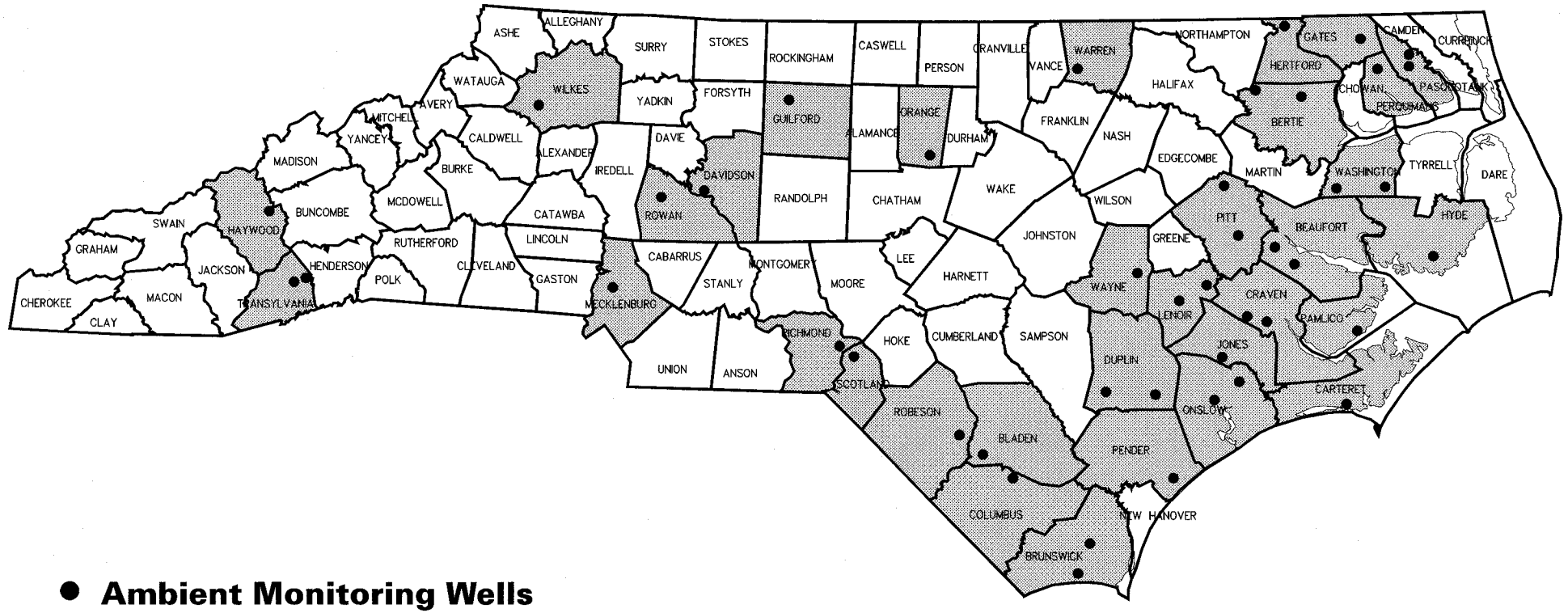
Sorption - a chemical attraction between two substances allowing for the binding of one substance to another.

TQL - target quantitation limit. The concentration of an analyte in a sample, which can be reliably measured and quantitated by a given method.

USDA - United States Department of Agriculture.

USGS - United States Geological Survey.

Figure 1. Locations of ambient monitoring wells sampled in phase I.



● **Ambient Monitoring Wells**
[Note: Some of the well symbols represent more than one well due to their close proximity.]

Scale 1:3,300,000

0 50 100 150 200 250 300 MILES

0 500000 1000000 1500000 FEET

North Carolina State Plane Coordinate System

February 1997

Figure 2. Plot of the depths of ambient monitoring wells.

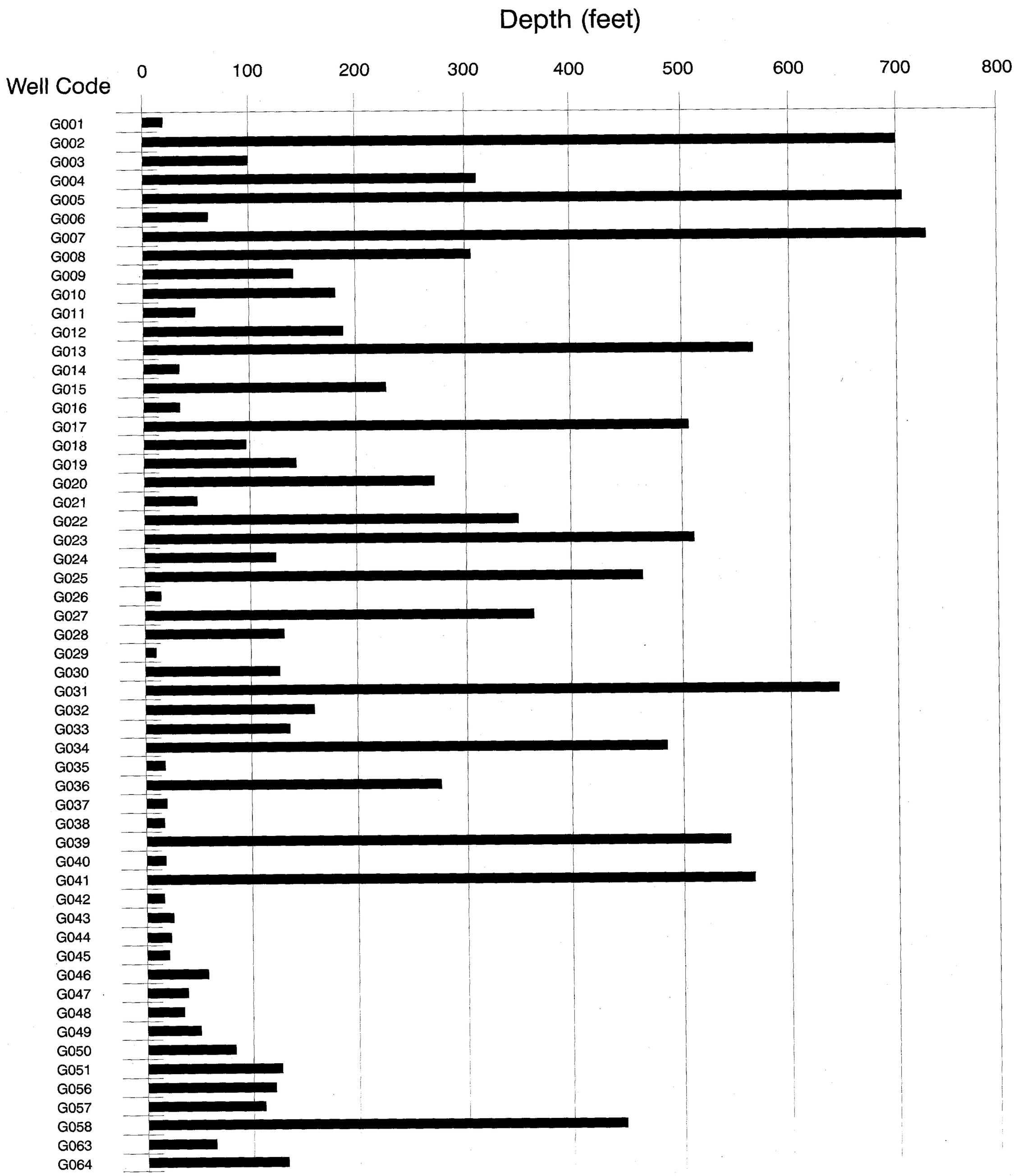
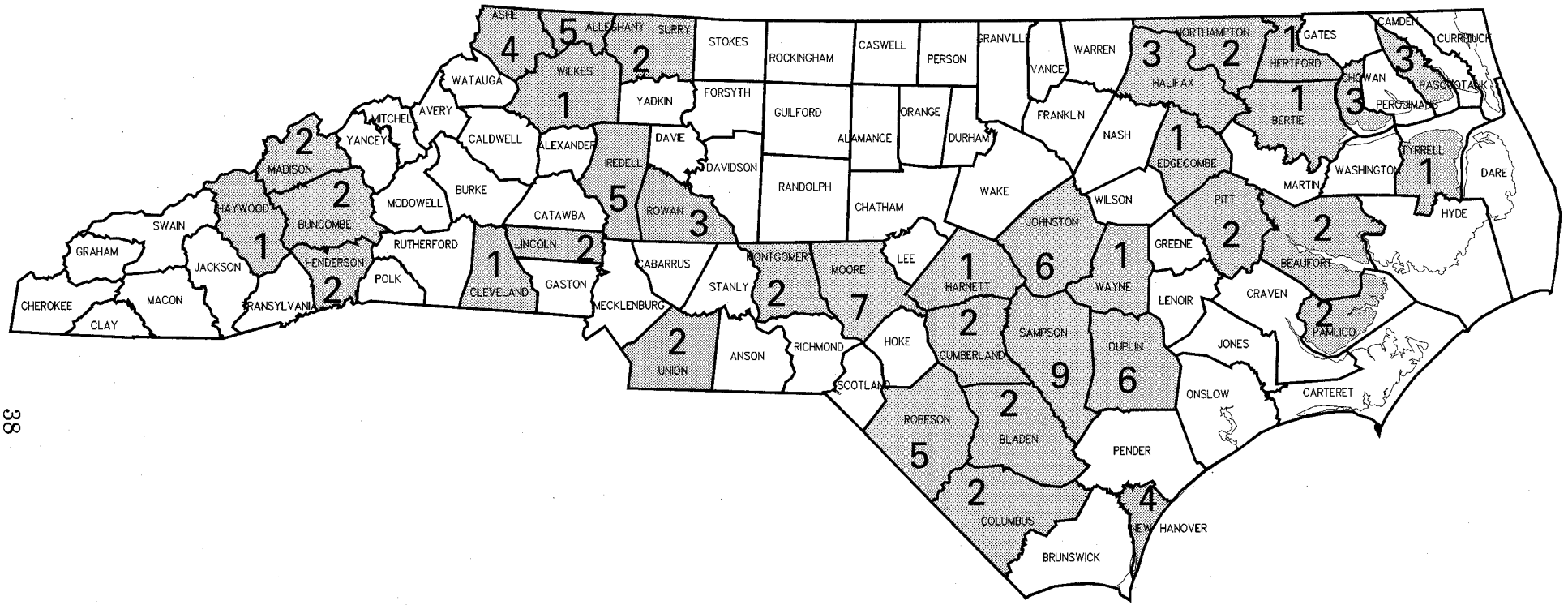


Figure 3. Number of cooperator monitoring wells in each county in phase II.



Counties with cooperator monitoring wells

Scale 1:3,300,000

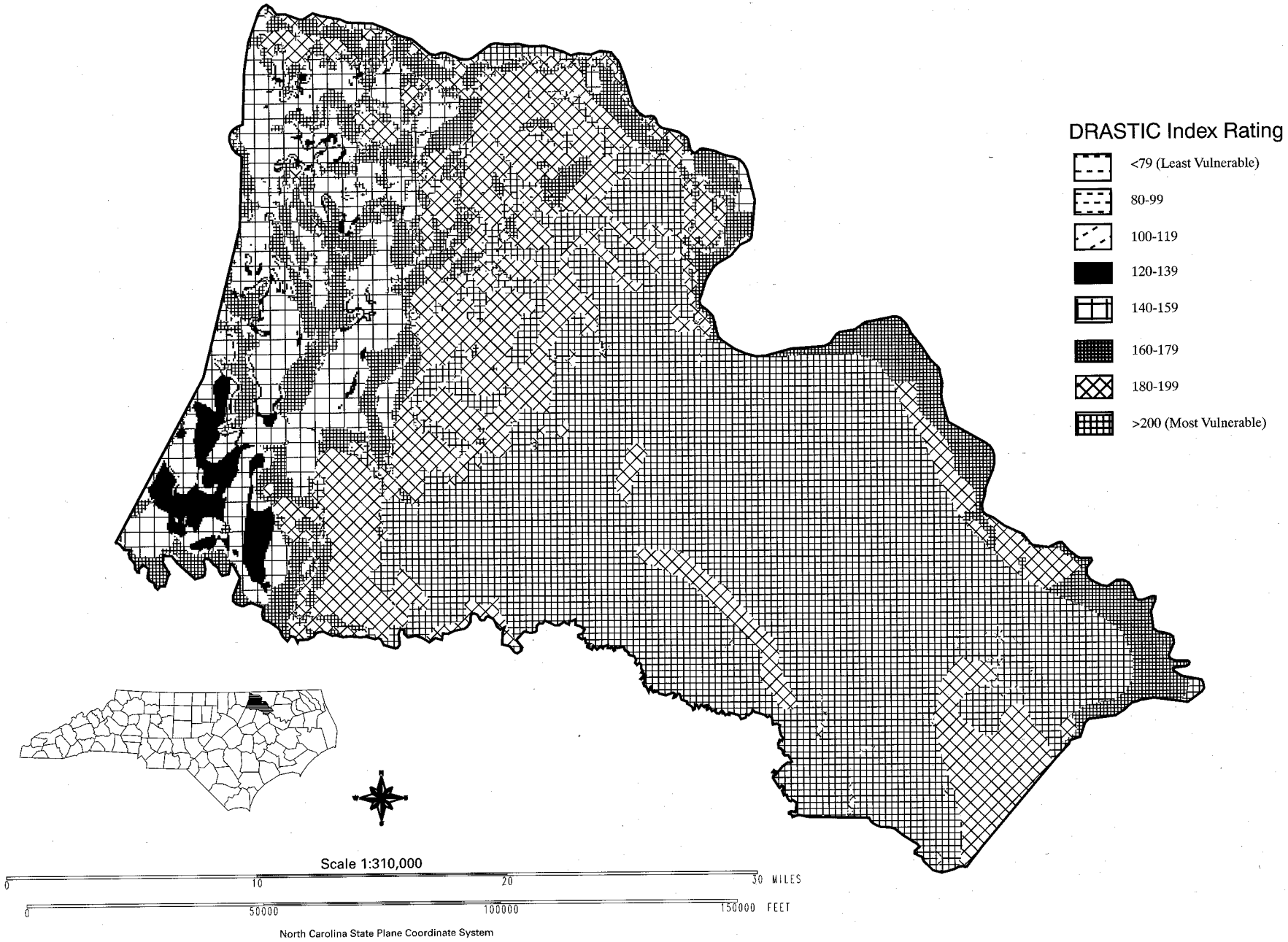
0 50 100 150 200 250 300 MILES

0 500000 1000000 1500000 FEET

North Carolina State Plane Coordinate System

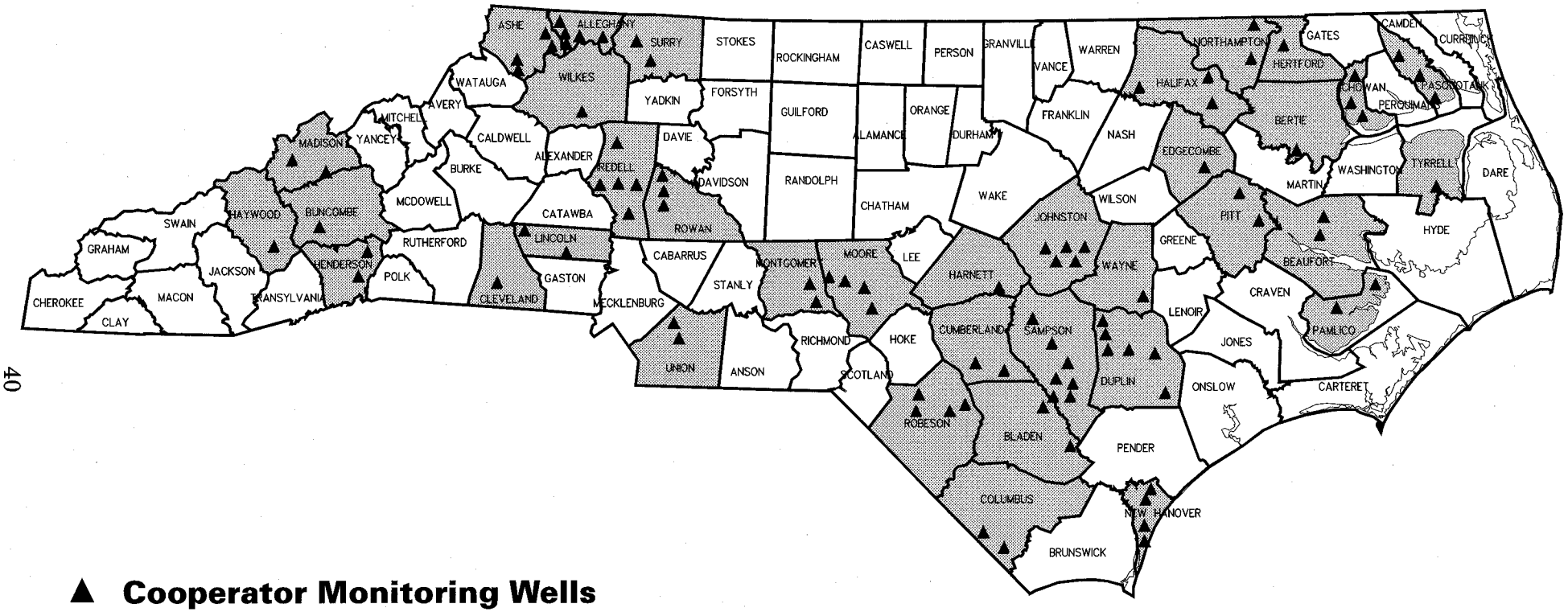
February 1997

the Pesticide DRASTIC method for Halifax County, North Carolina.



February 1997

Figure 5. Locations of cooperator monitoring wells sampled in phase II.



▲ **Cooperator Monitoring Wells**
(Note: Some of the well symbols represent more than one well due to their close proximity.)

Scale 1:3,300,000

0 50 100 150 200 250 300 MILES

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Figure 6. Diagram of cooperator monitoring well construction details.

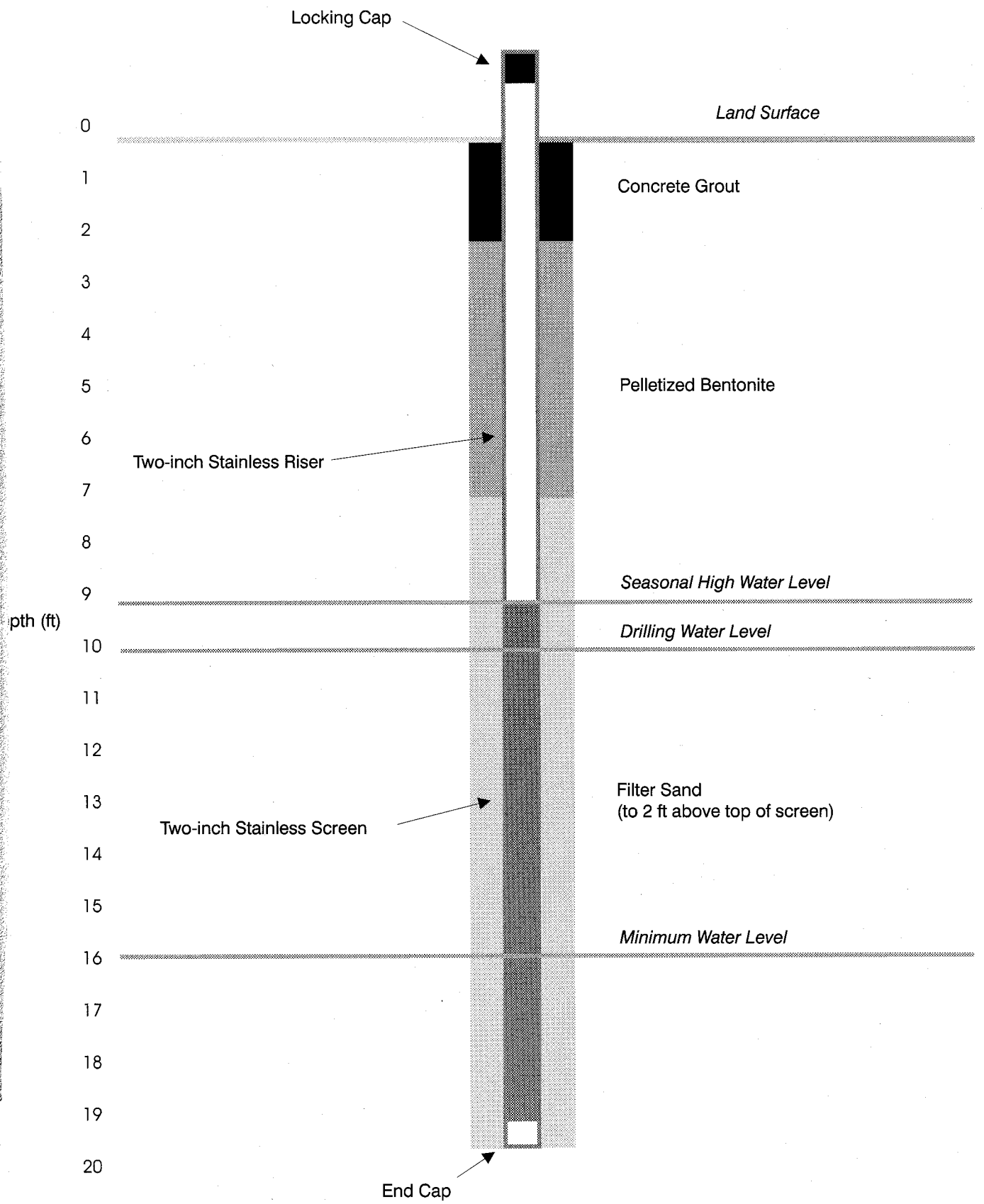
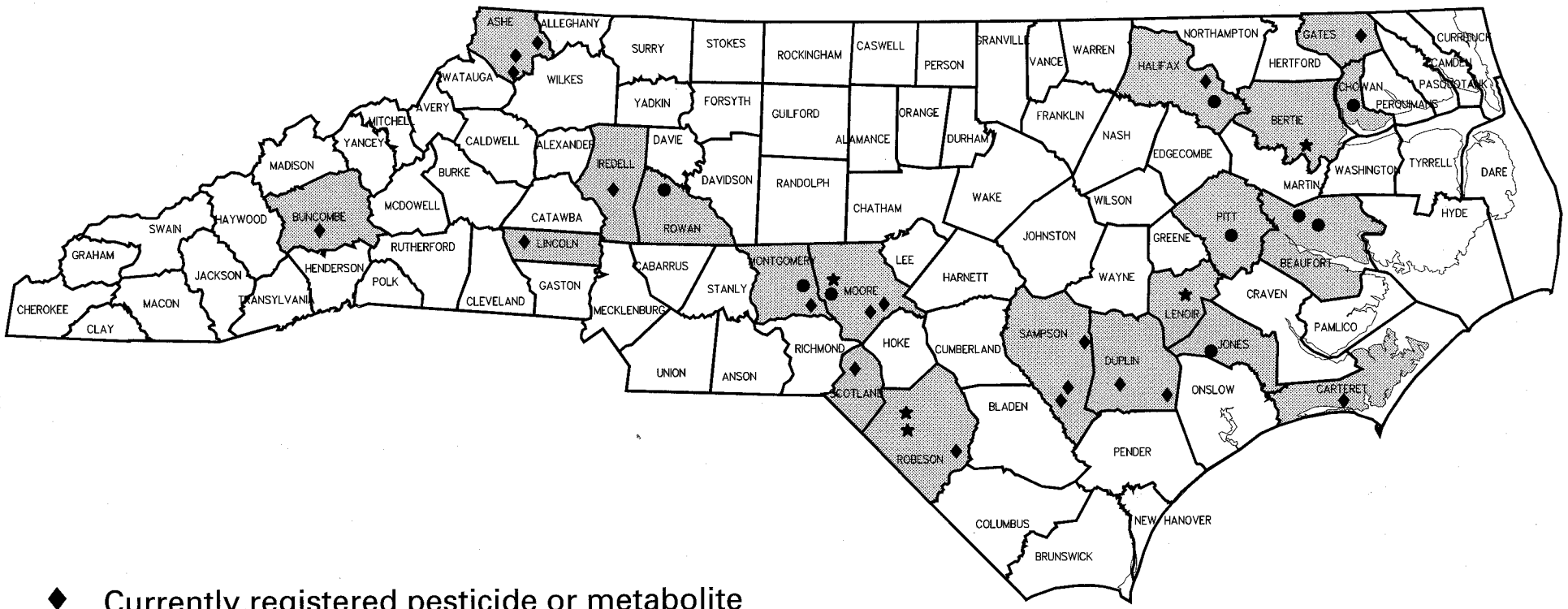


Figure 7. Locations of detected pesticides or metabolites in monitoring wells.



- ♦ Currently registered pesticide or metabolite
- ● Previously registered pesticide or metabolite
- ★ Currently registered and previously registered pesticides or metabolites

Scale 1:3,300,000

0 50 100 150 200 250 300 MILES

0 500000 1000000 1500000 FEET

February 1997

Table 1. The 31 primary target pesticides, their pesticide leaching potential ratings, and the number of monitoring wells with nearby pesticide use.

Pesticide	Pesticide Leaching Potential Rating*	Ambient Monitoring Wells	Cooperator Monitoring Wells
acifluorfen	M	3	16
alachlor	M	2	18
aldicarb	H	1	13
ametryn	M	0	2
atrazine	M-H	4	22
butylate	M	1	1
carbaryl	L	1	20
carbofuran	H	1	6
carboxin	M	0	0
chloramben	H	0	0
chlordane	VL	0	2
chlorothalonil	L	1	15
cyanazine	M	0	0
2,4-D	M	1	25
DCPA	H	0	2
diazinon	M	0	8
dicamba	M-H	0	6
diphenamid	M	0	2
disulfoton	M	0	10
diuron	M-H	0	2
fluometuron	M	0	4
heptachlor	VL	0	0
hexazinone	H	1	6
methomyl	M	1	13
metolachlor	M	3	28
metribuzin	M	0	13
oxamyl	M	0	3
propachlor	M	0	0
simazine	M-H	0	20
terbacil	M-H	0	2
trifluralin	L	1	16

*McLaughlin, R.A., J.B. Weber, and R.L. Warren. 1994. Soil Facts - Protecting Groundwater in North Carolina: A Pesticide and Soil Ranking System. North Carolina Cooperative Extension Service. Publication AG-439-31.

*Weber, J.B. 1995. Personal communications.

*VL - very low
L - low
M - moderate
H - high

Table 2. List of laboratory analytes and their target quantitation limit in parts per billion for the Division of Environmental Management Laboratory. *NE - No established target quantiition limit,

acifluorfen (0.50)
alachlor (0.10)
aldrin (0.08)
ametryn (1 .1)
arochlor 1016 (0.50)
arochlor 1221 (0.50)
arochlor 1232 (0.50)
arochlor 1242 (0.50)
arochlor 1248 (0.50)
arochlor 1254 (0.50)
arochlor 1260 (0.50)
arochlor 1262 (0.50)
atrazine (0.8)
bentazon (5.0)
benzene (1 .0)
BHC-alpha (0.02)
BHC-beta (0.03)
BHC-delta (0.03)
bromacil (3.4)
bromobenzene (1 .0)
bromochloromethane (0.75)
bromodichloromethane (0.25)
bromoform (0.5)
butachlor (4.8)
butylate (2.2)
carbon tetrachloride (0.75)
carbophenothion (1 .O)
carboxin (6.5)
chloramben (0.50)
chlordane-alpha (0.02)
chlordane-gamma (0.03)
chlordane, technical (0.30)
chlordene (0.02)
chlorobenzene (0.25)
chlorobenzilate (5.0)
chloroform (0.25)
chloroneb (0.03)
chlorothalonil (0.03)
2-chlorotoluene (0.25)
4-chlorotoluene (0.25)
chlorpropham (4.2)
chlorpyrifos (0.98)
cis-1,2-dichloroethene (0.25)
cis-1,3-dichloropropene (0.25)
cycloate (2.4)
2,4-D (1.6)
2,4-DB (5.0)
DCPA (0.02)
DCPA acid metabolites (0.36)
DDD, o,p (0.06)
DDD, p,p (0.04)
DDE, o,p (0.05)
DDE, p,p (0.02)
DDT, o,p (0.04)
DDT, p,p (0.06)
DEF (2.5)
demeton (2.5)
diazinon (0.8)
1,2-dibromo-3-chloropropane (1 .O)
dibromochloromethane (0.75)
1,2-dibromoethane (1 .0)
dibromomethane (1 .0)
dicamba (0.35)
1,2-dichlorobenzene (0.25)
1,3-dichlorobenzene (0.25)
1,4-dichlorobenzene (0.25)
3,5-dichlorobenzoic acid (0.5)
1 ,1 -dichloroethane (0.25)
1,2-dichloroethane (0.25)
1,1 -dichloroethene (0.75)
1,2-dichloropropane (0.25)
1,3-dichloropropane (0.25)
2,2-dichloropropane (0.25)
1,1 -dichloropropene (0.25)
dichlorprop (8.5)
dichlorvos (2.1)
dieldrin (0.02)
dimethoate (3.5)
dinoseb (0.4)
diphenamid (2.8)
disulfoton (1 .0)
disulfoton sulfone (2.3)
disulfoton sulfoxide (*NE)
endosulfan I (0.03)
endosulfan II (0.01)
endosulfan sulfate (0.02)
endrin (0.03)
endrin aldehyde (0.05)
endrin ketone (0.04)
EPN (4.0)
EPTC (2.3)
ethazole (0.03)
ethion (1.3)
ethoprop (2.0)

Table 2 (continued)

ethylbenzene (1 .O)
fenamiphos (1.2)
fensulfothion (10.0)
fenthion (2.0)
Folex (2.0)
heptachlor (0.02)
heptachlor epoxide (0.01)
ihexachlorobenzene (0.01)
hexachlorobutadiene (0.25)
hexazinone (5.7)
5-hydroxdicamba (2.00)
isopropylbenzene (1 .O)
lindane (0.01)
malathion (0.08)
methoxychlor, pp (0.05)
methylene chloride (10.0)
methyl-tert-butyl ether (5.0)
netolachlor (4.2)
netribuzin (1.6)
nevinphos (1.9)
MGK 264 (5.7)
nirex (0.03)
nolinate (2.1)
nonocrotophos (10.0)
n,p-xylenes (2.0)
naled (4.0)
naphthalene (1 .O)
napropamide (2.6)
n-butylbenzene (1 .O)
4-nitrophenol (4.0)
norflurazon (7.1)
n-propylbenzene (1 .O)
oxychlordane (0.02)
o-xylene (1 .O)
parathion, ethyl (0.65)
parathion, methyl (1.5)
pebulate (6.7)
pentachlorophenol (0.30)
permethrins, mixed (1 .O)
phorate (1.5)
picloram (1 .0)
p-isopropyltoluene (1 .0)
prometon (14)
prometryn (2.4)
pronamide (7.6)
propachlor (0.10)
propazine (1 .0)
ronnel (0.75)
set-butylbenzene (1 .O)
simazine (1 .1)
simetryn (2.2)
styrene (1 .O)
sulfotepp (0.25)
2,4,5-T (0.75)
tebuthiuron (3.1)
tecnazene (0.02)
terbacil (4.4)
terbufos (1 .1)
terbutryn (1.4)
tert-butylbenzene (1 .O)
1 ,1,1,2-tetrachloroethane (0.25)
1 ,1,2,2-tetrachloroethane (0.75)
tetrachloroethene (0.25)
toluene (1.0)
toxaphene (1.5)
2,4,5-TP (1.5)
trans-1,2-dichloroethene (0.75)
trans-1,3-dichloropropene (0.25)
trans-nonachlor (0.02)
1,2,3-trichlorobenzene (0.75)
1,2,4-trichlorobenzene (0.25)
1 ,1,1 -trichloroethane (0.25)
1 ,1,2-trichloroethane (0.25)
trichloroethene (0.25)
1,2,3-trichloropropane (0.25)
trifluralin (0.03)
1,2,4-trimethylbenzene (1 .0)
1,3,5-trimethylbenzene (1 .O)
vernolate (0.63)

Table 3. List of laboratory analytes and their limit of detection in parts per billion for the North Carolina Department of Agriculture Laboratory.

acifluotfen (0.1)
alachlor (0.3)
alachlor DEA metabolite (0.26)
alachlor HEEA metabolite (0.46)
aldicarb (3.0)
aldicarb sulfone (1 .0)
aldicarb sulfoxide (1 .O)
aldrin (0.08)
ametryn (2.0)
arochlor 1016 (0.8)
arochlor 1221 (0.8)
arochlor 1232 (0.8)
arochlor 1242 (0.8)
arochlor 1248 (0.8)
arochlor 1254 (0.8)
arochlor 1260 (0.8)
arochlor 1262 (0.8)
atraton (0.6)
atrazine (0.5)
barban (0.6)
bentazon (0.20)
BHC-alpha (0.03)
BHC-beta (0.01)
BHC-delta (0.02)
bromacil (2.5)
butachlor (0.15)
butylate (0.26)
carbaryl (2.0)
carbofuran (2.0)
carboxin (0.6)
carboxin sulfoxide (0.2)
chloramben (0.09)
chlordane-alpha (0.01)
chlordane-gamma (0.01)
chlorobenzilate (5.0)
chloroneb (0.5)
chlorothalonil (0.03)
chlorpropham (0.5)
chlorpyrifos (0.2)
cyanazine (0.5)
cycloate (0.25)
2,4-D (0.20)
dalapon (1.6)
2,4-DB (0.8)
DCPA (0.02)
DDD, o,p (0.03)
DDD, p,p (0.03)
DDE, o,p (0.06)
DDE, p,p (0.01)
DDT, o,p (0.04)
DDT, p,p (0.07)
diazinon (0.25)
dibromochloropropane (0.02)
dicamba (0.08)
3,5-dichlorobenzoic acid (0.06)
1,2-dichloropropane (4.4)
1,3-dichloropropene, cis (0.1)
1,3-dichloropropene, trans (0.2)
dichlorvos (2.5)
dieldrin (0.02)
dinoseb (0.19)
diphenamid (0.6)
disulfoton (0.3)
disulfoton sulfone (3.8)
disulfoton sulfoxide (0.38)
diuron (0.1)
2,4-DP (0.26)
endosulfan I (0.02)
endosulfan II (0.02)
endosulfan sulfate (0.03)
endrin (0.02)
endrin aldehyde (0.05)
EPTC (0.22)
ethoprop (0.19)
ethylene dibromide (EDB) (0.03)
ethylene thiourea (0.70)
etridiazole (0.03)
fenamiphos (1 .0)
fenamiphos sulfone (3.3)
fenamiphos sulfoxide (1 .1)
fenarimol (0.38)
fluridone (3.8)
heptachlor (0.01)
heptachlor epoxide (0.02)
hexazinone (0.76)
3-hydroxy carbofuran (2.0)
5-hydroxy dicamba (0.40)
linuron (0.1)
malathion (0.06)
MCPA (1.5)
MCPP (2.0)
merphos (0.25)
methiocarb (4.0)
methomyl (1 .O)

Table 3 (continued)

methoxychlor (0.05)
methyl paraoxon (2.5)
metolachlor (0.42)
metribuzin (0.15)
metribuzin DA (0.1)
metribuzin DADK (0.2)
metribuzin DK (0.2)
MGK 264 (0.5)
molinate (0.3)
1-naphthol (6.0)
napropamide (0.5)
neburon (0.1)
4-nitrophenol (0.13)
not-flurazon (0.5)
oxamyl (2.0)
parathion, ethyl (0.4)
parathion, methyl (0.3)
PCP (0.08)
pebulate (0.2)
permethrin, cis (0.5)
permethrin, trans (0.5)
picloram (0.14)
prometon (0.14)
prometryn (0.19)
pronamide (0.76)
propachlor (0.5)
propanil (0.1)
propazine (0.13)
propoxur (2.0)
simazine (0.5)
simetryn (0.25)
stirofos (0.76)
2,4,5-T (0.08)
tebuthiuron (0.1)
tebuthiuron EL-l 09(OH) (1.7)
terbacil (4.5)
terbufos (0.5)
terbutryn (0.25)
2,4,5-TP (0.08)
triademefon (0.65)
triazine dealkylated ethyl (0.2)
triazine dealkylated isopropyl (0.3)
triclopyr (0.5)
tricyclozole (1 .O)
trifluralin (0.03)
vernolate (0.23)

Table 4. Counties, number of cooperator monitoring wells, and type of monitoring sites.

County	# Wells	Monitoring Sites
Alleghany	5	burley tobacco, Christmas trees (3), field corn
Ashe	4	Christmas trees (3), nursery
Beaufort	2	sovbeans, wheat
Bertie	1	peanuts
Bladen	2	blueberries, grapes
Buncombe	2	grapes, hay
Chowan	3	residential termite control, sweet corn, watermelons
Cleveland	1	wheat
Columbus	2	cabbage, sweet potatoes
Cumberland	2	highway right-of-way, rye
Duplin	6	blueberries, electrical substation, field corn, peppers, snap beans, strawberries
Edgecombe	1	cotton
Halifax	3	cotton, peanuts, sweet corn
Harnett	1	oats
Haywood	1	tomatoes
Henderson	2	apples, peppers
Hertford	1	watermelons
Iredell	5	field corn, electrical substation (2), hay, residential termite control
Johnston	6	cucumbers, flue-cured tobacco, oats, highway right-of-way (2), sweet potatoes
Lincoln	2	apples, electrical substation
Madison	2	burley tobacco (2)
Montgomery	2	peaches, soybeans
Moore	7	forest, golf course (2), grapes, peaches, rye, sweet corn
New Hanover	4	golf course, mosquito abatement area (3)
Northampton	2	cotton, peanuts
Pamlico	2	mosquito abatement area, potatoes
Pasquotank	3	cabbage, potatoes, residential termite control
Pitt	2	field corn, flue-cured tobacco
Robeson	5	cabbage, field corn, flue-cured tobacco, sovbeans, wheat
Rowan	3	barley, soybeans, tomatoes
Sampson	9	blueberries, cucumbers, electrical substation, forest, nursery, peppers, snap beans, tomatoes, watermelons
Surry	2	grapes, strawberries
Tyrrell	1	potatoes
Union	2	nursery, soybeans
Wayne	1	golf course
Wilkes	1	apples

cooperator monitoring wells.

Well Code	County	Round 1 Sampling Date	Chemical Detected	ppb	Round 1 Follow-up Date	Chemical Detected	ppb	Round 2 Sampling Date	Chemical Detected	ppb	Round 2 Follow-up Date	Chemical Detected	ppb	Total Depth or Screened Interval (feet)	Measured Depth to water Maximum (feet)	Measured Depth to water Minimum (feet)
PHASE I AMBIENT MONITORING WELLS																
G001	Brunswick	4/8/91	ND					2/3/92	ND					15.00		
G002	Hyde	4/9/91	ND					2/10/92	ND					700.00		
G003	Brunswick	4/15/91	ND					2/3/92	ND					102.00		
G004	Beaufort	4/16/91	ND					4/13/92	ND					310.00		
G005	Beaufort	4/16/91	ND					4/13/92	ND					705.00		
G006	Onslow	4/22/91	ND					3/9/92	ND					68.00		
G007	Craven	4/23/91	ND					3/30/92	ND					726.00		
G008	Craven	4/23/91	ND					3/30/92	ND					307.00		
G009	Brunswick	4/29/91	ND					2/10/92	ND					140.00		
G010	Beaufort	4/29/91	ND					4/7/92	ND					186.00		
G011	Beaufort	4/29/91	ND					4/7/92	ND					49.00		
G012	Carteret	5/6/91	metribuzin	4.5	7/29/91	ND		2/24/92	ND		3/30/92	ND		180-191	11.6	8.0
G013	Gates	5/6/91	pentachlorophenol	0.01	7/30/91	ND		2/17/92	ND					555-565		
G014	Gates	5/6/91	ND					2/17/92	ND					30.00		
G015	Bertie	5/13/91	ND					5/4/92	ND					225.00		
G016	Bertie	5/13/91	ND					3/24/92	ND					32.00		
G017	Columbus	5/14/91	ND					2/10/92	ND					506.00		
G018	Duplin	5/20/91	ND					2/17/92	BHC - alpha	0.02	5/12/92	ND		83.0-98.0	16.2	15.9
G019	Beaufort	5/20/91	ND					3/3/92	ND					142.00		
G020	Pamlico	5/20/91	ND					3/3/92	ND					275.00		
G021	Perquimans	5/28/91	ND					4/20/92	ND					49.00		
G022	Perquimans	5/28/91	ND					4/20/92	ND					351.00		
G023	Washington	6/3/91	ND					3/16/92	ND					510.00		
G024	Washington	6/3/91	ND					3/16/92	ND					120.00		
G025	Duplin	12/15/92	ND					9/14/93	ND					470.00		
G026	Pitt	6/10/91	ND					4/6/92	ND					14.00		
G027	Pitt	6/10/91	ND					4/6/92	ND					370.00		
G028	Pitt	6/17/91	2,4,5-T	0.02	10/14/91	ND		2/11/92	ND					122-132	20.4	19.0

ND - no detection; NS - no sample collected due to insufficient volume of water in monitoring well; ** not a pesticide; * point source**

Table 5 (continued)

Well Code	County	Round 1 Sampling Date	Chemical Detected	ppb	Round 1 Follow-up Date	Chemical Detected	ppb	Round 2 Sampling Date	Chemical Detected	ppb	Round 2 Follow-up Date	Chemical Detected	ppb	Total Depth or Screened Interval (feet)	Measured Depth to water Maximum (feet)	Measured Depth to water Minimum (feet)
G029	Pasquotank	6/24/91	(Abandoned well)											10.00		
G030	Pasquotank	6/24/91	ND					5/4/92	ND					130.00		
G031	Onslow	6/24/91	ND					3/2/92	ND					640.00		
G032	Pender	7/8/91	ND					2/17/92	ND					160.00		
G033	Lenoir	7/8/91	ND					4/21/92	ND					134.00		
G034	Lenoir	7/8/91	2,4,5-T	0.07	10/8/91	pentachlorophenol	0.1	3/2/92	ND		10/6/92	ND		480-490	105.9	104.4
G035	Jones	7/15/91	ND					4/27/92	DDT	0.02	7/13/92	ND		10.0-15.0	8.5	5.2
G036	Jones	7/15/91	ND					4/27/92	ND					284.00		
G037	Washington	7/16/91	ND					3/17/92	ND					15.00		
G038	Bertie	7/30/91	ND					3/24/92	ND					12.00		
G039	Jones	8/5/91	ND					5/19/92	ND					545.00		
G040	Wayne	8/6/91	ND					7/6/92	ND					18.00		
G041	Hertford	8/12/91	arochlor 1260 **	0.61	10/15/91	ND		2/18/92	ND					570.00	158.2	157.3
G042	Mecklenburg	9/17/91	ND					3/2/92	ND					17.00		
G043	Transylvania	9/23/91	ND					4/6/92	ND					25.00		
G044	Haywood	9/24/91	ND					4/6/92	ND					24.00		
G045	Rowan	9/30/91	merphos ***	0.07	3/17/92	ND		9/29/92	ND		4/27/93	ND		22.00		
G046	Transylvania	10/1/91	malathion ***	0.22	2/19/92	malathion ***	0.06	4/20/92	ND		5/26/92	ND		15.0-58.0	31.3	28.6
G047	Scotland	10/30/91	hexazinone	1.5	10/20/92	ND		12/1/92	hexazinone	5.2	4/28/93	ND		31.0-36.0	32.3	30.3
G048	Warren	11/6/91	ND					2/12/92	ND					32.00		
G049	Orange	11/13/91	ND					2/3/92	ND					48.00		
G050	Guilford	3/31/92	ND					10/26/92	ND					85.00		
G051	Davidson	4/14/92	ND					10/27/92	ND					125.00		
G056	Wilkes	10/5/92	ND					9/20/93	ND					120.00		
G057	Bladen	10/19/92	ND					4/20/93	ND					110.00		
G058	Robeson	10/19/92	ND					5/11/93	ND					449.00		
G063	Richmond	10/27/92	ND					4/20/93	ND					60.00		
G064	Duplin	6/3/91	ND					10/26/92	ND					130.00		

ND

Well Code	County	Round 1 Sampling Date	Chemical Detected	ppb	Round 1 Follow-up Date	Chemical Detected	ppb	Round 2 Sampling Date	Chemical Detected	ppb	Round 2 Follow-up Date	Chemical Detected	ppb	Total Depth or Screened Interval (feet)	Measured Depth to water Maximum (feet)	Measured Depth to water Minimum (feet)
PHASE II COOPERATOR MONITORING WELLS																
G052	Chowan	6/22/92	ND					12/8/92	DDT	0.02	2/15/93	ND		14.0-24.0	4.3	
G053	Chowan	6/22/92	ND					12/8/92	ND					5.5-15.5	4.9	1.6
G054	Pasquotank	6/22/92	ND					12/7/92	ND					6.0-16.0	6.3	4.5
G055	Pasquotank	6/22/92	ND					12/7/92	ND					12.5-22.5	3.0	
G059	Beaufort	12/1/92	DDD	0.03	2/16/93	DDD	0.06	7/14/93	ND					8.5-13.5	4.5	1.8
G060	Beaufort	12/1/92	DDD	0.05	2/16/93	ND		7/12/93	ND					4.0-14.0	6.2	4.8
G061	Pamlico	12/2/92	ND					9/27/93	ND					3.0-13.0	3.3	3.3
G062	Tyrrell	11/30/92	ND					10/19/93	ND					5.5-10.5	2.7	1.1
G065	Pamlico	1/19/93	ND					9/27/93	ND					7.0-12.0	3.5	0.6
G066	New Hanover	7/7/93	ND					2/7/94	ND					12.0-22.0	15.3	14.5
G067	New Hanover	3/1/93	ND					9/21/93	ND					5.0-10.0	3.9	2.4
G068	New Hanover	2/1/93	ND					9/20/93	ND					5.0-10.0	3.0	1.5
G069	Halifax	4/12/93	atrazine	2.5	5/4/93	atrazine	2.1	(Abandoned well 10/20/94)						6.0-11.0	7.0	6.9
						triazine dealkylated										
						isopropyl	0.8									
G070	Halifax	3/31/93	dinoseb	1.4	7/6/93	dinoseb	0.46	11/16/93	ND					6.0-11.0	4.7	2.4
G071	Halifax	3/29/93	ND					4/5/95	ND					2.5-7.5	3.7	0.1
G072	Hertford	4/5/93	ND					11/15/93	ND					9.0-14.0	10.1	5.0
G073	Bertie	4/13/93	atrazine	0.67	5/3/93	atrazine	0.75	11/15/93	atrazine	0.40	3/28/94	atrazine	1.0	3.0-8.0	2.0	0.1
			DDE	0.01		triazine dealkylated			DDE	0.02		DDE	0.05			
						isopropyl	1.4		triazine dealkylated			triazine dealkylated				
									isopropyl	1.2		isopropyl	0.75			
G074	Northampton	8/11/93	ND					3/16/94	ND					5.0-12.5	6.1	1.5
G075	Northampton	10/5/93	ND					3/16/94	ND					5-15.0	7.6	2.4
G076	Pitt	10/18/93	ND					3/21/94	ND					4.5-9.5	3.1	1.8
G077	Harnett	8/10/93	ND					9/6/94	ND					8.5-13.5	3.6	3.5
G078	Cumberland	8/4/93	ND					2/15/94	ND					10.5-15.5	7.4	5.5

ND - no detection; NS - no sample collected due to insufficient volume of water in monitoring well; ** not a pesticide; * point source**

Table 5 (continued)

Well Code	County	Round 1 Sampling Date	Chemical Detected	ppb	Round 1 Follow-up Date	Chemical Detected	ppb	Round 2 Sampling Date	Chemical Detected	ppb	Round 2 Follow-up Date	Chemical Detected	ppb	Total Depth or Screened Interval (feet)	Measured Depth to water Maximum (feet)	Measured Depth to water Minimum (feet)
G079	Bladen	8/9/93	ND					4/5/94	ND					9.0-14.0	6.9	3.9
G080	Bladen	9/15/93	ND					4/5/94	ND					7.0-12.0	2.6	2.0
G081	Columbus	9/20/93	ND					3/1/94	ND					4.0-9.0	4.2	3.5
G082	Columbus	9/20/93	ND					3/18/94	ND					9.5-17.0	2.8	1.5
G083	Sampson	9/13/93	ND					4/4/94	ND					7.5-12.5	3.2	1.8
G084	Sampson	9/13/93	ND					4/4/94	ND					3.5-8.5	2.5	2.0
G085	Chowan	10/21/93	ND					3/22/94	ND					5.0-10.0	1.4	1.0
G086	Pasquotank	10/21/93	ND					3/22/94	ND					10-15.0	5.0	3.2
G087	Pitt	10/19/93	ND					3/21/94	ND					13-18.0	3.3	3.0
G088	Edgecombe	11/16/93	ND					9/14/94	ND					9-14.0	8.3	5.7
G089	Sampson	12/7/93	ND					9/7/94	ND					14.0-19.0	9.5	3.4
G090	Sampson	11/29/93	BHC - alpha	0.01	7/11/94	ND		11/7/94	ND					11-21.0	7.8	7.5
G091	Sampson	11/29/93	ND					7/6/94	ND					11-21.0	6.3	3.8
G092	Sampson	12/8/93	ND					7/20/94	ND					11.5-16.5	6.7	5.5
G093	Johnston	10/27/93	ND					8/30/94	ND					30-35.0	33.0	12.0
G094	Johnston	10/27/93	ND					8/29/94	ND					15 - 20.0	8.7	8.5
G095	Robeson	2/21/94	endrin ketone	0.17	7/25/94	endrin ketone	0.34	11/8/94	endrin ketone	0.20	1/9/95	endrin ketone	0.04	14.0-19.0	6.2	5.5
												acifluorfen	0.10			
G096	Robeson	2/22/94	endrin ketone	0.07	7/27/94	endrin ketone	0.07	11/8/94	endrin ketone	0.05	1/10/95	endrin ketone	0.15	13.0-18.0	6.1	5.5
									acifluorfen	0.40		DCPA	0.02			
G097	Robeson	2/14/94	prometon	6.2	8/3/94	prometon	2.0	11/8/94	ND					8.0-13.0	4.1	1.5
G098	Robeson	2/14/94	ND					7/25/94	ND					13.0-18.0	3.0	2.5
G099	Cumberland	4/6/94	ND					11/29/94	ND					8.5-13.5	8.5	
G100	Johnston	11/3/93	ND					8/29/94	ND					13.0-18.0	9.3	7.5
G101	Johnston	11/3/93	ND					4/5/95	ND					13.5-16.0	5.7	4.5
G102	Johnston	11/2/93	ND					8/30/94	ND					18.0-23.0	3.0	2.6
G103	Johnston	11/2/93	ND					8/30/94	ND					18.0-23.0	5.5	5.5
G104	Robeson	2/22/94	ND					8/3/94	ND					8.0-18.0	3.1	3.0
G105	Sampson	12/7/93	hexazinone	34.0	2/2/94	hexazinone	0.74	9/7/94	hexazinone	8.1	1/3/95	hexazinone	5.2	14.5-19.5	10.3	7.3

Well Code	County	Round 1 Sampling Date	Chemical Detected	ppb	Round 1 Follow-up Date	Chemical Detected	ppb	Round 2 Sampling Date	Chemical Detected	ppb	Round 2 Follow-up Date	Chemical Detected	ppb	Total Depth or Screened Interval (feet)	Measured Depth to water Maximum (feet)	Measured Depth to water Minimum (feet)
G106	Sampson	12/8/93	ND					7/20/94	ND					5.0-10.0	4.3	2.7
G107	Duplin	11/29/93	ND					7/12/94	ND					8.5-13.5	6.5	3.5
G108	Duplin	2/8/94	ND					7/19/94	ND					4.0-9.0	1.4	0.5
G109	Wayne	3/23/94	ND					9/13/94	ND					12.0-22.0	9.1	9.0
G110	Duplin	11/29/93	ND					7/6/94	ND					7.5-12.5	6.3	5.5
G111	Duplin	12/13/93	ND					7/12/94	ND					10-15.0	6.3	5.4
G112	Duplin	2/9/94	ND					7/13/94	ND					9.0-14.0	4.8	1.5
G113	Sampson	12/13/93	tebuthiuron	1.3	2/2/94	ND		9/7/94	ND					9.0-19.0	7.5	4.4
G114	Duplin	2/8/94	tebuthiuron	108	7/18/94	tebuthiuron	88	11/7/94	tebuthiuron	89	1/3/95	tebuthiuron	123	4.5-19.5	15.0	5.3
			prometon	0.14		prometon	3.5					prometon	2.7			
G115	New Hanover	2/7/94	ND					9/27/94	ND					9.0-14.0	0.5	
G116	Moore	3/8/94	ND					9/13/94	dibromochloro-		11/28/94	dibromochloro-		18.0-23.0	10.9	9.5
									propane	0.50		propane	0.45			
G117	Moore	3/7/94	ND					9/13/94	metribuzin DA	1.6	11/29/94	ND		12.5-17.5	7.5	7.1
G118	Moore	3/7/94	ND					9/6/94	ND					8.5-18.5	5.0	4.9
G119	Moore	3/8/94	BHC - delta	0.02	8/3/94	methylene chloride	120	9/26/94	ND					23.0-33.0	23.7	23.0
G120	Union	8/16/94	ND					3/7/95	ND					14.0-19.0	7.3	6.7
G121	Union	8/16/94	NS					3/7/95	NS					12.0-27.0	3.7	2.4
G122	Montgomery	8/8/94	1,2-dichloro -		9/28/94	1,2-dichloro -		3/6/95	ND					13.0-23.0	20.1	18.9
			propane	0.32		propane	0.37									
G123	Montgomery	8/8/94	BHC-alpha	0.01	1/16/95	BHC-alpha	0.01	3/6/95	ND					18.0-28.0	23.0	19.8
G124	Moore	8/9/94	ND					3/6/95	ND					13.0-23.0	14.2	10.5
G125	Moore	8/9/94	simazine	1.60	10/10/94	simazine	3.1	3/7/95	simazine	7.4	5/15/95	simazine	1.1	10.0-20.0	15.2	10.3
			triazine						triazine			triazine				
			dealkylated ethyl	0.69					dealkylated ethyl	2.2		dealkylated ethyl	0.98			
G126	Moore	8/9/94	ND					3/7/95	ND					17.0-27.0	4.0	3.0
G127	Cleveland	9/19/94	ND					3/14/95	ND					10.0-20.0	6.7	
G128	Rowan	8/15/94	ND					2/28/95	ND					9.0-14.0	5.4	2.6
G129	Rowan	8/15/94	NS					3/13/95	NS					22.0-27.0	dry	dry

ND - no detection; NS - no sample collected due to insufficient volume of water in monitoring well; ** not a pesticide; * point source**

Table 5 (continued)

Well Code	County	Round 1 Sampling Date	Chemical Detected	ppb	Round 1 Follow-up Date	Chemical Detected	ppb	Round 2 Sampling Date	Chemical Detected	ppb	Round 2 Follow-up Date	Chemical Detected	ppb	Total Depth or Screened Interval (feet)	Measured Depth to water Maximum (feet)	Measured Depth to water Minimum (feet)
G130	Rowan	8/15/94	ND					1/31/95	mirex	0.06	3/13/95	ND		12.0-22.0	12.8	6.8
G131	Iredell	8/15/94	ND					1/31/95	ND					7.0-12.0	3.4	
G132	Iredell	9/19/94	ND					2/28/95	ND					38.0-48.0	35.6	
G133	Iredell	8/16/94	ND					1/31/95	ND					10.0-15.0	6.7	1.5
G134	Alleghany	10/3/94	ND					3/28/95	ND					23.0-33.0	9.7	
G135	Ashe	11/15/94	ND					4/25/95	simazine	1.2	5/23/95	simazine	1.0	5.0-15.0	4.0	2.2
									triazine							
									dealkylated ethyl	1.0						
G136	Ashe	11/15/94	ND					4/25/95	ND					15.0-20.0	1.9	
G137	Ashe	11/15/94	ND					4/25/95	simazine	0.33	5/23/95	ND		34.0-44.0	20.7	19.6
									triazine							
									dealkylated ethyl	0.53						
G138	Lincoln	9/19/94	norflurazon	1.7	12/13/94	norflurazon	5.3	2/28/95	norflurazon	2.6	5/8/95	norflurazon	1.5	12.0-17.0	6.8	5.1
						simazine	0.72		simazine	2.0		simazine	0.62			
G139	Surry	12/5/94	ND					5/1/95	ND					10.0-20	4.0	
G140	Alleghany	10/3/94	ND					3/28/95	ND					10.0-15.0	10.8	
G141	Alleghany	10/3/94	ND					3/27/95	ND					8.0-18.0	6.0	
G142	Madison	12/13/94	ND					5/9/95	ND					9.0-19.0	4.4	
G143	Madison	12/13/94	ND					5/9/95	ND					5.0-15.0	5.0	
G144	Henderson	10/31/94	ND					4/18/95	ND					20.0-30.0	12.5	
G145	Henderson	10/31/94	ND					4/18/95	ND					5.0-10.0	2.8	
G146	Haywood	12/13/94	ND					4/18/95	ND					3.0-8.0	1.8	
G147	Buncombe	11/1/94	dichlorprop	2.2	3/14/95	ND		4/18/95	ND					4.0-9.0	1.5	0.8
G148	Buncombe	11/1/94	ND					4/18/95	ND					9.0-19.0	4.8	
G149	Surry	12/5/94	ND					5/1/95	ND					35.0-45.0	28.8	
G150	Wilkes	12/6/94	ND					5/2/95	ND					19.0-24.0	12.4	
G151	Alleghany	10/3/94	ND					3/27/95	ND					4.0-14.0	3.6	
G152	Alleghany	10/3/94	ND					3/28/95	ND					4.0-9.0	2.8	
G153	Ashe	11/15/94	simazine	0.9	1/30/95	ND		4/25/95	simazine	0.54	5/23/95	ND		9.0-19.0	4.1	4.0
			triazine	2.0					triazine	0.39						
			dealkylated ethyl						dealkylated ethyl							
G154	Iredell	9/20/94	tebuthiuron	4.8	12/6/94	tebuthiuron	3.4	2/28/95	tebuthiuron	7.3	5/2/95	tebuthiuron	5.7	13.0-23.0	14.1	13.8
G155	Iredell	9/20/94	NS					4/11/95	NS					63.0-73.0	dry	dry
G156	Lincoln	9/19/94	ND					2/28/95	ND					16.0-21.0	14.0	

NC

Table 3. [illegible]
and cooperator monitoring wells.

Well Code	County	List of Target Pesticides and Their Pesticide Leaching Potential Rating*	Site Type	Soil Series	Soil Leaching Potential Index	DRASTIC PARAMETERS: Depth to Water	Recharge	Aquifer Media	Soil Media	Topog-raphy	Impact of Vadose Zone	Hydraulic Conductivity	Pdrastic+ Rating
PHASE I AMBIENT MONITORING WELLS													
G001	Brunswick		ambient										
G002	Hyde		ambient										
G003	Brunswick		ambient										
G004	Beaufort		ambient										
G005	Beaufort		ambient										
G006	Onslow	2,4-D-M	ambient										
G007	Craven		ambient										
G008	Craven		ambient										
G009	Brunswick		ambient										
G010	Beaufort		ambient										
G011	Beaufort		ambient										
G012	Carteret		ambient										
G013	Gates		ambient										
G014	Gates		ambient										
G015	Bertie		ambient										
G016	Bertie	acifluorfen-M; atrazine-M-H; metolachlor-M	ambient										
G017	Columbus		ambient										
G018	Duplin		ambient										
G019	Beaufort		ambient										
G020	Pamlico		ambient										
G021	Perquimans		ambient										
G022	Perquimans		ambient										
G023	Washington		ambient										
G024	Washington		ambient										
G025	Duplin		ambient										
G026	Pitt		ambient										

*** VL - very low; L - low; M - moderate; H - high; VH - very high; NA - not available**

+Pesticide DRASTIC rating

**** not a target pesticide but used <300 feet from the well**

Table 6 (continued)

Well Code	County	List of Target Pesticides and Their Pesticide Leaching Potential Rating*	Site Type	Soil Series	Soil Leaching Potential Index	DRASTIC PARAMETERS: Depth to Water	Recharge	Aquifer Media	Soil Media	Topog-raphy	Impact of Vadose Zone	Hydraulic Conductivity	Pdrastic+ Rating
G027	Pitt		ambient										
G028	Pitt		ambient										
G029	Pasquotank		ambient										
G030	Pasquotank		ambient										
G031	Onslow		ambient										
G032	Pender		ambient										
G033	Lenoir	2,4-D-M; diuron-M-H	ambient										
G034	Lenoir		ambient										
G035	Jones	alachlor-M; atrazine-M-H	ambient										
G036	Jones	alachlor-M; atrazine-M-H	ambient										
G037	Washington		ambient										
G038	Bertie	acifluorfen-M; atrazine-M-H; metolachlor-M	ambient										
G039	Jones	alachlor-M; atrazine-M-H	ambient										
G040	Wayne		ambient										
G041	Hertford		ambient										
G042	Mecklenburg		ambient										
G043	Transylvania		ambient										
G044	Haywood		ambient										
G045	Rowan	acifluorfen-M; alachlor-M; atrazine-M-H;	ambient										
		aldicarb-H; butylate-M; carbaryl-L;											
		carbofuran-H; chlorothalonil-L; methomyl-M											
G046	Transylvania		ambient										
G047	Scotland	hexazinone-H	ambient	Lakeland	88								
G048	Warren	trifluralin-L; metolachlor-M	ambient										
G049	Orange		ambient										
G050	Guilford		ambient										
G051	Davidson		ambient										
G056	Wilkes		ambient										

* VL - very low; L - low; M - [illegible]

Table 6 (continued)

Well Code	County	List of Target Pesticides and Their Pesticide Leaching Potential Rating*	Site Type	Soil Series	Soil Leaching Potential Index	DRASTIC PARAMETERS: Depth to Water	Recharge	Aquifer Media	Soil Media	Topog-raphy	Impact of Vadose Zone	Hydraulic Conductivity	Pdrastic+ Rating
G057	Bladen	alachlor-M; atrazine-M-H; carbaryl-L; 2,4-D-M;	ambient										
		metolachlor-M; disulfoton-M; metribuzin-M											
G058	Robeson		ambient										
G063	Richmond		ambient										
G064	Duplin		ambient										
PHASE II COOPERATOR MONITORING WELLS													
G052	Chowan	alachlor-M; aldicarb-H; carbofuran-H;	watermelons	Seabrook	88	10	9	6	7	10	8	2	205
		metolachlor-M; chlorothalonil-L											
G053	Chowan	alachlor-M; atrazine-M-H; butylate-M;	sweet corn	Lynnhaven	63	10	9	6	7	10	8	2	205
		methomyl-M; metribuzin-M											
G054	Pasquotank	acifluorfen-M; alachlor-M; 2,4-D-M;	cabbage	Barclay	77	10	8	6	6	10	6	2	188
		methomyl-M; DCPA-H											
G055	Pasquotank	acifluorfen-M; alachlor-M; atrazine-M-H;	potatoes	Nixonton	82	10	8	6	6	10	6	2	188
		ametryn-M; carbofuran-H; 2,4-D-M;											
		metolachlor-M; metribuzin-M; oxamyl-M											
G059	Beaufort	alachlor-M; atrazine-M-H;	soybeans	Bayboro	10	10	8	8	6	10	6	6	202
		2,4-D-M; metolachlor-M											
G060	Beaufort	acifluorfen-M; alachlor-M; hexazinone-H;	wheat	Leaf	35	10	5	8	6	10	4	6	182
		2,4-D-M; metolachlor-M;											
		disulfoton-M; diuron-M-H											
G061	Pamlico	acifluorfen-M; dicamba-M-H;	potatoes	Yonges	54	10	9	8	5	10	8	6	209
		metribuzin-M; oxamyl-M											
G062	Tyrrell	acifluorfen-M; alachlor-M; atrazine-M-H;	potatoes	Weeksville	30	10	5	6	6	10	4	2	168
		ametryn-M; carbofuran-H; 2,4-D-M; diazinon-M;											
		dicamba-M-H; metribuzin-M											
G065	Pamlico	malathion-VL**	mosquito	Stockade	25	10	8	7	5	10	6	4	190
			abatement										

*** VL - very low; L - low; M - moderate; H - high; VH - very high; NA - not available**

+Pesticide DRASTIC rating

**** not a target pesticide but used <300 feet from the well**

Table 6 (continued)

Well Code	County	List of Target Pesticides and Their Pesticide Leaching Potential Rating*	Site Type	Soil Series	Soil Leaching Potential Index	DRASTIC PARAMETERS: Depth to Water	Recharge	Aquifer Media	Soil Media	Topog-raphy	Impact of Vadose Zone	Hydraulic Conductivity	Pdrastic+ Rating
G066	New Hanover	malathion-VL**	mosquito abatement	Lakeland	88	10	9	8	8	10	8	6	224
G067	New Hanover	malathion-VL**	mosquito abatement	Lakeland	88	10	9	8	8	10	8	6	224
G068	New Hanover	malathion-VL**	mosquito abatement	Corolla	95	9	9	8	9	10	8	6	224
G069	Halifax	alachlor-M; atrazine-M-H; trifluralin-L; methomyl-M; metolachlor-M	sweet corn	State	70	10	5	7	6	10	4	4	175
G070	Halifax	acifluorfen-M; aldicarb-H	cotton	Gritney	37	10	9	8	6	10	8	6	214
G071	Halifax	acifluorfen-M; atrazine-M-H; aldicarb-H; trifluralin-L; chlorothalonil-L; metolachlor-M	peanuts	Gritney	37	10	9	8	8	10	8	6	224
G072	Hertford	acifluorfen-M; aldicarb-H; carbofuran-H; chlorothalonil-L; methomyl-M; metolachlor-M	watermelons	Goldsboro	70	10	9	8	8	10	8	6	224
G073	Bertie	acifluorfen-M; alachlor-M; atrazine-M-H; aldicarb-H; carbaryl-L; chlorothalonil-L; metolachlor-M; fluometuron-M	peanuts	Tarboro	88	10	5	7	6	10	4	4	175
G074	Northampton	acifluorfen-M; atrazine-M-H; aldicarb-H; chlorothalonil-L; metolachlor-M; fluometuron-M	cotton	Norfolk	74	10	9	8	8	10	8	6	224
G075	Northampton	atrazine-M-H; aldicarb-H; chlorothalonil-L; metolachlor-M	peanuts	Norfolk	74	10	9	7	8	10	8	4	217
G076	Pitt	alachlor-M; 2,4-D-M; metolachlor-M;fluometuron-M	field corn	Portsmouth	11	10	9	8	7	10	8	6	219
G077	Harnett	atrazine-M-H; carbofuran-H; 2,4-D-M; methomyl-M; metolachlor-M; metribuzin-M	oats	Goldsboro	70	10	8	8	8	10	6	6	212
G078	Cumberland	atrazine-M-H; 2,4-D-M; simazine-M-H	highway right-of-way	Altavista	68	10	8	7	6	9	6	4	192
G079	Bladen	carbaryl-L	grapes	Ocilla	81	10	9	7	8	10	8	4	217
G080	Bladen	hexazinone-H	blueberries	Leon	61	10	9	7	8	10	8	4	217

* VL - very low

Table 6 (cont.)

Well Code	County	List of Target Pesticides and Their Pesticide Leaching Potential Rating*	Site Type	Soil Series	Soil Leaching Potential Index	DRASTIC PARAMETERS: Depth to Water	Recharge	Aquifer Media	Soil Media	Topog-raphy	Impact of Vadose Zone	Hydraulic Conductivity	Pdrastic+ Rating
G081	Columbus	atrazine-M-H; aldicarb-H; metolachlor-M;	sweet potatoes	Rains	46	10	5	6	6	10	4	2	168
		diazinon-M; diphenamid-M											
G082	Columbus	trifluralin-L; methomyl-M	cabbage	Autryville	85	10	5	6	8	10	4	2	178
G083	Sampson	atrazine-M-H; hexazinone-H; 2,4-D-M;	blueberries	Leon	61	10	9	7	9	10	8	4	222
		metolachlor-M; simazine-M-H; terbacil-M-H											
G084	Sampson	alachlor-M; chlorothanil-L ; 2,4-D-M	watermelons	Torhunta	21	10	9	7	8	10	8	4	217
G085	Chowan	diazinon-M	residential	Lynnhaven	63	10	5	6	7	10	8	2	189
G086	Pasquotank	chlordane-L	residential	Dragston	80	10	5	6	7	10	4	2	173
G087	Pitt	acifluorfen-M; aldicarb-H; methomyl-M	flue-cured	Goldsboro	70	10	5	8	6	10	4	6	182
			tobacco										
G088	Edgecombe	acifluorfen-M; alachlor-M; aldicarb-H;	cotton	Goldsboro	70	10	9	6	6	10	8	2	200
		chlorothalonil-L; methomyl-M; metolachlor-M											
G089	Sampson	chlorpyrifos-L**; fenamiphos-H**	peppers	Wagram	83	10	9	7	7	10	8	4	212
G090	Sampson	atrazine-M-H; carbaryl-L; 2,4-D-M;	cucumbers	Lynchburg	44	10	5	6	6	10	4	2	168
		methomyl-M; metolachlor-M											
G091	Sampson	carbaryl-L; metolachlor-M; diazinon-M	snap beans	Norfolk	74	10	5	6	6	10	4	2	168
G092	Sampson	carbaryl-L; chlorothalonil-L	tomatoes	Wagram	83	10	9	6	5	10	8	2	195
G093	Johnston	2,4-D-M; simazine-M-H	highway	Udorthents	NA	5	8	6	7	10	6	2	168
			right-of-way										
G094	Johnston	atrazine-M-H; 2,4-D-M; simazine-M-H	highway	Udorthents	NA	5	8	6	7	10	6	2	168
			right-of-way										
G095	Robeson	aldicarb-H; trifluralin-L; methomyl-M;	soybeans	Cainhoy	85	10	9	7	7	10	8	4	212
		metolachlor-M; disulfoton-M; metribuzin-M;											
		acifluorfen-M											
G096	Robeson	aldicarb-H; methomyl-M; metolachlor-M;	flue-cured	Norfolk	74	10	9	7	7	10	8	4	212
		disulfoton-M; metribuzin-M; acifluorfen-M	tobacco										
G097	Robeson	alachlor-M; atrazine-M-H; metolachlor-M	field corn	Goldsboro	70	10	9	7	7	10	8	4	212
G098	Robeson	alachlor-M; metolachlor-M	wheat	Norfolk	74	10	5	8	7	10	4	6	187

*** VL - very low; L - low; M - moderate; H - high; VH - very high; NA - not available**

+Pesticide DRASTIC rating

**** not a target pesticide but used <300 feet from the well**

Table 6 (continued)

Well Code	County	List of Target Pesticides and Their Pesticide Leaching Potential Rating*	Site Type	Soil Series	Soil Leaching Potential Index	DRASTIC PARAMETERS: Depth to Water	Recharge	Aquifer Media	Soil Media	Topog-raphy	Impact of Vadose Zone	Hydraulic Conductivity	Pdrastic+ Rating
G099	Cumberland	2,4-D-M	rye	Candor	87	10	8	7	6	10	6	4	195
G100	Johnston	trifluralin-L	sweet potatoes	Wagram	83	10	9	7	7	10	8	4	212
G101	Johnston	trifluralin-L	flue-cured tobacco	Blanton	88	10	9	7	7	10	8	4	212
G102	Johnston	alachlor-M; trifluralin-L; 2,4-D-M; disulfoton-M	cucumbers	Rains	46	10	8	6	7	10	6	2	193
G103	Johnston	alachlor-M; trifluralin-L; 2,4-D-M	oats	Toisnot	79	10	8	6	7	10	6	2	193
G104	Robeson	trifluralin-L; carbaryl-L; methomyl-M	cabbage	Goldsboro	70	10	9	8	7	10	8	6	219
G105	Sampson	hexazinone-H	forest	Cainhoy	85	10	9	7	9	10	8	4	222
G106	Sampson	carbaryl-L; diazinon-M	nursery	Wagram	83	10	9	6	7	10	8	2	205
G107	Duplin	atrazine-M-H; metolachlor-M	field corn	Dragston	80	5	8	4	5	10	6	2	152
G108	Duplin	hexazinone-H	blueberries	Ruston	74	10	8	8	8	10	6	6	212
G109	Wayne	carbaryl-L; simazine-M-H	golf course	Troup	80	10	9	8	8	10	8	6	224
G110	Duplin	carbaryl-L; metolachlor-M; diazinon-M	snap beans	Rains	46	10	5	6	6	10	4	2	168
G111	Duplin	trifluralin-L; metribuzin-M	peppers	Plummer	79	10	5	6	6	10	4	2	168
G112	Duplin	carbaryl-L	strawberries	Lynchburg	46	10	9	6	5	10	8	2	195
G113	Sampson	tebuthiuron-VH**	electrical substation	Wagram	83	10	9	7	8	10	8	4	217
G114	Duplin	alachlor-M; tebuthiuron-VH**	electrical substation	Lakeland	88	10	8	8	4	10	6	6	192
G115	New Hanover	2,4-D-M; diazinon-M; dicamba-M-H; metribuzin-M; simazine-M-H	golf course	Rimini	84	10	9	7	9	10	8	4	222
G116	Moore	simazine-M-H	grapes	Candor	87	9	9	8	8	10	8	6	219
G117	Moore	carbaryl-L; chlorothalonil-L	golf course	Ailey	79	7	9	7	8	9	8	4	199
G118	Moore	acifluorfen-M; 2,4-D-M; metolachlor-M; dicamba-M-H	rye	Gilead	66	7	9	7	8	9	8	4	199
G119	Moore	atrazine-M-H; aldicarb-H; carbaryl-L; chlorothalonil-L; methomyl-M; metolachlor-M	sweet corn	Candor	87	9	9	8	8	10	8	6	219

* VL - very low

Table 6 (continued)

Well Code	County	List of Target Pesticides and Their Pesticide Leaching Potential Rating*	Site Type	Soil Series	Soil Leaching Potential Index	DRASTIC PARAMETERS: Depth to Water	Recharge	Aquifer Media	Soil Media	Topog-raphy	Impact of Vadose Zone	Hydraulic Conductivity	Pdrastic+ Rating
G120	Union	carbaryl-L; chlorothalonil-L	nursery	Tatum	62	5	6	3	4	10	5	2	132
G121	Union	atrazine-M-H; aldicarb-H;	soybeans	Badin	62	5	8	5	4	10	6	2	150
		trifluralin-L; simazine-M-H		Channery									
G122	Montgomery	simazine-M-H	peaches	Norfolk	74	7	9	8	8	9	8	6	206
G123	Montgomery	trifluralin-L; diphenamid-M	soybeans	Norfolk	74	9	3	8	8	10	3	6	175
G124	Moore	simazine-M-H	peaches	Vaucluse	72	9	9	8	8	10	8	6	219
G125	Moore	simazine-M-H	golf course	Candor	87	9	9	7	8	10	8	4	212
G126	Moore	hexazinone-H	forest	Fuquay	79	9	9	8	8	10	8	6	219
G127	Cleveland	acifluorfen-M; carbaryl-L; 2,4-D-M	wheat	Pacolet/	60	7	9	5	6	9	8	2	179
				Bethlehem									
G128	Rowan	atrazine-M-H; carbaryl-L;	soybeans	Enon	52	9	8	5	5	10	6	2	175
		2,4-D-M; metribuzin-M											
G129	Rowan	acifluorfen-M; alachlor-M; atrazine-M-H;	barley	Mecklinburg	70	5	8	5	5	10	6	2	155
		carbaryl-L; 2,4-D-M; dicamba-M-H											
G130	Rowan	chlorothalonil-L; diazinon-M; metribuzin-M	tomatoes	Enon	52	5	8	5	5	10	6	2	155
G131	Iredell	atrazine-M-H; 2,4-D-M;	field corn	Chewacla	50	9	8	5	5	10	6	2	175
		dicamba-M-H; metolachlor-M											
G132	Iredell	trifluralin-L; chlordane-L	residential	Cecil	62	5	8	4	5	10	6	2	152
G133	Iredell	2,4-D-M; dicamba-M-H	hay	Chewacla	50	7	9	5	5	9	8	2	174
G134	Alleghany	triclopyr-H **	Christmas trees	Watauga	72	7	9	5	5	5	8	2	162
G135	Ashe	simazine-M-H	Christmas trees	Toxaway	29	9	9	4	6	10	8	2	189
G136	Ashe	disulfoton-M; simazine-M-H	Christmas trees	Watauga	72	7	9	4	6	5	8	2	164
G137	Ashe	disulfoton-M; simazine-M-H	Christmas trees	Chandler	52	9	9	4	6	5	8	2	174
G138	Lincoln	carbaryl-L; 2,4-D-M; simazine-M-H	apples	Pacolet	60	5	9	5	5	10	8	2	167
G139	Surry	carbaryl-L; 2,4-D-M; DCPA-H	strawberries	Pacolet	60	7	9	4	6	9	8	2	176
G140	Alleghany	disulfoton-M; simazine-M-H	Christmas trees	Tate	69	9	9	5	5	9	8	2	184
G141	Alleghany	disulfoton-M; simazine-M-H	Christmas trees	Chester	44	7	9	4	6	5	8	2	164
G142	Madison	disulfoton-M; oxamyl-M	burley tobacco	French	81	9	8	4	5	9	6	2	169
G143	Madison	napropamide-M**	burley tobacco	French	81	10	8	4	5	5	6	2	162

*** VL - very low; L - low; M - moderate; H - high; VH - very high; NA - not available**

+Pesticide DRASTIC rating

**** not a target pesticide but used <300 feet from the well**

Table 6 (continued)

Well Code	County	List of Target Pesticides and Their Pesticide Leaching Potential Rating*	Site Type	Soil Series	Soil Leaching Potential Index	DRASTIC PARAMETERS: Depth to Water	Recharge	Aquifer Media	Soil Media	Topog-raphy	Impact of Vadose Zone	Hydraulic Conductivity	Pdrastic+ Rating
G144	Henderson	terbacil-M-H; carbaryl-L;	apples	Hayesville	63	9	9	4	5	9	8	2	181
		diuron-M-H; simazine-M-H											
G145	Henderson	atrazine-M-H; chlorothalonil-L;	peppers	Toxaway	29	9	9	4	5	10	8	2	184
		metolachlor-M; metribuzin-M											
G146	Haywood	carbaryl-L; chlorothalonil-L; metribuzin-M	tomatoes	Rosman	49	9	9	4	5	9	8	2	181
G147	Buncombe	carbofuran-H	hay	Hayesville	63	9	9	5	5	10	8	2	187
G148	Buncombe	carbaryl-L	grapes	Hayesville	63	9	9	5	5	9	8	2	184
G149	Surry	carbaryl-L; simazine-M-H	grapes	Pacolet	60	9	9	4	5	10	8	2	184
G150	Wilkes	carbaryl-L; 2,4-D-M; simazine-M-H	apples	Tate	69	5	9	5	5	9	8	2	164
G151	Alleghany	napropamide-M**; chlorpyrifos-L**	burley tobacco	Codorus	81	9	9	5	6	9	8	2	189
G152	Alleghany	alachlor-M; atrazine-M-H; metolachlor-M	field corn	Cullowhee	77	9	9	5	5	10	8	2	187
G153	Ashe	disulfoton-M; simazine-M-H	Christmas trees	Watauga	72	5	9	5	6	5	8	2	157
G154	Iredell	trifluralin-L; tebuthiuron-VH**	electrical	Cecil	62	5	9	5	5	10	8	2	167
			substation										
G155	Iredell	trifluralin-L; tebuthiuron-VH**	electrical	Davidson	63	7	9	5	5	9	8	2	174
			substation										
G156	Lincoln	trifluralin-L; tebuthiuron-VH**	electrical	Hulette	62	5	8	4	5	10	6	2	152
			substation										

*** VL - very low; L - low; M - moderate; H - high; VH - very high; NA - not available**

+Pesticide DRASTIC rating

**** not a target pesticide but used <300 feet from the well**

Table 7. Summary of laboratory analyses of ground water samples collected from monitoring wells.

	Phase I	Phase II	Total
Wells sampled at least twice	55	97	152
Wells with at least 1 sample detection of a pesticide or metabolite	7[a,b,c]	26	33[a,b,c]
Wells with at least 2 sample detections of the same pesticide or metabolite	1[b]	17	18[b]
Wells containing registered pesticides or metabolites exceeding heatth standards	1	5	6
Wells containing previously registered pesticides or metabolites exceeding health standards	0	2	2
Same pesticide or metabolite detected in at least 2 samples from the same well	1[b]	15	15[b,d]
Registered pesticides or metabolites detected in at least 2 samples from the same well	1[b]	9	9[b,d]
Registered pesticides or metabolites detected at least once	4[b,c]	14	16[b,c,e]
Previously registered pesticides or metabolites detected at least once	2	9	10'

[a] Excludes G41 which contained the nonpesticide arochlor 1260.
[b] Excludes G46, a malathion point source contamination.
[c] Excludes G45, a merphos point source contamination.
[d] Phase I plus phase II does not equal total because hexazinone was detected in both phases.
[e] Phase I plus phase II does not equal total because BHC-alpha and hexazinone were detected in both phases.
[f] Phase I plus phase II does not equal total because DDT was detected in both phases.

Table 8. Sampling dates and laboratory analytical data for groundwater samples collected from domestic wells after two detections of the same pesticide in an ambient or cooperator monitoring well.

Well Code	County	Site Type	Chemical Confirmed in Monitoring Well	Domestic Well Number	Date Sampled	Chemical Detected in Domestic Well	ppb
G046	Transylvania	ambient	malathion	1	5/8/92	ND	
				2	5/8/92	ND	
				3	5/8/92	ND	
				4	5/8/92	ND	
G047	Scotland	ambient	hexazinone	1	7/8/93	ND	
G059	Beaufort	soybeans	DDD	1	4/22/93	ND	
				2	4/22/93	ND	
				3	4/22/93	ND	
G069	Halifax	sweet corn	atrazine	1	8/4/93	ND	
				2	8/4/93	ND	
G070	Halifax	cotton	dinoseb	1	9/24/93	ND	
				2	9/24/93	ND	
				3	9/24/93	alachlor	0.60
G073	Bertie	peanuts	atrazine	1	7/15/93	ND	
			DDE	1	4/20/94	ND	
			triazine dealkylated isopropyl	2	7/15/93	atrazine	0.20
						alachlor	9.20
				2	4/20/94	atrazine	0.30
						alachlor	5.00
				3	7/15/93	ND	
G095	Robeson	soybeans	endrin ketone	1	1/18/95	ND	
G096	Robeson	flue-cured tobacco	endrin ketone	1	1/18/95	ND	
G097	Robeson	field corn	prometon	1	3/9/95	prometon	0.22
						2,4-D	0.40
						2,4,5-TP	0.10
						DCPA	0.50
						bentazon	0.30
						atrazine	<1.0
				1	11/29/95	ND	
				2	11/29/95	ND	
				3	11/29/95	ND	
G105	Sampson	forest	hexazinone	1	7/12/94	ND	
				2	7/12/94	ND	
G114	Duplin	electrical substation	tebuthiuron	1	11/3/94	ND	
			prometon	2	11/3/94	ND	

ND = no detection

Table 8 (continued)

Well Code	County	Site Type	Chemical Confirmed in Monitoring Well	Domestic Well Number	Date Sampled	Chemical Detected in Domestic Well	ppb
G116	Moore	grapes	dibromochloropropane	1	2/6/95	ND	
				2	2/6/95	ND	
G122	Montgomery	peaches	1,2-dichloropropane	1	2/6/95	1,2-dichloropropane	2.50
				1	10/22/95	1,2-dichloropropane	2.00
						1,2,3-trichloropropane	<1.0
				2	3/15/95	1,2-dichloropropane	5.50
				2	10/22/95	1,2-dichloropropane	5.60
						1,3-dichloropropane	<1.0
						acetone	23.70
						1,2,3-trichloropropane	1.50
				3	3/15/95	ND	
				3	10/22/95	chloroform	<1.0
						1,2-dichloroethane	<1.0
				4	3/15/95	ND	
G123	Montgomery	soybeans	BHC-alpha	1	3/15/95	ND	
				2	3/15/95	ND	
				3	3/15/95	ND	
G125	Moore	golf course	simazine	1	12/21/94	ND	
			triazine	2	12/21/94	simazine	1.00
			dealkylated ethyl	2	3/15/95	simazine	1.00
				2	11/27/95	simazine	4.10
				3	12/21/94	ND	
				4	3/15/95	ND	
				5	3/15/95	ND	
				6	11/27/95	ND	
G135	Ashe	Christmas	simazine	1	11/27/95	lindane	0.15
		trees		2	11/27/95	ND	
G138	Lincoln	apples	norflurazon	1	10/13/95	ND	
			simazine	2	10/13/95	ND	
G153	Ashe	Christmas	simazine	1	10/18/95	ND	
		trees	triazine	2	10/18/95	ND	
			dealkylated ethyl	(spring)	10/18/95	ND	
G154	Iredell	electrical	tebuthiuron	Not applicable: municipal water system			
		substation		- no wells sampled			

ND - no detection

Table 9. Health-based guidance levels calculated by a N.C. state toxicologist with the Occupational and Environmental Epidemiology Section, DEHNR; ground water quality standards adopted by the N.C. Environmental Management Commission in N.C. Administrative Code Title 15A, Subchapter 2L, Section .0202; health advisory levels adopted by the US. EPA; and maximum contaminant levels adopted by the U.S. EPA for detected chemicals.

CHEMICAL	HEALTH-BASED GUIDANCE LEVEL (ppb)	GROUND WATER QUALITY STANDARD (ppb)	HEALTH ADVISORY LEVEL LIFETIME (ppb)	MAXIMUM CONTAMINANT LEVEL (ppb)
acetone	----	700	----	----
acifluorfen	1	----	----	----
alachlor and related metabolites	0.4 (Total)	----	----	2 (alachlor)
arochlor 1260	0.0045	----	----	----
atrazine, triazine dealkylated ethyl, and triazine dealkylated isopropyl	24.5 (Total)	3* (atrazine)	3 (atrazine)	3 (atrazine)
bentazon	17.5	----	20	----
BHC-alpha, BHC-delta, and BHC-gamma	0.0056 (Total)	----	----	----
chloroform	----	0.19	----	100
2,4-D	70	70	70	70
DCPA	70	----	----	4,000
DDD	0.14	----	----	----
DDE	0.10	----	----	----
DDT	0.10	----	----	----
dibromochloropropane	0.025	0.025	----	0.2
1,2-dichloroethane	----	0.38	----	5
1,2-dichloropropane	0.51	0.56	----	5
1,3-dichloropropane	----	----	----	----
dichlorprop	0	----	----	----
dinoseb	7	----	7	7
endrin and endrin ketone	2.1 (Total)	2 (endrin)	2 (endrin)	2 (endrin)
hexazinone	231	----	200	----
lindane (BHC-gamma)	0.2	0.2	0.2	0.2
malathion	140	----	200	----
merphos	0.21	----	----	----
methylene chloride	4.6	5	----	----
metribuzin and metribuzin DA	91 (Total)	----	200 (metribuzin)	----
mirex	1.4	----	----	----
norflurazon	280	----	----	----
pentachlorophenol	0.29	0.3	----	1
prometon	105	----	100	----
simazine	3.5	3.5*	4	4
2,4,5-T	70	----	70	----
tebuthiuron	490	----	500	----
2,4,5-TP	50	50	50	50
1,2,3-trichloropropane	----	----	40	----

* interim maximum allowable concentration
---- No standard

Table 10. Site and soil data, Pdrastic† rating or aquifer, chemical reported and concentrations, >50% of GWQS* or IMAC**, screen and water level data for all monitoring wells with detections of pesticides from nonpoint sources.

Well Code	County	Site Type	Soil Series	Soil Leaching Potential Index	Aquifer	Chemical Detected	Concentration (ppb)	(ppb)	(ppb)	(ppb)	Currently Registered Pesticide	Pesticide Leaching Potential	>50% of GWQS* or IMAC**	Measured Screened Interval (feet)	Depth to water Minimum (feet)
PHASE I															
G012	Carteret	ambient	NA	NA	Castle Hayne	metribuzin	4.5	ND	ND	ND	Yes	Moderate	##	181.0-191.0	8.0
G013	Gates	ambient	NA	NA	Upper Cape Fear	pentachlorophenol	0.01	ND	ND	***	Yes	High	No	555.0-565.0	NA
G018	Duplin	ambient	NA	NA	Peedee	BHC-alpha ^ ^	ND	***	0.02	ND	Yes	Moderate	##	83.0-98.0	15.9
G028	Pitt	ambient	NA	NA	Peedee	2,4,5-T	0.02	ND	ND	***	NO	High	##	122.0-132.0	19.0
G034	Lenoir	ambient	NA	NA	Upper Cape Fear	2,4,5-T	0.07	ND	ND	ND	NO	High	##	480.0-490.0	104.4
						pentachlorophenol	ND	0.1	ND	ND	Yes	High	No		
G035	Jones	ambient	NA	NA	Surficial	DDT	ND	0.02	ND	***	NO	Very Low	##	10.0-15.0	5.2
G047	Scotland	ambient	Lakeland	88	Surficial	hexazinone	1.5	ND	5.2	ND	Yes	High	##	31.0-36.0	30.3
PHASE II															
G052	Chowan	watermelon	Seabrook	88	205	DDT	ND	***	0.02	ND	NO	Very Low	##	14.0-24.0	4.3
G059	Beaufort	soybeans	Bayboro	10	202	DDD	0.03	0.06	ND	***	NO	Very Low	##	8.5-13.5	1.8
G060	Beaufort	wheat	Leaf	35	182	DDD	0.05	ND	ND	***	NO	Very Low	##	4.0-14.0	4.8
G069	Halifax	sweet corn	State	70	175	atrazine	2.5	2.1	***	***	Yes	Moderate to High	Yes	6.0-11.0	6.9
						triazine dealkylated isopropyl ^ ^	ND	0.8	***	***	Yes	Moderate to High	##		
G070	Halifax	cotton	Gritney	37	214	dinoseb	1.4	0.46	ND	***	NO	Moderate	##	6.0-11.0	2.4
G073	Bertie	peanuts	Tarboro	88	175	atrazine	0.67	0.75	0.40	1.0	Yes	Moderate to High	No	3.0-8.0	0.1
						DDE ^ ^	0.01	ND	0.02	0.05	NO	Very Low	##		
						triazine dealkylated isopropyl ^ ^	ND	1.4	1.20	0.75	Yes	Moderate to High	##		

† Pesticide DRASTIC; ## no current standard; * Ground Water Quality Standard; ** Interim Maximum Allowable Concentration; *** no sample collected; ^ ^ metabolite; NA - not available; ND - no detection

Table 10 (continued)

PHASE II															
Well Code	County	Site Type	Soil Series	Soil Leaching Potential Index	Pdrastic † Rating	Chemical Detected	Concentration (ppb)	(ppb)	(ppb)	(ppb)	Currently Registered Pesticide	Pesticide Leaching Potential	>50% of GWQS* or IMAC**	Measured Screened Interval (feet)	Depth to water Minimum (feet)
G090	Sampson	cucumbers	Lynchburg	44	168	BHC-alpha ^ ^	0.01	ND	ND	***	Yes	Moderate	##	11.0-21.0	7.5
G095	Robeson	soybeans	Cainhoy	85	212	endrin ketone ^ ^	0.17	0.34	0.20	0.04	NO	Low	##	14.0-19.0	5.5
						acifluorfen	ND	ND	ND	0.10	Yes	Moderate	##		
G096	Robeson	flue-cured tobacco	Norfolk	74	212	endrin ketone ^ ^	0.07	0.07	0.05	0.15	NO	Low	##	13.0-18.0	5.5
						acifluorfen	ND	ND	0.40	ND	Yes	Moderate	##		
						DCPA	ND	ND	ND	0.02	Yes	High	##		
G097	Robeson	field corn	Goldsboro	70	212	prometon	6.2	2.0	ND	***	Yes	High to Very High	##	8.0-13.0	1.5
G105	Sampson	forest	Cainhoy	85	222	hexazinone	34	0.74	8.1	5.2	Yes	High	##	14.5-19.5	7.3
G113	Sampson	electrical substation	Wagram	83	217	tebuthiuron	1.3	ND	ND	***	Yes	Very High	##	9.0-19.0	1.5
G114	Duplin	electrical substation	Lakeland	88	192	tebuthiuron	108	88	89	123	Yes	Very High	##	4.5-19.5	5.3
						prometon	0.14	3.50	ND	2.7	Yes	High to Very High	##		
G116	Moore	grapes	Candor	87	219	dibromochloropropane	ND	***	0.50	0.45	NO	Very High	Yes	18.0-23.0	9.5
G117	Moore	golf course	Ailey	79	199	metribuzin DA ^ ^	ND	1.6	ND	***	Yes	Moderate	##	12.5-17.5	7.1
G119	Moore	sweet corn	Candor	87	219	BHC - delta ^ ^	0.02	ND	ND	***	Yes	Moderate	##	23.0-33.0	23.0
						methylene chloride	ND	120	ND	***	NO	High	Yes		
G122	Montgomery	peaches	Norfolk	74	206	1,2-dichloropropane	0.32	0.37	ND	***	NO	Very High	Yes	13.0-23.0	18.9
G123	Montgomery	soybeans	Norfolk	74	175	BHC-alpha ^ ^	0.01	0.01	ND	***	Yes	Moderate	##	18.0-28.0	19.8
G125	Moore	golf course	Candor	87	212	simazine	1.6	3.1	7.4	1.1	Yes	Moderate to High	Yes	10.0-20.0	10.3
						triazine dealkylated ethyl ^ ^	0.69	ND	2.2	0.98	Yes	Moderate to High	##		
G130	Rowan	tomatoes	Enon	52	155	mirex	ND	***	0.06	ND	NO	Moderate	##	12.0-22.0	6.8

† Pesticide DRASTIC; ## no current standard; * Ground Water Quality Standard; ** Interim Maximum Allowable Concentration; *** no sample collected; ^ ^ metabolite; NA - not available; ND - no detection

Table 10 (continued)

PHASE II

Well Code	County	Site Type	Soil Series	Soil Leaching Potential Index	Pdrastic† Rating	Chemical Detected	Concentration (ppb)	(ppb)	(ppb)	(ppb)	Currently Registered Pesticide	Pesticide Leaching Potential	> 50% of GWQS* or IMAC**	Measured Screened Interval (feet)	Depth to water Minimun (feet)
G135	Ashe	Christmas trees	Toxaway	29	189	simazine	ND	***	1.2	1.0	Yes	Moderate to High	No	5.0-l 5.0	2.2
						triazine dealkylated ethyl ^^	ND	***	1.0	ND	Yes	Moderate to High	# #		
G137	Ashe	Christmas trees	Chandler	52	174	simazine	ND	***	0.33	ND	Yes	Moderate to High	No	34.0-44.0	19.6
						triazine dealkylated ethyl ^^	ND	***	0.53	ND	Yes	Moderate to High	# #		
G138	Lincoln	apples	Pacolet	60	167	norflurazon	1.7	5.3	2.6	1.5	Yes	Moderate	# #	12.0-l 7.0	5.1
						simazine	ND	0.72	2.0	0.62	Yes	Moderate to High	Yes		
G147	Buncombe	hay	Hayesville	63	187	dichlorprop	2.2	ND	ND	***	Yes	Moderate	# #	4.0-9.0	0.8
G153	Ashe	Christmas trees	Watauga	72	157	simazine	0.90	ND	0.54	ND	Yes	Moderate to High	No	9.0-19.0	4.0
						triazine dealkylated ethyl ^^	2.0	ND	0.39	ND	Yes	Moderate to High	# #		
G154	Iredell	electrical substation	Cecil	62	167	tebuthiuron	4.8	3.4	7.3	5.7	Yes	Very High	##	13.0-23.0	13.8

† Pesticide DRASTIC; ## no current standard; * Ground Water Quality Standard; ** Interim Maximum Allowable Concentration; *** no sample collected; ^^ metabolite; NA - not available: ND - no detection

Table 11. Summary of laboratory analyses of ground water samples collected from domestic wells.

	Phase I	Phase II	Total
Domestic wells sampled	5	41*	46
Domestic wells with at least 1 sample detection	0	8	8
Domestic wells with at least 2 sample detections of the same pesticide or metabolite	0	4	4
Domestic wells containing registered pesticides or metabolites exceeding health standards	0	3	3
Domestic wells containing previously registered pesticides or metabolites exceeding health standards	0	2	2
Same pesticide or metabolite detected in at least 2 samples from the same domestic well	0	4	4
Registered pesticides or metabolites detected in at least 2 samples from the same domestic well	0	3	3
Registered pesticides or metabolites detected at least once	0	9	9
Previously registered pesticides or metabolites detected at least once	0	2	2

* One spring box included.