

# Minnesota Ground Water Association

www.mgwa.org

## Newsletter

December 2010  
Volume 29, Number 4

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MGWA President  
Steve Robertson

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### President's Letter

By Steve Robertson

As fall turns to winter and I see next spring's runoff beginning to accrue outside, it is an appropriate time to take stock and prepare for winter. As an urban dweller, I have little to get ready compared to folks who live and earn a livelihood in agricultural areas. We all learned at the fall MGWA conference (see wrap-up inside this issue) that many agricultural producers (i.e. farmers) run sophisticated operations these days. Above all, we learned that the economics of production motivates behavior in agricultural areas. Our last speaker at the conference, Dave Legvold, a farmer from the Northfield area, started his talk with an admission of being cheap in the tradition of Norwegian farmers. So when rain and snow bring moisture to his soils, it's his and he wants to keep it. Likewise with nitrogen in his soil, especially supplements he pays for – it's his,

he's paid for it, and he wants to keep it. One of his points was simply that nitrogen fertilizer costs are significant for most producers. They stand to make more money by practicing good land stewardship and doing all they can to preserve the resources they pay for and those that fall from the sky. Federal incentives for farmers have used financial tools to help make U.S. agriculture among the most productive in the world. But still, as groundwater experts we know this drive to produce has sometimes come at a high cost, especially in vulnerable settings. Production incentives need to be balanced with more intelligent working practices or conservation measures so lands in sensitive areas are not worked so hard that groundwater resources, especially drinking water supplies, are degraded. Clearly, this needs to be addressed in federal agricultural legislation. This issue of the newsletter will be the last of 2010. As the year comes to a close,

— continued on page 6

### Mark your calendar! Talk to your training manager!

The Geological Society of America's (GSA) annual meeting will be in Minneapolis October 9-12, 2011. In addition to the meeting itself, which will be filled with topical sessions, special sessions, and discipline-specific sessions, GSA 2011 will include course offerings and field trips before (and potentially after) the meeting itself.

Because of shrinking training budgets everywhere and severe out-of-state travel restrictions for scientists working in the public sector, attending the GSA Annual Meeting could be a rare opportunity. October 2011 will be a fantastic and uncommon chance for all of us to attend a significant, international geosciences conference locally. Additionally, the meeting's proximity offers an opportunity for MGWA and its members to play an active role in proposing

and organizing field trips, technical sessions, and short courses. Consider proposing a technical session (deadline January 11, 2011) or short course (deadline February 1, 2011) of particular interest to MGWA members at [www.geosociety.org/meetings/2011/](http://www.geosociety.org/meetings/2011/). There will also be an opportunity early in 2011 to submit abstracts for platform presentations or posters.

MGWA will be sponsoring a spring conference in 2011 -- but no fall conference -- to encourage as many MGWA members as possible to attend GSA 2011. We have a wide range of interesting and important groundwater work happening in Minnesota, and GSA 2011 will be a chance to showcase our work and our active groundwater community. Please consider being actively involved in GSA 2011 as a session organizer, presenter -- or attendee!

Mindy Erickson, MGWA President-Elect and GSA 2011 Local Committee Member and Short Course Co-chair



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### Newsletter Deadlines

Issue	Due to Editor
March '11	02/04/11
June '11	05/06/11
September '11	08/05/11
December '11	11/05/11

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## MEMBER NEWS

### Tom Clark Retires

**Tom Clark**, a senior hydrologist with the MPCA's Remediation Division, is retiring at the end of December 2010 after over 33 years at the agency. Tom has a BA in Geology from Oberlin College in Ohio and an MA in Hydrogeology with a minor in Environmental Health Engineering from the University of Texas at Austin. Before coming to MPCA, Tom worked for 5 years as a geologist for the Illinois Environmental Protection Agency in Springfield. Tom's experience at MPCA includes the solid waste program, both the underground storage tank (UST) and leaking underground storage tank (LUST) programs, six years as team leader for the Ground Water Monitoring and Assessment Program (GWMAP, now the Ambient Groundwater Monitoring Program), and over ten years providing hydrologic support to the Environmental Reporting and Special Studies Unit. Tom is a charter member of MGWA and has served as membership director, newsletter editor, and an editorial team member. Tom is also a member of the American Institute of Professional Geologists (AIPG) and is a licensed professional geologist in Minnesota.

In retirement, Tom plans to remain active in MGWA and AIPG as a retiree member. In addition, he'll spend more time assisting his wife Cindy with her crafting and quilting business, a portion of which includes making gifts out of recycled materials. He will continue his interest in radio broadcasting which began in college and now includes producing a weekly program, Mother Earth, for the Radio Talking Book Network. Tom's favorite outdoor activities are bicycling, snowshoeing and travelling. On the home front, Tom and Cindy's two daughters and four granddaughters keep them busy.

### Dagmar Romano Retires

**Dagmar Romano**, a project manager with the MPCA's Superfund program is retiring at the end of December 2010 after over 25 years at the agency. Dagmar has an MA from the University of Minnesota's Hubert H. Humphrey Institute. Before coming to MPCA, Dagmar taught for three years in Africa and travelled extensively through Europe and southeast Asia. Back in the United States, she taught special education, worked for the non-profit Acid Rain Foundation and the Midwest Commission on Low-Level Radioactive Waste.

In addition to her experience with the Superfund Program at the MPCA, Dagmar has worked on low-level radioactive waste issues, the household hazardous waste program, and the leaking underground storage tank (LUST) program, among others. But she may be best remembered for her long-standing work as project manager for one of the most complex Superfund sites in the state, the Twin Cities Army Ammunition Plant, or TCAAP, north of the Twin Cities (see related update on the facing page).

In retirement, Dagmar plans to spend more time with her kids and grandkids and resume cello lessons. She also looks forward to having more time to read, garden, camp in the Boundary Waters, and take long-distance bicycle trips as well as other travelling.

— Member News continues on page 5



## A Summary of the Status of the Twin Cities Army Ammunition Plant (TCAAP) Superfund Site

The TCAAP site consists of four square miles and has over 20 source areas of on-site contamination. Media of concern are surface and groundwater, shallow and deep soils and sediments. The most widespread contaminants of concern are metals, PCBs, PAHs and VOCs. Most of the original on-site contamination has been remediated to industrial use standards. There is a 25-square-mile groundwater plume still being monitored and remediated by the Army.

The treatment numbers at TCAAP are impressive. Approximately 94,000 cubic yards of soils have been treated and/or removed at source areas. Over 49.4 billion gallons of groundwater have been treated, with over 223,000 pounds of VOCs removed. An additional 220,000 pounds of VOCs have been removed from the soils through vapor extraction systems. MPCA project manager Dagmar Romano says TCAAP has been a massively complex but rewarding site to work on, and it will be satisfying to turn the last portion of it over to others now. The new MPCA project manager taking over for Dagmar is Deepa

DeAlwis. Dagmar says she has enjoyed a good working relationship with the Army, the USEPA, other state and federal agencies, as well as MPCA staff, contractors and consultants, and a citizen's committee that has been actively engaged at the site for over a decade.

The remediation of the TCAAP site played a part in the development of the Rice Creek Water Trail from its headwaters at Lake Peltier, to its confluence with the Mississippi River. Access to the river was formerly restricted through the TCAAP site, but restrictions have since been removed and canoeists, kayakers and other water enthusiasts can now enjoy the whole route unimpeded. The DNR's Minnesota Conservation Volunteer magazine published a feature story on the Rice Creek Water Trail in its March-April 2010 issue. You can view a video of a trip down Rice Creek at this DNR web site: [www.dnr.state.mn.us/volunteer/marapr10/getaways\\_video.html](http://www.dnr.state.mn.us/volunteer/marapr10/getaways_video.html)

*This article was compiled by Dagmar Romano and Tom Clark*

### Abbreviations and Acronyms

ASTM – American Society for Testing and Materials  
DNR – Minnesota Department of Natural Resources  
MDA – Minnesota Department of Agriculture  
MDH – Minnesota Department of Health  
MGS – Minnesota Geological Survey  
MPCA – Minnesota Pollution Control Agency  
USEPA or EPA – United States Environmental Protection Agency  
USGS – United States Geological Survey



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### 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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**Officer Candidates**



**Kelton Barr**, candidate for President-Elect, is a Principal Hydrogeologist for the Braun Intertec Corporation. For more than 36 years, he has been a consulting hydrogeologist for several local and national firms. During this time he has been involved with the investigation and modeling of groundwater hydrology, karst flow systems, bioremediation, and geothermal systems, working on projects throughout the United States. Kelton has a B.A. in geology from Carleton College and a M.S. in hydrogeology from the University of Minnesota. He has conducted short courses on behalf of the University of Wisconsin, U.S. Environmental Protection Agency, U.S. Air Force, several oil companies, and more than 20 states' regulatory agencies.

*"I have been involved in the Minnesota Ground Water Association since its beginning, helping to found the organization in the early 1980s. Since then I have attended almost all of its conferences and field trips and regularly read its newsletter, so I am very familiar with and greatly appreciate its many benefits for groundwater professionals. All of MGWA's activities need to be sustained and revitalized so they can continue to be relevant, timely, and useful for its members. In these challenging times, MGWA also can play an important role in educating professionals and lay people in the importance of groundwater and of science-based policies. I would welcome the chance to work with all of MGWA's members in keeping MGWA strong, vibrant, and furthering our science".*



**Audrey Van Cleve**, candidate for Treasurer, received her Bachelor of Science in Geo Engineering from the University of Minnesota in 1985. She is a professional licensed geologist. For the past four years, Audrey has worked at the Minnesota Pollution Control Agency. As a hydrologist in the MPCA's Petroleum Remediation Program, she is responsible for assessing contaminant investigations and corrective actions to protect the public health and the environment from petroleum releases. Before joining the MPCA, Audrey worked at an environmental consulting firm for twenty years. There she assessed environmental risks at hazardous waste facilities as part of the Resource Conservation and Recovery Act permitting process, conducted investigations and performed corrective actions at petroleum release sites, and developed water conservation practices for federal facilities.

*"I have attended MGWA and American Institute of Professional Geologists (AIPG) conferences, presentations, and field trips since the mid-1980s. To give back to organizations that provide so much to their members, I decided to volunteer my time. I served as the AIPG Minnesota Section Vice President in 2004 and 2010. In 2006, I participated in planning the AIPG's annual meeting in St. Paul; as the food and beverage committee chair, I played a significant role in ensuring the fiscal success of the annual meeting. I served on the board of the Forum of Women in the Environmental Field from 2005 through 2007 and served as its Co-Chair in 2007. As treasurer for MGWA, I hope to serve our members by managing the organization's finances to support MGWA's primary objectives in providing information to guide public policy, supporting continuing education, supporting a common forum for ground water professionals, and educating the general public about groundwater resources."*

**Save these Dates!**

**MGWA's next Spring  
Conference May 4, 2011**

**GSA Annual Meeting  
October 9 - 12, 2011**

## Laurel Reeves Retires

After over 40 years working as a geologist and hydrogeologist in consulting and public service, **Laurel Reeves** retired on October 1, 2010. She retired from state service but not from her interest and involvement in water resources.

Laurel has been extensively involved in Minnesota's water sustainability initiatives. She served as MGWA President in 2005. In that year, Laurel led the MGWA in our effort to inform key legislators, including the Legislative Commission on Minnesota Resources (LCMR), through site visits about groundwater and significant related issues. Laurel organized the 2005 MGWA spring conference, Ground Water Sustainability Symposium, which was embedded in the North Central GSA conference and featured invited nationally known experts. Laurel contributed to and edited several sustainability related publications including 'Minnesota's Water Supply' which, ten years after its publication, still serves as a primer on the state's water management issues. Although not successful in obtaining the money, Laurel initiated LCMR/LCCMR proposals for interagency monitoring coordination, Mt. Simon monitoring, and aquifer management areas that laid the groundwork for subsequent initiatives.



The majority of Laurel's career, 29 plus years, was with the State of Minnesota, Department of Natural Resources, Waters Division with a brief intervening period with the Minnesota Pollution Control Agency. For sixteen years she managed the state's groundwater level monitoring program with a focus on

trend monitoring. During that time the monitoring network was

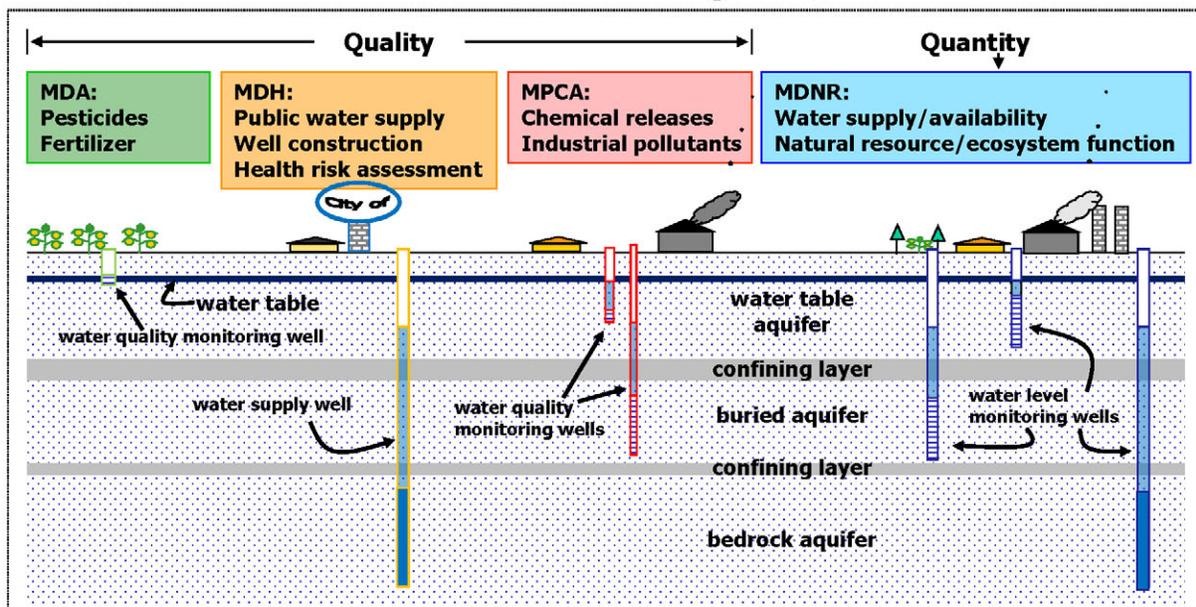
expanded to include locations of current and likely future water use, new monitoring techniques were implemented, and data was made available on the web. She served on teams and committees that developed the initial local water planning and the wellhead protection guidance, compiled public waters inventory maps, developed a state agency water data dictionary, studied water reuse, prepared and implemented metro water supply planning and other similar efforts. Other duties included a myriad of water resource management activities including environmental review, planning, permits, Superfund sites, landfills, Great Lakes conservation, watershed plans, and ditch report review. Laurel says, 'I've particularly enjoyed talking about groundwater basics and issues to non-technical audiences. They can ask questions that challenge your ability to explain and cause you to take another look at your assumptions and beliefs.'

Following graduation from Macalester College in 1970, she joined an engineering consulting firm. Geologists were uncommon in engineering companies at that time; woman professionals were even more uncommon. She was the first woman to participate in the metro area engineers' golf tournament (she did not have the worst score) and broke the women's dress code her first year by appearing at work in a pantsuit! Affirmative action laws forced a change in hiring practice, but the opportunity for professional development through field work and travel were limited. Laurel vividly remembers being chased off a construction site because women were not allowed on-site. Nonetheless, during her ten years with this firm, Laurel classified thousands of soil samples from throughout the Upper Midwest which provided her an excellent, dirt-under-fingernails understanding of glacial sediments.

After retirement, Laurel is focusing on her avocations related to horses, dogs, and photography.

The most simple concepts are often the most used and remembered. Laurel created the diagram below for a funding initiative several years ago. This diagram has been updated and reused many times and perhaps summarizes, most succinctly, her career of providing readily understandable, basic groundwater information.

## Groundwater – state agency roles



## Organization News

### From the Editors

The MGWA Newsletter team is losing two longstanding members. The rest of the team would like to personally thank **Tom Clark** and **Jan Falteisek** for their service to the organization.

Jan started working on the Newsletter in 1990. In her article on page seven, Jan reflects on the many changes technology has brought to the production of the Newsletter over the past 20 years. Tom took over from Jan and served as editor until 2002 when **Norm Mofjeld** stepped in as editor. During Tom's tenure the concept of a newsletter team evolved and the team was officially recognized in the March 2000 issue.

Jan and Tom have helped make the Newsletter an outstanding publication and their participation on the team will be greatly missed. They were honored at the Fall Conference for their service to the MGWA. Thanks again and best of luck to Jan and Tom!



### President's Letter, cont.

it is appropriate to point out some of the changes that will occur in the coming years for the MGWA membership. Many of you may have noticed by now the fee for MGWA membership has increased for 2011. This is an issue the MGWA Board approached with care because of the nature of the economy right now. We know conditions are tough for some among the membership. On the other hand, we are faced with a situation in which the existing fees have not been meeting the association expenses relative to membership, as required by MGWA's policies (and more importantly, Internal Revenue Service rules). Revenues generated by the conferences have been used to address the shortfall on an interim basis, but because the next two years will not allow MGWA to offer fall conferences, such funds may not be available in the future. Our hope is that the \$35 annual fee is still within reach for the majority of the membership. We also found that the newsletter subscription fees were not keeping up with costs – accordingly, those wanting to obtain a printed copy of the MGWA newsletter will now have to pay more than in years past. Among the things to look forward to in the next year or two is the annual Geological Society of America (GSA) conference to be held in Minneapolis in October 2011. The MGWA Board is discussing options for sponsoring a session at the conference so as to provide some local flavor to the national conference. Next year's MGWA President,

### Letter to the Organization

The MGWA Office recently received the following e-mail from **Bart Biernat** of Anoka County Environmental Services. We would like to thank Mr. Biernat for taking the time to write. His note also serves as a reminder to members that the conference materials uploaded on the MGWA web site are a valuable resource.

'Hi Laurel Reeves and the Minnesota Ground Water Association team:

I wanted to write you a quick note to thank you and congratulate MGWA on the professional way that you produce the conferences.

Yesterday, I had a client stop by my office with a water sample from her cabin well in Emily, MN. She asked me to analyze her water for manganese. I remember reading something about bore-hole mining for manganese in Emily in the MGWA newsletter. I found and reviewed Liljegren's materials on the MGWA website (spring conference 2010) and was able to listen to his presentation.

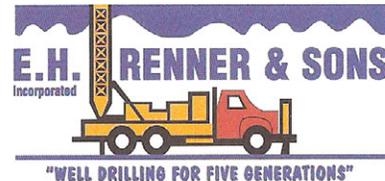
I wasn't able to attend the conference but still benefited from Liljegren's presentation via your website; so did my client.

You are providing outstanding service to MGWA members. Keep up the great work and thank you.

Bart'

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**Mindy Erickson**, has been coordinating several things with the GSA. One of her current efforts is to try to secure "affiliated" status for MGWA. Such an arrangement will allow our members to attend the GSA annual conference at discounted rates. That designation, if approved by GSA, would have substantial benefits to MGWA members. Look in this space next year to see if that pans out. In 2012 it is likely that Minnesota will again be the site of the annual Midwest Ground Water Conference. Like the GSA conference, this conference takes place in the fall, and is sufficiently similar in scope and breadth that we will likely not run a separate MGWA conference. Key differences, however, are that it often draws speakers and attendees from a multi-state area and that it usually lasts two or more days. If, as now seems likely, the MGWA will play a significant role in organizing the 2012 Midwest Ground Water Conference, then there will not be a regular fall MGWA conference. As 2010 comes to a close, it is a pleasure to acknowledge the contributions of outgoing MGWA board members **Scott Alexander** and **Craig Kurtz**, each of whom has added substantially to the MGWA. Next year will bring a new role for Mindy Erickson, who will assume the presidency, and the Board will welcome two new members in the positions of President-elect and Treasurer. Look for information on the candidates elsewhere in this issue.

## Jan Falteisek Steps Down from Newsletter Team

### From glue paste-ups to editing in 'the cloud'

I've been involved in the production of the MGWA Newsletter since the September 1990 issue. I've been production assistant, advertising manager, editor, designer, and newsletter team member at varying times over the years. During that time, it has been personally very satisfying to have helped to produce an excellent newsletter for MGWA members. Since the very beginning, the newsletter has always had several purposes: member education, sharing news about members and colleagues, and noting developments in our field. After the creation of the MGWA Foundation, the newsletter included a section for Foundation news. The content of the newsletter hasn't changed that much since its beginning (and I invite you to look at some early issues on the MGWA web site), but what has changed is how the newsletter is physically and electronically produced. As I transition out of the newsletter team it's appropriate to review some of those changes.

For many years, the newsletter was produced using layout software for one-color (i.e., black) and offset print on tabloid size paper which was then folded, stapled, and then physically mailed to members. This operations model held up pretty well although it did require producing newsletters in multiples of four pages, hand-pasting photographs, illustrations, and ad materials. There were many last minute trips to the photo-litho shop to have materials processed so it would print well using offset printing. Today, I don't think there's one photo-litho shop left in the Twin Cities.

Time moved on, computer technology changed, scanners became available, and the beginnings of email and the web surfaced. But, until member email and browser services (something better than s-l-o-o-w dialup) could handle a fairly large electronic file,

newsletters still needed to be prepared for printing and mailing in the traditional manner. Color started to appear more often, but the last page still had the 'presorted' mail tag on it.

Again, time moved on, fast internet became generally available to most MGWA members, so that by 2002 your MGWA newsletter could be downloaded from the MGWA website without waiting too long. Beginning in 2003 the newsletter was distributed by web download, a paper copy cost extra, and the mail tag was gone from the last page. Still, over this entire time, although there was more use of color, the newsletter looked essentially the same since its very beginning. That all changed in 2006, when the now-familiar blue drawdown curve banner and updated page and section design was created. I hope you like it, since I had a hand in the concept and created the updated banner. During the redesign, I also noted the newsletter hadn't had a name since 1989, just Minnesota Ground Water Association at the top of the first page, so 'Newsletter' again appeared. I'm not sure what the next look of the newsletter will be, but I'm sure the content will continue to serve and reflect the lively membership of the association.

As I take my leave of the MGWA newsletter team, the team is starting up the learning curve to use more up-to-date editing and collaboration tools. Now they edit and assemble the newsletter material 'in the cloud' using the web-based Google Docs. Using the 'cloud' approach gets around being buried in email and not always knowing if the article content to be edited is the current version. Cloud collaboration and editing has its own special challenges, but I'm sure the newsletter team will make it work.

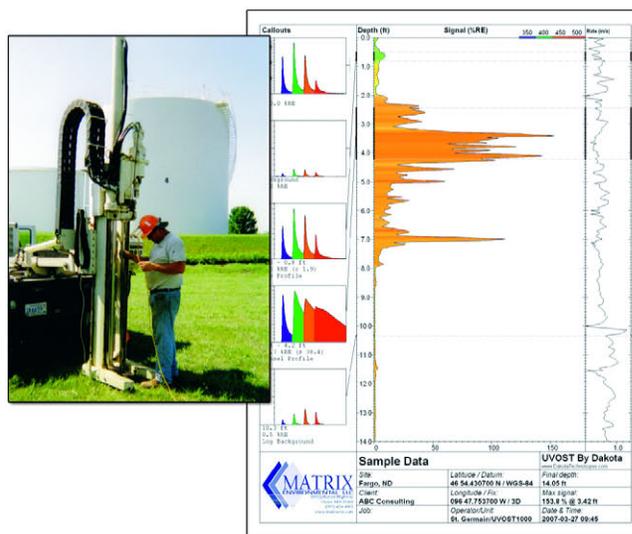
I'd like to encourage members to support their newsletter by submitting articles and other information items that would benefit the membership. Another way to support your newsletter is to make your interests and needs known. Lastly, you can be part of the story by becoming a member of the newsletter team---and you'll have a great time, too!

— Jan Falteisek, former MGWA newsletter team member



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## Joy Loughry Joins Newsletter Team

**Joy Loughry** is the newest member of the MGWA Newsletter Team. She has 8 years of experience in the field of hydrogeology. Joy has been employed as a hydrogeologist at the Minnesota Department of Natural Resources since 2008, where she is the groundwater modeler for the Inventory, Monitoring, and Analysis Unit of the Ecological and Water Resources Division.

Prior to her work for the State of Minnesota, she was employed as a hydrogeologist with Aquifer Science and Technology where she worked on water supply and wellhead protection projects including well siting, groundwater modeling, and aquifer storage.

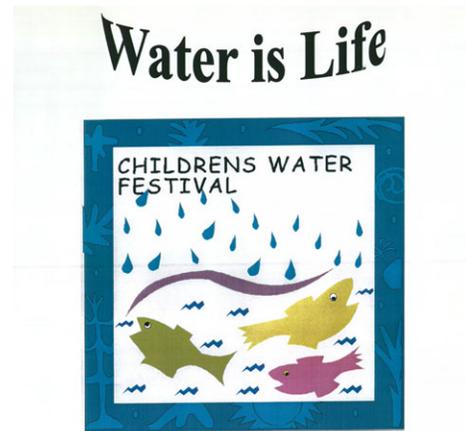
Joy earned a Bachelor of Arts degree in Geology from the University of Minnesota-Morris and a Master of Science degree in Geosciences from the University of Wisconsin-Milwaukee. Joy is licensed as a Professional Geologist in Minnesota and Wisconsin.



## Kids Have Fun, Learn About Water

by Tom Clark

The 13th annual Metro Children's Water Festival (CWF), held September 29, 2010 at the Minnesota State Fairgrounds. The CWF provided nearly 1,300 fifth graders from 45 schools representing all of the seven Twin Cities Metropolitan counties with opportunities to learn about where water goes when the toilet gets flushed, how tiny bugs can serve as an indicator of water quality, and the importance of wetlands in the water cycle. A large group of volunteers from the public and private sectors, including retirees from both sectors, gave their time and talents toward assuring these young minds would leave with a greater appreciation of the important role that water plays on planet Earth. This year, the MGWA Foundation contributed \$1,500 to the operation and success of the CWF. Next year's CWF is tentatively set for September 28, 2011.



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## LOSSES IN THE GROUNDWATER COMMUNITY

### Tom Winter

**Thomas C. Winter**, Scientist Emeritus with U.S. Geological Survey (USGS), died at his home on October 8th. Although retired in 2007, Tom never left his USGS home and continued to actively pursue research on lake and wetland hydrology and groundwater/surface-water exchange. His death was sudden and unexpected; the shock and loss will be felt throughout USGS and the broader hydrogeological and limnological communities.

Tom was born and raised in West St. Paul. After receiving BS and MS degrees in geology at the University of Minnesota in 1958 and 1961, Tom began his career with part-time employment with USGS and the University of Minnesota Limnological Research



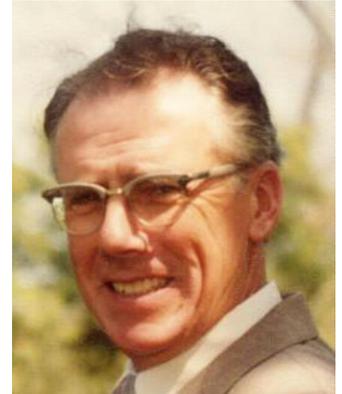
Center. Tom made considerable contributions to the field of palynology until he found permanent employment with USGS in the St. Paul office. Tom spent his early career as a hydrologist drilling hundreds of test holes across the State and interpreting the glacial history of Minnesota. After serving as Minnesota assistant district chief, Tom returned to graduate school at the University of Minnesota to study hydrogeology and the effect of groundwater on lake hydrology. Just prior to finishing his PhD, Tom obtained what he considered to be the best possible position with USGS, working as a research hydrologist with the National Research Program. Over the next 30 years, Tom's reputation as a preeminent leader in the field of lake and wetland hydrology, and groundwater/surface-water exchange, was firmly established world-wide. Tom lived that definition, as evidenced by the many national and international awards he received during and following his tenure with USGS, including the Geological Society of America's Meinzer Award, Society of Wetland Scientists' Lifetime Achievement Award, National Ground Water Association's M. King Hubbert Award, and the USGS Superior, Meritorious, and Distinguished Service Awards. Tom was a fellow of both the Geological Society of America and the Society of Wetland Scientists and a member of the American Geophysical Union and National Ground Water Association. His service to USGS, the hydrogeology and limnology communities, and the Public, will be sorely missed.

— Reprinted from *USGS Minnesota Water Science Center Newsletter, Fall 2010*

### James Fredin

**James Lowell Fredin**, 82, of Comfrey died Sept. 22, 2010, at St. John Lutheran Home in Springfield. He was born Jan. 6, 1928, to Milton and Lena (Ibeling) Fredin in Mountain Lake, Minnesota. He graduated from Comfrey High School in 1945.

In 1949, Jim married Marian Anacker in Darfur. They raised three sons on their farm south of Comfrey where they lived until moving to Brickstone Manor in Comfrey in 2007. They have been residents at the St. John Lutheran Home since February.



Jim loved farming and raising beef cattle for over 50 years. Even in retirement, he continued raising sheep and calves. He and Marian also were Master Gardeners who grew and sold vegetables at local farmer's markets. He served on the Comfrey school board from 1961 to 1976 and was its chairman for many years. Jim also was a member of the Darfur Farmers Elevator board, Faith Lutheran Church board and the National Cattlemen's Association. A founding member of the Red Rock Rural Water System board and its chairman for many years, Jim was honored for 25 years of service to the board in 2006.

Jim will be remembered for making things last just a little bit longer, making ice candles in the snow at Christmas, and pulling many vehicles from snowdrifts at the corner of County Road 1 and Highway 30. He also will be remembered for his kindness, quiet sense of humor and energy.

Survivors include his wife, Marian; their children: Brian (Laurie) Fredin of Mountain Lake; Todd (Nancy) Fredin of Surrey, England; and Tracy Fredin and Debra Petersen of Minneapolis; 13 grandchildren and great-grandchildren; and brothers- and sisters-in-law: Norm (Joyce) Fredin of Albert Lea, Marian Fredin of Mountain Lake and Wendell (Martha) Fredin of Comfrey.

— Submitted by Laurie Fredin

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## MGWA Fall Conference 2010 — Nonpoint and Ambient Water Quality Issues Affecting Minnesota

Radium, arsenic and nitrogen (not to mention potatoes) were featured topics at the Fall 2010 Conference of the MGWA. Held on November 9, 2010, the conference drew over 200 attendees to the University of Minnesota Saint Paul campus for a day of learning and interaction. Thirteen speakers discussed a wide range of topics relating to nonpoint source groundwater pollution and ambient water quality in Minnesota.



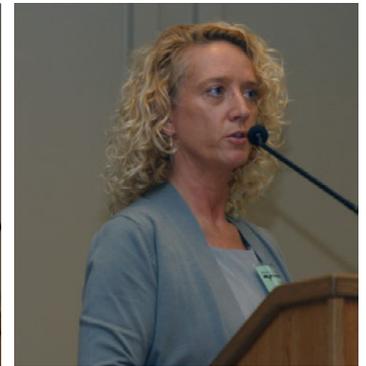
**Pete McMahon**, Research Hydrologist with the U.S. Geological Survey in Denver, started the day by presenting an overview of redox concepts associated with groundwater systems and their application to understanding the occurrence and distribution of contaminants in groundwater throughout the U.S. The concentration and detection frequency of many common groundwater contaminants

was related to the amount of oxygen in the groundwater. High concentrations of nitrate most often occurred in oxic groundwater. In contrast, high arsenic concentrations often were associated with anoxic water. Pete ended his talk with the point that, 'if you measure no other redox parameter in groundwater, measure dissolved oxygen.'



**David Vinson**, Duke University, described ongoing research on naturally occurring radium in the Jordan Sandstone. He is working with Jim Lundy at MDH to find out what causes high and low radium levels in groundwater. This could help avoid surprises when new wells are installed. Groundwater from the Jordan, one of Minnesota's major resources, sometimes exceeds the maximum contaminant level of 5 picocuries per

liter radium. He looked at controls on the abundance of radium in the subsurface environment, with particular focus on the balance between radioactive source and chemical removal. Radium is strongly adsorbed to the redox sensitive oxides, so redox conditions are important. Radium 228/226 ratios are examined to determine the source of radium in an aquifer. Surface coating and cements were found to be natural sources of radium.



**Sherri Kroening**, MPCA, and **Constance Holth**, MDA, presented an overview of the ambient groundwater quality monitoring conducted by these agencies. The MPCA and MDA jointly operate an ambient groundwater quality monitoring network for the State. The MPCA maintains a network of wells in urban and undeveloped parts of the state, and the MDA monitors a network of wells in agricultural areas. Both networks focus on monitoring the groundwater most susceptible to anthropogenic contamination. The MPCA currently is expanding its part of the network to better understand the effect various urban land uses have on groundwater quality. The data from both networks are available online from the MPCA's Environmental Data Access.



**Scott Korom**, University of North Dakota, shifted the focus to redox reactions that remove nitrate from the groundwater. He described the construction of in situ 'mesocosms', which are stainless steel chambers, open on the bottom to create a controlled environment in which to quantify the denitrification rate. His research has found the outwash aquifers with the greatest denitrification rates appear

to be associated with certain shale formations.

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## 2010 MGWA Fall Conference, cont.

**Brandy Toner**, University of Minnesota, posed the important question: ‘Can we predict arsenic vulnerability in western Minnesota?’ Arsenic in Minnesota groundwater likely originates from naturally occurring minerals. She went on to describe research she has been doing to resolve mineral phases that host arsenic using X-ray absorption spectroscopy. Problems remain with identifying arsenic sources to groundwater due to the inherent complexity of natural systems, but they found a valuable resource when they demonstrated they were able to use archived sonic cores as a sample set on which to test arsenic geochemistry.



**Michael Russelle**, U.S. Department of Agriculture, discussed land management practices to reduce nitrate loss, with a focus on using alfalfa to remove nitrate from soil and reduce the water flux, leveraging the capacity of this plant’s deep roots. He pointed out that grazing land in Minnesota has lower nitrogen losses than land planted with row crops.



**Carl Rosen**, University of Minnesota, discussed strategies to reduce nitrate leaching from irrigated potato farms in Minnesota, the potential for nitrate leaching into the groundwater system, and strategies to reduce nitrate leaching. Potatoes mainly are grown on vulnerable soils, such as glacial outwash. They have a shallow root zone, require a large amount of nitrogen fertilizer, and are sensitive to water stress. These

factors contribute to a high potential for nitrate leaching from the soil. Best management practices such as planting different varieties and timed nitrogen applications minimize nitrate leaching; however, there is no magic bullet and this remains a challenge.



**Luke Stuewe**, Minnesota Department of Agriculture, discussed nitrate contamination in the City of Park Rapids’ drinking water supply, which is related to nearby potato farming. The City utilizes the shallow groundwater for drinking which is particularly vulnerable to nitrogen leaching. He described the practical use of a rotation of perennials to reduce fertilizer use, clean

up residual nitrogen from the potato crop, and use as a green manure crop to reduce erosion.



**Tim Cowdery**, U.S. Geological Survey, described the science of age dating the young fraction of the groundwater, using trace levels of atmospheric gases dissolved in groundwater, such as chlorofluorocarbons. **Rich Soule**, Minnesota Department of Health, gave an example from Cold Spring, Minnesota, where future nitrate levels in the groundwater were estimated using a groundwater flow and nitrogen mass-balance model. He identified areas where wells may be lower in nitrate and where to focus efforts to reduce nitrate.

**Dave Legvold** provided the perspective from a ‘cheap Norwegian farmer’. He focused on the economics of nitrate efficiency and manure use and challenges in placing nitrate fertilizer for maximum crop uptake.

A new poster session was initiated at the fall conference. The USGS, MPCA, MDH and Bay West exhibited posters (**Jared Trost**’s, poster, USGS, is shown).



For more information on the presentations given at the fall conference, including the poster session, please visit our website at [www.mgwa.org](http://www.mgwa.org).

## The Soudan Underground Mine: A window into the deep subsurface microbial biosphere

By Jeffrey A. Gralnick, Department of Microbiology and BioTechnology Institute, University of Minnesota

Our planet is dominated by life unseen – microscopic, single cells spanning all three domains of life: Bacterial, Eukaryotic and Archaeal. Microbiologists have hunted for microbes across the surface of our planet for many decades, searching for both the causes and cures for disease, organisms that can transform carbon dioxide into transportation fuels, and places once thought to be too harsh to harbor life. In recent years, this search has turned downward, into the subsurface of our planet. Surprisingly, much like the surface of our planet, the subsurface is also home to a staggering number of microorganisms. In oceans, the sub-sea-floor has been estimated to contain two-thirds of Earth's total bacterial biomass, which is likely to be an underestimate [Roussel, 2008]. In comparison to the sub-sea-floor, the deep continental biosphere is less explored, but Minnesota has a unique resource that will help to literally shed light onto the matter: The Soudan Underground Mine.

### The Soudan Underground Mine

The Soudan Underground Mine is located on the Vermillion Iron Range in Northern Minnesota, 20 miles west of Ely, MN. At 2,341 feet underground, the lowest level of the Soudan Underground Mine is home to an extraordinary and extreme environment where the fields of microbiology, geochemistry and mineralogy converge. The sedimentary iron-rich rock that was mined for 80 years until the mine was closed in the early 1960s is known as a 'Banded Iron Formation' or BIF. BIFs can be found across the planet (Brazil, Australia and South Africa have some of the largest deposits). These formations contain a substantial portion of the iron found on the surface of our planet, and the Soudan BIF is estimated to be around 2.7 billion years old. Typically, oxygen is required to form rust (as we know all too well in Minnesota); however, the Soudan BIF was deposited ~ 300 million years before the Great Oxidation Event (Figure 1).

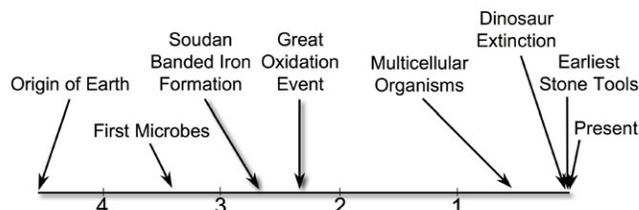


Figure 1. Timeline of Earth History. Our planet is approximately 4.6 billion years old. Note that microbes have been present for a large portion of Earth's history, while humans only evolved very recently.

### Life in an Ancient Ocean

Imagine a salty ocean teeming with microscopic life over 2.7 billion years ago, filled with soluble ferrous iron from hydrothermal vents, probably a few degrees warmer than our current ocean with zero or very low levels of oxygen gas ( $O_2$ ). Iron oxide – rust – accumulated at the bottom of this ocean as fluffy layers that compacted and transformed over time forming iron-rich layers (Figure 2). BIFs older than 2.4 billion years constitute an impor-

tant geological mystery: how do you make rust without  $O_2$ ? There is very good chemical evidence the atmosphere of our planet dramatically changed 2.4 billion years ago [Sessions, 2009], an incredible change called the Great Oxidation Event. Before this time,  $O_2$  was not present in significant concentrations in the atmosphere. The Great Oxidation Event was a critical tipping point in the history of our planet – we simply couldn't be here today without the bacteria who figured out how to split water using light energy (oxygenic photosynthesis).



Figure 2. Sample rock of the Soudan Underground Mine Banded Iron Formation (note pen for scale). Both red and grey layers are iron-rich. The grey layers are magnetic. The ore body mined at Soudan was derived from Banded Iron such as this. Geothermal heating of these rocks promotes silica leaching, further increasing the concentration of iron. The iron content of the ore body from the Soudan is so high that two pieces can be welded together!

Did these new photosynthetic microbes (cyanobacteria) arise slowly, where  $O_2$  reacted with ferrous iron resulting in rust and ancient BIFs such as the Soudan formation, or did they come on the scene rapidly, cataclysmically changing the chemistry of the atmosphere and oceans forever? If the ocean 2.7 billion years ago was devoid of  $O_2$ , microbiologists could have an answer to explain the BIF mystery. Light-utilizing iron-oxidizing bacteria could have been responsible for these ancient sedimentary formations [Kappler, 2005]. Additional study of the Soudan Iron Mine may lend insight into whether it was a slow or a fast build-up of atmospheric gases. In some ways, the Soudan Iron Mine is not only a window into the deep subsurface, but it is also a portal back in time.

### An Extreme Environment on Level 27

In the lowest level of the Soudan Iron Mine (level 27) water seeping from boreholes drilled in the waning days of the mine can be found (Figure 3). This water is quite unusual since it is devoid of  $O_2$  until it begins mixing with the mine atmosphere at the beginning of the borehole. The water ranges from two to almost three times saltier than seawater. However, unlike seawater, the primary cation in the mine water is not sodium, but calcium [Edwards, 2006]. These calcium-chloride brines have been found in a variety of subsurface environments in Canada, Finland, Germany and Sweden, but there is no consensus on their origin and age [Rosenthal, 1997]. The two primary models for formation of these brines are intrusion by marine sources (allochthonous) or as a result of rock-water interactions (autochthonous).

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## Soudan Mine, cont.



Figure 3. A top-down picture of a downward dipping borehole on the level 27 west side. The bubbles emanating periodically from this hole are primarily composed of methane. A wooden plug from the early 1960's was inserted into the top of the hole, but no longer prevents the brine from seeping out.

Associated with many of these horizontal boreholes are curious iron oxide formations that we have described as 'siderothems' as seen in Figure 4. The water chemistry seems to promote the formation of rimstone dams and throughout this strange water are poorly characterized iron minerals and thriving microbial communities. Some of the bacteria we have analyzed from this environment appear to be distant relatives of bacteria found in the ocean. What are bacteria from the ocean doing in water found 2,341 feet underground in northern Minnesota? Are descendants of organisms that helped form the Soudan BIF still living in waters trapped within the iron formation?



Figure 4. Siderothem formation on the level 27 east side. A horizontal borehole was drilled into the end of this alcove on September 14, 1961, resulting in the formation of this iron feature (siderothem). Rimstone dams comprised of iron oxide can be seen in the foreground of the picture.

## A Connection to Mars?

These unusual brines may be analogs for conditions and features on other planets and in particular Mars [Alexander, 2007]. Concentrated  $\text{CaCl}_2$  brines are stable fluids at pressures and temperatures present during the Martian summers. Features visible in the Mars orbital photography may have analogs in the Soudan mine rimstone dams (Figure 4).

## Science and Innovation from the Soudan Iron Mine

We have assembled an interdisciplinary team at the University of Minnesota to begin studying the linkages between biology, chemistry and geology at this unique site. Our first basic goal is to determine the microbial community present in the bottom of the mine, thriving in these brines: Who is there? What are they eating? Who are they related to? How did they get there? A second goal is to understand how the microbes influence the formation of iron oxide minerals: What minerals do we see? How is mineral formation influenced by brine chemistry? Our third basic goal is to study the brine itself: How old is it? How does the composition of the brine change across level 27 of the mine? Beyond these basic questions, we also will be isolating new microbes that have never been studied. We will explore biotechnological applications of some of these organisms in several areas ranging from production of antimicrobial and anticancer compounds to bioenergy and bioremediation. This work has recently been funded by Minnesota's Environment and Natural Resources Trust Fund via the Legislative Citizen Commission on Minnesota Resources and includes plans for outreach and education based at the mine.

## Visit the Mine

Though we are at the very early stages of our project at the Soudan Underground Mine, readers who are interested are encouraged to visit the mine, as it is one of the most unique State Parks in the United States. Two different tours are available, the historical Underground Mine Tour and the High Energy Physics Tour. As our work progresses, we hope to be able to provide information regarding the microbes, minerals and brines we are studying on level 27. Tours run daily from Memorial Day weekend through the end of September and the first three weekends in October. Visit [www.dnr.state.mn.us/soudan/tours.html](http://www.dnr.state.mn.us/soudan/tours.html) for more information.

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# New Analytical Methods at Minnesota Department of Agriculture

By Heather Johnson, Minnesota Department of Agriculture

Minnesota's water resources are valuable assets. To help preserve and protect them, the Minnesota Department of Agriculture (MDA) has monitored the impacts of the normal use of pesticides and fertilizers on the State's water resources for over 20 years as part of the agency's ambient monitoring activities. Monitoring results are used to determine the identity, concentration, and frequency of detections of pesticides and nutrients in Minnesota's ground and surface water. Long-term monitoring is essential to evaluate how water quality is changing over time.

In general, the MDA looks for pesticides that are widely used and/or pose the greatest risk to groundwater or surface water. The MDA follows a pesticide analyte selection process that prioritizes the specific compounds to be tested. With hundreds of different pesticides on the market, it is only practical to test for those with high use patterns and that pose the greatest potential risk to the water resources. Common compounds tested include pesticides applied in agricultural and lawn and garden settings. This article will focus on MDA's effort to monitor pesticides in groundwater throughout Minnesota.

## Background

Direction for groundwater monitoring by MDA is derived from the Minnesota Pesticide Control Law (M.S. 18B) and the Minnesota Groundwater Protection Act (M.S. 103H). Specific information describing goals, objectives, and practices pursued in implementing the charge to monitor groundwater are described in a Groundwater Monitoring Design Document. The design document and supporting material are available on the web at: [www.mda.state.mn.us/monitoring](http://www.mda.state.mn.us/monitoring).

Planning and prioritization are essential to the practical implementation of monitoring to meet MDA's goals and objectives related to groundwater. Implemented projects are pursued to optimize outcomes from limited resources, thus projects and procedures are constantly evaluated to maximize benefits and minimize costs.

MDA water quality concerns are focused on the impact of pesticides on groundwater. A pesticide impact means the occurrence of any pesticide in groundwater, regardless of concentration. Any pesticide is a possible target for analysis, although acetochlor, alachlor, atrazine, metolachlor, and metribuzin are of particular concern due to detections in previous monitoring efforts. The occurrence and concentration changes of the aforementioned pesticides over time also are of concern.

The groundwater monitoring program has been designed to satisfy the following three primary goals:

- ◆ Evaluate the impacts of pesticides to the most vulnerable groundwater within the 10 MDA Pesticide Monitoring Regions (PMRs) displayed in Figure 1.
- ◆ Determine the frequency of detections, the concentration of detections, and changes in detections and concentration over space and time.
- ◆ Evaluate the need for pesticide best management practices and other pesticide management plan activities in the various regions of the state.

Monitoring groundwater in sensitive areas of each PMR of the state provides the MDA with the ability to interpret the collected data on a regional and statewide basis. Pesticide Monitoring Regions are based on areas of similar agricultural practices and

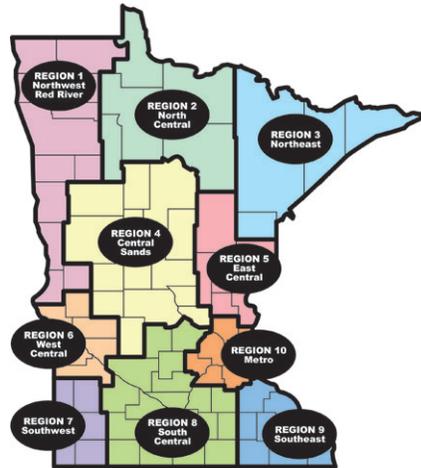


Figure 1. Pesticide monitoring regions of Minnesota

hydrologic/geologic characteristics. The PMR boundaries follow county boundaries but also generally represent different hydrologic regions of Minnesota. Focusing on sensitive areas also helps provide guidance in developing and assessing the effectiveness of pesticide management practices in protecting the groundwater in individual regions of the state.

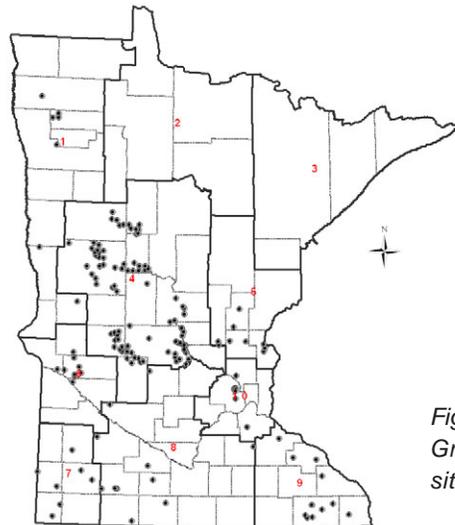


Figure 2. 2010 Groundwater sampling sites

Figure 2 shows MDA's groundwater monitoring locations in 2010. There are approximately 143 sites with monitoring wells, 14 with private drinking water wells, and 12 springs. In addition, nine new deep wells have been added to the network, which are nested at current well locations. These wells were added to provide more insight into potential impacts to deeper parts of the surficial sand aquifers than is represented by sampling the water table alone. The deeper wells also were instrumented with automated water level recorders to provide information needed for evaluating the dynamics of groundwater recharge in these systems.

## Past Lab Capabilities

Pesticides in the water quality samples are analyzed by the MDA's laboratory, located in St. Paul, Minnesota. This state-of-the-art laboratory is equipped with instrumentation to detect pesticides at very low levels. In 2002, the MDA laboratory began analysis of groundwater samples for the primary and secondary degradates of acetochlor, alachlor, dimethenamid and metolachlor. Prior to this, only parent compound analysis had been

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## New MDA Lab Capabilities, cont.

available for approximately 30 pesticides. In late May 2004, six additional base neutral pesticide analytes and three degradates of metribuzin were added to the list of target analytes.

In 2009, groundwater samples were analyzed for both target and non-target base neutral pesticides as well as chloroacetanilide degradates in all agricultural settings. In urban areas, water samples were analyzed for base neutral pesticides and chlorophenoxy acid herbicides. Base neutral pesticide analytes included acetochlor, alachlor, atrazine, metolachlor, and metribuzin, among approximately 25 others. Acid herbicide pesticide analytes included 2,4-D, dicamba, dichlorprop, 2-methyl-4-chlorophenoxyacetic acid (MCPA), meta-chlorophenylpiperazine (MCP), and triclopyr. Pesticide degrade analytes included breakdown products for acetochlor, alachlor, dimethenamid and metolachlor. For a full list of analytes from 2009, please reference the 2009 Annual Report, available at [www.mda.state.mn.us/monitoring](http://www.mda.state.mn.us/monitoring)

## Current Lab Capabilities

In 2008 the MDA was awarded a Legislative-Citizen Commission on Minnesota Resources (LCCMR) grant for the purpose of developing additional analytical capabilities for pesticides in groundwater and surface water. Previous laboratory analyses consisted of a separate analytical procedure for base neutral pesticides, chloroacetanilide degradates, and chlorophenoxy acid herbicides. This meant that each analysis needed a separately collected container for each different procedure. To increase laboratory efficiency and capacity, the MDA used the LCCMR grant to purchase equipment for a liquid chromatography with tandem mass spectrometry (LC-MS/MS) analytical method capable of detecting a much broader suite of chemicals, and at lower concentrations for some chemicals. In addition to LCCMR funding, funds from the Clean Water Fund were used to purchase a second LC-MS/MS to analyze additional samples. Basic development of the method was complete by January 1, 2010, and final validation was completed in May 2010. The MDA Lab also continues to use a gas chromatography mass spectrometry (GC/MS) procedure for analytes not captured by the new LC-MS/MS method. Figure 3 depicts MDA's LC-MS/MS instrument.



Figure 3. Liquid chromatography with tandem mass spectrometry (LC-MS/MS) equipment

These changes in analytical methods have greatly expanded the MDA's monitoring capability. The MDA analyzed water samples for approximately 44 chemicals in 2009; whereas the MDA analyzed for over 100 different chemicals in 2010. The MDA laboratory was able to maintain all the analytes from the previous methods. The most significant component of the new methods is the ability to quantify concentrations for many of these chemicals

at much lower levels. See Table 1 for a list of the 2010 chemicals. All of the pesticides now analyzed with the LC-MS/MS method are being quantified at parts per trillion levels. Approximately 1600 pesticide samples were submitted for analysis during 2010; an increase of 600 samples compared to 2009. Results from the 2010 sampling season will be available in the 2010 Annual Report, expected to be released in early spring 2011.

Table 1. 2010 GC/MS and LC-MS/MS analytes at MN Dept of Agriculture.

GC-MS Monitoring (ppb)	LC-MS/MS (+) Monitoring (ppt)	LCMS/MS (-) Monitoring (ppt)
Acetochlor	Acetamidiprid	2,4,5-T
Alachlor	Aldicarb sulfone	2,4,5-TP
Atrazine	Aldicarb sulfoxide	2,4-D
Boscalid	Azoxystrobin	2,4-DB
Chlorothalonil	Bensulfuron Methyl	Acetochlor ESA
Chlorpyrifos	Bromacil	Acetochlor OXA
Clomazone	Carbaryl	Alachlor ESA
Cyanazine	Carbofuran	Alachlor OXA
Cyfluthrin	Chlorimuron Ethyl	Bentazon
Deisopropylatrazine	DEDI Atrazine	Clopyralid
Desethylatrazine	Disulfoton Sulfone	Dicamba
Diazinon	Diuron	Dichlorprop
Dimethenamid	Halosulfuron Methyl	Dimethenamid ESA
Dimethoate	Hexazinone	Dimethenamid OXA
Disulfoton	Hydroxyatrazine	Flufenacet OXA
EPTC	Imazamethabenz Acid	Isoxaflutole Deg
Esfenvalerate	Imazamethabenz Methyl	MCPA
Ethafuralin	Imazamox	MCPB
Fonofos	Imazapic	MCP
Lambda Cyhalothrin	Imazapyr	Mesotrione
Malathion	Imazaquin	Metolachlor ESA
Metolachlor	Imazethapyr	Metolachlor OXA
Metribuzin	Imidacloprid	Picloram
Metribuzin DA	Isoxaflutole	Propachlor ESA
Metribuzin DADK	Linuron	Propachlor OXA
Metribuzin DK	Metalaxyl	Tembotrione
Myclobutanil ND	Metsulfuron methyl	Triclopyr
Oxadiazon ND	Neburon	
Parathion, Methyl	Nicosulfuron	
Pendimethalin	Norflurazon	
Phorate	Prometryn	
Prometon	Propoxur	
Propachlor	Saflufenacil	
Propazine	Siduron	
Propiconazole	Sulfometuron methyl	
Pyraclostrobin	Thiamethoxam	
Simazine	Thifensulfuron Methyl	
Tebuconazole	Thiobencarb	
Tebuprimiphos	Triasulfuron	
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# WEBINAR SCHEDULE 2011

- January 11 **HOW TO BE AN EFFECTIVE EXPERT WITNESS:** for Environmental and Engineering Professionals  
CW Fetter, Jr., PhD, PG; Author of *Applied Hydrogeology* and *Contaminant Hydrogeology*
- January 7 **HYDROGEOLOGY OF AQUITARDS AND LOW-PERMEABILITY MATERIALS, PART 1:** Analyzing Aquitard Integrity for Water Resources Protection and Contaminated Sites  
Ken Bradbury, Ph.D., PG and David Hart, Ph.D., PG
- January 14 **HYDROGEOLOGY OF AQUITARDS AND LOW-PERMEABILITY MATERIALS, PART 2:** Analyzing Head Distributions and Vertical Hydraulic Gradients  
Ken Bradbury, Ph.D., PG and David Hart, Ph.D., PG
- January 19 **ETHICS FOR GEOLOGISTS AND ENGINEERS:** Realizations of Everyday Decisions and Common Behaviors  
By Chris Mathewson, PhD, PG,
- January 20 **MARKETING & BUSINESS RELATIONSHIPS:** The Key to Your Company's Future and Your Personal Success  
Stu Walesh, Ph.D., P.E.
- January 26 **SLUG TESTING FOR SITE CHARACTERIZATION:** Practical Guidelines for Improving Efficiency and Accuracy  
Jim Butler, PhD, Author of *The Design, Performance, and Analysis of Slug Tests*
- February 2 **PUMPING TESTS FOR AQUIFER EVALUATION: Part 1:** Some Practical Guidelines to Get More from Your Test Data  
Jim Butler, PhD
- February 9 **PUMPING TESTS FOR AQUIFER EVALUATION: Part 2:** Fundamentals of Pumping Test Interpretation  
Chris Neville, PE
- February 16 **PUMPING TESTS FOR AQUIFER EVALUATION, Part 3:** Understanding Well Hydraulics through Step Tests  
Chris Neville, PE
- February 23 **PUMPING TESTS FOR AQUIFER EVALUATION: Part 4:** Handling Data from Tests with Variable Pumping Rates and Interpreting Recovery Test Data  
Chris Neville, PE
- February 24 **IMPROVED PROJECT COMMUNICATION:** You and Others Within and Outside of the Project Team  
Stu Walesh, Ph.D., P.E.
- March 3 **ANAEROBIC ATTENUATION OF PETROLEUM CONTAMINATION:** Advances and New Trends in Measuring Natural Attenuation  
Lyle Bruce, PhD, PG
- March 10 **ENVIRONMENTAL FORENSICS AND CHEMICAL FINGERPRINTING:** Assessing Analytical Methods and Understanding Hydrocarbon Chemistry  
Lyle Bruce, PhD, PG
- March 8 **GLACIAL SEQUENCES Part I:** Deciphering Stratigraphy and Depositional Environments  
Tim Kemmis, PhD, PG
- March 15 **GLACIAL SEQUENCES Part II:** Understanding the Effects of Post-Depositional Weathering: Development of Weathering Zones and Secondary Jointing"  
Tim Kemmis, PhD, PG
- March 22 **MANAGING UNANTICIPATED SUBSURFACE CONDITIONS IN THE FIELD:** Confident Characterizations When Budgets Matter Most  
Dan Kelleher, PG, CIPM
- April 4 **PHARMACEUTICALS IN GROUND WATER:** Understanding the Environmental Fate of Drugs in the Water  
Melissa Lenczewski, PhD
- April 6 **BOREHOLE FLOW METER TECHNIQUES:** for Assessing Bedrock Stratigraphy and Fracture Hydraulics **Just Added!**  
Ken Bradbury, Ph.D., PG and David Hart, Ph.D., PG
- April 11 **ANALYTICAL DETECTS:** Why Subbing One-Half the Detection limit is Trouble, And What You Can Do Instead **Just Added!**  
Dennis Helsel, PhD
- April 12 **LNAPL TRANSMISSIVITY AS A METRIC:** The Future in Tracking LNAPL Recovery Progress  
Mark Adamski, PG and Andrew Kirkman, PE
- April 13 **STEP-BY-STEP PACKER TESTING:** for Hydrogeologic Projects **Just Added!**  
Ken Bradbury, Ph.D., PG and David Hart, Ph.D., PG
- April 20 **AVOIDING SCOPE CREEP:** Methods to Prevent Financial Erosion and Improve Your Project Management Skills  
Stu Walesh, Ph.D., P.E.
- May 2 **UNDERSTANDING LNAPL IN FINE GRAINED SOIL:** Convention, Misconceptions and New Advances  
Mark Adamski, PG and Andrew Kirkman, PE
- May 16 **HANDLING NONDETECT DATA CORRECTLY** **Just Added!**  
Dennis Helsel, PhD
- May 19 **KARST CHARACTERIZATION USING GEOPHYSICS, PART 1:** Effective Geophysical Methods for Karst  
Phil Carpenter, PhD
- May 20 **KARST CHARACTERIZATION USING GEOPHYSICS, PART 2:** Do's and Dont's Through Case Histories and Examples  
Phil Carpenter, PhD

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### Todd County Geologic Atlas, Part B, Now Available

Part B of the Todd County Geologic Atlas is now available. The report, recently published by the Minnesota Department of Natural Resources (DNR), includes four map plates that describe the county's surficial and buried sand aquifers and the sensitivity of those aquifers to pollution. The report builds on the series of geologic maps created by the Minnesota Geological Survey (MGS) for Part A of the atlas.

The Part B atlas includes extent and thickness of the surficial sand aquifer and eight buried sand aquifers, six hydrogeologic cross sections, water table and potentiometric surface elevation maps, a summary of the natural chemistry and residence time of groundwater, direction of groundwater flow, summary of aquifer characteristics, and pollution sensitivity interpretation.

The Todd County Geologic Atlas is a cooperative effort of the MGS, the DNR, and Todd County. The Part B atlas report joins the previously completed Part A that includes maps of surficial and bedrock geology and the data sets that support the maps.

Other County Geologic Atlas, Part B reports underway at DNR include: Benton, Carlton, Carver, Chisago, and McLeod. In addition, Part A reports underway at the MGS include Anoka, Blue Earth, Clay, Morrison, Nicollet, Renville, Sherburne, Sibley, and Wright. Each Part A report in preparation at the MGS will be followed by a Part B to be prepared by the DNR.

See Figure 1 for the status of county geologic atlases in Minnesota. Reports in the County Geologic Atlas Series may be purchased at the Minnesota Geological Survey, Publications Sales Office, at 2642 University Avenue, St. Paul, 55114, phone (612) 627-4782.

Development of these county atlas reports is supported by funding from the Minnesota Department of Natural Resources, the Minnesota Environment and Natural Resources Trust Fund as recommended by the Legislative-Citizen Commission on Minnesota Resources, and the Clean Water Legacy Fund. At the MGS, county atlas funding is augmented with federal funds under the STATEMAP program of the National Cooperative Geologic Mapping Program of the U. S. Geological Survey.

The Todd County Geologic Atlas, Part B, was prepared using geographic information system (GIS) technology. A DVD will be available for the report that includes versions of the atlas maps and data in versions accessible both to GIS users and to those who do not use this technology. Data files and portable document format (PDF) images of plates are available on-line for download. Data for the previously published Part A of the atlas is accessed from the MGS web site at:

[www.geo.umn.edu/mgs/county\\_atlas/countyatlas.htm](http://www.geo.umn.edu/mgs/county_atlas/countyatlas.htm) or

[www.mngs.umn.edu/index.html](http://www.mngs.umn.edu/index.html). For access to completed Part B reports please see the DNR Waters web site at [www.dnr.state.mn.us/waters/groundwater\\_section/mapping/status.html](http://www.dnr.state.mn.us/waters/groundwater_section/mapping/status.html).

For more information contact the Minnesota Geological Survey, at (612) 627-4780 or Jan Falteisek, DNR Ecological and Water Resources Division, at (651)259-5665.

### MGS Scanning Maps and Reports for Web Access

Since its beginning in 1872, the Minnesota Geological Survey (MGS) has published over 40,000 pages of reports and more than 600 maps. These documents remain a crucial source of information for the people of Minnesota to ensure wise stewardship of their water, land, and mineral resources. The documents also facilitate societal benefits related to economic prosperity, public health, natural hazards, aesthetic appreciation, and preservation of our natural heritage. In the current era, people access much of the information that they need, or wish to view, through the Internet and the web. In 2007, under the leadership of their Director, Dr. Harvey Thorleifson, the MGS launched a project to scan and make web-accessible every map and document formally published in the history of the organization. The project has been supported by the Minnesota Digital Library and the University of Minnesota Libraries Digital Collections Unit. The maps and reports are available as PDF documents ranging from less than 10 to about 40 megabytes in size. For more information on the scanning project, please see [www.mngs.umn.edu/scan\\_summary.htm](http://www.mngs.umn.edu/scan_summary.htm) for details. Links to the scanned maps and documents can be found on the MGS home page at [www.mngs.umn.edu/index.html](http://www.mngs.umn.edu/index.html)

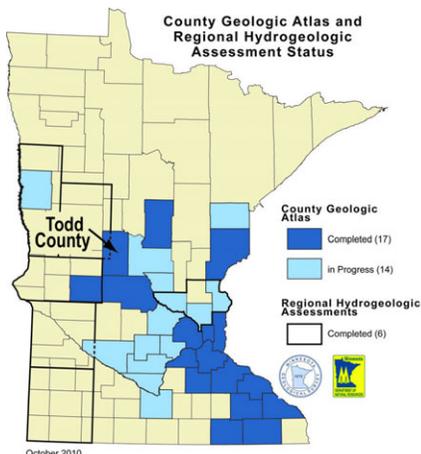


Figure 1. Status of County Geologic Atlases.

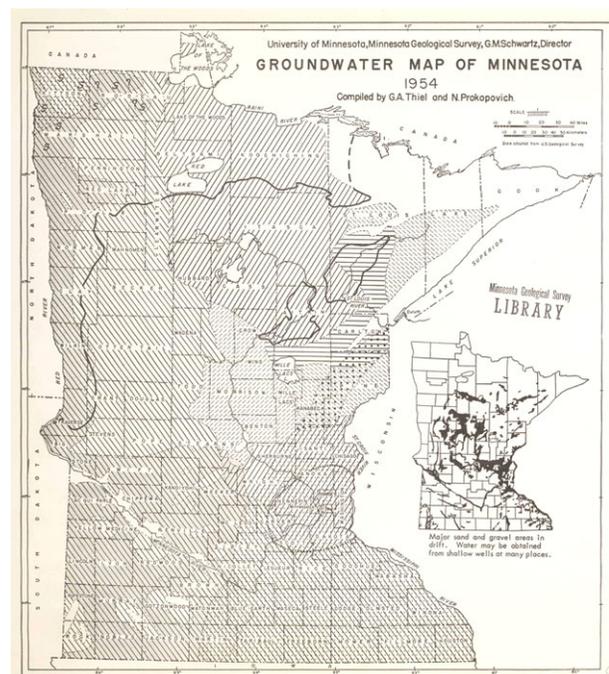


Figure 1. Image of 1954 groundwater map published by the Minnesota Geological Survey that has been scanned and which is now available on-line. This map is available at <http://purl.umn.edu/59836>

## MGWA BOARD MINUTES

### Minnesota Ground Water Association Board Meeting Minutes

<b>Meeting Date:</b>	<b>October 1, 2010</b>
<b>Location:</b>	Fresh Grounds Coffee Shop, 1362 West 7th Street, St. Paul, Minnesota
<b>Attending:</b>	Steve Robertson, President; Mindy Erickson, President-Elect; Jill Trescott, Secretary; Tedd Ronning, Newsletter; Jeanette Leete, WRI; Sean Hunt, WRI; Scott Alexander, Foundation; Craig Kurtz, Treasurer
<b>Past Minutes:</b>	September minutes approved.
<b>Treasury:</b>	Cash on hand is approximately \$39,500. Summer is a slow period for financial activity.
<b>Newsletter:</b>	Everything has been submitted for the September newsletter.
<b>Web Page:</b>	Conference information on the web page has been updated with speaker updates and presentation titles.
<b>WRI Report:</b>	The managers' report was submitted. WRI paid \$1,500 from the Foundation to the Children's Water Festival.
<b>Foundation:</b>	The Foundation may have a change in officers.
<b>Old Business:</b>	<u>GSA 2011</u> – cost will be approximately \$400 to register for the full week. MGWA members will be allowed to register at the GSA member rate. <u>Hydrostratigraphy workgroup</u> – there will be an update at the conference <u>Fall Conference (November 9)</u> – Draft schedule was distributed; there will be a few changes. <u>Dues for 2011</u> – Raising the membership rate was discussed. The tax structure of MGWA requires that membership dues cover the costs of member services. The current dues of \$30 per year are not sufficient. Craig moved to raise the membership dues from \$30 to \$35 per year for Professional members. Mindy seconded; all were in favor. Other membership rates were discussed. Scott moved to maintain the current dues for students at \$15 and the price for a printed membership directory at \$7, but raise the cost for printed newsletters from \$10 per year to \$20 per year. Mindy seconded and all were in favor.
<b>New Business:</b>	<u>Elections</u> – Candidates for officers were discussed. Kelton Barr is being nominated for President-Elect. A Treasurer candidate is needed; volunteers are encouraged. Voting will be in December. <u>Distinguished Service Awards</u> discussed. To be awarded at the Fall Conference. <u>Laptop</u> – Craig brought up that the MGWA laptop can't process the newsletter and recommended that the laptop be replaced. WRI was asked to present the Board with a proposal for a replacement laptop at a future meeting.
<b>Meeting Date:</b>	<b>November 5, 2010</b>
<b>Location:</b>	Fresh Grounds Restaurant, 1362 West 7th Street, St. Paul, MN
<b>Attendance:</b>	Steve Robertson, President; Mindy Erickson, President-Elect; Jill Trescott, Secretary; Jeanette Leete, WRI; Sean Hunt, WRI; Scott Alexander, Foundation
<b>Past Minutes:</b>	October minutes approved.
<b>Treasury:</b>	Treasurer's report was submitted by e-mail. Cash on hand is approximately \$53,500. \$22,840 in Fall Conference revenue has been received to date, which is sufficient to cover the conference's expenses.
<b>Newsletter:</b>	The December newsletter will include bios of the officer candidates, conference highlights, and a memorial to Tom Winter. The President's Letter will include an explanation of the increase in dues.
<b>Web Page:</b>	The September newsletter and Fall Conference updates have been put on the web page.
<b>WRI Report:</b>	The managers' report was submitted. Membership renewals have been coming in; 194 members have renewed to date. Taxes have been paid for the third quarter.
<b>Foundation:</b>	WRI has sent thank-you receipts to donors on behalf of the foundation.
<b>Old Business:</b>	<u>GSA 2011</u> – Mindy will prepare the application for Associated Membership to submit to the GSA. Potential session and field trip topics were discussed. <u>Fall Conference (November 9)</u> – The business meeting will be conducted before the afternoon break. The Distinguished Service Award plaques will be presented at that time. There will be a call to close nominations for officers. <u>Elections</u> – Audrey Van Cleve has been proposed for Treasurer. Voting will be in December. <u>Laptop</u> – Jeanette recommended that software be upgraded when the hardware is replaced. She said the laptop could be replaced for about \$1,200. Quickbooks will be \$200 or less. Creative Suite for Adobe (CS5), which is used to produce the newsletter, is \$689. Jill moved to approve purchase of the new laptop and software upgrades. Mindy seconded. All in favor.
<b>New Business:</b>	The Birdsall-Dreiss lecture at the Midwest Groundwater Conference was discussed. The MGWA Officers' Handbook was discussed.
<b>Next Meeting:</b>	Friday, December 3, 2010, at 11:30 at Fresh Grounds at 1362 West 7th Street, St. Paul, Minnesota.

**The MGWA Board of Directors meets once a month.**

**All members are welcome to attend and observe.**



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### Guidelines for Submission of Newsletter Articles

The newsletter team appreciates the efforts of article contributors, without whom our newsletter would not be possible. To make the process easier on the author, the newsletter team and production staff, we have established some guidelines we would like authors to follow. For a complete list of guidelines, please see the MGWA web site:

- ◆ Submittals should be complete and ready for publication.
- ◆ The text of the article should be submitted as a Microsoft Word document in an attachment to an e-mail or on disk.
- ◆ Tables, captions, figures and graphics should be submitted individually as separate high quality files.
- ◆ A version of the article with embedded tables, figures, and graphics may be submitted as an additional file to indicate the preferred layout of the tables, figures and graphics within the article.
- ◆ The contributor should include the contributor's name and affiliation following "By" below the title of the article.
- ◆ The contributor should secure permission to print or reprint if applicable and provide the required text to be included with the article.
- ◆ Materials should be submitted before the deadline.

If there is any question about the suitability of a proposed article's content for the MGWA newsletter, it is advisable for the contributor to call the editor before investing significant time in article preparation.

### MGWA 2011 Membership Dues

Professional Rate:	\$35
Full-time Student Rate:	\$15
Newsletter (printed and mailed)	\$20
Directory	\$7

Membership dues rates were revised at the October 1, 2010 meeting of the MGWA Board. The Board intends to balance the membership services budget.





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Webinar featuring **Ken Bradbury, PhD, PG** and **David Hart, PhD, PG**

**Hydrogeology of Aquitards and Low-Permeability Materials**

7 January 2011

**Part 1: Analyzing Aquitard Integrity for Water Resources Protection and Contaminated Sites**

14 January 2011

**Part 2: Analyzing Head Distributions and Vertical Hydraulic Gradients**

Webinar Featuring **C.W. Fetter, Jr., PhD,**  
Author of *Applied Hydrogeology and Contaminant Hydrogeology*

**How to be an Effective Expert Witness**

11 January 2011

for Environmental & Engineering Professionals

one's self during court when under pressure, and how to prepare for discovery, deposition, and trial from by C.W. Fetter, Jr. who has more than 40 years of being an expert and having testified in more than 75 administrative hearings, depositions and trials. Multiple Webinar Series Discount available.

Webinar featuring  
**Chris Mathewson, PhD, PE, PG.,** Regents Professor at Texas A&M University

**Ethics for Geologists and Engineers**

19 January 2011

Personal Realizations and Corporate Consequences of Everyday Decisions and Common Behaviors

help you more easily make decisions while equipping you with a clear process that you can comfortably discuss issues with colleagues, supervisors, clients or regulatory staff. This webinar addresses the typical kinds of problems we face in working in the environmental and engineering industry and identifies resources and thought processes we can use to make ethical decisions. Multiple Webinar Series Discount available.

Webinar featuring **Stu Welsh, Ph.D., PE.,**  
Author of *Managing and Leading: 52 Lessons Learned for Engineers*

**Marketing and Business Relationships**

20 January 2011

The Key to Your Company's Future and Your Personal Success

facing difficult times and may appreciate an empathetic listener with fresh ideas. Register now and re-energize your marketing efforts using a proven approach that professionals can ethically and enthusiastically embrace and with which they can achieve results, for them and those they serve. Multiple Webinar Series Discount available.

Webinar featuring **Jim Butler, Ph.D., PG.**  
Author of *"The Design, Performance, and Analysis of Slug Tests"*

**Slug Testing for Site Characterization**

26 January 2011

Practical Guidelines for Improving Efficiency and Accuracy

inappropriate field and analysis procedures. Webinar attendees will learn practical guidelines that they can apply immediately to their work to significantly improve the quality of parameter estimates obtained from slug tests.

**This 2-part webinar series provides a process to assess aquitard integrity.** You will learn the unique hydrogeologic properties of aquitards while gaining insight to evaluating the effectiveness of low-permeability units to inhibit ground water flow. Discover how typical monitoring well configurations can yield misleading information in low-permeability settings. Learn the definition and how to recognize the water table in low-K settings and evidence for or against perched conditions. Two-Part Discount available.

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**This webinar is designed to give consulting scientists and engineers and regulators the information they need to get reliable information from slug tests.** Despite being the most common technique for acquiring information about transmissive properties of subsurface units, much of the information currently obtained from slug tests is of questionable quality as a result of

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## FOUNDATION MESSAGE

### MGWA Foundation and Scholarship Fund

In the 1970s, the director of the Minnesota Geologic Survey (MGS), Dr. Matt Walton, was attending a budget hearing at the state capital about funding the MGS again for mapping the geology of Minnesota. The story goes that one of the legislatures asked Matt if this budget request would allow the MGS to finish mapping the geology of Minnesota; and, when would this occur? Matt replied that the MGS would finish mapping at the same time the legislators finished passing all the laws needed to run the state. Matt was right, we are still mapping Minnesota and it looks like it will continue as long as we continue to pass laws.

This was most apparent to me when I recently attended a presentation by Tony Runkel of the MGS regarding work he and his colleagues have been pursuing on the hydrostratigraphy of the Paleozoics of southeastern Minnesota. In particular, their findings are recognizing discrete intervals of high conductivity within both aquifers and aquitards. In the late 1970s I worked at the MGS with Roman Kanivetsky on the Bedrock and Quaternary Hydrogeologic Maps of Minnesota. We lumped a lot of units, either aquifers or aquitards, based on the formation's general lithology. This was basic mapping at that time. The first county atlas would not come

out until 1982 and who knows when the last county will be mapped.

We have come a long way since the 1970s. We have new ways of looking at data and maps and are finding better ways to interpret them. We will never know everything about the subsurface; but, with each day we chip away at the assumptions we have made and answer a few more of those unknowns. We are so good at interpreting so much with so little. There is a lot of work ahead. Who will do this work in the future? Simple answer: the next generation of students.

We must encourage students to pursue careers in groundwater. A primary objective of the MGWA is to support groundwater education. MGWA established the MGWA Foundation (a non-profit, tax-exempt 501(c)(3) organization) to distribute funds generated by MGWA and member donations for ground water education. Our goal is to establish a \$100,000 endowment to generate scholarship funds for students studying groundwater resources.

The endowment is currently at \$96,000. We are **so** close! If each member sent in \$10, we would be there. If half the members sent in \$20, the same result. Please consider giving back to your profession. Donate to MGWA's Foundation at [www.mgwa.org/store](http://www.mgwa.org/store)

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