

Minnesota Ground Water Association

www.mgwa.org

Volume 24, Number 4: December 2005

MGWA 2005 Fall Conference and Workshop – GeoChemistry for Scientific Investigations

On a sharp, chilly morning, Laurel Reeves, MGWA President, welcomed an audience of about 200 to a day's learning on the geochemical tools that can help investigate and solve ground water "mysteries".

Dr. Laine Vignona, University of Wisconsin, River Falls, led off the morning's program with her presentation, "Geochemistry Refresher and Pollution Study Applications", that challenged us to dust the cobwebs off perhaps hazy memories of chemistry and aqueous geochemistry. She covered the basics beginning with the general properties of water and then moved on to basic chemistry. To illustrate the importance of equilibrium constants, she focused on the cycling of mercury species in the environment. She also reviewed the

ecological redox sequence and its importance in denitrification and other chemical transformation processes. She concluded her presentation by discussing two issues of concern: the distribution of mercury in soil and ground water and the detection of pharmaceuticals in surface and ground water.



MGWA Past President Chris Elvrum (l.) received the MGWA Distinguished Service Award from MGWA President Laurel Reeves at the 2005 Fall Conference

Scott Alexander, University of Minnesota, Department of Geology and Geophysics, presented "Non-contaminant Chemistry of Natural Waters" and provided a number of examples of the wealth of information that can be extracted from relatively inexpensive analyses. The major chemical components of water are useful in understanding the source and history of a water sample. Using an example from Goodhue County, Scott demonstrated how the rock and sediment of the ground water recharge area influence the resulting major ion chemistry of a water sample. In several examples, Scott showed how "bread and butter" chemistry can sometimes quickly and inexpensively answer the question whether or not a water sample has been affected by anthropogenic-source waste or processes, such as inorganic fertilizer, water softener salt, or road salt. These applications work best when plenty of data, including complete suites of ions, is available and the samples are analyzed at low

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President's Letter

Over 70% of Minnesotans obtain their water supply from ground water. The remainder is supplied by surface water, mostly one particular river. Seldom do we stop to consider that the base flow for that river relies entirely on ground water. In that light, well, nearly all of our water supply is ground water at some time in the hydrologic cycle. It's the point when water is ground water — which is our organization's concern — that the future presence of water is often taken for granted, even by ground-water professionals.

Our task is to step away from our *niche* in the profession and market our science. Society's health and welfare depend on our ability to inform leaders, managers, neighbors and friends on the long-term implications

of our decisions and prompt them toward enlightened progress. Will there still be an adequate and clean ground-water supply at the end of this century? In 150 years? In just seven generations? Melodramatic perhaps, but I'm not willing to stake future generations' lives on moment to moment, often uninformed, choices. Please get involved and put your ground-water knowledge to work in your community.

As the year and my term come to a close, my thanks go to the MGWA members for allowing me this opportunity, to the MGWA Board for their insight and their time, and to my colleagues in the Waters Division of the Department of Natural Resources for their ideas and their patience.

Take care,

Laurel Reeves, MGWA President

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MGWA Newsletter Contacts

Editor-In-Chief

Norm Mofjeld, current issue editor
Minnesota Department of Health
(651)201-4593

norman.mofjeld@health.state.mn.us

Newsletter Team

Tom Clark
Minnesota Pollution Control Agency
tom.p.clark@pca.state.mn.us

Jan Falteisek
Minnesota Department of
Natural Resources
jan.falteisek@dnr.state.mn.us

Steve Robertson
Minnesota Department of Health
steve.robertson@health.state.mn.us

Kurt Schroeder
Minnesota Pollution Control Agency
kurt.schroeder@pca.state.mn.us

Advertising Manager

Jim Aiken
McCain Associates
(952)470-0983
jaiken@mccainassociates.com

MGWA Management & Publications

Dr. Jeanette Leete
WRI Association Mgmt Co.
(651)276-8208
Office@MGWA.org

MGWA Web Page

Visit www.mgwa.org for MGWA
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conference transactions.

2006 Newsletter Deadlines

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September	08/11/2006
December	11/09/2006

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Members in the News

On October 4, 2005, **John Aho**, Senior Hydrologist and 31-year employee with the Minnesota Pollution Control Agency, retired from State service. John was a veteran of countless hours in the field (pictured below), providing hydrogeologic support to the Agency's highly regarded Emergency Response Unit. Best wishes to John on his retirement!



Hydrologist and Principal Planner **Cathy O'Dell** has recently accepted a new position at the Minnesota Pollution Control Agency. After eight years with the Voluntary Investigation and Cleanup (VIC) Program, Cathy has joined the Environmental Information and Reporting Unit where her main responsibilities will be water monitoring assessment and coordination, as well as environmental reporting. Cathy previously worked for the Minnesota Department of Natural Resources and in the private sector as an environmental consultant. Cathy served as MGWA President in 1995.

A PhD Dissertation Award Honorable Mention went to University of Minnesota Water Resource Science alumna and MGWA member, **Melinda (Mindy) Erickson**. Her dissertation was titled "Arsenic in Upper Midwest Ground Water: Occurrence and Geochemical Mobilization Mechanisms". Mindy now works as a Senior Research Specialist for the Minnesota Department of Transportation.

Gregory L. Small is now with American Engineering Testing, Inc. In his position as a Senior Scientist he will be working with a variety of private and public sector clients to resolve their environmental issues. In particular, he will be working with developers to redevelop brownfield sites and several industrial clients with chemical contamination issues. His email address has changed to gsmall@amengtest.com.

Dirk Leemkuil is now with Kleinfelder, an employee-owned engineering and environmental science firm. Most of Kleinfelder's offices are in the western United States. Dirk's email address has changed to dleemkuil@kleinfelder.com

Robert Frykman is now with Golder Associates in their Roseville office.

Patricia Bloomgren is taking a break from being the Director of Environmental Health at the Minnesota Department of Health and has accepted a temporary assignment to be the Director of the Infectious Disease Epidemiology, Prevention and Control (IDEPC) Division, also with the Minnesota Department of Health. John Linc Stine, Assistant Division Director, is the Acting Division Director.

Karlene French is now a Hydrologist 3 with the Minnesota Department of Transportation. Her e-mail is Karlene.French@state.mn.us.

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Member News, cont.

AE2S (Advanced Engineering and Environmental Services, Inc.) has acquired ERI (Engineering Resources, Inc.) from MGWA member **Costa Dimitracopoulos**, PE, and his partner Jason Benson, PE.

Costa will be managing the office. He has over 20 years of experience in project development and management including wastewater treatment facilities, lift stations, water treatment, water supply, water storage and distribution facilities, and solid waste facilities. He is a registered Professional Engineer in the states of Minnesota, North Dakota, Wisconsin, and Iowa.

Jason Benson is a registered Professional Engineer in Minnesota and North Dakota with over 10 years of experience.

Dimitracopoulos and Benson, pictured below, work in offices located in the Water Tower Business Center in Maple Grove. Costa's new e-mail address is costa@ae2s.com.



Fall Conference, cont.



Goeff Delin, USGS.

detection limits

Geoff Delin, U.S. Geological Survey, in his talk, "The Use of Environmental Tracers to Age-date Recently Recharged Waters" reviewed the use of several tracers, both natural and anthropogenic, to age-date waters. Tritium, an isotope of hydrogen commonly used for age dating, is a useful if rather blunt sword for identifying recent waters. More precise tools such as chlorofluorocarbons (CFC's), sulfur hexafluoride (SF_6), and tritium/helium allow greater certainty in the age of a water sample. Geoff showed several application examples including ground water recharge rate estimation, ground water residence time, and ground water stratification in unconfined aquifers.

The final three speakers on the morning's program were all hydrogeologists with the Minnesota Department of Health and focused on water supply and wellhead protection.

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2005 Board of Directors

Past President

Chris Elvrum
Metropolitan Council
(651)602-1066
christopher.elvrum@metc.state.mn.us

President

Laurel Reeves
DNR Waters
(651)296-0321

laurel.reeves@dnr.state.mn.us

President-Elect

Dale Setterholm
Minnesota Geological Survey
(612)627-4780
sette001@umn.edu

Secretary/Membership

Jon Pollock
Frontline Environmental
(952)892-0367
frontline@uscorp.net

Treasurer

Craig Kurtz
SEH, Inc.
(651)490-2022
ckurtz@sehinc.com

The primary objectives of the MGWA are:

- Promote and encourage scientific and public policy aspects of ground water as an information provider;
- Protect public health and safety through continuing education for ground water professionals;
- Establish a common forum for scientists, engineers, planners, educators, attorneys, and other persons concerned with ground water;
- Educate the general public regarding ground water resources; and
- Disseminate information on ground water.



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Fall Conference, cont.



Steve Robertson, MDH.

Steve Robertson presented "Sleuthing for Contaminant Pathways in a Fractured Aquifer Setting Near a Contaminated Municipal Supply Well" and described an investigation of volatile organic compounds (VOC) contamination in one of the City of Edina's wells, which was shut down when the vinyl chloride concentration exceeded the EPA maximum contaminant level (MCL). He described the continuing investigation of City Well Number 7, a 550-foot well with 200 feet of open hole mostly in the Prairie du Chien aquifer that is dominated by secondary porosity. The hydraulically active zone in the Prairie du Chien aquifer at the well is 50 to 90 feet above the top of the Jordan aquifer. Because of several pumping wells in the area, ground water flow direction may vary and transient conditions may be important. Geochemical and contaminant data have not yet identified the source of the VOC's, so contaminant plume mapping continues.



Jim Walsh, MDH.

Jim Walsh presented "Isotope Investigations in Wellhead Protection Areas" and showed a number of examples of the application of geochemistry and isotopes to resolve source water questions of water supply wells. For example, in Alexandria tritium data indicated recent recharge and in addition, the well had geochemical indicators of lake water. Another example from Bemidji demonstrated how stable isotopes were used to show that the source of water to the well was ground water and not lake water. Other examples, including Luverne, Hastings, Keewatin, and Moose Lake, showed the value of chemical, geochemical, and isotope data to identify water sources to wells, and thus focus needed protection and remediation efforts.

Jim Lundy closed the morning's program with his presentation, "Looking for Radium in all the Right Places." He noted that the highest radium concentrations in water samples in Minnesota are from the Paleozoic rocks. A study of radium in the Mt. Simon aquifer by the Minnesota Geological Survey in the early 1990's showed no consistent spatial pattern. Jim described current efforts in the extended Twin Cities metro area, especially the northern, western, and southern areas to better define and understand the source of radium in ground water and the conditions under which it is mobilized and transported.



Mindy Erickson, MnDOT.

The afternoon session began with a presentation by Dr. Melinda Erickson of the Minnesota Department of Transportation. The title of her presentation was "Geochemical Investigation of Naturally Occurring Arsenic in Upper Midwest Ground Water." She described how arsenic is distributed in Minnesota and how it is related to geological parent material. She reviewed the forms of arsenic in

ground water and discussed the geochemical mechanisms involved in the release of arsenic from the sediment into ground water. Her research has shown that public water supply wells have less arsenic than other wells because the well screen is located further into the aquifer. She concluded that the investigation of the availability of arsenic in ground water has more to do with geochemistry than defining a source or the extent of the source.



Mike Berndt, DNR.

Dr. Mike Berndt of the Minnesota Department of Natural Resources presented "Use of Halide Tracers to Constrain Hydrology of an Open-Pit Tailings Disposal Site in Northeast Minnesota". Bromide and chloride were monitored in a well and mine pits in order to find primary flow paths, evaluate chemical changes relative to these elements and constrain water balances. He explained how the amount of water exiting a mine pit could be determined by measuring bromide concentration in water entering and exiting the pit.

Dr. Calvin Alexander of the University of Minnesota explained how "Conduits Rule, Fractures Drool and Pores Suck (Karst and the Nature of Hydrogeologic Reality)". He said that porous media models are based on assumptions that aquifers are isotropic and homogeneous. He stated that aquifers are heterogeneous at the human scale and neither isotropic nor homogeneous at any scale. He noted that there is a growing engineering and science literature regarding heterogeneous materials. New technology, such as computers, GIS, GPS, dataloggers, auto samplers, and sensors, make it possible to obtain and manipulate information on a smaller scale and in shorter time frames. He recommended staying the course with

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MGWA Newsletter, December 2005

Fall Conference, cont.

more research and data collection and establishing a Darcy Prize to award a prize for turbulent flow research.

Joe Magner of the Minnesota Pollution Control Agency addressed the question "Is There a Role for Geochemical Tools in the Clean Water Legacy?" He defined Total Maximum Daily Load (TMDL) as noted in the Clean Water Act (CWA). He said the TMDL in Lake Pepin has halted the growth of the cities of Maple Lake and Annandale, because the Crow River flows into the Mississippi River. The Clean Water Legacy is an attempt by a policy work group to fund TMDL studies in the state since only 10-15% of the waters in the state have been tested. These studies require an understanding of pathways and processes, including whether ground water supplies water to a lake or river. He concluded that geochemical tools are needed to solve pathway-process mysteries.

Dr. Carol Kendall of the U.S. Geological Survey provided the concluding

presentation for the conference. Her presentation was titled "CSI: Isotope Forensics - How to Use Isotope Fingerprints to Solve Hydrological 'who dunnits.'" She discussed the applications of isotopes to environmental forensics. As a case study she showed how causes of hypoxia could be traced using isotope techniques. Causes of low dissolved oxygen levels include hydrology, geochemistry, and anthropogenic nutrients resulting in algal blooms. The main source of nitrate in the San Joaquin River was traced to small dairy operations along the river rather than to agricultural drains or minor tributaries to the river. The main source of particulate organic matter in the river was determined to be algae rather than bacteria or terrestrial detritus. In conclusion, Carol noted that isotope results can reverse commonly held ideas and increase the likelihood that the real problem is correctly identified.

Isotope Hydrology Workshop

Friday, November 18 dawned as a sparkling cold day, and, as fate would have it, a wonderful day to sit and

learn about applications of isotope geochemistry to hydrologic processes. USGS researcher Dr. Carol Kendall presented for the entire morning and half of the afternoon. Dr. Calvin Alexander, Dr. Emi Ito, and Dr. Martin Saar (all from Department of Geology and Geophysics, University of Minnesota) each gave short presentations in the afternoon.

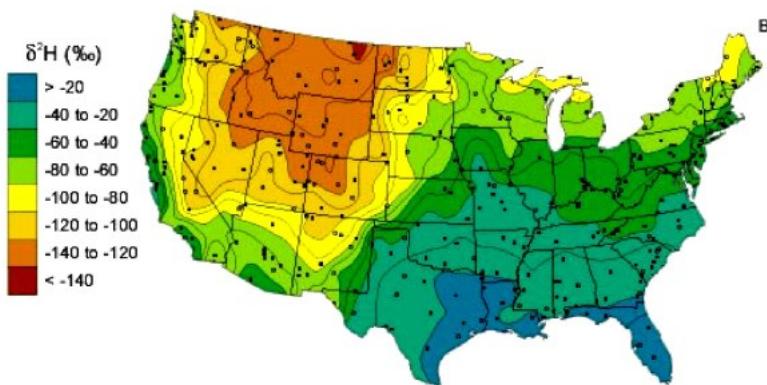
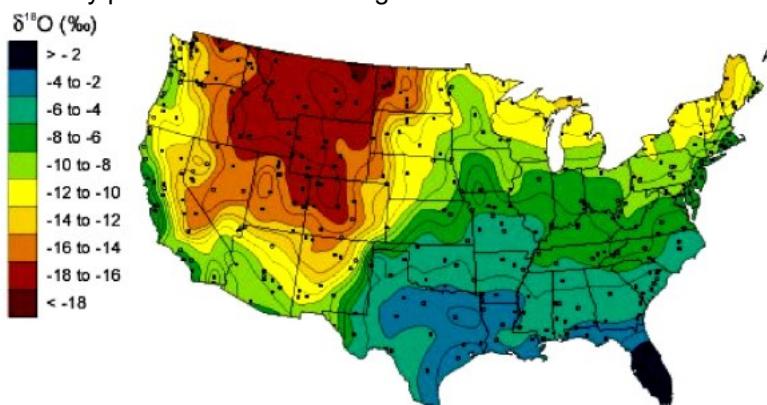
Dr. Kendall's presentation modules were: fundamentals of isotope geochemistry, isotope hydrology, isotope biogeochemistry, and ecological applications of isotope geochemistry. Each of these sessions emphasized stable isotope geochemistry. The fundamentals session was chiefly a review of terminology and basic processes such as fractionation and exchange mechanisms which were explained using the context of national and global distribution patterns in ^{18}O and ^2H . Practical concerns such as sample collection were also addressed. Applications that were covered in Dr. Kendall's discussion of isotope hydrology included ground water-surface water interactions, landfill leakage, hydrograph separation techniques, and water residence time. Dr. Kendall's isotope hydrology session focused primarily on tracing sources of nitrate.

Dr. Alexander discussed observed breakthrough curves in several carbonate rock environments. His observations allow differentiation of normal and high-flow conditions in dendritic karst conduit systems. In addition, he discussed observed breakthrough curves for high transmissivity zones in anastamosing systems, vadose zone flow, and mixed flow systems.

Dr. Ito discussed her research on two lakes in North Dakota and her findings relative to tracking continental climate history. While many techniques are used in such efforts, including isotope techniques, she discussed the use of several types of proxies that record landscape processes. In the end, conclusions should be based on study of the entire core, not just one aspect.

Dr. Saar discussed some of his research using helium isotopes as a natural tracer. He applied this technique to identifying shallow and deep ground water pathways associated with cold and warm springs in Oregon.

Submitted by Jan Falteisek, Norm Mofjeld and Steve Robertson, Newsletter Team.



Spatial variation in the A: ^{18}O and B: ^2H of rivers in the USA (source [Kendall C., and Coplen T. B. \(2001\)](#)) Distribution of oxygen-18 and deuterium in river waters across the United States. *Hydrological Processes* 15, 1363–1393.

MGWA Officer Ballot - 2006

President-Elect

Jeff Stoner



Jeff Stoner, Candidate for President-Elect

Jeff Stoner currently is Director for the U.S. Geological Survey (USGS) Water Science Center of Minnesota. He holds degrees in Geological Engineering from the University of Minnesota and Civil Engineering from Colorado State University. During his career as a USGS hydrologist, he has participated in numerous studies of ground water and water quality in Montana, Pennsylvania, Minnesota, and North Dakota. He has led hydrologic investigations in Minnesota and the Red River of the North study of the National Water-Quality Assessment (NAWQA) Program and later directed the nutrients synthesis project for the NAWQA Program in Denver, Colorado. He returned to his roots in Minnesota in 2002.

Vision for MGWA: To maintain our role as leaders in education, ethics, and information for the ground-water profession in Minnesota.

Secretary

Jon Pollock



Jon Pollock, Candidate for Secretary

I have been, and am volunteering to become Secretary of the MGWA in an effort to support the Association's objectives of promoting and encouraging scientific and public policy aspects of issues related to ground water, protecting the public health and safety through continuing education for ground water professionals, establishing a common forum for scientists, engineers, planners, well drillers, educators, policy makers and all others involved with ground water issues, along with educating the general public and disseminating information concerning ground water.

I am currently President of Frontline Environmental, LLC providing environmental consulting and management service to both the private and public sectors. Previous positions include eight years with the Minnesota Pollution Control Agency as a hydrologist, several years of laboratory experience, as well as environmental consulting and oil and gas exploration work. My formal education includes Bachelor of Science degrees in Geology and Geophysics and a Masters Degree in Geological Sciences. I am a firefighter for the City of Lakeville.

**Please make a copy/printout of this page, mark as you see fit and return it to the MGWA Office at:
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Deadline = January 1, 2006

AIPG Fall Field Trip – Aggregate Resources of the Twin Cities Area

By Minnesota Section, AIPG

The Minnesota Section of the American Institute of Professional Geologists (AIPG) conducted a field trip on September 23-24, 2005, that provided a broad overview of the aggregate resources of the Twin Cities Area. This included stops at some of the largest mines and quarries in the state owned by some of the largest mining companies in the state and nation, and largely ignored the hundreds of small sand and gravel quarries where a great volume of aggregate is produced annually. Many of these companies produce aggregate as a portion of their business, and include other ventures such as construction, asphalt and concrete production, fuel distribution, and general contracting. AIPG was granted access to these stops by these very generous companies, and we thank them.

Minnesota's aggregate industry mines three types of materials:

1. Sand and gravel mined from glacial or alluvial deposits – this material represents the majority of aggregate production and is sometimes referred to as "natural" aggregate.
2. Crushed carbonate rock mined from bedrock in southeastern Minnesota and in the metropolitan area.
3. Crushed rock mined from granite, quartzite, or trap rock elsewhere in the state.

In addition to aggregate deposits that are mined, "recycled aggregate" can be made from demolition material that is crushed and cleaned of impurities.

For information about specific stops on the field trip, please contact the Minnesota Section of the AIPG. The web site is www.aipgmn.org.

The Field Trip group is pictured to the right.

Impressions of the 50th Annual Midwest Ground Water Conference

By Sarah Tufford, DNR Waters

This year the Midwest Ground Water Conference returned to Urbana, Illinois where it all began 50 years ago. One person in attendance, Robert Sasman, had participated in that first conference. The organizers of that first conference might be amazed at the technological tools that are available today, but the issues we are all trying to address haven't changed that much. One especially interesting presentation was given by Tom Prickett on the History of Ground Water Modeling. While the tools are more sophisticated today, the need to learn more about the availability of ground water, to characterize its quality, its capacity to support withdrawals, and its relationship to surface water systems and sources of contamination remains.

One message I brought home from the conference is that the Midwest is more dependent on ground water to meet its desired uses than the rest of the country. The demands placed on aquifers are growing faster than the rate of population growth at the same time that the data collection and analysis programs are being reduced due to funding limitations. (See National Ground Water Association, www.ngwa.org and The National Research Council reports titled "Envisioning the Agenda for Water Resources Research" and "Confronting the Nation's Water Problems: the Role of Research"). Existing data can be compiled to give a broad picture of the current condition of water

resources and, in combination with modern tools, may allow the decision-maker to have a much better understanding of the likely consequences of possible choices. However, much additional investment in studies and monitoring will be needed to address the likely conflicts as more users wish to use the same limited resource.

Another interesting development involves public participation. In the Barrington, Illinois, area, public concern over water resources has led to a project to develop baseline conditions using limited resources. A professional advisor was hired by the organization of villages and townships to guide a committee of volunteers that is doing most of the work. Existing databases were queried to generate maps, and well log and boring data were compiled into one large database. Hydraulic parameters were assigned to the units reflected in the logs. The information is being used to generate cross-sections and identify areas of potential recharge.

Many other ideas were brought forth in the papers and in discussions during the breaks. The organizing committee made sure that we were well taken care of. Attendance this year (as always happens) came mostly from the host state with a smattering of representatives from around the Midwest. Unfortunately that distribution was not as diverse as other years. To those who did not come this year, you missed a very fine conference. Next year the conference will be held in Lincoln, Nebraska, on October 23-26. The theme Nebraska has chosen is "Convergence of Rural and Urban Ground Water Issues".



LCMR's Metro Area Site Visits

By Dale Setterholm, Minnesota Geological Survey, and Laurel Reeves, Minnesota Department of Natural Resources

On a beautiful October 27th, MGWA led a tour of ground water related sites for members and staff of the Legislative Commission on Minnesota Resources (LCMR) and other interested legislators. This was a great opportunity for ground water scientists to raise awareness of ground water issues of the day with those who make important decisions that affect the resource.

Our first stop was the flowing well, which was constructed through the financial assistance of the MGWA Foundation, in the Big Backyard at the Science Museum of Minnesota (SMM). At this stop Dale Setterholm and Bob Tipping both of the Minnesota Geological Survey explained the Twin Cities Artesian Basin, the concept of a stacked series of aquifers, and why the educational display materials that LCMR recommended funding for weren't there! Patrick Hamilton of SMM explained his vision for the display, and provided us all with cold and delicious water bottled from the well.

The tour then headed northwest toward the edges of the metro area. Dale and Bob explained how ground water resources are not equally distributed. This distribution could be an important consideration with all the population growth projected in that direction. In the northwest metro area and beyond, ground water is more commonly found in shallow or surficial aquifers and it is well-connected with surface water features. An increased demand for water in this area may affect surface water features including changes in habitat, recreational opportunities, and the resource available to downstream water users. The tour stopped at Mississippi West Regional Park to discuss these issues in detail. Chris Elvrum described the work of the Northwest Metro Water Supply Work Group. Brian Olson, City Engineer for the City of Ramsey, described the difficulties his community has supplying ground water and some of the issues in their consideration of surface water supplies. Pat Bloomgren of the Minnesota Department of Health then explained wellhead protection, the influence of land use on water quality,

and the proposed use of aquifer storage and recovery at Elk River.

As the bus took us south toward lunch at the Hyland Lake Park Reserve Visitor Center, we noted the change from sand plain geomorphology and drainage to till plain conditions. This was a good opportunity to explain the concept of ground water sensitivity, and opportunities to use it as a land use planning tool. We also re-emphasized the interaction of ground water and surface water features, and the need to manage them in an integrated manner. While eating our box lunches at the park, we continued to discuss ground water with the Commission members in small groups. A brief program followed. Jeanette Leete (Jennie) of the Minnesota Department of Natural Resources gave an overview of the creation and role of the MGWA Foundation and how the structure of this organization is used to raise private funds for ground water education. Using recent examples from agricultural processing and mining, Laurel Reeves with contributions by Jennie discussed the importance of understanding water availability and the trade-offs required when making economic growth decisions.

Our next stop was the headwaters of Eagle Creek, known as Boiling Spring. The development of housing and business in the area, and the associated demand for water have made it necessary to carefully manage ground water withdrawals to preserve the spring and the trout habitat it provides. Both sides of that equation were explained by Mark Nemeth of DNR Fisheries, and Barry Stock of the City of Savage. Dale and Bob also described the geologic setting and the workings of Boiling Springs. Similarly, our next stop, the Savage Fen, relies on close monitoring and careful decisions about which aquifers are used and what pumping rates and uses are allowed to preserve this unique habitat. Jennie explained the details and history of the fen to the tour group. Using the fen's ground water level monitoring wells as background, Laurel gave an overview of ground water monitoring while Jennie demonstrated taking water levels, a basic of ground water science.

Our last stop was just down the road at the Burnsville Quarry operated by Edward Kraemer and Sons. This vast excavation provides an opportunity to see an aquifer from a new perspective—the inside! Dave Edmunds

explained the operation, including dewatering of the pit, and a proposal to use that water to augment the municipal drinking water supply. Geologist Jim Small pointed out the abundant stromatolites and answered questions about the exposed strata.

Comments on the way home made it clear that most everyone found the tour informative and enjoyable. These opportunities for ground water scientists to share their insights with decision-makers should be cultivated.

Thanks to Dale Setterholm, Laurel Reeves, and Chris Elvrum of MGWA; Jeanette Leete of DNR; Bob Tipping of the MGS; Pat Bloomgren of MDH; John Velin, Susan Thornton, Susan Von Mosch, and Sandy Smith of LCMR; and all the legislators and their staff who made time to join us.

The photomontage on the facing page shows glimpses of the day's activities, assembled by Laurel Reeves from photos taken by Chris Elvrum.

Dr. William Woessner Presents Birdsall-Dreiss Lecture in Minnesota

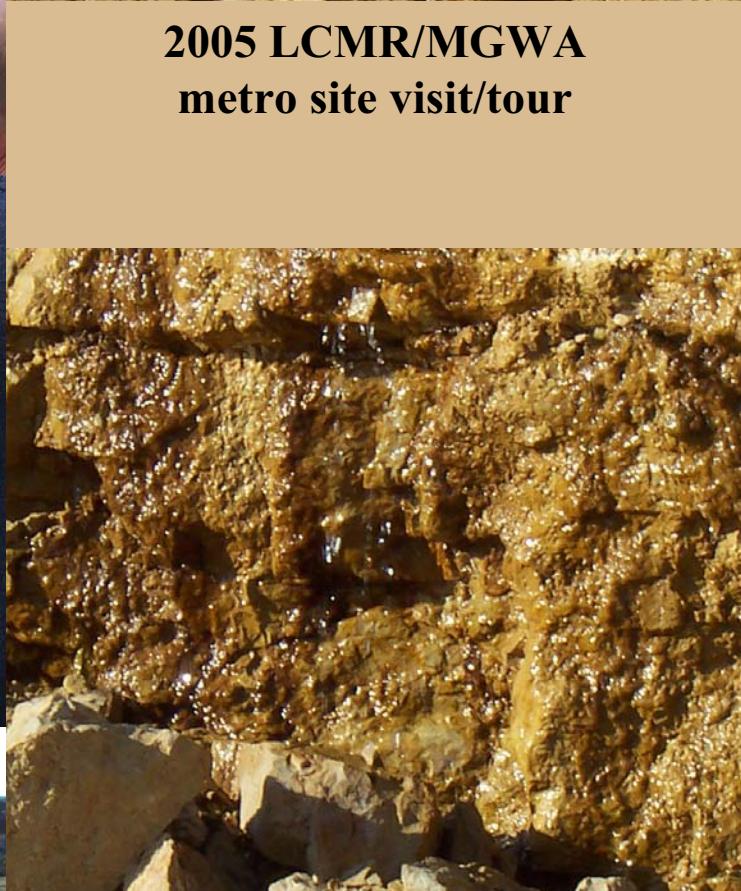
On Friday November 4th, Dr. William Woessner, University of Montana presented the 2005 Birdsall-Dreiss Lecture in Pillsbury Hall at the University of Minnesota. The many in attendance heard a very good presentation on the effects on ground water quality of wastewater disposal in unsewered areas. This is an area Professor Woessner has been studying for over 20 years.

When the densities of dwellings using septic systems increase, adjacent homeowners and/or local and state governments raise concerns that potable ground water may be affected. Though individual household wells are usually not tested regularly, ground water serving multiple households, communities, or the public must be free of fecal coliform bacteria and must not contain nitrate-nitrogen above 10 mg/L. Recently, however, federal regulators have suggested ground water supplies should be tested for viruses. In addition, the discovery of trace quantities of pharmaceuticals in surface water impacted by sewage and sewage treatment plant waste has raised concerns that ground water degraded by septic system effluent may contain

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2005 LCMR/MGWA metro site visit/tour



Birdsall-Dreiss Lecture, cont.

low levels of pharmaceuticals.

The talk focused on the occurrence of a select group of viruses and pharmaceuticals in septic systems and the processes controlling the transport and fate of these constituents in the underlying shallow aquifers. Results of sampling sewage-impacted ground water associated with a high school drain field and virus tracer experiments used to assess transport processes in shallow sand and gravel dominated aquifers were presented. A survey level study chronicled the occurrence of 20 pharmaceutical compounds in a large number of individual septic tanks and the prevalence and fate of these compounds in the associated ground water. The study detected both prescription and nonprescription drugs. The presentation concluded with a discussion of how hydrogeological data may or may not be used to examine related human health risks.

Some of the research presented by Professor Woessner may be found in the following publications:

Godfrey, Emily and William W. Woessner. 2004. Screening level study of pharmaceuticals in septic tank effluent and a wastewater treatment plant waste stream. Proceedings of the 4th International Conference on Pharmaceuticals and Endocrine Disrupting Chemicals in Water, National Ground Water Association: 296-308.

Woessner, W. W., Ball, P. N., DeBorde, D. C and Troy, T. L., 2001. Viral transport in a sand and gravel aquifer under field pumping conditions. *Ground Water* 39 (6), p. 886-894.

Thanks to the Geological Society of America, sponsor of the Birdsall-Dreiss Lecture Series, and the Department of Geology at the University of Minnesota.



— Dr. William Woessner, University of Montana, 2005 Birdsall-Dreiss Lecturer (Photo: GSA Web Site).

Question of the Quarter

The Question of the Quarter is a continuing feature in our newsletter. Each quarter a different question is posed and all members are invited to respond.

Match the following cave dwellers to the appropriate description.

- | | |
|-------------|--|
| Stygophile | A. Obligate ground water inhabiting species - most often envisioned as species found in slow moving interstitial ground-water |
| Stygoxene | B. Aquatic species which are obligate cave dwellers adapted so completely to caves that they are restricted to this environment |
| Stygotite | C. Species occurring commonly in caves, but must leave the cave at some point in their life cycle, typically for feeding. |
| Phreatobite | D. Aquatic species which occur in caves and can complete their entire life cycle there, but which are also found in similar habitats above ground. |

Email your answer and your "two cents worth" to: newsletter@mgwa.org

Fish and Ground Water

The Question of the Quarter posed in the September newsletter was: **Do fish live in Minnesota ground water?**

- A. no
- B. maybe, but none have been found to date.
- C. yes, but they are not permanent residents.
- D. yes, but they are blind.

Jim Lundy of the Minnesota Department of Health—not satisfied with MGWA's selection of possible answers to this question—responds:

"Yes....but only in *perched* aquifers." (italics added)



© JOSEPH TOMEILLERI

yellow perch (*Perca flavescens*)

Well, Jim is right, in part. Certainly, our ground water fish are in shallow aquifers. The most correct answer is C. To date, no fish have been found to reside permanently in Minnesota caves. Warren Netherton, cave specialist with the Minnesota DNR, reported accidental fish in Mystery Cave after some high water events. He said that cave-adapted fish have not been found in Pleistocene glaciated areas of the upper Midwest.

A full write-up of a study done on the fish species identified in the cave can be found at www.nativefish.org/articles/MysteryCaveSurvey.php. None of the species found was adapted for long term cave habitation. Therefore, blind cave fish that would be permanent residents of ground water are not found in Minnesota.



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Ground Water Contamination Found in Bayport Municipal Well

The Minnesota Department of Health detected 1,2-trichloroethene (TCE) in several municipal wells in Bayport, Washington County, in July and August 2005. TCE concentrations at and above 5 micrograms per liter ($\mu\text{g/L}$) were detected in Bayport Well #2. The city of Bayport is located on the St. Croix River in eastern Washington County (see Figure 1). Trace levels of TCE were found in Bayport's other two municipal wells. While Safe Drinking Water Act regulations for public water systems have not been violated, the Minnesota Pollution Control Agency (MPCA) has agreed to design and install an air stripping treatment system on Well #2 to remove the TCE.

The MPCA believes that the TCE contamination is coming from the Baytown Township Superfund Site. Ground water flow trends from Lake Elmo in the west to Bayport and the St. Croix River in the east. In 2004, MPCA completed additional investigation of the source area of the Baytown Township Superfund Site. The main source was found at the property now occupied by Hagberg's Country Market in Lake Elmo. A metal-working and finishing business that occupied the property in the 1940's to 1960's is suspected to have used TCE. Concentrations of TCE as high as 89 milligrams per liter (mg/L) were detected in the ground water beneath the market in 2004. The resulting TCE ground water plume covers nearly seven square miles of Lake Elmo, Bayport and Baytown and West Lakeland townships. A smaller source of TCE also appears to be present at Lake Elmo Airport that is downgradient of the main source.

Bayport Well #2 is completed in the Franconia-Ironton-Galesville Aquifer. Figure 2 depicts a west-to-east geologic cross section at Baytown Township and Bayport. Well #2 is located on the slope of the bluff where the Jordan Sandstone and younger Ordovician formations are likely eroded away. It is unclear if there is a St. Lawrence confining bed above the contaminated well. The St. Croix River valley is mainly filled with fluvio-glacial and alluvial deposits. Although

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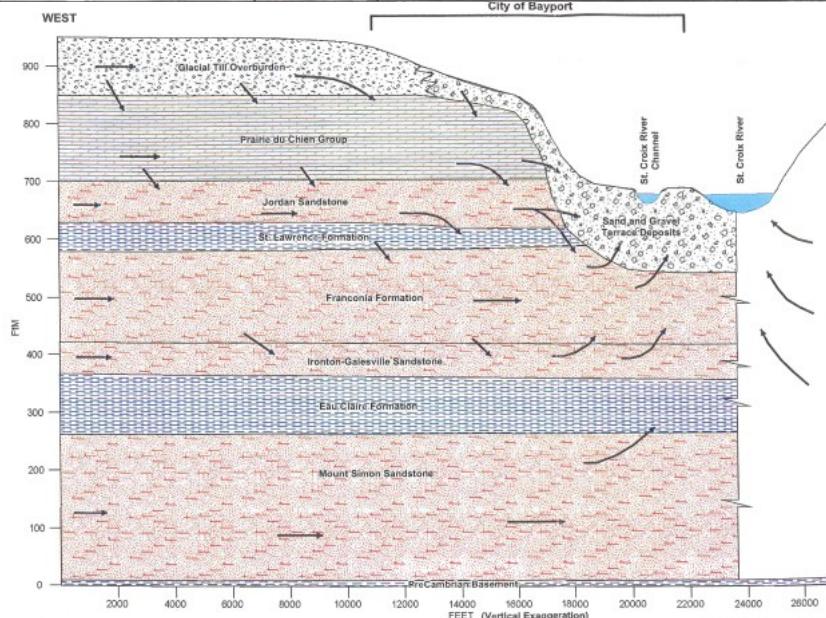
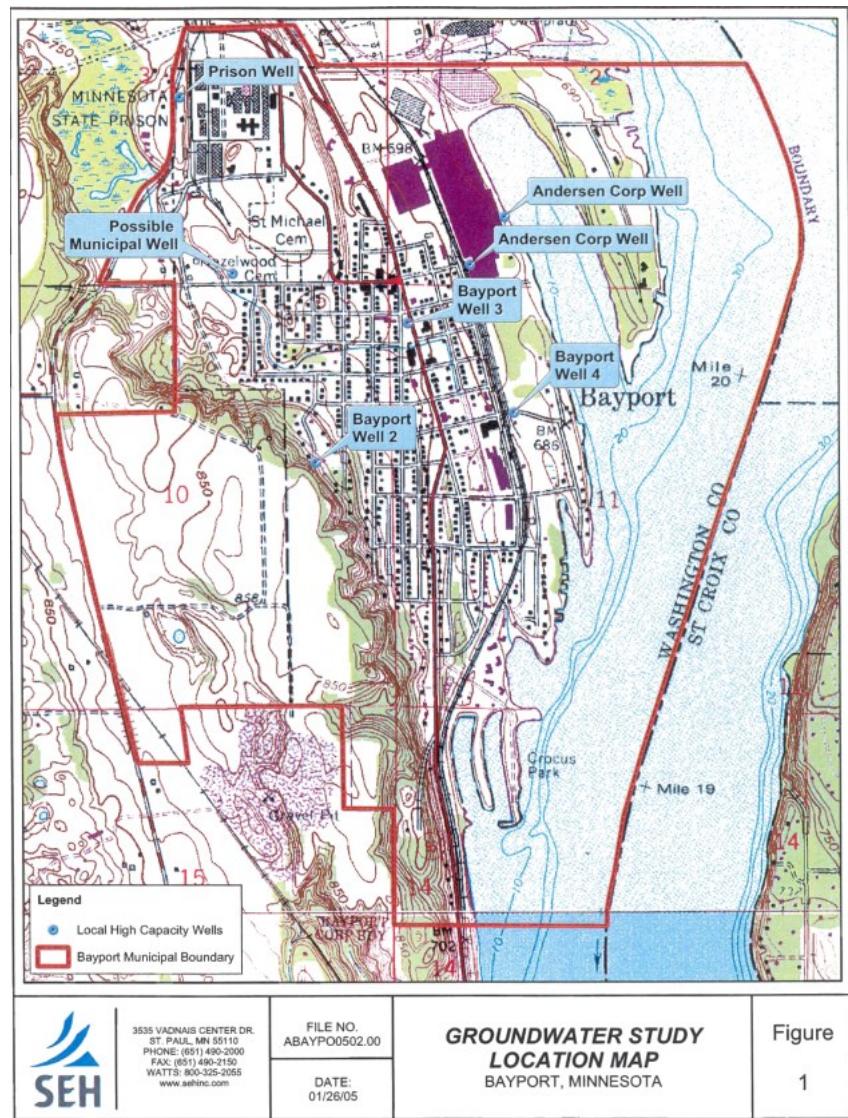


Figure 2, West to east geologic cross section at Baytown Township and Bayport, courtesy SEH.

Bayport Contamination, cont.

the TCE plume entered this unconsolidated aquifer before 1988, TCE was not found in the Franconia Sandstone until 2003.

In 2003, TCE was detected in three private wells at the top of the bluff just west of Bayport and in Bayport Well #2. These wells are completed in the Franconia Sandstone. Although the St. Lawrence Dolostone is present there, it is unclear whether or not it is a competent confining unit given the presence of the contamination. Tritium analysis in private wells indicates that the Franconia water is a mix of pre-1953 and post-1953 origin. No TCE has been found in the handful of Franconia Sandstone wells completed farther to the west in Baytown and West Lakeland townships.

The MPCA believes that the treatment and continued pumping of Bayport Well #2 is preferred over installation of an alternate, deeper well. This is because the well may serve as a barrier to contamination moving toward well #4 which is downgradient near the St. Croix

River. Also, new wells in deeper aquifers such as the Mount Simon-Hinckley are limited by Minnesota statute (section 103G.271, subdivision 4a) use restrictions:

The commissioner (of DNR) may not issue new water use permits that will appropriate water from the Mt. Simon-Hinckley aquifer in a metropolitan county, unless the appropriation is for potable water use, there are no feasible or practical alternatives to this source, and a water conservation plan is incorporated with the permit.

Furthermore, the Mount Simon-Hinckley Aquifer has its own water quality problem with naturally occurring radium.

MPCA is currently evaluating the source area in Lake Elmo for implementation of ground water remedies. MPCA is working with the Minnesota Department of Health and Washington County Department of Public Health and Environment to ensure the protection of water users in the affected area of Washington County.

Kurt Schroeder, Newsletter Team

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St. Paul's Legendary Subterranean Lakes

By Greg A. Brick

"A vast, limitless expanse of water, the end of a lake if not of an ocean, spread before us, until it was lost in the distance.... My feeble brain found itself wholly at fault." (Jules Verne, *A Journey to the Centre of the Earth*)

St. Paul, Minnesota, has at least one legendary subterranean lake under its downtown area. Apparently, it was modeled on the lake inside St. Paul's most famous cave —Carver's Cave, in nearby Dayton's Bluff, see illustration.

The first clipping below, "A Natural Wonder," from the St. Paul Pioneer, September 3, 1869, describes this subterranean lake; the article was carried by newspapers as far away as Clarksville, Tennessee. In fact, a cave does exist at the location described — but it's a small, smoke-blackened cave in the St. Peter Sandstone, whose Gothic-shaped entrance can easily be seen above the stone retaining wall along the railroad tracks below Irvine Park (see photo). Needless to say, it bears little resemblance to the cave of fantasy.

Note that about the same time, Jules Verne's *Journey to the Centre of the Earth*, originally published in 1864, featured the "Central Sea" (as it was called in the English version), located deep underground in a granite cavern.

The second clipping, "A Nut for the Savant," from the St. Paul Daily Press, October 19, 1871, is somewhat less serious. Here, we almost seem to have a second subterranean lake under downtown St. Paul (or perhaps the other end of the one already mentioned!) except that, reading more closely, it appears that the writer conceived of the water-table itself (responsible for the wet basement described therein) as a subterranean lake. Even the 1881 edition of the Encyclopaedia Britannica followed this sort of usage, as noted by the Oxford English Dictionary: "At varying distances from the surface there exists a great subterranean lake or sea, known as the ground-water or water-table."

The imagery of surface waters — lakes and rivers — was thus imported to the underworld, becoming an early



The interior of Carver's Cave as it looked on May 1, 1867, showing St. Paul's archetypal subterranean lake (sketch by Robert O. Sweeney, from 1980 NSS Convention Guidebook, edited by Dr. Calvin Alexander).

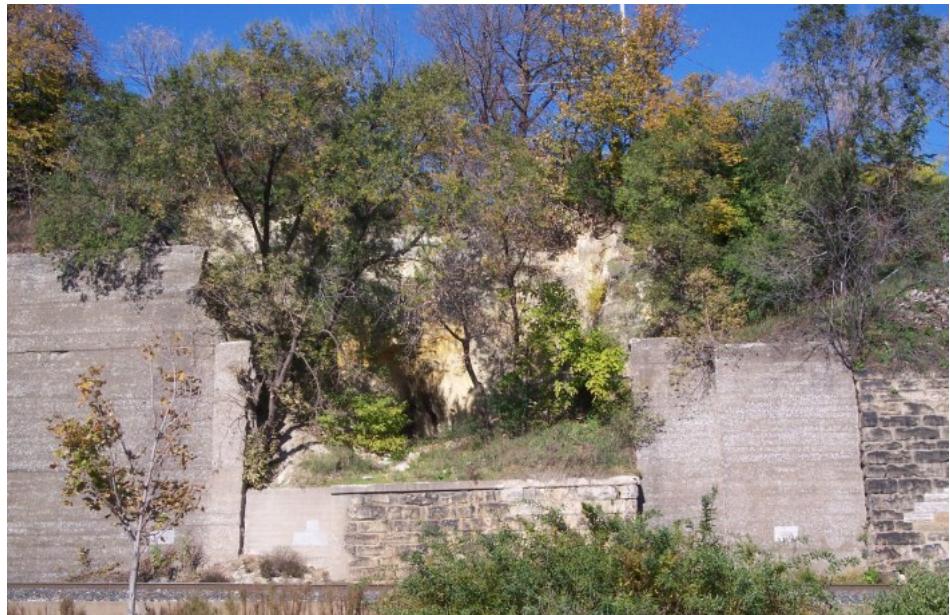


Photo of small sandstone cave along Shepard Road, below Irvine Park, matching location of the subterranean lake described in 1869 (Photo: Greg Brick).

way of conceptualizing ground water, and still is among laypersons, even in non-karst areas. For further information on these notions I recommend the excellent overview by Meyer (1987).

William Bruce Meyer, 1987. Vernacular American Theories of Earth Science. *Journal of Geological Education* 35: 193-196.

A Natural Wonder Discovery of a Subterranean Basin A Second Carver's Cave Under the Bluff near the Levee

St. Paul Pioneer, September 3, 1869

On Saturday afternoon last, while the workmen were engaged in digging down the bluff near the foot of Chestnut street, for the grade of the St. Paul & Sioux City road, they made a curious discovery, the full nature of which we are, as yet, unable to explain. The bluff at that point, is composed partly of sand-rock, and the work of levelling it is expedited by blasting. On Saturday afternoon a heavy blast was exploded, when what was the surprise, not to say consternation, of the workmen to see a huge portion of the bluff, fully 75 yards of the sand rock, suddenly sink out of sight, instead of

continued on next page

Ground Water History, cont.

rolling off below, as formerly.

Hurrying to the spot they discovered an aperture or fissure about ten feet wide, which on a closer examination proved to be the mouth of an immense cavern under which was a lake of pure crystal water, cold enough to chill a man to death in a few moments. We paid a visit to this natural wonder yesterday, and are indebted to Mr. Thomas Marshall, the foreman of Messrs. Langdon & Carpenter, who have the contract for grading on the Road, for all the information in regard to it in his possession. He has experimented to find the depth of the water, but so far without success. As far as the eye can reach, which is only some 20 or 30 feet on each side, the cavern and water extends, and its full extent is left entirely to conjecture.

Some 400 feet above the mouth of the cave there is a small stream or spring of the purest and coldest water bubbling up, which evidently is an outlet of this lake, showing that it extends that far up the bluff, at all events.

The prosecution of the work in digging away the bluff for railroad purposes may develop something further that will lead to a knowledge of the dimensions of this apparently limitless and bottomless lake. It is located directly under the dwellings of a number of the residents of that part of the city, who until this discovery supposed they had obeyed the scriptural injunction, and "built their house upon a rock," which rock, it seems now, has no foundation, and may take a notion some day to disappear altogether.

We shall keep our readers advised of future developments, and in the meantime this singular subterranean lake is well worthy a visit from all lovers of the curious and strange in nature.

A Nut for the Savant. Is it a Cave or Subterranean Lake?

*St. Paul Daily Press, October 19,
1871*

For several months past, the occupants of rooms in the buildings on the north-west corner of Jackson and Fifth streets, have noticed that whenever a heavily laden wagon passed on either street above mentioned, the jarring was distinctly felt even in the

rear portions of the rooms. This peculiarity has not been observed in any other quarter of the city, and is of such a marked character in the vicinity indicated, that one gentleman, Truman M. Smith, has been endeavoring to find a solution of the mystery. Mr. Smith states that he has been frequently notified of the passage of vehicles, by the tremulous motion underneath him, but he has been unable to discover any satisfactory reason why a small earthquake should occur whenever a vehicle of "heavy tonnage" passes his stand. Sometimes the phenomenon has been observed when the wagons were passing up Fifth Street in the direction of Robert, and quite a distance from the shivering timbers or floors. Notwithstanding the unsettled question whether the trembling motion is to be attributed to the existence of a huge cave or subterranean lake in that quarter, no immediate danger of dropping into the bowels of the land is apprehended, but the matter is worthy of an investigation by those interested in, or disposed to unravel such mysteries, as that herein briefly alluded to.

Another fact may be stated as having some bearing upon this recent discovery. While Mr.

Chas. Coulter occupied the building known as Colter's Block, he was greatly troubled by the water which oozed through the bottom of his cellar at all seasons, and in spite of every means used to stop it. Mr. Colter (sic) spent considerable sums of money at different times in trying to stop the flow, but his efforts were unavailing, and the money was sunk—in more than one sense. In the absence of a solution, it is proper to suggest that Mr. Wimbish's badger may have been a delegate from an extensive badger vault in that neighborhood.

Stormwater Basin Fails in Woodbury

Severe weather on October 4, 2005, dropped 5 to 7 inches of rain across the Twin Cities Metropolitan Area. Runoff generated by the rains taxed many a stormwater system around the area, but none more so than the basin called Dancing Waters Lake in Woodbury. Over the weekend of October 8-9, a sinkhole opened up at the bottom of the basin draining an estimated 80 acre-ft of water into the subsurface.

The area of the failure is noteworthy because of the presence of St. Peter Sandstone in close proximity to the ground surface. Separating the top of the St. Peter from the ground surface is as little as a few feet of glacial till. Fractures are clearly visible in the St. Peter, and likely extend up from the underlying Prairie du Chien Dolomite. The City of Woodbury has sampled private wells in the area, is planning to use geophysics to better characterize the stratigraphy under the basin, and is working to remediate the situation. See photos on facing page.

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Looking west across the pond. Sinkhole is on left of photo. Water was reportedly up to the base of the culverts prior to collapse. (Photo: Bob Tipping)



Joint opening in St. Peter Sandstone. Maximum aperture is approximately 2.5-3 inches. (Photo: Steve Robertson)



Looking south from northwest end of sinkhole. Clearly visible are joints in the St. Peter Sandstone and the contact between the St. Peter and overlying glacial till. (Photo: Bob Tipping)



Looking south from north end of sinkhole. Calvin Alexander (University of Minnesota) in sinkhole and Steve Kernik (City of Woodbury) above on rim, are standing over the deepest part of the sinkhole (not shown), which is about 17 ft deep. (Photo: Bob Tipping)

Metro Children's Water Festival

By Joe Enfield, Environmental Services Dept., Carver County

Some 1200 fifth-grade students from the Seven County Metro Area attended the Eighth Annual Metro Children's Water Festival September 28, at the Minnesota State Fairgrounds to learn how to care for something that is as common as the air we breathe and just as important: water.

Students participated in interactive learning stations and presentations by the Science Museum of Minnesota and meteorologist Paul Douglas. Hands-on opportunities helped students learn about where water goes when the toilet is flushed, how tiny bugs can serve as an indicator of water quality, the importance of wetlands, and the way that water's movement through different soils can affect what

comes out of our kitchen faucets. One of the major objectives of the Children's Water Festival is to provide hands-on learning for students in water science in an outdoor classroom setting. The approximately 150 presenters and volunteer staff came from private industry and metro county offices, MN Pollution Control Agency, MN Department of Natural Resources, MN Department of Health, MN Department of Agriculture, Metropolitan Council Environmental Services, soil and water conservation districts, University of Minnesota Extension Service, and the Board of Water and Soil Resources.

The Metro Children's Water Festival would like to thank the Minnesota Ground Water Association Foundation for their financial contribution to this event. For more information or to inquire about next year's event, call Joe Enfield at (952) 361-1801; jenfield@co.carver.mn.us or John Bilotta at (952) 361-1814; bilot002@umn.edu.

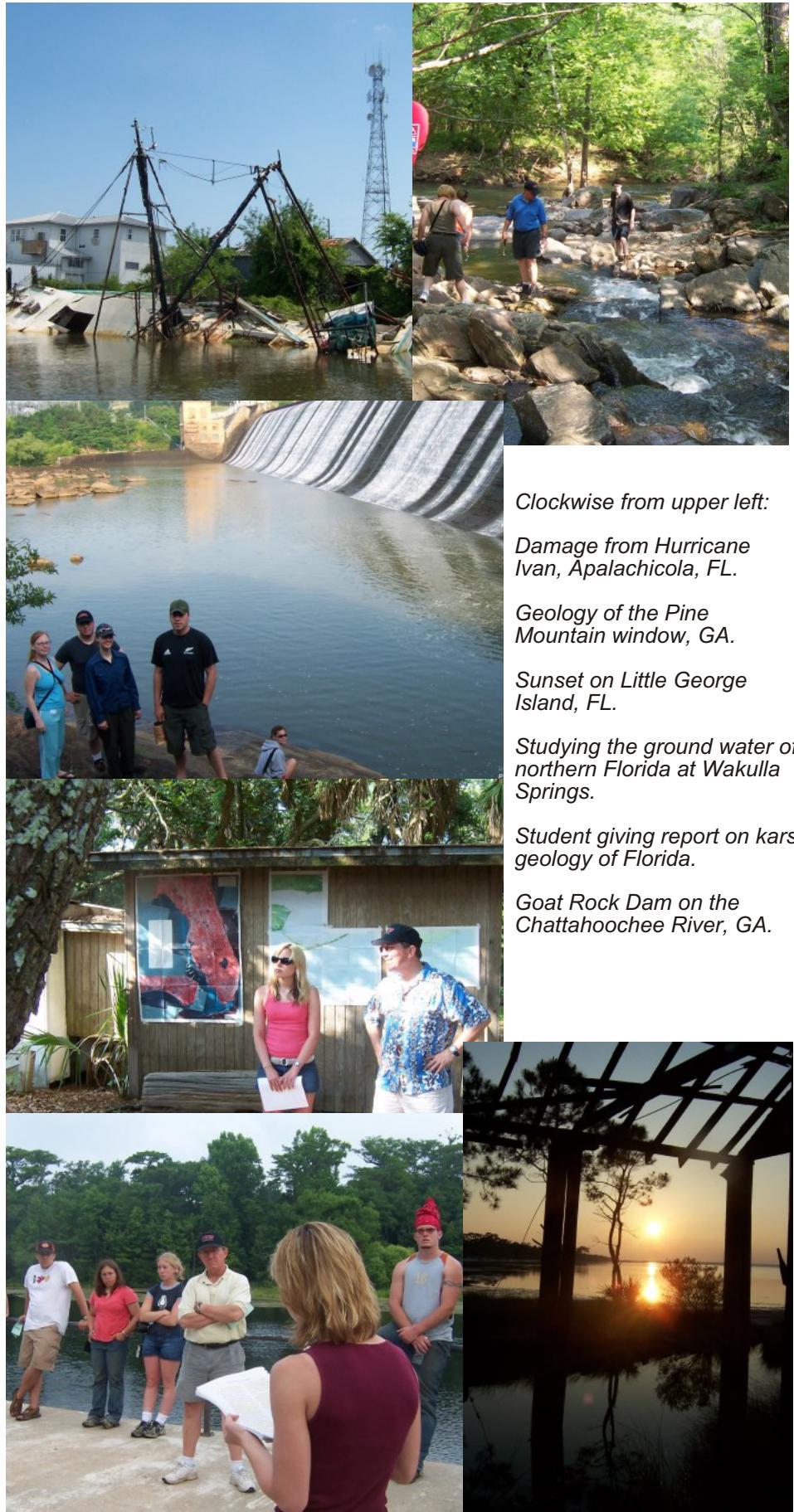
UW River Falls Field Trip

By Bob Baker, Department of Plant and Earth Sciences, University of Wisconsin, River Falls

The University of Wisconsin-River Falls takes its geology students on an annual field trip to a different part of the United States or Canada. In May 2005 our 14 day camping trip traveled to the southeastern US with 24 students and three faculty members where a number of aspects of the regional geology were studied. Trip highlights included:

- Karst development in Mammoth Cave National Park, KY.
- Plant fossil collecting in the Pottsville Fm. (Pennsylvanian), AL.
- Structural geology of Birmingham, AL.
- The Wetumpka, AL meteorite impact-crater.
- The geology of the Pine Mountain structural belt, GA.
- Goat Rock Dam on the Chattahoochee River, GA.
- The coastal plain of the Southeast, including the fall line.
- Providence Canyon, GA, the Grand Canyon of the south.
- Barrier Islands, especially Little St. George Island, FL.
- Apalachicola National Estuarine Preserve, FL.
- Wakulla Springs, Florida's largest spring.
- Karst development in Florida, including the Devil's Millhopper sinkhole.
- The coquina industry of Florida.
- Geology of Stone Mountain, GA.
- Geology of Dahlonega, GA, site of America's first gold rush.
- The Ocoee River, Tennessee.

From the list of highlights above it can be seen that although all aspects of the regional geology were studied, approximately 50% of our stops focused on either ground water or surface water phenomena. We camped each night and cooked all our meals on camp stoves in order to reduce overall costs. Thanks to the generous support of the Minnesota Ground Water Association Foundation and the UWRF Department of Plant and Earth Science, the total cost, including transportation, meals, camping, and admission/entrance fees was \$275/student.



Clockwise from upper left:

Damage from Hurricane Ivan, Apalachicola, FL.

Geology of the Pine Mountain window, GA.

Sunset on Little George Island, FL.

Studying the ground water of northern Florida at Wakulla Springs.

Student giving report on karst geology of Florida.

Goat Rock Dam on the Chattahoochee River, GA.

MGWA Works with Students in the Minnehaha Creek Watershed

By Mike Trojan, MGWA Environmental Education Committee

In 2004-05, the Minnesota Ground Water Association worked on a service learning project with students from Benilde-St. Margaret's High School in St. Louis Park. Students examined and reported on the water resources of the Minnehaha Creek Watershed. They gathered information about water quality, soils, geology, ground water, ecology, hydrology, history, land use, and management for individual lakes and Minnehaha Creek (see photos at right). They then placed this information on their school website

(<http://www.bsm-online.org/bsmonline.aspx?pgID=1461>). Additional information about the project and ground water resources of the watershed are found at www.pca.state.mn.us/water/groundwater/gwmap/minnehaha-learningproject.pdf.

Students observed that significant changes have occurred in the hydrology of the watershed. The project was therefore a natural jumping-off point for an additional study of ground water recharge under different land uses in the watershed. In autumn of 2005, four monitoring wells, each under a different land use, were equipped with continuous water level-temperature recorders. Students will download information from these recorders, compare recharge rates and patterns of recharge between the different land uses, and summarize their results in an annual report. This is a long term study designed to expose students to practical application of science and math skills and will also provide hydrologic information to local water resource managers.

This project was a joint effort of MGWA, Minnehaha Creek Watershed District, Minnesota Pollution Control Agency, and Benilde-St. Margaret's High School. The project was partially funded by the Minnehaha Creek Watershed District through the Cynthia Krieg Watershed Stewardship Fund. If you have questions or comments, please contact Mike Trojan at the Minnesota Pollution Control Agency (mike.trojan@pca.state.mn.us 651-297-5219).



MGWA Foundation Report

By Chris Elvrum

The MGWA Foundation approved three funding requests this fall. One was for \$630 to the Department of Geology and Geophysics at the University of Minnesota - Twin Cities to support student participation in a hydrogeology field camp at Williams Lake. The second was for \$740 to

partially fund a dye trace project for University of Minnesota geology students and Hill-Murray High School students. The third was for \$600 to allow students to attend the MGWA fall conference and workshop. The Foundation continues to pursue options for funding to complete the ground water display at the Science Museum of Minnesota. The Board is also evaluating various means to build the Foundation's endowment.

MDH Releases Draft Guidance for Performing Wellhead Delineations in Fractured and Solution-Enhanced Aquifer Settings

Minnesota Department of Health (MDH) staff has long recognized that the process of delineating capture zones for wells completed in fractured and solution-weathered aquifers is complicated by the physical characteristics of these aquifer settings. Public water suppliers that pump from such aquifers rarely have the resources needed to conduct extensive field studies that can help define ground water flow characteristics. As a result, it is important that wellhead protection area (WHPA) delineation methods exist that are both practical and technically defensible.

The MDH is in the process of establishing guidelines for WHPA delineations in karst and fractured aquifer settings in Minnesota. These guidelines incorporate a menu of options that relate to specific aquifer settings. They range from deeply buried settings where hydraulic gradients are low or unknown to shallow, water table settings. In addition, the guidelines address dual porosity settings and cases where a karst or fractured aquifer is hydraulically connected with adjacent porous media aquifers. Emphasis is placed on using existing data and relatively simple calculations combined with hydrogeologic mapping for the delineation of conservative capture zones. The methods are scaleable so that the results of more sophisticated fracture-flow investigations can be readily incorporated to provide more accurate delineations.

The United States Geological Survey (USGS) has recently entered into an agreement with the MDH to evaluate the proposed guidelines by comparing them with other delineation methods at a series of example sites in Minnesota. The results of this analysis will be incorporated into the MDH guidance document, at which time it will become a reference for WHPA delineation in Minnesota.

To obtain a copy of the draft guidance, email Bruce Olsen, MDH at bruce.olsen@state.mn.us.

Air, Water and Waste Conference, February 14-16, 2006

The Minnesota Pollution Control Agency will host its annual Air, Water and Waste Conference at the Sheraton Bloomington Hotel, Highway 100 and I-494, February 14-16, 2006. The conference is designed to appeal to a broad audience and will address media-specific topics and emerging environmental concerns. This year, the Water Track includes seven sessions covering a broad range of issues impacting both ground water and surface water:

- Your Medication, Shampoo and Morning Beverage Affects Our Environment
- Clean Water Legacy Update
- Total Maximum Daily Load (TMDL): Assessment, Protocol and Studies
- Protecting Public Water Supplies in Rural Communities
- Balancing Water Quality and Agricultural Production
- Lakeshed Management: Trends in Stormwater and Wastewater Planning
- Environmental Forensics: CSI Fish Kill

The program tracks in Remediation and Stormwater also have sessions that may be of interest to ground water professionals.

In addition to the technical presentations, about 80 exhibitors from the public and private sectors will showcase their environmental products and services in one of the largest such exhibits in Minnesota. The conference is designed to meet continuing education requirements of various professional certification and licensing programs. For further details, visit:

<http://www.pca.state.mn.us/news/training/mawwconference/index.html>

On the Web

U.S. National Academies Launches Water Information Center

A web portal of more than 100 peer-reviewed reports from the U.S. National Academies on water-related issues is now available. The Water Information Center at <http://water.nationalacademies.org/> aims to assist the work of water scientists, engineers, managers, policy-makers, and students throughout the world. These reports represent independent and objective consensus among experts from academia, industry, and other entities.

The website features reports and books in the following areas: water supply and sanitation; water and soil remediation; hydrologic hazards; water quality in the natural environment; river basin systems; environmental assessment, management, and restoration; and water science and research. All of the reports can be read free on-line and report summaries are available as .pdf documents.

The U.S. National Academies of Sciences is a non-profit organization that brings together committees of experts in all areas of scientific and technological endeavor. These experts serve pro bono to address critical national issues and give advice to the federal government and the public. The organization is composed of the National Academy of Sciences, the National Academy of Engineering, the Institute of Medicine, and the National Research Council.

New USGS Publications

Effects of Rain Gardens on the Quality of Water in the Minneapolis-St. Paul Metropolitan Area of Minnesota, 2002–04. U.S. Geological Survey, Scientific Investigations Report 2005-5189 by Lan H. Tornes. 22p. Prepared in cooperation with the Metropolitan Council of the Twin Cities.

The Value of Hydrologic Data and Interagency Coordination in Protecting Drinking Water Supplies in Minnesota Rivers. U.S. Geological Survey, Fact Sheet 2005-3094 by J. R. Stark and A. D. Arntson, U.S. Geological Survey, and D.L. Brostrom, David L. Brostrom Consulting Services. 4 p.

Water-Quality Assessment of Part of the Upper Mississippi River Basin, Minnesota and Wisconsin—Ground-Water Quality along a Flow System in the Twin Cities Metropolitan Area, Minnesota, 1997-1998. U.S. Geological Survey, Scientific Investigations Report 2005-5120 by William J. Andrews, James R. Stark, Alison L. Fong, and James D. Fallon. 44p.



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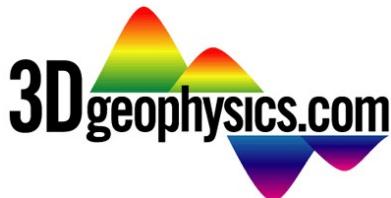
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2006 dues are \$30 for professional members and \$15 for students. Members are entitled to subscribe to the paper version of the newsletter for \$10/yr, the electronic version is available on the website for members at no additional charge. Members are also entitled to purchase a paper copy of the annual membership directory for \$7; an electronic version is available on the website for paid members at no additional charge. Additional donations to the MGWA Foundation will be gratefully accepted. Dues paid to MGWA are **not** deductible as charitable contributions for federal income tax purposes. However, dues payments are deductible as ordinary and necessary business expenses to the extent allowed by law. The MGWA Foundation is a 501(c)3 non-profit and donations to it **are** deductible as charitable contributions.

Just complete the form below and mail to: MGWA, c/o WRI, 4779 126th St. N, White Bear Lake, MN 55110-5910. Or you may choose to enroll online at www.mgwa.org

Name _____ Full-Time Student? _____

Affiliation/Employer _____

Work Address _____

City, State, Zip Code _____

Work Telephone Number _____ E-mail _____

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Which Telephone Number should we use for Directory Listing? _____

Please indicate if you want to have the Directory (\$7) _____ or Newsletter (\$10) mailed to you _____

MGWA Board Meeting Minutes

August 24, 2005

Place: Keys Café, Lexington and Larpenteur in Roseville

Attending: Laurel Reeves, President; Dale Setterholm, President Elect; Chris Elvrum, Past President; Craig Kurtz, Treasurer; Jon Pollock, Secretary; Norm Mofjeld, Newsletter Editor; Jennie Leete and Sean Hunt, WRI

Treasurer: Net income was \$4676.78. This does not include the \$5375.00 profit from the Spring Conference. \$23,731.31 in Wells Fargo and Affinity Plus accounts. Discussion of transferring money to the MGWA Foundation.

Motion: Allocate funds totaling \$12,445.00 from last year's profits to the MGWA Foundation with a minimum of one-half of the allocated funds going to the endowment. Motion passed.

Web Page: August edition of directory on web page. Minor updates made to web page. Renewed agreement with web page provider.

Foundation: Next Foundation meeting is scheduled for September 13. Discussed funding of Science Museum project in light of veto of LCMR funding.

Newsletter: CD for next edition received by WRI. Looking at a gradual change to format of newsletter.

Old Business: Fall Event: Conference planning committee meeting was held today prior to MGWA Board meeting. Discussed how much to charge for 1st and 2nd days of the fall event. Decided to charge fulltime students \$30.00 for the first day and \$50.00 for the second day, members \$95.00/day, and \$130.00/day for non-members, with a \$25.00 late registration fee.

Legislative Information: MGWA working with LCMR on their tour events. Possible stop locations include Science Museum (well), Savage (flowing springs), Minnesota River, Kramer Quarry (Burnsville), boiling springs, Chaska (fen) and the Mississippi River in Elk River. President and President Elect are coordinating.

New Business: Should MGWA join the Minnesota Environmental Partnership? MGWA President will look into this.

September 20, 2005

Place: Keys Café, Lexington and Larpenteur in Roseville, Minnesota

Attending: Laurel Reeves, President; Dale Setterholm, President Elect; Chris Elvrum, Past President; Craig Kurtz, Treasurer; Jon Pollock, Secretary; Norm Mofjeld, Newsletter Editor; Sean Hunt, WRI

Treasurer: \$12,445 check to MGWA Foundation. Net income this year \$13,874.43.

Membership: Approximately 60 emails returned with inadequate addresses.

Web Page: Sent out paid email. Newsletter on web page. Ground Water Information Guide updated.

Foundation: Foundation is looking at updating MGWA brochure and sending out to schools to indicate that funds are available for undergraduate ground water research. Discussion of funds available for students to attend conference (MGWA Foundation will look into this).

Education: Discussed how to fund \$65,000 Science Museum display.

Newsletter: Looking at a gradual change to format of newsletter working on front page first. December issue going well.

Old Business: Fall Event: Updated conference brochure. Requesting MGWAF funds to fund fulltime students at conference.

Legislative Information: MGWA President and President Elect are working with LCMR on putting together 1-day field trip to educate legislators about ground water and ground water-surface water interaction.

Minnesota Environmental Partnership: Cost to join is \$50.00 to \$250.00 depending on operating budget. Benefits include: Coordination of legislative efforts (last year was the clean water legacy), provide administrative support, have lobbyist to lobby and provide training on how to lobby, help with web site construction, provide news clip service. Will not have to provide membership list. President will follow up on this issue.

New Business Fall 2006 Conference: MGWA member inquired if MGWA is interested in scheduling the fall 2006 conference in conjunction with the AIPG national conference.

Officers: Let President Elect know of any nominations or candidates.

October 19, 2005

Place: Keys Café, Lexington and Larpenteur in Roseville, Minnesota

Attending: Laurel Reeves, President; Dale Setterholm, President Elect; Chris Elvrum, Past President; Craig Kurtz, Treasurer; Jon Pollock, Secretary; Norm Mofjeld, Newsletter Editor; Jennie Leete, WRI; Sean Hunt, WRI

Treasurer: Balance sheet shows \$15,788.80 in total checking/savings. Profit Loss Statement shows a net income of \$7,689.98. Breakeven point for conference is 170 attendees and 32 for workshop. Currently 17 people registered for conference and 12 for workshop.

Membership: Next month membership renewal will be sent out for next year.

Web Page: Conference materials and registration portion are on web page.

Foundation: Awarded \$630.00 for field trip costs associated with the University of Minnesota. Made \$600.00 available to MGWA for students to attend conference or workshop. Awarded \$740.00 to Hill-Murray High School for dye tracing field trip.

Old Business: Fall Event: Brochure sent out. Request for biographies and abstracts. Email reminder for conference to be sent out. Foundation approved money for student scholarships for MGWA conference. Any funds left over will be sent back to the Foundation. Student rate for conference for fully retired people, with fully retired status to be defined by WRI representatives.

Legislative Information: One-day field trip to educate legislators about ground water and surface water interaction will be paid for by the LCMR.

Minnesota Environmental Partnership: MGWA's application was sent in and will be considered at their November meeting.

New Business: Spring 2006 Conference: Conference to be held on April 12, 2006. Potential topic relates to problems associated with our normal practices. How well is our current system doing, what other technologies are available, and what are the future problems associated with how we currently do things. There was a request for a conference on aquifer testing. President Elect would like to consider field trip in 2006.