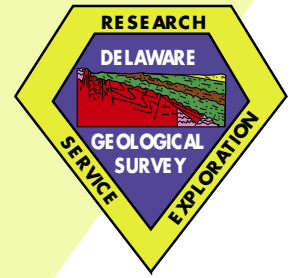


# First State Geology

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

Published twice yearly by the Delaware Geological Survey  
University of Delaware



Vol. 26, No. 1 • Winter 2008

## Delaware Geologic Information Resource (DGIR)

By W. S. Schenck

The Delaware Geological Survey is proud to announce the creation and deployment of the Delaware Geologic Information Resource DGIR (pronounced DIGGER)—a new mechanism for accessing geologic and hydrologic data for Delaware. DGIR is a web mapping service hosted on the DGS web site (<http://www.dgs.udel.edu>). The DGIR map viewer allows viewing of published, peer reviewed DGS digital data in map format. Creating and printing geologic maps is possible as well as extracting the digital data used to make the maps for use in your own desktop GIS. Special tools allow the user to find the depth to the water table and water-table elevation for the Coastal Plain of Delaware. A tool is also available to query the geologic map for

information about the geologic formations shown in the viewer window.

DGS geologic and hydrologic data are displayed above a base map derived from the Delaware Spatial Data Framework layers of the Delaware DataMIL. This ensures that the base map portrays the most current data available. The most current (2002) orthophotography is also available for use as the base map when viewing geologic and hydrologic feature service data offered through DGIR. Current geologic and hydrologic feature service data layers being offered through DGIR include existing statewide surficial 1:24,000-scale geology in the Piedmont and selected areas of the Coastal Plain, depth to the water table in dry, normal, and wet years, and elevation of the water table in dry, normal, and wet years in the Coastal Plain, and groundwater recharge potential areas for Kent and Sussex counties.

Future additions to DGIR will include a Help/FAQ (frequently asked questions)

section, enhanced contact mechanisms, a 1:100,000-scale statewide geologic map, and tools for identifying Coastal Plain aquifers. The DGS plans to use the DGIR web page and viewer as the access point for all published DGS data and data sets in the future.

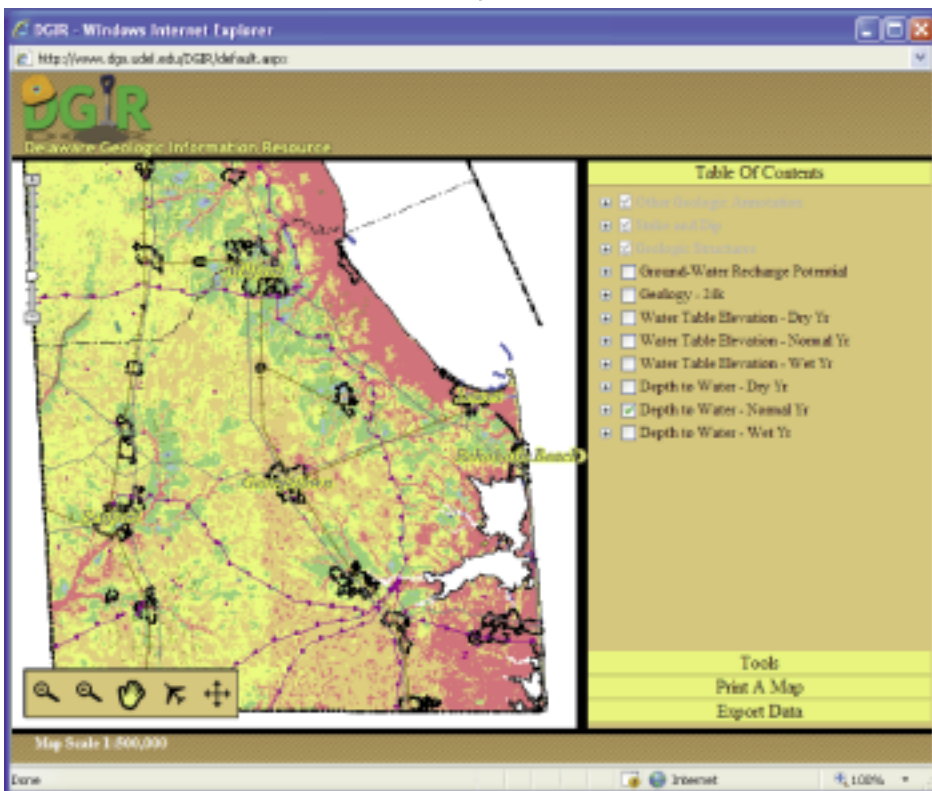
## DGS Issues Report on Results of Water-Table Mapping

By A. S. Andres

The Delaware Geological Survey released a new technical report entitled *Analysis and Summary of Water-Table Maps for the Delaware Coastal Plain*, which was prepared by Matthew J. Martin and A. Scott Andres of the Survey. The project was conducted with the cooperation and support of the Delaware Department of Natural Resources and Environmental Control. DGS Report of Investigations No. 73 covers the completion of work started in the Inland Bays watershed and documented in Special Publication No. 27, *Water Table in the Inland Bays, Delaware*, and Report of Investigations No. 68, *Estimation of the Water Table for the Inland Bays Watershed, Delaware*.

Water-table depth is a key factor in many engineering, hydrogeologic, and environmental management and regulatory decisions. Depth to water is an important factor in risk assessments, site assessments, evaluation of permit compliance data, and registration of pesticides and determination of acceptable application rates. Obtaining an accurate representation of the water table is also crucial to the success of many hydrologic modeling efforts.

Mapping the water-table elevation of the Delaware Coastal Plain was accomplished by using pre-existing data such as long-term hydrographs to determine dry, normal, and wet hydrologic conditions, a 30-meter DEM to assign elevations to surface-water features, and well completion reports used to obtain static water levels in shallow domestic wells to pro-



Screen shot of DGIR showing depth to water under normal conditions in Sussex County.

duce the regression coefficients that were inserted into a multiple linear regression equation. The resultant products are GIS-ready grids with a horizontal spacing of 30 m and a vertical resolution of 1 ft. The report details the technical aspects of the water-table mapping program, including methods, fluctuations in water-table depths, depth to water, water-table elevation, and discussion of applications of water-table maps to real world issues.

This report complements previous DGS digital publications, Digital Product 05-01, (*Digital Water-Table Data for Sussex County, Delaware*), Digital Product 05-03, (*Digital Water-Table Data for Kent County, Delaware*), and Digital Product 05-04, (*Digital Water-Table Data for New Castle County, Delaware*). The report, digital products, and poster provide information that will be useful in guiding anticipated growth and economic development, developing and protecting water resources, supporting agriculture, and educating the public about ground water. Ground water provides nearly all fresh water for public, domestic, commercial, irrigation, and industrial uses in Delaware

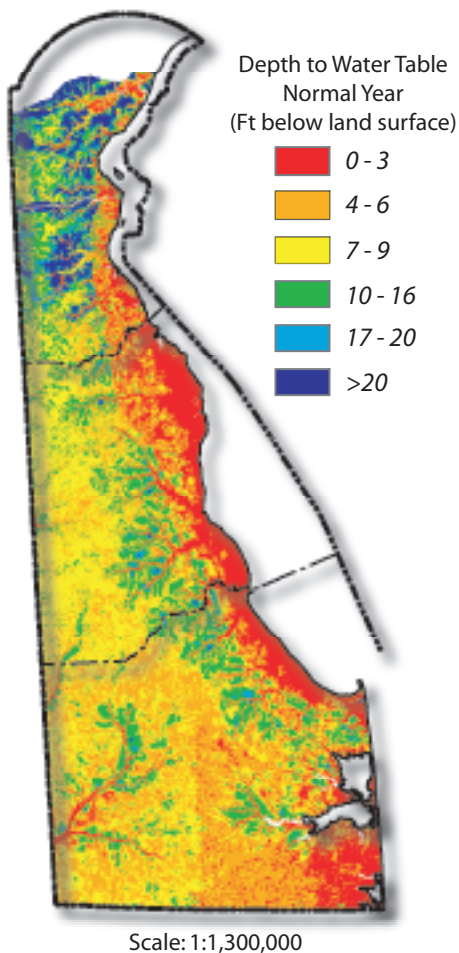


Figure showing the depth of the water table under normal conditions for the state using the Delaware Geologic Information Resource (DGIR).

south of the Chesapeake and Delaware Canal and about 25 percent north of the Canal.

All digital products associated with this report are accessible as Digital Data Products and can be downloaded at <http://www.dgs.udel.edu/publications>. The files can also be used interactively through the Delaware Geologic Information Resource (DGIR) at <http://www.dgs.udel.edu>. Printed copies of all DGS publications may be requested by contacting the Survey at (302) 831-2833 or by email at [delgeosurvey@udel.edu](mailto:delgeosurvey@udel.edu).

## Locating Ground-Water Discharge Areas Using Landsat 7 Imagery

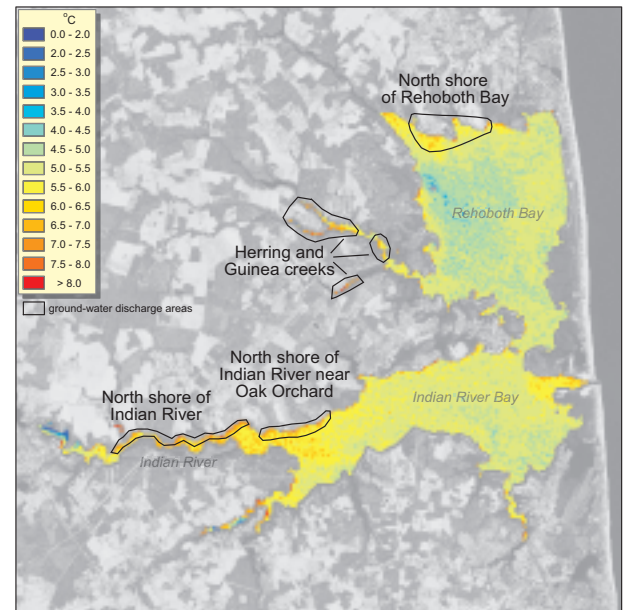
By L. T. Wang and T. E. McKenna

The Delaware Geological Survey released a new technical report (Report of Investigations No. 74) entitled *Locating Ground-Water Discharge Areas in Rehoboth and Indian River Bays and Indian River, Delaware, Using Landsat 7 Imagery*, which was prepared by Lillian T. Wang, and Thomas E. McKenna (DGS), and Tracy L. DeLiberty (University of Delaware, Department of Geography).

Delaware's Inland Bays in southeastern Sussex County (Rehoboth Bay, Indian River Bay, and Little Assawoman Bay) are valuable natural resources supporting ecology, tourism, community-based recreation, and fisheries. One of the primary environmental problems in the Inland Bays is nutrient over-enrichment. Nitrogen and phosphorous are delivered to the bays by ground water, surface water and air. Nitrogen loading from ground-water discharge to the bays is one of the most difficult to quantify. Difficulties include identifying the ground-water flow paths, locating where ground water discharges to the bays, obtaining discharge measurements, and quantifying biogeochemical reactions occurring in discharge areas.

Satellite imagery was used to identify locations of ground-water discharge to estuaries and determine locations of discharge into the Inland Bays. In most environments, ground water between about 5-and-100-meter depths has a nearly constant temperature of 1 to 2°C higher than the mean-annual air temperature. If

Ground-water discharge areas successfully located using satellite imagery.



the discharging ground water is hotter or colder than the surface water that it discharges into, a thermal anomaly may be detectable in the surface water. In this study, we observed a signature of warmer ground water discharging into cooler ambient surface water in satellite images collected during the winter.

The methods used in locating ground-water discharge areas included selecting and processing the images, validating temperatures, and identifying discharge locations. Image selection included choosing a satellite platform and a preferred date of image acquisition. Image processing consisted of shoreline delineation, evaluation of atmospheric conditions, and conversion of at-sensor radiance to kinetic temperature. Temperatures were validated using in-situ measurements from buoys. Potential discharge locations were identified by analyzing processed thermal images along with the panchromatic and near-infrared spectral bands.

Ground-water discharge areas were successfully located on the north shore of Rehoboth Bay west of the Lewes and Rehoboth Canal, on Herring and Guinea creeks, on the north shore of Indian River, and on the north shore of Indian River Bay near Oak Orchard.

Report of Investigations No. 74 is available in pdf format from the DGS web site at <http://www.dgs.udel.edu/publications>. Additional information can be found by contacting the Survey at (302) 831-2833 or via email at [delgeosurvey@udel.edu](mailto:delgeosurvey@udel.edu).



## DGS Welcomes New Staff Members

Three new persons were added to the professional staff of the DGS. Changming He began his work as an associate scientist to perform investigations and conduct applied research in ground-water modeling. Muserreff Turkmen, a post-doctoral researcher, and Edward Walther, a limited-term researcher, were hired to assist DGS Senior Scientist, A. Scott Andres, on a project investigating the operation of rapid infiltration wastewater disposal methods and the effects of this practice on Delaware's water resources.

Dr. He came to the DGS from Earth Tech, Inc., where he was primarily involved with an installation restoration program for the U.S. Air Force at Edwards Air Force Base in California. Dr. He has joined project teams working on the application of numerical models to estimate ground-water availability in high-growth areas of the state and to assess impacts of wastewater disposal practices on ground- and surface-water resources. Dr. He received B.S. (1996) and M.S. (1999) degrees in hydrogeology from Nanjing University, Nanjing, China, and his Ph.D. from the University of Nevada in 2004.

Dr. Muserreff Turkmen is an environmental engineer specializing in wastewater treatment. Dr. Turkmen received her Ph.D in environmental engineering from the University of Delaware in 2007. Mr. Walther, an environmental scientist, obtained a B.S. in environmental science with a minor in climatology from the University of Delaware in 2007.

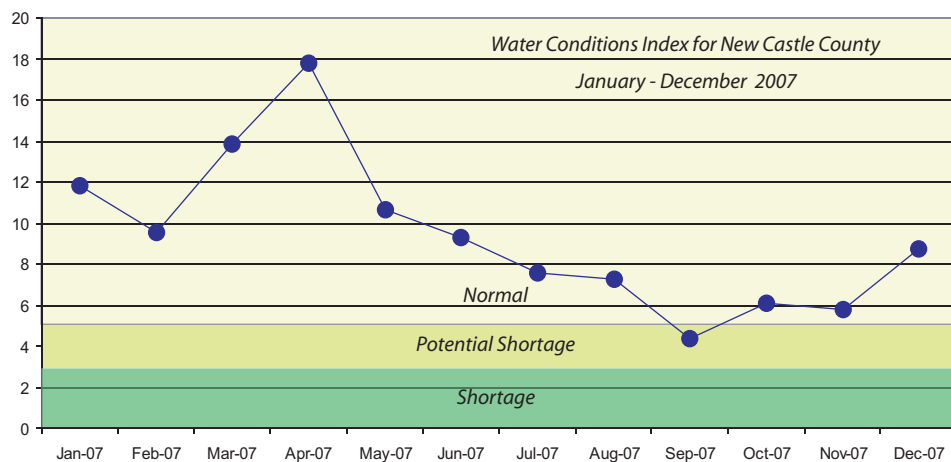
We welcome our new colleagues and look forward to their contributions to further our understanding of the geology and hydrology in Delaware.

## Water Conditions Summary for 2007

By J. H. Talley

Governor Ruth Ann Minner, on October 20<sup>th</sup>, declared a state-wide Drought Watch in response to significantly below normal precipitation from May through September and associated declining streamflows and ground-water levels.

Precipitation was highly variable monthly, seasonally, and geographically throughout Delaware during 2007. Total annual precipitation was near normal in New Castle County, in the Dover area of Kent County, and near Lewes in Sussex County ranging from 103% of normal in



Wilmington to 93% at Lewes. However, total annual precipitation was significantly below normal in southern Kent and most of Sussex County with totals ranging from 73% of normal (-12.10") at Georgetown to 71% of normal (-13.19") at Greenwood. Record-low yearly totals were recorded at Greenwood (32.80") and Georgetown 33.24".

Precipitation during the five-month period May through September, which coincided with the growing season, was significantly below normal with totals ranging from 72% of normal at Wilmington (5.99" below normal) to 39% at Greenwood (12.64" below normal). This extended dry period had a significant adverse impact on agriculture throughout Delaware.

Monthly mean streamflows were generally in the normal to above normal range from January through June. However, dry conditions during the period May through September coupled with declining ground-water levels resulted in declining streamflows especially in southern Delaware. Monthly mean streamflows were below normal on the Nanticoke River near Bridgeville from June through December with the second

lowest monthly mean of record recorded in November.

Ground-water levels were generally in the above normal to normal range throughout Delaware from January through June. Water levels generally declined into the below normal range from June into July and have remained in the below normal range since that time. Ground-water levels started to rise during late December in response to recharge associated with above normal precipitation in October and December; however, it is anticipated that ground-water levels will generally remain below normal or in the very low end of the normal range in the absence of normal to above normal precipitation in the coming months.

The DGS Water Conditions Index for New Castle County was generally above the normal range from January through May, but declined into the potential shortage range during September. The Index exhibited a rising trend from October through December as normal precipitation returned.

The DGS prepares a Summary of Water Conditions on a monthly basis, which is available on the DGS website at <http://www.dgs.udel.edu>.

	Total Precipitation	Normal Precipitation	Departure	% of Normal
Wilmington (Porter Reservoir)	46.94"	45.48"	+1.46"	103%
New Castle (Airport)	41.81"	42.81"	-1.00"	98%
Dover	41.48"	46.28"	-4.80"	90%
Greenwood	32.80"	45.99"	-13.19"	71%
Lewes	42.89"	46.00"	-3.11"	93%
Georgetown	33.24"	45.34"	-12.10"	73%

Precipitation statistics for the period January through December, 2007.

## Publications

### Recent DGS Publications Report of Investigations

No. 73, Analysis and Summary of Water-Table Maps for the Delaware Coastal Plain: **Matthew J. Martin** and **A. Scott Andres**, 10 p. and 2 plates.

No. 74, Locating Ground-Water Discharge Areas in Rehoboth and Indian River Bays and Indian River, Delaware Using Landsat 7 Imagery: **Lillian T. Wang**, **Thomas E. McKenna**, and Tracy L. DeLiberty, 11 p. and 3 plates.

## Staff Notes

### Presentations

**Changming He**, "Using Geophysical Logs and Markov-chain Method to Map Hydraulic Property" at the American Geophysical Union meeting, San Francisco, Dec 13.

**Peter P. McLaughlin, Jr.**, "Delaware Geology: Recent DGS Work of Interest to Delaware's Water Drillers," Delaware Board of Well Drillers Continuing Education Seminar, Dover, Nov. 9 and "Life of Our Ancient Lands and Seas:

Dinosaurs, Plants, and Marine Life of the Delaware Valley region in the Mesozoic Era," Delaware Museum of Natural History, Wilmington, Dec. 27.

**Kelvin W. Ramsey** and Livia Montone, "Forensic Hurricanology of Late 19<sup>th</sup> to Early 21<sup>st</sup> Century Mid-Atlantic Coast Tropical Systems," Geography Department Seminar, University of Delaware, Nov. 30.

**John H. Talley**, "Ground-Water Resources of the Delmarva Peninsula: Trends in water Use and Potential Conflicts," Maryland Crop Management School, Ocean City, Nov. 14 and "Are Water Resource Conflicts in our Future in Delaware?" Vegetable Growers Association of Delaware, Delaware Ag Week, Harrington, Jan. 7, 2008.

**Muserref Turkmen**, "Evaluation of Rapid Infiltration Basin Systems (RIBS) for Delaware," 11th Annual Conference & Exhibition of Delaware On-Site Wastewater Recycling Association, Delaware State Fairgrounds, Harrington, Oct. 23.

## Service and Awards

**Thomas E. McKenna** organized "Advances in Subsurface Exploration

Methods," which was a workshop hosted by the DGS, the UD College of Agriculture and Natural Resources, and Geoprobe Systems at the UD Farm in Newark, Oct. 30. Many of the 140 participants used the workshop to earn continuing education credits required for professional geologist and water-well driller licenses.

**Miriam L. Pomilio** and **Lillian T. Wang**, participated in GIS night in Felton, Nov. 13.

**John H. Talley**, chaired the External Advisory Committee that conducted a program review and evaluation of the Indiana Geological Survey.

**William S. Schenck** represented the Delaware Board of Geology at the National Association of State Boards of Geology, Denver, Oct. 23-26.

**Lillian T. Wang** met the standards and requirements established by the GIS Certification Institute (GISCI) on September 10, 2007 and became a Certified Geographic Information Systems Professional (GISP).



Delaware Geological Survey  
University of Delaware  
Newark, DE 19716-7501

*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.

John H. Talley  
*Director and State Geologist*  
Stefanie Baxter  
*Editor, First State Geology*

CHANGE OF ADDRESS?  
Send mailing label and your new address, and/or

REQUESTS FOR PUBLICATIONS to:  
Laura K. Wisk  
Delaware Geological Survey  
University of Delaware  
Newark, DE 19716-7501  
302-831-2834  
delgeosurvey@udel.edu  
www.udel.edu/dgs

First Class  
Postage  
**PAID**  
Newark, DE 19716  
Permit No. 26