Minnesota Ground Water Association

Volume 11, Number 4: January, 1993

President's Column

It is a pleasure to serve as the MGWA President for 1993. The outgoing officers have helped us celebrate the first 10 years of our organization. We now pick up the challenge to continue the work of MGWA as we begin our second decade.

I offer a special thanks to Sheila Grow, 1992 President, for her energetic and faithful leadership during this past year. Under her guidance, MGWA has coordinated two record-breaking conferences, co-sponsored a very popular field trip to northeast Minnesota, provided scholarships to college and university geology departments in Minnesota, and has steadfastly promoted the MGWA goals of ground water education and advocacy for the ground water resource.

Susan Price, outgoing Treasurer, will be replaced by Rita O'Connell. Bruce Olsen will serve the remainder of his two year term as Secretary. Doug Connell is the new President Elect. Jan Falteisek will continue as Editor, with support from Jeanette Leete.

The new officers will be introduced to you on pages 2 and 3 in this newsletter.

We have already begun to plan the 1993 activities: the Birdsall lecturer, Don Siegel, will speak at our winter seminars on February 11th (6:30 pm at the University of Minnesota Geology Department) and February 12th (11:45 am at the Macalester College Geology Department), we will hold a spring conference on Geographic Information Systems (GIS) and Ground Water (April 20), a field trip (probably southwestern Minnesota), and a fall conference (topic as yet unknown). Your comments and suggestions are welcome as always.

The Minnesota Ground Water Association has been approached by the Minnesota Water Well Association (MWWA) to promote communication among the members of the organizations. A prime opportunity for this interaction is the February 1-2 MWWA conference in Minnetonka (see page 19). We encourage communication among the many "friends of the ground water" community.

— Larry Johnson

MGWA Winter Seminar(s)

There will be two opportunities to hear Don Siegel at the MGWA Winter Seminars. Because this visit is co-sponsored by Macalester College and the University of Minnesota, talks will be held at both institutions.

The Hydrogeology of Wetlands: Paradigm Lost
John Birdsall Distinguished Lecturer:
Donald Siegel
February 11th, 1993
6:30 pm
110 Pillsbury Hall, University of Minnesota, Minneapolis Campus

Synopsis:

Recent investigations of the hydrogeology of wetlands have often contradicted "common wisdom" with respect to the hydrologic and chemical budgets of wetland systems. In this talk, Don Siegel will review the results of hydraulic, geochemical and modeling studies which show that the hydrogeology of many wetlands, ranging from small kettle depression bogs to vast mires, is dynamic.

Ground water discharge is prerequisite for the ecological succession in fens as well as the initial growth of domed, acidic bogs. Perturbations in climate, such as droughts, can dramatically modify the directions of ground water flow in wetlands by changing the material properties of peat and the relative influence of local-scale over regional-scale flow systems.

—continued on page 2

Table of Contents

Similarly, how much carbon dioxide and methane is contributed by wetlands to the atmosphere is regulated, at least in part, by the extent to which wetlands are located over ground water recharge of discharge zones.

From Dilution to Pollution
John Birdsall Distinguished Lecturer
Donald Siegel
February 12th, 1993
11:45 am
Olin Hall 300, Macalester College, St. Paul

Synopsis:

The chemical composition of ground water is often viewed as a product of water-rock chemical reactions operating under modern hydraulic gradients. If ground water residence time is long, its chemistry can also reflect aspects of paleohydrogeologic flow regimes. Don will discuss how Pleistocene glaciers greatly modified the ground water chemistry in confined regional aquifers in the Northern United States by decreasing and/or increasing concentrations of dissolved solids. Subglacial meltwater recharge diluted more saline ground water and formed extensive zones of ground water with low dissolved solids that are anomalous relative to what would be predicted from the extant flow systems. Conversely, reversals in hydraulic gradients caused by ice lobes induced more saline water to recharge fresher ground water systems. Intriguingly, the isotopic signature of the affected ground water in dilute zones suggests that the climate during the last glaciations was subtropical at times.

Background Information on Donald Siegel:
Donald I. Siegel received his Doctorate from the University of Minnesota in 1981. His professional experience includes work as an exploration geologist with Amerada Hess Corporation, as a hydrologist with the U.S. Geological Survey, and as a professor at Syracuse University. His professional interests include paleohydrogeology, wetland hydrogeology and geochemistry, and various aspects of contaminant hydrogeology.

Publication to Help Ground Water Programs

Suggestions for State and Local Ground Water Protection Programs, a Three-Volume Set, is now available.

Individual volumes are:

Providing Information to Ground Water Managers to Help Them Allocate Resources and Improve Their Programs, by Harry P. Hatry, E. Blaine Liner, and Elaine Morley;

Encouraging Local Ground Water Protection Efforts, by Elaine Morley, Pat Dusenbury, E. Blaine Liner, and Harry P. Hatry; and

Outreach and Education Efforts to Encourage Business and Public Involvement in Ground Water Protection, by Elaine Morley, Harry P. Hatry, and E. Blaine Liner.

Information is drawn from the experiences of 25 states, 32 state agencies, and 25 other organizations, including local governments, special districts, universities, and environmental organizations.

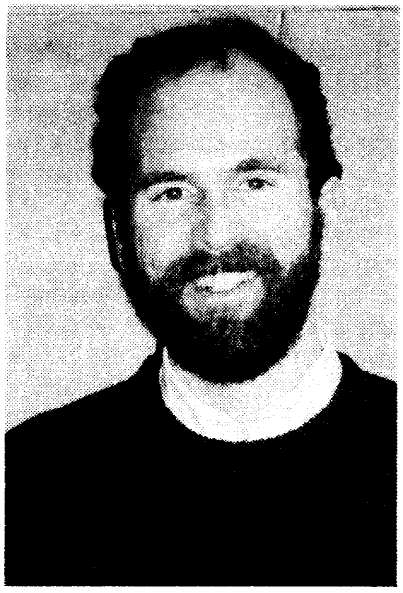
The price is $5 for one three-volume set; $1 for each additional set, depending on supplies.

To order, contact The Urban Institute, P.O. Box 7273, Dept. C., Washington, D.C. 20044. Orders must be prepaid. Make check or money order payable to The Urban Institute.

—Water Well Journal, December 1992

Doug Connell new MGWA President Elect

Doug Connell has been a hydrogeologist with Barr Engineering Co. for the past eight years. He received M.S. degrees from the University of Wisconsin-Madison in Water Resources Management and Geology in 1984 and a B.A. degree in Geology and Environmental Studies from Macalester College in 1980. During his undergraduate days he worked at the U.S. Bureau



of Mines Twin Cities Research Center and at the Minnesota Department of Natural Resources Minerals Division.

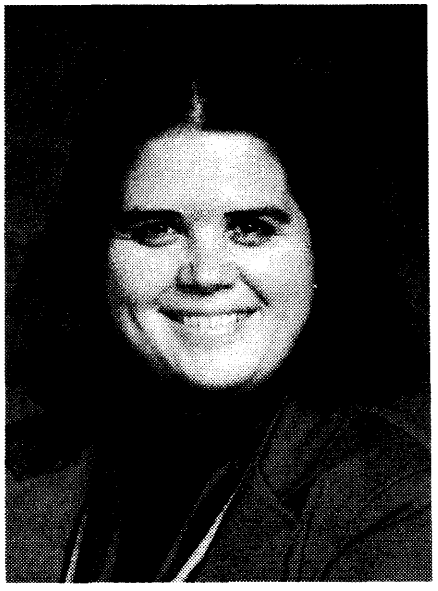
Doug has been involved in RCRA permitting, "Superfund" remedial investigations, feasibility studies, and remedial action implementation at sites throughout Minnesota and the Upper Midwest. He has worked extensively at petroleum refineries, wood treating sites, landfills, and mining sites as well as at general manufacturing facilities.

Doug is a Certified Professional Geologist, and has served on advisory committees for the Minnesota Pollution Control Agency and the Minnesota Chamber Environmental Committee.

Doug's duties as President Elect in 1993 and as President in 1994 will compete with his passion for being outdoors skiing, skijouring, bicycling, windsurfing, and kayaking.

Rita O'Connell new MGWA Treasurer

Dr. Rita O'Connell is a ground water quality policy analyst for the Minnesota Pollution Control Agency. She has worked at the MPCA since 1984 in a variety of positions: wastewater treatment facility permit writer, project leader for Superfund cleanups of landfills, and program coordinator for the Metropolitan Landfill Contingency Action Fund. In her current position her tasks include reporting on MPCA ground water activities funded by the U.S. EPA Ground Water Grant, providing technical support for agency policy makers, and coordinating the planning stages of the state's response to EPA's request for development of a Comprehensive State Ground Water Protection Program.



Before working at the MPCA, she spent ten years in the Los Angeles area, working in cancer research and earning two graduate degrees (she returned to Minnesota for a "vacation" in 1982 and is still here.) She is originally from the Duluth area where many of her family members still live. She has a doctorate in Environmental Science and Engineering (D. Env. - not Ph.D.) from UCLA, a M.S. in biology (ecology emphasis) from California State University at Northridge, and a B.A. in biology from the College of St. Scholastica in Duluth.

When not involved with environmental work, she enjoys camping, hiking, basketry using wild Minnesota plants, knitting sweaters and items of her own design (she won grand champion in hand-knitting in 1991 and 1992 at the Minnesota State Fair), teaching knitting and other crafts, and learning and using the Spanish language.

MGWA Awards Six Scholarships

In celebration of the tenth anniversary of the founding of the MGWA, the Association is providing six scholarships of $300 each to Minnesota institutes of higher education. The scholarships are intended to enable Minnesota schools to provide field experiences for their students. At most institutions, field trips are severely underfunded leading to fewer trips of shorter distance and duration.

The MGWA is funding these scholarships because the Board believes that field experiences can excite the enthusiasm of future ground water professionals.

The institutions are planning a number of interesting trips: the University of Minnesota award will help fund a field trip to southeastern Utah in the spring of 1993. Macalester College is planning to use their award toward a trip to the Black Hills. The University of Minnesota-Duluth Geology Club will travel to the southwest. A trip to the Florida Keys is planned by the St. Cloud State University Earth Sciences Department. Also heading to the southwest with the help of their award is the Gustavus Adolphus College Geology Department. The award to the Carleton College Geology Department will support their field trip programs.

As a condition of the award, each scholarship recipient has been asked to provide the MGWA with a short write-up of the trip and a picture suitable for use in this newsletter.

1993 Board of Directors

Past President
Sheila Grow
Camp, Dresser & McKee
(612)293-1313
FAX(612)293-0547

President
Larry Johnson
Dames & Moore
(612)631-8838
FAX (612)631-8872

President Elect
Doug Connell
Barr Engineering Co.
(612)832-2722
FAX(612)835-0186

Secretary/Membership
Bruce Olsen
MN Dept. of Health
(612)627-5167
FAX (612)623-5135

Treasurer
Rita O'Connell
MN Pollution Control Agency
(612)296-8568
FAX (612)296-9707

Editor
Jan Falteisek
MN DNR Division of Waters
(612)297-3877
FAX (612)296-0445

Business Management & Publications
Dr. Jeanette Leete
Watershed Research, Inc.
(612)426-8795
FAX (612)426-5449

Kentucky Implements Geology Registration Law

Kentucky's new law for registration of professional geologists became effective July 14, 1992. The law requires the registration of all geologists offering their professional services to the public in Kentucky. The grandfather period will be from January 10, 1993 through January 9, 1994.

Qualifications required of the grandfather applicants are as follows:

A. Baccalaureate degree in geology, geophysics, geochemistry, or geological/geotechnical engineering from an accredited college or university plus five years of professional geological work. The registration board may give one year of credit each for a master's or doctoral degree in the listed disciplines. During the grandfather period, the registration board will waive the examination requirements for applicants qualified by education and experience.

B. The registration board may waive the education requirements for persons who derive their livelihood from the public practice of geology who do not meet the education requirements, but who can demonstrate to the satisfaction of the board their competency and who have at least eight years of experience in professional geological work.

In order to qualify after the grandfather period, applicants must meet all the requirements listed in Part A, plus successfully complete an examination designed by the board to demonstrate the applicant's knowledge and skill required to exercise the responsibilities of the public practice of geology. For more information, contact Kentucky Board of Registration for Professional Geologists, 228 Mining and Mineral Resources Building, University of Kentucky, Lexington, KY 40506-0107.

—AGWSE Newsletter, December 1992

Newsletter Available on Innovative Ground Water Treatment Technology

EPA's Technology Innovation Office has instituted a newsletter, Ground Water Currents, to report on innovative in situ and ex situ ground water remediation technologies. The newsletter will report on technologies that are ready to be applied in the field and on research. Ground Water Currents will be published approximately four times a year. To be put on the mailing list, write or fax EPA Publications and Information Center, 11029 Kenwood Road, Bldg. 5, Cincinnati OH 45242, fax (513) 891-6685. State that you would like to receive Ground Water Currents, EPA/542/N-92/005.

—AGWSE Newsletter, December 1992

Groups Suggest Change in Terminology

Ask the average person on the street what the term non-point source pollution (NPS) means and you're likely to get a blank stare. That's why some clean water groups, in addition to the U.S. Environmental Protection Agency (EPA), are advocating a change in terminology to describe what usually ends up in storm sewers.

At a forum sponsored by the Environmental and Energy Study Conference, the National Resources Defense Council posed the possibility of coining a new term "polluted runoff" to better describe what currently is called non-point source pollution.

Talking about polluted runoff would "give the average person on the street a more vivid picture of just what we're talking about," said Diane Cameron, a lobbyist for the council. According to Cameron, the EPA has agreed in principle that the change should take place.

—U.S. Water News

MGWA SPRING CONFERENCE

GIS and Ground Water - What's In It For Me?

April 20th, 1-5pm
Earle Brown Center
St. Paul Campus
University of Minnesota

- What is GIS? And what is it NOT?
- How can GIS support your ground water investigation and analysis assignments?
- Current ground water-related GIS applications in Minnesota.
- Future of GIS-supported ground water activities.

Watch for further announcements and registration.

For more information, contact Larry Johnson, Dames and Moore, 631-8838.

Newsletter Advertising Policy for 1993

Advertising space is available to businesses and organizations. Display ads (4 issues = 1 year) are charged by fractional page:

Size	inches	Annual Rate
business card	3.5x2.4	$50
quarter page	3.5x5	$90
half page	7x5	$170
full page	7x10	$320

Copy should be a photostat of your camera-ready artwork.

The Editor has final determination on the acceptance of materials submitted. There are no commissions on ads. Advertising copy must be received by the publication deadlines: February 15, May 15, August 15, or November 15. The ad should be accompanied by a purchase order or a check payable to MGWA. All materials should be sent to the Editor:

Jan Falteisek
Editor, MGWA Newsletter
DNR - Division of Waters
500 Lafayette Road
St. Paul, MN 55155-4032

Winter Seminars 1993

University of Minnesota Department of Geology and Geophysics

Professor Richard B. Alley, Department of Geosciences, Pennsylvania State University:

February 4. *Timing and Nature of the Younger Dryas Event in the GISP-II Ice Core: The Ice Age Ended in Three Years.*

February 5, 10:15am, 121 Pillsbury Hall. *The Simplest Subglacial Hydrology?*

Professor Scott Stine, Department of Geography and Environmental Studies, California State University at Hayward, & Lamont-Doherty Geological Observatory, New York:

February 11. *Paleo-Droughts in California and Patagonia: The Past 2000 Years.*

February 12, 10:15am, 121 Pillsbury Hall. *Deltaic Processes and Their Bearing on the Fluctuations of Closed Lakes.*

Professor Norman Herz, Department of Geology, University of Georgia:

February 18. *Stable Isotope Geochemistry and Archeology*. A joint seminar with the Department of Art History

Professor Alexandra Navrotsky, Department of Geological and Geophysical Sciences & Princeton Materials Institute, Princeton University, Mineralogical Society of America/Center for High Pressure Research Special Lecturer.

March 3, special lecture at Macalester College, *Earth Materials, Environment, and the Role of Mineralogy.*

March 4, (regular lecture), *What minerals are in the Lower Mantle?*

Dr. Warren Beck, Department of Geology and Geophysics, University of Minnesota, Mpls, March 11, *Ocean Temperatures from Coral Skeletal Isotopic and Trace-Element Ratios.*

Seminars are presented on Thursdays (unless otherwise noted) at 3:30 pm in 110 Pillsbury Hall, followed by refreshments in 121 Pillsbury Hall.

Earwigs Can Cause Problems in Wells

The new Wisconsin menace is earwigs. These pests are brownish insects about 1-inch long and 1/4-inch wide. They have fierce-looking tail pinchers.

They started in the United States on the east coast, and have been steadily moving across the country. In recent mild winters they have been moving north and have been found in the southern part of Wisconsin. Central Wisconsin may have some also.

Earwigs eat decaying plant matter and thrive in cool, moist places, such as the inside of a well casing. Wells located near woodpiles and shrubs with bark landscaping are especially vulnerable to earwig infestation. During summer's heat, earwigs seek the coolness of a well casing. In the fall, they look for the water well's moderate climate.

If the well does not have a vermin-proof cap, earwigs can and will use the well for a home. They enter in large numbers. Earwigs do not stay at the top of the well. They crawl down to the water level, or fall down.

Earwigs are not known disease carriers, but they do cause coliform bacteria problems in wells. The insects fall into the water and provide a food source for continuing bacteria growth. Even after chlorination, high bacterial counts are possible. Chlorination can leave earwig bodies intact, in the bottom of the well, with pieces in the water system.

If there are only a few in a well, you might be able to get most of them out with a shop vacuum, before chlorinating. Should the earwigs be numerous and in the water, you may have to physically remove them from a well if a few chlorinations do not do the job. The well may have to be cleaned with a bailer or blown out with compressed air.

The best safeguard is the installation of a vermin-proof cap.

—Water Well Journal, October 1992

AIH Plans Second U.S.A./C.I.S. Conference

The American Institute of Hydrology (AIH), in collaboration with and under sponsorship of the U.S. Geological Survey and the Russian Academy of Sciences, is organizing the Second U.S.A./C.I.S. Joint Conference on Environmental Hydrology and Hydrogeology at the Hyatt Regency Hotel Crystal City, Arlington, Virginia, from May 15-21, 1993.

This conference is a continuation of joint meetings on the problems of environmental hydrology and hydrogeology in the U.S.A. and C.I.S. organized by the American Institute of Hydrology in cooperation with major governmental and scientific organizations in both countries.

The three-day conference includes 25 invited papers in four plenary sessions, 152 invited and contributed papers in 15 concurrent technical sessions, and more than 100 poster presentations. A two-day workshop on International Water-Data Information Systems, co-sponsored by UNESCO and the International Association of Hydrogeologists, will be held in conjunction with the conference.

The organizing committee has prepared several short courses for those who either find the specialized information useful in their own work or wish to broaden their general knowledge. These short courses will be conducted on Saturday prior to the beginning of the meeting. The topics of the three short courses being planned are ground water flow modeling, total quality management, and wellhead protection.

Representatives from industry, governmental agencies, and academic institutions will be exhibiting state-of-the-art technology, equipment, technical services, methods, publications, and software.

For registration or other information, please contact AIH, 3416 University Ave. S.E., Minneapolis, MN 55414-3328. Phone: (612)379-1030, Fax: (612)379-0169.

Water Research Data Bases Available on CD-ROM

The University of Minnesota Libraries house numerous CD-ROM (compact disc, read-only memory) data bases. Many of these are specific to or include water resources information. This compact source of information, combined with powerful software, allows users to search and print abstracts or the full text of journal articles, government reports, and other publications.

Following is a list of data bases that may be of interest to water researchers. They are available to students, faculty and university staff. The library where each data base can be found is noted in parentheses.

Selected Water Resources Abstracts: Produced by USGS. Covers characteristics, supply, condition, conservation, control, use, management, and legal aspects of water resources. Update quarterly. 1967 - (Forestry).

GeoRef: Premier database for geology and geophysics. Updated quarterly. Coverage for N. America is 1785-; other regions, 1933-. (Science and Engineering Ref. Service.)

NTIS: Bibliographic citations and abstracts to unrestricted technical reports from both U.S. and non-U.S. government sponsored research. Compiled by National Technical Information Service. Updated quarterly. 1983-. (St. Paul Central, Bio-Medical.)

Science Citation Index: Covers over 3,300 journals from all major scientific disciplines. Updated quarterly. 1986-. (St. Paul Central, Bio-Medical.)

Compendex: Corresponds to Engineering Index and Compendex on-line data base, providing worldwide coverage of literature on engineering and technology. Updated quarterly. 1985-. (Science and Engineering Ref. Service.)

Toxic Chemical Release Inventory: Reports to U.S. EPA detailing toxic chemical emissions from facilities which manufacture, process, or use listed toxic chemicals in excess of specified threshold levels. Updated quarterly. 1987-. (Government Publications.)

APSRS: Aerial Photography Summary Record System indexes all available aerial photography for the U.S. Access by geographic coordinates, county, government agency, contracting agency, or date. (Borchert Map Library.)

For general information about CD-ROMs available at the University, contact Librarian Nancy K. Herther at 624-2020.

— Library Line, University of Minnesota Libraries, University of Minnesota, December 1992

News of Members

The USGS at Mounds View has named **George Garklavs** as chief of water resources operations in Minnesota. As chief, Garklavs is responsible for managing the $4.2 million program, including supervision of 58 employees in Mounds View and Grand Rapids. Garklavs has been with the USGS since 1977, having worked in Illinois, North Dakota, and Colorado.

Dr. Raymond Thron has stepped down from the Environmental Health Director's position at the Minnesota Department of Health and taken a job with a private consulting firm. The new Director of the Division of Environmental Health is **Patricia Bloomgren**. Pat has an extensive environmental background with an emphasis in water-related programs. Pat was most recently assistant commissioner with the Minnesota Pollution Control Agency. She has also worked for the Board of Water and Soil Resources, the Minnesota Department of Health, and the Minnesota Department of Natural Resources.

Mike Convery is the new supervisor of the operations group of the Well Management Unit at the Minnesota Department of Health.

Join the Minnesota Ground Water Association!

If you are reading this newsletter second-hand, we'd like to take this opportunity to invite you to become a member of **MGWA** for 1993. Annual dues are $15 for professional members and $10 for students. Additional donations toward the use of 100% recycled paper will be gratefully accepted.

Just complete the form below and mail to: MGWA, c/o WRI, 4779 126th St. N, White Bear Lake, MN 55110.

Name _____

Affiliation _____

Mailing Address _____

City, State, Zip Code _____

Work Telephone Number _____

Home Address (optional) _____

City, State, Zip Code _____

Home Telephone Number _____

Which Address should we use for Directory Listing? _____

Which Telephone Number should we use for Directory Listing? _____

Hydrogeology and Pollution Sensitivity of the Quaternary and Prairie Du Chien - Jordan Aquifers in Ramsey County

by Roman Kanivetsky[1], W. Patrick Twiss[2], and Jan Falteisek[3]

In October 1992, the Minnesota Geological Survey published the Ramsey County Geologic Atlas. It is the fifth atlas produced within the metropolitan area and the seventh statewide. The atlas is the culmination of a two year research project investigating the geologic and hydrogeologic characteristics of Ramsey County.

The atlas is a collection of ten plates presenting a variety of maps and data describing the Quaternary and bedrock geology and hydrogeology of the county. In addition, the atlas includes derivative maps that depict bedrock topography, stratigraphy and thickness of Quaternary deposits, basal confining units of the St. Peter Sandstone, proper well construction and sealing practices, and the sensitivity of ground water systems to pollution.

The ground water resources of Ramsey County supply drinking water for many municipalities and most of the water required by industry and business within the county. Water is withdrawn from glacial deposits of Quaternary age and from several bedrock aquifers. This article summarizes the hydrogeologic conditions of two of these aquifer systems, the Quaternary and the Prairie du Chien-Jordan. The Quaternary aquifer system includes both the water-table aquifer and buried glacial aquifers.

Water-Table System

Areas where the glacial deposits are thick enough and sufficiently porous and permeable to yield water to wells in Ramsey County are shown on Figure 1. The potentiometric contours based on measured water levels in wells in these deposits are also shown. The highest elevation of the water table is in the extreme east-central part of Ramsey County where the land surface is also generally the highest. The rate and direction of ground water movement are indicated by the spacing of the potentiometric contours. More closely spaced potentiometric contours reflect a steeper hydraulic gradient and faster ground water movement, and indicate discharge into the river valleys.

Recharge to the water-table system by infiltration of precipitation occurs throughout the county and not just in the areas of highest potentiometric value. The rate of recharge, however, is a function of the hydraulic conductivity of geologic materials above the water table.

Ground water of the water-table system discharges into the Mississippi and Minnesota river systems. Surface elevations of lakes in the county, which decrease toward the rivers, reflect the ground water movement. Water-table system ground water divides occur within the highest potentiometric contours shown on Figure 1, but seasonal fluctuations of the ground water level make it difficult to define the ground water divides with precision.

Wetlands occur throughout most of the county, with the exception of the southwestern part where they have been drained and filled. Most of the wetlands are surface exposures of the water table. However, wetlands can be perched above the actual water table if they are underlain by relatively impermeable layers of clay-rich sediments.

In most of the county the water-table aquifer is not a major source of ground water, and pumping information for it was not available. High-capacity wells could be developed in Mississippi and Minnesota River valley alluvium and terraces, because these deposits are hydrologically connected to the surface-water system.

Buried Glacial Aquifer System

In northwestern Ramsey County, a thick sequence of clay-rich till forms a confining unit between the overlying saturated zone of the water-table system and the glacial deposits and bedrock beneath the clay-rich till. The glacial deposits elsewhere in the county may also be separated into two aquifers, but this separation cannot be confirmed with available data. Ground water in the buried glacial aquifer is mostly under confined conditions.

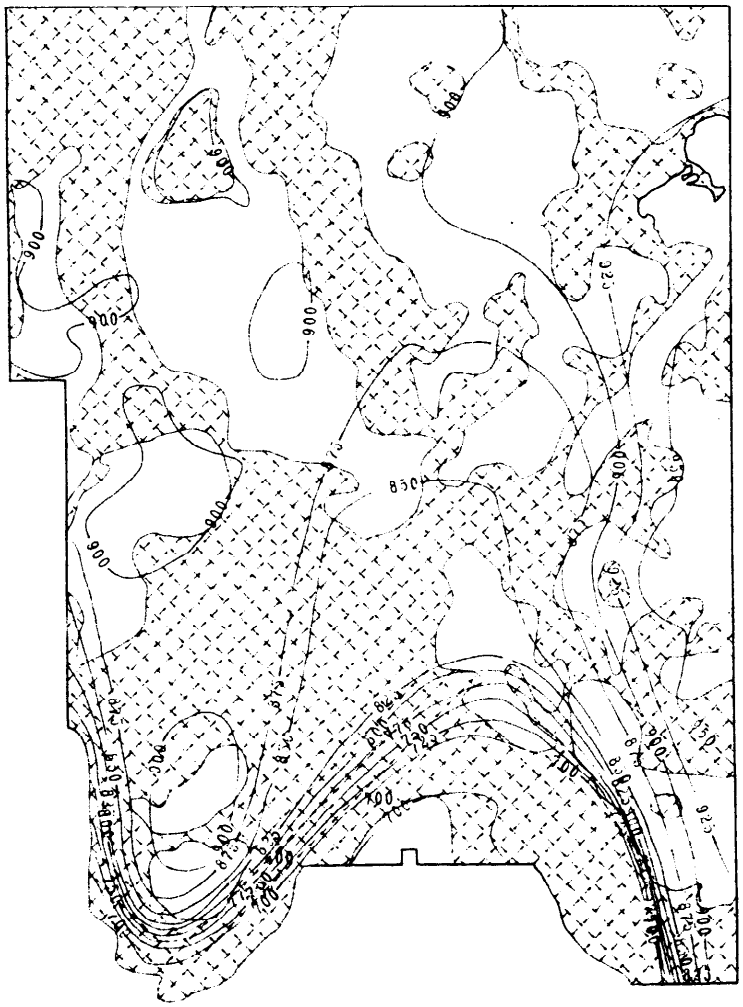
Data on water levels were not sufficient for a potentiometric contour map in the atlas for the buried glacial aquifer. However, the general direction of ground water movement probably is similar to that in the water-table aquifer.

The buried glacial aquifer is not a major source of water. It is used locally for residential and other low-capacity water supplies. Where it fills a bedrock valley in the northwestern part of the county, it consists of a thick sequence of sand and gravel and could supply water for high-capacity wells. The variability of the Quaternary deposits greatly influences the hydrologic conditions of the buried aquifer. As a result of these variations, neighboring wells can have quite different yields, and pumping tests are needed to determine site-specific yield.

Prairie Du Chien-Jordan Aquifer

The Prairie du Chien Group and Jordan Sandstone together form the most heavily used aquifer in the county . This aquifer provides more than 90% of all the ground water used annually within the county. The Prairie du Chien-Jordan aquifer is present throughout the county (Figure 2) except in a narrow bedrock valley in the northwest, where the first bedrock is the St. Lawrence or Franconia Formation. The aquifer is overlain by the shaley basal part of the St. Peter Sandstone in

[1]*Minnesota Geological Survey,*
[2]*Ramsey County Soil and Water Conservation District*
[3]*Minnesota Department of Natural Resources*

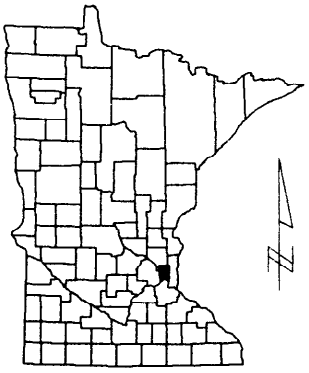


Surficial Aquifer

— 900 — Water Table Elevation

Scale 1:200,000

Figure 1. Surficial Hydrogeology of Ramsey County (rescaled and simplified black and white version of color plate)



Ramsey County Location Map

much of the county. The Prairie du Chien Group is chiefly dolostone, and water flows mainly through fractures, joints, and solution cavities. Its total thickness is about 120 to 130 feet. The Jordan Sandstone (70 to 100 feet thick) consists of highly permeable, fine- to coarse-grained quartzose sandstone, and most water movement is intergranular. Despite the difference in rock type, the Prairie du Chien Group and Jordan Sandstone function as a single aquifer because no regional confining bed separates them. Locally, however, small water-level differences may exist, owing to relatively impermeable beds of shale of limited extent.

As shown in Figure 2, ground water in the Prairie du Chien-Jordan aquifer generally flows from areas with the highest hydraulic head in northeastern Ramsey County toward the Mississippi River and discharges into the river. The flow pattern may be altered by pumping of high-capacity wells, especially during the summer when demands are heavy. The aquifer is confined except for the southeastern corner of the county.

The Prairie du Chien-Jordan aquifer has the greatest maximum yield in the western and extreme southeastern parts of the county. Sustained-yield ratings for the Prairie du Chien-Jordan aquifer are not shown in Figure 2 but are illustrated in the atlas. The values given in the atlas are approximations, which are useful on a county-wide scale. Determining site-specific aquifer performance requires test pumping.

Large withdrawals of ground water have lowered potentiometric head in the Prairie du Chien-Jordan aquifer. Since initial development in the 1880s, the potentiometric head in the Prairie du Chien-Jordan has declined more than 50 feet in Ramsey County, compared to a decline of more than 125 feet in the Mt. Simon aquifer. In addition, each year potentiometric head declines sharply during the summer as pumping increases, and then recovers during the winter as pumping rates decline.

The Minnesota Geological Survey measured monthly water levels from November 1990 to December 1991 in 45 wells. Additional water-level data were obtained from the Minnesota Department of Natural Resources. The Prairie du Chien-Jordan poten-

—continued on page 10

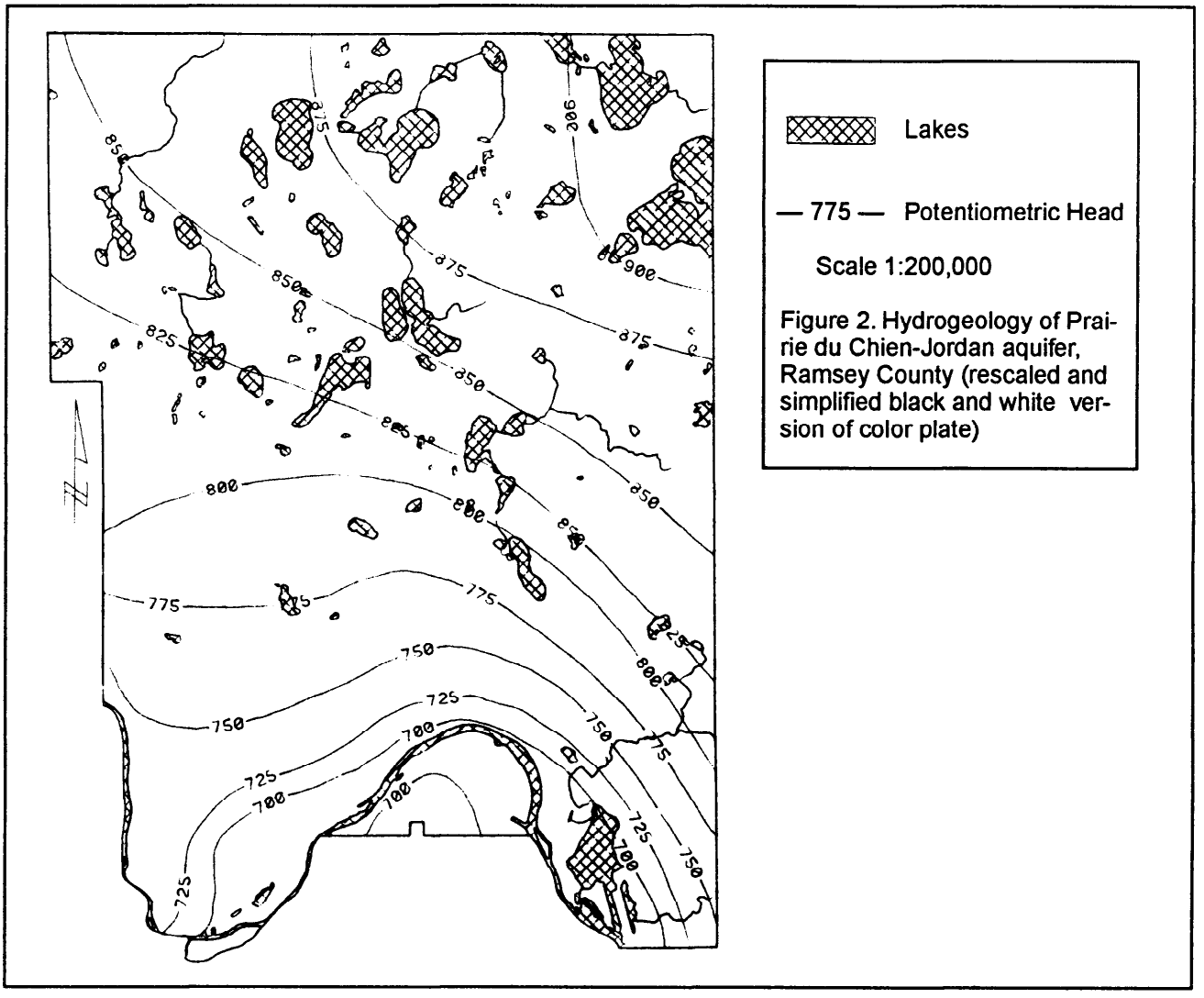


Figure 2. Hydrogeology of Prairie du Chien-Jordan aquifer, Ramsey County (rescaled and simplified black and white version of color plate)

Table 1. *Natural Characteristics of the Ground Water in Ramsey County*

[Minnesota Geological Survey file data, 1991. Constituents in parts per million except as noted; n.d., no data]

Source	Ca^{+2}	Mg^{+2}	Na^{+1}	K^{+1}	SO_4^{-2}	Cl^{-1}	NO_3-N	F^{-1}	Alkalinity[1]	$Fe^{+2/+3}$	TDS[2]	pH[3]	DO[4]	Tritium[5]	$\delta^{18}O$[6]	δD[7]	°C[8]
Precipitation	n.d.	n.d.	n.d.	n.d.	1–6	1.5–2.0	<.01–.94	.07–.16	8–15	n.d.	48–55	5.4–6.7	n.d.	n.d.	n.d.	n.d.	n.d.
Surface water	23–3	11–13	9–31	.01–3.1	12–17	10–45	.008–.014	.12–.13	96–105.	10–.15	83–126	8.3–8.4	12–15	13.2–14.8	-3.8 – -4.9	-29 – -43	12–16
Glacial aquifers	56–84	17–42	4–19	1.0–2.9	19–40	14–43	.008–.013	.13–.25	180–312	.16–.79	260–360	7.2–7.6	.02–3.3	2.7–31.2	-4.2 – -9.4	-44 – -73	10–11
St. Peter aquifer	57–71	24–39	4–6	1.7–2.2	4–15	1–4	.008–.01	.23–.31	235–337	.37–2.5	198–275	7.3–7.8	12–.47	<0.8–1.0	-7.1 – -9.5	-50 – -65	9–15
Prairie du Chien–Jordan aquifer	54–65	23–30	4–5	1.4–1.9	4–25	3–14	.01–.10	.20–.24	224–233	.19–.48	220–290	7.2–7.8	2.1–7.0	2.3–20.0	-7.6 – -9.1	-58 – -63	9–15

[1]Alkalinity (as $CaCO_3$) of water refers to its ability to neutralize acid.

[2]TDS, total dissolved solids—residue on evaporation at 180°C.

[3]pH, the balance between acidity and alkalinity on a scale of 0 (alkaline) to 14 (acid) with 7 representing neutrality.

[4]DO, dissolved oxygen.

[5]Hydrogen-3; recorded in tritium units (TU).

[6]$d^{18}O$, ratio of oxygen-18 to oxygen-16; the values are negative.

[7]dD, ratio of deuterium (hydrogen-2) to hydrogen; the values are negative.

[8]°C, temperature in degrees Celsius. The temperatures are ranges, not seasonal variations. Water in the bedrock aquifers ranges from 48.2 to 59 degrees Fahrenheit.

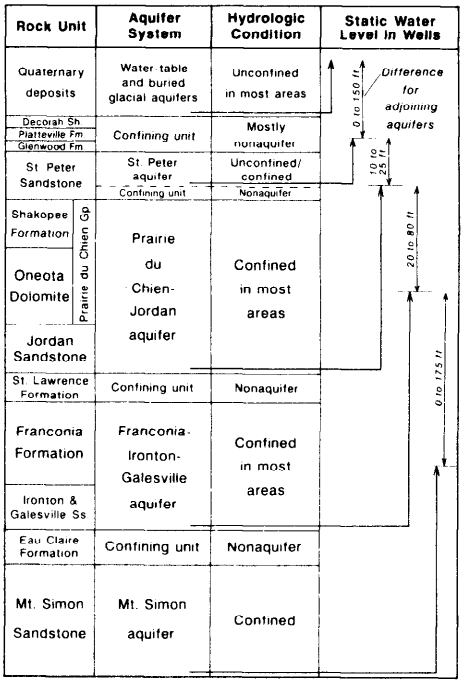


Figure 3. Sequence of Aquifers and Water-Level Relationships in Ramsey County

which contaminants move. The sensitivity of an aquifer is inversely proportional to the time of travel. Longer travel times represent a greater degree of geologic protection and reduced sensitivity to ground water pollution. Shorter travel times represent an increased sensitivity and a decreased ability to protect ground water from vertical contaminant movement.

Sensitivity ratings are used to classify the pollution sensitivity of a particular area. They describe the time of travel for contaminants to reach either the water-table system (Figure 4) or the Prairie du Chien-Jordan aquifer (Figure 5) and represent the effectiveness of geologic protection above these ground water resources.

The pollution sensitivity maps were constructed from information derived from other maps in the geologic atlas, from the data bases used for atlas preparation, and from sensitivity mapping guidelines developed by the Minnesota Department of Natural Resources. Such sources probably caused the relatively high nitrate content (2.5-5.2 ppm) in a few Department of Health samples from St. Peter and Prairie du Chien-Jordan wells in the central and extreme southeastern parts of the county.

The oxygen and deuterium isotopic data show that most of the water in the surficial aquifers is from precipitation, and that lakes are not the source of water for bedrock aquifers in Ramsey County.

The tritium analyses indicate that the water in bedrock aquifers originated before 1953, except where the bedrock and surficial aquifers are hydrologically connected, in which case the water could be a mixture of older and younger waters.

Pollution Sensitivity

Pollution sensitivity provides a general picture of the susceptibility of an aquifer to pollution in the event of a contamination incident. It does not indicate that contamination has resulted and does not reflect actual ground water quality. Sensitivity maps act as warning signs which help locate and prioritize areas where special precautions may be needed to protect aquifer resources. By identifying sensitive geologic areas, local governments can include ground water concerns into land-use decisions and direct regulations, management activities and fiscal resources to areas most threatened by contamination.

Geologic sensitivity represents the degree of protection provided by geologic materials overlying an aquifer. It is based on the vertical travel time required for a water-borne contaminant released at or near the land surface to enter the ground water. Travel time, which reflects the ability of geologic materials to impede the vertical movement of contamination, is controlled by the permeability, thickness, and lithology of the geologic materials through

tiometric surface shown on Figure 2 is based mostly on static potentiometric head measured from January to April 1991. Comparison of these winter data in 1991 with winter data in 1980 indicates no significant changes in the Prairie du Chien-Jordan potentiometric surface during this eleven-year period.

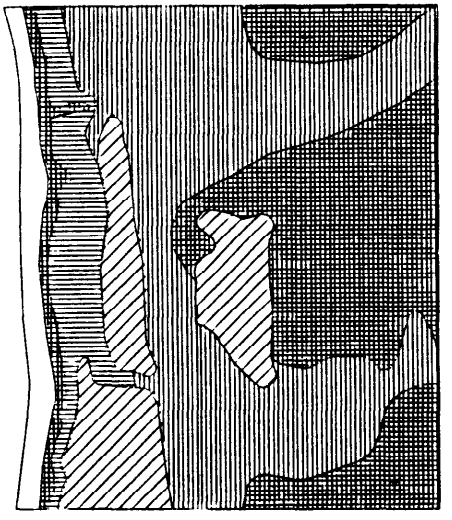
Overlying aquifers in Ramsey County have higher potentiometric head than deeper aquifers (Figure 3). Therefore, in addition to lateral flow, water leaks downward into lower aquifers. The amount of this vertical recharge and the areas where it is most likely to occur cannot be determined from existing information. Proper well construction must avoid increasing the interaquifer connection.

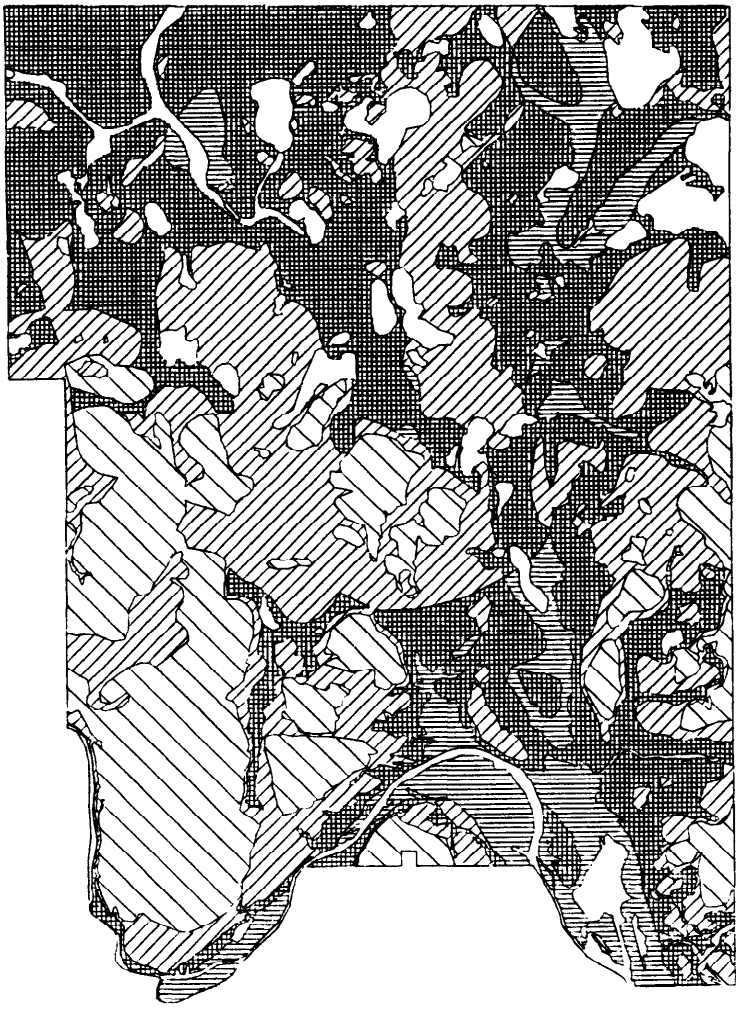
Ground Water Quality

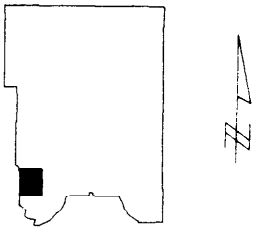
Water samples were collected for the Ramsey County atlas in the fall of 1991 (Table 1). Total dissolved solids ranged from 200 to 360 ppm (parts per million), well below the recommended maximum for drinking water of 500 ppm. Except for chloride, the concentrations of major constituents for the aquifers shown in Table 1 were similar. The chloride concentration ranged in surface water to as much as 45 ppm and in the glacial aquifers to 43 ppm. These values are well below the recommended maximum for drinking water of 250 ppm. In the St. Peter and Prairie du Chien-Jordan aquifers, chloride concentrations are even lower (2-4 ppm), although in the central part of the county they are slightly higher (up to 14 ppm). Sources of the chloride include road salt and well chlorination.

Nitrate concentrations in Ramsey County ranged from 0.008 to 0.9 ppm (Table 1). These concentrations are significantly below the drinking water limit of 10 ppm NO_3 as N, and indicate that regional nitrate contamination has not occurred in the county. Locally however, contamination can result from septic tanks, fertilizers, and improperly constructed

—continued on page 12







Scale 1:48,000

Figure 4. Surficial Aquifer Sensitivity to Pollution, Ramsey County (portion of a simplified black and white version of color plate)

Scale 1:200,000

Figure 5. Pollution Sensitivity of Prairie du Chien-Jordan aquifer, Ramsey County (rescaled and simplified black and white version of color plate)

Key for Figures 4 and 5

Not rated — (bedrock and surface water)

High — weeks to years

Moderate — several years to decades

Low — several decades to centuries

Very Low — more than a century

sources, Division of Waters. Several generalizations were made in order to produce the maps shown in Figures 4 and 5. Individual contaminants and contaminant attenuation processes were not addressed. Contaminants were considered to be inert and to have the same behavior as water. All water was assumed to flow vertically downward, as within a recharge area; lateral movement of water was ignored.

The sensitivity of the water-table system to pollution (Figure 4) was assessed on the basis of the depth to the local water table and the vertical permeability of geologic materials in the unsaturated zone. Areas with a shallow water table overlain by permeable sediments will be more sensitive than areas where the water table is deeper and covered by less permeable materials. Unsaturated zone materials such as glacial lake clays, till, and shale bedrock exhibit relatively good confining properties and provide significant aquifer protection. Outwash, sandstone and carbonate bedrock are highly permeable deposits that offer little aquifer protection.

The sensitivity of the Prairie du Chien-Jordan aquifer (Figure 5) was estimated by considering the number and effectiveness of bedrock confining units above the aquifer and the composition and thickness of overlying unconsolidated deposits. The Decorah Shale and the Glenwood Formation are two effective bedrock confining layers. However, both units are located in limited parts of the county and do not cover the entire area of the Prairie du Chien-Jordan. The base of the St. Peter Sandstone, a series of discontinuous and overlapping shale and siltstone beds, is the least effective bedrock confining unit. However, research conducted as part of atlas preparation indicates that the shaley basal portion is present throughout the county wherever the St. Peter Sandstone occurs.

Quaternary deposits also affect the pollution sensitivity of the Prairie du Chien-Jordan aquifer. Clayey sediment significantly increases aquifer protection. Sandy till adds protection where there is substantial thickness. Sand and gravel deposits add limited protection. The presence of confined buried glacial aquifers, as discussed above, is a good indicator of the protective properties of some Quaternary materials in Ramsey County.

Buried valleys have a considerable effect upon the pollution sensitivity of the Prairie du Chien-Jordan aquifer. Valleys were formed when pre- and inter- glacial streams incised into and eroded the underlying bedrock surface. Glacial depositional processes subsequently filled in these valleys with a mixture of sediment which is dominated by sand and gravel. Sediment of this type is generally more permeable than original bedrock units and may allow water to move rapidly into deeper aquifers. Since bedrock confining units are eroded within valleys, aquifers are no longer hydrologically isolated from one another and waters from separate aquifers can mix. Water can travel laterally to the edges of confined bedrock aquifers and move into deeper portions of the aquifer system. In general, High and Moderate sensitivities for the Prairie du Chien-Jordan aquifer are found in buried valleys where bedrock and Quaternary confining units are thin or absent. Very Low and Low ratings tend to occur where bedrock confining units are intact.

The sensitivity of the water-table system in Ramsey County, part of which is shown in Figure 4, is dominated by areas of Very High and High sensitivity because of shallow water table depths and the high permeability of most of the surficial geologic deposits. The water-table system, while not a primary drinking water source, is an important unit due to its direct connection with many lakes, streams, and wetlands. In contrast to the water-table system, the sensitivity of the Prairie du Chien-Jordan aquifer in Ramsey County (Figure 5) is generally rated Moderate and Low. This degree of protection bodes well for the county's most heavily used ground water source. Yet, areas with higher sensitivities often occur where the aquifer is utilized for water supply.

The potential for aquifer contamination is not solely dependent on the sensitivity of a particular area. The likelihood of a pollution event relates to many factors, especially the proper management of contamination sources. By combining the information in the geologic atlas with sound planning decisions and other management practices, future pollution mishaps can be prevented.

Summary

Ground water contamination is often foreseeable and preventable. Investigation and analysis of the hydrogeology and pollution sensitivity of ground water systems is necessary to protect this essential natural resource.

The Ramsey County Geologic Atlas is an excellent reference tool for educators, policy makers, developers, planners, and regulatory agencies. In addition, the atlas will assist in the proper use, management and planning of land and water resources. Currently, the atlas serves as an information base for the preparation of a county ground water quality protection plan.

A more detailed description of the geology and hydrogeology of Ramsey County is included in County Geologic Atlas C-7, available from the Minnesota Geological Survey Map Sales Office, 2642 University Avenue, St. Paul, MN 55114-1057 (627-4782) or the Ramsey Soil and Water Conservation District (488-1476).

Editor's note: Thanks to Joyce Meints, Minnesota Geological Survey, University of Minnesota and Bruce Dahlman, Minnesota Department of Natural Resources for map preparation. Many of the Ramsey County atlas maps are available as ARC/INFO coverages. Contact the MGS for more information on the use and transfer of digital atlas products.

Directory Update

These corrections and additions are current through January 15, 1993. Please let us know when your information changes!

Listing Format:

Last Name, First Name
Employer
Preferred Mailing Address
(not necessarily at work)
City , State Zip
Work Phone
Fax Number

Ansari, Azher
331 Metcalf Drive
Eagan, MN 55122

Blomquist, Dr. Roger V.
Braun Intertec
1345 Northland Drive
Mendota Heights, MN 55120-1141
(612)683-8928

Burman, Sandeep
University of Minnesota
Geology Department
310 Pillsbury Dr SE
Minneapolis, MN 55455
(612)624-7876

Burns, Greg
PACE, Inc.
1710 Douglas Drive N
Minneapolis, MN 55422-4399
(612)525-3443
(612)525-3377

Cook, William B.
Howard Needles Tammen, *et al.*
6700 France Ave S
Minneapolis, MN 55435
(612)920-4666
(612)920-0173

Crum, Richard
Northeast Technical Services
315 Chestnut St PO Box 1142
Virginia, MN 55792
(218)741-4290

Fashbaugh, Earl F.
4329 Oakley St
Duluth, MN 55804
(218)722-3915

FitzGerald, Tom
Carbonair
8640 Monticello Lane
Maple Grove, MN 55369-4547
(612)425-2992
(612)425-6882

Fong, Alison L.
MN Pollution Control Agency
425 13th Ave SE #606
Minneapolis, MN 55414
(612)297-8476

Fryzek, Todd
Woodward Clyde Consultants
6465 Wayzata Blvd, Suite 660
Minneapolis, MN 55426
(612)593-5650
(612)593-0094

Gowan, Angela S.
University of Minnesota Duluth
117 W 8th St
Duluth, MN 55806
(218)726-7935

Harrison, Barry
Barr Engineering Co.
8300 Norman Center Dr
Minneapolis, MN 55437-1026
(612)832-2714
(612)835-0186

Harrod, Leigh
Hennepin Conservation Dist.
10801 Wayzata Blvd #240
Minnetonka, MN 55305
(612)544-8572

Hemstreet, Mark
Leggette, Brashears & Graham
1210 W Co Rd E Suite 700
St. Paul, MN 55112-3739
(612)490-1405

Hinkel, Robert J.
Twin Ports Testing, Inc.
728 Garfield Ave
Duluth, MN 55802-2634
(218)722-1911
(218)722-3295

Hoyer, Marcus C.
2347 Elm Drive
White Bear Lake, MN 55110
(612)625-6853
(612)624-0293

Hunt, Dr. Randy
USGS WRD
6417 Normandy Ln
Madison, WI 53719

Isberg, Gunnar
MWCC
230 E 5th Street
St. Paul, MN 55101
(612)229-3271
(612)229-2121

Johannessen, Kim
Barr Engineering Co.
8300 Norman Center Drive
#300
Minneapolis, MN 55437-1026
(612)832-2686
(612)835-0186

Johnson, Barb
Association of MN Counties
125 Charles Ave.
St. Paul, MN 55103
(612)224-3344

Johnson, Kurt B.
RCM, Inc.
10901 Red Circle Drive
PO Box 130
Minnetonka, MN 55343
(612)935-6901
(612)935-8814

Kocon, Robert T.
Mateffy Engineering, Inc.
663 Old Hwy 8
New Brighton, MN 55112
(612)636-6116
(612)636-2100

Larson, Mark B.
Braun Intertec Environmental, Inc.
1345 Northland Drive
Mendota Heights, MN 55120-1141
(612)638-8700
(612)683-8888

Lehn, Rod
ATEC
4765 Debra Ln
Shoreview, MN 55126
(612)645-9520
(612)645-4529

Lowell, Rhea K.
Geraghty & Miller, Inc.
105 5th Ave. South Ste 350
Minneapolis, MN 55401-2535
(612)339-9434
(612)336-4538

Mahle, BethAnn
Dahl & Associates, Inc.
4390 McMenemy Road
St. Paul, MN 55127-6004
(612)490-2905
(612)490-3777

Marxen, Robert J.
Twin City Testing
737 Pelham Ave
St. Paul, MN 55114
(612)659-7592

Mateffy, Leslie H.
Mateffy Engineering, Inc.
663 Old Hwy 8
New Brighton, MN 55112
(612)636-6116
(612)636-2100

Meyerson, Tim
Leonard, Street and Deinard
150 S. 5th St. Ste 2300
Minneapolis, MN 55402
(612)335-1741
(612)335-1657

Morseth-Mayer, Mark R.
WW Engineering & Science
5301 East River Rd Suite 110
Minneapolis, MN 55421-1024
(612)571-2869
(612)571-2989

O'Grady, Kathleen
University of Minnesota
Geology Department
9800 Beard Ave S
Bloomington, MN 55431
(612)624-6541

Orner, Kathy
Applied Engineering, Inc.
2905 Oak Lea Terrace
Mayzata, MN 55391-2533
(612)939-9095
(612)939-9095

Pearson, Scott Richard
Liesch Environmental Serv.
13400 15th Ave N
Plymouth, MN 55441
(612)559-1423

Peterson, Norville D.
Peterson Drilling, Inc.
PO Box 1045
Virginia, MN 55792
(218)741-4070
(218)749-6368

Piegat, Dr. James
Hennepin Conservation Dist.
10801 Wayzata Blvd Ste 240
Minnetonka, MN 55305
(612)544-8572

Pofahl, Robert J.
Resources Engineering Assoc.
8505 University Green
Middleton, WI 53562
(608)831-6563
(608)831-6564

Rapp, Keith B.
SEACOR
3531 Owasso St #302
Shoreview, MN 55126
(612)627-0340
(612)627-9082

Rausch, Deborah E.
American Engineering Testing
4431 W Michigan St.,
PO 16008
Duluth, MN 55816
(218)628-1518
(218)628-1580

Richard, Don E
Barr Engineering Co.
8300 Norman Center Dr
Ste 300
Minnespolis, MN 55437-1026
(612)832-2732
(612)835-0186

Rick, Jerry R.
Delta Environmental Cons., Inc.
3900 Northwoods Dr
St Paul, MN 55112
(612)486-8022
(612)486-8021

Ronning, Tedd
Remediation Technologies, Inc.
413 Waconta St
300 Gilbert Bld
St. Paul, MN 55101
(612)222-0841
(612)222-8914

Schafer, David
Geraghty & Miller, Inc.
105 5th Ave. South Ste 350
Minneapolis, MN 55401-2535
(612)339-9434
(612)336-4538

Scheinost, Lisa
IT Corporation
4190 N Lexington Ave
St. Paul, MN 55126
(612)481-8084
(612)481-9697

Schilling, Don
Wright College
2383 Duncan Dr Apt 7
Fairborn, OH 45324
(513)873-3464

Schilling, Glen
Univ of Minnesota, Morris
PO Box 524
Morris, MN 56267
(612)589-2385

Schlotthauer, Jennifer
MN Pollution Control Agency
MPCA GW&SW
520 Lafayette Road
St. Paul, MN 55155-3898
(612)644-1126

Schmidt, Robert D.
U.S. Bureau of Mines
5629 Minnehaha Ave South
Minneapolis, MN 55417-3099
(612)725-4675
(612)725-4526

Schnorr, Ralph J.
USDA Soil Conservation Serv.
RR 4 Box 391
Aberdeen, SD 57401
(605)226-3879

Siedlecki, Mary
5740 E River Road #314
Fridley, MN 55432

Smith, Rennie
Concept Environmental Services, Inc.
14791 60th St N #6
Stillwater, MN 55082-6359
(612)439-1634

Smith, Rich
PACE, Inc.
1710 Douglas Dr N
Minneapolis, MN 55422-4399
(612)544-5543
(612)525-3377

Splinter, Dr. Roger C.
PACE, Inc.
1710 Douglas Dr N
Minneapolis, MN 55422
(612)525-3453
(612)525-3377

Spong, Ronald C.
Dakota County Environmental Management Department
1772 Ashland Ave
St. Paul, MN 55104-6037
(612)891-7542
(612)891-7031

St. George, Lynette
University of Minnesota Duluth
229 Heller Hall
10 University Drive
Duluth, MN 33812-2996
(218)726-7935

Steinward, Shari A.
Department of Geology
Hella Hall 226
10 University Dr UMD
Duluth, MN 55812
(218)726-7935

Twiss, Patrick
Ramsey Co SWCD
2015 Rice St
Roseville, MN 55113
(612)488-1476

Umholtz, Mark V.
Groundwater Technology, Inc.
151 W Burnsville Parkway
#201
Burnsville, MN 55337
(612)890-0665

Vick, Timothy
Carleton College
Geology Department
Northfield, MN 55057-4025
(507)663-4401
(507)663-4200

Williams, Charles E.
Terracon Environmental, Inc.
3535 Hoffman Rd East
White Bear Lake, MN 55110
(612)770-1500
(612)770-1657

New Aquifer Standards Under Development

Standards relating to the determination of hydrogeologic properties of ground water aquifers have been, and are continuing to be, developed by Subcommittee D18.21 on Ground Water and Vadose Zone Investigations, a subdivision of Subcommittee D18 on Soil and Rock of the American Society for Testing and Materials (ASTM). Members of Section D18.04 on Hydrogeologic Parameters serve as reviewers of draft methods prepared by a task group. Expenses for task group meetings are provided through an agreement with the Environmental Protection Agency, U.S. Geological Survey, and U.S. Navy in order to expedite the development of standards related to ground water monitoring and investigation.

At a late 1991 meeting, Task Group Chairman M.S. "Doug" Bedinger (University of Nevada Las Vegas) announced that in a matter of only two years of effort, the following six standards for ground water investigations have successfully completed all balloting and are available in print: (1) Guide for Selection of Aquifer Test Field and Analytical Procedures in Determination of Hydraulic Properties by Analytical Procedures in Determination of Hydraulic Properties by Well Techniques; (2) Test Method (Analytical Procedure) for Determining Transmissivity of Non-Leaky Confined Aquifers by Over-Damped Well Response to Instantaneous Change in Head (Slug Test); (3) Standard Test Method (Field Procedure) for Instantaneous Change in Head (Slug) Tests for Determining Hydraulic Properties of Aquifers; (4) Test Method (Field Procedure) for Withdrawal and Injection Well Tests for Determining Hydraulic Properties of Aquifer Systems; (5) Test Method (Analytical Procedure) for Determining Transmissivity and Storage Coefficient of Non-Leaky Confined Aquifers by the Modified Theis Nonequilibrium Method; and (6) Test Method (Analytical Procedure) for Determining Transmissivity and Storage Coefficient of Non-Leaky Confined Aquifers by the Theis Nonequilibrium Method.

Each of these standards contains ground water terminology that will become a part of ASTM Standard D653 on Terminology Related to Soil, Rock, and Contained Fluids.

Ground water specialists interested in assisting in the development of standards related to ground water or vadose zone investigations are invited to participate in meetings of the Hydrogeologic Parameters Section and any of the other nine sections of Subcommittee D18.21. For additional information on the above described activities, contact M.S. Bedinger, chairman, Section D18.21.04, Environmental Research Center, University of Nevada-Las Vegas, 5025 S. Eastern Ave. 16-306, Las Vegas, NV 89119, Phone: (702) 798 -2372; David Nielsen, chairman, ASTM Subcommittee D18.21, Nielsen Ground Water Science, 4686 State Route 605 South, Galena, OH 43021, Phone: (702)295-7234; or Robert Morgan, staff manager, ASTM, 1916 Race St., Philadelphia, PA 19103, Phone: (215) 299-5520.

Subcommittee D18.21 has a Section D18.21.10 on Ground Water Modeling. The task group is developing guidelines for ground water modeling that relate to both model applications and software. A cooperative agreement between EPA, USGS, and the U.S. Navy is sponsoring the work of a task group to develop draft standards for final development by Section D18.21.10 and subsequent balloting in Committee D18 on Soil and Rock.

Section D18.21.10 has two draft guidelines that were reviewed at their task group meeting held in 1991. The draft standards have been balloted in subcommittee and comments were being resolved at that meeting. These include the Standard Guide for Comparing Ground Water Flow Model Simulations to Site Specific Information, and the Standard Guide for Application of a Ground Water Flow Model to a Site Specific Problem.

Nineteen other proposed standards are under consideration.

Professionals familiar with ground water modeling are encouraged to get involved in ASTM Section D18.21.10 standards development activities. Individuals interested in participating in this activity should write to Joe Ritchey, chairman, ASTM Subcommittee D18.21.10, Heritage Remediation/ Engineering, 5656 Opportunity Dr., Toledo, OH 43612; or Jim Rumbough, vice-chairman, Subcommittee D18.21.10, Geraghty & Miller Inc., 10700 Parkridge Blvd., Ste. 600, Reston, VA 22091. The ground water modeling section usually meets the last week of January and the last week of June.

Individuals interested in information of future meetings or in participating in other ASTM Sections under Subcommittee D18.21, contact Robert Morgan at his previously listed address.

—Ground Water Monitoring Review, Fall 1992

Ground Water Policy Updated by EPA

To promote a consistent ground water cleanup approach for both Superfund sites and facilities subject to corrective action under the Resource Conservation and Recovery Act (RCRA), EPA's Office of Solid Waste and Emergency Response (OSWER) has updated a 1989 ground water policy. The new directive builds on previous policies and program experience to address special ground water problems associated with non-aqueous phase liquid (NAPL) contaminants. Ground water contamination affects more than 70 percent of Superfund National Priorities List (NPL) sites and almost 50 percent of permitted RCRA land disposal facilities.

continued on page 18

Fall Meeting on Characterizing Aquifer Conditions — Another SRO

The afternoon of November 10th, nearly 140 ground water professionals attended the MGWA Fall Meeting on characterizing aquifer conditions at the Earle Brown Center. The agenda included presentations on formation sampling, lab testing of aquifer samples, conducting and analyzing aquifer tests, and use of computer aids for analyzing aquifer test data.

Sheila Grow kicked off the meeting by announcing that November 10th was Minnesota Ground Water Association Day as proclaimed by Governor Arne Carlson. The proclamation was in recognition of MGWA's tenth anniversary. (The proclamation is reproduced below.)

Steve Bennet, Minnesota Health Department, headed the program by reviewing formation sampling techniques and, of course, problems. He said that while the geology of an area is a major factor when designing a sampling program, cultural factors such as power lines and something as basic as the weather can affect which sampling technique is appropriate, useable and cost-effective.

STATE OF MINNESOTA

THE GREAT SEAL OF THE STATE OF MINNESOTA • 1858 •

Proclamation

WHEREAS: Ground water in Minnesota is recognized to be an important and valuable natural resource; and

WHEREAS: The Minnesota Ground Water Association was formed in 1982 to serve the citizens of Minnesota; and

WHEREAS: The Minnesota Ground Water Association has pledged to advocate for the wise use and protection of ground water to provide education to users of Minnesota ground water; and

WHEREAS: There are over 600 members in the Minnesota Ground Water Association, including technical professionals, legislators and other concerned citizens; and

WHEREAS: The Minnesota Ground Water Association is celebrating 10 years of service to the State of Minnesota;

NOW THEREFORE, I, ARNE H. CARLSON, Governor of the State of Minnesota, do hereby proclaim November 10, 1992 to be

MINNESOTA GROUND WATER ASSOCIATION DAY

IN WITNESS WHEREOF, I have hereunto set my hand and caused the Great Seal of the State of Minnesota to be affixed at the State Capitol this tenth day of November in the year of our Lord one thousand nine hundred and ninety-two, and of the State the one hundred thirty-fourth.

SECRETARY OF STATE

GOVERNOR

Steve reviewed the standard sampling equipment types including augers, split spoons, and thin-walls with reminders on proper technique. He then went on to introduce some of the newer techniques including hydro-punch, wire-line cores, and rotosonic drilling.

According to Steve, the quality of formation samples has dropped lately. Lack of driller experience, cutting corners and clients that won't pay for good technique are some of the reasons he cited.

Gordy Eischens, Soil and Engineering Testing, Inc., reviewed laboratory testing procedures for formation samples, emphasizing engineering-type testing techniques. This included procedures for pervious materials (water content, dry density, sieve analysis and constant head analysis), clayey materials (falling head and back-pressure permeability) as well as basic materials classification and properties (sieve analysis, atterberg, hydrometer and related ASTM methods.)

Much of Gordy's talk focused on "getting good results." He reviewed the questions that must be asked (and answered) when planning a sampling program, such as

- What do you want to know?
- Which layer is important?
- Which direction?
- How will you retreive the samples? How disturbed will they be?
- Which analyses will be run on which samples?

Gordy reminded the audience of the importance of choosing the correct testing method for the sample. He also said that quality lab results require good quality samples; that a properly done test on the wrong type of badly disturbed sample is worthless. Gordy decried the "stinginess" of some current projects that require shortcuts, limiting time and funds. He also said "sample quality is no better than twenty years ago', adding that "agencies require methods

—continued on page 18

Fall Meeting, cont.

and numbers of tests rather than performance."

Next, Larry Johnson, Dames and Moore, and Jay Frischman, Department of Natural Resources, waded into the murky waters of pumping tests, illustrating their talk from experience learned the hard way. They reviewed planning considerations:

- objectives
- pre-test calculations
- pumping strategy
- pumping well location, pump type and development
- ob-well locations
- pump rate measurement
- water level measurement
- test mechanics (e.g., Where DO you get rid of all that water?)

All these considerations are just the preparation to actually running the test which requires:

- all the prep work has been completed
- equipment has been calibrated
- baseline water level data collected
- site conditions are documented throughout the test
- logarithmic time sequence is followed for both drawdown and recovery
- the pumping rate is constant throughout the test

Both Larry and Jay emphasized plotting up the data while on site, as the test proceeds. An on-site plot can identify if something is wrong, such as if the pumping rate needs to be adjusted or if a piece of equipment has failed. On-site plots can also help determine when to terminate the test.

Dave Schafer of Geraghty and Miller continued the program, discussing the mysteries of pump test analysis and those elusive aquifer characteristics, K, T, and S. He reminded the audience that estimating aquifer parameters will not be sufficient in many cases where capture zones and pump-out response must be well known to assure a contaminant plume is captured. In addition, well-defined aquifer parameters allow better estimates of costs over the life of a pump-out operation.

Dave reveiwed the Jacob-Theis (confined), Hantush (leaky confined) and Neuman (unconfined) analysis methods, pointing out their appropriate application.

Wrapping up the afternoon was a question and answer session on computer analysis of aquifer test data. Larry Johnson, Dave Schafer and Jeanette Leete, DNR, shared their experience working with several programs.

—to top of next column

ISGS Conducts Soil Barrier Experiments

Compacted soil liners are widely used at landfills and waste lagoons to contain leachates and liquid wastes. How effective are they at controlling seepage? Can they be constructed to meet the U.S. EPA's standard for saturated hydraulic conductivity of no more than $1x10^{-7}$ cm/s?

Results have been encouraging in the first long-term, field-scale experiments on soil barriers, currently being conducted at the Illinois State Geological Survey (ISGS) by a team of hydrogeologists, chemists, and engineers.

Design, construction, and monitoring of a prototype liner alerted researchers to the need for soil processing and rigid QA/QC before building the large-scale liner (7.3 x 14.6 x 0.9 m). Full scale equipment was used to compact six 15 cm lifts.

After one year of monitoring and collecting data on the large scale liner, ISGS researchers estimated saturated hydraulic conductivities at 3.3×10^{-9} cm/s (large ring infiltrometer data), 5.3×10^{-8} cm/s (small ring infiltrometer data), and 6.7×10^{-8} cm/s (water balance analysis). Measurements of soil tension by pressure-transducer tensionmeters indicated that the wetting front had reached a depth greater than 20 cm.

Predictions of when water would break through the base of the liner have ranged from 2.4 to 12.6 years. ISGS researchers, now in their third year of monitoring, still see no breakthrough.

A report on this study is available for $4, plus shipping and handling, from ISGS. For more information, write ISGS, 615 E. Peabody Dr., Champaign, IL 61820; Phone: (217)333-4747.

—Ground Water Monitoring Review, Fall 1992

Annual Water Well Conference

The Minnesota Department of Health Well Management Unit will hold the Annual Water Well Conference on Wednesday, March 24, 1993. Six hours of continuing education credit will be awarded to attendees.

The morning agenda includes the new code and iron and sulfur bacteria. The afternoon offerings include three concurrent sessions: for well contractors, for monitoring well engineers, and for limited licensees.

The conference fee, including lunch, is $45 in advance, $50 at the door. Preregistration is requested; the deadline is March 15, 1993. For further information, call Roman Koch at (612)627-5153 or Gunilla Montgomery at (612)627-5125.

Chrysalis Scholarship

The Association for Women Geoscientists Foundation is pleased to announce Chrysalis, a scholarship for a woman who needs money to complete her thesis. Three scholarships of $750 each will be awarded in 1993. The money may be used for typing, drafting, childcare, or whatever it takes to finish the thesis and complete a Masters or PhD degree program in a geoscience field.

Criteria

1. The applicant must be a women whose education has been interrupted for at least one year.
2. The applicant must be a candidate for an advanced degree in a geoscience field.
3. The applicant must be completing her thesis during the current academic year.

Application Procedure

The applicant should submit:

1. A letter which contains a short statement of her background, her career goals and objectives, how she will use the money, and the nature and length of the interruption to her education.
2. Two letters of reference, the first from her advisor and the second from a person of her choice who can attest to her qualifications for this award. The referenece letter from her thesis advisor should include a statement of the applicant's prospects for future contributions to the geosciences, and of the anticipated date of completion of her degree.

All application materials should be clearly labeled with the applicant's name and address and should be sent to:

Chrysalis Scholarship, Association for Women Geoscientists Foundation, Macalester College Geology Department, 1600 Grand Avenue, St. Paul MN 55105-1899. *Deadline for application is February 28, 1993.*

Two Ground Water Protection Documents Available from EPA

As part of its ground water protection strategy for the 1990s, the U.S. EPA has made available two new documents: Draft Comprehensive State Ground Water Protection Program Guidance and A Handbook for State Ground Water Managers.

The Draft Guidance is designed to enhance and encourage the progress that states, local governments, citizens, and other federal agencies are making in ground water protection. The Handbook describes 14 EPA ground water protection grant programs.

For more information or copies of the two documents, contact Roy Simon at (202)240-7077.

—Water Well Journal, October 1992

Minnesota Water Well Convention

The 71st Annual Convention of the Minnesota Water Well Association will be held February 1-2, 1993. The convention will feature seminars, a trade show and a half-day program on public education about ground water issues.

Special speakers include: Andrew Stone, American Ground Water Trust, the organizer of the half-day seminar, *Ground Water Education for the Public: Why is it Needed and How to do it*; Dr. Robert Farvolden, National Ground Water Association; Carl Mason of Baroid Industries, Inc., who will speak on adverse drilling conditions; Dan Wilson of the Minnesota Department of Health, who will review Health Department rules; Fletcher Driscoll, Geraghty & Miller, Inc., who will provide a presentation on the Geologic Character of Ground Water Systems in Minnesota.

For more information or to request a brochure, please call the Minnesota Water Well Association at (612)290-2823.

Ground Water Policy, cont.

Specific recommendations in the new policy directive include EPA's need to determine the likelihood of NAPL contamination — especially dense NAPLs — as soon as possible during overall site investigations. Where NAPLs are likely, the nature and extent of contamination should be characterized to determine appropriate remedial actions. Early response actions should be used to minimize further migration of dissolved and/or NAPL contaminants and should be implemented in phases to allow coordination with later cleanup efforts. Careful ground water monitoring should be included in all cleanups in order to measure effectiveness and allow design improvements, when necessary. Furthermore, for sites where hydrogeologic and/or contaminant characteristics ultimately may not allow long-term ground water cleanup targets to be achieved, EPA is reserving the right to issue technical impracticability waivers for NPL sites and to modify RCRA permits or enforcement orders. In these cases, EPA will identify alternative remedial requirements to protect human health and the environment appropriate for that site's conditions. Copies of OSWER Directive 9283.106, "Considerations in Ground Water Remediation at Superfund Sites and RCRA Facilities: Update," can be obtained from the National Technical Information Service at (703)487-4650.

—Ground Water Monitoring Review, Fall 1992

Paperbox Checkoff

Please note that MGWA is soliciting your contributions toward our use of recycled paper via a special checkoff on your membership renewal form.

Donations in any amount are appreciated. MGWA uses 100% recycled paper which is substantially more expensive than new, bleached paper.

Donors will be recognized in the next issue of the newsletter.

Calendar

1993

February 1 - 3. *71st Annual MWWA Convention and Exposition, Hazmat Conference.* For more information, contact Michael Maile (612)290-2823.

February 4 - 5. *39th Annual Wastes Engineering Conference.* Thunderbird Hotel, Bloomington. Information: Department of Professional Development, University of Minnesota (612)625-4331.

February 16 - 18. *Practical Optimization Modeling for Ground Water Management.* To be held in Phoenix, AZ by NGWA.

February 21 - 24. *Agricultural Research to Protect Water Quality.* Radisson Hotel South, Bloomington, MN. Co-hosted by the Management Systems Evaluation Area Program and the Soil and Water Conservation Society. Contact: SWCS, 7515 Northeast Ankeny Rd., Ankeny, IA 50021-9764; (800) THE-SOIL.

February 24. *Erosion and Sediment Control Inspection and Enforcement in the Metropolitan Area.* To be held at the Earle Browne Continuing Education Center, University of Minnesota. For more information, contact Bev Ringsak (612)625-6689.

March 14 - 17. *Spring Symposium on Geographic Information Systems & Water Resources.* Mobile, Alabama. Contact AWRA.

March 29 - 30. *GSA North-Central Section Meeting.* Rolla, Missouri. Information: Richard Hagni, Dept. of Geology and Geophysics, University of Missouri, Rolla, MO 65401, (314)341-4616.

April 17 - 21. *Canadian Quaternary Association (CANQUA).* Victoria, British Columbia, Canada. Information: Environmental Geology Section, BC Geological Survey Branch, 553 Superior St., Victoria, British Columbia, V8V 1X4, Canada, (604)387-6249, fax (604)356-8153.

May 1 - 2. *First Great Lakes Ground Water Information System Regional Workshop.* Pheasant Run Conference Center, St. Charles, IL. Contact: Freshwater Foundation, Spring Hill Center, 725 County Road Six, Wayzata, MN 55391; (612)449-0092, fax (612) 449-0592.

May 19 - 21. *6th Symposium on Artificial Recharge of Ground Water: Purpose, Problems, & Progress.* Phoenix, AZ. Contact: WRRC, University of Arizona, 250 N. Campbell, Tucson, AZ,

More details available from:

AWRA, contact Michael C. Fink, AWRA, 5410 Grosvenor Lane, Suite 220, Bethesda, MD 20814-2192, (301)493-8600, Fax: (301)493-5844.

NGWA, 6375 Riverside Drive, Dublin, Ohio 43017 (614) 761-1711.

IGWMC, Institute for Ground Water Research and Education, Colorado School of Mines, Golden, Colorado 80401-1887, (303)273-3103, Fax (303)273-3278.

Minnesota Ground Water Association
P. O. Box 65362
St. Paul, MN 55165

100%
recycled

First Class
U.S. Postage
PAID
St. Paul, MN
Permit No. 7122