NEWS
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OF THE UNIVERSITY OF NORTH CAROLINA

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THE ACID RAIN THREAT

It is increasingly apparent that acid precipitation has an impact in North Carolina. Within 2 1/2 decades the area of the eastern U.S. subject to a rainfall with an abnormally acidic average pH of 4.5 has tripled, and is predicted to soon include the Great Smokey and Blue Ridge mountains. In Raleigh, five storms with an average pH of 3.3 were recorded in 1979. A pH of 7 is neutral while pH 3.3 is similar to that of vinegar.

The Midwest is accused of furnishing most of the pollutants which contribute to acid rain. Nitrogen and sulfur, from heavy industry and other sources combines with sunlight and moisture in the atmosphere to form acid solutions that travel long distances with the prevailing winds. The current national tendency to use coal as a fuel source may increase acid rain occurrences that can affect the entire Eastern Seaboard.

The environmental impacts of acid rain are severe. A 1975 survey of the Adirondack Mountains in New York, where acid rainfall has been a problem for many years, indicated that 56% of the high elevation, wilderness lakes were devoid of fish life. To date, N.C. lakes and streams have been able to recover from acid storms, but the impact on organisms caught in a critical life cycle during such rainfall is unpredictable. Effects on plant life, soils, and stone outcroppings such as mountain balds, have also been documented, as well as corrosion of stone structures in cities.

There are approximately 4000 stations in the U.S. that record the amount of rainfall during any one event. Only 35 of these also determine the chemistry of the precipitation. It is apparent that a major research effort is needed to combat the problems. Toward this end, President Carter announced in August that $25 million was available for acid rain investigations. As part of this initiative, Dr. Ellis Cowling, associate dean of research at NCSU's School of Forestry, has been awarded $500,000 to administer and coordinate a nationwide program of major, long-term investigations on acid rain effects. Dr. Cowling, as well as Dr. Lars Overein of Norway and Dr. David Shriner of the Oak Ridge National Laboratory, have each held seminars on acid rain.

Many agree that the acid rain dilemma is complex and that solutions will involve changes in technology and life styles. For a comprehensive and well written perspective in this phenomenon, see Mark Taylor's "The Rain That Kills" in Wildlife in North Carolina, November, 1979.

SWISS WATERWORKS OBSERVATIONS MADE Dr. Daniel A. Okun, with the Department of Environmental Sciences and Engineering, UNC at Chapel Hill, recently visited the water works in Zurich, Switzerland, and relates information that may be of interest to readers of the NEWS.

Dr. Okun informs us that Zurich's water supply is drawn from wells, springs, and two points in Lake Zurich. Because of lake contamination, the raw water is subjected to sophisticated physico-chemical treatment before entering the distribution system. The treatment process consists of prechlorination with chlorine dioxide gas, alum addition prior to rapid sand filtration, ozonation, granular activated carbon adsorption and a final security measure of slow sand filtration.

Evidently such extensive treatment is commonplace throughout Switzerland. The unique features of the plant Dr. Okun toured include complete automation, remote control equipment and security measures to ensure water purity. In addition, the city is well prepared for emergencies: each householder is provided with a three day supply of water (10 liters), inoculated with silver and bagged in plastic. This water will maintain its quality for 4 years. For prolonged emergencies there is a gravity, spring-fed supply which leads to fountains, to hospitals, and to major centers such as emergency shelters throughout Zurich.

Another impressive feature is the Zurich waterwork's investment and use of water storage which permits purchase of offpeak power. During daytime peak water consumption the plant operates at its lowest rate, with one pump in six operating. The heaviest treatment loads, and highest rates of both low and high lift pumping, are in the evening. Accordingly, the storage tanks are allowed to deplete, but there is an automatic override which, if the tank falls too low, would automatically increase the treatment rate.

Perhaps we in the U.S. can learn something from the hospitable Swiss!

1980 IS SEEN AS CRUCIAL YEAR FOR CONSERVATION A warning has been issued to farmers in North Carolina and the nation that 1980 may be a year when increased planting will mean a severe loss of irreplaceable topsoil.

"This warning comes from the Secretary of Agriculture, who is really concerned about soil loss," said Jesse L. Hicks who heads the USDA - Soil Conservation Service in North Carolina, "and we share his feelings."

Secretary Bob S. Bergland sees the threat because of "an excellent demand for American grain in the year ahead. There is no set-aside or diversion for wheat and feed grains, and each farmer will decide how much to plant."

Bergland recalled that back in the 1973-74 crop year, when farm operators were urged to plant as much land as possible, farmers plowed up nine million acres of marginal land. "This is land that's almost impossible to protect from soil erosion. As a result, we lost 60 million more tons of soil on those nine million acres alone. That was the bitter result of planting from fence to fence."

Setback Is Seen

He warned that switching to crop production on hard-to-protect acres "can undo years of work and hundreds of millions of dollars invested in soil conservation practices through the years."

Secretary Bergland appealed to landowners to protect their soil, and to keep marginal land in its present use--pasture, woodland or conserving practices.

RURAL CLEAN WATER PROGRAM FUNDED FOR BMP'S Late this summer, Congress appropriated $50 million to the experimental Rural Clean Water Program, an amendment to section 208 of the Clean Water Act introduced by Senator Culver (D-Iowa).

This program, to be administered by USDA's Agricultural Stabilization and Conservation Service (ASCS), will provide cost-sharing and other incentives to farmers who install Best Management Practices (BMP's) for erosion control.

Once this Agricultural Appropriation Act was passed, ASCS began rewriting the rules and regulations for the program. Their preparation will enable administration of projects chosen as a result of proposals received from local entities. The Wake County, N.C. Soil and Water Conservation District, with the aid of the State Rural Clean Water Coordinating Committee initiated such a proposal for the Black Creek and Middle Creek drainage area which awaits consideration. Their proposal was endorsed by North Carolina Governor James B. Hunt.

Regulations under the Rural Clean Water Program specify that funds will be used only in areas with critical non-point source pollution.

FIRST PHASE OF LEVEL B STUDY AVAILABLE

The first of three 'Plans' to be produced by the Yadkin-Pee Dee River Basin Study is being circulated for review and comment. The Existing Plan identifies present water resource problems in the Basin and any programs and projects planned or in operation to solve them. The Study's next two phases will consist of the Alternative Plan and Recommended Plan, scheduled for completion by June 1, 1981.

The working document assesses the status of water resources problems and solutions in an area that occupies 18,040 square miles of North Carolina, South Carolina and a small section of Virginia. North Carolina and South Carolina participated in the plan formulation with substantial advice and help from six Citizen Advisory Committees, state and federal agencies, and major private water users.

Comment sheets with specified questions and space for additional remarks are disseminated with the plan. Comments and suggestions for solving the water resource problems identified within the report are requested so that they may be incorporated into the other Study phases. The major opportunity for comment was at Citizen Advisory Committee meetings held in each CAC area at the end of November. The formal review period ended December 7, 1979. Copies are available from:

Yadkin-Pee Dee Level B Water Resources Study
Water Planning and Development Section, DNRCD
P.O. Box 27687
Raleigh, N.C. 27611

COASTAL IMPACT PROJECTS SELECTED

The N.C. DNRCD has selected 12 research projects totalling $431,662, for funding under the Coastal Energy Impact Program (CEIP). CEIP is a federally financed program, administered by the Office of Coastal Zone Management (OCZM) through state control management persons, designed to offset the adverse economic and environmental impacts of energy development in the Coastal Zone.

Of the projects selected, the following directly relate to water resources development:

Freshwater Influx into Nursery Areas From Peat Mining Drainage (N.C. Division of Marine Fisheries) - $17,200

Coastal Energy Impacts in Fisheries Resources of Albemarle and Pamlico Sound (N.C. Division of Marine Fisheries) - $31,833

Peat Mining Impacts on the Proposed Lake Phelps Area of Environmental Concerns (Washington County) - $17,700

Oil Spill Impacts on Beach Community Recreation Resources (Brunswick County) - $60,000

Environmental and Geological Atlas for Four Coastal Counties (East Carolina University) - $69,696

Pipeline Corridors in the Coastal Zone (N.C. State University) - $75,651

Hydrological Impacts of Peat Mining (Water Resources Research Institute, UNC) - $8,868

An additional $550,000 will be available for the program beginning April 1980.

For additional information contact:

Jim Smith
CEIP Coordinator
Office of Coastal Management
DNRCD
Box 27687
Raleigh, NC 27611

Telephone: (919) 733-2293

DISCOUNT RATE SET AT 7 1/8 PERCENT

Leo M. Eisel, Director of the U.S. Water Resources Council, Announced that the interest rate to be used by Federal agencies in formulating and evaluating plans for water and related land resources is 7 1/8 percent for the period October 1, 1979, through November 30, 1980.

The new discount rate was published in the Federal Register on Monday, October 29, 1979.

HELMS APPOINTED DEPUTY DIRECTOR OF DIVISION OF ENVIRONMENTAL MANAGEMENT

Robert F. Helms has been appointed Deputy Director of the Division of Environmental Management, N.C. Department of Natural Resources and Community Development. Mr. Helms is from Albemarle, NC. He was educated at North Carolina State University and at The Citadel where he earned a B.S. in Civil Engineering. He has worked in Tarboro as a city engineer, Moore County as a planner and county administrator and in Stanly County as county manager. He has also practiced consulting engineering and has been a partner and superintendent of construction with a Lumberton company. He is a licensed professional engineer. Mr. Helms began work in his new position as Deputy Director of the Division of Environmental Management on December 17, 1979. Helms' responsibility will focus on improving management with the Division which has responsibility for several state and federal environmental programs. One of Mr. Helms major roles will be to help the Division mesh its programs better with the local governments and consulting engineers of North Carolina.

LAND USE AND DRAINAGE ON ALBEMARLE-PAMLICO PENINSULA MAPPED

Land use, land cover, and drainage maps of the 2,000 square mile Albemarle-Pamlico peninsula of eastern North Carolina have been prepared by the U.S. Geological Survey as part of a study of the effects of large-scale land clearing on regional water resources.

The map, complete with text, was prepared in cooperation with the North Carolina Department of Natural Resources and Community Development. Published at a scale of 2 miles to the inch, the maps cover the entire area east of the Suffork Scarp for the year 1974. The land use and drainage information on the maps was compiled from high altitude photography and satellite imagery taken during 1974-76.

The peninsula includes the most extensive area of wetland in North Carolina and one of the largest in the country. In recent years the pace of land clearing on the peninsula has accelerated as more and more land is being converted from forest, swamp, and brushland to agricutural use. Conversion of swamps to intensive farming operations requires profound changes in the landscape. Vegetation is uprooted and burned and ditches and canals are dug to remove excess water.

What is the impact of these changes on ground-water supplies and on the streams and surrounding coastal waters which receive the runoff? According to Dr. Charles C. Daniel, hydrologist with the Geological Survey, and author of the report, "These maps will aid in answering these and similar questions that have arisen about patterns of land use and the artificial drainage system that has been created to remove excess water from the land. By showing both land use and drainage, these maps can be used to identify those areas where water-related problems may occur and help assess the nature and causes of these problems."

The map report, "Land use, land cover, and drainage on the Albemarle-Pamlico peninsula, eastern North Carolina, 1974," by C. C. Daniel III is available for inspection at Room 5B410, U.S. Geological Survey, National Center, Reston, Virginia 22092 or at the U.S. Geological Survey, P.O. Box 2857, Raleigh, NC 27602.

ACCORDING TO USGS PUBLICATION WATER QUALITY OF FRENCH BROAD RIVER IMPROVES

The chemical quality of water in the French Broad River has significantly improved during the last decade, according to a just-published report by the U.S. Geological Survey, Department of the Interior. Dr. Charles C. Daniel, Hydrologist with the Geological Survey and senior author of the report, states that as recently as 1974 the quantity of dissolved inorganic pollutants in the river water at Marshall, N.C., amounted to 126,000 tons annually, but that by 1977 the annual load had declined to 83,000 tons. Daniel attributed this rather dramatic improvement in water quality to a combination of better waste-water treatment facilities and improved industrial technology.

The report, "Water Quality of the French Broad River, North Carolina--An analysis of data collected at Marshall, 1958-77," by C. C. Daniel III, H. B. Wilder, and M. S. Weiner, U.S. Geological Survey Water Resources Investigations 79-87, is offered for sale by the National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Road, Springfield, VA 22151. A limited number of copies are also available free on request to District Chief, U.S. Geological Survey, P.O. Box 2857, Raleigh, NC 27602.

ARSENIC AND SELENIUM FROM A COAL-FIRED POWER PLANT

Two recent studies document the release and environmental accumulation of arsenic and selenium from a coal-fired power plant at Belews Lake in Stokes County, North Carolina. The two investigations were conducted independently from 1976 to 1978 by P. M. Cumbie, biologist with Duke Power Company, and E. A. Holland, graduate student in the Department of Environmental Sciences and Engineering, UNC-Chapel Hill.

Approximately 13 kg of arsenic and 8 kg of selenium entered the 3800-acre impoundment each day via the ash pond return flow of the 2280 MW Belews Creek Steam Station, the largest coal-fired electrical generating facility in the Duke Power system. Trace amounts of arsenic and selenium are present in coal, and are leached from the residual fly ash. Cumbie and Holland reported the resulting patterns of arsenic and selenium distribution among the water, sediments, and biota of the lake system. Cumbie attributed the total reproductive failure of the Belews Lake fish population to the bioaccumulation of selenium. Holland reported that selenium concentrations of 100 parts per million (ppm) dry weight measured in tissues of the few remaining fish could constitute a health problem if consumed by humans. Arsenic concentrations in fish samples were generally less than 1 ppm, and apparently did not contribute to the loss of fish in Belews Lake or represent a public health problem.

The lake was created by impounding Belews Creek upstream of its confluence with the Dan River to provide condenser cooling water for the Belews Creek Steam Station, which began operating in August 1974. The lake has a tributary inflow of 91 cubic feet per second (CFS), a retention time of 3 1/2 years, and is subject to substantial hydraulic influence by the 2300 cfs circulation pattern of the condenser cooling circuit. The 20 cfs ash pond return flow to the lake typically displayed a pH of 9.0 to 9.5 and specific conductivity of 300 to 400 ymhos/cm^2. Arsenic and selenium in the ash pond effluent usually ranged between 150 and 200 parts per billion (ppb), and existed primarily as soluble chemical species (0.45 u).

Major ions released from the ash pond produced a lakewide increase in specific conductivity from 60-70 ymhos/cm^2 in 1974 to 120 ymhos/cm^2 in 1977. Arsenic and selenium concentrations in the lake increased to about 5 and 10 - 15 ppb, respectively. Background concentrations in tributaries to Belews Lake were less than 1 ppb for both elements. North Carolina standards for Class C waters are 100 ppb arsenic and 10 ppb selenium.

Bottom sediments contained as much as 75 ppm arsenic and 40 ppm selenium on a dry weight basis. Concentrations decreased with distance from the ash pond outfall. Arsenic exceeded selenium in all sediment samples. Both elements were significantly elevated above background levels in aquatic and shoreline plants analyzed by Holland. Samples included submerged macrophytes, filamentous algae, emergent rushes, and shoreline grasses. Dry weight concentration, ranging from 5 to 500 ppm arsenic and 5 to 200 ppm selenium, decreased with distance from the ash pond. Holland noted that sediment and plant tissue concentrations of both elements were at least an order of magnitude higher downstream of the Belews Dam spillway than at tributary control locations upstream of the lake. Both investigators analyzed zooplankton samples and reported substantial accumulations of selenium (up to 75 ppm dry weight), but not of arsenic. Holland reported up to 120 ppm dry weight selenium in benthic damsel fly larvae sampled near the ash pond.

Cumbie's comprehensive analyses of fish tissues for a variety of trace elements and pesticides did not reveal abnormal concentrations of any substance except selenium. Both studies reported selenium levels of 100 ppm dry weight in fish, which was more than 20 times higher than concentrations from uncontaminated environments. Cumbie observed that ovaries from female fish specimens contained up to 3 times the selenium concentration of skeletal muscle tissue, and related this to other reports of selenium interference with animal reproduction. Both Cumbie's and Holland's work illustrated typical bioaccumulation patterns of arsenic and selenium reported elsewhere in the literature. Both elements become concentrated into biological tissues, but only selenium is accumulated through successive levels of the food chain.

Despite the drastic effect on fish reproduction in Belews Lake, it is noteworthy that selenium concentrations in the water column were only slightly higher than applicable water quality standards, and were far below reported levels for acute toxicity in aquatic organisms. It is likely that the selenium uptake by fish in Belews Lake occurred through ingestion of selenium-rich benthic and planktonic food chain organisms.

Holland described the movement of arsenic and selenium from the ash pond through the lake system. He estimated that 85 and 70 percent, respectively, of the daily arsenic and selenium inputs to the lake were sequestered in the bottom sediments, with the remainder being discharged to the Dan River through the dam spillway. The mass of arsenic and selenium associated with biotic compartments appeared to represnet only a small fraction of the total "standing load" of the system. Neither Holland nor Cumbie observed any remobilization of arsenic or selenium from bottom sediments to the water column, even during periods of hypolimnetic oxygen depletion.

Additional details are available in the following studies.

Cumbie, P. M., "Belews Lake Environmental Study Report: Selenium and Arsenic Accumulation," Duke Power Company, Charlotte, North Carolina, Technical Report Series No. 78-04, (April 1978)

and

Holland, E. A., "Arsenic and Selenium in the Water, Sediments, and Biota Near a Coal-Fired Power Plant - Belews Lake, North Carolina," MSPH Technical Report, Department of Environmental Sciences and Engineering, School of Public Health, University of North Carolina, Chapel Hill, NC, (April 1979).

FLOATING VASCULAR PLANT SYSTEMS FOR UPGRADING WASTEWATERS

Research in Florida, Mississippi, California, and elsewhere has shown that the use of floating vascular plants in lagoons can greatly improve the quality of wastewaters for several important parameters. Normally BOD_5 and suspended solids in problem stabilization lagoons are reduced to well below the usual upper regulatory limits of 30 milligrams per liter for each by passing the waters through lagoons covered with floating vascular plants. Ammonia, total nitrogen, phosphorus, and total and fecal coliform bacteria can also be reduced with these systems.

So far water hyacinths and, to some extent, duckweeds have been the plants used. Depending on factors such as water depth and temperature, the effective hydraulic retention time for upgrading wastewaters with these systems has varied between around three to eight days. For Texas conditions a one-acre pond with floating vascular plants will process 200,000 gallons of stabilization lagoon effluent per day.

Some of the processes involved in wastewater modification in floating vascular plant systems are not fully understood. The plants obviously prevent growth of algae and reduce their numbers with significant reductions in BOD and suspended solids resulting from this alone. Nitrogen phosphorus, and heavy metals accumulate in the floating plants and harvest of the plants, then, removes these elements from the system. Regular harvest is the only important way phosphorus and heavy metals can be removed. However, the floating vascular plant ecosystem can remove BOD, suspended solids, nitrogen, and coliform bacteria with infrequent plant harvest.

Floating vascular plant systems have great potential for upgrading wastewaters from a variety of sources but the most important use now will likely be for processing waters from municipal stabilization lagoons. The greatest problem in adapting these systems for use in temperate regions is to find plants which will live and maintain a functional system during the winter with little or no energy costs for warming. There are several plants found in North Carolina which may be useful in temperate zone systems. For example, duckweeds have been observed to live through the winter in North Carolina as far west as Charlotte. In addition to solving over-wintering problems, the use of water hyacinth systems outside their natural range would require that provisions be made to prevent their escape and possible establishment in natural waters. For many years these plants have caused serious problems in usage of waterways along the Gulf Coast.

...*Dr. Graham Davis*
Department of Biology
East Carolina University

CONFERENCES AND WORKSHOPS

Pocosins--A conference on Alternative Uses of Coastal Plain Freshwater Wetlands in North Carolina. January 3-4, 1980, Beaufort, North Carolina.

The pocosins conference is viewed as the first step in developing management guidelines for these valuable and threatened natural resources. Participants from varied resource disciplines will discuss the present knowledge of the effects of alternative uses of coastal plain freshwater wetlands in terms of ecological, economic and policy criteria, and they will identify future research needs. This comprehensive effort will contribute to the understanding of the benefits, costs and risks associated with the conversion of large tracts of North Carolina wetlands.

Questions? Write or call Stephen A. Anderson, Pocosins Conference Coordinator, Integrated Case Studies Program, School of Forestry and Environmental Studies, Duke University, Durham, NC 27706; telephone (919) 684-2802.

Business and the Environment--Atlanta, January 28-29 (Mon./Tues.), Tower Place Hotel, 404-231-1234.

The program seeks to school business executives (and their professional advisors) in the pragmatic management options available to meet the demands of environmental regulation--and in the considerations necessary for reaching intelligent management decisions. It covers (as detailed in the Course Curriculum) such matters as: working with government regulations; dealing with EPA; establishing production facilities; running your operations; financing problems; government enforcement policies; and SEC matters--all from the standpoint of responsible management. It will be conducted by a Course Director of unusual competence, and his instruction will be supplemented by a permanent-reference Course Manual.

This program has been developed and is administered for the University by Federal Publications Inc. If added information is desired, contact: Miss J. K. Van Wycks, Seminar Division Office, Suite 500, 1725 K Street, NW, Washington, DC 20006. Telephone: 202-337-7000.

EPA SWMM Workshop--January 8-9, 1980, J. Wayne Reitz Student Union, University of Florida, Gainesville, Florida 32611.

The purpose of the workshop is to acquaint previous and new SWMM users with the current status of all model blocks as coded for the SWMM Version III. This will include a discussion of theory, program coding and examples.

Preliminary Agenda

Tuesday, January 8

A.M.

Executive and Combine Blocks, Graphing Routines
Runoff Block

P.M.

Transport Block
Receiving Block

Wednesday, January 9

A.M.

Storage/Treatment Block

P.M.

Extended Transport Block
(WRE Transport Model)

Tentative Cost: $40 for two days. This includes duplication of written material (e.g., Version III Users Manual and Documentation) and coffee breaks.

Speakers: These will include Wayne Huber and Stephan Nix from the University of Florida and Larry Roesner from Water Resources Engineers (for the Extended Transport Block).

For Additional Information: Please contact

Dr. Wayne C. Huber
Department of Environmental Engineering Sciences
University of Florida
Gainesville, Florida 32611
(904) 392-0846

POSITIONS AVAILABLE

Senior Research Associate, Virginia Water Resources Research Center, Virginia Polytechnic Institute and State University. Major Responsibilities: Develop 5-Year Research Plan which addresses water and land related problems, work with legislative commissions on policy issues related to water, formulate state and national conferences on water policy issues, e.g. coastal zone management, groundwater quality protection; conduct research as part of interdisciplinary team on complex problems where water resources are either part of the problem or a part of the solution; provide liaison between users and researchers to facilitate the use of best information to solve problems or formulate policy; and prepare appropriate publications for use in continuing education program.

Direct All Inquiries To:

William R. Walker, Director
Virginia Water Resources Research Center
617 North Main Street
Blacksburg, Virginia 24060

The Department of Environmental Sciences and Engineering, University of North Carolina at Chapel Hill, invites applications for a tenure track position at the Assistant Professor level in the Water Resources Engineering Program of the department. Candidates must have a doctorate in engineering with interests in water quality and water resources engineering. Duties include graduate teaching and research. The position is open in the 1979-80 academic year. The University of North Carolina is an affirmative action, equal opportunity employer. Send resume to Professor Charles R. O'Melia, Department of Environmental Sciences and Engineering, University of North Carolina, Chapel Hill, NC 27514.

Director of Maryland Water Resources Res. Center. Position will approximate a 75% commitment to administration of the the Center and a 25% commitment to water-related research and scholarship in a scientific discipline. The director shall be the chief administrative officer of the WRRC and shall be responsible to the Provost of the Division of Agricultural and Life Sciences for the quality of research conducted through the Center.

The position is currently available. Closing date for applications is January 15, 1980, or until suitable candidates are identified by the Search Committee, whichever is later.

Applications should be addressed to the Chairman of the Search Committee:

Dr. Glenn W. Patterson
Chairman, Department of Botany
University of Maryland
College Park, MD 20742

The Department of Environmental Sciences, University of Virginia, invites applications for a tenure-track faculty position in HYDROLOGY. The department offers a broad-based interdisciplinary program at both undergraduate and graduate levels with particular strength in the areas of meteorology, ecology, geology and hydrology. Salaries and teaching loads are competitive and the position provides an excellent opportunity for collaborative research. Candidates should have an earned doctorate and show evidence of research capability in some area of hydrology or hydrogeology. Applicants in all areas of hydrology will be considered but preference may be given to applicants with interest in catchment processes and experience in application of statistical and/or stochastic methods. Send resume, reprints and three references to G. M. Hornberger, Department of Environmental Sciences, Clark Hall, University of Virginia, Charlottesville, Virginia 22903. The University of Virginia *is an equal-opportunity/affirmative-action* employer.

The School of Civil Engineering at Purdue University seeks applications for a tenure-track assistant/associate professorship in environmental engineering. Send resume and the names of three references to Professor H. L. Michael, Head, School of Civil Engineering, Purdue University, West Lafayette, Indiana 47907. Purdue University is an affirmative action equal opportunity employer.

Four openings available in the Division of Environmental Management, N.C. DNRCD.

Consulting Engineer I with batchelor's degree in civil, environmental, public health or other engineering and 1 year's experience in environmental engineering. To develop Data Need Analysis Report Study for environmental planning and organize and develop Water Use Data Program, including program format for coding. Salary--$16,188 - $22,428.

Environmental Engineer II with batchelor's degree in chemical, civil, environmental, public health, sanitary or other engineering and 3 years' experience as an environmental engineer. Working knowledge of civil engineering and computer modeling. Coordinate computer related support to expedite functions of planning and hydrologic systems and to collect and store water use information. Salary--$18,540 - $25,860.

Senior Environmental Engineer with batchelor's degree in civil or other engineering detree and at least 4 years' experience in water resources related engineering. Will be the head of a new unit of Water Supply Assistance, dealing with assistance to municipalities, with technical assistance given to those areas facing immediate or near term water supply shortages. Salary negotiable.

Senior Environmental Engineer with master of science in civil, environmental, public health, sanitary or other engineering degree and at least 6 years' experience in sanitary or water resources related engineering. To fill position of head of Water Supply Assistance Branch to expand planning assistance to local communities statewide. Salary negotiable.

For above four positions, send applications to:

John Wray
DEM, NRCD
P.O. Box 27687
Raleigh, NC 27611

WATER RESOURCES CONDITIONS IN NORTH CAROLINA Streamflow was well above normal. Widespread rains on November 2-3, 10-11, and 25-26 caused moderate rises on most streams across the State. Minor flooding occurred in the upper French Broad River basin on the 2nd and 25th.

Monthly-mean flows at index gaging stations ranged from about 2-1/2 times normal in the western Piedmont to over 4 times normal in the north-east Piedmont. Flow at the French Broad River station at Asheville was the highest November mean for the station since records began in 1895.

Ground-water levels generally rose in the Mountain region and declined slightly elsewhere. Levels were above long-term averages for November in the Mountains and Piedmont and below average in the Coastal Plain.

... *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 from the organization issuing the publications. The addresses are provided by the News for this purpose.)

Water Resources Planning

"A Three-Dimensional Model for Estuaries and Coastal Seas: Volume VI, Bristol Bay Simulations," 9/79, by Shiao-Kung Liu, *et al*, avail. from Rand, Santa Monica, CA 90406. (02L)

"Land and Water Resources Planning Using Goal Programming," (#95), 7/79, by R. L. Rossmiller, WRRI, Iowa State U., 355 Town Engr. Bldg., Ames, IA 50011. (06A)

"Multiobjective Analysis in the Maumee River Basin: A Case Study," 10/79, by Y. Y. Haimes, *et al*, avail. from Systems Engineering Department, Case Institute of Technology, Case Western Reserve U., Cleveland, OH 44106. (06B)

"Environmental Management of Multipurpose Reservoirs Subject to Fluctuation Flood Pools," (#84), 6/79, by T. A. Austin, *et al*, WRRI, Iowa State U., 355 Town Engr. Bldg, Ames, IA 50011. (06G)

"Public Recreation on Virginia's Inland Streams: Legal Rights and Landowners' Perceptions," 9/79, (#120), by W. E. Cox, *et al*, avail. from WRRC, VPI & SU, Blacksburg, VA 24060. (06E)

"Maximum Utilization of Water Resources in a Planned Community--Executive Summary," (EPA-600/2-79-050a), 7/79, by W. G. Characklis, *et al*, NTIS, Springfield, VA 22161. (06A)

Water Quality

"Improving Water Quality by Control of Algae: Biochemical Characterization of the Polysaccharides of Blue-Green Algae and Their Role in Bacterial-Algal Relationships," (#94), 4/79, by R. B. Wildman, *et al*, WRRI, Iowa State U., 355 Town Engr. Bldg., Ames, IA. (05G)

"Investigation of the Long-Term Effects of Chlorine on the Oxygen Demand of Wastewaters," 9/77, by J. C. Young, *et al*, WRRI, Iowa State, 403 Town Engr. Bldg., Ames, IA 50011. (05D)

"Effect of Particulates on Disinfection of Enteroviruses in Water by Chlorine Dioxide," (EPA-600/2-79-054), 7/79, by P. V. Scarpino, avail. from NTIS, Springfield, VA 22161. (05F)

"Determination of Giardia Cyst Viability," (EPA-600/2-79-063), by E. A. Meyer, 7/79, avail. from NTIS, Springfield, VA 22161. (05F)

"Human Viruses in the Aquatic Environment: A Status Report With Emphasis on the EPA Research Program," (EPA-570/9-78-006) 12/78, Office of Drinking Water, U.S. EPA, Washington, DC 20460. (05A)

"Long-Term Effects of Land Application of Domestic Wastewater: Tooele, Utah, Slow Rate Site, Volume 1: Field Investigation," (EPA-600/2-79-171a), 8/79, by T. N. Debo, avail. from NTIS, Springfield, VA 22161. (05D)

"The Effects of Decreased Nutrient Loading on the Limnology of Diamond Lake, Oregon," (EPA-600/8-79-017a), 6/79, by W. L. Lauer, *et al*, avail. from NTIS, Springfield, VA 22161. (05C)

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Water Quantity

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SPECIAL

RESIDENTIAL WATER CONSERVATION

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The average North Carolinian consumes between 50 and 75 gallons of water each day. In years past when our water supply was abundant and our population small, this water consumption was probably not very critical. Today, however, with the rising cost of our water supply systems, our water treatment systems, and our wastewater treatment systems, wasteful consumption of water should be and is being discouraged. Both the state and federal governments are encouraging individuals, communities, industries, and large municipalities to conserve water. The reasons for this are twofold: (1) The water supply is limited and (2) Water conservation is also energy conservation for as water consumption is reduced, the energy required to pump, treat, and often heat that water is also reduced. Furthermore, if you are using a septic tank at your home, then water conservation can improve and prolong the operation of your system; and if your septic tank system fails or begins to show signs of failure, the installation of water saving devices and appliances are simply low-volume fixtures that accomplish the same function as higher volume conventional fixtures--only they use less water.

There are several water conserving devices, some special water conserving appliances, and a few common sense rules which will help us all reduce the amount of water we consume. Listed below you will find some useful water conserving ideas. As you might suspect, some are appropriate for you while others may not be so. The text which follows is divided into several major headings including commode modifications, shower modifications, faucet modifications, supply modifications, water conserving appliances, and common sense.

Commode Inserts and Modifications:

A. Plastic Bottles: Once filled and weighted, plastic bottles displace water and reduce the flush volume by the amount of water initially displaced. Bottles work well and they are free! A one-quart bottle will displace one quart of water; a one-gallon bottle will displace one gallon of water and this reduces the flush volume accordingly. To install a plastic bottle in your water closet, simply put about 1" of sand or gravel in the bottom of a bottle then fill the remainder of the bottle with water. Place the filled bottle on the right side of the flapper valve as far away from the flush mechanism as possible. Replace the tank cover and your bottle will save water for you.

B. Dams: These devices block off the lower portion of your water closet tank and prevent the water from behind the dam from ever leaving the water closet. Generally these devices are installed in pairs, one dam on each side of the flapper valve. Properly installed dams will reduce water consumption by about two gallons per flush. They are easy to install and they do maintain the hydraulic head in your tank. This is very important for it is the hydraulic head which moves waste from your tank bowl into your sewer system. The cost of these devices is about $5.95.

C. Dual Flush Modifications: Several of these are currently available. The simplest merely add weight to the flapper valve. This closes it before all the water has left the tank. A "light" flush is generally adequate for liquid wastes, while a "heavy" flush is necessary for solid wastes. These devices will reduce water consumption by about two gallons per flush with a "light" flush, but for a "heavy flush" the entire five gallons are required. The cost of these devices ranges from $2.00 on up to about $10.00.

D. Level Adjusting Valves: Some of these valves are advertised as "Space Age technology in the toilet." In principle, an adjustable diaphragm type valve simply controls the water level in your water closet. By setting the diaphragm for a low water level, less water is required to fill the tank. The big disadvantage of these is that the hydraulic head is lost and, as we just mentioned, the head is the force that moves waste from your bowl into your sewer system. The cost of these items is about $4.95.

E. Low Volume Toilets: The average commode requires approximately five gallons of water per flush. Recently, most American plumbing appliance manufacturers have started to market low volume commodes. These utilize only three gallons of water per flush and over the course of one day they may save the average family almost 40 gallons of water. These units are available in porcelain or as porcelain bowls with a plastic tank. They also come in a wide variety of colors. Several of these low volume commodes have been tested scientifically and they do perform as well as the old standard models. Cost ranges from about $50.00 up to over $100.00. These costs generally prohibit retrofit of these; but if an individual is planning on remodeling the bathroom, then these are cost effective.

Shower and Faucet Modifications:

A. Water Saving Shower Heads: Several of these are currently available on the market and all are easily installed with only a pair of pliers. Most have a design capacity of between 2.5 and 3.5 gallons per minute. Compare this to a flow of 6 to 10 gallons per minute for a conventional shower head. Several studies have been accomplished, and these all indicate that the average person showers five minutes per day so you can see that substantial savings are potentially realizable, i.e., 30 to 50 gallons compared to 12.5 to 15 gallons. There are two varieties of water saving shower heads available: one is simply a flow restricting shower head; the second is an aerating shower head. Recently even the shower massage industry has been struck by the water conservation bug and a water conserving shower massager is available. Big savings are realized here in energy too. Most showers are about 60% hot water and as less hot water is used (1 1/2 to 2 gpm with a saver shower as compared to 4-6 gpm for a conventional shower), less energy is required to heat that which is being used. At $0.04 per KWH it costs about $0.01 to heat one gallon of water. The homeowner can save quite a bit of energy money too. The cost of a water saving shower head is between $7.95 and $21.95.

B. Faucet Aerators: These devices decrease water usage at the faucet. Faucets generally require about four gallons per minute as compared to about 2.5 gallons per minute with conserving faucet aerators. Granted the potential savings here are not great, but they are realizable. Faucet aerators are recommended more for bathrooms than for kitchens. The cost of these devices is about $2.00 and that $2.00 can be recovered after only 55 minutes of hot water has run through the faucet aerator.

C. Line Inserts and Flow Restrictors: These devices reduce the size of the orifice through which water may flow. Reducing the cross-sectional area of a pipe while maintaining the same water pressure will reduce the flow of water through that pipe. Unfortunately most plumbing fixtures are designed to operate at a specified design flow (like six gallons per minute for some shower heads) and a reduction in this flow decreases the efficiency of the plumbing fixture. Generally these flow restricting devices and line inserts are quite expensive, but the cost can be as low as $1.00.

Pressure Reducing Valves:

In areas with excessively high water pressure, large quantities of water may be used inadvertently. Excessively high water pressure is any water pressure greater than 60 psi. Much of this flow could be reduced through a pressure reducing valve. Valves should be adjusted to reduce household water pressures to about 40 psi. This is sufficient to operate most household appliances and it does maintain water flows at sufficient levels without creating excess or waste. A pressure reducing valve which reduces water pressure from 60 psi to 40 psi will reduce the flow through a 1/2 inch pipe by almost 5 gallons per minute. Assuming other factors remain the same, this could reduce the hydraulic load to a soil adsorption system considerably, and as we mentioned earlier, this could improve and prolong the life of that system. The cost of pressure reducing valves is about $80.00.

Appliances:

Several household appliances now come as water conserving appliances. Some washing machines and dishwashers are now equipped with water conserving features, such as load levelers, load controls, and rinse adjustments. The homeowner can actually adjust the amount of water required for each wash. The water required for washing machines varies considerably from lows of about 35 gallons per load to highs of over 50 gallons. These low volume appliances may substantially reduce the hydraulic load into a soil adsorption system and they may demonstrate considerable conservation of both water and energy provided these features are utilized effectively. The cost of these appliances is high. Some washing machines for example may cost over $400; dishwashers may cost as much as $300.

Common Sense:

Water use like any other commodity we use requires common sense. Wasteful consumption of any resource is not recommended. Water is a valuable natural resource. In years to come the value of our water resources will increase manyfold. Common sense water management includes such things as fixing leaky faucets, washing full loads of clothes or dishes, the utilization of waste baskets rather than commodes to dispose of cigarette butts and kleenex, and the pooling or ponding of water in kitchen sinks to wash vegetables or other food products.

ITEMS OF INTEREST

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