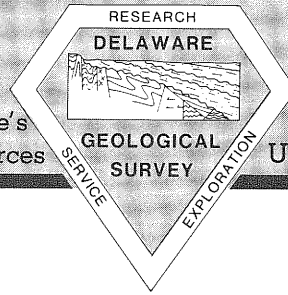


First State Geology

Current information about Delaware's geology, hydrology and mineral resources



Published twice yearly
by the Delaware Geological Survey,
University of Delaware, Newark, DE 19716

Vol. 13, No. 2

Summer 1995

Below Normal Water Conditions

By John H. Talley

Water conditions have generally been below normal in Delaware between October 1, 1994, and April 30, 1995. Cumulative precipitation during the seven-month period at six stations ranged from 19.06" (5.91" below normal) at Wilmington to 15.28" (8.52" below normal) at Dover. Above normal precipitation was recorded only at Greenwood and Georgetown in November.

Below normal precipitation resulted in below average recharge to shallow water-table aquifers throughout Delaware. Although ground-water levels rose seasonally, they did not rise as high as they normally do. Levels are substantially below those recorded during the corresponding period one year ago and have generally been below normal since February. This means that in the absence of above to well above normal precipitation during the next several months, the amount of ground water available for base flow discharge (fair weather flow) will be below normal. Consequently, the amount of water available for use in northern New Castle County may be below normal during summer fair weather periods.

Monthly mean streamflows ranged

from normal to below normal during the past seven months with no above normal flows recorded. Flows have been below the median since November on the Brandywine Creek at Wilmington, the St. Jones River at Dover, and the Nanticoke River near Bridgeville. Significantly below normal flows were recorded for April on water courses used for public water supplies in northern New Castle County (Brandywine, Red Clay and White Clay creeks, and Christina River).

The DGS developed a Water Conditions Index for New Castle County in 1982 in response to a need for a relatively simple indicator of water supply conditions in Delaware, especially in New Castle County where surface water is the principal source of public water supply. The Index is derived from precipitation, streamflow, and ground-water level data in addition to water usage defined by the population of northern New Castle County. The accompanying graph shows that the index has been in the "low normal" range for the past several months. The index is normally higher during winter and early spring.

As we approach the high water-demand period of the summer months there is potential for shortfalls if hot, dry conditions prevail, so water levels and streamflow data collection will be intensified to carefully monitor overall water conditions. The Christina River Basin

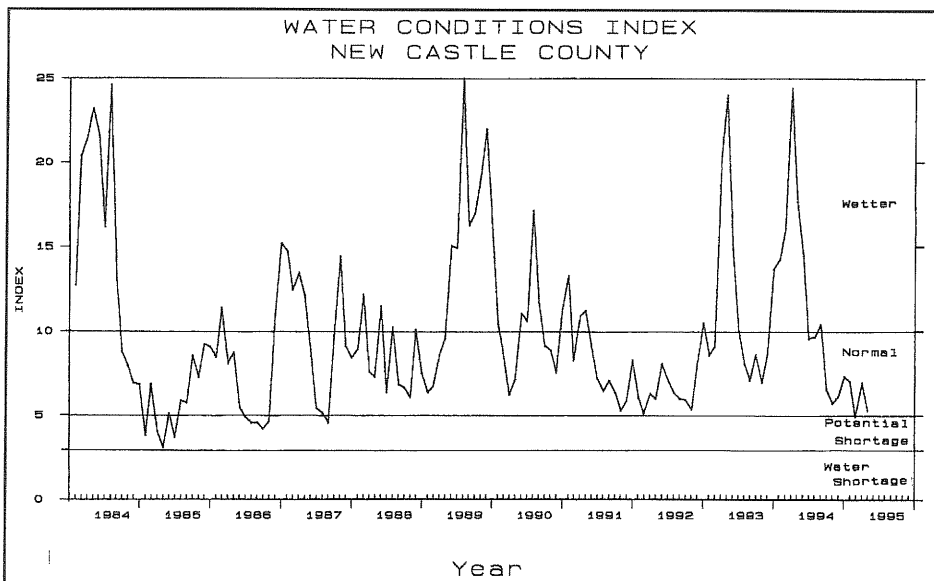
Drought Management Committee met to discuss water conditions in the basin. Similar below normal conditions exist in the Pennsylvania portion of the Christina River Basin. The bi-state committee concluded that no specific action is required at this time; however, if conditions deteriorate, appropriate recommendations will be made to ensure adequate water supplies.

Draft Proposed OCS Oil and Gas Leasing Program

By Richard N. Benson

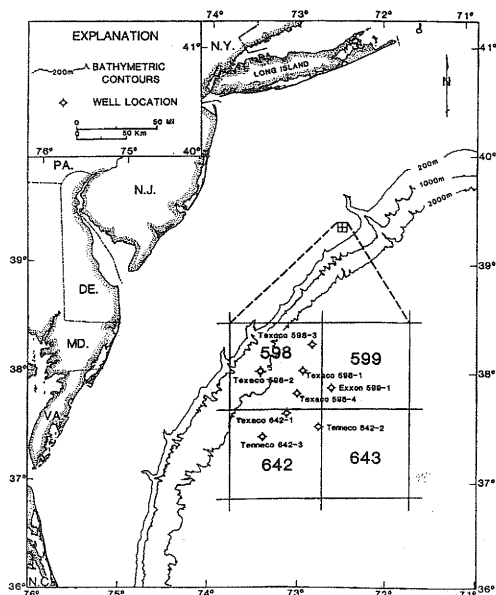
In July, the Minerals Management Service (MMS) of the U. S. Department of the Interior is scheduled to release the first draft of the next 5-year program for oil and gas lease sales on the OCS (Outer Continental Shelf) for the years 1997-2002. Later drafts of the Program and accompanying Environmental Impact Statement (EIS), each developed after comment periods, will follow, with congressional review and approval of the Final Program and EIS by the Secretary of Interior scheduled for October 1996.

The Mid-Atlantic OCS is currently under a congressional moratorium that prevents oil and gas lease sales. Between 1976 and 1983 there were five Mid-Atlantic sales, and through 1984, 32 exploratory wells were drilled. There was only one significant discovery, a noncommercial gas deposit in what is called the "Texaco-Tenneco" structure underlying four blocks of OCS Protraction Diagram NJ 18-3 (Hudson Canyon), about 80 miles off the New Jersey coast (see map). Five of the eight wells drilled here during 1978-1981 had significant flows of natural gas. The four blocks were unitized in 1982, and 3-D seismic data were collected in order to study the complex faulting of the structure. Even with this information the oil companies were unable to declare the discovery a commercial one. Onshore it would have been a giant field, but this far offshore without an existing pipeline infrastructure, there were not enough estimated reserves to justify further development, and the lease unit expired in April 1984. One fact of



importance is that an untested deep over-pressured gas zone near 18,000 feet was penetrated by the Texaco 642-1 well. If this zone were in a reservoir-quality sand, the reserves would be considerably higher than the 1984 MMS estimates of only about a quarter of a trillion cubic feet of recoverable unproved gas reserves.

Whether or not the OCS blocks overlying this geologic structure will be included in the Draft Proposed Program will be known after release of that document. DGS will continue to work with MMS in that federal agency's effort to consult with states bordering the OCS as it develops the final 5-year leasing program.



Baltimore Canyon trough area and location of the "Texaco-Tenneco" unit with well locations. Map provided by Minerals Management Service.

National Seismograph Network

By John H. Talley

The Delaware Geological Survey and the University of Delaware are cooperating with the National Earthquake Information Center, U. S. Geological Survey, for the installation, operation, and maintenance of a U. S. National Seismograph Network station in Delaware. This station will be one of a series of specially designed seismological stations to provide earthquake data to the National Earthquake Information Center in Colorado through satellite communication links and to the Delaware Geological Survey. This strategically located station will provide geographic coverage between New York to the north and southern Virginia to the south.

At this time the DGS operates a three-station seismic array in northern Delaware and is trying to reestablish two seismic stations in central and southern Delaware that were decommissioned several years ago owing to loss of operating funds.

Since 1972, the DGS has confirmed at

least 49 earthquakes within Delaware. These seismic events have ranged in magnitude from about 1 (not felt) to a 3.8 recorded on February 28, 1973. In addition, the DGS has recorded several hundred earthquakes in nearby portions of Maryland, Pennsylvania, and New Jersey.

Oil Pollution Act of 1990

By Robert R. Jordan

The Oil Pollution Act (OPA) of 1990 was passed by the U. S. Congress after the 1989 Exxon Valdez oil spill in Prince William Sound, Alaska. Major provisions of the act require the demonstration of financial responsibility for vessels and facilities containing oil. Enforcement of vessels was assigned to the Coast Guard and for facilities to the Minerals Management Service (MMS) of the Department of the Interior. Implementation of regulations for vessels began near the end of 1994, but almost five years after the act was passed, MMS has still to develop enforceable regulations.

The issues that have prevented Interior's role in implementation of the act are very controversial. The Department had received almost 3000 comments on their proposed rules, a Department of Energy advisory group had written a massive report, and a formal solicitor's opinion had been obtained. Some major questions were (1) whether the act should apply to all waters, including inland waters and wetlands, or just the federal offshore, (2) definitions of "facilities," and (3) the amounts of financial responsibility to be demonstrated. An important distinction must be made between liability and responsibility as used in the context of oil spill actions. Everyone is liable for damages from spilled oil under several provisions of law; however, OPA '90 added that financial responsibility must be demonstrated up front for oil-related activities. The questions were where oil spill financial responsibility must be demonstrated, by what facilities, and in what amounts.

The Department of the Interior asked the Outer Continental Shelf Policy Committee (OSCPC), an advisory body to the Secretary of the Interior, for help in breaking the stalemate over OPA '90. In response, the OSCPC formed a Subcommittee on the OPA (SOPA) and asked Robert R. Jordan, Delaware's representative on the OSCPC, to chair it. SOPA comprised 13 members representative of affected parties ranging from environmental organizations and major oil companies through marina operators and small boat owners.

SOPA submitted its recommendations, and the OSCPC approved them and forwarded them to Secretary Babbitt, in May. Recommendations requiring amendments of OPA '90 are being incorporated into legislation under consideration in the Congress. Legislative

changes were found necessary to define the jurisdiction as the federal offshore and the facilities as traditional fixed oil facilities. Statute and regulation might address the amounts of financial responsibility for spills which would be related to risk, with special consideration given to sensitive environmental settings. The Secretary was urged to be creative in the role that insurance plays in demonstrating financial responsibility.

Delaware has its own strong law to apply in the case of an oil spill. Clarification of the federal law is important to Delaware because the Delaware Estuary is the site of a major oil port with large lightering operations, and our coastal marshes and beaches are highly vulnerable to spills from offshore or within inland waters.

Earthquake Preparedness

By Suzanne Sayer

Suzanne Sayer and John H. Talley of the DGS and Vincent Sakovich of the Delaware Emergency Management Agency (DEMA) participated in the 1995 Earthquake Program Information Exchange (EPIE) Workshop in Los Angeles. The Earthquake Program was implemented as part of the national Earthquake Hazards Reduction Act. The Act was developed, in the area of seismic risk, to improve understanding of and capability to deal with earthquake related issues including methods of controlling risks, planning to prevent risks, organizing emergency services, and planning for post-earthquake recovery.

Various technical, educational, and economic and social impact sessions comprised the meeting. The technical session concentrated on geology and seismicity, both historic and current, in areas throughout the United States. The social impact session discussed community involvement and education in planning for and responding to earthquakes and the loss of community integrity in the aftermath. The meeting included a field trip to Santa Monica to observe damage to structures by the January 1994 Northridge earthquake. Every agency represented was given the opportunity to present the status and successes of their programs. Of special interest to the DGS, because Delaware is in the National Earthquake Hazards Reduction Program (NEHRP) on a provisional basis, were the programs set up in Pennsylvania, New Jersey, New York, Connecticut, New Hampshire, Massachusetts, West Virginia, and North Carolina, all presently participating in NEHRP.

Delaware's presentation was on the frequency, distribution, and potential for moderate earthquakes that could possibly impact Delaware. Records of historical seismicity indicate that an earthquake of magnitude 6 could occur anywhere on the East Coast. A magnitude 6 near a heavily populated area with brick, stone, or

unreinforced concrete structures could cause large scale damage over a restricted area. Charleston, South Carolina, experienced an earthquake in 1886 with a postulated Richter magnitude of 7.5, suggesting that without a longer period of recorded history and seismic instrumentation, the possibility of an earthquake with this magnitude occurring should not be completely ruled out in any areas with low level seismicity (See *First State Geology*, Vol. 12, no. 2, for a discussion of seismicity in Delaware). The energy released by a magnitude 7.5 earthquake is about 45 times as great as a 6, given the logarithmic magnitude scale in which the amplitude of earthquake motion and the associated energy release is measured. The amplitude of ground motion increases by a factor of about 10 for each increment in magnitude, whereas the energy released increases by a factor of 30. For this reason, an earthquake of magnitude 7.5 within a 150-mile radius of Delaware could impact Delaware.

DEMA is developing contingency plans for mitigating or responding to disasters of all types that could potentially affect Delaware. The DGS is helping to evaluate natural geologic hazards including earthquakes, stream flooding, slope failures, sinkholes, and coastal storms.

Thickness of Quaternary in New Castle County

By Nenad Spoljaric

A study is in progress to develop maps of the base and thickness of the Quaternary sediments in southern New Castle County. The Quaternary sediments are primarily represented by the fluvial deposits of the Columbia Formation that blanket older sediments in the area. They are composed of coarse to fine sands, gravels, and some silts and clay and are yellow to brown in color owing to the presence of iron oxides and hydroxides produced by weathering processes.

The Columbia Formation was deposited by complex, braided fluvial systems that flowed in a southward direction. These streams were characterized by shifting channels, high velocity, and high-competency flows. They were capable of carrying cobble-size materials into the area.

Data from about 1,800 wells are being used in the present study. The study should reveal the drainage systems that existed in southern New Castle County at the time the sediments were deposited.

Both the thickness and the base maps will be applied to hydrologic evaluation of the Columbia Formation as a recharge unit as well as an aquifer. The study is scheduled for completion later in 1995.

Data Report on Piedmont Rock Cores

Open File Report No. 38, "Data Report on Rock Cores from Red Mill Road, Harmony Road, Prices Corner, and Newport, Delaware," by W. S. Schenck and M. O. Plank is in press. It gives the results of lithologic analysis of 54 rock cores housed in the DGS Core and Sample Library. The cores are from engineering test borings taken by the Delaware Department of Transportation (DelDOT) for road construction projects. The report organizes the geologic information obtained from the cores to make it easily accessible. As construction covers the land surface of the City of Wilmington and its suburbs, there is less access to rocks in the field. We expect the DGS Core Library to become increasingly important as a repository for information on Delaware's crystalline bedrock.

Existing geologic maps of the Delaware Piedmont were compiled by K. D. Woodruff and A. M. Thompson in 1972 and 1975. A new mapping project of the Delaware Piedmont that will incorporate new data acquired since the 1970s, including those in Open File Report No. 38, is now in progress.

Hydrology News

A. Scott Andres has begun work on a multi-disciplinary, multi-agency project to study how plant nutrients move from agricultural fields into drainage ditches, streams, and ground water. The one-year project, "Assessing the Impact of Agricultural Drainage on Ground and Surface Water Quality in Delaware," is being done in conjunction with Dr. J. T. Sims of the University's Department of Plant and Soil Science and J. M. Denver of the U. S. Geological Survey. Other cooperators in the project include the Sussex Conservation District, the Department of Natural Resources and Environmental Control (DNREC), and two farm operators.

The project uses data from two sites in eastern Sussex County and is sponsored by the DNREC Non-Point Source Pollution program through a grant to the state from the U. S. Environmental Protection Agency. Results of the project are expected to be used to assist farm operators in managing their use of fertilizers, animal-waste products, and irrigation and drainage waters.

DGS Welcomes New Staff Members

In February, two geologists joined the professional staff of the Delaware Geological Survey. Their expertise will be directed to geophysics and hydrology.

Suzanne Sayer joins us from Virginia Tech where she is finishing a Ph. D. in

engineering geophysics using shallow potential field methods and seismic reflection. She received a B. S. in geology from Tufts University in 1970 and a M. S. in geochemistry from Massachusetts Institute of Technology in 1974. She has experience in the oil industry, in ground-water consulting, and in solid and hazardous waste in a state environmental resources department.

Suzanne will be working on the National Earthquake Hazards Reduction Program (NEHRP) and upgrading and digitizing the DGS seismic network and expanding it to five stations including one with a three-component system. She also will be doing geophysical well-logging and supporting our program in ground-water studies. She will interact with the Geology Department geophysics faculty in their use of ground penetrating radar, electrical resistivity, and magnetic and gravity surveys in environmental applications.

Stefanie J. Baxter joined the DGS as a project geologist. She is working on a project to evaluate the occurrence and availability of ground water in southern New Castle County. She is also working on a ground-water quality and ground-water level monitoring project in southern New Castle County. She received a B. A. in Geology from Kean College in New Jersey in 1992 and an M. S. in Oceanography from the Graduate College of Marine Studies, University of Delaware, in 1994.

Information on Gopher and Mosaic

In the Winter 1995 edition of *First State Geology*, we announced that the DGS List of Publications was available over the Internet via Gopher. Steps are currently being taken that will enable access to more DGS information resources via Gopher and World Wide Web (WWW) servers here at the University of Delaware.

A direct link to the U. S. Geological Survey Gopher server in Reston, Virginia, was added to the directory list in the current DGS Gopher listing. This allows the user to have direct access to the USGS without going to Gopherspace to find the USGS Gopher server.

The DGS Cartographic Information Center data bases DGSCIC (inventory of maps and aerial photographs in Delaware), BENCHMARK (location descriptions of the vertical control points for Delaware), and BOUNDARY (location and condition of the Delaware State Boundary monuments) are currently being moved to the WWW server. This will allow public searching of these data. Other DGS data to be added to both Gopher and WWW will be DGS Programs, *First State Geology* (Past Issues), DGS press Releases, DGS Cartographic Information Center (description), DGS Seismic Network, Water Conditions (State Conditions Report), Water-Level Monitoring Network data, Streamgage Monitoring Network data, and

Precipitation Network data.

Watch future newsletters for specific electronic paths and addresses for access to these data.

Cartographic Corner

By W. S. Schenck

- The 5-year agreement with the USGS has finally produced the last of the 7.5-minute digital hypography layers for Delaware. These layers will become available on a loaner CD from the DGS after July 1, 1995. To borrow the CD or for more information call W. S. Schenck at (302) 831-8262.
- The University of Delaware is shutting down the VM operating system on the IBM mainframe computer. This means access to the DGS CARTOGRAPHIC, BENCHMARK, AND BOUNDARY data bases will have to be moved onto the UNIX machines. Possible access avenues to these data bases are currently being explored by the DGS and the University Computer Network Services via internet facilities such as the University Gopher and Mosaic/World Wide Web (WWW). Watch for more information concerning this move in future Cartographic Corner releases.
- The DGS has hundreds of out-of-date topographic maps available for educational purposes. If you are in need of topographic map materials, the DGS/CIC can give you as many maps as you need; however, the areas covered are random. Please send your requests in writing to the DGS Cartographic Information Center, University of Delaware, Delaware Geological Survey Building, Newark, DE 19716-7501, ATTN: W. S. Schenck.

Publications

Forthcoming DGS Publications

Bulletin No. 19, Geology and Hydrology of the Cocksylville Formation, Northern New Castle County, Delaware: John H.

Talley, editor; authors K. D. Woodruff and M. O. Plank, both DGS, and W. H. Werkheiser, USGS.

Report of Investigations No. 52, Quality and Geochemistry of Ground Water in Southern New Castle County, Delaware: L. J. Bachman and M. J. Ferrari, both USGS.

Report of Investigations No. 53, Geology of the Milford and Mispillion River Quadrangles: K. W. Ramsey.

Geologic Map No. 9, Geologic Map of the Seaford Area, Delaware: A. S. Andres and K. W. Ramsey, scale 1:24,000.

Open File Report No. 38, Data Report on Rock Cores from Red Mill Road, Harmony Road, Prices Corner, and Newport, Delaware: W. S. Schenck and M. O. Plank.

Open File Report No. 39, Basic Data for the Geologic Map of the Seaford Area, Delaware: A. S. Andres and K. W. Ramsey.

Other Publications by DGS Staff

J. J. Groot and R. N. Benson, both DGS, and J. F. Wehmiller, Department of Geology, 1995, Palynological, Foraminiferal, and Aminostratigraphic Studies of Quaternary Sediments from the U. S. Middle Atlantic Upper Continental Slope, Continental Shelf, and Coastal Plain: Quaternary Science Reviews, v. 14, p. 17-49.

Staff Notes

Presentations

Thomas E. Pickett, on the geology of Delaware, at St. Hedwig's School, Wilmington, January 26.

William S. Schenck, on vertical control data in Delaware and the services of the DGS Cartographic Information Center, at Floodplain Management Workshop, Clayton Hall, University of Delaware, February 22.

Service and Awards

Richard N. Benson and **Roland E. Bounds** received University of Delaware service awards for completion of 20 and 15 years

with the DGS, respectively.

Roland E. Bounds was elected president of the Friends of Mineralogy, Pennsylvania Chapter.

Robert R. Jordan was appointed to the Strategic Planning Committee of the American Geological Institute; also, Jordan serves on a subcommittee of the Outer Continental Shelf Policy Committee to investigate access to sand and gravel resources beneath federal waters.

Thomas E. Pickett was elected a Fellow of the Geological Society of London. Pickett participated in the cluster meeting of the U. S. Geological Survey and eastern U. S. state geological surveys in New Harmony, Indiana, April 2-4.

Suzanne Sayer and **John H. Talley** participated in an earthquake preparedness information exchange sponsored by the Federal Emergency Management Agency (FEMA) under the National Earthquake Hazards Reduction Program, in Los Angeles, May 1-5. Sayer presented a review of eastern U. S. seismicity and the potential for impacts on Delaware by moderate earthquakes.

Externally Supported Projects

A. Scott Andres from the Delaware Department of Natural Resources and Environmental Control for (1) assessing the impact of agricultural drainage on ground and surface water quality in Delaware and (2) ground-water recharge mapping in the Bennetts Pier, Bombay Hook, Frederica, Little Creek, and Wyoming quadrangles.

John H. Talley from the Water Resources Agency for New Castle County for an evaluation of ground-water occurrence and availability in southern New Castle County; from the Delaware Department of Health and Social Services to investigate the radon potential of Tertiary sedimentary rocks in selected areas of Kent County; and, with Suzanne Sayer, from the Delaware Emergency Management Agency through FEMA to participate in the National Earthquake Hazards Reduction Program.

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First State Geology is published by the Delaware Geological Survey, a State agency established by an Act of the Delaware General Assembly in 1951 and organized as a unit of the University of Delaware.

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