NEWS
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OF THE UNIVERSITY OF NORTH CAROLINA

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WATER RESOURCES RESEARCH INSTITUTES HAVE SERVED THE NATION FOR 25 YEARS

PARTNERSHIPS LEVERAGE STATE AND LOCAL GOVERNMENTS IN SUPPORTING THEIR RESEARCH NEEDS

July 17, 1989, was the twenty-fifth anniversary of the signing by President Lyndon B. Johnson of the Water Resources Research Act of 1964, which established the original 50 state water resources research institutes.

Patterned after the Hatch Act of 1887—which established the Agricultural Experiment Station program in the land grant colleges, this act established a national network of water resources research centers to draw upon the technical expertise of university personnel and the advice of state and local water users and managers. The centers were charged with developing efficient methods for resolving local, state, and national water resources problems; training water scientists and engineers through on-the-job participation in research; and encouraging application of research through information dissemination and technology transfer.

Later amendments to and reauthorizations of the act designated additional institutes in the District of Columbia, the Virgin Islands, Puerto Rico and Guam; required institutes to provide nonfederal cost sharing; added a technology development program; andconsolidated the program in the U.S. Geological Survey of the Department of the Interior.

The major thrust of the Water Resources Research Program is research. Approximately 250 projects

WE'VE MOVED!

The UNC Water Resources Research Institute is now headquartered in Office Suite 1131 of the NCSU Natural Resources Research Center at the Corner of Western Blvd. and Morrill Drive in Raleigh.

Our mailing address and phone number remain the same.

are completed each year that address problems of national, state, and local concern. Published results from these projects form a large percentage of the literature in the water resources field. A summary of the first ten years of the water research/institutes program showed that the Water Resources Research Program produced from one-fourth to one-third of the technical literature published in the field while accounting for only 10 percent of the total expenditure on water research.

In addition to research, the institutes conduct vigorous programs of information dissemination. At the heart of this program is the publication of technical reports and other forms of information about research projects conducted under institute funding. Many institutes also publish newsletters, conduct conferences and workshops, and maintain lending libraries.

The Water Resources Research Program also provides opportunities for education and training through its information transfer operations and its support for undergraduate and graduate students working on research projects. Approximately 20,000 students have broadened their educational experience through participation in water institute projects over the last 25 years. As a result, the Water Resources Research Program has made a major contribution to the pool of trained professionals in the water resources area.

The institutes respond to water research needs from a grassroots level and build on these needs toward a national perspective. Therefore, federal funds invested in the program and matched by nonfederal dollars leverage the states, as well as local governments and authorities, in supporting their own research needs. The result is a research program that responds to national priorities that are also state and local priorities and one that multiplies the federal funds.

STEWART TO RETIRE OCTOBER 31

Dr. James M. Stewart, who has been associated with the Water Resources Research Institute for 20 years, has announced plans to retire October 31. Currently the Institute's associate director, Stewart will retire to Kinston, NC, to begin restoration of a home built in 1825 and to engage in a fruit and vegetable farming enterprise.

A North Carolina native, Stewart began work with N.C. State University in 1958 as an Agricultural Extension Agent in Madison County. He served as county extension chairman in Cherokee and Granville counties before returning to NCSU to work as a Community Development Specialist. His work at WRRI began as a graduate student. He has directed the technology transfer program, producing newsletters and publications and conducting conferences, workshops, and additional outreach initiatives. He received NCSU's Outstanding Extension Award in 1979. His technology transfer work also included projects with the World Bank, UNESCO, the Department of Interior, and other universities and state agencies.

Stewart, who has also served as acting director of WRRI, was a member of the board of directors of the Universities Council on Water Resources from 1982 to 1988. He said that he has enjoyed his work with water researchers in the universities and the many agency people in state and local government.

The Water Resources Research Institute of The University of North Carolina

The Water Resources Research Institute (WRRI) of The University of North Carolina began operating in 1965 under the guidance of Dr. F. J. Hassler of the NCSU Department of Biological and Agricultural Engineering. The Institute's first full-time director was David H. Howells, a public health professional and a professor in the UNC Department of Environmental Sciences and Engineering and the NCSU Departments of Biological and Agricultural Engineering and Civil Engineering. He was succeeded in 1977 by Dr. Neil S. Grigg, now Director of the Colorado Water Resources Research Institute. In 1982 the current director, Dr. David H. Moreau—Professor of Urban and Regional Planning at UNC-Chapel Hill, assumed the leadership role.

A 29-member advisory committee whose membership represents state and federal agencies, industry, agriculture, local government, and the public helps keep WRRI attuned to water issues throughout North Carolina. University researchers across the state address these water issues through the creation and dissemination of new knowledge. During its nearly 25 years of activity, WRRI has responded to major water problems in the state through 260 water-related research projects and through support of 1,244 graduate and undergraduate students. Some research projects supported by WRRI have focused on mitigating the effects of agricultural drainage on North Carolina's coastal waters, controlling exotic aquatic plants in North Carolina waterways, understanding how nutrients in runoff encourage noxious algae growth in eastern North Carolina rivers, determining where in the state radon in groundwater might pose a health threat, developing biological

methods for removing phosphorous from wastewater treatment plant effluent, and eliminating toxic substances in drinking water.

Focus on Federal/State/Local Partnerships

In the last few years, the major responsibility for planning, managing, and funding water supply, water quality, and wastewater treatment projects has been shifted from federal to state and local governments. This shift has placed an increasing burden on states and municipalities, and in North Carolina, where population and economic growth are increasing the pressure on water resources, WRRI's work with state and local governments is becoming critically important. One way in which the Institute assists local governments is by providing a program of research, development, and technology transfer through the Urban Water Consortium. Established in 1985, the Consortium provides a way for urban areas to pool their resources and support research and technology transfer on specific problems which they share. Annual dues paid by the members have been supplemented by state funds through the Department of Environment, Health, and Natural Resources and by appropriations from the N.C. General Assembly.

USGS ANNOUNCES DEADLINES FOR MATCHING GRANT PROGRAM

The U.S. Geological Survey has announced a deadline of November 21 for receipt of grant proposals under the Section 105 matching grant program under the Water Resources Research Act. Program announcements and application forms are available from:

UNC Water Resources
Research Institute
Box 7912
North Carolina state University
Raleigh, NC 27695-7912
(919) 737-2815

The following areas are of particular interest in FY 1990: groundwater quality, water quality management, institutional change in water resource management, and climate variability and the hydrologic cycle.

The Water Resources Research Institute will be happy to assist investigators with the task of satisfying the matching requirement. Only those proposals that are submitted through WRRI are eligible for Institute funds. To undergo appropriate review, proposals need to be at the Institute office by November 3.

LAMBERT RECIEVES DISTINGUISHED PERFORMANCE AWARD

Linda Lambert, Administrative Officer for the Water Resources Research Institute has received the Distinguished Performance Award for the Chancellor's Unit at N.C. State University. She was honored at a reception on September 22 when she received a $500 savings bond.

Lambert joined WRRI in 1969 after working in the NCSU business office and for the N.C. Department of Transportation. She was chosen for the Distinguished Performance Award from among nominations submitted by heads of units within the Chancellor's Unit, which includes institutional research, athletics, alumni relations, university relations, university development, the Sea Grant College Program, and WRRI.

N.C. DEPARTMENT OF ENVIRONMENT, HEALTH, AND NATURAL RESOURCES FORMED

In August, William W. Cobey, Jr. was sworn in as the first secretary of North Carolina's newest government agency—the Department of Environment, Health, and Natural Resources. (EHNR). Created by the General Assembly during the closing days of its 1989 session, the new department combines many of the Health Services programs from the Department of Human Resources (DHR) with divisions of the now defunct Department of Natural Resources and Community Development (NRCD). The bill creating the new department was passed on August 3, 1989, and made retroactive to July 1, 1989.

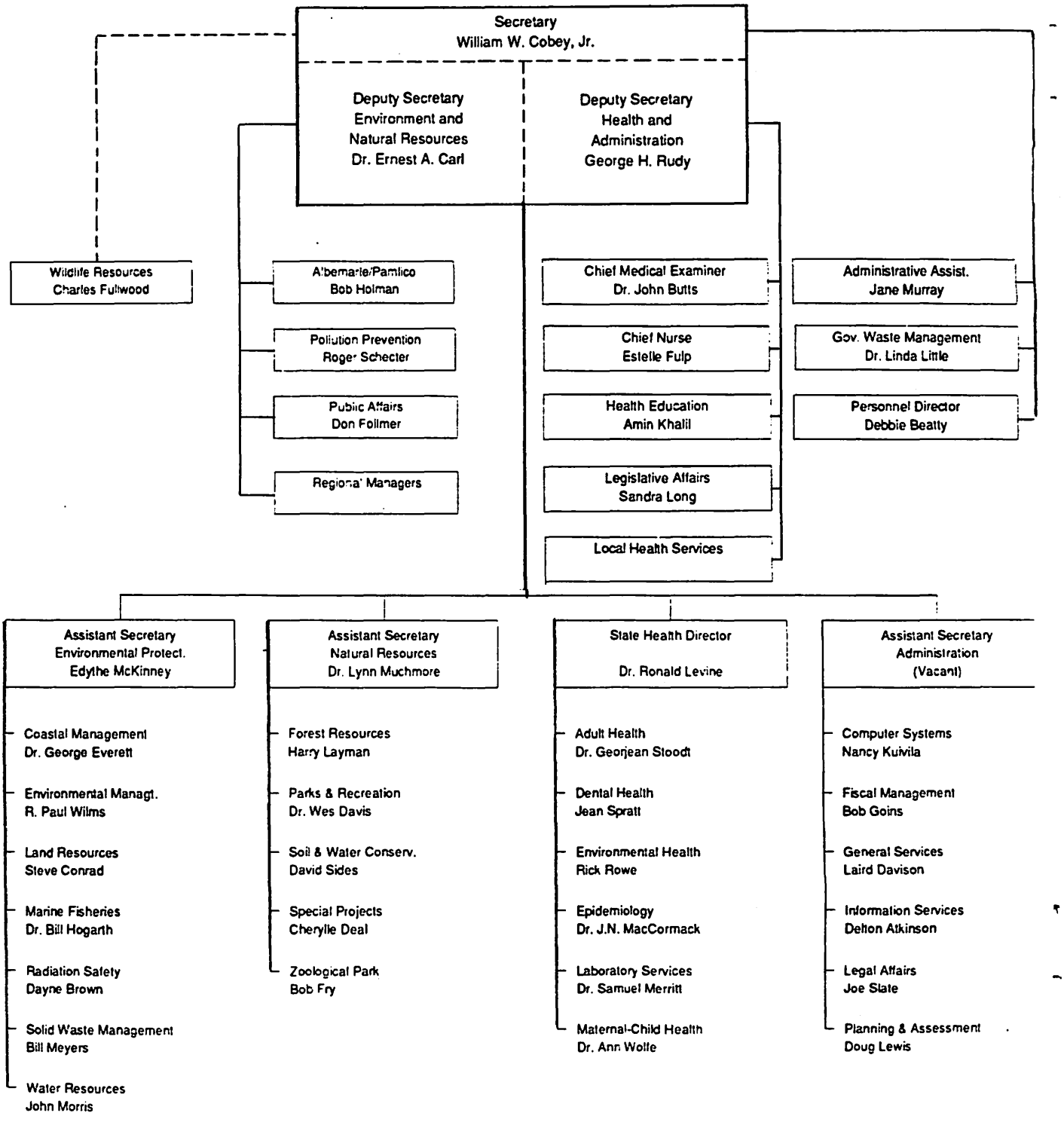
Several sections in the Department of Human Resources are now Divisions in the new department. The Radiation Protection Division of DEHNR assumes duties of the Radiation Protection Section of the Division of Facilities Services of the Department of Human Resources. The Solid Waste Managment Division of DEHNR assumes duties of the Solid Waste Management Section of the Divison of Health Services of the Department of Human Resources.

The Environmental Health Section of the Department of Human Resources is now the Division of Environmental Health in the new department. Water-related programs in this division are on-site sanitation, administered by the Environmental Health Services Section, and public water supply, administered by the Public Water Supply Section.

Senior management of the new department is composed of two deputy secretaries and four assistant secretaries. Serving as deputy secretaries are Dr. Ernest A. Carl, who was deputy secretary of NRCD, and George H. Rudy, who has been

Environment, Health, & Natural Resources

Organization Chart



senior advisor (counselor) and regional director with the U.S. Department of Health and Human Services for the past eight years.

The assistant secretary for Environmental Protection is Mrs. Edythe McKinney, who served most recently as director of federal-state relations in NRCD. Mrs. McKinney replaces Mary John Pugh, who has moved to a new position as Deputy Director of the N.C. ZoologicalPark. Assistant secretary for Natural Resources is Dr. Lynn Muchmore who served in this capacity in NRCD from 1985 to 1988, and most recently as NRCD's assistant secretary for Administration. Dr. Ronald H. Levine, who has served as State Health Director in the DHR, will continue to serve in that capacity as an assistant secretary in EHNR.

Directors for the department's 17 operational divisions have not changed. See the accompanying EHNR organizational chart.

Three of the divisions from the old NRCD were transferred to other departments. The Division of Economic Opportunity became part of the DHR, while the Division of Employment and Training and the Division of Community Assistance joined the Department of Commerce.

GENERAL ASSEMBLY PASSES SIGNIFICANT WATER-RELATED LEGISLATION

The 1989 Session of the N.C. General Assembly considered a host of environmentally related bills and passed a number that could have significant effects on water quantity and quality statewide. Among the legislation passed is the following:

AN ACT TO IMPROVE THE MANAGEMENT OF SOLID WASTES: This legislation establishes as State policy the following hierarch of solid waste management methods:

(1) Waste volume reduction at the source
(2) Recycling and reuse
(3) Composting
(4) Incineration with energy production
(5) Incineration for volume reduction
(6) Disposal in landfills

Among the major provisions of the legislation are the following:

* Sets a goal of recycling 25 percent of the state's total waste stream by January 1, 1993.

* Requires the Department of Environment, Health and Natural Resources (DEHNR) to develop a comprehensive State solid waste management plan by March 1991 and requires each state agency and all counties (in cooperation with their municipalities) to develop a comprehensive solid waste management plan. Counties must submit their plans to DEHNR for approval and must update and resubmit plans every two years.

* Requires DEHNR to provide guidance and planning, technical and financial assistance to local government and State agencies for reduction, recycling, reuse, and processing of solid waste and for safe and environmentally sound solid waste management and disposal and to undertake other activities to promote solid waste reduction and recycling.

* Requires the Commission of Health Services to adopt rules for determining the cost of solid waste management within a service area and requires that within one year after the rules become effective, each county and municipality must determine the full annual cost of solid waste management within its service area and update the full cost determination each year.

* Requires DEHNR to provide for public education and training of professionals in support of solid waste reduction, recycling, and proper waste management and to inform local governments of their solid waste management responsibilities and opportunities through literature and workshops.

* Requires DEHNR to report in 1991 and every year thereafter on the volume of waste generated in the state, the amount recycled, and the amount disposed of; on the success of each county in meeting the solid waste reduction goal; and on the markets for recycled materials and the efforts and successes of state and local government and private industry to enhance markets for such materials.

* Requires local governments to initiate a recycling program by July 1, 1991. These programs must (1) separate and segregate construction and demolition debris, (2) separate and offer for recycling marketable materials, (3) consider separating for recycling plastics, metals, and paper and composting yard trash and other compostable materials, (4) be designed to reduce solid waste with the county and its municipalities by at least 25 percent by January 1, 1993.

* Bans sale after January 1, 1990, of beverage containers opened by detaching a metal ring or tab.

* Requires that after July 1, 1991, all plastic containers over a specified capacity sold in the state be labeled to show what plastic resins they are made of.

* Bans the provision by retailers to shoppers of nonrecyclable plastic bags after January 1, 1991. (After January 1, 1993, recyclable plastic bags may be used only if DEHNR certifies that 25 percent of the bags are actually being recycled.)

* Bans use after October 1, 1991, of packaging manufactured with halogenated chlorofluorocarbons (CFCs) and sale or distribution of polystyrene food containers unless they are recyclable. (After October 1, 1993, recyclable polystyrene foam food containers may be used only if DEHNR certifies that at least 25 percent of the containers are actually being recycled.)

* Bans from landfills (1) after January 1, 1991, lead-acid batteries and white goods, (2) after January 1, 1993, yard trash, and (3) after October 1, 1990, used oil.

* Provides for the establishment of standards and applications for compost produced by solid waste facilities.

* Establishes the Solid Waste Management Trust Fund to be financed in part by 10 percent of the proceeds of the scrap tire disposal fee and to be used for activities which promote waste reduction and recycling, including public education, technical assistance to local government, and research. (The fund received a $300,000 appropriation in the general appropriations bill.)

* Requires state agencies, the General Assembly, the N.C. courts and the University of North Carolina system to establish programs for waste source reduction and for recycling aluminum and wastepaper and requires the N.C. Public Schools to promote recycling awareness among school children.

* Requires the Department of Economic and Community Development to assist and encourage the recycling industry in the state by identifying markets for recycled materials and providing information to businesses and industries on the availability and benefits of using recycled materials and to evaluate the market for composted materials.

N. C. SOLID WASTE SECTION INTRODUCES SOLID WASTE POLICY AND LANDFILL REGULATIONS AT CAPACITY WORKSHOP

More than 200 local government officials and employees and others concerned with implementing North Carolina's new solid waste policy and solid waste landfill regulations gathered in Raleigh on September 6 for an introduction to the policy and the regulations. According to Bill Myers, head of the new Solid Waste Management Division in the N.C. Department of Environment, Health and Natural Resources, the workshop was the largest and most significant related to solid waste in ten years. Titled "A Workshop on Siting, Design, and Permitting of Solid Waste Landfills," it was presented by the Solid Waste Section of the Solid Waste Management Division in cooperation with WRRI.

J. Gordon Layton, chief of the Solid Waste Section, provided an overview of solid waste issues in North Carolina and discussed the section's current focuses and new initiatives. Layton predicted that the development of regional solid waste landfills will emerge as a primary option for small counties with limited resources.

Paul Crissman, Deputy Director of the Solid Waste Management Division, reviewed various pieces of legislation dealing with solid waste passed by the 1989 General Assembly. He said the upshot of all the new legislation is that businesses and individuals accustomed to simply throwing away waste will to have to start managing waste.

Section Permitting Engineers Jim Coffey, Mike Babuin, and Gary Ahlberg discussed technical aspects of siting, designing and permitting solid waste landfills. The site plan and construction plan applications required for permits to construct and operate landfills must include extensive data, much of which must come from studies of site characteristics. Incomplete applications can delay permitting, and the permitting engineers reviewed requirements to emphasize where attention should be given.

North Carolina now requires all new landfills and all major expansions of exiting landfills to have liners, leachate collection systems, and caps which prevent the infiltration of water into the waste cells. In addition, monitoring systems must be provided for groundwater and surface water monitoring systems and methane. An introduction to this "high tech" landfill design was provided by engineers involved with design and construction of landfills at New Hanover County, Rowan County, and Kernersville.

The U.S. EPA is expected to issue its final solid waste landfill regulations as Subtitle D of the Resource Conservation and Recovery Act in December. Dexter Matthews, section waste management specialist, reviewed the EPA's proposed regulations and noted that North Carolina's rules and policies anticipate stricter federal regulations.

William W. Cobey, Secretary of Environment, Health, and Natural Resources, addressed the group during lunch. Cobey noted that North Carolina has come a long way in its waste management practices since the days of open dumps and that the state's new solid waste policy represents a third phase in solid waste management that will concentrate more on recovery and recycling. He announced that recent appropriations by the General Assembly will provide for a new education and planning unit in the Solid Waste Section to assist local governments in their efforts to implement the new solid waste management policy.

Requires all agencies of state government to use compost products whenever possible.

* Regulates the transport and disposal of used oil and requires DEHNR to promote used oil recycling.

* Provides for establishment of regulations for the disposal of medical waste and ash from solid waste incinerators.

* Imposes a one percent scrap tire disposal fee on the retail sale of tires and provides for the establishment of standards for scrap tire collection and disposal, for cleaning up nuisance tire collection sites after July 1, 1990, and for fines for illegal scrap tire management.

* Directs the Department of Transportation to conduct research into the feasibility of using recovered materials in highway construction and to review bid procedures to make sure they do not discriminate against recycled products.

* Provides for tougher penalties for littering, including mandatory litter cleanup, assessment of one point against a driver's license when a vehicle is used to dump litter exceeding a specified amount, and seizure of vehicles, vessels, aircraft, or other machines used to dump litter exceeding a specified amount.

* Instructs the Secretary of Administration to determine the feasibility of using recycled paper products in all agencies and units of state government.

SOLID WASTE LOAN FUND This legislation seeks to facilitate the implementation of local and regional solid waste management programs by establishing a loan fund for financing the capital expenses of landfill construction, incinerator construction, and recycling, composting, and source reduction programs. It creates the North Carolina Solid Waste Management Capital Projects Financing Agency which has the power to issue bonds and notes and make loans to local governments and creates the Solid Waste Management Loan Fund through which local governments may pool their financing needs and thereby have access to a broader bond market and greater number of financing options at reduced financing cost. This legislation also authorizes local governments to issue special obligation bonds and notes for solid waste management capital projects. An appropriation of $5 million was made for the loan fund; however, this money will be used only to guarantee loans. Funds borrowed by local governments must come from bonds and notes.

OTHER SOLID WASTE LEGISLATION In addition to the legislation noted above, the general appropriations bill mandates waste stream analyses across the state and provides for $500,000 to match local or other funds committed for waste stream analysis. It also establishes a technical assistance unit in the Solid Waste Section of the Solid Waste Management Division of DEHNR and provides funds for 4 positions to provide technical assistance to local governments in solid waste management planning and alternatives.

STATE WATER SUPPLY PLAN This legislation requires DEHNR and local governments that provide public water services to prepare water supply plans. Local government water supply plans are to be updated every five years and are to include at a minimum present and projected population and water use, present and future water supplies, and an estimate of the technical assistance that the local government will need to address projected water needs. The state water supply plan is to include the information and projections from local plans, an evaluation of the compatibility of local plans, and a summary of the technical assistance needs indicated by local plans. Through this state plan, DEHNR is to identify potential conflicts among the various local plans and ways in which local water supply programs can be better coordinated.

WATER SUPPLY WATERSHED CLASSIFICATION AND PROTECTION ACT This legislation requires the Environmental Management Commission to establish minimum statewide water supply watershed management requirements and provides for a cooperative program to be administered by local governments. Among the law's provisions are the following:

* The EMC must establish water supply watershed classifications and rules for protecting surface water supplies through minimum performance-based (structural) controls applicable to each classification and must classify all existing water supply watersheds no later than January 1, 1992. The EMC must approve and make available to local governments a model local water supply watershed management and protection ordinance that includes as options (1) controlling development density, (2) engineered, performance-based alternatives to development density, and (3) a combination of density controls and structural controls.

* Local governments with jurisdiction of all or a portion of a water supply watershed must submit a management and protection ordinance for approval by July 1, 1992. The ordinance must provide for maintenance and inspection of structural controls and for enforcement procedures.

* If a local government fails to carry out its watershed management responsibilities, the Environmental Management Commission shall enforce the statewide minimum

requirements and may assess local governments civil penalties of up to $10,000 per month to finance administration of the program.

* The EMC may designate water supply watersheds (or portions thereof) as critical water supply watersheds and impose management requirements that are more stringent than the statewide minimum.

* Persons found to be causing or contributing to pollution of waters within a protected watershed may be directed by special orders to refrain from polluting activities and may be assessed civil fines up to $10,000 per day and be subject to civil action in court.

* Agricultural operations are not subject to special orders or fines. The reduction of agricultural nonpoint source discharges is to be accomplished primarily through the Agriculture Cost Share Program.

STORMWATER RUNOFF ACT This legislation directs the EMC to develop a plan for protecting shellfish waters, water supply watersheds, outstanding resource waters, and other high quality waters from the effects of stormwater runoff and to control stormwater runoff disposal in coastal counties and other nonpoint sources.

EROSION CONTROL CRITERIA This legislation authorizes the N.C. Sedimentation Commission and local governments to consider the performance history of an applicant submitting an erosion control plan prior to approving such a plan, provides for a setback for land-disturbing activities near certain trout waters, increases the civil penalties for violations of the Sedimentation Pollution Control Act, and authorizes the Coastal Resources Commission and local governments to consider the performance history of an applicant for a permit required by the Coastal Area Management Act prior to approving a permit.

WRRI SPECIAL REPORT EXAMINES THE HISTORY OF PUBLIC WATER SUPPLIES IN NORTH CAROLINA

Historical Account of Public Water Supplies in North Carolina

by David H. Howells, Professor Emeritus, Department of Biological and Agricultural Engineering, North Carolina State University, and Department of Environmental Sciences and Engineering, University of North Carolina at Chapel Hill

By tracing the development of public water supply systems and the history of public water supply issues in North Carolina, NCSU and UNC-CH Professor Emeritus David H. Howells draws attention to the relationship between water supplies and human health and makes the case for preservation of the state's remaining high quality sources of public water supply.

According to Professor Howells, when the first water system built to serve a community in North Carolina was erected by the town of Salem in 1778, contaminated drinking water supplies ranked as the major cause of disease in the state, and waterborne diseases such as cholera and typhoid fever were common causes of death. The practices of locating privies near shallow wells used for drinking water or near streams almost assured that water sources within settled areas were contaminated by human waste. Gradually, it became obvious that uncontaminated drinking water could be found only in unsettled or sparsely settled areas or in deep wells, and communities began erecting systems of pumps and pipes to transport clean water and prevent the spread of disease.

As the state's population grew, settled areas spread out and industry sprang up, and communities found it increasingly difficult to obtain pure water supplies. The State Board of Health, whose responsibility it was to inspect water supplies and assure their safety, tried as early as 1897 to get legislation passed to enable cities and towns to protect their watersheds, saying that "it is far safer and easier to prevent disease germs from getting into the water than to get them out after they have taken possession." The 1897 watershed protection initiative never reached the floor of the House, however, and public water supply watershed protection was left to the discretion of private water companies and municipalities, most of which did not adopt protection measures. By the turn of the century, about 7% of the state's population obtained drinking water from public supply systems, but inspections by the State Board of Health revealed that in "too many instances...the purpose is to simply furnish water without regard to its character or purity," and deaths from waterborne typhoid fever were still common.

With the passage by the N.C. General Assembly in 1903 of An Act to Protect Water Supplies, untreated wastewater discharges into sources of public water supply were prohibited, and the State Board of Health was empowered to perform analyses of public water supplies. It soon became evident

that, according to Dr. Levy of the Board of Health, "in the present built-up condition of our country, very few streams indeed furnish a water satisfactory from a sanitary standpoint without the adoption of some means of artificial purification."

Water purification technology, rudimentary in the early 1900s, took on increasing importance and sophistication from that point on. By the 1920s most public water supplies taken from rivers and lakes were treated by coagulation, sedimentation, and filtration as well as disinfection by chlorination. Still, the 1920 report of the State Board of Health showed that a relatively high proportion of the 106 public water supplies in the state were contaminated.

While annual reports from the State Board of Health made it increasingly obvious that stream pollution by domestic and industrial wastewater discharges constituted a major public health threat, strong state legislative action to control waste discharges did not emerge until impetus was provided by passage in 1948 of the first Federal Water Pollution Control Act. Passage in 1951 of the State Stream Sanitation Law established a comprehensive stream pollution control program in the state and provided for classification of waters according to best usage. Later initiation of federal construction grants for wastewater treatment plant construction, imposition of stream water quality standards, and, in 1972, adoption of the National Pollutant Discharge Elimination System (NPDES) permitting constituted a broad technology-based effort to provide safe public water supplies.

Throughout the decades of developing water purification technology, wastewater treatment technology, and pollution control regulation–all of which had been aimed primarily at eliminating bacterial contamination, State Board of Health officials and others continued to sound the theme of water supply watershed protection as a crucial component of a safe drinking water program. However, state laws, necessary to enable and encourage local watershed protection programs, did not emerge. As urbanization and industrialization continued at a rapid pace, the number of waste dischargers to streams and rivers multiplied, the volume of runoff from urban areas swelled, and the composition of both point and nonpoint discharges became more complex.

Today says Professor Howells, "a disproportionate number of people in North Carolina are being served by water supplies taken from sources which have no categorical restrictions on point source wastewater discharges and no requirements for local nonpoint source control programs." And, while sophisticated treatment technologies have for the most part eliminated the problems of bacterial contamination of drinking water supplies, the threat of bacterial contamination of groundwater supplies looms as large as ever, and a new threat of toxic chemical contamination of both groundwater and surface water supplies has emerged.

As the state looks back over one hundred years of public water supply history, the early admonitions to protect water supply watersheds echo prophetically that "the hour is late and many opportunities have already slipped away."

The report (WRRI No. 244) is available from the Water Resources Research Institute of the University of North Carolina, Box 7912, Raleigh, NC 27695-7912 (919/737-2815).

The Conservation Council of North Carolina's fall meeting, with the theme "Implementing Policies at the Local Level," will be held October 14 at Camp New Hope near Chapel Hill. Registration deadline is October 1. For additional infomation call Scott Breidenbach (919) 942-7935.

WRRI REPORT AVAILABLE

The UNC Water Resources Research Institute has recently published a report on a research project for which it provided funding. Free single copies of the report are available to federal water resource agencies, state water resources research institute, and other water research institutions with which reciprocal exchange agreements have been made.

Single copies of Institute reports are free to public agencies, institutions, industries, and private citizens of North Carolina as long as they are in print. Copies of out-of-print publications are available for a $5 reproduction charge ($10 if billed). Nonresidents of North Carolina will be charged a prepaid amount of $8 per copy and $10 if billed. Reports may be obtained from

WRRI, Box 7912
North Carolina State University
Raleigh, NC 27695-7912
(919/737-2815)

Report No. 246

Modeling Organic Contaminant Sorption Impacts on Aquifer Restoration

by Dr. Cass T. Miller, Joseph A. Pedit, Edward G. Staes, and Robert H. Gilbertsen, Department of Environmental Sciences and Engineering, University of North Carolina at Chapel Hill

With the aid of field samples and laboratory studies, the researchers have developed and validated mathematical models that can be used to simulate the processes by which organic compounds that may adsorb and absorb to aquifer soils are later released from the soil into groundwater. Since the models can predict how long organic contaminants will continue to be released by aquifer soils, they can be useful in estimating

how long it will take to clean up aquifers contaminated by such pollutants. Estimating the length of clean-up time is crucial for realistically predicting the cost of cleaning up groundwater contamination because the single biggest cost of cleanup is often for energy to maintain purge-well pumping for the years required to cleanse an aquifer.

Use in laboratory experiments of aquifer material collected from a Camp Lejeune field site allowed researchers to observe the rate and equilibrium of sorption of three common organic contaminants (toluene, o-xylene, and 1,4 dichlorobenzene) to material from a coastal aquifer. Analysis was performed to describe conditions under which contaminant sorption/desorption will prolong groundwater cleanup times.

Research recommendations include first analyzing site conditions to determine if sorption/desorption might play an important role in cleanup efforts and, if an effect is indicated, gathering several kinds of quantitative data needed for the models and using them in estimating cleanup time.

The effect on the cleanup time for a given aquifer is a function of the contaminant source distribution, the pollutant of concern, the solid-phase properties, and the cleanup level needed for the given pollutant to meet water quality standards.

REPORT ASSESSES COASTAL DOMESTIC WASTEWATER DISPOSAL ALTERNATIVES

A recent report prepared for the N.C. Division of Coastal Management by a Duke University graduate intern with the N.C. Department of Natural Resources and Community Development advocates ocean outfall and land application as the best wastewater disposal methods for high density coastal counties.

In a report titled "Assessment of Coastal North Carolina Domestic Wastewater Disposal Alternatives with Regard to Fate of Nitrogen, Phosphorus, and Coliforms" Thomas P. Augspurger reviews and evaluates currently practiced and alternative systems of domestic wastewater disposal in the 20 coastal counties defined by the Coastal Area Management Act of 1974. The purpose of the report is to assess the degree of nitrogen, phosphorus, and coliform immobilization and transformation offered by the different disposal techniques. The information utilized was obtained by a three-phase literature review of (1) the transport and fate of nitrogen, phosphorus, and coliforms, (2) constraints imposed by the physical environment on siting of sanitary facilities, and (3) various wastewater management alternatives including conventional on-site septic systems (with subsurface soil absorption of effluents), modified on-site systems (mounds, low-pressure piping, and recirculating sand filters), package treatment plants, and sewerage with conventional, off-site, wastewater treatment (with effluent disposal by land application, direct discharge to near-shore surface waters, and ocean outfall).

The report concludes the following:

* The 30 cm separation between septic system drain line bottoms and the seasonally high water table does not ensure adequate aerobic conditions to properly treat domestic wastewater. Negligible nitrification and enhanced coliform survival in many high water table soils are well documented as is pollution of surface water adjacent to failing septic tank systems. Good subsurface sewage treatment has been observed in systems with at least 60 cm separation in low density development.

* Alternative on-site systems can provide improved effluent treatment, but the only information available for these devices cites failures due to improper placement, poor design, or sporadic maintenance.

* Municipal wastewater treatment plants provide an alternative to on-site disposal, but the discharge of treated sewage effluents has also resulted in well-chronicled surface water degradation.

* Package treatment plants are capable of advanced nitrogen, phosphorus, and coliform treatment, but improper operation and inadequate maintenance have resulted in many system failures in the study area.

* Both ocean outfall and land application will reduce the coliform bacteria and nutrient burdens of near-shore coastal waters. Evidence suggests these alternatives to be environmentally sound and practical from an engineering view.

The report is available from the N.C. Division of Coastal Management, P.O. Box 27687, Raleigh, NC 27611-7687; Phone: (919) 733-2293.

STUDY DESCRIBES 20 YEARS OF GROWTH IN COASTAL NORTH CAROLINA

A report written as part of a graduate internship with the N.C. Department of Natural Resources and Community Development and a master's project for the Duke University School of Forestry and Environmental Studies concludes that regulations and procedures put into place by the Coastal Area Management Act of 1974 have not

slowed growth or development in North Carolina's 20 coastal counties defined under the act.

"An Analysis of Coastal Growth and Development in North Carolina since the Enactment of CAMA" by Neil Alan Armigeon is based on analysis of CAMA permitting trends, population growth and projections, travel and tourism expenditures, a questionnaire regarding CAMA and coastal development, and residential building permits. According to the report, CAMA permitting began in 1978, and the total number of permits issued increased steadily until 1986. Permitting trends vary from county to county; however, in 1986 and 1987, Brunswick, Dare, and Carteret counties accounted for over 60 percent of the total CAMA permits issued. During the period 1980 to 1986, four of the five fastest growing counties in the state were located in the coastal region. Projected permanent population estimates indicate that many coastal counties' populations will continue to increase at a rate that is above the state's projected growth.

Tourism is the fastest growing industry in the coastal region. Since 1971, the coastal counties' travel and tourism revenues have increased almost nine-fold. The majority of those who responded to the questionnaire indicated that CAMA regulations have not had a negative effect on the construction industry. Federal and state agencies use building permits as an economic index of the construction industry. To quantitatively determine CAMA's effects on the housing industry, residential building permit data for the coastal counties were compared to statewide building permit data. From 1978 to 1986, the issuance rate of building permits in the 20 coastal counties exceeded the permit issuance rate statewide.

The report is available from the N.C. Division of Coastal Management, P.O. Box 27687, Raleigh, NC 27611-7687; Phone: (919) 733-2293.

USGS/NRCD STUDY SHOWS LAND USE AFFECTS WATER QUALITY OF N.C. PIEDMONT STREAMS

The quality of water in three streams of the Piedmont region of North Carolina and the aquatic life in those streams has been shown to be affected by land use within the watersheds, according to the results of a recent cooperative study between the N.C. Department of Natural Resources and Community Development and the U.S. Geological Survey.

In a comparison of Smith Creek in Granville County, Devil's Cradle Creek in Franklin County, and Marsh Creek in Wake County, study results indicate that (1) limited communities of aquatic insects and fish exist in Marsh Creek, an urban stream draining North Raleigh, and (2) biological communities with high taxa richness, high numbers of species intolerant of pollution, and high numbers of unique species exist in the stream draining forested watershed, Smith Creek. According to the authors of a report resulting from the study, water quality of the streams differed in certain aspects —that is, the stream draining the urban watershed had the highest suspended-sediment yield and the stream draining the agricultural watershed had the highest nutrient concentrations. Concentrations of metals in all three streams at times exceeded North Carolina water-quality standards but did not appear to reduce the number of invertebrate species or fish or the numbers of individuals within a species.

The report, titled "Effects of Land Use on Water Quality and Biota of Three Streams in the Piedmont Province of North Carolina," by J. Kent Crawford, USGS, and David R. Lenat, N.C. NRCD, has been published as U.S. Geological Survey Water-Resources Investigations Report 89-4007 and is available for inspection at the U.S. Geological Survey, Century Postal Station, 300 Fayetteville Street Mall, Raleigh, NC. Copies of the report can be purchased from Books and Open-File Reports, USGS, Box 25425, Federal Center, Building 810, Denver, CO 80225.

CONFERENCE ON GROUND WATER IN THE PIEDMONT OF THE EASTERN UNITED STATES TO BE HELD OCTOBER 16-18, 1989

A conference to be held October 16-18, 1989, at the Royce Hotel in Charlotte, NC, will address ground-water issues as they related to the complex heterogeneous fractured rock aquifer system that characterizes the Piedmont. The goal is to integrate research, field and laboratory experiments and knowledge gained from hydrogeologic case studies in fractured rock terrans to help solve problems faced by groundwater professionals in the region. Keynote addresses will be given by Ralph C. Heath, retired District Chief USGS; Dr. Philip LaMoreaux, president LaMoreaux and Associates; and Marian Mlay, Director of the Office of Ground Water Protection, U.S. EPA. Proceedings of the conference will be published, and a post-conference field trip will visit the Ridgeway Gold Mine, the largest gold mine east of the Mississippi River.

The conference registration fee of $125 covers all technical sessions, a copy of the proceedings, refreshment breaks, and two luncheons. Advance registration will be accepted until September 15, 1989. After that date, a late charge of $25 will be charged. Student rates will be $50 ($75 after September 15). The fee for attending the post-conference field trip is $25.

For additional information write or call Richard K. White, General

Chairman, Groundwater in the Piedmont, Department of Agricultural Engineering, 113 McAdams Hall, Clemson University, Clemson, SC 29634-0357 (803/656-3250)

WORKSHOP ON UNDERGROUND STORAGE TANK REGULATIONS TO BE HELD NOVEMBER 9

A workshop to be held Thursday, November 9, 1989, will address new and existing regulations governing underground storage tanks and how best to comply with them. The workshop titled "Underground Storage Tanks: The Impact of New and Existing Regulations" is designed to explain recent and pending state regulations regarding corrosion control, leak detection and spill prevention, spilled fuel recovery , and financial responsibility certification requirements.

The all-day workshop will be held at the Jane S. McKimmon Center in Raleigh. The fee of $55 includes a 150-page workbook containing reference materials and abstracts of the presentations, lunch and refreshments. To register contact the Professional Engineers of North Carolina, 4000 Wake Forest Road, Suite 108, Raleigh, NC 27609 (919/872-0683).

AMERICAN WATER RESOURCES ASSOCIATION CALLS FOR ANNUAL CONFERENCE/ SYMPOSIUM PAPERS

The American Water Resources Association has issued a call for papers for its 26th annual conference, this year titled "The Science of Water Resources: 1990 and Beyond," and symposium, this year focusing on "Transferring Models to Users."

CONFERENCE: Both invited and contributed papers will be presented in conference poster and technical sessions. Poster papers and oral papers are called for on the following and other related topics: Hydrologic Trends, Legal Issues, Water Resources Development, Emerging Issues.

SYMPOSIUM: Both invited and contributed papers will be presented in symposium poster and oral technical sessions. Poster and oral papers are called on the following or other related topics: Technical and Legal Implications of Nonexperts Using Complex Models, Responsibility for User and Program Errors in Models, Case Studies of User Experiences, Management Responsibility for Computer Application, Quality Assurance of Computer Analysis, Organizational Responsibility in Model Creation, PC Based Models, Moving Mainframe Models to PC's, Models as a Basis for Regulation, Sensitivity of Models to User Error.

The conference and symposium will be held November 4-9, 1990, in Denver, Colorado. Abstracts for both conference and symposium papers must be submitted by November 1, 1989. For additional information write or call American Water Resources Association, 7104 Ohms Lane, Suite 220, Bethesda, MD 20814-2192 (Phone:301/493-8600 FAX 301/493-5844)

POSITIONS AVAILABLE

The **U.S. Geological Survey** is seeking applications for the position of **Chief, Office of External Research, Water Resources Division, Reston, Virginia.** The position is open to qualified applicants in any of the major disciplines involved in the Water Resources Research Institutes and Water Research Grants programs for which the Office of External Research has administrative responsibility. Closing date is October 2, 1989. For information regarding the position and eligibility requirements, call the Recruitment and Placement Section, Personnel at (703) 648-6131.

The **Department of Civil Engineering and the Wyoming Water Research Center at the University of Wyoming** have a joint faculty position available at the Assistant/Associate Professor level for an individual with expertise in the area of groundwater contaminant transport modeling and remediation techniques. The position will be available after January 1, 1990. Application deadline is November 15, 1989. For additional details contact Dr. Victor R. Hasfurther, Chairman, Search Committee, Civil Engineering Department, P.O. Box 3295, University Station, University of Wyoming, Laramie, Wyoming 82071.

The **University of Nebraska-Lincoln Department of Geology** invites applications for a tenure-track position in **hydrogeology.** Closing date is October 1. For additional information contact Chairman, Geology Search Committee, 214 Bessey Hall, Department of Geology, University of Nebraska-Lincoln, Lincoln, NE 68588-0340 (402) 472-2663.

The **Water and Energy Research Institute of the Western Pacific at the University of Guam** is seeking applications for three tenure-track faculty positions: assistant/associate professor in the area of hydraulics or groundwater hydrology; assistant/associate professor in the area of environmental toxicology, environmental chemistry, and/or environmental biology; assistant/associate professor in the area of geology, hydrology, or meteorology. Review of applicants will continue until the positions are filled. For additional information contact Shahram Khosrowpanah, Acting

Director, University of Guam/WERI, Mangilao, Guam 96923; Phone: (671) 734-3132; Telex: UOG GUAM 6275.

The Mecklenburg County Department of Environmental Protection seeks to fill the position of Senior Environmental Engineer II. Contact: Jane Griffith, Mecklenburg County Dept. of Environmental Protection, 1200 Blythe Blvd, Charlotte, NC 28203; Phone (704) 376-4603.

The University of Connecticut seeks to fill a tenure-traci faculty position in forest hydrology/watershed management. Applications will be received until Oct. 1 or until a suitable candidate is found. Contact Dr. Hugo H. John, Dept. Natural Resources Management & Engineering, University of Connecticut, 1376 Storrs Road, Box U-87, Storrs, CT 06269-4087.

WATER RESOURCES CONDITIONS FOR AUGUST

August rainfall at Asheville and Raleigh was 0.19 and 0.64 inches above normal, respectively, and 0.76 and 1.88 inches below normal at Charlotte and Greensboro, respectively, according to the National Weather Service. Minor flooding was reported in southern Transylvania county on August 28.

Streamflow conditions were excessive at reporting stations on the French Broad River at Asheville and on Contentnea Creek near Hookerton. Streamflow was in the normal range, but above the long-term August median, for the rest of the reporting stations. Streamflow ranged from a low of 103 percent of long-term August median for Elk Creek at Elkville to a high of 292 percent for Contentnea Creek.

Narrows, High Rock, and Bridgewater reservoirs in the Piedmont contained 94 percent of combined capacity on August 28, compared with 73 percent last August and 83 percent for the long-term average.

Groundwater levels in the unconfined (water-table) aquifers declined seasonally in index wells in the blue Ridge and Piedmont provinces. The water level in the index well in the Coastal Plain rose slightly. Water levels in all index wells were above average.

— *U.S. Geological Survey*

NEW PUBLICATIONS RECEIVED BY THE INSTITUTE

Residents of North Carolina may borrow these from the Institute for a two-week period. Where individual copies are desired, readers are encouraged to request copies form the organization issuing the publication. The addresses are provided by the NEWS for this purpose.

WATER RESOURCES PLANNING

"Application of Seismic-Refraction Techniques to Hydrologic Studies," (Bk2, ChDw), by F.P. Haeni, avail. from Books and Open-File Reports Section, USGS, Fed. Center, Box 25425, Denver, CO 80225. (04B)

"A Study of Infiltration Trenches," (#163), 4/89, by C.Y. Kuo, et al., avail. from VA WRRC, 617 N. Main St., Blacksburg, VA 24060. (04A Urban Stormwater)

"Evaluation of Methods for the Estimation of Tributary Mass Loading Rates," (#187), 6/89, by S.D. Preston, et al., avail. from WRRC, Purdue Univ., W. Lafayette, IN 47907. (05B)

WATER QUALITY MANAGEMENT

"Tar-Pamlico River Basin Nutrient Sensitive Waters Designation and Nutrient Management Strategy," (4/89), by and avail. from Water Quality Sec., DEM, DEHNR, P.O. Box 27687, Raleigh, NC 27611. (05G)

"Variable Source Area Concept for Identifying Critical Runoff-Generating Areas in a Watershed," (#164), 5/89, by G.V. Loganathan, et al., avail. from VA WRRC, 617 N. Main St., Blacksburg, VA 24060. (04D)

"Effects of Land Use on the Water Quality and Biota of Three Streams in the Piedmont Province of North Carolina," (WR #89-4007), 1989, by J.K. Crawford, et al., avail. from Books and Open-File Reports, USGS, Fed Center, Bldg. 810, Box 25425, Denver, CO 80225. (05C)

WATER QUANTITY MANAGEMENT

Ground-Water Level Data for North Carolina-1987," (OFR 89-68), by R.W. Coble, et al., avail. from USGS, Water Resources Div., P.O. Box 2857, Raleigh, NC 27602.

"Groundwater Resources Assessment of the Piedmont Region in South Carolina," (#129), 5/88, by R.K. White, et al., avail. from SC WRRI, Clemson Univ., Clemson, SC 29634-2900. (04B GW)

"Measurement of Recharge Rates Through an Unsaturated Glacial Till by Tritium Analyses, " (#181), 6/89, by D.P. Daniels, et al., avail. from WRRC, Purdue Univ., West Lafayette, IN 47907. (04B GW)

"Contribution of Subsoil and Aquifer Microorganisms to Groundwater Quality," (#177), 6/89, by R.F. Turco, et al., avail. from WRRC, Purdue Univ., W. Lafayette, IN 47907. (04B)

MISCELLANEOUS

"Mississippi Water Resources Conference 1989," (Proceedings), ed. by E.J. Hawkins, avail. from WRRI, P.O. Drawer AD, MS State University, MS State, MS 39762. (Inst. Rpts.)

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