

# Minnesota Ground Water Association

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## MDH, City of Maplewood, and Well Contractor Dig Deep to find Abandoned Railroad Well

In 1995, the Minnesota Department of Health (MDH) Well Management Section became aware of the existence of an old, abandoned, unsealed railroad well that was located somewhere on a 26 acre, former railroad property in Maplewood, Minnesota. An old record documenting the well's existence was obtained from a 1936 geological bulletin published by the University of Minnesota. The record indicated that the well was 615 feet deep and that it had been drilled through several different aquifers. The MDH had no documentation indicating that the abandoned well had been properly sealed. Consequently, locating this well, and getting it permanently sealed, were high priorities for the protection of groundwater quality and public health and safety in the area.

**History** – In 1887, the St. Paul and Duluth Railroad Company built shops for the manufacture and repair of railroad cars in the city of

Gladstone (what is now Maplewood), Minnesota. A 615-foot deep well was drilled to supply water to the shops. In 1949, the Seeger Refrigeration Company (later Whirlpool Corporation) leased the land and buildings for storage. In 1979, all the buildings on the property were demolished and removed. The property sat vacant until 1995 when the City of Maplewood offered to buy the property. At the time, the sellers did not know where the well was located. The sellers and the City of Maplewood contacted the MDH for assistance in finding the well. This was a problem because all former buildings and landmarks on the property had been torn down and removed in 1979. All that remained was a flat, partially wooded, 26 acre parcel of land. Working with little more than a hand drawn sketch map and a few notes, the seller made an attempt to locate the well by excavating with a backhoe. A large hole was excavated in the middle of the property to a depth of 12 feet; but the well was not found. The sellers proceeded to request and obtain a variance from the MDH to postpone permanent

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## President's Column

I look forward to serving all the MGWA members as President in this coming year. I would like to thank Rob Caho and the 2002 MGWA Board for their hard work during the MGWA 20th year. The 2002 MGWA conferences were educational and very successful.

This year's MGWA Board consisting of President-Elect Chris Elvrum, Treasurer Eric Hansen, Secretary/Membership Director Jon Pollock, Past President Rob Caho, and myself, are committed to working together to continue to grow and expand the MGWA.

The Spring Conference will be on Thursday April 17, 2003, at the Earl Brown Center located at the University of Minnesota St. Paul Campus. The 2003 Spring Conference topic is "Interaction of Ground Water and Surface Water". Volunteers for the day of the Spring Conference are still needed. Committee members are also needed for the MGWA Fall Conference. If you would like to volunteer for any of MGWA's activities, please contact me at DPRA Incorporated (651) 227-6500 extension 3140 or [marty.bonnell@dpra.com](mailto:marty.bonnell@dpra.com).

— Marty Bonnell MGWA President

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Site of buried, unsealed, abandoned railroad well, Maplewood, Minnesota.

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### 2003 Newsletter Deadlines

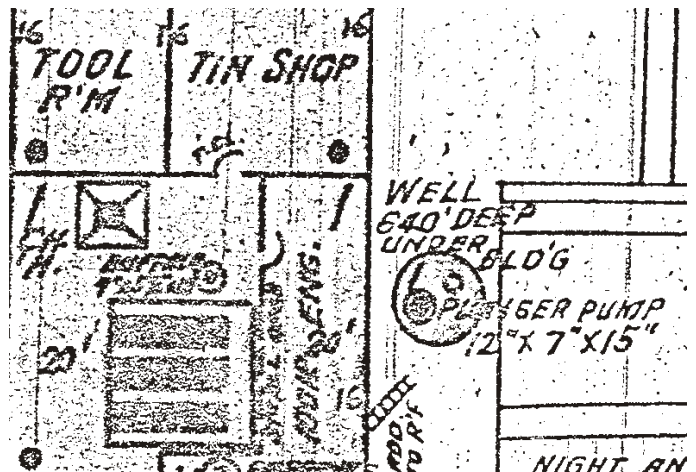
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### Maplewood RR well, cont.

Fire Insurance  
map from the  
early 1900s  
showing the  
location of a  
640 foot deep well,  
Maplewood,  
Minnesota.



sealing of the well until better informa-  
tion about its location came to light.  
The property (and the unsealed, lost  
well) was purchased by the City of  
Maplewood. The city planned to use  
the property for open space/park land.

**Search for Information** - Over the  
next several years, as time permitted,  
the MDH continued to search and  
compile information about the location  
of the well. Retirees from the Whirl-  
pool Corporation, who had worked at  
the facility, were contacted for infor-  
mation about the well. One retiree  
provided a blurry aerial photograph of  
the property showing the buildings on  
the site. Another recalled that the well  
was located in a well pit, under a well  
house, and that an extension ladder  
was needed to get to the bottom of  
the pit to access the wellhead. De-  
tailed maps of the Northern Pacific  
Railway's Gladstone/ Gloster Train  
Station were located in the company's  
records on file at the Minnesota His-  
tory Center in St. Paul, Minnesota.



Aerial photograph from 1978 showing  
well house near former railroad  
maintenance facility

Fire insurance maps were also  
obtained at the history center. The  
maps showed the locations of the  
buildings on the site, including the  
well house. Some even contained  
descriptions of the pumping equip-  
ment and the well depth. A major  
development in the search for the  
well came in 1997 when a high qual-  
ity aerial photograph of the property,  
taken from directly above the prop-  
erty, was obtained from the  
Maplewood Area Historical Society.  
The photograph was taken in 1978,  
the year before the buildings were  
torn down. The well house was  
clearly visible in the photograph.

The search for information did not  
stop there. MDH staff wanted to learn  
as much about the well and its exact  
location, before asking the City of  
Maplewood to hire an excavator to  
dig and locate the well. Staff in the  
MDH's Source Water Protection Unit  
were called in to assist in using the  
aerial photograph to help pinpoint the  
well house location on the actual  
property. They were able to scan the  
aerial photograph into the depart-  
ment's Geographical Information Sys-  
tem (GIS). From there they were able  
to overlay it on top of a digitized  
county road map. Once this was  
done, they selected the location of  
the well house, and the GIS program  
provided a latitude and longitude  
coordinate for the well house. MDH  
staff then used a Global Positioning  
System (GPS) receiver to navigate to  
the coordinate on the property. A  
stake was placed in the ground at this  
location to mark the possible location

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## Membership News and Information Update:

Now ground water information can flow two ways! Our Newsletter can be a forum for every member to share information they encounter. Are you working on an interesting project? Have you come across an interesting fact? Describe something you experienced or witnessed. What progress or developments is your organization making? Let us know if you've changed job positions recently. Let's keep our membership in touch with one another! Selected comments will appear in the next issue.

Email your comments to: [newsletter@mgwa.org](mailto:newsletter@mgwa.org)

### Maplewood RR well, cont.

of the well. Certainly, this was by no means an absolute location. Each step of the process introduced error into the estimate of the well's actual location. MDH staff continued to look for other methods to locate the well.

During the next phase of the investigation, MDH staff enlisted the help of the Minnesota Department of Natural Resources (MnDNR), Division of Waters staff, and their proton magnetometer equipment. In November of 1998, MDH and MnDNR staff traveled to the property and set up a square grid 48 meters by 48 meters encompassing the suspected location of the buried well. A magnetometer survey of the area inside the grid was conducted. Magnetic field strength readings were taken at 3 meter intervals across the grid. Several magnetic anomalies were detected within the grid, but only one gave an anomaly that was large enough in area to be consistent with a buried, steel cased well. A second

stake was placed in the ground to mark this location. The second stake was approximately 10 feet away from the previous estimate generated by the digitized coordinate from the aerial photograph.

After obtaining the records, maps, eyewitness accounts, aerial photographs, and conducting the GIS analysis, and the magnetometer survey, the MDH felt that it had enough information to warrant another attempt to uncover the well. We knew the well was buried, but didn't know how deep the top of the casing was below the surface. We also knew that the well was in a well pit, but were unsure if the pit was intact, or if it had been demolished with the other buildings on the site in 1979.

**The Dig** - In September 2000, the City of Maplewood hired an excavator with a large track-hoe excavator, to dig in the area of the two stakes. Initially, a hole approximately 30 feet square and 12 feet deep was dug. A

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Todd Petersen, Minnesota Department of Natural Resources, Waters Division, conducting a magnetometer survey in November 1998 to search for the buried railroad well, Maplewood, Minnesota

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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.



## Maplewood RR well, cont.

couple of abandoned steel water-main distribution pipes were found, but not the well. The excavator continued digging on one side of the excavation and hit something hard. Further exploration revealed a round structure made of limestone blocks that was 8 feet in diameter. The structure was filled with brick, wood, and other demolition debris. The excavator dug down outside of this structure and exposed one side of it. One of the water main pipes led right into the side of this structure, about 10 feet below the surface. At this point, we believed we had found the well pit. But how deep was it? Was the pit completely full of demolition debris? The decision was made to leave the well pit intact and to try to clean it out rather than excavate it, because we didn't know how deep the pit was, or how far down the top of the well was.

The City of Maplewood hired Johnson Bros. Well Drilling Company, from Little Canada, Minnesota to clean out the well pit and permanently seal the well. Johnson Bros. moved equipment to the site in May 2001 and began cleaning out the pit. They were able to clean out bricks, wood, and other miscellaneous debris to a depth of approximately 10 feet with a backhoe. Then they began lowering a barrel into the pit,



Eight foot diameter well pit found during excavation

filling it by the shovel and handful, and then hoisting it out with a pump-hoisting rig. John Johnson, and his son Roger, took turns climbing up and down an extension ladder to fill the barrel by hand. Progress was slow, but steady. John and Roger used a blower to blow fresh air down to the bottom of the pit, and also used climbing harnesses and safety ropes. The top of the 8-inch diameter, steel well casing was eventually found 35 feet below the surface! The entire well pit (8 feet in diameter and 35 feet deep) had been completely filled with bricks and demolition debris from the well house and other buildings on the site.

**Trouble** - Upon reaching the well casing, John and Roger discovered that the well casing had a mixture of cement and gravel in it. As mentioned earlier, the MDH had no record indicating that the well had been properly sealed. A well company that routinely did well work for the Whirlpool Corporation on other properties had previously reported that they had not sealed a well on this property. The MDH contacted that well company a second time and asked that they search their records again based on what was found in the well. This time, the well contractor found time sheets

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Well contractor, John Johnson, removing demolition debris from well pit



Abandoned 8-inch diameter railroad well improperly sealed with gravel and cement

## Maplewood RR well, cont.

from 1979, indicating that one of their employees sealed a 155 foot deep, 8-inch diameter well, located in the bottom of a 40-foot deep well pit, with 1½ yards of pea-rock and 10 sacks of cement. Considering that the historical records reported that the well was over 600 feet deep, and that the well contractor said that only the top 155 feet of the well was filled; the MDH concluded that the well was not properly sealed, and required it to be cleaned out so that it could be properly sealed in accordance with Minnesota statutes and rules.

Johnson Bros. Well Company set up a cable-tool drilling rig over the well to drill out the obstructions. A mixture of gravel and cement (mostly gravel) was easily drilled and bailed out of the well to a depth of 139 feet. A hard obstruction was encountered at a depth of 139 feet. John Johnson was able to fish out a 4-inch diameter stroke pump cylinder. The top of a 4-inch diameter liner casing was encountered below the cylinder, and the remainder of the well was open to 568 feet. The MDH video-logged the well with a downhole well inspection camera and determined that the well was constructed with 8-inch casing to a depth of 258 feet, 4-inch liner casing from a depth of 139 feet to 237 feet, and had open hole in bedrock from 258 feet to a depth of 568 feet. The well was gamma-logged by the Minnesota Geological Survey (MGS) to determine the geologic formations penetrated by the well. The MGS reported the following results:

<b>Interval (in feet)</b>	<b>Geologic Formation</b>
0-248	Glacial drift
248-371	Prairie du Chien limestone (aquifer)
371-471	Jordan sandstone (aquifer)
471-508	St. Lawrence formation (confining layer)
508-573	Franconia sandstone (aquifer)

Minnesota rules require that a liner casing in a well either be grouted in place, be removed, or be perforated prior to sealing the well to ensure that all open spaces in the well, including

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## Question of the Quarter! ?

The Question of the Quarter is a new section in our newsletter. Each quarter a different question will be posed and all members are invited to offer their "two cents worth".

Selected responses will appear in the next newsletter.

### The Question of the Quarter is: Ground Water or Groundwater? (Is it One Word or Two?)

? Email your responses to:

[Newsletter@mgwa.org](mailto:Newsletter@mgwa.org)

the open annular space outside of an ungrouted liner casing, gets sealed. In September 2001, John Johnson perforated the 4-inch liner casing in the railroad well with his cable-tool rig and a casing ripper to prepare the well for sealing. Then he installed tremie pipe to the bottom of the well and proceeded to mix and pump 155 sacks of neat cement grout to permanently seal this 114- year-old well.

This old railroad well was a multi-aquifer well that interconnected several aquifers and breached a confining layer. Abandoned, multi-aquifer wells are a threat to groundwater supplies and public health and safety. Abandoned wells left unsealed are potential pathways through which surface contaminants and surface runoff can travel to contaminate drinking water aquifers. They are also a safety hazard because people and animals may accidentally fall into them. The permanent sealing of this well is a great accomplishment. It will go a long way towards protecting and preserving the groundwater resources in these aquifers, in this area, for generations to come.

The MDH commends the City of Maplewood, the Maplewood Historical Society, the Ramsey/Washington Metro Watershed District, Whirlpool retirees, the MnDNR, the MGS, and Johnson Bros. Well Company for their efforts in assisting to locate and permanently seal this well.

— *submitted by Pat Sarafolean, Minnesota Department of Health, this*

*article appeared earlier in "Minnesota Well Management News" Vol. 22 No. 3, Fall/Winter 2002/2003.*

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## Project WET Ground Water Workshop April 5

DNR's MN Project WET program and the MGWA Education Committee are holding a Project WET educator's workshop. The workshop will be held April 5, 2003, from 9 AM until 4 PM, at Fort Snelling State Park. This Project WET workshop focuses solely on ground water concepts and issues. Included are visits to fens and springs and information about the cultural importance of Camp Cold Spring.

Project WET (Water Education for Teachers) is a nationally acclaimed program used by thousands of K-12 educators in all states. The program includes an educator guide containing over 90 interdisciplinary, hands-on activities for formal and non-formal educators, an interactive workshop to help educators incorporate the activities into their curriculum, and on-going support through Minnesota Project WET. See <http://www.dnr.state.mn.us/projectwet/index.html#> or contact Mike Trojan at 651-297-5219 [mike.trojan@pca.state.mn.us](mailto:mike.trojan@pca.state.mn.us) to register or get more information about the workshop.



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## Hydrogeology in Southeastern Minnesota

— submitted by [Tony Runkel, MGS](#)

The Minnesota Geological Survey announces the publication of Report of Investigations 61, ***Hydrogeology of the Paleozoic Bedrock in Southeastern Minnesota***. The publication characterizes the hydrogeologic attributes of this heavily used aquifer system from extensive hydrostratigraphic and hydraulic data. The resulting hydrogeologic framework is a tool to formulate more effective ground-water management strategies. In particular, it improves our ability to predict aquifer productivity and contaminant transport paths. The authors are Anthony Runkel, Robert Tipping, and John Mossler of the Minnesota Geological Survey; E. Calvin Alexander Jr. and Scott Alexander of the University of Minnesota; and Jeff Green of the Minnesota Department of Natural Resources, Division of Waters.

The hydrostratigraphic analysis is based chiefly on plug tests of rock samples, observations of secondary pores in outcrop and core, and borehole geophysical techniques. Collectively, these sources provide the means to depict the spatial distribution of matrix and secondary porosity in a variety of geologic settings. Of particular importance are the distribution and abundance of fractures and dissolution cavities. Hydraulic analyses of Paleozoic strata (pump tests, dye-trace studies, borehole flowmeter logs, water chemistry, and potentiometric data) provide information on how ground water travels through matrix and secondary pores.

The new framework differs from those previously published in its classification of 11 regionally extensive aquifers separated by 10 confining units. It also places greater emphasis on the importance of flow through secondary pores. A major advance is the recognition that large volumes of water travel in both aquifers and confining units through conduit networks. The networks display recharge through vertical fractures and lateral transport through an interconnected system of bedding-plane parallel

secondary pores of high hydraulic conductivity.

The hydrogeologic framework delineates three major karst systems. Southeastern Minnesota karst systems are composed of carbonate-dominated strata where they lie in shallow bedrock conditions. Each system is characterized by relatively abundant secondary pores, including large cavities and dissolution-enlarged systematic and nonsystematic fractures, and rapid, direct connections between surface water and ground water.

The report provides recommendations on how these results can be used. For example, in the past, conductivity of hydrogeologic units has typically been calculated using conventional aquifer tests, the assumption being that the entire thickness of a unit contributes equally to a borehole, and that porous media flow dominates the system. Our documentation of preferential flow paths through secondary pores provides information that will lead to more

accurate calculation of travel times and flow paths of ground water than those predicted using conventional assumptions. Additionally, existing regional-scale characterizations of potentiometric levels and water chemistry need to be used with greater caution because they were developed using data collected from boreholes that we now know expose multiple aquifers and confining units. Creators of wellhead-protection plans and other environmental management strategies may wish to consider the implications of our results.

### Acknowledgments:

Bea Hoffmann of the Southeast Minnesota Water Resources Board recognized that a synthesis of hydrogeologic data for southeastern Minnesota was needed to produce improved wellhead protection plans. Her support led to the early development of this report. The Southeast Minnesota Water Resources Board

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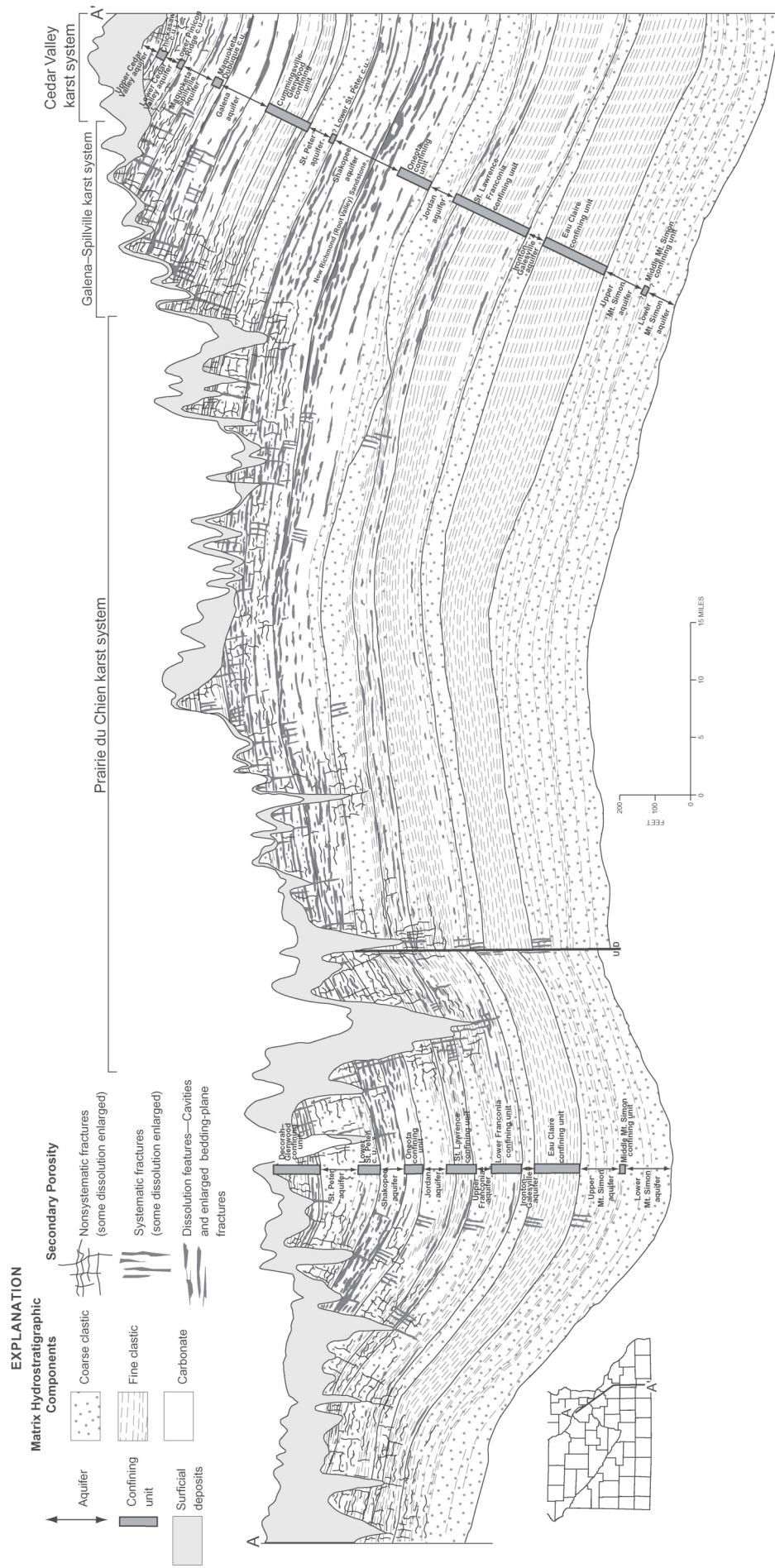
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**Figure 1. (on next page)** Cross section of Paleozoic bedrock from the northern part of the Twin Cities Metropolitan Area south to central Mower County, showing hydrostratigraphic attributes, classification of aquifers and confining units, and major karst systems.

*Paleozoic bedrock is dominated by three principal matrix hydrostratigraphic components: (1) coarse clastic rock of high porosity and permeability; (2) fine clastic rock of low porosity and permeability; and (3) carbonate rock, also of low porosity and permeability. The three components possess secondary pores, such as systematic and nonsystematic fractures and dissolution features that are most abundant in so-called shallow-bedrock conditions, areas where Paleozoic strata are within about 200 feet of the bedrock surface. In deeper bedrock conditions, secondary pores are also known to be present, but limited data suggest they are concentrated along a few discrete stratigraphic intervals.*

*The classification of aquifers and confining units is based on their hydrostratigraphic and hydraulic character in deep (relatively minimally fractured) bedrock settings. Major aquifers are composed chiefly of the coarse clastic strata and carbonate rock and contain abundant dissolution features. They typically have bulk horizontal hydraulic conductivity that ranges from about 5 feet to a few tens of feet per day. Discrete horizons with abundant secondary pores within the aquifers are known to have conductivities of hundreds of feet per day or greater. Confining units are regionally extensive layers of fine clastic and relatively "tight" carbonate rock with low bulk vertical conductivity ( $10^{-7}$  to  $10^{-3}$  ft/day). They provide confinement under particular conditions of hydraulic stress where they are not breached by vertical fractures.*

*In shallow bedrock conditions, all bedrock has fractures and (or) dissolution cavities, and ground-water flow characteristics may be dominated by such features. Hydrogeologic units showing low vertical hydraulic conductivity in deep bedrock settings may have much higher conductivity and, at least locally, lose the ability to serve as a confining unit in shallow bedrock settings.*





## Capillary Fringe

Jim Lundy, Past President MGWA

### A Voice for Cassandra

Budgetary issues currently debated in government will affect ground water programs and the work of ground water professionals, and I don't mean positively. This became crystal clear when, within two days, I spoke with three hydrogeologists who, facing layoffs, changed careers.

Some who support reducing environmental programs have the attitude of "*corpus quo*"—a noticeable lack of dead bodies, which they say argues against costly maintenance of ground water protection and cleanup programs. Some say hydrogeologists often cry "wolf" when no wolf exists.

I think our role more closely resembles Cassandra, the Trojan mortal destined to foretell catastrophe, but always upon deaf ears. Poor disheveled Cassandra, with her wild hair and flashing eyes, ignored, seeing always what others could not. Seeing the truth, Cassandra yet did not persuade.

You don't have to be Cassandra to see that MGWA is at a crossroads. We have capable leadership, but a klunky process and the crush of events force the board into a corner where there is little time for anything but planning the next conference.

Those well-received professional conferences provide an important service to ground water professionals, 99% of MGWA membership. The heart of MGWA has always been in a good place with respect to the needs of ground water professionals, and efforts in this direction should continue.

However if we provide ourselves only professional development, we differ little from trade organizations. MGWA claims to be about ground water, not about professions. MGWA objectives, written when money for ground water projects gushed like a Winona County spring after a rain, include "educating the general public regarding ground water resources." In those days, educating the general public sounded fun.

Now, as the economy declines to something like base flow, and layoffs loom, *public education is inoculation against the outright dismemberment of the ground water infrastructure in Minnesota.* We serve Minnesota's thirsty throngs, safeguarding an adequate high quality water supply for all. If there is virtue in our work, we must communicate that well. If we aren't heard, if like Cassandra we see the truth but fail to persuade, then we risk irrelevancy and the public will perceive our good work as expendable.

After all, where are the dead bodies?

There is only so much effort available, and we can't afford to spend it all on educating ourselves. Educating ourselves is admirable, practical, and fun. Educating the public is all this, and essential besides.

That is why I challenge the MGWA board and membership to decide during 2003 whether to be merely a CEU-producing organization, or to give Cassandra a voice by advocating for the ground water resource in Minnesota. Let's start with these questions:

- **How do we measure MGWA's success?** Are the organization's objectives fulfilled? Have we ever measured? Do our objectives still guide us to be what we ought?
- **Should MGWA maintain an inward or an outward focus?** Should we educate ourselves or those who benefit, or both? Should we change the perceived entitlement to essentially free, unlimited ground water and drinking water?
- **Can membership be increased and broadened? How?** Should we set membership goals? Should we attract new membership categories? Some examples may be farmers, surface water scientists, municipal water providers, drillers, attorneys, non-profit organizations, media, interested citizens, decision-makers. What benefits can we offer these prospective members?
- **Can volunteer participation be increased? How?** The board, volunteers all, desperately needs help but few step forward. This

means MGWA will plan more meetings and write more newsletters, and that may be all. Is that our vision?

- **How can MGWA publicly recognize the "good work" of its members?** "Good work" means success stories, projects that protect ground water resources for people, but projects that might otherwise garner little public notice. People can't value what they don't see, so let's become adept at engaging presentations that display the best value of our work. Let's become media-savvy. We have an important story to tell; let's tell it.

An optimist said that times are tough, but that also creates opportunity. The ranks of ground water professionals may decrease, and important ground water work may soon go ignored or unfinished. That creates an opportunity for MGWA to become more important and more relevant than ever, but only if we give Cassandra a voice.

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## SE MN Hydrogeology, cont.

was funded to initiate such a synthesis by the Minnesota Board of Water Resources through two "Challenge Grants" from its local water-resources protection and management program. Much of the information on the Prairie du Chien Group and Jordan Sandstone was compiled by the Minnesota Geological Survey as part of two projects approved by the Minnesota Legislature for funding as recommended by the Legislative Commission on Minnesota Resources. Additionally, those same projects provided part of the funds used to purchase borehole geophysical equipment that has been essential in characterizing the hydrogeologic attributes of the Paleozoic stratigraphic section. An ongoing investigation of the attributes of the Franconia Formation and Ironton and Galesville Sandstones, funded by the Metropolitan Council, also provided important borehole flowmeter data.



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## The Virtual Hall of Springs

— Greg Brick, Professor of Geology,  
Normandale Community College

**"Springs are attractive not only to the thirsty traveler, but also to the artist, the photographer, and the lover of pretty nooks and rustic scenery." (James Reuel Smith, Springs and Wells of Manhattan and the Bronx)**

After working in the consulting grind a number of years I found that groundwater was becoming a very dry subject (forgive the oxymoron). It was dealt with only in terms of equations, contracts, and litigation. The finite-element grids of the modelers seemed to me a veritable spider's web in which I had become entangled. I won't even mention all the pink slips. I found the cure in a refreshing draught of spring water.

Springs present a colorful, romantic side of groundwater. In toying with the notion, I created a website, the Virtual Hall of Springs, at [www.virtualhallofsprings.com](http://www.virtualhallofsprings.com). The name of the website was inspired by the Hall of Springs, a spa constructed in Saratoga Springs, New York, under the New Deal of the 1930s (Swanner, 1988). The website has nothing to do with New York, however. It aims to sample the wide diversity among Minnesota's springs. From big springs to little springs, from artesian springs to falling springs, from alluvial springs to cave spring — you get the picture. The website has no pretensions to complete or systematic coverage. GeoCities, the web host, limits



the amount of free storage you receive.

Minnesota was not a big spa state but it did have a few gems of its own. To attract settlers, Minnesota promoted itself as a health resort. It is interesting to note that Dr. Mayo himself was attracted to Minnesota in the first place by these claims. His sons established the now world-famous clinic in Rochester. In that sense, Minnesota remains a health resort to the present day (Clapesattle, 1957).

The most famous mineral water resort in Minnesota's early history was Chalybeate Springs, just below St. Anthony Falls, in Minneapolis. O'Brien (1904) described visitors "wending their way to the springs to invigorate their torpid livers with the impregnation of iron, magnesia and sulphur, as it oozed out of the reservoir in Nature's laboratory." He suggested that it was increased visitation to these springs, especially by "the wealth and fashion of the South who came hither to escape the heated term," that resulted in construction of a magnificent hotel, the Winslow House, in Minneapolis. Clapesattle (1943) wrote of "the famed Winslow House, which later became the largest water cure establishment in the United States, accommodating 500 patients." Jordan Sulphur Springs Mudbath Sanitarium was another spa in the Twin Cities area. By 1908, the U. S. Geological Survey reported that Minnesota "leads all other States in mineral water sold" (Sanford, 1909).

For the past year, I have been writing a book about Iowa's caves and mines for a commercial publisher and have begun to "collect" the springs of that state, too. The magnetic spas of Iowa are a subject in their own right (Pederson, Onnen, & Smith, 1964).

I will not revisit here the larger story of our local springs, having dealt with the subject already (Brick, 1997). I have learned about many more springs since then. The website is very much a work in progress.

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## MGWA Spring Conference dedicated to David R. Ford

The MGWA Spring Conference Planning Committee has been busy planning this year's Spring Conference — "Interaction of Ground Water and Surface Water". The conference, scheduled for Thursday April 17, 2003, will be held at the Earle Brown Continuing Education Center at the University of Minnesota's St Paul Campus. This conference is dedicated to the life and work of David R. Ford, DNR's Lake Specialist, who lost his battle with cancer in January.

Speakers from Kelton Barr Consulting, Dakota County, SERVICE Environmental, U of MN, USGS, MGS, MDH, MPCA, and DNR Waters are on the agenda.

MGWA provides one of the most cost- and time-effective ways to earn Continuing Education hours. Registration forms have been mailed and [on-line registration](#) is already open. Let your surface water coworkers know about our meeting. Attendance must be limited, so please register early.

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## “Black Holes”: Need for Ground Water Education Greater Than Ever

— Tom Clark, Minnesota Pollution Control Agency.

Areas of open water on normally-frozen Minnesota lakes observed throughout January 2003 resulted in a number of scientifically-interesting—but dangerous—“black holes” that, to the lay public, seemed to defy explanation. One theory proposed by several hydrologists who studied the problem was that relatively warm ground water from abnormally high water tables is recharging certain lakes. The circulation patterns in those lakes might then bring warmer water toward the surface resulting in open water where ice would typically be well-established during a “normal” year. Regardless of the cause(s) of these ice holes, which are discussed in more detail below, the unusual ice-making conditions of the late fall and early winter certainly may have contributed to the problem.

The popular media gave much attention to one such hole that appeared in North Long Lake near Brainerd in early January, and some even speculated — tongue-in-cheek, I hope — that aliens or lake monsters might have been responsible. By the end of the month, the Wall Street Journal, the Canadian Broadcasting Corporation and ABC World News Tonight also had done stories on the hole. Clearly, this is an opportunity for us as hydrologists to educate others about the science behind this phenomena and how important an understanding of ground water-surface water interaction, lake hydrology, and climate can be to our personal safety and our economy.

The personal safety lesson was tragically taught when an unusual patch of open water on Lake Minnetonka claimed the lives of two teenagers driving on the lake the night of January 21. These deaths brought to 10 the number of ice-related deaths for the season in Minnesota. “We’re just holding our breath at this point,” Tim Smalley, a Department of Natural Resources (DNR) water safety specialist, said at the time.

The unusual conditions had economic consequences as well, when officials had to close Forest Lake to vehicular traffic and cancel one of the largest ice fishing contests in the country, which in past years, has attracted as many as 8,000 anglers to fuel the local economy. “I’ve never seen anything like this on the lake,” said Forest Lake Police Chief Dave Schwartz, a 34-year veteran of the department. “It’s bizarre.” By late January, a hole, 200 by 100 yards had opened on the northeast side of the lake in an area where ice would normally be 30 inches thick.

Steve McComas, an aquatic specialist from St. Paul, provided further perspective on the ground water infiltration theory. In a January 22 report, he said that flow in the Mississippi River had spiked recently and that “ground water is on the move.” He said an underwater television camera lowered into North Long Lake, site of one of the earliest-reported “black holes” showed ground water flowing in with enough force to make underwater plants wave. “It looks like ground water is coming up through the lake bed with enough force and velocity to erode the bottom of the ice and open it.” Mike Mueller, a DNR hydrologist, concurred, adding, “The surplus of warmer ground water (caused by the abnormally wet summer of 2002) is flowing in from the lake bottoms, producing currents that are melting ice in some areas or creating thin ice in others.”

However, not all the hydrologic evidence necessarily supported this theory. Laurel Reeves, the DNR hydrologist who oversees the DNR’s ground water level monitoring, examined long-term water level records for a number of observation wells in close proximity to both North Long and Forest lakes and found no evidence of rising ground water levels that would suggest that January 2003 was any different than previous Januaries when these lakes were totally frozen. In addition, reports were coming in from other upper Midwest states including Wisconsin and Michigan that unexplained open water areas were occurring on certain lakes there as well, where ground water may or may not have been a factor.

- The solar radiation theory: A combination of minimal snow cover, clear ice and an abundance of sunny days allowed for a much greater penetration of sunlight into lakes than might occur in a more typical winter. Increasing day length and a higher sun angle in January resulted in increasing solar radiation that raised the ice temperature enough to melt it in areas where it was thinnest.
- The “burp” theory: Decomposing aquatic plant material on the lake bottom generated gases, such as methane, that rose toward the surface, bringing somewhat warmer bottom-dwelling water along, and caused melting of the ice cover from below. This may have been a factor on a lake in northern Michigan that had been treated with an herbicide to kill Eurasian water milfoil last fall. Divers searching for the bodies of two snowmobilers who drove into open water on the normally-frozen lake reported finding a six-foot deep layer of dead vegetation at the bottom of the lake.

Perhaps the convergence of several of these factors (a so-called meteorological and geological “perfect storm”) was the cause — we may never know. By the end of January, the watershed district investigating North Long Lake decided not to pour any more money into the “black hole.” The district spent about \$6000 to send divers to investigate the lake bottom, and on January 29, district chairman Dick Beeson said it was time to call it quits. “We accomplished what we set out to do,” he said after meeting with the lab that performed tests on lake samples. “We got the word out that this is a dangerous area and we know from the test results that the lake is in good shape.” He added, though, that independently-funded study teams might continue to investigate the problem.

During January, the State Climatology Office also received many

— *continued on next page*



## Black Holes, cont.

inquiries regarding the occurrence of ice holes on Minnesota lakes. Greg Spoden of that office included the following points in the February 2003 edition of HydroClim Minnesota, a monthly electronic newsletter summarizing Minnesota's climate conditions and their resulting impact on water resources:

1. The number one issue remains public safety;
2. The phenomenon is relatively rare and not well-studied. DNR staff have offered their thoughts on the subject, but no definitive conclusion has been reached. We may be dealing with the unknowable.
3. Some forces creating the phenomenon may include:
  - The unusual lack of snow cover. High albedo snow cover typically reflects incoming short-wave radiation back into space. Lake ice, and the water immediately beneath it, may have absorbed greater than average solar energy this winter. In spite of cold mid-January temperatures, this energy may have been adequate to melt ice or to keep ice from forming.
  - Ground water upwelling (which of course occurs every year). However, the holes may have formed in areas with historically thinner ice.
  - Unusually warm early winter weather leading to atypical thermal stratification in the affected lakes.
  - Some combination of all of the above.

Contact Greg Spoden for HydroClim subscriptions by e-mail at: [greg.spoden@dnr.state.mn.us](mailto:greg.spoden@dnr.state.mn.us), or by phone at 651-296-4214. Portions of this article were compiled from reports published in the Minneapolis Star-Tribune, January 22-23, 2003, and the Brainerd Daily Dispatch, January 29, 2003. I would like to thank Laurel Reeves, Jan Falteisek and Greg Spoden of the DNR's Waters Division for providing background material used in this report.

## Volunteers Urgently Needed

Planning for the Fall Conference and the Fall Field Trip will get into full swing following the Spring Conference.

Conference and field trip planning committees typically meet once or twice a month for an hour or two. Don't forget that planning committee service may also count toward PDH requirements.

Please contact [Marty Bonnell](#) (MGWA President) at (651)227-6500, if you are interested in helping plan the fall conference or [Chris Elvrum](#) (MGWA President Elect) at (651)602-1066, if you are interested in helping plan the fall field trip.

## 2003 AIH Conference

### Achieving Sustainable Water Resources in Areas Experiencing Rapid Population Growth

The conference will be held October 19 - 22, 2003, in Atlanta, Georgia to convene scientists, government officials, environmental advocates and business/agri-business personnel to share scientific and technical information on activities and developments within the fields of environmental hydrology and hydrogeology throughout the United States as well as other countries. Technical presentations and posters sessions will be used to document and transfer information throughout the conference. The program will also include keynote speakers, plenary sessions, short courses, field trips and the AIH Annual Business Meeting. Three major awards will be presented: The Ray K. Linsley Award, the C.V. Theis Award and the AIH Founders Award.

### Technical Program

The technical program for the 2003 Meeting is aimed to cover all of the areas of the hydrologic sciences but with special emphasis on the water resource needs and problems associated with rapid population growth. The tentative program themes are:

## MGWA Thanks its Corporate Members

Our list of corporate members includes:

**Howard R. Green**

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- Impacts of ground and surface water withdrawals on plant and animal habitat.
- Water as a commodity (Issues & Trends).
- Safe surface and ground water yields (What does this really mean?).
- Interstate water disputes.
- Rethinking how federal reservoirs should be managed for the public good.
- Case studies of water-supply projects.
- Optimum conjunctive use of surface and ground-water resources.

### Abstracts

Presenters/Authors should submit an abstract of not more than 250 words. The abstract must include the title of the paper, as well as each author's name, affiliation, address, telephone, fax and email address. Send your abstracts by e-mail to: [AIHydro@aol.com](mailto:AIHydro@aol.com).

The conference will provide a forum for discussion and exchange of information on a broad spectrum of areas in hydrology and hydrogeology, water quality, water resources, planning and management, as well as climate, ecology, environment, and human health.

## Storage of Natural Gas and Liquefied Petroleum Gas Underground in Minnesota

— [Norm Mofjeld](#), Minnesota Department of Health

Minnesota has two sites where natural gas and liquefied petroleum gas (LPG) are stored underground in geologic formations. At the first site, natural gas is stored within the Mt. Simon formation near the southern Minnesota city of Waterville. The storage facility, operated by CenterPoint Energy Minnegasco (formerly Minnegasco) injects natural gas during non-heating months that can be tapped during the winter when the demand for gas exceeds the supply that can be provided from the fixed daily output of pipelines. At the second site, Solar Gas Company stores LPG in a cavern mined from “erskinite”, a metamorphic rock, near the northwestern Minnesota cities of Erskine (hence the name) and Mentor in Polk County. Solar Gas Company receives LPG supplied by railroad car and truck, and withdraws the LPG through the winter months.

Storage of natural gas in an aquifer within a geologic formation is dependent on certain geologic conditions: the bedrock must have sufficient porosity and permeability to contain and transmit the gas; an impermeable caprock must overly the storage rock to prevent the gas from moving upward; and a geologic structure must exist to trap the gas and prevent it from escaping horizontally. Structures used for gas storage are the same types of structures where gas or oil deposits occur naturally: a dome, anticline, or arch of stratified rock; or a sedimentary lens (significant lithology/permeability change), or a fault that seals the upward side of the reservoir by moving an impermeable layer next to the reservoir rock. Groundwater, which is displaced from the injection of gas, acts as another seal to keep the gas from moving.

The natural gas storage reservoir at the Waterville site is a dome in the Paleozoic sedimentary Mt. Simon

## Corporate Membership Rates

Membership Levels	Annual Package Cost	Annual per Item Cost	Annual Savings	Percent Savings
Basic Level	\$350	\$369	\$19	5%
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Corporate Sponsor	\$1530	\$1986	\$456	30%

### Corporate Membership Features:

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- Industry Leader: Half page ad in newsletter and directory, “Lobby Copy” of membership directory, web page sidebar, Certificate of Membership, and up to 14 employee memberships
- Corporate Sponsor: Full sponsor acknowledgement in MGWA conference publications, full page ad in newsletter and directory, “Lobby Copy” of membership directory, Certificate of Membership, web page sidebar and up to 20 employee memberships

Please make checks payable to “Minnesota Ground Water Association” or “MGWA.” Direct your orders and questions concerning corporate memberships and policy to the Advertising Manager: Jim Aiken, MGWA Advertising Manager, c/o MGWA, 4779 126 St N, White Bear Lake MN 55110; Email [jaiken@mccainassociates.com](mailto:jaiken@mccainassociates.com).

Sandstone. The overlying Eau Claire formation serves as the shale “caprock” or confining layer. The reservoir is over 900 feet below the land surface. The dome is under approximately 8,400 acres of farmland. The gas “bubble” is approximately 3 miles long, 1-1/2 miles wide and has an average thickness of 30 feet. The maximum amount of gas allowed to be stored in the reservoir was increased from 5 to 10 billion cubic feet (bcf) in 1980. To date the reservoir has held a maximum of 6.5 bcf of gas. As a point of reference, approximately 340 bcf of natural gas are used in Minnesota each year.

The Waterville site has over 70 wells associated with the facility and has been in operation since 1968. Approximately thirty wells are used for injecting and withdrawing natural gas, and for measuring gas pressures. The remaining wells are used for monitoring water levels and for sampling. Some of the wells keep track of the gas bubble’s size, and monitor the overlying formations should gas ever leak through the

caprock. Whenever natural geologic formations are used to store gas or liquid under pressure causing groundwater to be displaced, Minnesota Statutes, sections 1031.681-1031.691 require that the Minnesota Department of Natural Resources (DNR) review, analyze, monitor and permit these activities. Other state agencies are also involved in the permit process. Once a month, the Division of Waters of the DNR receives data collected by CenterPoint Energy Minnegasco on water levels, gas pressures, combustible gas readings, and gas inventory. Approximately 40 water level observation wells are sampled twice a year and analyzed for dissolved gases by CenterPoint Energy Minnegasco and the DNR. The Office of Pipeline Safety of the Department of Public Safety inspects the pipelines that come into and exit the Waterville facility.

LPG can be stored underground in mined caverns, salt-solution caverns,

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## Underground Gas, cont.

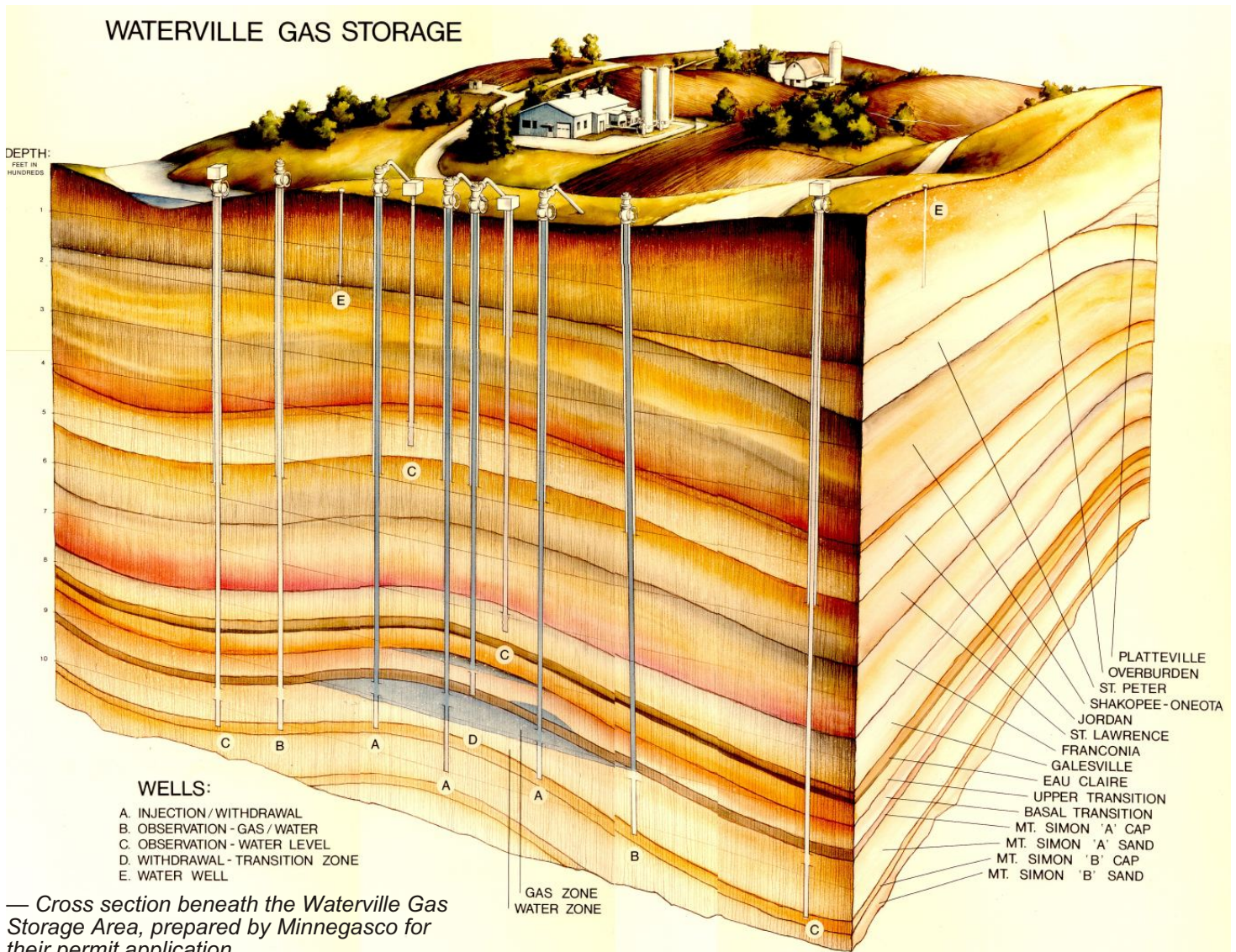
or abandoned coal mines. Unlike the storage of natural gas within a permeable and porous formation (in the case of the Waterville site, an aquifer), LPG is typically stored in a low permeability or confining formation. At Minnesota's site near Mentor, the LPG is stored in a cavern mined into crystalline metamorphic rock. The cavern was excavated out of this rock from March 1961 to May 1962 for the purpose of storing LPG. The cavern is 350 feet long, 285 feet wide, with the cavern floor at a depth of 530 feet and the ceiling at a depth of 505 feet. Seventeen million tons of rock were excavated to develop the cavern. The cavern holds 14 million gallons of LPG and has been in operation since 1962.

According to Solar Gas Company, the LPG site near Mentor has four gas injection/extraction wells. One is 42 inches in diameter and is used to inject LPG for storage. The other three are 14 inches in diameter and used for withdrawal of LPG. The pressure of the LPG is dependent on the depth at which it is stored and the temperature of the underground environment, and is approximately 110 pounds per square inch at the Mentor facility. At the depth of the Mentor facility, the temperature is about 56 degrees. The groundwater has a pressure higher than the LPG, which keeps the LPG from moving into any fractures. A pressure gauge is located at the top of each of the injection/extraction wells. The Solar Gas Company monitors these gauges and if there was a significant release of

LPG it would show up as a pressure drop on a pressure gauge.

The importance of monitoring natural gas and LPG storage sites cannot be overemphasized. In January 2001, a series of natural gas explosions occurred in buildings in the City of Hutchison, Kansas. Natural gas was stored underground eight miles from the city in salt caverns, at depths of 650 to 900 feet. The caverns, called "jugs", were initially used to store propane but were converted to store natural gas in the 1990s. An injection well cased into one of the "jugs" failed under gas pressure, and gas escaped through a crack in the casing, into an overlying laterally continuous, gypsiferous zone. The

— concluded on page 14



— Cross section beneath the Waterville Gas Storage Area, prepared by Minnegasco for their permit application.



## Underground Gas, cont.

gas moved along a small northwesterly plunging anticline, and made its way to Hutchinson, where it entered unsealed brine wells located in some buildings in the city. In response to the crisis, a series of wells were drilled to find and vent gas to the surface. The Kansas State Geological Survey was instrumental in determining the cause of the problem, locating the gas pathways and providing the information to the concerned public. Once the vent wells had been drilled, the Survey turned to the task of locating the brine wells, numbering as many as 160, and properly sealing them. Many of these wells had been filled with rocks, brick, or dirt, or just left open. The information about this incident was taken from an article printed in the October 2001 issue of *Geotimes*. The author was M. Lee Allison. The article "Hutchinson, Kansas: A Geologic Detective Story" can be found on-line at <http://www.agiweb.org/geotimes>.

The tragedy in Kansas points to the need for three important types of regulations (which we have in Minnesota) and which can help reduce the likelihood of such an occurrence happening in this state. One is the importance of monitoring underground natural gas and LPG facilities. A second is the importance of sealing unused wells properly. In Minnesota a well is required to be sealed by a licensed well contractor with approved grout throughout the length of the casing. A third is the requirement to disclose wells at the time of property transfer. This regulation encourages the process of locating and sealing unused wells.

I would like to thank Brian Rongitsch, Division of Waters, Minnesota Department of Natural Resources, for providing information regarding the natural gas and LPG storage sites in Minnesota. Mr. Rongitsch was the author of an article that appeared in the September-October 1984 issue of the *Minnesota Volunteer* entitled "Tapping Waterville's Gas 'Bubble'", which discusses these sites. I would also like to thank Milt Brumwell of Solar Gas Co. for his information regarding the LPG storage site.

## Science Museum Ground Water Exhibit Planned with MGWA Help

The Minnesota Ground Water Association (MGWA) Ground Water Education Committee (GWEC) has been working with the Science Museum of Minnesota (SMM) to incorporate a ground water educational exhibit into their new outdoor Science Park. The Science Park is a set of interactive, hands-on exhibits focused on soils, non-point source pollution and landscape processes that the SMM is developing in the area between the museum building and Shepard Road. Science Park will open to the public in summer 2004 in time for the culmination of the Grand Excursion which will draw tens of thousands of visitors to downtown St. Paul during the week of the Fourth of July.

Patrick Hamilton, Director of Environmental Sciences and Earth-system Sciences at the Science Museum, said, "I am excited by the possibilities both because I would like to find ways to help museum visitors better appreciate the nature of ground water but also because such exhibits would be a very welcome addition to the outdoor exhibits the museum is in the process of developing".

According to Patrick, over the next two years, the museum will transform the Science Park into an outstanding outdoor science education experience. Science Park will be the educational focal point of a unique partnership between the University of Minnesota and the SMM as part of a five-year, \$19.3 million National Science Foundation grant recently awarded to the St. Anthony Falls Laboratory for the establishment of the National Center for Earth-Surface Dynamics.

The outdoor exhibits developed for Science Park will be arranged around a building currently under construction in the park. The Environmental Experiment Center (EEC) will be a 1,000 square-foot, four-season building that will serve as the operations center for the Science Park and as a flexible space that depending on the need at any given time can serve as a classroom, a public laboratory, an

exhibit area, or a special event space.

The EEC has been modeled and designed to operate as a near zero-emissions building. It will heat, cool, and light itself without the use of fossil fuels.

Several different ground water exhibit ideas were discussed with SMM staff over the past several months. The initial exhibit will include a drive point or small well with a hand pump that will be used to pump shallow ground water by museum visitors. The shallow ground water extracted from this well will be circulated through a treatment system that may include activated carbon, air stripping materials and/or other methods which will remove the low levels of petroleum related compounds present in the shallow ground water. The exact design of the treatment system will be developed as planning for the Science Park continues. This exhibit will be designed so that visitors will not come into direct contact with the extracted ground water. It is hoped that additional sand points can be installed so that the concepts of the water table and the flow of ground water could be explained.

Previous environmental investigative activities were completed at the SMM by Peer Engineering, Inc. in 1996-1997. Two monitoring wells, which were installed in the area of the outdoor science park (MW-2 and MW-3) at that time, detected low levels of volatile and semi-volatile organic compounds in the shallow ground water.

Three temporary boreholes were completed in the in the area of the outdoor science park in December 2002 to better characterize the shallow ground water. Soil and ground water samples were collected by Jim Stockinger of the Minnesota Pollution Control Agency (MPCA) and Cathy Villas-Horns of the Minnesota Department of Agriculture (MDA) using the MPCA's direct push drilling equipment.

A peristaltic pump was used to collect shallow ground water samples through a temporary screen. Three ground water samples were

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## Science Museum exhibit, cont.

analyzed for volatile organic compounds (VOCs), gasoline range organics (WI GRO) and diesel range organics (WI DRO) at no charge by Pace Analytical Services, Inc. Low levels of DRO were found in one of the three ground water samples.

The MGWA Ground Water Education Committee is working with the MPCA Voluntary Investigation and Cleanup Unit on this project. The GWEC continue to work with the SMM to design an accurate and meaningful ground water exhibit. Although the generosity of MGWA has allowed the preliminary planning to be done without cost to the SMM, additional donations and sources of funding will be needed to construct the display.

— submitted by [Chris Elvrum](#), Metropolitan Council and [Cathy Villas-Horns](#), Minnesota Department of Agriculture. For more information or if you wish to donate services, materials or funding to this project, please contact Chris Elvrum at (651)

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## Summary Report 2002

### MGWA Ground Water Education Committee

The Minnesota Ground Water Association (MGWA) Ground Water Education committee (“committee”) met monthly throughout 2002. Regular attendees included Mark Ferrey (MPCA), Mike Trojan (MPCA), Cathy Villas-Horns (MDA), Chris Elvrum (Met Council), Jim Lundy (MPCA), Dan Hunter (WCEC), and Barb Liukkonen (Water Resources Center, University of Minnesota). The committee meets the week prior to regular MGWA board meetings for approximately 90 minutes. A committee representative attends board meetings as a liaison. Meeting summaries are published in the MGWA newsletter.

The following items summarize major committee achievements during 2002.

**Web page.** The committee published a web page in September 2002 (<http://www.mgwa.org/education>). The page features lesson plans, classroom activities, educational web links, and a speaker’s bureau. The page is updated twice yearly.

### Tracking appearances by MGWA members at educational events.

During 2002, five MGWA members appeared at 12 events held at grade schools, high schools, a conference, an Earth Day event, and the State Fair. In total, these presentations reached 1100 people. The committee tracks MGWA members’ presentations to students and other lay audiences.

**Ground Water component, “Science Park”, Science Museum of Minnesota (SMM).** The committee and SMM are developing a ground water component to the “Science Park” exhibit, opening in 2004. SMM is located on a ground water remediation site, so the “Science Park” proposal includes a remedial well and water treatment system to be operated by museum visitors (visitor will not be exposed to contaminants).

**Legislative Commentary.** The committee believes MGWA should provide unbiased, technically sound scientific comment on legislative and other policy initiatives that involve

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## Join the Minnesota Ground Water Association!

Annual dues are \$25 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.

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Work Telephone Number \_\_\_\_\_ E-mail \_\_\_\_\_  
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Please indicate if you want to have the Directory (\$7) \_\_\_\_\_ or Newsletter (\$10) mailed to you \_\_\_\_\_

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# Minnesota Ground Water Association Newsletter Advertising Policy

## Display ads:

Size	Inches Hor. x Vert.	Quarterly Newsletter Annual Rate; 4 issues	2003 Membership Directory Annual Rate; 1 issue
Business Card	3.5 x 2.3	\$66	\$50
Quarter Page	3.5 x 4.8	\$121	\$99
Half Page	7.5 x 4.8	\$225	\$190
Full Page	7.5 x 9.75	\$425	\$360
Inside Cover	7.5 x 9.75	not available	\$395

**Classified ads:** Classified ads in the newsletter are charged at the rate of \$3 per 45 characters (including spaces and punctuation) per newsletter issue.

**E-mail notices:** A one-time e-mailing to the membership costs \$10 for an individual (e.g., seeking a job), and \$50 for an organization (e.g., announcing a new product, job opening etc.). A 200 word limit is imposed. The advantage of e-mail is the speed of dissemination.

The Advertising Manager has final determination on the acceptance of materials submitted. There are no commissions on ads. Copy must be received by the publication deadlines: 14 February, 16 May, 15 August, or 14 November. Advertisers should submit their material as a digital file in TIFF, JPEG or PCX format at 300 to 600 dpi. A set-up charge will be applied to non-digital ad material.

Please make checks payable to "Minnesota Ground Water Association" or "MGWA." Direct your orders and questions concerning advertising rates and policy to the Advertising Manager: Jim Aiken, Advertising Manager, c/o MGWA, 4779 126th Street, White Bear Lake MN 55110-5910; Phone (952)470-0983 ; jaiken@mccainassociates.com

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## Education Summary, cont.

ground water. The MGWA board has approved this concept, and the committee is developing a practical process to carry it out.

**Project WET.** The committee is coordinating with Minnesota Department of Natural Resources (MDNR), which administers Project WET, to present a training session with a ground water emphasis, scheduled for April 2003. Science teachers and ground water professionals with an interest in presenting ground water topics in the classroom are encouraged to attend.

**Minnehaha Creek Watershed proposal.** The committee submitted a proposal (pending) to help high school students in the watershed work with MGWA members to assess ground water resources of the Minnehaha Creek Watershed.

**Classroom CD.** The committee has begun work on a CD to be used by middle school teachers in preparing lesson plans involving ground water. Committee members will provide the

science, while teachers will provide the format and structure of the CD.

**Committee Mission statement:**  
*More than two-thirds of Minnesotans get their drinking water from ground water; yet many citizens, legislators, and even environmental professionals have little or no understanding of this critical resource. Ground water supplies are vulnerable to depletion and contamination as population and land use change. The MGWA Ground Water Education Committee is dedicated to educating people about ground water.*

*We promote partnerships with those that provide education about ground water, provide educators with tools for teaching students about ground water, and provide information to citizens, legislators, and resource managers to help them understand how they can protect ground water. Our expanding emphasis on education reflects a realization that protection of the ground water resource can only occur if the public is knowledgeable about ground water.*

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## Past Field Trip Guidebooks Are Available from MGWA

The following field trip guidebooks are available:

- "Brainerd Area Geology"
- "Geology and Geohydrology of the North Shore and Gunflint Trail"
- "Lower Minnesota River Valley"
- "Karst of Southeastern Minnesota"

The cost for each guidebook is \$15. There is a limited supply of the guidebooks. They can be ordered online through the MGWA web page or contact the office at: office@mgwa.org. You can also write to the office at MGWA c/o WRI, 4779 126<sup>th</sup> St. N., White Bear Lake, MN 55110-5910.



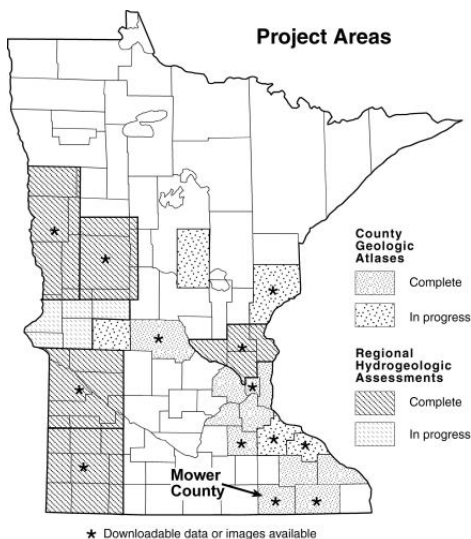
## Mower County Geologic Atlas, Part B, Completed

Part B of the Mower County Geologic Atlas is now available. The report, recently published by DNR Waters, includes four map plates and a technical appendix that describe the county's ground-water conditions, pollution sensitivity, and karst hydrogeomorphology.

The Mower County Geologic Atlas is the 11th report in the County Geologic Atlas Series, a cooperative effort with the Minnesota Geological Survey.

This atlas joins the previously published portion of the report, Part A, prepared by the Minnesota Geological Survey that includes maps of surficial and bedrock geology; stratigraphy; and mineral resources. Report of Investigations RI-50, *Contributions to the Geology of Mower County, Minnesota*, includes more detailed information on the geology, late-Quaternary landscape evolution, and mineral resources of the county.

County Geologic Atlases underway include Goodhue, Pine, Wabasha, Pope, and Crow Wing. Part A reports for Goodhue, Pine, and Wabasha counties have been published by the Minnesota Geological Survey. Reports in the County Geologic Atlas Series can be purchased at the Minnesota Geological Survey,



Publications Office, at 2642 University Avenue, St. Paul, 55114, phone (612) 627-4782.

The Mower County Geologic Atlas was prepared using geographic information systems (GIS) technology. Data files and portable document format (PDF) images of plates are available for download. 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 data availability and download instructions. Data for the MGS portion of the report is downloadable from their ftp site at <ftp://156.98.153.1/pub3/c-11/>. The Report of Investigations is downloadable as a PDF file from <ftp://156.98.153.1/pub2/ri50/>. More information is on the MGS web site at [www.geo.umn.edu/mgs/](http://www.geo.umn.edu/mgs/).

For more information contact Jan Falteisek, DNR Waters, at (651)297-3877 or Dale Setterholm, Minnesota Geological Survey, at (612)627-4780.

## Midwest Ground Water Conference

Western Michigan Univ. has issued a first call for papers for the 48th Annual Midwest Ground Water Conference to be held on their campus in Kalamazoo, October 1-3, 2003. Session Topics will include:

- Agricultural Chemicals in Ground Water
- Modeling, Management and Sustainability of Ground Water Resources
- Novel Remediation Methods
- Applications of Isotopes in Ground Water
- Geophysical Applications to Ground Water Flow and Contamination
- Ground Water Interactions with Lakes and Rivers

Abstracts will be accepted until May 31, 2003. Further details from Alan Kehew, Geology Dept., WMU at 269-387-5486, or [www.wmich.edu/geology/mwggwc.htm](http://www.wmich.edu/geology/mwggwc.htm)

## Initial Foundation Goal Achieved

When the Minnesota Groundwater Association Foundation was established, a goal of \$25K was set for the initial endowment. Prior to attaining that goal, only monies earned from return on investments or donations that were specified for other use were available for distribution to requested educational and other groundwater awareness and support activities. Due to the tremendous popularity of the Ground Water Association programs, your support of our silent auction, and generous individual donations, the Minnesota Groundwater Association Foundation has reached the initial funding goal of \$25,000 that was set for building the basic Foundation endowment. The MGWA members, attendees of MGWA events, those who purchased items in support of the Silent Auction at the fall conference, as well as individual donations have all contributed to building the fund up to and beyond the initial target level. Now that the funding level has reached that goal, the interest will be available for distribution to qualifying activities and organizations. Future donations and monies from MGWA functions will be used to increase the endowment and also be distributed to provide significant and long-term support for future educational activities.

The specific objectives and purpose of the Foundation as presented in the Foundation Bylaws include:

- Education of the public concerning the necessity of protecting the groundwater resource from over-use and contamination;
- Providing scholarship funds for students studying the groundwater resource;
- Providing assistance to educational institutions in support of groundwater education;
- Publication of educational materials on groundwater issues; and
- Organization and/or support of seminars, conferences, field trips, and other events where ground-

— continued on next page

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## Foundation Goal, cont.

water topics that serve to educate, and are open to, the public are presented and discussed with the objective of exchanging ideas, suggesting solutions, and strategizing for sustainable groundwater resource management.

If you are a member of a group or organization that operates to fulfill these actions and you are looking for financial support, you are urged to apply to the Foundation for possible funding. We are actively seeking applicants for funding. Additional information on the Foundation and electronic application forms are available on the MGWA web page <http://www.mgwa.org/foundation.html>

The forms are relatively short and the questions brief. However, please be sure to provide an adequate description of the activity, who receives the funding and how the funds will be used, how the request is consistent with the objectives and purposes presented above, and the amount being requested. The current fund resources would indicate that the maximum support available for any one application or request is approximately \$1,000.00

Please contact Foundation Board Members (Gordie Hess, Rob Caho, Dave Kill, Jeanette Leete) with any questions or for additional information.

— submitted by [Gordie Hess](#),  
ARCADIS

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## World Water Day, March 22, 2003

World Water Day 2003, March 22, 2003, seeks to inspire worldwide political and community action and encourage global understanding of responsible water use and conservation. Organized by the United Nations Environment Programme (UNEP), the theme for World Water Day 2003 is “**Water for the Future**”. For further information, see <http://www.waterday2003.org/>

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## Minnesota Pollution Control Agency Announces “What’s in My Neighborhood?” Web Page

The MPCA is excited to announce the soon to be released “What’s in My Neighborhood?” web page. This web page will allow the user to view known and potential sources of soil and ground water contamination. Visitors to this page can choose from one of two options.

If they would just like to view, or obtain, a list of sites in a given county or zipcode, for example, they could choose the application that would provide just that. It would allow them to view on the screen, or print a report, of all sites in the area that they select.

If the viewer would like to see these contamination sources on a map, and produce a map for personal use, they could choose the option allowing for interactive mapping (GIS) abilities. In this application they could conduct searches by site name, city, zipcode, county or even street address. If they need to know of sites within a certain distance of a point of interest they could create a buffer for up to 5 miles from that selected site. This web browser will allow the visitor to print a map of their findings along with a report including sites that were identified in their area of interest.

This web page should be available to the public after March 10, 2003. An announcement will be made in the MPCA internet under the “In the Spotlight” section. The MPCA Internet address is [www.pca.state.mn.us](http://www.pca.state.mn.us). Keep a watchful eye for the link or address to this new “What’s in My Neighborhood?” web page. If you have any questions, contact Linda Moon of the MPCA at 651/297-2731 or by e-mail at [linda.moon@pca.state.mn.us](mailto:linda.moon@pca.state.mn.us).

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## Water Resources Specialist Heads Minnesota Pollution Control Agency

MGWA members can take heart in Governor Pawlenty’s appointment of a water resources specialist with a degree in geology to the top post at MPCA. Sheryl Corrigan, most recently an environmental health and safety manager at 3M, was named Commissioner of the same agency where she worked in the late 1980’s, coordinating local water planning programs and analyzing and interpreting environmental regulations in air, water and hazardous waste. Following MPCA, she worked for the Metropolitan Council, the King County (Washington) Water Management Program, Northern Environmental Technologies (an environmental consulting firm in New Brighton), and 3M in St. Paul, holding several positions from 1996 through December 2002.

In making the appointment, Governor Pawlenty said, “Minnesota’s natural resources are an important part of our outstanding quality of life. With Corrigan’s leadership abilities, we can protect the environment, and improve the business and agricultural climate, while still living within our budget constraints. Sheryl is an environmental expert and will work hard to keep our waters clean and our air pure.”

— submitted by Tom Clark





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## MGWA Education Committee Meeting Notes

The meeting occurred on Thursday January 30 at the MPCA. Attendees included Dan Hunter, Jim Lundy, Mark Ferrey, Barb Liukkonen, and Mike Trojan.

Education activities since last meeting:

- Mahtomedi Middle School, Jan. 9, about 250 3rd graders
- SE MN Board of Water Resources, Jan. 13, 25 people present

Up-coming educational events - Jim has 3 school talks planned

Database update – The Education Committee continues to track educational activities and presentations.

Jim submitted a synopsis of Education Committee activities to the Board (see Capillary Fringe).

Samples were taken in early December at the Science Museum in anticipation of well installation for the soon-to-be constructed outdoor water exhibit.

MGWA is organizing an upcoming Project WET workshop for Saturday, April 5, 9 to 4 PM, at Fort Snelling State Park. See the notice in this Newsletter.

The MGWA Education Committee will be giving a Brown Bag presentation at the OEA on April 16, noon. The presentation provides information about MGWA to others interested in environmental education.

Don Berger of the MPCA is setting up a conference call to solicit input from teachers on a ground water CD. The call should occur sometime within the next month.

Mark completed a summary describing a Legislative update process. The proposal will go before the Board for approval in March.

Sean Hunt has made some web updates ([www.mgwa.org/education/index.html](http://www.mgwa.org/education/index.html)) The Education Committee felt the upcoming activities and projects need to be drawn out in the Web page and will recommend some changes to Sean.

Other stuff:

- MN Association for Environmental Education conference will be held in Rosemount in March 2003 on Friday 21st and Saturday 22nd <http://www.naaee.org/maee/Conference2003Web/index.html>. The website is under construction and many things cannot be viewed. Mike will follow up and get conference information to see if MGWA might want to be an exhibitor.
- Minnesota Science Teachers Association annual conference is in St. Cloud, April 11-12. Mike will see if funding might be available to attend and have an exhibition table at this event (<http://www.mnsta.org/>).
- Mike attended the MGWA Board meeting on February 5

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## MGWA Board Meetings

### November 7, 2002

**Place:** USGS WRD Office in Mounds View, Minnesota

**Attending:** Rob Caho, President; Marty Bonnell, President Elect; Jim Stark, Past President; Eric Hansen, Treasurer; Sean Hunt, WRI; Jennie Leete, WRI; Jon Pollock, Secretary; Norm Mofjeld, Editor; Scott Franzmeier, Vice President – Administration at Ewald Consulting; Joe Freeborn, Second Vice President of the Minnesota Water Well Association.

**Minnesota Water Well Association** Scott Franzmeier gave a background on the Minnesota Water Well Association. The organization was founded in 1923. Represents well drillers. Hold winter conference every year during the last week of January. Tradeshow for septic tank installers held in conjunction with winter conference. Bimonthly newsletter. Potential areas of collaboration with MGWA include education, communication between members and legislation. Jennie indicated that MGWA is able to lobby but has not yet done so. Discussion of erecting the MGWA display board at capitol for new legislators. Following the discussion the MWWA members left the meeting.

**Approval of Minutes:** Minutes for the Regular Board Meeting held on September 5, 2002 were revised and approved by the Board.

**Treasurer's Report:** Eric indicated that nine invoices for Spring Conf. have not been paid. Two were people who did not show up and seven paid the member rate, each still owing \$20.00. No collection effort will be taken. Affinity Plus now has funds. Project profit from Fall Conf. expected to be approximately \$7400.00. Total profit in 2002 expected to be approximately \$12,300.00.

**Membership:** Renewals are pending and will go out following conference.

**Web Page:** Shopping cart working well; a couple of minor problems have been worked out. An email for the seminar at the U of M will be sent, as it is not a fee-based conference. Emails for fee-based conferences may require a fee.

**Foundation:** Motion made: Allotting \$300.00 for Jennie to acquire items for silent auction, only spending money after contacting Gordie to see if additional items are needed. Motion approved by the Board.

**Education:** No representatives present; however, meeting minutes were sent to Rob.

**Newsletter:** Norm: Newsletter team working on increasing member interaction:

1. Question of the Quarter
2. New Members/ Member News
3. Response to Articles

Sean: Email link allowing members to respond to the above three items is easy to set up. Aaron will work with Jennie and Sean on this

Norm: Newsletter team will be meeting first Tuesday of the Month. Deadlines will be moved up one week in an attempt to get newsletter out earlier.

### **Old Business:**

Advertising Corporate Membership. Eric: Called Jim A. Jim is still interested in working on corporate membership. Jennie has been looking at magazines to extract names and addresses to solicit more advertisers.

## Board Minutes, cont.

Eric volunteered to continue this effort.

Fall Conference: Setting up for 220 people. Approved for 6 CEUs (MDH).

### New Business

MGWA Board of Director Positions: Eric has agreed to continue on as Treasurer. Chris Elvrum and Jeff Stoner running for President.

Minnesota Water Well Association: Motion: Board will explore opportunities to cooperatively work with the MWWA. Board approved.

### December 5, 2002

**Place:** USGS WRD Office in Mounds View, Minnesota

**Attending:** Rob Caho, President; Marty Bonnell, President Elect, Jim Stark; Past President, Eric Hansen, Treasurer; Sean Hunt, WRI; Jennie Leete, WRI; Jon Pollock, Secretary; Norm Mofjeld; Gordie Hess, Foundation, Jim Lundy, Education

**Approval of Minutes:** Minutes for the Regular Board Meeting held on November 7, 2002 were approved by the Board.

**Treasurer's Report:** Eric reported that the Fall Conference net income is estimated to be approximately \$6,010.00 making the estimated net income for 2002 \$9,030.00.

**Membership:** Paper membership renewals have been sent out and are being returned.

**Web Page:** Sean asked for any items to be added to the calendar of events such as upcoming conferences etc.

**Foundation:** Gordy reported that the Silent Auction at Fall Conference took in \$767.00 with \$300.00 of expenses. May try this event again next year. As past President, Rob will be the Foundation Secretary in 2003.

**Education:** Jim Lundy indicated that the Education Committee will submit a 2002 report on activities. The committee is currently working on several items including the Science Museum exhibit, "Science Park" dealing with groundwater cleanup under the Science Museum, and the classroom CD etc. The Committee tracks classroom and other education

appearances and estimates that 1,100 people came in contact with MGWA representatives in 2002.

**Newsletter:** Newsletter team working on increasing member interaction:

1. Question of the Quarter
2. New Members/ Member News
3. Response to Articles

### Old Business

Fall Conference: Sean distributed comments, approximately 30 responses submitted. The comments were generally favorable.

Fall Field Trip: AIPG will pay 50 % of the loss. AIPG has indicated that they are interested in running their own conference every other year.

### New Business

New Board Meeting Location: We will meet at Black Bear Crossing.

Spring Conference: Date set for April 17th. Rob Caho, Jim Stark and Jon Pollock volunteered to help plan. Marty write guidelines for outstanding service award for the next Board Meeting.

### January 8, 2003

**Place:** Black Bear Crossing, St. Paul, Minnesota

**Attending:** Marty Bonnell, President; Chris Elvrum, President Elect, Rob Caho; Past President, Eric Hansen, Treasurer; Sean Hunt, WRI; Jennie Leete, WRI; Jon Pollock, Secretary; Norm Mofjeld; Gordy Hess, Foundation, Jim Lundy, Education Rob called meeting to order at approximately 0740.

**Approval of Minutes:** Minutes for the Regular Board Meeting held on December 5, 2002 were approved by the Board.

**Treasurer's Report:** Current assets are \$17,500.00. Motion was made to transfer \$8,400.00 to the MGWA Foundation endowment following a profitable Spring Conference was approved by the Board. The budget for 2003 was presented by Eric and Jennie.

**Membership:** Sean distributed a table and graph showing membership information. Currently there are 322 paid members for 2003, which is

approximately 30 percent higher than this time last year.

**Web Page:** Sean is developing a way to receive interactive feedback from the electronic newsletter. Jim asked if past field trip guidebooks could be put on the web page. Sean indicated guidebooks are not electronic. Jennie will provide Norm with a list of available past field trip guidebooks. Norm will put a newsletter article together indicating which past field tip guidebooks are available.

**Foundation:** The Foundation has \$28,400.00, of which \$25,000.00 is endowment, leaving \$3,400.00 available for distribution. Gordy will put something together for the Spring Conference and Newsletter discussing the amount available for distribution and how to apply for it. Foundation funds are in a money market account. Gordy is looking into other places to keep the funds.

**Education:** Jim presented the Education Committee summary for 2002.

**Newsletter:** Prior year financial report, put together by Jennie and Eric will go into March 2003 Newsletter. Sean will take picture of Chris for the Newsletter. Sean indicated that at the end of newsletter articles there will be an email address for people to respond to the article.

### Old Business:

Spring Conference: The topic for the Spring Conference will be Lakes and Groundwater Interaction.

Outstanding Service Award: Committee membership was discussed. Several suggestions were made including having the President Elect on the committee, having Past Presidents on the committee. Marty indicated that he will contact the present committee members. Marty will update current guidelines.

### New Business:

Contract: The 2003 contract between WRI and the MGWA was reviewed and discussed. Motion to accept contract without markup for outside services and the addition of \$300.00 for outside insurance. Motion approved by the Board.

Materials: Eric inventoried approximately 200 mugs and 500 pens left over from Fall Conference.



## New Officers Installed

Chris Elvrum, President-Elect, and Eric Hansen, Treasurer, attended their first board meetings of their current terms on January 8th. Eric is serving his second term, 2003-2004, as Treasurer, and Chris will serve as President-Elect in 2003, as MGWA President in 2004, and as Past-President in 2005.

Rob Caho, Immediate Past President, has begun a term on the MGWA Foundation Board, where he serves with Gordie Hess, Dave Kill and Jeanette Leete. MGWA is grateful that our past-presidents continue to serve as such dedicated volunteers. The Association benefits greatly from being able to continue to draw on their leadership skills.



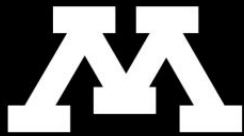
— Chris Elvrum, Metropolitan Council.



— Eric Hansen, Pinnacle Engineering

## MGWA 2002 Financial Report

	Jan - Dec 02
<b>Income</b>	
Total 3100 Contributions	pass through
Total 3200 Dues	12,779.00
Total 3300 Ads	1,863.00
<b>3400 Interest</b>	78.75
<b>3500 Prog. Fees</b>	
3510 Spring Conference	18,380.00
3520 Fall Conference Fees	18,556.90
3530 Field Trip Fees	540.42
3550 Hog Roast	100.00
<b>Total 3500 Prog. Fees</b>	37,577.32
<b>Total 3600 Products</b>	417.08
<b>Uncategorized Income</b>	0.00
<b>Total Income</b>	52,715.15
<b>Total COGS</b>	30.84
<b>Gross Profit</b>	52,684.31
<b>Expense</b>	
<b>4000 Admin</b>	
4051 General Tasks	330.00
4066 Gen. Phone	78.20
<b>Total 4100 Fin. Admin.</b>	1,865.62
<b>Total 4300 Corr.</b>	330.00
<b>Total 4400 BOD</b>	53.10
<b>Total 4500 Dues</b>	1,215.38
<b>Total 4600 DB Maint</b>	2,400.00
<b>Total 4000 Admin</b>	6,272.30
<b>5000 Programs</b>	
Total 5100 Spring Conf	13,474.64
Total 5200 Fall Conf	11,376.85
Total 5300 Field Trip	1,080.84
Total 5500 Networking Event	1,081.47
<b>Total 5000 Programs</b>	27,013.80
<b>6000 Mem Services</b>	
Total 6100 Newsletter	7,907.55
Total 6200 Directory	1,220.51
Total 6300 Member Corresp.	5.50
<b>Total 6000 Mem Services</b>	9,133.56
<b>Total 7000 Public Service</b>	2,089.60
<b>Total 8000 Products</b>	3.95
<b>Total Expense</b>	44,513.21
<b>Net Income</b>	<b>8,171.10</b>



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This course begins with a brief overview of hydrogeologic principles of pumping and slug testing then continues at an advanced level throughout the course to cover the range of conditions typically encountered during field investigations.

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Jim Butler taught during the 2000 Midwest GeoSciences Group Short Course in Minneapolis: **Advances in Site Characterization for Environmental and Engineering Projects at Glaciated Sites**

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Wednesday and Thursday  
May 21 & 22, 2003

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Wisconsin Geological Survey

Maureen Muldoon, PhD  
U. of Wisconsin - Oshkosh

Willard Murray, PhD  
Wakefield MA

Glenn Duffield  
Developer of AQTESOLV for Windows

E. Calvin Alexander, Jr., PhD  
University of Minnesota

Tony Runkel, PhD  
Minnesota Geological Survey

Dan Kelleher  
Earth Tech, Inc.

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Minneapolis, Minnesota

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Professional (after May 8) \$699

**Continuing Education Units from:**  
University of Minnesota  
16 Professional Development Hours  
(1.6 CEUs)

This two-day course provides attendees with the practical knowledge to significantly improve hydrogeologic analysis of fractured bedrock, including carbonate, crystalline, and metamorphic rocks. The first day consists of real-world applications for evaluating the role of bedrock fractures in ground-water movement and contaminant transport. Special attention is given to the inherent difficulties of ground water modeling in fractured bedrock systems. The second day includes a comprehensive comparison of different hydrogeologic field tests and analytical methods for characterizing aquifer properties. In addition, the latest techniques for designing ground water monitoring systems and remediation systems in fractured systems is presented. Hands-on exercises include improving rock core description, calculating recovery and RQD values, and characterizing rock cores representing a wide variety of lithologies and rock stratigraphic units. The computer session consisting of a series of hands-on data analysis exercises using *AQTESOLV* software

This course covers hydrogeologic principles for fractured bedrock and continues at an advanced level throughout the course to match the range of conditions typically encountered during field investigations. The rock core logging workshop includes methods to improve rock core description for hydrogeologic projects.

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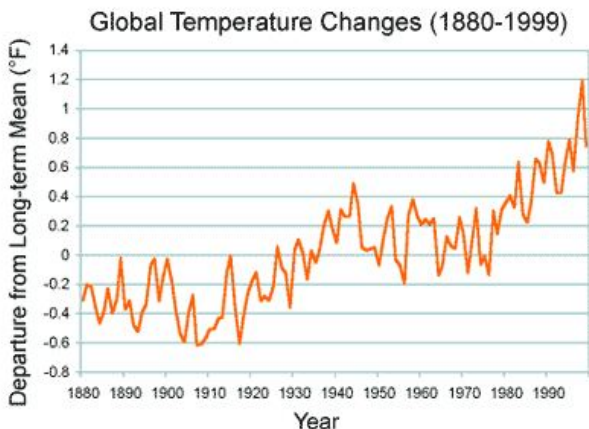
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Globally, sea level has risen 4-10 inches over the past century. Worldwide precipitation over land has increased by about one percent. The frequency of extremely heavy rainfalls has increased throughout much of the United States.



Source: National Climatic Data Center, 2000. Climate of 1999 - Annual Review.  
 Online at <http://www.ncdc.noaa.gov/ol/climate/research/1999/ann/ann99.html>

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