Minnesota Ground Water Association

www.mgwa.org

Volume 24, Number 3: September 2005

President s Letter

The final days of this year s legislative session were a disappointment and an eye-opener. Years of work and fund raising to create an educational exhibit on ground water at the Big Back Yard of the Science Museum of Minnesota were thwarted at the stroke of a pen. The Governor vetoed the Legislative Commission on Minnesota Resources (LCMR) project meant to provide a portion of the funding needed to create ground water exhibits and a statewide traveling ground water classroom program. These exhibits were intended to complement the well that was installed this past winter, funded by your contributions (see MGWA Newsletter, March 2005).

So, what next? It seems to me that MGWA has a lot of work to do. The explanation given in news accounts indicated to me that there is a lack of understanding about the importance, or even perhaps the existence, of ground water as a natural resource. Support for ground water related programs and regulations continues to erode from the high interest in the late 1980 s after the last major

MGWA President Laurel Reeves.

state-wide drought. Ground water interests are not included in new water initiatives. The effects of these misunderstandings and lack of interest will certainly be felt in the long-term not only by ground water professionals but also by the public at large.

At a recent MGWA Board meeting we discussed the need to help inform Legislative and Executive Branch decisions. To that end we are working to ensure that decision makers know about MGWA and use us as a non-partisan information resource. We also are exploring options to deliver ground water information to these officials. These efforts will be discussed further with you at the Fall Conference and in future newsletters.

More important than these group contacts are those each of you make with your legislators, with your local officials, and with your friends, neighbors and family. Thus I challenge each MGWA member to become involved locally. Talk with your government representatives; talk in your schools; talk with your neighbors; talk with the person behind you at the grocery check-out. Take the initiative to raise the topic of ground water supply, ground water quality, ground water influence on our daily activities talk about our future.

Until we meet again, work safely and take care,

Laurel Reeves, MGWA President

— Artist's rendering of the new building for the Departments of Health and Agriculture (Courtesy Hammel, Green and Abrahamson - Architects). See article on page 11.

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Remaining 2005 Newsletter Deadline

Issue	To Editor
December	11/04/2005

Members in the News

Jeffrey M. Neisse

Jeffrey M. Neisse changed employment in early August and is now working for ATC Associates Inc. in Roseville, Minnesota, as a project geologist. He was formerly employed at Delta Environmental Consultants.

Tom Clark

Tom Clark, a senior hydrologist with the Minnesota Pollution Control Agency and a member of the MGWA newsletter team, sustained a fall on August 5th while trying to chase a bird out of his daughter's living room. His daughter, Emily, was overdue with his third granddaughter and she and her husband Brandon were on a night out before the new arrival. Tom ended up having non-elective surgery to reattach the quadriceps tendons to the patellae (knee caps) of both legs. He will be off his feet for a while and won't be back to work until late September.

Tom reports that the two great "outcomes" of the week that followed were the birth of a healthy Sarah Grace Burbach weighing 7 lbs. 11 oz. on Monday, August 8th and a good prognosis for his recovery. He has indicated, however, that the rental of Alfred Hitchcock's "The Birds" is not part of his post-op therapy routine.

Nominate Your Friends! Two MGWA Officers Sought for 2006

Call for Nominations: The MGWA membership needs to fill two officer positions — Secretary and President-Elect — for the year 2006.

The **Secretary** keeps the minutes of all MGWA Board Meetings and is the custodian of the Association's official paperwork. He or she also assists with conference planning. **The President-Elect** takes a leadership role in the planning of one or more of the MGWA meetings while "learning the ropes" of MGWA leadership. Here's a chance for you or someone you nominate to get in on the front end of ground-water resource protection in Minnesota.

The Secretary serves a two-year term, and the President-Elect serves a year before becoming President in 2007, followed by a year as past-president. Send your nominations by November 1 to MGWA, 4779 126th St. North, White Bear Lake, MN 55110-5910, or by e-mail to: office@mgwa.org.

Selected Outcomes of the 2005 Minnesota Legislative Session

The 2005 Minnesota legislative session was eventful in a variety of ways, including the partial shutdown of state government for the first two weeks in July. The inability of the House and the Senate to agree on budget bills resulted in the two-week furlough of employees in the departments of Health, Transportation, and others. A long special session, extending beyond the end of the state fiscal year, was required to complete necessary business. The following is a summary of selected outcomes related to ground water and water resource protection and management.

Carried over from 2004 was the bonding bill and which included not just major construction projects but also some smaller projects. For example, the bill included $10 million for the Closed Landfill Program to complete remedial design and construction work at approximately 12 publicly owned facilities.

New Legislative Actions

The Office of Environmental Assistance is now part of the Pollution Control Agency.

The legislature directed that the Minnesota Pollution Control Agency (MPCA) spend at least $2 million on cleanup at the Valentine Clark and Reserve Mining Superfund sites in fiscal years 2006 and 2007. Valentine Clark is a wood treatment contamination site along the St. Paul/Minneapolis boundary. Reserve Mining is near Silver Bay.

continued on next page

2005 Legislative Session, cont.

Legislation included new procedures that municipalities must follow when proposing new or amended zoning control over feedlots. The MPCA and the Minnesota Department of Agriculture (MDA) must be notified at the beginning of the process. The legislation also provides for reciprocal setbacks for feedlots and residences.

The increased water use fees paid by ground water and surface water appropriators also included a summer surcharge for some uses. The intent is to reduce summer water usage for some uses, such as lawn watering. The receipts go to the General Fund.

Legislation included a change to the prohibition on ground water withdrawals for once-through cooling. An exemption gives the Commissioner of the Department of Natural Resources the authority to issue once-through system water use permits on an annual basis for aquifer storage and recovery systems that return all once-through system water to the source aquifer. The approval of the Commissioners of Health and the Pollution Control Agency is also required.

Fee increases were approved for the Health Department to use for new and ongoing efforts to implement the Safe Drinking Water Act.

The Metropolitan Council is directed to develop and expand regional water supply planning activities, to be conducted in consultation with a metropolitan area water supply advisory committee. (See article on page 9).

The legislature increased funding at MDA for ground water and surface water monitoring for pesticides by $150,000 per year. The legislature also directed the legislative auditor to conduct an audit of Minnesota's pesticide regulatory processes, which include ground water and surface water monitoring activities. This report should be completed in January 2006.

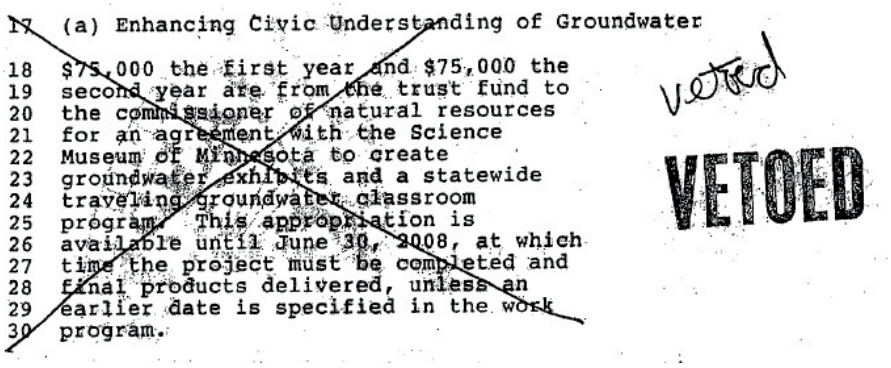
Legislative actions also included appropriation of over $39 million for new and continuing projects from the Environment and Natural Resources Trust Fund, as recommended by the Legislative Commission on Minnesota Resources (LCMR). Most familiar for providing recreational and environmental funding, the final bill included $1 million for water management challenge grants, $300,000 to study estrogenic compounds in wastewater, $587,000 for studies to reduce nitrate and phosphorus losses in the central sands, and $500,000 to continue development of soil surveys. One project not funded was the ground water education exhibit at the Science Museum of Minnesota.

It should also be noted that the second year of administrative funding for the LCMR was vetoed. Governor Pawlenty has stated that he wishes to reform how theLCMR is organized.

Bills not enacted

Some significant bills were not passed in 2005. Most notable may be the failure of the Clean Water Legacy Act to pass. The act would have required a sizeable commitment of new funds. Agreement could not be reached on how to fund the initiative to clean up surface waters. The so-called "e-waste" bill, requiring manufacturers to recycle video display devices, also failed to pass.

For complete details, see the Minnesota legislation and bill status page at www.leg.state.mn.us/leg/legis.asp . The page provides links to the text of the bills and a log of the governor's actions.


17 (a) Enhancing Civic Understanding of Groundwater

18 $75,000 the first year and $75,000 the
19 second year are from the trust fund to
20 the commissioner of natural resources
21 for an agreement with the Science
22 Museum of Minnesota to create
23 groundwater exhibits and a statewide
24 traveling groundwater classroom
25 program. This appropriation is
26 available until June 30, 2008, at which
27 time the project must be completed and
28 final products delivered, unless an
29 earlier date is specified in the work
30 program.

vetoed

VETOED

— Governor Pawlenty vetoed the LCMR proposal for the ground water exhibit at the Science Museum of Minnesota.

2005 Board of Directors

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.

Wabasha County Geologic Atlas, Part B Hydrogeology and Pollution Sensitivity

by Todd Petersen, DNR Waters

Part B of the Wabasha County Geologic Atlas is now available (Figure 1). The report, recently published by DNR Waters, includes three map plates that describe the county s ground-water conditions and pollution sensitivity. This atlas joins the previously published portion of the report, Part A, prepared by the Minnesota Geological Survey that contains seven map plates describing the surficial and bedrock geology and includes a plate focusing on karst features.

Two very different ground-water systems exist in the county: the river valley system and the upland area system (Figure 2). Ground water is recharged in upland areas north and south of the Zumbro River and flows toward the Zumbro and Mississippi Rivers.

Ground-water supplies in Wabasha County are pumped from nine bedrock and surficial sand and gravel aquifers. The relationships between geologic units and aquifers, as well as the hydrologic conditions of those aquifers, are shown in Figure 3. Chemistry and tritium data indicate that the uppermost aquifers are readily recharged and often show evidence of anthropogenic contaminants such as nitrate.

In the upland areas the county is endowed with generally abundant ground-water resources from several bedrock aquifers. Shallow perched water tables exist at least seasonally, but the true water table is quite deep and often located in the karsted Prairie du Chien Formation. The Jordan Sandstone is the most commonly used bedrock aquifer, followed by the Franconia Formation.

The Mississippi and Zumbro River valleys were both deeply incised and aggraded during the Pleistocene and are largely filled with sand and gravel deposits or glacial outwash. Unlike the upland areas, the water table in the valley fill is relatively shallow. Most wells in the Mississippi and eastern Zumbro River valleys are completed in the Quaternary sediment. These Quaternary wells account for approximately percent of the wells in the county. Bedrock aquifers exist beneath the Quaternary sediment, but are rarely used.

Aquifers of Wabasha County

Quaternary sand and gravel aquifer. The Quaternary sand and gravel aquifer is present only in the major valleys of the Zumbro and Mississippi rivers. This aquifer is the most used aquifer in Wabasha County. It is generally productive, and is used for both municipal and domestic supply.

Prairie du Chien aquifer. The Prairie du Chien aquifer is the uppermost bedrock aquifer currently in use. There are few wells, mostly older domestic and farm wells, completed in this aquifer. The Prairie du Chien aquifer is usually the uppermost bedrock aquifer and in most of the county, there is very little overlying Quaternary sediment. It is usually unconfined.

Jordan aquifer. The Jordan Sandstone is an upward coarsening sequence of two facies: (1) a quartzose, friable sandstone and (2) a feldspathic fine-grained sandstone. The Jordan aquifer is the second most used aquifer in Wabasha County. The Jordan aquifer is used primarily in the western two-thirds of the county.

St. Lawrence aquifer. The St. Lawrence Formation consists of dolostone and sandstone, well cemented and thin to medium bedded. The lower half of the St. Lawrence Formation is usually a good aquifer. This aquifer is most used in the westernmost portion of the Zumbro River valley.

Franconia aquifer. The upper half of the Franconia Formation is usually a good aquifer. Shallow fractured bedrock conditions can enhance the transmissivity (Runkel, A.C., unpub. data, 2004). This aquifer is used fairly evenly across the county with a slightly greater concentration of use in the western Zumbro River valley and on the bluff lands just west of the Mississippi River valley where the Jordan aquifer is not present.

Ironton-Galesville aquifer. The Ironton and Galesville Sandstones are poorly sorted, coarser-grained sandstone,

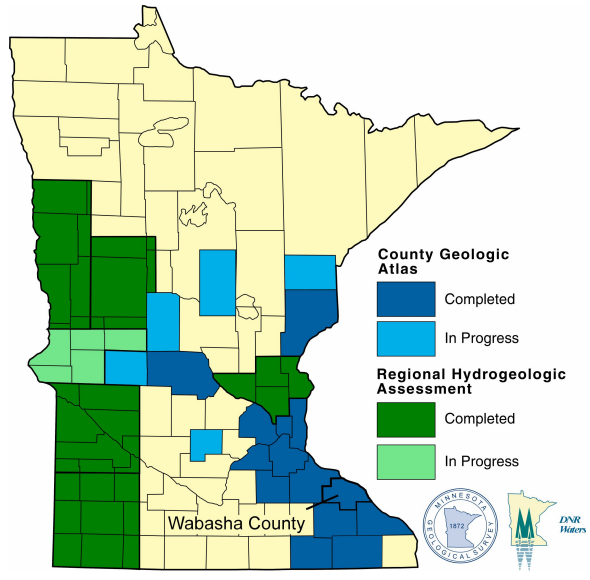


Figure 1. Location of Wabasha County and status of County Geologic Atlas series.

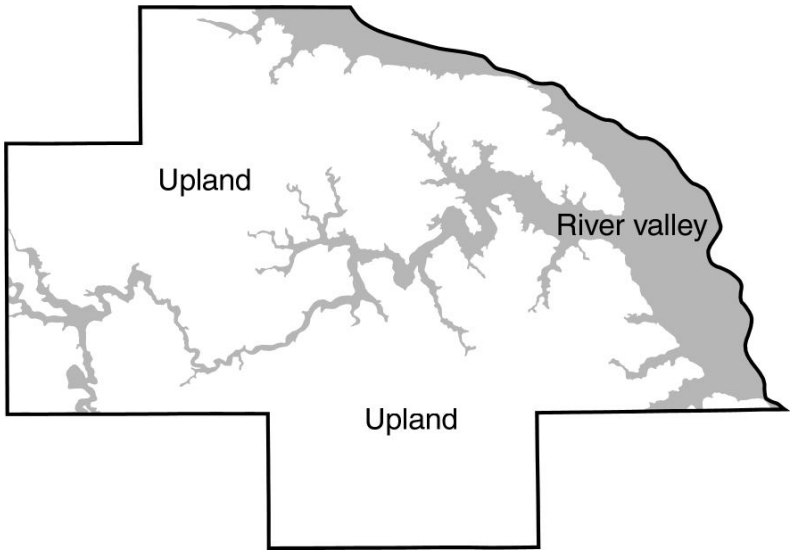


Figure 2. The upland and river valley systems in Wabasha County.

overlying fine to coarse-grained, well-sorted to moderately sorted sandstone. This aquifer is used primarily in the bluff lands just west of the Mississippi River and in the Zumbro River valley.

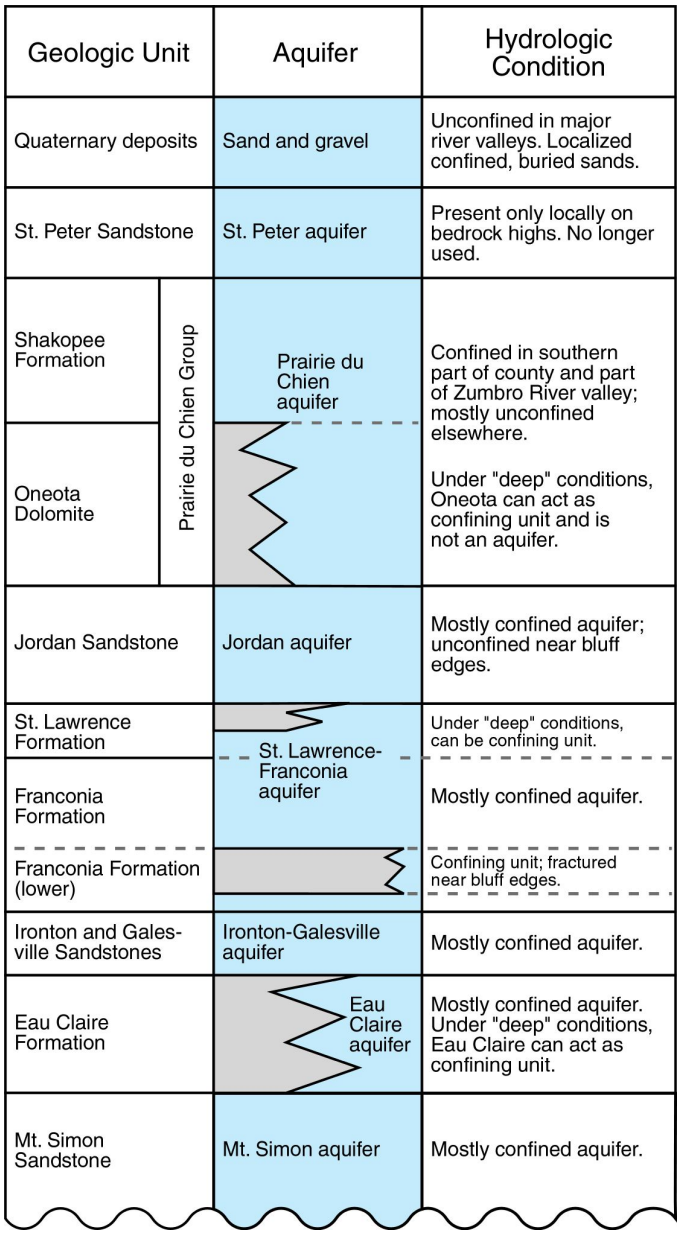


Figure 3. Aquifer relationships and hydrologic conditions in Wabasha County.

Potentiometric Surfaces of the Uppermost Water-Supply Bedrock Aquifers.

Figure 4 on page 6 shows the potentiometric surface of the Jordan aquifer in the higher elevation upland areas of Wabasha County (contours) and the elevation of the Quaternary water table aquifer in the Zumbro and Mississippi River valleys (colored shading). Ground water is largely recharged in the upland area north and south of the Zumbro River and flows toward the Zumbro and Mississippi rivers. The Jordan aquifer is typically fully saturated, but on the eastern side of the county and near the Zumbro River, the Jordan aquifer becomes dewatered near the bluff edges and is no longer an aquifer.

The potentiometric surface of the combined St. Lawrence-Franconia-Ironton-Galesville (available in the Part B Atlas publication) is similar to the Jordan potentiometric surface, with recharge zones in the upland areas flowing to discharge zones in the Zumbro and Mississippi River valleys.

Pollution Sensitivity and Ground-Water Residence Time

The primary purpose of the Part B atlases is to predict the sensitivity of the uppermost aquifers to water-borne pollution. The karst-prone Prairie du Chien Formation is the uppermost bedrock unit over most of Wabasha County. The overlying till can locally exceed 100 feet in thickness, but it is more typically thin or absent. Thus, most of the county is sensitive to pollution (Figure 5 on page 6).

In areas without till cover, the sensitivity to pollution of the uppermost bedrock aquifer is rated Very High. Areas with up to 50 feet of alluvium or till covering bedrock have a rating of High. Areas with more than 50 feet of sediment on top of the bedrock are rated Moderate. No areas of the county are rated Low or Very Low. The sensitivity model only considers vertical flow paths and uses sediment type and thickness to estimate vertical time of travel.

The predicted sensitivity can be tested by looking at the ground water residence time as shown in the cross sections in Figure 6 on page 7. The pink, green, and blue areas shown in these cross sections represent the age of the ground water, also known as ground-water residence time. This is the approximate time that has elapsed from the moment the water infiltrated the land surface to the time it was pumped from the aquifer. Tritium is a naturally occurring radioactive isotope of hydrogen. Concentrations of this isotope were greatly increased between about 1953 and 1963 by above-ground nuclear tests (Alexander and Alexander, 1989). This isotope decays at a known rate. Because of this, the proportion of recently recharged water (within about the last 50 years) can be estimated based on its tritium content. Water samples with tritium concentrations of 10 or more tritium units (TU) are considered to be recent water, the water having entered the ground in about the last 50 years. Water samples with tritium concentrations of 1 TU or less are classified as vintage water, which entered the ground before about 1953. Water samples with tritium concentrations greater than 1 TU and less than 10 TU are considered mixed waters. They are a mixture of vintage and recent waters.

Recent age ground water (based on tritium content) is found in some areas covered by thick till and beneath apparently unfractured Oneota Dolomite, such as in the Plainview area along cross section C-C (Figure 6), implying that horizontal flow paths (possibly due to karst development) may be important in some places. The Prairie du Chien aquifer typically has recent age ground water, based on tritium content. The Jordan aquifer often has mixed age ground water, based on tritium. In the Franconia and deeper aquifers, ground water is often vintage age based on tritium.

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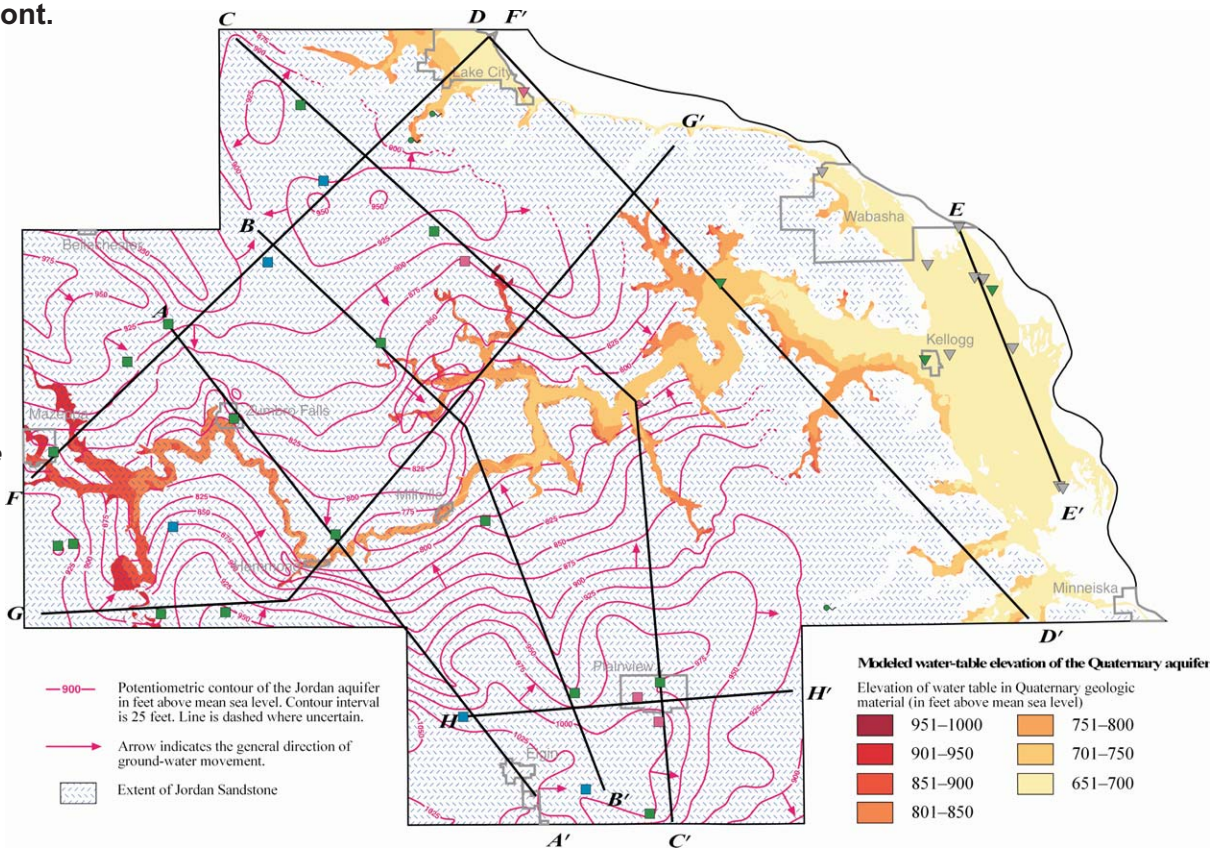


Figure 4. Potentiometric surface of the Jordan aquifer (contours) and elevation of the Quaternary water table aquifer in the Zumbro and Mississippi River valleys (colored shading) in Wabasha County.

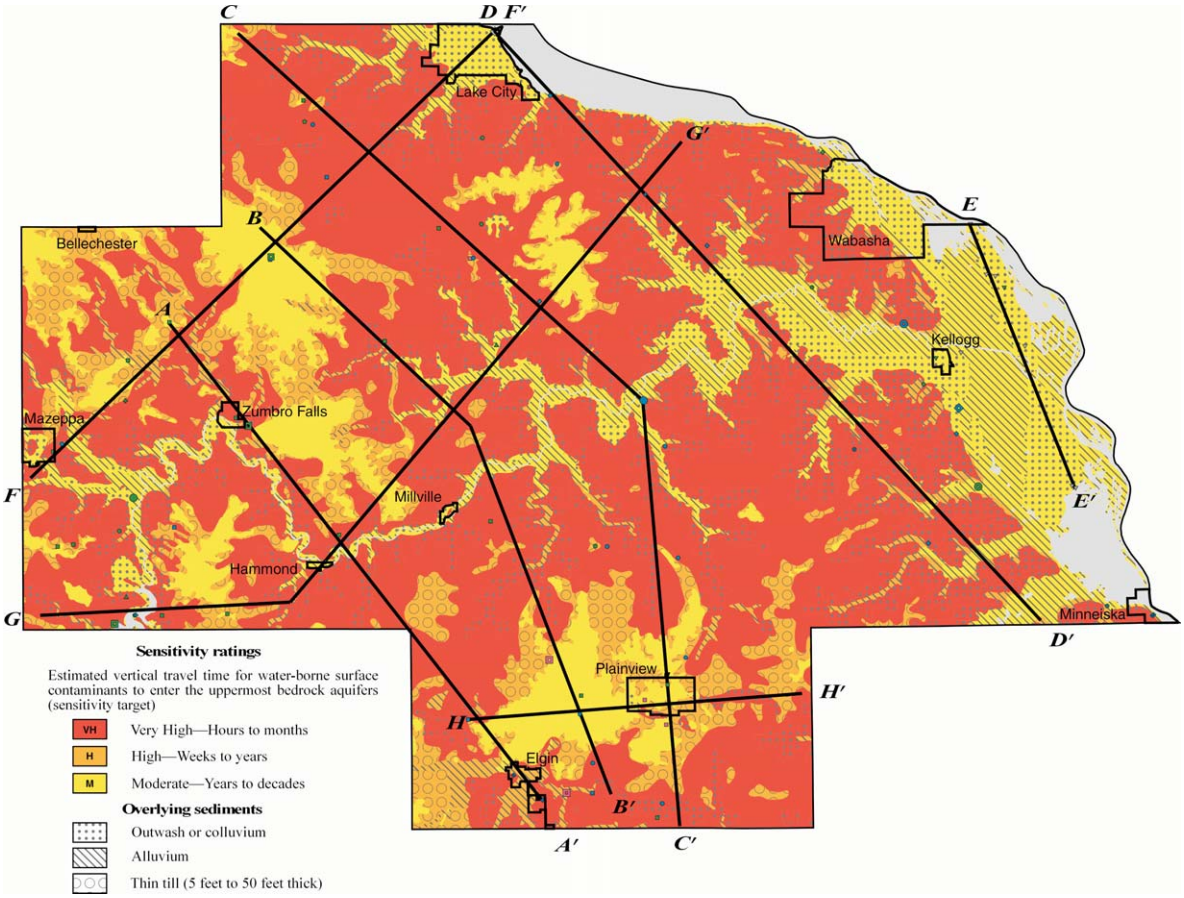


Figure 5. Pollution sensitivity of the uppermost bedrock aquifers in Wabasha County.

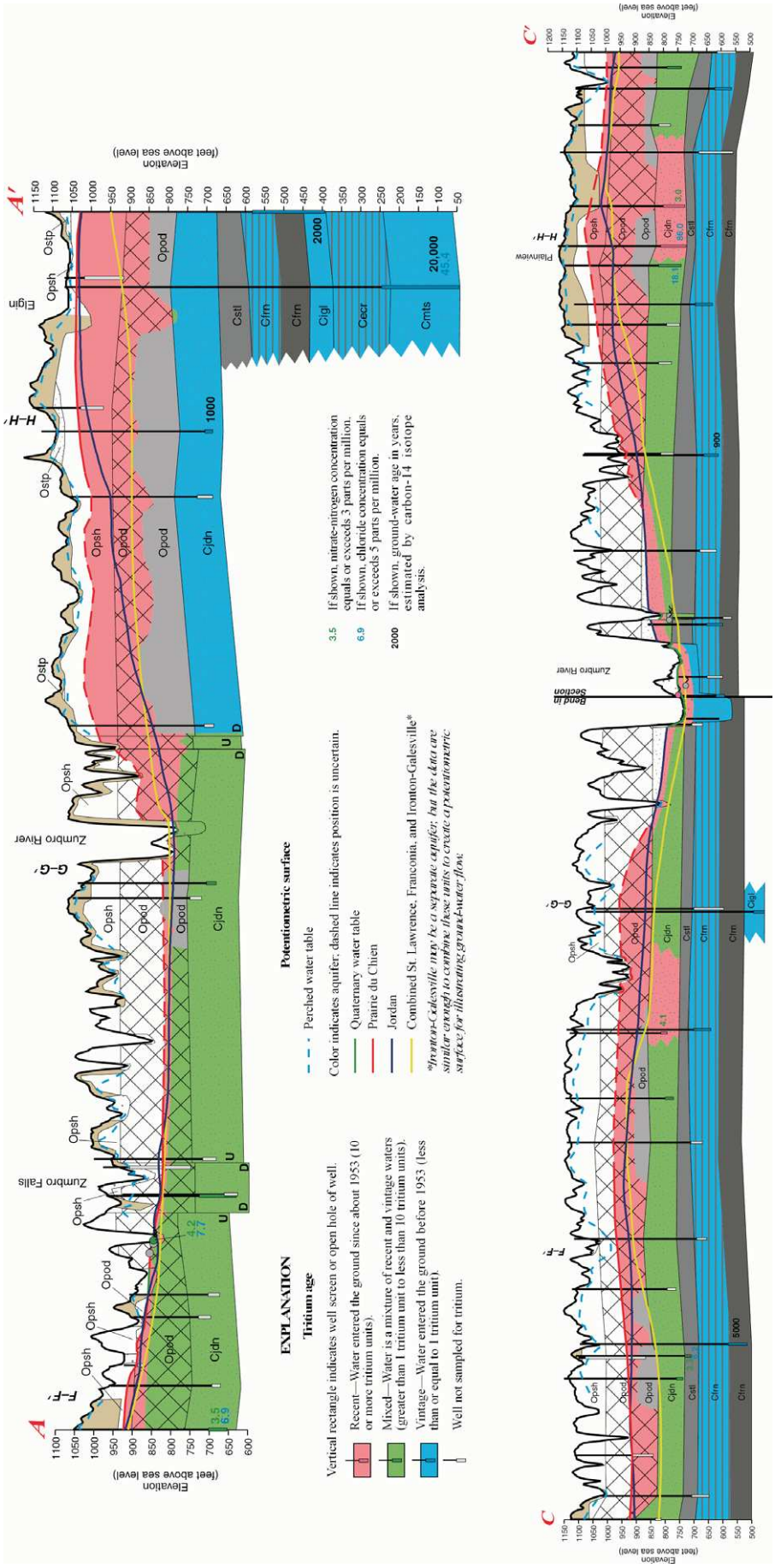


Figure 6. Selected hydrogeologic cross sections showing ground water residence time.

Wabasha Atlas, cont.

Deep ground water can be quite old in Wabasha County. Three carbon-14 samples were collected from wells completed at different depths near the City of Elgin (cross section A-A) (Figure 6). The shallowest well tested (completed in the Jordan Sandstone) had a carbon-14 age of 1000 years. The Elgin well completed in the Franconia and Ironton-Galesville Formations had a carbon-14 age of 2000 years. The deep Mt. Simon Elgin well had a carbon-14 age of 20,000 years.

The shallow hydrogeologic system in Wabasha County is fairly open and recent age water can penetrate fairly deeply. However, the deepest ground water in the county can be thousands of years old.

To Obtain Reports and Data

Part B of the Wabasha County Atlas is now available. The Wabasha County Geologic atlas is the fourteenth report of the County Geologic Atlas Series, a cooperative effort between the Minnesota Geological Survey (MGS), Wabasha County, and DNR Waters.

County Geologic Atlases underway include Pope, Crow Wing, Todd, Carlton, and McLeod. Part A reports for Pope and Crow Wing counties have been published by the MGS. 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 Wabasha County Geologic atlas was prepared using geographic information systems (GIS) technology. Portable document (PDF) images of plates are available for download. Please see the DNR web site at: www.dnr.state.mn.us/waters/groundwater_section/mapping/status.html for Part B availability and download instructions. GIS data for Part B will be posted by the end of August. PDF images and data for Part A of the report are downloadable from the MGS ftp site at ftp://156.98.153.1/pub3/c-14/. Also available from the MGS ftp site is a companion report (Report of Investigations 59) discussing the geology and karst of Wabasha County. More information is on the MGS web site at www.geo.umn.edu/mgs/. For more information contact Todd Petersen or Jan Falteisek, DNR Waters at (651) 296-4800 or Dale Setterholm, Minnesota Geological Survey, at (612) 627-4780.

Reference Cited

Alexander, S.C., and Alexander, E.C., Jr., 1989, Residence times of Minnesota groundwaters: Minnesota Academy of Sciences Journal, v. 55, no. 1, p. 48-52.

McLeod and Carlton Counties Initiate Geologic Atlas Projects

The Minnesota Geological Survey and the Department of Natural Resources Division of Waters have begun work on geologic atlases of McLeod and Carlton counties. The first part of each atlas, geology, will be published in 2009. In both counties, expected increases in population and related demands on natural systems have fostered a need for better information for decision-makers. The products of the atlases will be useful for managing the beneficial use and protection of ground water and other resources. Each atlas will produce printed maps and texts describing the geology and hydrology of the area, and include electronic versions of the information for all levels of users. A geographic information system (GIS) project for each county will allow full access to the maps and related databases, and will also allow users to create new maps derived from the atlas data, or from a combination of atlas and other data sets.

For more information, contact Terry Boerboom (for Carlton County), Barb Lusardi (for McLeod County), or Dale Setterholm at the Minnesota Geological Survey, 612-627-4780.

Minnesota Ground Water Sustainability Summary of Issues and Needs

The Department of Natural Resources has completed and posted to its web site a short summary of the issues and needs facing ground water sustainability in Minnesota. The 6-page summary is based on a series of topical fact sheets that will also be posted to the web as soon as they are finalized. Fact sheets at this time include general ground water availability, ground water and surface water interaction, and management options. For more information and links to the summary and available fact sheets, see www.dnr.state.mn.us/waters/groundwater_section/sustainability/index.html .

Minnesota Ground-Water Information Guide Expanded

By Tim Thurnblad

Imagine how convenient it would be if you only needed one Internet bookmark (favorite) to find hundreds of sources of Minnesota ground-water information. The Minnesota Ground-Water Information Guide is designed to provide a user-friendly Internet gateway, or portal, to ground-water information and expertise. The guide has been updated recently and now includes four components; the original version only had one component. Each component is designed to meet a different set of site-visitor needs. The guide is available at www.mgwa.org/gwig/ or www.geo.umn.edu/mgs/gwig/. If you d like to know more about the guide and what you ll find in each of the four components, keep reading.

The Purpose of the Guide

The primary purpose of the guide is to make it easier for you to find the information or expertise you need for your ground-water related projects and decisions. The guide includes much more than just a list of books and articles; you can browse or search the guide in at least six different ways to speed up information gathering. In many cases, just a few mouse clicks

— *continued on next page.*

Ground Water Guide, cont.

will get you the telephone number you need or open up the report, map or table of data that you needed for your project. And yes, the guide provides help for finding information that is only available on paper too.

The Concept Behind the Guide

When I returned to Minnesota in 1990, after working in the southwestern U.S. as a consulting hydrogeologist and manager for many years, I was surprised that it was not easier to find ground-water and hydrogeologic information for Minnesota projects at my new job. Minnesota ground-water information is distributed among so many different programs in so many different organizations that, even with a thorough effort, it was difficult to determine whether or not you ve found all the important sources of information for a project.

It became apparent that you had to be in the right (a certain) program and know where the secret caches of maps, reports, etc., were kept to get your hands on them. Sometimes, the only copy of a document in the building was in a certain unidentified cabinet or drawer near somebody s desk on another floor of the building. I rarely worked on projects where I needed site-specific information, but at times, when I was lucky enough to get help from a co-worker, I d find myself thinking I didn t even know that series of reports existed . I wondered what a challenge it must be for those Minnesota ground-water hydrologists that have no co-workers that specialize in ground-water work or for those researching a ground water topic for the first time.

In subsequent years, during meetings of the (State) Interagency Ground Water Monitoring Group and the Metro Area Ground Water Alliance (MAGWA), we often spoke of the need for an up-to-date ground water bibliography or something similar. And as several State of Minnesota ground-water related programs experienced substantial funding and staffing reductions, the need to make ground-water information more easily available for the remaining staff seemed urgent.

As the prominence of the Internet grew and more ground-water related programs and information went

— *continued on page 11.*

Question of the Quarter

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

Do fish live in Minnesota ground water?

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

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

Metropolitan Council Water Supply Planning Legislation

Chris Elvrum, Metropolitan Council

The Twin Cities metropolitan area has relatively abundant local water supplies compared to other parts of the United States. However, supplies are not infinite and withdrawals can have adverse impacts.

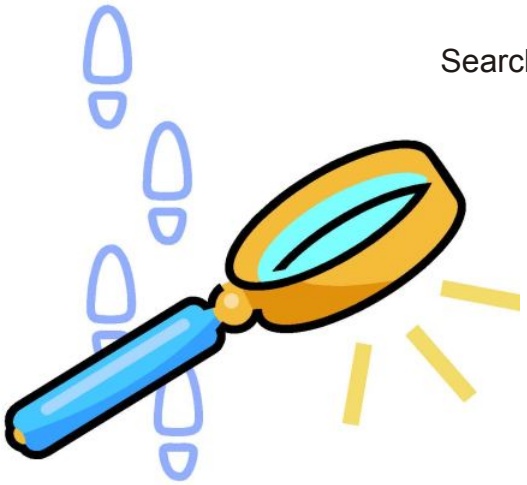
Nor is water always located where it s most needed – where growth is occurring. The Twin Cities region is expecting close to one million more people between 2000 and 2030, and they will have at least one thing in common. They are going to need water.

Under a measure approved by the 2005 Legislature, the Metropolitan Council is making regional water supply planning a top priority. The legislation has three main goals: 1) develop a base of technical information needed for sound water supply decisions, 2) develop a regional master plan for local systems and future regional investments, emphasizing conservation, cooperation, security and long-term sustainability, and 3) clarify agency responsibilities with an eye toward streamlining the regulatory process.

To help achieve these goals, the legislation empowers the Governor to appoint a regional water supply advisory committee with representatives from state agencies, county and local governments. The committee will advise the Council and the agencies regarding water supply, consult in developing the regional master plan and serve as a liaison to local communities. The Council must report initial findings to the Legislature in time for the 2007 session.

The water supply study will be funded by the Council, which will explore long-term funding options for infrastructure investments and ongoing planning and technical studies. Technical studies conducted under the legislation will likely include such things as water supply system inventories, geologic mapping, aquifer recharge studies, water conservation effectiveness, and river analysis. The scope of the studies will be developed with input from the Council s partners and the regional water supply advisory committee.

Council officials say the water supply initiative is good planning and yet another step toward improving the region s quality of life and livability and ensuring the Twin Cities remains a great place to live, work and raise a family.

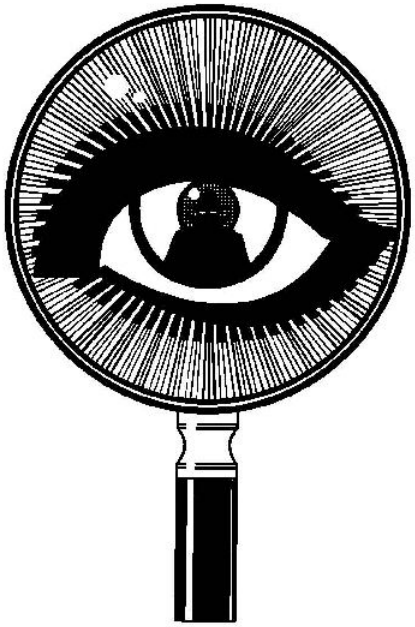


Searching for a way to squeeze more from your water analyses?

Join us at MGWA s annual fall conference and workshop.

GeoChemistry for Scientific Investigations

There s more to it than meets the eye!



November 17, 2005 Conference
November 18, 2005 - Workshop

Do you enjoy a solving a mystery?

Don t let your mind go numb at the mention of the word, geochemistry. This conference will take you beyond the typical ground water chemistry analysis. It s as basic as **using natural and anthropogenic evidence to solve problems.** The problems may be where did the water originate, where is it now, where has it been in the meantime, what might have happened to it to result in the observed geochemistry?

In fact there is so much to discuss, two days are planned. The first day, organized in our usual format, will start with a refresher in **Geochemistry 101**. Then we progress to **applied geochemistry**. (We re still contacting speakers. Watch for the conference brochure for the nearly final line-up.) Following the general discussion, we ll move to the subtopic of **tracers**. We ll have Minnesota examples from mine pits to wellheads to geologic mapping to karst to ??? The first day will conclude with the basics of **isotope geochemistry**. **Dr. Carol Kendall, USGS,** an expert s expert, will be presenting this portion!

The second day s workshop will be a reprise and update of the **Isotope Hydrology Workshop** that MGWA sponsored ten (yes, ten) years ago**. Dr. Carol Kendall and other experts** (We re still selecting speakers for this too.) will get to the nitty-gritty for those who want and need an in-depth, technical discussion. Since the last workshop, the world of investigation, problem solving and discovery using isotopes has flourished including growing uses in medical geology, ground water flow analysis, paleoclimate, paleohydrology, and environmental change.

Geochemistry it s not just for geochemists any more.

Ground Water Guide, cont.

online, the idea of using the Internet to go beyond development of a simple bibliography evolved. These events led to the creation of the Minnesota Ground-Water Information Guide, first published in April 2003. Thanks to the cooperation of many organizations and individuals, Minnesota, through this guide now has the equivalent of a virtual unified ground-water information center. The new version of the guide, dated July 2005, is updated, refined and expanded as described below.

The Four Components of the Guide

Information Resources: (by far the most comprehensive component) featuring hydrogeologic atlases, reports, technical data, maps, bibliographies, ground-water programs; it also helps you to find information about surface water, climatology, ground water education and more, plus how to find paper copies of important information when you can t find it online.

Technical Reference List: environmental investigation and clean up methodologies, wells and wellhead protection, water quality standards, quality assurance, analytical laboratories, and more.

Current Topics Web Review: (probably the most interesting component) focuses on newer and popular ground-water related topics such as ground-water and surface-water interactions, karst, ground-water sustainability, stormwater, monitoring and a variety of important contaminants including emerging contaminants.

Ground-Water Directory (organizations and people): similar to an annotated telephone book for Minnesota ground-water programs.

Help is Available - Call for a Presentation

If you have any questions, need assistance or your organization would like to receive a presentation about the guide, please contact Tim Thurnblad at telephone number 651-296-8582 or email tim.thurnblad@state.mn.us .

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Web Page Volunteer?

We d like our web page to be more attractive, but our current efforts need to be directed more to content than appearance until we can find some additional help. Please contact the editor at newsletter@mgwa.org if you would be willing to assist with this project.

New Buildings for Minnesota Departments of Agriculture and Health

By Norman Mofjeld, MDH

The Minnesota Department of Agriculture (MDA) and the Minnesota Department of Health (MDH) will be moving this fall into two new buildings on the Capitol Complex in St. Paul. The MDA will be moving from the end of October until the beginning of December. The MDH will be moving from the end of September until the beginning of December.

The buildings are located on Robert Street just north of I-94 across the street from the Stassen Office Building (Minnesota Department of Revenue). The MDA/MDH Lab Building will house the MDH Public Health Laboratories Division and the MDA Agriculture Laboratories.

The Orville L. Freeman Building will contain the MDA and part of the MDH, including the Environmental Health Division. The remaining part of the MDH will be located in the Golden Rule Building in downtown St. Paul.

The new general phone number for the MDA will be (651) 201-6000. The new general phone number for the MDH will be (651) 201-5000. Listed below are the building and mailing addresses for the new buildings:

MDA/MDH Lab Building
601 North Robert Street
St. Paul, MN 55155

Orville L. Freeman Building
625 North Robert Street
St. Paul, MN 55155

Mailing address for the
Orville L. Freeman Building:
P.O. Box 64975
St. Paul, MN 55164-0975

Artist's rendering of the new laboratory building for the MDH Public Health Laboratories Division and the MDA Agriculture Laboratories. (Courtesy Hammel, Green and Abrahamson - Architects)

Bedrock Faults In Southern Washington County

By Robert Tipping and John Mossler, Minnesota Geological Survey

Introduction

During the review process for the Cottage Grove Nitrate Study (2003) conducted by the Washington County Public Health and Environment Department (WCPHE) and others, it was recommended that elevation offsets in the ground-water model layers be re-evaluated in light of possible faulting. Faults have been recognized and mapped in southern Washington County (Mossler and Bloomgren, 1990; Mossler and Tipping, 2000), but generally have not been incorporated into ground-water models of the Paleozoic bedrock of southeastern Minnesota. The Minnesota Department of Health, along with the WCPHE and Minnesota Pollution Control Agency, established that current geologic mapping did not contain the detail necessary to define fault distribution and offsets necessary for ground-water management and modeling in southern Washington County. As a result, they jointly contracted with the Minnesota Geological Survey to update fault mapping in southern Washington County, and to provide a structure map for the top of the Jordan Sandstone for that area. This article presents study methods and results, provides some background on the geologic history and structure of southern Washington County, and gives examples of how the results of the study have been used.

Geologic History and Structure

The bedrock of southern Washington County is marine sedimentary rock of Early Paleozoic age (525 to 400 million years B.P.). A sequence of Upper Cambrian sandstone, shale, and siltstone about 620 to 665 feet thick is overlain by 300 to 400 feet of Ordovician dolostone, limestone, sandstone, and shale. During the Early Paleozoic era, most of northern Iowa, southwestern Wisconsin, and southern Minnesota (including Washington County) was occupied by a shallow bay, the Hollandale embayment, that lay on the edge of a vast epicontinental sea, which covered most of the North American continent (Bunker and others, 1988). The Hollandale embayment followed the trace of predecessor basins that had formed along the Mesoproterozoic Midcontinent rift system (about 900 to 1,200 million years B.P.). The rift system formed during a thermal tectonic event that involved extension of the crust with associated mafic volcanism and plutonism, followed by a long interval of clastic sedimentation (Van Schmus and Hinze, 1985; Chandler and others, 1989). The rift is now a large geologic feature composed of thick lava flows and red, clastic, sedimentary rocks. Large-scale block faulting in these rocks during the Proterozoic eon caused the formation of an elongated basin beneath what was to become the Twin Cities Metropolitan region. Minor recurrent movements during the Early Paleozoic era, possibly caused by isostatic or thermal adjustment along large-scale faults bounding grabens, basins, and horsts of the Proterozoic rift system, were responsible for the initial development and configuration of the Hollandale embayment. Continued recurrent movement along these faults created the smaller structures located within the embayment, such as the Twin Cities basin, southern Minnesota syncline, and numerous smaller folds and normal faults.

In southern Washington County, the recurrent movement occurred along the faults that bound the Hudson Afton horst, the Cottage Grove and Hastings faults, as well as smaller subsidiary faults (Figure 1 on page 13). This horst bounded the eastern side of the Proterozoic basin, which preceded, underlies, and conforms in outline to the successor Paleozoic Twin Cities basin (Sims and Zeitz, 1967).

Although some of the motion along the fault zones took place contemporaneously with deposition of Early Paleozoic rocks as is indicated by subtle variations in thickness and lithology of some of the Cambrian geologic units (Mossler, 1972) in well cores and cuttings, most movement occurred after the formations were deposited. Much of the development of the Twin Cities structural basin evidently took place after the deposition of the Paleozoic rocks that still are preserved in it. The Ordovician Platteville Formation, a thin carbonate formation characterized by beds that are uniform in character and traceable from outcrop to outcrop, exemplifies this. The Platteville Formation occurs at an elevation of 800 feet above mean sea level in the center of the Twin Cities basin, but occurs above 1,050 feet above mean sea level in places in southern Washington County and southern Dakota County. The uniformity of the carbonate beds indicates that the more than 200 feet of displacement must have occurred after they were deposited.

Methods

Because a large number of wells have been drilled since the bedrock geology of southern Washington County was last mapped (Mossler

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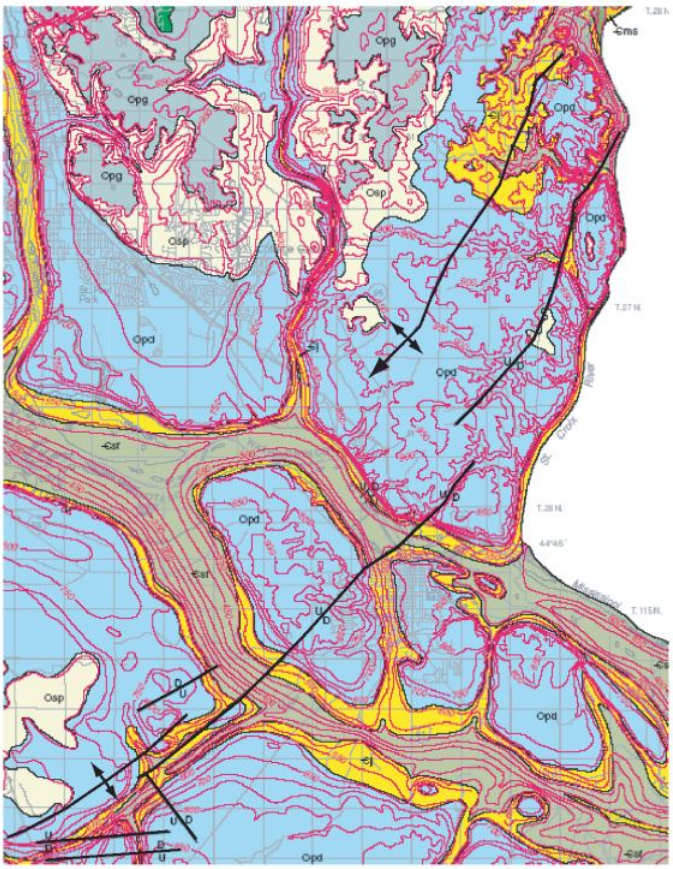
A.



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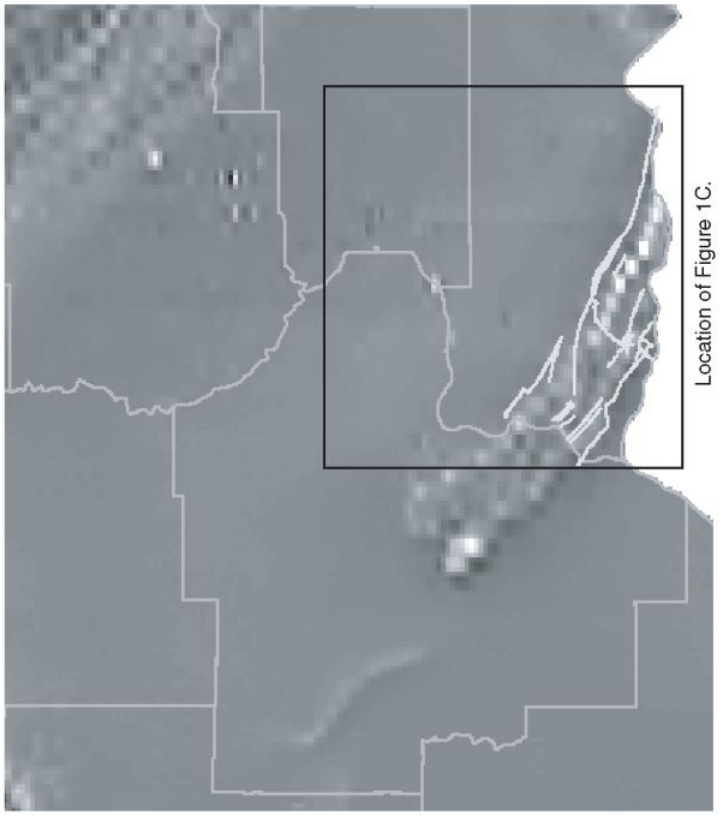

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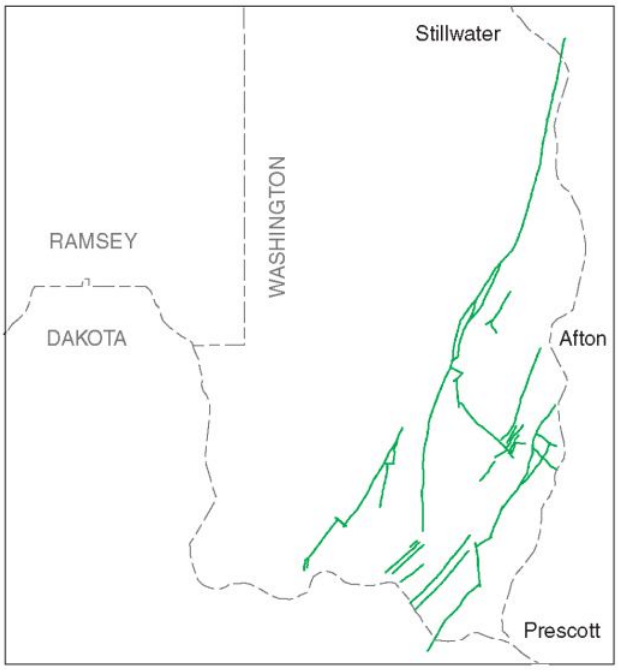

Figure 1. Progression of fault mapping in southern Washington County/northeastern Dakota County.

A. Bedrock units and structure from Mossler and others (2000).

B. Faults from Mossler (2004) superimposed on first derivative aeromagnetic anomaly data (Chandler and others, 2004).

C. Currently mapped fault locations (Mossler, 2004). Figure location is shown on Figure 1B.

— continued on next page

Faults in Southern Washington County, cont.

and Bloomgren, 1990), the first step for this study was to update site locations and interpret driller s descriptions for these newly located wells. Substantial assistance with well locating came from the WCPHE. Once the wells had been entered into the County Well Index and driller s logs had been interpreted, mapping began with the revision of bedrock topography. Several new bedrock valleys were added, and borders to previously mapped valleys were revised. Elevations for the top of the Jordan Sandstone were then plotted and hand contoured (Figure 2). Many logs required re-interpretation in the context of newly located wells and existing gamma logs.

Faults have been rarely documented in outcrops in the Twin Cities area. The best-documented ones are those in the bluffs along the Mississippi River north of Hastings, just upstream from the lock and dam (Figure 1; Schwartz, 1936). Faults were inferred from subsurface data where the difference in elevation of the top of the Jordan Sandstone between neighboring wells 500 to 1,000 feet apart was 100 feet or more above mean sea level for major faults and 30 to 50 feet for secondary faults (Figure 2). However, in many areas on the map, sparse density of water wells required additional criteria be used to determine placement of the faults. The placement and trend of the faults in Paleozoic rocks is based upon the position and orientation of faults inferred in Proterozoic rocks from aeromagnetic patterns (Sims and Zeitz, 1967). Placement of the faults was also based upon the trend of bedrock valleys, which in many cases appear to follow fractured zones in the bedrock. Although outcrops are not plentiful in the area, those present were useful in determining the position of offset strata.

Efforts are underway to improve representation of subsurface contacts in a Geographic Information Systems (GIS) environment, particularly along faults. Digital elevation models (DEMs) work very well for representing geologic contacts, but are not adequate for fault contacts. Interpolation methods that produce DEMs mute abrupt changes in elevation by making the change gradational, similar to a tablecloth overlying a book on a table (Figure 3A on page 15). As part of this project, the top of the Jordan Sandstone was modeled as a triangulated irregular surface (TIN). Steps used to create the TIN involved duplicating fault traces and then slightly offsetting the new pairs from one another. Elevation values were assigned along the fault traces by linearly interpolating between contact points with structural contours. The fault trace pairs were then used as breaklines to control TIN construction (Figure 3B, C, D).

Results and Discussion

Elevation above mean sea level of the top of the Jordan Sandstone in the Cottage Grove area is about 575 to 600 feet. Along the Hudson Afton horst, near Afton, the elevation of the top of the Jordan Sandstone is over 950 feet in some wells (Figure 2). Offsets along the major faults, the Cottage Grove and Hastings faults, are interpreted to be 100 feet or more, based on water well data. Offsets along subsidiary faults are lower, generally less than 50 feet (Mossler, 2005).

Faults can be both conduits for and barriers to ground-water flow. In either circumstance, faults are an important component of a ground-water model, either as a zone of modified permeability or as a boundary condition. In Paleozoic rocks of southeastern Minnesota, large-scale faulting that offsets lithostratigraphic units against one another is rare. As a result, faults have been rarely incorporated into ground-water models, and our experience of distinguishing the conduit/barrier ground-water flow characteristics of faults is limited. Clearly, the offsets in southern Washington County are an exception to this; the Jordan Sandstone, for example, is offset greater than its thickness and cannot be adequately represented in a simple layer-cake model.

Although it is difficult to model faults, their influence on hydrogeology is less ambiguous. The headwaters of Valley Creek form at a series of springs located along the western edge of the upthrown block (Figures. 3C, 4) and could likely be the result of ground water moving from the west, upwelling along the fault. Because the fault offsets several bedrock units, it is not clear what aquifer(s) contributes to the springs.

Hydrogeologic Applications

Initiative and funding for the fault study and derivative projects have been driven largely by the Washington County Public Health and Environment Department; additional work has been initiated by the Washington Conservation District. These projects include development of a ground water - surface water model to evaluate water resources in the Woodbury-Afton area (Washington County Public Health and Environment Department, 2005). Results of this project are being used to evaluate infiltration and discharge zones as part of a study of surface water/ground water interactions in the broader southern Washington County area (Washington County Public Health and Environment Department, 2005). Results were also used for a spring inventory, mapping, and characterization study for the lower St. Croix Valley watershed (Washington County Public

— *text continues on page 16*

Figure 2. North to south cross section showing Jordan Sandstone top elevations from the County Well Index water well database in the Stillwater/Afton area. Elevation change for the top of the Jordan Sandstone is over 300 feet. The large spread of top elevation around the Afton area reflects projection of data that include wells on both upthrown and downthrown sides of faults.

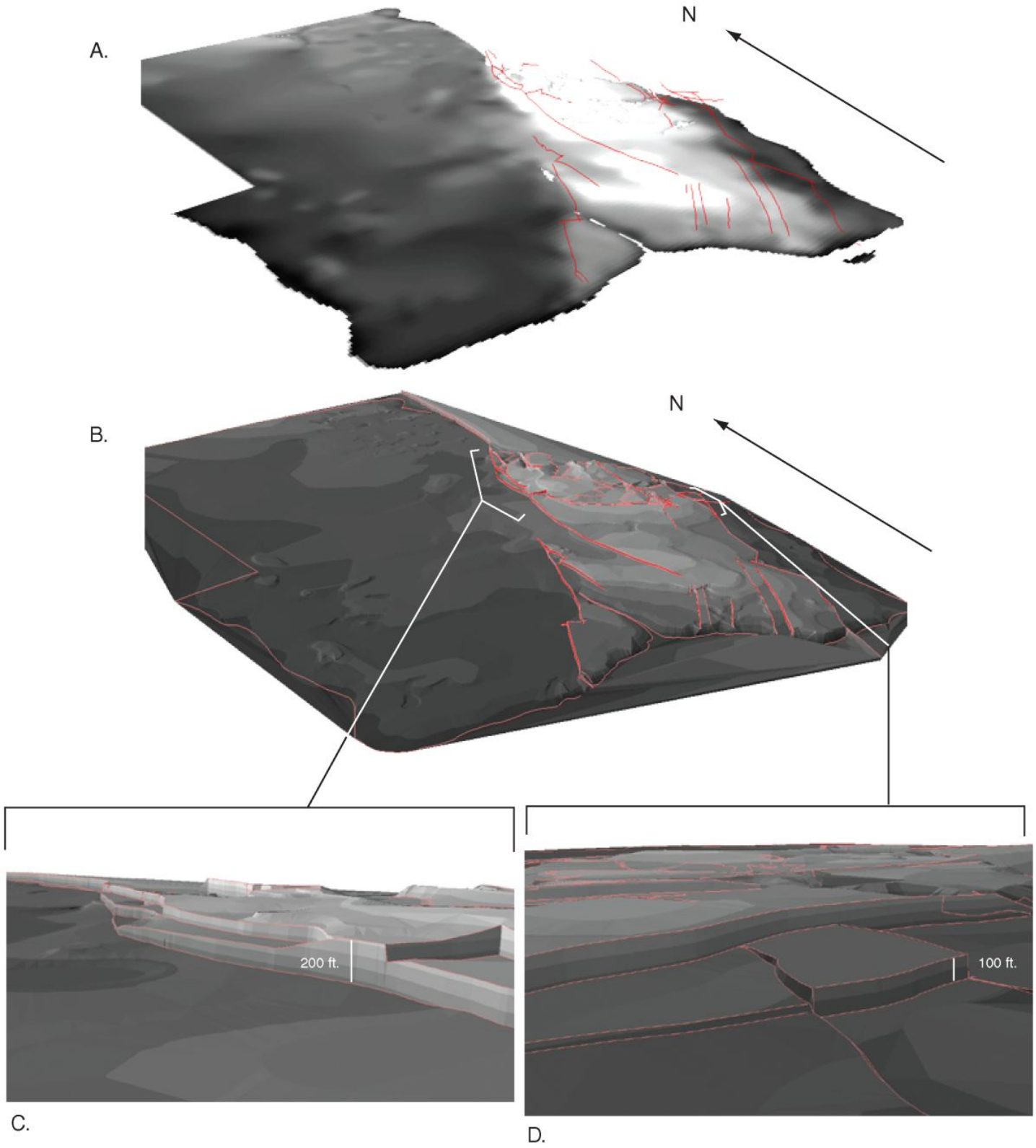

Figure 3. Perspective views from GIS datasets showing elevation change and fault structure in southeastern Washington County. **A.** Digital elevation model for the top of the Jordan Sandstone. Elevation differences are highlighted (lighter shades of gray indicate higher elevation), but borders of fault blocks lack distinct boundaries. **B**. Triangulated irregular network (TIN) model for the top of the Jordan Sandstone. Elevation differences are highlighted (lighter shades of gray indicate higher elevation); borders of fault blocks show distinct changes in elevation. **C.** Close-up of the Jordan TIN surface on the western side of the upthrown section, detailing the area near the headwaters of Valley Creek. **D.** Close-up of the Jordan TIN surface on the eastern side of the upthrown section, highlighting detail of the mapped fault blocks.

Faults in Southern Washington County, cont.

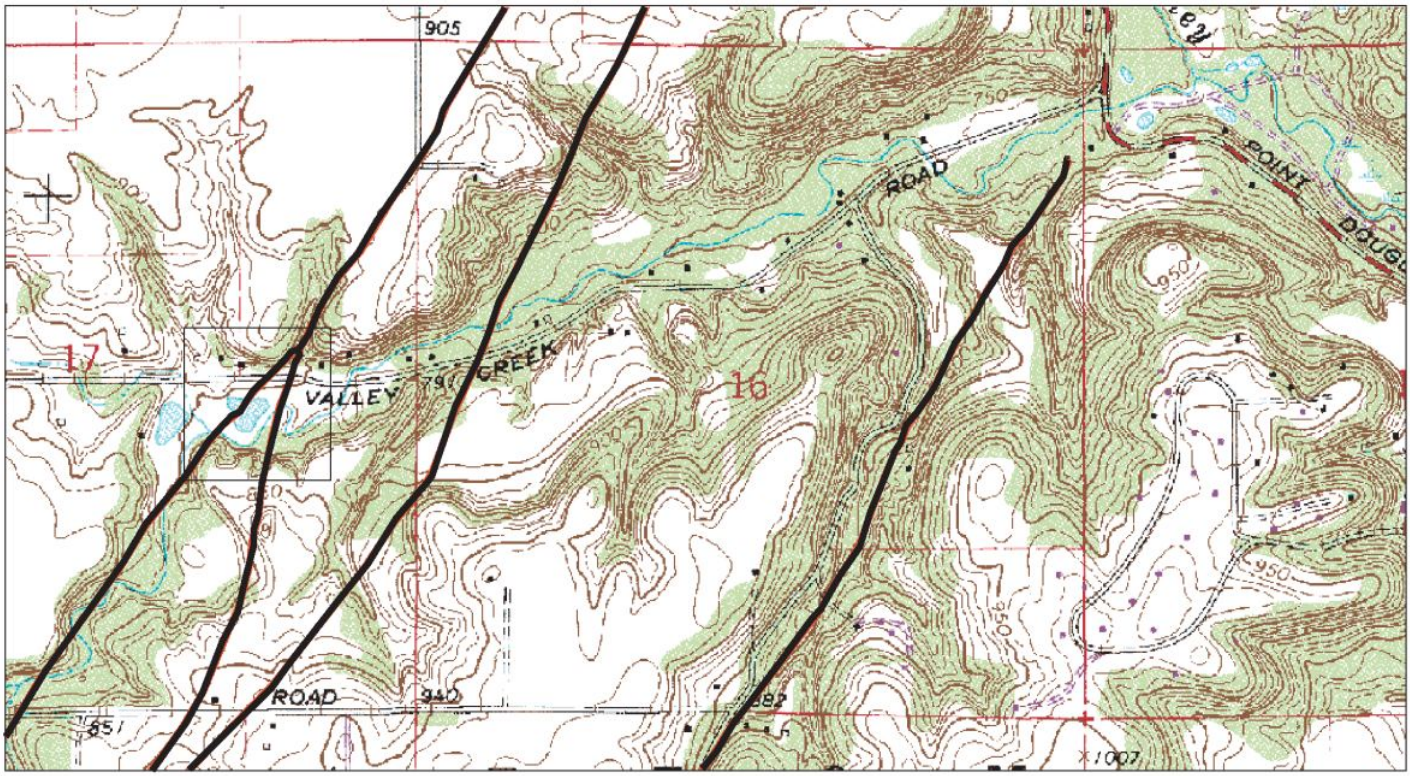

Figure 4. Fault traces superimposed on sections 16 and 17, T. 28 N., R. 20 W. on the Hudson 1:24,000 quadrangle showing the area near the headwaters of Valley Creek (box).

Health and Environment Department, 2005). Partners in these studies have been the Washington Conservation District, watershed districts, city officials, and water management organizations.

Funding for this project came from the Minnesota Department of Heath and the Minnesota Pollution Control Agency in cooperation with the WCPHE. The goal of this project was to provide a broader geologic framework for looking at ground-water flow at the Baytown Township ground-water contamination site and at nitrate contamination in southern Washington County.

Conclusions and Future Work

The ground-water flow model used in the Cottage Grove Area Nitrate Study that initiated this work was revisited using results from the fault mapping study. High permeability zones were assigned along fault traces; models appear to indicate a link between occurrences of elevated nitrate-nitrogen levels in ground water and fault zones within the project area (Washington County Public Health and Environment Department, 2005). Future work in subsurface modeling at the Minnesota Geological Survey includes establishing a dataset that allows for assigning geologic and hydrogeologic attributes at regular intervals in the subsurface. They aim to record geologic and hydrogeologic features such as facies or permeability changes that occur between modeled geologic contacts (DEMs) and store the information in a format easily exportable to a variety of geologic and hydrogeologic software.

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Private Water Wells in Minnesota: Recommended Tests for Contaminants

By Michael P. Convery, M.S.

Abstract

Approximately 1.25 million Minnesotans get their drinking water from private wells. These wells may contain coliform bacteria, nitrate, arsenic, and other contaminants that can pose health risks. In order to ensure the safety of drinking water, the Minnesota Department of Health recommends that well owners test for such contaminants and perform periodic checks of the physical condition of the well. Health officials also recommend that unused or abandoned wells be properly sealed to prevent contamination of ground water.

In most of Minnesota, ground water is relatively plentiful and provides a reliable source of safe drinking water. Approximately 1.25 million Minnesotans depend on private wells as their primary source of drinking water. In addition, many Minnesotans rely on such wells at their lake cabins, hunting camps, and other seasonal properties. More than 12,000 private wells are constructed annually in the state.

Since 1972, the Minnesota Department of Health has licensed well contractors and regulated the construction, repair, and sealing of wells that serve homes and recreational properties. The state well code (Minnesota Rules Chapter 4725) establishes minimum standards for well construction, specifying the materials that can be used to make well components, the distance required between wells and common contaminant sources, the grouting of open space around well casings, and the necessary testing for new wells. The purpose of the code is twofold: to assure sanitary construction so the well can provide water that is safe for consumption and to protect ground water quality. Although many well owners tend to think of threats to their drinking water as coming from major environmental contamination sources, such as landfills and major industrial facilities that may be located miles away, the real culprits are more likely to come from nearby, everyday sources, such as on-site septic systems, animal yards, and fuel storage tanks.

When a new well is constructed, the well contractor is required to test the water for coliform bacteria and nitrate, the two basic sanitary indicators of water quality. Starting in 2006, arsenic testing will also be required for new wells. The state does not require that private wells be tested regularly. Consequently, many well owners never test their well water.

Recommendations for Well Testing

Private well owners should test their well water as they would the batteries in smoke detectors. Health officials recommend testing for the following compounds in order to avoid the chance of becoming ill from drinking contaminated water or in order to prevent problems caused by a lack of certain compounds.

Coliform Bacteria

Waterborne infectious diseases such as diarrhea, dysentery, salmonellosis, hepatitis, and giardiasis are caused by a number of different bacteria, viruses, and protozoa. Although a number of cases of waterborne diseases have been clearly linked to consuming contaminated well water, most people mistake such diseases for food poisoning or flu. In many cases, well users may develop immunity to their own well water, but visitors may become ill when they consume the water.

At any given time, approximately 25% of private wells in Minnesota test positive for coliform bacteria, which are found naturally in soil as well as in sewage and animal waste. Although not all coliform bacteria are pathogenic, the test has long been used as an indicator of sanitary quality of drinking water. About 4.5% of wells test positive for fecal coliform or *Escherichia coli*.[1] The vast majority showing positive coliform reflect either poor well construction or subsequent deterioration of the well or damage to the well.

Wells should be tested for coliform bacteria annually and whenever the user notices a sudden change in water quality, such as turbidity or cloudiness, which may reflect damage to the well. If a well tests positive for coliform bacteria, the water should not be consumed without boiling, and the well and plumbing system should be disinfected. Although well owners can disinfect their wells with chlorine bleach, the Department of Health recommends that they hire a well contractor to inspect the well for any problems, to make necessary repairs and to thoroughly disinfect the well as well as the entire plumbing system. Only when the well water tests negative for coliform bacteria should it be considered safe to drink.

Nitrate

Nitrate enters the soil and ground water when plant and animal wastes decompose. Natural levels of nitrate in Minnesota ground water are usually quite low (less than 1 milligram per liter [mg/L]). Runoff from barnyards and feedlots, excessive use of fertilizers, and septic systems can cause the level of nitrate in ground water to rise.

Approximately 5% of the wells in Minnesota produce water that exceeds 10 mg/L of nitrate, which is the health risk limit for drinking water.[1] Nitrate poses a particular risk to infants. Water with nitrate levels exceeding 10 mg/L can cause a potentially fatal condition methemoglobinemia in infants younger than 6 months of age. Naturally occurring bacteria in the infant s digestive system convert the nitrate to nitrite, which interferes with the ability of hemoglobin to carry oxygen. As the child matures beyond 6 months, these nitrate-converting bacteria no longer survive.

The Department of Health recommends that wells be tested once every 2 or 3 years for nitrate. If detected, the well should then be tested annually. Boiling water with any chemical contaminant, such as nitrate, will only concentrate the dissolved chemical. Therefore, the only way to remove nitrate from well water is to use a water treatment system, such as reverse osmosis.

Arsenic

Arsenic occurs naturally in two-thirds of wells in Minnesota and is more prevalent in the western part of the state. Approximately 15% of wells in Minnesota produce water with arsenic levels exceeding the health risk limit of 10 micrograms/liter (μg /L).[2] Chronic exposure to low levels of inorganic arsenic in drinking water increases the risk of cardiovascular and peripheral vascular disease; hypertension; diabetes; cancer of the bladder, liver, prostate, and skin; neurological disorders; renal disorders; and developmental delays.[3] Wells should be tested at least once for arsenic. Some water treatment systems, such as reverse osmosis (with pretreatment) and

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Domestic Well Sampling Recommendations, cont.

distillation, can reduce arsenic levels in water. The options for removing arsenic are increasing, as new types of water treatment systems come on the market.

Fluoride

Most ground water in Minnesota has very low fluoride levels. Because fluoride protects against tooth decay, dentists typically prescribe supplements to provide adequate protection against dental caries in areas where homeowners rely on well water. A well should be tested at least once in order to determine whether the water has adequate fluoride. Excessive fluoride levels (> 4 mg/L) may result in mottling of teeth.

Lead

Lead from drinking water can build up in the body, causing damage to the brain, nervous system, red blood cells, and kidneys. Pregnant women and nursing mothers need to be especially concerned about lead levels in drinking water because it can be passed on to unborn children and breast-fed babies. Lead is found naturally in ground water but usually at very low levels. However, lead also can leach from plumbing and fixtures. Copper plumbing installed prior to 1985 often was joined by lead solder. Even today, brass components, such as faucets, valves, and heating and cooling elements may contain up to 8% lead. Lead levels in water tend to be highest during the first flushing in the morning, as the water sitting in the plumbing overnight has leached lead from piping and components. Letting the water run for approximately 2 minutes, until it becomes cold, goes a long way toward minimizing lead exposure. Nonetheless, drinking water should be tested at least once for lead because some ground waters can be corrosive to plumbing.

Naturally Occurring Compounds

A variety of chemicals found in ground water can stain porcelain fixtures and laundry (iron, manganese), form deposits of lime scale and reduce the effectiveness of laundry soap (calcium, magnesium), and produce rotten egg odors (hydrogen sulfide). The concentrations of these chemicals typically are not a concern to health and can be effectively treated and removed by water conditioning equipment. One important point to note is the fact that hard water is beneficial to the cardiovascular system. In addition, water softeners that reduce hardness usually use sodium zeolite resins, which substitute sodium for calcium and magnesium in the water. The added sodium may be a concern for individuals watching their sodium intake. Plumbers and water conditioning contractors should provide a cold-water bypass around the softener to the kitchen sink to provide hard water for drinking and food preparation.

Other Chemicals

Many well owners are concerned about contamination from pesticides, volatile organic chemicals (VOCs) from petroleum products and solvents, and similar chemicals. However, the occurrence of these chemicals is most commonly associated with sites where these materials were produced, handled, stored, and/or spilled. An estimated 2% of private wells show detectable levels of one or more VOC; these wells tend to be shallow or substandard and located near commercial or industrial areas. Normal use or application of these materials usually does not affect ground water quality. Therefore, the Department of Health usually recommends testing only if the circumstances warrant it.

The Testing Process

Water samples should be analyzed by a state-certified laboratory, which uses approved analytical methods, has properly trained staff, and follows proper procedures in order to assure quality. County health departments often provide certified testing for bacteria and nitrate, either directly or through agreements with private commercial laboratories. Testing for bacteria, nitrate, lead, arsenic, and fluoride is not expensive, usually $20 to $40 per test. Many well owners assume such tests cost hundreds or thousands of dollars and for that reason do not bother to test their well water.

The Department of Health establishes health risk limits for contaminants in drinking water. These guidelines apply to private wells. The U.S. Environmental Protection Agency establishes maximum contaminant levels for public water supply systems, such as municipal systems. These standards can be used when evaluating any water test results.

Physical Condition of the Well

Well owners also should inspect their wells periodically to make sure that the cap is tight, the electrical conduit is intact, the well shows no evidence of damage from being hit by vehicles or equipment, and surface water drains away from the well. A loose cap or a cracked well casing can allow dirt, insects, and even small animals to enter the well. Wells predating Minnesota s well code often were constructed for ease of access or convenience, without much consideration for protection from contamination. Many wells were constructed in pits or in basements to protect them from frost, but often they are too close to contaminant sources, such as sewers and septic systems, and are vulnerable to runoff, flooding, or sewer backups. Wells installed today must be constructed at least 1 foot above grade, preferably on high ground, with the ground surface sloping away from the well for drainage.

Sealing Old Wells

Minnesota law requires that wells that are no longer in use be properly and permanently sealed. Unused or abandoned wells provide a direct conduit for contaminants to enter ground water from the surface or near the surface, bypassing the natural protection provided by soil and geology. An unused well often represents the greatest threat of contamination to a nearby active well. Also, some individuals use unused wells for disposal of wastes and other inappropriate materials. Crankcase oil, garbage, hypodermic needles, sewage, and pesticides all have been removed from unused wells in Minnesota. Although it has not been reported in Minnesota, elsewhere in the country people or animals have fallen into unsealed, abandoned wells, and extraordinary efforts have been required to rescue them.

Sealing a well involves removing any pumping equipment and debris, clearing the well to its original depth, and sealing it from bottom to top with either neat cement (cement with no additives) or bentonite grout. Bentonite is a special clay that swells 10 to15 times in size upon wetting and is an effective sealing agent. Well sealing must be performed by a licensed well contractor. Sealing is usually done when ownership of a property is transferred or when a new well is drilled.

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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.

Join the Minnesota Ground Water Association!

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

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

- -

Name ____________________ Full-Time Student? ____________________

Affiliation/Employer ____

Work Address ____________________

City, State, Zip Code ____

Work Telephone Number ____________________ E-mail ____________________

Fax Number ____________________

Home Address ____

City, State, Zip Code ____

Home Telephone Number ____________________

Which Telephone Number should we use for Directory Listing? ____________________

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

Domestic Well Sampling Recommendations, cont.

Well Water and Health

Linking health effects with the quality of well water is often difficult. Although contamination by microorganisms and nitrate can cause acute disease, the symptoms oftentimes are attributed to other causes. Other contaminants pose threats of chronic disease, but the cause and effect may not be recognized by individuals or their physicians. Nationally, arsenic in drinking water is receiving greater scrutiny because it affects the function of a number of body organs and is found in a significant percentage of wells at concentrations above health standards. Having well water tested is the best way to know whether those who consume it are at risk.

With proper maintenance and periodic testing, a well will continue to provide safe drinking water for many years, even generations. However, it is up to well owners to make sure their wells and water systems are in good working order and that the water remains free of harmful chemicals.

Michael Convery is operations supervisor of the Minnesota Department of Health s Well Management Section.

References

1. Centers for Disease Control and Prevention. A Survey of the Quality of Water Drawn from Domestic Wells in Nine Midwest States. Atlanta. Centers for Disease Control and Prevention, National Center for Environmental Health; 1998.

2. Minnesota Department of Health. Arsenic in Well Water. St. Paul, Minn. Minnesota Department of Health, Well Management Section; 2004.

3. Minnesota Department of Health, Arsenic in Drinking Water and Your Patients Health. St. Paul, Minn. Minnesota Department of Health, Health Risk Unit; 2005.

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Minnesota Ground Water Association - Board Meeting Minutes

June 2, 2005.

Place: Keys Cafe, Lexington and Larpenteur, Roseville, Minnesota.

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

Past Minutes: Minutes for the meeting held 5/12/05 were approved as amended.

Treasurer: $48,317.28 in Wells Fargo account. $13,060.71 in Affinity Plus account. Advertisement income approximately $500.00 to $600.00 ahead of last year. $5,714.80 invoiced to GSA.

Membership: 4-5 new members. Membership at approximately 575.

Foundation: Need to replace Rob Caho (President). Foundation will fill vacancy from within.

Newsletter: 2004 newsletter financial report distributed to Board. Currently advertising covers approximately 1/6 of newsletter. Treasurer will discuss possibility of increasing revenues with WRI and the Advertising Manager and put information together for next Board meeting. June newsletter is progressing. Most material has been submitted to WRI. Potential articles for September newsletter discussed.

Old Business: Spring Conference: President Elect has display board that was revised for the Spring Conference. Fall Conference: November 17, 2005. Discussion of conference topics including ambient water quality, soil description/core logging workshop, tracers, groundwater and wildlife habitat, drought. Awards: Board will look into process next Fall.

July 22, 2005

Place: Keys Cafe, Lexington and Larpenteur, Roseville, Minnesota.

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

Past Minutes: Minutes for the meeting held 6/2/05 were approved.

Treasurer: $11,997.11 in Wells Fargo account. $13,060.71 in Affinity Plus account. Income less Cost of Goods Sold (Gross Profit) year to date is $22,972.86. Net Income (Gross Profit less Expenses) year to date is $5,978.29. Legal status is 501(c)4. We are organized to benefit the ground water resource, not to benefit members, thus the income from dues funds member benefits and income from conferences funds educational programs (usually through MGWA Foundation). Dues and advertising should cover newsletter, directory, administration, and membership services.
Motion: Professional membership dues will be raised $5.00 for 2006 and beyond. Motion passed.
Motion: Corporate dues will be raised (basic to $370.00, Standard to $580.00, Industry to $805.00, and corporate to $1630.00) with their next renewal. Motion passed.

Membership: Nothing new to report.

Web Page: June 2005 newsletter on web page in June. Tim Thurnblad is working on new draft of the groundwater information guide. Mike Trojan working on Minnehaha Creek update. An email concerning Science Museum Funding was sent. Biographies and some presentations from last conference are on members only web page. Newsletter CD added as product in shopping area.

Foundation: In process of working with science museum to inquire about display in light of Governor s veto.

Education: No report.

Newsletter: Discussed deadline and articles for next newsletter.

Old Business: Spring Conference: Treasurer will contact GSA for MGWA profit from conference.

Fall Conference: Will have Business Report at fall conference to keep members informed.

New Business: Discussed conference/tour for legislators to inform them about groundwater and to help them understand groundwater issues. MGWA President Elect will work MGWA President on this issue. Discussion of implications of Governor s veto of LCMR funding to Science Museum.

2005 Calendar of Events

September 23-24, 2005
2005 AIPG Fall Field Trip
Aggregate Resources of the Twin Cities Metro Area, Contact: Bruce Johnson bjohnson@summite.com, www.aipgmn.org/events.htm

September 28, 2005
2005 Metro Area Children s Water Festival, Minnesota State Fairgrounds Contact: Bart Biernat, Anoka Co. bart.biernat@co.anoka.mn.us

October 4, 2005
Update on Delineating Wellhead Protection Areas, Minnesota Department of Health, Information at (651)215-0800

October 25-26, 2005
Minnesota Water 2005 and Annual Water Resources Joint Conference University of Minnesota s Water Resource Center. Information: wrc.coafes.umn.edu/waterconf

November 1-3, 2005
50th Midwest Ground Water Conference, Holiday Inn, Urbana, IL Information: midwestgroundwater.org

November 2-4, 2005
Groundwater Foundation: Coming Together for Ground water, Nebraska City, NE, www.groundwater.org

November 17, 2005
MGWA Fall Conference 2005, Geo-Chemistry for Scientific Investigations (GeoCSI), 8 am - 5 pm
Continuing Education and Conference Center, University of Minnesota, St Paul Campus, www.mgwa.org

November 18, 2005
MGWA Fall Workshop 2005
Isotope Hydrology Workshop with Dr. Carol Kendall, USGS, Continuing Education and Conference Center University of Minnesota, St Paul Campus, www.mgwa.org

November 30, 2005
Southwest Minnesota Ground Water Workshop, 9 am - 3:30 pm, Southwest Minnesota State University in Marshall, MInnesota Rural Water Association, (800)367-6792

Faults in Washington Co., cont.

Mossler, J.H., and Tipping, R.G., 2000, Bedrock geology and structure of the seven-county Twin Cities metropolitan area, Minnesota: Minnesota Geological Survey Miscellaneous Map M-104, scale 1:125,000.

2004, Geology in support of ground water management for southern Washington County: Unpublished maps and grids submitted to the Minnesota Department of Health, Minnesota Pollution Control Agency, and Washington County Public Health and Environment Department; on file at the Minnesota Geological Survey.

Schwartz, G.M., 1936, The geology of the Minneapolis St. Paul metropolitan area: Minnesota Geological Survey Bulletin 27, 267 p., 7 pl.

Sims, P.K., and Zeitz, I., 1967, Aeromagnetic and inferred Precambrian paleogeographic map of east-central Minnesota and part of Wisconsin: U.S. Geological Survey Geophysical Investigations Map GP-563, 6 p., scale 1:250,000.

Tipping, R.G., and Mossler, J.H., 1996, Digital elevation models for the tops of the St. Peter Sandstone, Prairie du Chien Group, Jordan Sandstone and St. Lawrence/St. Lawrence Franconia Formations within the seven-county metropolitan area: Unpublished maps on file at the Minnesota Geological Survey, scale 1:100,000.

Van Schmus, W.R., and Hinze, W.J., 1985, The Midcontinent rift system: Annual Review of Earth and Planetary Sciences, v. 13, p. 345-383.

Washington County Public Health and Environment Department, 2003, Cottage Grove Area Nitrate Study, Washington County, Minn., 32 p.

Washington County Public Health and Environment Department, 2005, Washington County Groundwater Plan 2005 work plan: Washington County, Minn., 85 p.

Minnesota Ground Water Association Newsletter Advertising Policy

2006 Annual Rate for Display ads:

	Horz x Vert (in.)	Newsletter	Directory
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

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 given on the inside front page. 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

Ground Water History

A Piping Voice: Theories of Cave Genesis in Minnesota Prior to 1880

By Greg A. Brick

When considering theories of cave genesis in Minnesota most researchers think first of Mystery Cave, the longest cave in the state. But it was not always so. In the nineteenth century, Fountain Cave, a historic sandstone cave in St. Paul, held the importance that Mystery Cave, a limestone cave, was to hold in the twentieth century and beyond. Unlike other caves before and since, almost every visitor to Fountain Cave had something to say about its genesis. While some discussed the cave's origin per se, others addressed the cave's ongoing development. No other cave even comes close in the sheer volume of references — a selection of which is included below.

All the early ideas about the genesis of Fountain Cave involved "piping," a kind of mechanical erosion in which sediments are washed away by flowing groundwater, usually leaving a pipe-like void. Cause and effect were juxtaposed at Fountain Cave as nowhere else. The sight of the flowing stream in contact with the loose sandstone made the conclusion obvious. It was not so obvious at the other major sandstone cave in the vicinity—the even more famous Carver's Cave—which contained a stagnant pool, rather than a stream. But no one used the term "piping" back then; the word was borrowed from engineers in the late 1940s by soil scientists and geologists who applied it to caves. Hogberg and Bayer's Guide to the Caves of Minnesota, published in 1967, gave currency locally to the term piping in that context.

Major Stephen H. Long, of the U. S. Corps of Topographical Engineers, discovered and named Fountain Cave in 1817 while searching for a good location for siting a fort—what later became Fort Snelling. In his journal for July 16, 1817, he reported that "instead of a stagnant pool and only one accessible room of a very different form, this cavern [Fountain Cave] has a brook running thro' it and at least 4 rooms in succession one after the other. Carver's Cave is fast filling up with sand so that no water is now to be found in it, whereas this from the very nature of the place must be enlarging, as the fountain will carry along with its impact all the sand that falls into it from the roofs & sides of the Cavern." Henry R. Schoolcraft, who would discover the veritas caput ("true head") of the Mississippi River in 1832, wrote in his Narrative Journal of Travels (1821), for August 2, 1820, that, "the rock is of a very friable nature, and easily acted upon by running water…thus enlarging the boundaries of the cave." The official secretary of that expedition, James Duane Doty, later governor of Wisconsin, mentioned "a stream of water which runs on its bottom, and by which the cave appears to have been formed." George W. Featherstonhaugh, the first person to hold the title "United States Geologist," in his Canoe Voyage up the Minnay Sotor (1847), wrote for September 12, 1835, "Like many other caves, this appears to have a reservoir of water in it arising from springs, that in long periods of time have effected the excavations in the rock, which is so soft and incoherent as to be easily cut by a knife." A Canadian

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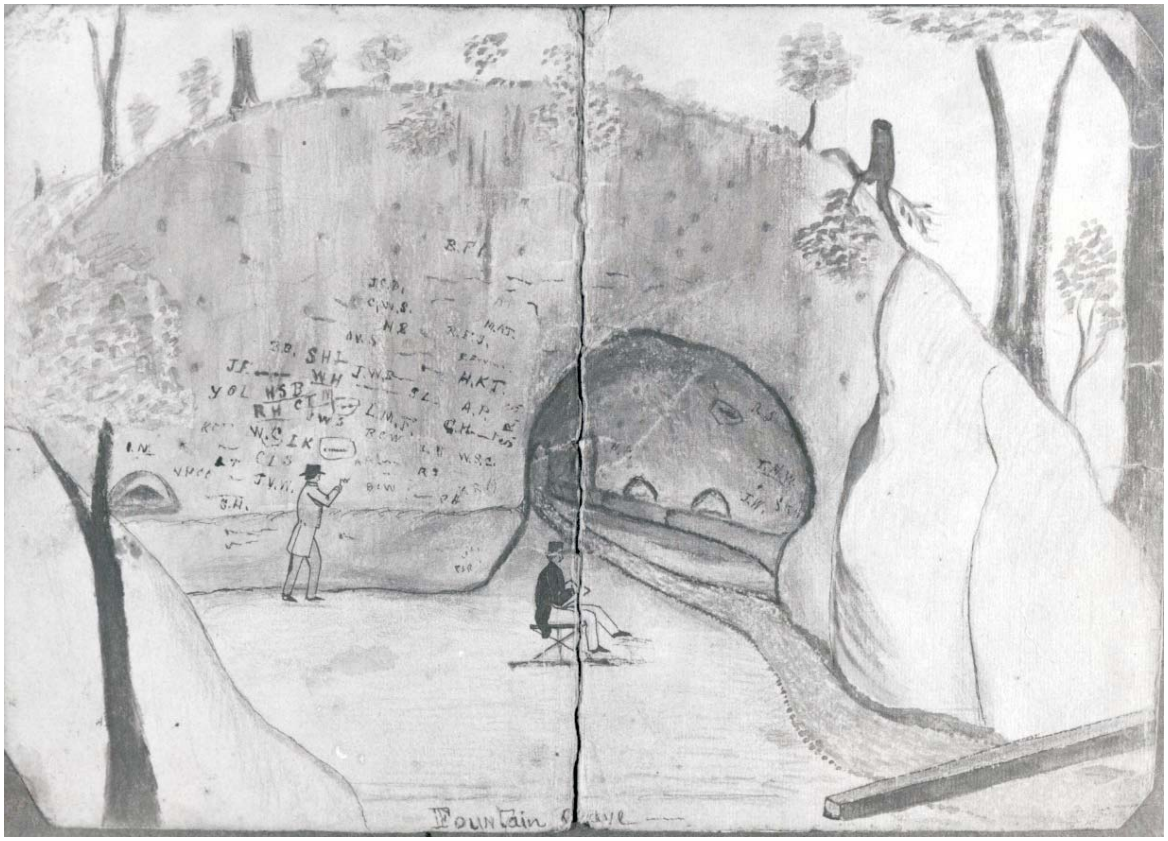

Fountain Cave, pencil and watercolor by unknown artist, about 1850. This is the oldest known image of a Minnesota Cave. (Author's collection)

Early Cave Genesis Theories in Minnesota, cont.

visitor, Peter Garrioch, in his diary for November 16, 1837, described "narrow passages formed by the force of the stream of water running through the cave and washing away the sand from between the contiguous and more consolidated rocks. The apartments diminish in size, however, as they approach the head or termination of the cavern. The water running through the cave, and which doubtless has brought it to its present form, is a beautiful, crystal stream, and as pleasant to the taste as any water I ever tasted."

Joseph N. Nicollet gave the most elaborate account of the genesis of Fountain Cave. After a mathematical career in France, Nicollet immigrated to the United States in 1832 and devoted the rest of his life to mapping the Upper Mississippi, determining for the first time accurate longitudes, latitudes, and altitudes. His great cartographic work is considered the "mother map" of Minnesota. In his *Report Intended to Illustrate a Map of the Hydrographical Basin of the Upper Mississippi River* (1843), writing about Fountain Cave, he stated that, "It owes its formation to the dislocation and decomposition of the upland [Platteville] limestone, which have left sloughy places; the waters of which have penetrated into the [St. Peter] sandstone, wearing it away, and giving origin to the streamlet [Fountain Creek] that issues from it. The location of this cave is on my map designated as the new cave." Two subsequent accounts are quite similar to Nicollet's, perhaps because of borrowing. E. S. Seymour, in his *Sketches of Minnesota, The New England of the West* (1850) wrote, "This cave is probably produced by the action of this stream of water, which has broken through the strata of superincumbent limestone, and worn a passage through the sandstone. The latter is constantly crumbling off, and is carried away by the current." The artist Henry Lewis, in his *Valley of the Mississippi Illustrated* (originally published in German in 1854), wrote that "This cave is, doubtless, of comparatively recent formation and owes its origin to the stream of water breaking through the fissures of the plate of limestone which forms the roof, disintegrating and washing out the stratum of soft sandstone beneath."

William Gates Le Duc, later Commissioner of Agriculture to President Rutherford B. Hayes, in his *Minnesota Year Book for 1852*, wrote of "Spring Cave [Fountain Cave], another cavity made in the soft granular sandstone by the constant action of the spring water." The German geographer Johann Georg Kohl, who traveled through St. Paul in 1855, wrote of Fountain Cave as "one of many remarkable caves that water has washed out of sandstone here and there." A letter to the Congregationalist of Boston, for September 19, 1856, signed "H," describes "A small stream, a rill of water, has worn itself a channel through this bed of sand-stone, and thus formed the cave." Robert Watt, a Danish visitor, wrote in 1871 (as translated by Jacob Hodnefield in 1929) that "A stream from within apparently has hollowed it out, and some maintain that a person could penetrate a couple of miles beneath the surface either by canoe or by picking his way along the narrow white sand edges of the stream." James Davenport, in his *Minnesota Tourist's and Traveller's Guide* (1872), wrote, "Here a stream of water, which empties into the [Mississippi] river a short distance below, has hollowed out a large cave over one hundred feet in length, while a narrow passage extends still further into the bowels of the earth, and is said to have been explored for a quarter of a mile by some adventurous persons some years since." Minnesota's third and most prominent early state geologist, Newton H. Winchell, although referring to Fountain Cave in his various reports, is silent regarding the cave's genesis—or the genesis of any other Minnesota cave, for that matter.

Fountain Cave largely disappears from the literature after 1880, when it became a sewer for the overlying Omaha Railroad shops, which were built that year. When the topic of cave genesis was next taken up seriously in Minnesota, in the early twentieth century, it was with regard to the chemical solution of limestone caves. The geomorphologist William M. Davis published his classic paper, "Origin of Limestone Caverns," in the *Bulletin of the Geological Society of America* in 1930, and within a dozen years four other important papers on cave genesis appeared. One of Davis's followers, the geologist J Harlen Bretz, of the University of Chicago, published his own paper, "Caves in the Galena Formation," in the *Journal of Geology* in 1938, dealing with the genesis of Niagara Cave (located near Harmony, Minnesota) among others. Mystery Cave, which subsequently inherited much of the speculative attention, was discovered about this same time, continuing a tradition that endures to the present day.

For more on this topic, refer to: Greg Brick, "What Happened to Fountain Cave?" Ramsey County History 29 (4) [Winter 1995]: 4-15.

Membership Report

MGWA starts counting members for the next year in August. We have stopped counting 2005 members, so now is a good time to look back at where we are for membership. Membership was in the high 500s, slightly lower than last year, but higher than the average of the last several years.

At its July meeting the MGWA Board voted to set individual membership dues starting in 2006 at $30. The last increase was 5 years ago when individual dues were set at $25. The corporate membership rates also were increased proportionally to account for the professional membership portion.