

Number 56

September, 1970

NEW INSTITUTE REPORTS

Report No. 39. Hydrography of the Pamlico River Estuary, by Dr. John E. Hobbie, Department of Zoology, North Carolina State University at Raleigh

This report covers salinity, temperature and dissolved oxygen measurements made in the Pamlico River Estuary of North Carolina in 1965, 1967, 1968 and 1969. The estuary is shallow and naturally productive with a salinity range of 0.5 to 15 or 20 ppt. The lunar tide is damped out by the Outer Banks so that there is only a 6-inch change in water level. Wind tides are more important and may raise or lower the water level more than three feet.

Changes in salinity were closely related to the amount of inflowing fresh water. This produced changes at one station, some ten miles from the mouth of the estuary, of 13 ppt. Upstream dams on the Tar River would certainly reduce much of this flushing of fresh water and would thereby change the character of the estuary. It is recommended that studies be made of the effect of these changes on the animals and plants of the estuary so that accurate predictions can be made.

There were also changes in the salinity distribution due to the wind speed and direction and also to the Coriolis Force. In general, the estuary had lower salinities along the south shore as a result of these factors.

Temperatures ranged from close to freezing up to 93°F, although temperatures above 89°F were unusual. There are no industrial effluents adding heat so the temperatures found were the natural condition of the estuary. It is also important to note that the temperature varied by as much as 7°F within the estuary so that average temperatures or natural conditions of the water are extremely difficult to define. These facts become important when standards are being set for thermal additions to estuaries. It is recommended that 93°F would be a logical upper limit for an absolute standard for this estuary instead of the 90°F proposed Federal Standard.

The estuary stratifies irregularly, but the waters are so rich that the bottom waters lose all their dissolved oxygen within a week or so after stratification. As a result, benthic animals (bottom dwelling) are killed throughout large areas of this estuary. Although the estuary still has its natural flora and fauna, it is being enriched by sewage and farm runoff. If this could be reduced, then the occurrence of these low oxygen levels would be reduced or halted entirely. The estuary would then become an even better environment. It is recommended, therefore, that every effort be made to reduce nutrient addition to this estuary from urban and farm wastes as well as from fertilizers.

Report No. 3.(revised). Water Resources Research Interests in the
Colleges and Universities of North Carolina (July 1, 1970)

A revised listing of the research interests of faculty members on the campuses of ten of the State's colleges and universities.

NEW FILM ON ENVIRONMENTAL POLLUTION

An outstanding new film on environmental pollution, The Gifts, has just been made available by the Federal Water Quality Administration on a no-fee loan basis. Inquiries should be addressed to:

Public Information Officer
Research & Development, Mid-Atlantic Region
Federal Water Quality Administration
U.S. Department of the Interior
918 Emmet Street
Charlottesville, Virginia 22901

The Gifts is among the very first films to be produced by the Federal Government on the subject of environmental pollution. It is also the Federal Water Quality Administration's initial venture into documentary film making. The film was photographed in 16 mm color. Running time: 28 minutes.

The Gifts was filmed nationwide, in eighteen states and the District of Columbia, in every region of the country. It is narrated by Lorne Green, star of Bonanza. The original score was written, arranged and conducted by Skitch Henderson. Mr. Henderson also wrote the lyrics to the song, "Shame, Shame, Shame," which is sung by Marlene Ver Planck. Musicians heard on the movie's soundtrack include percussionist Bobby Rosengarden, musical director of the "Dick Cavett Show," and "Toots" Thielmans, whose film credits include "Midnight Cowboy."

UNDERGROUND INJECTION OF WASTEWATERS

Questions concerning the safety and ultimate wisdom of waste disposal by deep-well injection are still unanswered. Those who are confronted with decisions in this area might do well to study the recent report of the Ohio River Valley Water Sanitation Commission entitled, "Perspective on the Regulation of Underground Injection of Wastewaters," which was previously listed by the News as a new publication received by the Institute.

The eight states represented on the Ohio River Valley Water Sanitation Commission (ORSANCO) concluded it would be of mutual interest to appraise policies, procedures and other matters allied to the practice of subsurface disposal. As a basis for such a review the staff of ORSANCO was directed to develop a monograph that would offer perspective and guidelines on the regulation of underground injection of wastewaters. This document is intended to fulfill that assignment.

The monograph is presented in two parts, each of which has been individually authored. The first section provides background on public policy issues associated with environmental factors and subsurface-resources stewardship, and it embraces consideration of legislative and legal aspects. Part II discusses administrative procedures, geological evaluation and technical criteria relating to injection-well practice, specifically with respect to circumstances in the Ohio Valley.

Jointly shared by the authors is the conclusion that the regulation of underground injection and the criteria for evaluating proposals merits comprehensive assessment. To this end suggestions on the conduct and scope of such an undertaking have been developed.

The Commission found the prevailing situation with respect to injection-well practice as reflected by viewpoints and findings set forth in the report to invite comprehensive assessment and recommended that ORSANCO establish an ad hoc expert committee to develop public policy guidelines, regulatory procedures and evaluation of criteria pertaining to the practice of underground injection of industrial wastewaters. The specific questions to be considered will be of interest to North Carolinians. These are:

1. On the basis of theoretical considerations and practical experience what might be an estimate of the risk probabilities of wastewater injection with respect to: (a) environmental hazards; and (b) impairment of utility of the underground and future extraction of its mineral resources?
2. Under what circumstances and conditions should society find it reasonable to trade off the potential imposition of risk?
3. What limitations and safeguards should be imposed to minimize environmental risks and provide protection for groundwater, oil, gas and other underground resources? This question embraces consideration of:
 - a. Are there specific horizons that should be ruled out, regionally or locally, for deep disposal and are there others that may be conditionally regarded as suitable for such use?
 - b. What requirements should be specified concerning well construction, logging, and testing procedures?
 - c. What constraints should be placed on formation treatment methods?
 - d. What operational requirements should prevail?
 - e. Where and when should monitoring provisions be required?
 - f. What conditions should be imposed on the abandonment of wells with respect to plugging, site identification and assumption of responsibility for future difficulties?

4. What categories of wastewaters produced by industries in the Ohio Valley could be favorably regarded for injection and what justifications can be advanced for their disposal underground?
5. What is the nature and scope of investigations and research that should be initiated to remedy deficiencies in information for the evaluation of injection-well proposals?
6. Should ORSANCO be charged with the duty of establishing and maintaining a registry of data on each well drilled and tested in the compact district for the purpose of providing a central file for such installations in the Ohio Valley and disseminating such information for reference needs?

NEW FEDERAL LEGISLATION PROPOSED ON MUNICIPAL WATER SUPPLIES

Rep. Howard W. Robison of New York has announced that he has authored legislation to protect Americans from impure drinking water and that he will introduce that measure when Congress returns to Washington after Labor Day. The Republican Congressman made his announcement at a news conference at the Cornell Water Resources and Marine Sciences Center in Ithaca. Leonard Dworsky, Director of the Center, was also present and was praised by Mr. Robison for supplying the Congressman with the concept and the necessary information upon which to base the legislation, which will be known as the Pure Drinking Water Act.

Mr. Robison said his bill would set minimum Federal standards for drinking water with special emphasis on potentially dangerous chemicals, bacteria, and contaminants. The Congressman said that he became aware of this problem when the Federal Bureau of Water Hygiene's Community Water Supply Study recently revealed that hundreds of thousands of families in the test areas (including the State of Vermont, New York City, and seven other metropolitan areas) were being supplied with inferior or potentially dangerous drinking water. Shortly thereafter, Dr. Dworsky conferred with the Congressman about the problem and showed him a resolution for action in this field passed by the Universities Council on Water Resources at their annual meeting in July.

"As yet, there has been no outbreak of disaster," Mr. Robison said, "but the Federal Government must move--and must move fast--if we are to prevent a serious crisis. As the Water Supply Study stated, 'That only recently has attention been focused on the problems of maintaining safe drinking water is illustrative of the dangerous complacency with which we have viewed the whole spectrum of environmental ills. My bill is designed to end this complacency.'"

The Robison bill would authorize \$120 million, over a five-year period, to be used by the Administrator of the Environmental Protection Agency to initiate

and accelerate a national research and development program for achieving consistently high quality drinking water throughout the nation.

The legislation would also authorize the Administrator to:

--provide technical assistance to state and local governments in developing comprehensive water hygiene programs

--gather and disseminate data on water hygiene research

--improve methods and procedures to identify and measure the health effects of pesticides, toxic metals, organic chemicals and other contaminants in drinking water

--improve the means of delivering safe water to all persons

--establish a National Water Hygiene Advisory Board to assist in the implementation of this new legislation.

Mr. Robison emphasized that his bill is one of the first measures to authorize specific action by the newly proposed Environmental Protection Agency. The EPA will be vested with the responsibility of coordinating and directing all Federal environmental and pollution control efforts.

In commenting on why he feels this legislation is mandatory now, Mr. Robison referred directly to the Community Water Supply Study in which it was found that of those systems studied:

--41 percent were delivering water of inferior quality

--79 percent had not been inspected by state or county authorities in the past year; and in 50 percent of the systems the local authorities could not remember when--if ever--such an inspection had been made.

"Even though most of the water of inferior quality was found in smaller communities," Mr. Robison continued, "large metropolitan areas are not immune to the impending crisis. For as the Community Water Supply Study concludes:

'The current Drinking Water Standards do little more than mention viruses, neglect numerous inorganic chemicals which are known to be toxic to man, and identify only one index that is supposed to cover the entire family of organic chemical compounds. These standards must be updated.'"

WATER RESOURCES ABSTRACTS

If you are not aware of the publications of the Water Resources Scientific Information Center (WRSIC), stop by the Institute Office where a complete file of Selected Water Resources Abstracts, Water Resources Research catalogs, and other publications of the Water Resources Scientific Information Center are maintained for your use.

A limited supply of brochures or publications and services of WRSIC are available from the Institute. They can also be obtained from:

Manager
Water Resources Scientific Information Center
Office of Water Resources Research
Department of the Interior
Washington, D. C. 20240

SCIENCE INFORMATION EXCHANGE

Potential investigators and others interested in summaries of research in progress will find the Science Information Exchange (SIE) a very useful source of information. Requests can be submitted on the "Request for Services" form or by telephone stating the specific research or problem on which information is obtained. A schedule of fees is available at the Institute. Individual copies of the SIE brochure, forms and fee schedules can be obtained from:

Mr. Monroe E. Freeman, Director
Science Information Exchange
300 Madison National Bank Building
1730 M Street, N.W.
Washington, D. C. 20036

CORPS PROPOSES MULTIPLE PURPOSE DAM ON CONTENTNEA CREEK IN NEUSE RIVER BASIN

Because of the critical water supply needs of the City of Wilson, North Carolina, the Wilmington District of the Corps of Engineers has completed an interim survey report on the Contentnea Creek Basin approximately three years ahead of the Neuse River Basin study.

The District Engineer found a present need for flood protection, water-quality control, water supply, recreation, and fish and wildlife conservation in the Contentnea Creek Basin. He has determined that the most practical, feasible, and economic means for providing for the water resource needs of the Contentnea Creek Basin over the next 100 years is the construction of the Buckhorn Lake, to be supplemented, as needed, by local protection projects and complementary conservation programs of other federal and state agencies.

The District Engineer estimates that the Buckhorn project would:

- a. Reduce average annual flood damages in the Contentnea Creek flood plain by about 54 percent.
- b. Provide 36,000 acre-feet of water-supply storage, yielding a dependable supply of 36 million gallons per day to meet pressing municipal and industrial water supply problems in the Contentnea Creek Basin.

- c. Provide 46,000 acre-feet of storage for water-quality-control purposes in the Contentnea Creek Basin.
- d. Provide recreational facilities for maximum annual visitations of 953,000 persons.

The estimated first cost for construction is \$13,600,000 with \$112,000 annually for operation, maintenance, and replacements.

The North Carolina Department of Water and Air Resources has requested that storage for water supply be included in the Buckhorn project.

NEW OIL POLLUTION REGULATIONS PUT IN EFFECT BY SECRETARY HICKEL

Secretary of the Interior Walter J. Hickel has put into effect tough new regulations for controlling water pollution caused by oil discharges. The new regulations, which are being published in the Federal Register, prohibit discharges of oil which violate applicable water quality standards or which cause a film or sheen upon or discoloration of the surface of the water or adjoining shorelines or which cause a sludge or emulsion to settle beneath the surface of the water or upon adjoining shorelines. "Oil" is defined as oil of any kind or in any form, including oil mixed with ballast or bilge.

The Secretary of the Interior may permit the discharge of oil in connection with research, demonstration projects or studies related to the prevention, control, or abatement of oil pollution.

The only other exception to the prohibition is normal discharges from a properly functioning vessel engine. But this exception does not apply when these normal discharges are accumulated in the bilges of vessels.

The Secretary said, "Tighter controls must be instituted now to protect our waters from further abuse of this sort. Oil spills are harmful to the whole aquatic environment and could cause lasting damage."

The regulations apply to discharges by all vessels and all offshore and on-shore facilities into navigable waters of the United States, a term which includes ocean waters within three miles of the coastline. In addition, the regulations apply to discharges by vessels in the contiguous zone, an area seaward of the three-mile zone out to a distance of twelve miles from the coastline.

Personnel in charge of a vessel or facility from which a prohibited discharge originates are required to notify the Coast Guard immediately, or face a penalty of up to \$10,000 and one year in jail. In addition, the owner or operator of a vessel or facility from which oil is knowingly discharged in violation of the regulations may be assessed a civil penalty of up to \$10,000 for each offense.

The owner or operator may be held liable to the United States Government for the costs of cleaning up the discharged oil.

These new regulations were first published as proposed rulemaking on July 24 in the Federal Register. Interested parties were given thirty days to comment, and minor changes were made in the final version.

GAO REPORT CRITICIZES OPERATION OF MUNICIPAL SEWAGE PLANTS

The General Accounting Office in a survey of sixty-nine municipal sewage treatment plants found many of them deficient and poorly operated and maintained. Operational, mechanical or structural problems existed at forty plants, it said. At one of twelve plants visited, a qualified operator was not available, and untreated sewage was bypassing the plant. In another, feathers and other wastes from a poultry plant disrupted plant operations and caused the operator to discharge untreated waste into the receiving stream.

GAO believes that operation and maintenance problems have resulted from a lack of qualified operating personnel, inadequate controls over industrial wastes and inadequate plant design or lack of adequate equipment. It suggested that FWQA be required to:

1. Establish, in cooperation with the states, comprehensive guidelines for use by municipalities, states and the Agency in determining the provisions necessary for ensuring proper and efficient operation and maintenance of municipal waste treatment plants;
2. Gather and disseminate information to help the states identify, develop and implement more effective procedures for prevention, detection and correction of plant operation and maintenance problems.

INTERIOR AND AGRICULTURE SELECT 47 RIVERS AS POTENTIAL WILD OR SCENIC STREAMS

Secretary of the Interior Walter J. Hickel and Secretary of Agriculture Clifford M. Hardin have announced the joint identification of all or portions of forty-seven rivers in twenty-four states as potential additions to the National Wild and Scenic Rivers System.

The selections are based on statutory requirements of the Wild and Scenic Rivers Act of 1968 (Public Law 90-542), which directs the two Secretaries either singly or jointly to identify rivers that have potential for inclusion in the national system.

The rivers announced are in addition to the eight rivers Congress designated as original components of the National Wild and Scenic Rivers System, the Allagash Wilderness Waterway, Maine, added to the System by the Secretary of the Interior, and the twenty-seven rivers listed for study in the Act. None of the designated rivers are in North Carolina.

ENVIRONMENTAL EDUCATION PROGRAM IN NORTH CAROLINA

A cooperative program in community adult education, involving faculty and students from six North Carolina universities, has been initiated to assist the people of the state in environmental decision-making. The objective of the program is to provide accurate information on existing and potential environmental problems and alternative courses of action for their alleviation or prevention.

Faculty and students from the cooperating universities are prepared to come to your community and present problem-related programs for community groups. Presentations will be tailored to the needs of the group and the community and will take the form of talks, seminars, or workshops. Inquiries regarding such presentations are invited from service clubs, government officials, chambers of commerce, civic organizations, and others. To request assistance, or to obtain further information, write or telephone Environmental Education Program for North Carolina at the address nearest you:

Department of Biology
East Carolina University
Greenville, N. C. 27834
Telephone: 919-758-6718

Institute of Urban Studies & Community Service
University of North Carolina at Charlotte
Charlotte, North Carolina 28213
Telephone: 704-596-5970

Department of Biology
Western Carolina University
Cullowhee, N. C.
Telephone: 704-293-7244

Department of Biology
University of North Carolina at Greensboro
Greensboro, North Carolina 27412
Telephone: 919-379-5387

Urban Affairs and Community Services Center
and Department of Civil Engineering
North Carolina State University
Box 5993
Raleigh, North Carolina 27607
Telephone: 919-755-2933

The program is supported in part by Title I funds under the Higher Education Act of 1965, as administered by the North Carolina Board of Higher Education.

CLOSED INDUSTRIAL WASTEWATER SYSTEMS TO ABATE POLLUTION

Secretary of the Interior Walter J. Hickel has announced that sixteen research and demonstration projects are currently being conducted under grants awarded by Interior's Federal Water Quality Administration to find ways of ending industrial pollution by creating closed recycling systems for wastes and water reuse.

Hickel said, "Such closed systems hold the promise of an ultimate solution in that they would abolish the discharge of polluted wastes to our waterways. The nation's industries are the largest users of water and a major factor in the continuing rise of water pollution. Research that could eliminate the discharge of industrial wastes is one obvious approach in seeking solutions to our water pollution problems."

Research projects aimed at developing closed systems are: Interlake Steel Corporation, Chicago, Illinois, a \$175,200 grant to help provide for the treatment and total recirculation of 7.2 million gallons a day of blast furnace gas washer water; Volco Brass and Copper Company, Kenilworth, New Jersey, a \$124,000 grant to recover copper electrolytically and permit reuse of over 95 percent of waste water as process water; The Beaton and Corbin Manufacturing Company, Southington, Connecticut, a \$37,250 grant to chemically treat and eliminate chromium, nickel, and metal ions and reuse two-thirds of the treated effluent for plating rinse water; Dow Chemical Company, Midland, Michigan, a \$509,810 grant for the reconditioning and reuse of organically contaminated brines; Green Bay Packaging, Inc., Green Bay, Wisconsin, a \$757,033 grant to test a 720,000-gallon-a-day closed loop system in pulp and paperboard production; St. Regis Paper Company, at plant sites in Jacksonville and Pensacola, Florida, and West Nyack, New York, a \$878,472 grant to develop maximum water reuse for kraft pulp and paper production; Georgia-Kraft Company, Rome, Georgia, a \$287,000 grant to determine the efficiency of cooling towers in both dissipating heat and recycling waste water; Archer Daniels Midland Company, Decatur, Illinois, a \$106,677 grant to develop treatment facilities to break up oil emulsions resulting from the processing of soybeans before discharge to a municipal sewer system, and to demonstrate ways of recovering wash water.

Also, the National Canners Association Research Foundation, Washington, D. C., a \$31,500 grant to determine the feasibility of reusing brine wastes resulting from olive packing at four locations in the Central Valley area of California; in addition, National Canners Association, a \$33,330 grant to develop ways of preventing harmful growths in recirculated water at a San Jose, California, canning plant; Beet Sugar Development Foundation, Fort Collins, Colorado, a \$102,000 grant to concentrate sugar beet factory wastes by chemical precipitation and reuse of

the treated water in a closed recirculation system; Winter Garden Citrus Products Cooperative, Winter Garden, Florida, a \$165,000 grant to study the lime treatment and reuse of activated sludge effluent from the treatment of citrus wastes; Johns-Manville Products Corporation, Manville, New Jersey, a \$82,350 grant to develop a closed water system that would end the discharge of phenolic wastes to the Maumee River by the firm's Defiance, Ohio, plant; Fiber Industries, Inc., Charlotte, North Carolina, a \$350,000 grant to find ways of reusing plant effluent and cooling water at the company's Shelby, North Carolina, plant; S. B. Foot Tanning Company, Red Wing, Minnesota, a \$475,000 grant to treat and reuse 2.1 million gallons a day of leather tannery waste discharges; Blueside Real Estate, Inc., Kansas City, Missouri, a \$110,950 grant to demonstrate the ability of a pilot plant at St. Joseph, Missouri, to remove and recover for reuse sulfide in tannery wastes.

STATUS OF WATER RESOURCES IN NORTH CAROLINA

The August report of the U.S. Geological Survey on Water Resource Conditions in North Carolina reported that the most significant aspect of streamflow in August was extensive flooding which occurred in the upper Yadkin, Catawba, and Broad River basins on August 9-12. Flooding in some areas approached but did not exceed that experienced during the floods of 1916 or 1940. Smaller drainage areas, many ungaged, were hard hit as reflected by shorter-term records in urban areas and by reports of flash flooding on many rural streams. Storage of floodwaters raised the level of the W. Kerr Scott Reservoir on the Yadkin River near Wilkesboro to its highest point since its completion in 1962. Prior to the flooding, runoff from the western Piedmont had been deficient for fifteen consecutive months. The heavy rains which caused the flooding did not extend into the eastern Piedmont and runoff in that area remained deficient. Runoff in the Mountains and Coastal Plain were normal for the month.

Ground-water levels declined in the Mountains and eastern Piedmont and rose in the western Piedmont and Coastal Plain.

WATER RESOURCES LEGISLATION IN THE CONGRESS

Bills Introduced:

H.R. 18949	To prohibit the discharge into any of the navigable waters of the U.S. or into international waters of any military material without a certification by the Council on Environmental Quality approving such discharge.
H.R. 19019	
H.R. 18964	To require the Council on Environmental Quality to make a full and complete investigation and study of national policy with respect to the discharging of material into the oceans.
H.R. 19018	

Bills Passed (Senate):

- S. 3553 To amend the Water Resources Research Act of 1964 by increasing authorized annual allotments to State Water Resources Research Institutes from \$100,000 to \$200,000 and authorizing programs for the dissemination and utilization of new research findings.

PUBLICATIONS RECEIVED BY THE INSTITUTE

(These may be borrowed from the Institute for a two-week period. Where individual copies are desired readers are encouraged to request copies from the organization issuing the publication. The addresses are provided by the News for this purpose.)

Water Resources Planning

- "Application of Marginal Economic Analysis to Reservoir Recreation Planning," by J. E. Sirles, III, Univ. of Ky., Water Res. Inst., Lexington, Ky., 40506, 1968.
- "Economic Data, Objectives & Economic Development," N. C. Dept. of Water & Air Res., P. O. Box 27048, Raleigh, N. C. 27611, Aug. 1970.
- "Human Factors Involved in the Development of a Watershed in Yabucoa," by F. del Rio, et al, Water Res. Res. Inst., Univ. of Puerto Rico, Mayaguez, P. R. 00708, July 1970.
- "N. C. Water Plan Progress Report - The Appalachian Region in N. C.," Chapter 44, N. C. Dept. of Water & Air Res., P. O. Box 27048, Raleigh, N. C. 27611, Aug. 1970.
- "Stochastic Analysis of Hydrologic Systems," by Ven Te Chow, Water Res. Center, Univ. of Ill., Urbana, Ill. 61801, December 1969.
- "Wake County Water Use Study," by N. C. Dept. of Water & Air Res., P. O. Box 27048, Raleigh, N. C. 27611, June 1970.
- "Water Resources Investigations in N. C. - 1969," USDI, Geol. Survey, P.O. Box 2857, Raleigh, N. C. 27602, 1969.
- "Water Resources Data for North Carolina," Part I - Surface Water Records, USDI, Geol. Survey, P. O. Box 2857, Raleigh, N. C. 27602, 1969.
- "Water Resources Data for N. C.," Part 2. Water Quality Records, Dist. Chief. Water Res. Div., USGS, 436 P. O. Bldg., 300 Fayetteville St., Raleigh, N. C. 27602 1968.
- "Supplemental Watershed Work Plan - Gum Neck Watershed - N. C.," USDA, Soil Cons. Serv., Forest Serv., P. O. Box 27307, Raleigh, N. C. 27611, Feb. 1970.
- "Supplemental Watershed Work Plan and Watershed Work Plan Agreement No. 2 - Stewarts Creek - Lovills Creek Watershed," USDA, Soil Conserv. Serv., Forest Serv., P. O. Box 27307, Raleigh, N. C. 27611, Aug. 1970.
- "A Wild and Scenic Rivers Symposium," sponsored by Water Res. Res. Inst. of the Univ. of Idaho, Moscow, Idaho 83843, Aug. 1970.
- "A Methodology Study to Develop Evaluation Criteria for Wild and Scenic Rivers," by J. J. Peebles, Water Res. Res. Inst., Univ. of Idaho, Moscow, Idaho 83843, Feb. 1970.

Water Quality Management

- "The Application of Phase Selective Alternating Current Polarography to the Analysis of Heavy Metals in Water," by P. E. Sturrock, et al, Sch. of Chemistry in coop. with Env. Res. Cntr., Ga. Inst. of Tech., Atlanta, Ga. 30332, June 1970.
- "Olean Water for the 1970's - A Status Report," USDI, FWQA, Washington, D. C. 20402, June 1970.
- "Dissolved Oxygen Resources and Waste Assimilative Capacity of the La Grange Pool, Illinois River," by T. A. Butts, et al, Rept. of Investigation 64, Dept. of Registration & Education, Urbana, Ill. 61801, 1970.
- "Ground Water Quality in Stanley County, N. C.," by Edward L. Berry, N. C. Dept. of Water and Air Res., P. O. Box 27048, Raleigh, N. C. 27603, Ground Water Circular No. 15, Aug. 1970.
- "Boundary Effects on Jet Flow Patterns Related to Water Quality and Pollution Problems," by W. H. C. Maxwell, et al, Water Res. Center, Univ. of Ill., Urbana, Ill., 61801, Jan. 1970.
- "Oil Tagging System Study," by Res. Div., Env. & Applied Sciences Center, MELPAR, Supt. of Doc., U.S. Gov't. Print. Office, Wash., D. C. 20402, May 1970, Price: \$1.50.
- "Destruction of Phytoplankton in the Cooling Water Supply of a Steam Electric Station," by R. P. Morgan, II, et al, Natural Res. Inst. & Dept. of Zoology, Univ. of Md., College Park, Md. 20740, Sept. - Dec. 1969.
- "Sewage and Water Works Construction," USDI, FWPCA, Wash., D. C. 20242, 1967.
- "Factors Affecting the Transfer of Materials Between Water and Sediments (Nutrient Take-Up and Release)," by Dr. G. F. Lee, Univ. of Wis., Water Res. Center, Madison, Wis. 53705, July 1970.
- "Proceedings of the National Conference on Sediment Control," Wash, D. C., Sept. 14-16, 1969, Pub. Serv. Cntr., Supplies & Facilities Mgmt. Br., Rm. B-258, HUD, Wash., D. C. 20410.
- "Determination of Upper Temperature Tolerance Triangles for Aquatic Organisms," Natural Res. Inst., Univ. of Md., College Park, Md. 20740, Sept. - Dec. 1969.
- "Chesapeake Science - Proceedings of the 2nd Thermal Workshop of the U.S. International Biological Program," Natural Res. Inst. of the Univ. of Md., Chesapeake Biol. Lab., Colomons, Md., L. E. Cronin, Dir., Vol. 10, Nos. 3-4 - Sept. - Dec. 1969.

Water Quantity Management

- "Flood Damage Abatement - Federal Assistance to Local Government," edited by W. R. Walker, et al, Water Res. Res. Center, VPI & State Univ., Blacksburg, Va., 24061, July 1970.
- "Little, Bolin, Booker & Morgan Creeks," Flood Plain Information, Corps of Engrs., U.S. Army, Wilmington, N. C., May 1970.
- "Geology and Ground-Water Resources of the Asheville Area, N. C.," by H. Trapp, Jr., N. C. Dept. of Water & Air Res., P. O. Box 27048, Ground Water Circular No. 16, Apr. 1970.
- "Geology and Ground-Water Resources of New Hanover County, N. C.," by G. L. Bain, N. C. Dept. of Water & Air Res., P. O. Box 27048, Ground Water Bulletin No. 17, Apr. 1970

- "Geology and Ground-Water Resources of Pitt County, N. C.," by C. T. Sumsion, N. C. Dept. of Water & Air Res., P. O. Box 27048, Ground Water Bulletin No. 18, March 1970.
- "An Approximate Method for Determining the Hydraulic Conductivity Function of Unsaturated Soil," by R. W. Skaggs, et al, Purdue Univ., Water Res. Res. Center, Lafayette, Ind., 47907, June 1970.
- "An Experimental Study of the Uptake of Water by Soybean Roots," by A. Klute, Water Res. Center, Univ. of Ill., Urbana, Ill., 61801, Jan. 1970.
- "Watershed Management in the United States: Concepts and Principles," by P. E. Packer, et al, Intermountain Forest & Range Exp. Sta., 507 25th St., Ogden, Utah 84401, 1969.

Miscellaneous

Annual Reports: State Water Resources Research Institutes

University of Maine
University of North Dakota
Rutgers University

- "Books, Publications, Project Completion Reports, & M.S. and Ph.D. Theses," Iowa State Water Res. Res. Inst., Iowa State Univ., Ames, Iowa 50010, June 30, 1970.
- "Studies on the Population Dynamics and Physiological Ecology of Four Species of Fresh-Water Isopods," by A. J. Seidenberg, Water Res. Center, Univ. of Ill., Urbana, Ill., 61801, Jan. 1970.
- "Marine Disposal of Solid Wastes off the West Coast," by C. G. Gunnerson, Bu. of Solid Waste Management. U.S. Public Health Serv., Wash., D. C., Apr. 1969.
- "Excerpts Relating to Solid Wastes from The President's Message on Environment," 91st Congress, 2nd Session, Reprinted by Bu. of Solid Waste Mgmt., Env. Hlth. Serv., U.S.D.H.E.W., Pub. Hlth. Serv., Wash., D. C. 20402, Feb. 1970.

Water Resources Research Institute
of the University of North Carolina
124 Riddick Building
North Carolina State University
Raleigh, North Carolina 27607

PRINTED MATTER