

Minnesota Ground Water Association

Volume 14, Number 2: June, 1995

MGWA President's Column

I'm glad to see that by late May, spring has finally arrived. The MGWA Spring Conference on Technical Communication was held on May 8, 1995, and by measure of the attendance (over 80) and attendee's comments it was a success. A summary of the conference is presented inside the newsletter on page 3.

Over the next month or so, the Board will be considering topics for the MGWA Fall Conference. Several suggestions for conference topics were received from those who attended the spring conference, including: regional scale groundwater monitoring, practical uses of stable isotopes in ground water, issues in private and rural water supply systems, and general negotiating techniques. The Board is always looking for member input, so call one of us if you'd like to share your suggestions.

At the May MGWA Board meeting, a motion was made and approved to donate \$250 to each of three groups who have requested funding from the MGWA in the past year. These are the Minnesota Water Line, the University of Minnesota Hydrogeology Field Camp (which will be held for the first time this summer), and the Metro Area Ground Water Alliance (MAGWA). In addition, a \$100 donation was also approved for construction of the National Ground Water Association's new headquarters in Dublin, Ohio. The Board felt that these requests were in keeping with the MGWA's mission to promote a better understanding and use of Minnesota's groundwater resources. Details concerning the requests are provided below.

Those of you who attended the MGWA spring conference will be

familiar with the Minnesota Water Line, a toll-free telephone line that has been set up through a partnership of the American Ground Water Trust and the University of Minnesota Extension Service to answer questions about water issues. The intent of the line is to use volunteer professionals to help answer questions raised by Minnesota Citizens about ground water and water-related issues. Our donation will provide financial support to the Minnesota Water Line, which began operating this spring in northeastern Minnesota.

As of this summer, the University of Minnesota will offer the first session of Geology 5112, its hydrogeology summer field course. The U of M is one of very few universities in the United States to offer a hydrogeology field camp for credit. It has requested support from the MGWA in the form of a scholarship (similar to field camp scholarships the MGWA currently sponsors, discussed below). The MGWA is considering sponsoring an annual hydrogeology field camp scholarship; in the meantime, the Board voted to make a donation of \$250 to go toward defraying the high equipment costs associated with the field camp.

The MAGWA is a coalition of county groundwater planners, hydrogeologists and Minnesota state agency staff that meet on a monthly basis to exchange information concerning water issues in their respective departments and to obtain feedback and cooperation in developing work products for the metropolitan area. The MAGWA, which is an unfunded organization, recently produced a poster that contains recommendations about management techniques that can be used for ground water

continued on page 6

Health Risk Limits Rules Revised—Now Include 120 Groundwater Contaminants

by Roberta Aitchison Olson, M.P.H. and Larry D. Gust, M.P.H., Minnesota Department of Health, and Elizabeth Wattenberg, Ph.D., School of Public Health, University of Minnesota

Thirty one additional groundwater contaminants were added to the Health Risk Limits (HRLs) rules at the end of 1994. Thirty two new contaminants were proposed for health risk limits rules, but opposition led to the exclusion of styrene from the present rules. The enabling legislation was revised to include a broader definition of data sources to be used in calculating the HRLs. This permitted MDH to establish HRLs for several Minnesota groundwater contaminants that potentially pose a public health concern. The revised table of health risk limits and toxicologic endpoints appears as the center-fold of this newsletter.

continued on page 2

Table of Contents

<i>President's Column</i>	1
<i>Health Risk Limits</i>	1
<i>Spring Conference Report</i>	3
<i>MN Drinking Water Quality</i>	4
<i>MDH Environmental Health Moves to St. Paul</i>	5
<i>Minnesota Water Line</i>	6
<i>Fall Field Trip</i>	7
<i>HRL Table</i>	9
<i>Registration Bill Passes</i>	13

New HRLs, cont.

A health risk limit (HRL) is the concentration of a groundwater contaminant, or a mixture of contaminants, that can be safely consumed daily for a lifetime. A health risk limit is expressed as a concentration in micrograms per liter, or as a "hazard index," an estimate of the effect of a mixture of substances.

The Minnesota Department of Health calculated the health risk limits risk assessment methods and data. These methods are described in the January 1994 *Minnesota Ground Water Association Newsletter*. The HRLs are calculated using the same methodology that generated the "recommended allowable limits" (RALs), unpromulgated advisory levels which are no longer used. The HRLs reflect health effects data alone; they do not incorporate economic or technological factors, such as treatment cost and treatment feasibility, as do federal Maximum Contaminant Levels (MCLs).

Uses of Health Risk Limits

The Minnesota Groundwater Protection Act of 1989 directed the Minnesota Department of Health to develop health risk limits for substances found to degrade Minnesota's groundwater. It did not establish how the health risk limits would be applied in groundwater protection programs or services, except as criteria for Best Management Practices and Water Resource Protection Requirements. Uses of the HRLs are largely determined by state groundwater protection programs of the Minnesota Pollution Control Agency and Department of Agriculture. The Minnesota Department of Health uses health risk limits for several public health protection purposes.

1. **Advice for Private Wells.** Because private well drinking water supplies are not regulated for contamination, HRLs are used to evaluate contaminated wells and provide advice to consumers and well owners about the suitability of their water supply for consumption and other uses.

2. **Unregulated Contaminants in Public Water Supplies.** In instances where no MCL exists for a contaminant in public water supplies, HRLs are used as criteria to evaluate options for reducing

the community's exposure to the contaminant.

3. **Environmental Review.** The Department of Health uses health risk limits as criteria in environmental review projects. For example, monitoring data may be compared to HRLs to evaluate potential project impacts on public health.

4. **Site Assessment Criteria.** The MDH's Site Assessment and Consultation program uses HRLs as criteria to evaluate potential site impacts on public health, to make recommendations on monitoring and mitigation.

The Department of Health is available for consultation on the use of health risk limits and the public health implications of potential applications.

Expanded Data Sources for Health Risk Limits

The 1989 Groundwater Protection Act specified the use of data from U.S. EPA's carcinogen assessment group, now EPA's Integrated Risk Information System (IRIS); to develop

the HRLs. This posed a limitation on development of health risk limits for some contaminants in Minnesota groundwater that are both prevalent and of public health concern, so a revision of the statute was sought and is embodied in the rule revisions of 1994. The statutory change allows the Department to use a broader range of data for establishing health risk limits.

Health Risk Limits for Mixtures of Contaminants

When groundwater monitoring reveals the presence of more than one contaminant, the Minnesota Department of Health determines the exposure limit for a mixture of contaminants by a method recommended by the U.S. Environmental Protection Agency (USEPA, 1987).

The additive model generates a hazard index (HI) for the mixture (see the example on this page) by adding together the ratios of the concentration of each substance or chemical detected in the groundwater to its health

Hazard Index for a Mixture: Example Calculation

Contaminant	Toxicologic Endpoint		C	HRL	C/HRL
	Liver	Kidney			
chlorobenzene	+	-	50	100	0.5
ethylbenzene	+	+	175	700	0.25
pyrene	-	+	300	600	0.5
ethyl ether	-	-	3	4	*
acetone	-	+	350	700	0.5

$$HI = \frac{C_1}{HRL_1} + \frac{C_2}{HRL_2} + \dots + \dots + \frac{C_n}{HRL_n}$$

* Ethyl ether is not included in a hazard index because no endpoint is listed in the HRL table.

For Liver

$$HI_{liver} = 0.5 + 0.25 = 0.75$$

$$HI < 1$$

Mixture does not exceed the exposure guideline for the liver endpoint

For Kidney

$$HI_{kidney} = 0.25 + 0.5 + 0.5 = 1.25$$

$$HI > 1$$

Mixture exceeds the exposure guideline for the kidney endpoint

risk limit. This method is described below:

1. Group the contaminants in the mixture according to the health effects they cause.

The health effects for each contaminant are listed under "toxicological endpoint" in the tables. All carcinogens list "cancer" under "toxicological endpoint." All contaminants that list "liver" under "toxicological endpoint" form another group, etc. Contaminants that have more than one toxicological endpoint listed should be included in all of the appropriate toxicological endpoint groups.

Contaminants that do not have a toxicological endpoint listed in the HRL table should not be included in the generation of a hazard index.

2. Generate a hazard index (HI) for each toxic endpoint.

For each group of contaminants that have a common toxicological endpoint, generate a hazard index (HI) using the following equation:

$$HI = \frac{C_1}{HRL_1} + \frac{C_2}{HRL_2} + \dots + \frac{C_n}{HRL_n}$$

C_n represents the concentration of the first, second, ... nth (third, fourth, etc.) contaminant in the endpoint group. HRL_n represents the HRL for the first, second, ... nth (third, fourth, etc.) contaminant in the endpoint group.

3. Determine if the HI for each toxic endpoint exceeds the health risk limit.

A hazard index equal to 1.0 for a mixture is analogous to the HRL for an individual contaminant. Therefore, a hazard index greater than 1.0 indicates that the mixture exceeds the health risk limit.

Notes on the Table (Centerfold)

Listed for each substance or chemical in the Table of Health Risk Limits and Toxicologic Endpoints are: 1. the chemical name; 2. a unique identifying number (CAS RN); 3. health risk limit value, in microgram(s) per liter ($\mu\text{g}/\text{l}$); and 4. toxicologic endpoint, where appropriate.

For further information about the Health Risk Limits rules, contact the Minnesota Department of Health at (612) 215-0700 (TDD 612/215-0707 or tollfree 1-800/627-3529).

MGWA Spring Conference

Technical Communication with the Public: Ground Rules for Scientists

The Association's Spring Conference, held May 8, 1995 at the Earle Brown Center on the St. Paul Campus of the University of Minnesota, proved to be a big success, with nearly 100 attending. Six professionals specializing in communicating scientific information to the public treated attendees to an afternoon of informative talks and discussion.

Cathy O'Dell, MGWA President, opened the conference by reviewing the agenda and introducing Andrew Stone of the American Ground Water Trust who set the tone for the talks to follow. Andrew observed that working in the ground water industry, we are constantly exchanging technical information with scientists, regulators, businesses and others familiar with ground water issues. However, the general public is less likely to be familiar with technical terms we use and most likely to be directly concerned by potential or real threats to their drinking water and environment. Andrew stated that the purpose of today's sessions is to provide information to help us all be better able to explain these issues to those affected by them.

Barb Liukkonen, a hydrogeologist and water resources education coordinator for the Board of Water and Soil Resources and the Minnesota Extension Service, discussed a number of factors which determine how well we communicate our technical messages to the public. Much of the data we generate must be interpreted in terms of real or anticipated risk to the general public. Risk communication must recognize that people are concerned more with their own self interest than with ground water basics. If people are sufficiently motivated, they are very capable of understanding complex risk information, even if they might not agree with what you are saying. Barb then went over some of the cardinal rules for risk communication, including the acceptance and involvement of the public as a legitimate partner. She concluded by debunking some of the commonly-held myths

—continued beneath officer listing

1995 Board of Directors

Past President

Doug Connell
Barr Engineering Co.
(612)832-2722
FAX(612)832-2601

President

Cathy O'Dell
Geraghty & Miller
(612)339-9434
FAX (612)336-4538

President Elect

Gretchen Sabel
Minnesota Pollution Control
(612)297-7574
FAX (612)282-6247

Secretary/Membership

Rich Soule
MN Dept. of Health
(612)215-0917

Treasurer

Paul Putzier
RETEC
(612)222-0841
FAX (612)222-8914

Editor

Tom Clark
Minnesota Pollution Control
(612)296-8580
FAX (612)296-9707

Business Management & Publications

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

Spring Conference, cont.

about technical communication with the public.

The next speaker was Scott Hvidsten, an information officer with the Minnesota Pollution Control Agency. Scott's main duties are to plan and manage public information activities

—continued on next page

Spring Conference, cont.

and major communications projects for the Ground Water and Solid Waste Division at MPCA. His topic was providing tips and tools in preparing for public meetings. Sometimes these meetings are controversial, other times not. Whatever the topic or degree of controversy of a meeting, there are several techniques which can be used to make it more successful. Generally, people attend public meetings to voice their opinions and obtain information about a proposal. The public wants information they can understand without a technical background. Generally, people won't support a project they don't understand. Knowing your audience and their level of technical knowledge will help determine how you should approach a presentation at a public meeting.

Dan Sola, a senior hydrologist with Conestoga Rovers and Associates, along with Andrew Stone, developed the concept of the Minnesota Water Line and worked with the Minnesota Extension Service to implement it. The details of how the Water Line works are discussed elsewhere in this newsletter in the article describing various on-line information services. In April 1995, the 1-800 Minnesota Water Line was introduced to help link Minnesota citizens and decision makers to expertise and professional assistance on water issues. Dan introduced **Deanne Roquet**, extension educator and staff person for the Water Line. Dan and Deanne are seeking volunteers such as hydrologists, geologists, planners and engineers to be technical consultants to augment services the Water Line provides. They then involved the whole audience in a short role play to illustrate the need for good communications skills when dealing with the public on controversial issues.

After a break, **Frank Rovers**, President of Conestoga Rovers and Associates, discussed his experience as an expert witness and provided examples of what a person in this position needs to know to be effective. Preparation and a high degree of personal commitment are keys, as the expert is often expected to shoulder serious responsibility for a matter on behalf of

a client. A thorough understanding of the issues of the case, having access to all files, and a site visit are all part of being prepared to testify as an expert witness. Your work today as a scientist may come under court scrutiny many years from now when you are on the stand as an expert, or if your company is involved in litigation on a past project.

Tom Meersman, environment and energy reporter for the Minneapolis Star Tribune newspaper, discussed why scientists and journalists sometimes have trouble communicating about environmental issues. The scientist often writes in technical language to be read by peers, while the journalist is writing for a general audience. The scientist conducts studies over months or even years, while the journalist is often faced with a daily deadline. With these tight time frames, the scientist should be prepared to be patient and give reporters the time they need in an interview to understand a topic. Misunderstandings and "quoting out of context" may be the result of too little time spent in an interview. Part of the reporter's job is to challenge a scientist's research or opinions and scientists should be prepared to discuss how their work might be criticized by others.

Andrew Stone, executive director of the American Ground Water Trust, a nonprofit membership organization, wrapped up the afternoon with a lively discussion which included the myths of water witches and underground rivers and how important the scientist's role is in getting good information out to the public. Increasingly, there are opportunities for the scientific community to volunteer services which can provide great economic and environmental benefit for our communities. Andrew finished with the challenge that if we don't take the responsibility for accurately and objectively informing the public, the courts, and the press about ground water issues, who will?

The American Ground Water Trust, in cooperation with MGWA, published a booklet of abstracts for the talks described above. Copies may be obtained by writing the Association.

—Compiled by Tom Clark, Editor

Note regarding MGWA Board Meetings:

The volunteer board of the Association meets monthly for breakfast and business discussions at 7:30 a.m. the first Thursday of the month at the Egg and I Restaurant, University and 280, in the Midway area. MGWA members are welcome to attend these meetings. If you are interested, call a few days ahead to Cathy O'Dell, MGWA President (339-9434) to confirm that a meeting is being held and reserve a space.

Little Evidence of Pesticides, Industrial Contaminants Found in State's Community Drinking Water Systems

The state's community water supply systems continue to provide safe drinking water to state residents, according to Minnesota Department of Health (MDH) officials, who based their announcement on 1994 test results for approximately 583 community water supply systems in Minnesota. MDH conducted 124,866 tests for individual pesticides and industrial contaminants during the year, as part of its responsibility for enforcing the federal Safe Drinking Water Act in Minnesota.

Although trace amounts of chemicals were found in some systems, none of the test results for 1994 exceeded the federal Maximum Contaminant Level (MCL) for any given contaminant. The MCL represents the lowest concentration at which a particular chemical is considered to represent a potential health concern.

The MCLs are calculated very conservatively - to provide a "margin of safety" for people using the water - and are based on the assumption that people would be consuming the water over an entire lifetime, according to MDH officials.

"Their test results underscore something that we've known for a long time," said Anne Barry, Acting Minnesota Health Commissioner. "Our

—continued on page 5

Minnesota Department of Health is Moving

During June 1995, the Division of Environmental Health will be moving from their offices in the Dinnaken Building in Minneapolis to the Metro Square Building in downtown Saint Paul, at Seventh and Robert Streets. The move will be completed by June 19, 1995.

The new addresses and phone numbers for common referrals are as follows:

Building Address

Minnesota Department of Health
Division of Environmental Health
Metro Square Building, Suite 220
121 East Seventh Street
St. Paul, Minnesota 55101

Mailing Address

Minnesota Department of Health
Division of Environmental Health
Metro Square Building
PO Box 64975
St. Paul, Minnesota 55164-0975

Well Management Unit:

Bud Anderson (monitoring wells, elevators) ___ (612)215-0813
Kim Benson-Johnson (delegated programs) ___ (612)215-0816
Norm Mofjeld (well disclosure, well sealing) ___ (612)215-0823
Jim Nye (well sealing, exploratory borings) ___ (612)215-0824
Janice Stanger (licensing) _____ (612)215-0829

Metro District:

Steve Bennett _____ (612)215-0815
Doug Edson _____ (612)215-0829
Pat Sarafolean _____ (612)215-0826
Jim Stevens _____ (612)215-0830
Well Management Receptionist _____ (612)215-0811

Special Services Unit:

Bruce Olsen (Wellhead Protection) _____ (612)215-0796
Justin Blum (GPS) _____ (612)215-0797

Public Water Supply Unit:

General Receptionist _____ (612)215-0700

Site Assessment and Consultation Unit:

Lisa Pogoff _____ (612)215-0916
Rich Soule _____ (612)215-0917

Health Risk Assessment Unit:

Health Advisory Line _____ (612)215-0950
(Health Risk Limits, Fish Consumption Advisories)

Environmental Health Division Receptionist (612)627-0700

55 Communities Enter 1995 Groundwater Guardian Program

Sponsored by the Groundwater Foundation, Groundwater Guardian is a national program which supports, recognizes and connects communities which are taking extraordinary care of their groundwater.

Fifty-five very diverse communities from twenty-eight states and one Canadian province have entered the 1995 Groundwater Guardian program. The community populations range from under 400 in Keysville, Georgia to almost one million in Hamilton County, Ohio. The geographical areas range from over 1,000 square miles to under one square mile. While a community is often thought of as a town or city, a Groundwater Guardian community can be as small as a village, as inclusive as a corporate entity or as two to three counties drawing from the same aquifer.

The diversity of the communities also comes through in the result-oriented activities they choose to implement. A community may choose to begin the protection process by building community awareness or to implement a completed Wellhead Protection plan. Whatever their groundwater protection need may be, the Groundwater Foundation offers support, assistance and linkages to both local and national experts.

For more information about Groundwater Guardian, contact The Groundwater Foundation, PO Box 22558, Lincoln, NE 68542-2558; phone (402)434-2740.

Drinking Water Quality, cont.

state's public water supply systems are very safe, and they generally have very few problems with contamination.

Although this is the first time MDH has formally announced its water testing results to the public, the agency plans to make it a regular proactive in the future.

—continued on page 8

New On-Line Water Information Services

Minnesota Water Line (800)455-4526

This toll-free phone line links Minnesota's citizens and decision makers to expertise and professional assistance on water issues.

The **Water Line** is operated as a partnership of the American Ground Water Trust and the Minnesota Extension Service, University of Minnesota.

A **Water Line** specialist will talk with you in non-technical language, and offer you advice on your question or problem related to water.

Call the **Water Line** when you have questions about:

- safety of your household water supply
- water well design, construction and operation
- septic system siting, design, and maintenance
- issues dealing with aquifer protection, water supply, lakes, rivers and wetlands
- other concerns about drinking water

The **Water Line** is a pilot project beginning in April 1995 and is available in these counties:

Carlton	Itasca	Mille Lacs
Chisago	Kanabec	Pine
Cook	Koochiching	St. Louis
Isanti	Lake	

A **Water Line** specialist will be available to take calls from 9:00 am to noon, Monday through Friday. At other times you can leave a message and your call will be returned.

When additional expertise is needed, the **Water Line** specialist will have a volunteer technical adviser contact you. These trained volunteers will have no financial or political interest in your concern, but will offer their expertise to help you make decisions. **Water Line** technical advisers are professionals, such as hydrogeologists, engineers, well contractors, attorneys, aquatic scientists and public agency staff - all interested in public education.

The **Minnesota Water Line** is a unique partnership that links the expertise of the University of Minnesota land grant institution with water industry professionals. The American Ground Water Trust is a national non-profit educational organization with active members in Minnesota. The Minnesota Extension Service is the University of Minnesota outreach network located in every county in the state.

Other cooperators are the Minnesota Board of Water and Soil Resources, St. Louis County, Minnesota Sea Grant College program, Minnesota Pollution Control Agency, and other state agencies.

Professional Water-Saving Information is on Internet

Useful information on what works best in water-saving programs is now available on the Internet computer system for water conservation professionals.

The Water Efficiency Clearinghouse, also known as **WaterWiser**, provides access to more than 3,000 references on water conservation programs conducted throughout the United States. Funded by the Environmental Protection Agency, the clearinghouse is located at the Denver offices of the American Water Works Association.

Although the primary users of **WaterWiser** are utility and government water management professionals, the service is available on a limited basis to the public. Access information is available by calling (800)559-9855 between 8 a.m. and 5 p.m. Mountain Time.

President's Letter, cont.

protection. The poster has been distributed free of charge to metropolitan area county offices, to the metro area soil and water conservation districts, and other units of government for distribution to the public. Although the distribution has been limited to the metropolitan area, the information in the poster is applicable to all areas of the state. Posters are available from these agencies or by contacting Eric Mohring of the Board of Soil and Water Resources at 291-7360. The MGWA's contribution will go toward the cost of printing the poster.

Finally, a \$100 donation was approved for construction of the new MGWA headquarters building in Dublin, Ohio. The MGWA owed the NGWA a debt of gratitude for pulling it out of a financial crisis in the early days of our organization. Because of the NGWA's prior financial support, the Board thought it appropriate to approve a donation.

As the last business item, I'd like the membership to know that the MGWA's annual field trip scholarships of \$300 each were awarded this year to Carleton College, the University of Minnesota, Winona State University, and St. Cloud State University. We will be getting reports and photos from the field trips soon.

That about wraps up the MGWA's gift-giving for this year. As I discussed in the March 1995 newsletter, we will be monitoring our budget closely to decide whether contributions such as these continue to be affordable without a change in our membership dues and conference rates.

But for now ... on to summer!

-Cathy O'Dell, MGWA President

Newsletter Deadlines — 1995

The MGWA board would like to ensure that this quarterly newsletter is distributed to the membership as regularly as possible during the first two weeks of March, June, September and December. With an all-volunteer board and reliance on you, the members, to submit articles in as timely a fashion as possible, your editor and publisher will try to meet this schedule as closely as we can. To help us in meeting this goal, the following are deadlines to be aware of for the two remaining 1995 MGWA newsletters:

Volume 14, number 3; September 1995

Submission of articles to editor — 8/11/95

Submission of copy to publisher — 8/18/95

Volume 14, number 4; December 1995

Submission of articles to editor — 11/10/95

Submission of copy to publisher — 11/17/95

New Publications

Groundwater Programs in the Great Lakes: A Networking Resource. Freshwater Foundation. 1994. Provides summaries of current groundwater programs and contacts in the Great Lakes Basin. Available for \$14 from Freshwater Foundation, 725 Co Rd 6, Wayzata, MN 55391. (612)449-0092.

Characterization of Ground Water from Bedrock Aquifers to the Mississippi and Minnesota Rivers of Three Areas, Minneapolis-St. Paul Area, Minnesota. Schoenberg, M.E. (U.S.G.S. Water Resources Investigations Report 94-4163). Characterizes ground water discharge from bedrock aquifers to the Mississippi and Minnesota Rivers in three areas: 1) along the Mississippi River between Fridley and Brooklyn Center, 2) along the Minnesota River between Eagan and Bloomington, and 3) along the Mississippi River at Minneapolis about 5 miles upstream of its confluence with the Minnesota River.

Characterization of the Hydrogeology and Water Quality at the Management Systems Evaluation Area Near Princeton, Minnesota, 1991-92. Delin, G.N., M.K. Landon, J.A. Lamb, and J. L. Anderson (U.S.G.S. Water Resources Investigations Report 94-4149). The Minnesota MSEA project, one of five national MSEA projects in the midwest, reports its characterization of the surficial aquifer and ground water at its research site in the Anoka Sand Plain, about 5 km southwest of Princeton, MN.

MGWA/AIPG/MRGS Fall Field Trip

The 1995 MGWA/AIPG fall field is scheduled to take place on September 8 & 9. The details of the trip have not been completely worked out, but this year's journey will be to the famous Minnesota Iron Range. The Mesabi Range Geological Society (MRGS) is co-sponsoring the field trip with the MGWA and American Institute of Professional Geologists (AIPG). Members of the MRGS are setting up tours of active and historic mining areas, and will most likely be digging up several guest speakers to unravel the mysteries of Minnesota's most famous geological setting. The center of the field trip activities will be Eveleth. If you have ideas for this year's expedition, or if you have any questions, contact either John Beck (AIPG) at (612)778-4842, or Rick Ruhanen (MRGS) at (218)262-6767.

Join the Minnesota Ground Water Association!

If you are reading this newsletter second-hand, we'd like to take this opportunity to invite you to become a member of MGWA for 1995. Annual dues are \$15 for professional members and \$10 for students. Additional donations toward the use of recycled paper will be gratefully accepted.

Just complete the form below and mail to: MGWA, c/o WRI, 4779 126th St. N, White Bear Lake, MN 55110-5910.

Name _____
Affiliation/Employer _____
Work Address _____
City, State, Zip Code _____
Work Telephone Number _____ E-mail _____
Fax Number _____
Home Address (optional) _____
City, State, Zip Code _____
Home Telephone Number _____
Which Address should we use for Directory Listing? _____
Which Telephone Number should we use for Directory Listing? _____

Drinking Water Quality, cont.

The drinking water tests are conducted on samples of treated - or "finished" - water from each water supply system. Each system is tested for up to 118 different pesticides and industrial contaminants, at intervals ranging from four times a year to once every six years. Not every system is tested every year. The exact list of contaminants - and the testing schedule - vary from one water supply system to another, based on the vulnerability of each system to various types of contamination. Factors that affect the testing schedule for a given system include the proximity of the system to potential contamination sources, whether the system uses wells or surface water, and the presence of natural geological barriers that serve to protect the water from contamination. The testing schedule also takes into account the depth of any wells used by the system, and past test results for that system.

If a water supply system were to exceed the MCL for a particular chemical, the water supply operator would be required to notify the people who use the water, and take appropriate corrective action. In the short term, that might mean taking a water well out of service, or advising customers of the system to use bottled water. In the long term, it might mean installing a new treatment system or drilling a new well. MDH will take steps to notify consumers of a contamination problem if the water supply operator isn't able to do it.

MCLs have not been established for all of the 118 pesticides and industrial contaminants we test for in Minnesota, MDH officials noted. However, MDH routinely compares test results for these "unregulated" chemicals with a set of state standards known as Health Risk Limits (HRLs). (See related article starting on page 1 of this newsletter and HRL Table in the center.) If there is no HRL for a particular chemical, MDH will do its own scientific estimate of the chemical's potential health impact. MDH will ask the water supply system to notify its customers - and take corrective action - if unacceptable levels of an unregulated chemical are present

in the water. None of the unregulated chemicals were found at unsafe levels in the state's community water systems during 1994.

The 1994 test results provide some badly needed perspective on drinking water issues, Commissioner Barry noted. "A number of recent news reports - many of them based on information provided by environmental activist groups - have suggested that we have widespread problems with our drinking water," she said. "In fact, that's simply not the case."

However, despite the programs' past successes, it's important that the state maintain its efforts to safeguard drinking water quality, she emphasized. "We need to remain vigilant," she said, "and continue the kinds of protective efforts that have allowed us to achieve these excellent results."

In addition to pesticides and industrial contaminants, MDH also tests water supply systems for other contaminants, including bacteria, nitrates and other inorganic chemicals, radioactive elements, lead and copper. Again, systems that exceed the MCL for any of these contaminants are required to notify their customers and take action to remove the contamination.

Community water supply systems include all systems that serve more than 25 people - or have more than 15 service connections - and provide water to people in their place of residence. In addition to city water systems, community systems can also serve smaller groups of people in apartment buildings, nursing homes, or manufactured home parks. In addition to regulating the state's 965 community systems, MDH also regulates approximately 8,800 "non-community" public water supply systems - including both "transient" systems like motels or restaurants, and "nontransient" systems like schools or factories.

*-Minnesota Department of Health
press release*

Upcoming Meetings, Courses, Seminars

Multi-component Reactive Transport Modeling

A three-day seminar for Faculty, Geologists, and Engineers. **July 24 - 26, 1995.** Lecturers: Carl Steefel and Steven Yabusaki, Pacific Northwest Laboratory, Richland Washington. Presented by the University of Minnesota Department of Geology and Geophysics, through the joint sponsorship of the GEOFLUIDS doctoral program in Crustal Scale Hydrology and Orpha and George Gibson Hydrogeology Endowment.

Course Description

The course will emphasize understanding of the basic concepts of multicomponent reactive transport in porous media. These concepts are a fundamental feature of many contemporary problems of interest to geoscientists. Example applications from contaminant hydrogeology and petrology (i.e. geochemistry of water-rock interactions) will be presented. The curriculum begins by considering batch reactors in the absence of transport, progresses to reactions coupled to transport in one-dimension, and ends with the general case of multicomponent reactive transport through multidimensional, physically and chemically heterogeneous porous media. Participants will gain hands-on experience using reactive transport models developed by the instructors. All software used in the course will be made available to participants.

Prerequisites

There are no prerequisites for the course, although some knowledge of hydrology and/or aqueous geochemistry would be helpful. Both topics will be reviewed briefly. Rudimentary skills in computer usage will also be helpful.

Schedule

Class hours will be from 8:30 a.m. until 12:15 and from 1:30 until 5:00 p.m. Instruction will be equally divided between lecture sessions in

— continued on page 12

Health Risk Limit

Chemical or Substance	CAS RN	µg/L	Toxicologic Endpoint
Acenaphthene	83-32-9	400	liver
Acetone	67-64-1	700	kidney
Alachlor	15972-60-8	4	cancer
Aldicarb	116-06-3	1	nervous system
Allyl chloride (3 chloropropene)	107-05-1	30	nervous system
Anthracene	120-12-7	2000	-----
Antimony	7440-36-0	6	-----
Atrazine	1912-24-9	20	cardiovascular system
Barium	7440-39-3	2000	cardiovascular system
Benzene	71-43-2	10	cancer
Benzoic acid	65-85-0	30,000	-----
Beryllium	7440-41-7	0.08	cancer
1,1-Biphenyl (Diphenyl)	92-52-4	300	kidney
Bis(chloroethyl)ether (BCEE)	111-44-4	0.3	cancer
Bis(chloromethyl)ether (BCME)	542-88-1	0.002	cancer
Boron	7440-42-8	600	male reproductive system
Bromodichloromethane	75-27-4	6	cancer
Bromoform	75-25-2	40	cancer
Bromomethane (Methyl bromide)	74-83-9	10	stomach
n-Butanol	71-36-3	700	nervous system
Butyl benzyl phthalate	85-68-7	100	-----
Butylphthalyl butylglycolate (BPBG)	85-70-1	7000	-----
Cadmium	7440-43-9	4	kidney
Carbon disulfide	75-15-0	700	developmental effects
Carbon tetrachloride	56-23-5	3	cancer
Chloramben	133-90-4	100	liver
Chlorobenzene	108-90-7	100	liver
Chloroform	67-66-3	60	cancer
2-Chlorophenol	95-57-8	30	developmental effects
Chlorothalonil	1897-45-6	30	cancer
Chromium III	16065-83-1	20,000	-----
Chromium VI	18540-29-9	100	-----
Cumene (Isopropyl benzene)	98-82-8	300	-----
Cyanide, free	57-12-5	100	endocrine system, nervous system
Dibromochloromethane	124-48-1	10	liver
1,2-Dibromoethane (Ethylene dibromide, EDB)	106-93-4	0.004	cancer
Dibutyl phthalate	84-74-2	700	-----
Dicamba	1918-00-9	200	developmental effects
1,2-Dichlorobenzene	95-50-1	600	liver
1,4-Dichlorobenzene (para)	106-46-7	10	cancer
3,3'-Dichlorobenzidine	91-94-1	0.8	cancer
Dichlorodifluoromethane	75-71-8	1000	-----
p,p'-Dichlorodiphenyldichloroethane (DDD)	72-54-8	1	cancer
p,p'-Dichlorodiphenyldichloroethylene (DDE)	72-55-9	1	cancer
p,p'-Dichlorodiphenyltrichloroethane (DDT)	50-29-3	1	cancer

Chemical or Substance	CAS RN	µg/L	Toxicologic Endpoint
1,1-Dichloroethane	75-34-3	70	kidney
1,2-Dichloroethane	107-06-2	4	cancer
1,2-Dichloroethylene (cis)	156-59-2	70	hematologic system
1,1-Dichloroethylene (Vinylidene chloride)	75-35-4	6	liver
1,2-Dichloroethylene, trans-	156-60-5	100	-----
Dichloromethane (Methylene chloride)	75-09-2	50	cancer
2,4-Dichlorophenol	120-83-2	20	immune system
2,4-Dichlorophenoxyacetic acid (2,4-D)	94-75-7	70	hematologic system, kidney, liver
1,2-Dichloropropane	78-87-5	5	cancer
1,3-Dichloropropene	542-75-6	2	cancer
Di(2-ethylhexyl)phthalate (DEHP)	117-81-7	20	cancer
Diethyl phthalate	84-66-2	6000	-----
2,4-Dimethylphenol	105-67-9	100	hematologic system, nervous system
Dimethylphthalate	131-11-3	70,000	kidney
2,4-Dinitrophenol	51-28-5	10	eyes
Disulfoton	298-04-4	0.3	nervous system
Ethylbenzene	100-41-4	700	kidney, liver
S-Ethyl dipropylthiocarbamate (EPTC)	759-94-4	200	cardiovascular system, nervous system
Ethyl ether	60-29-7	1000	-----
Ethylene glycol	107-21-1	10,000	kidney
Fluoranthene	206-44-0	300	kidney, liver
Fluorene (9H-Fluorene)	86-73-7	300	hematologic system
Formaldehyde	50-00-0	1000	stomach
Heptachlor	76-44-8	0.08	cancer
Heptachlor epoxide	1024-57-3	0.04	cancer
Hexachlorobenzene	118-74-1	0.2	cancer
Hexachlorobutadiene	87-68-3	1	kidney
Hexane (n-hexane)	110-54-3	400	nervous system
Isophorone	78-59-1	100	kidney
Linuron	330-55-2	1	hematologic system
Manganese	7439-96-5	100	nervous system
Methanol	67-56-1	3000	liver, nervous system
2-Methyl-4-chlorophenoxyacetic acid (MCPA)	94-74-6	3	kidney, liver
Methyl ethyl ketone (MEK, 2-butanone)	78-93-3	4000	developmental effects
Methyl isobutyl ketone (MIBK)	108-10-1	300	kidney, liver
2-Methylphenol (o-cresol)	95-48-7	30	nervous system
3-Methylphenol (m-cresol)	108-39-4	30	nervous system
4-Methylphenol (p-cresol)	106-44-5	3	-----
Metolachlor	51218-45-2	100	developmental effects
Metribuzin	21087-64-9	200	kidney, liver
Naphthalene	91-20-3	300	-----
Nickel, soluble salts	7440-02-0	100	-----
Nitrate (as nitrogen)	14797-55-8	10,000	hematologic system
N-Nitrosodiphenylamine	86-30-6	70	cancer
Pentachlorophenol	87-86-5	3	cancer

Chemical or Substance	CAS RN	µg/L	Toxicologic Endpoint
Phenol	108-95-2	4000	developmental effects
Picloram	1918-02-1	500	liver
Polychlorinated biphenyls (PCBs)	1336-36-3	0.04	cancer
Prometon	1610-18-0	100	-----
Propachlor	1918-16-7	90	-----
Pyrene	129-00-0	200	kidney
Selenium	7782-49-2	30	-----
Silver	7440-22-4	30	-----
Simazine	122-34-9	30	hematologic system
1,1,1,2-Tetrachloroethane	630-20-6	70	kidney, liver
1,1,2,2-Tetrachloroethane	79-34-5	2	cancer
1,1,2,2-Tetrachloroethylene	127-18-4	7	cancer
Thallium salts	7440-28-0	0.6	liver
Tin	7440-31-5	4000	kidney, liver
Toluene	108-88-3	1000	kidney, liver
Toxaphene	8001-35-2	0.3	cancer
1,1,1-Trichloroethane	71-55-6	600	liver
1,1,2-Trichloroethane	79-00-5	3	immune system
1,1,2-Trichloroethylene (TCE)	79-01-6	30	cancer
Trichlorofluoromethane	75-69-4	2000	-----
2,4,6-Trichlorophenol	88-06-2	30	cancer
2,4,5-Trichlorophenoxyacetic acid (2,4,5-T)	93-76-5	70	developmental effects, hematologic system
2 (2,4,5-Trichlorophenoxy) propionic acid	93-72-1	60	liver
1,2,3-Trichloropropane	96-18-4	40	kidney, liver
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	200,000	-----
1,3,5-Trinitrobenzene	99-35-4	0.3	-----
Vanadium	7440-62-2	50	-----
Vinyl chloride	75-01-4	0.2	cancer
Xylenes (mixture of isomers o, m, p)	1330-20-7	10,000	nervous system
Zinc	7440-66-6	2000	-----

The Chemical Abstracts Society Registry Number (**CAS RN**) is a unique number assigned to each substance or chemical by the American Chemical Society.

A **Health Risk Limit** is an exposure value for a concentration of a groundwater contaminant, expressed in micrograms per liter (µg/L), that can be safely consumed daily for a lifetime.

The **Toxicologic Endpoint** indicates the organ or organ system that is most sensitive to the contaminant. For carcinogens the endpoint is cancer.

Courses and Meetings, cont.

121 Pillsbury Hall, 310 Pillsbury Drive SE, Mpls, and computer labs in the Silicon Graphics Imaging Lab in 308 Mechanical Engineering Building, 11 Church Street SE, Mpls

Course Enrollment and Registration Fee

The registration fee is \$250 for graduate students and \$500 for non-students. A maximum of 25 applicants will be able to attend the course due to laboratory space limitations.

Application Process

Applications (name, affiliation, address, phone/fax/e-mail, and payment) are due by June 15, 1995 to: Dr. Mark Person, GEOFLUIDS Program Coordinator
University of Minnesota
Dept. of Geology and Geophysics,
310 Pillsbury Drive SE,
Minneapolis MN 55455
(612)625-7332, FAX: (612)625-3819, E-mail:
mperson@darcy.geo.umn.edu.

40th Annual Midwest Ground Water Conference

Columbia, Missouri, Ramada Inn, October 16 - 18, 1995

Sponsoring agencies: Missouri Department of Natural Resources, Missouri Ground Water Association, University of Missouri - Rolla, US Environmental Protection Agency - Region VII, US Geological Survey.

Session topics include:

- Regional Geohydrology/Aquifer Evaluation
- Water Quality/Geochemistry
- Agricultural Contamination
- Groundwater Management
- Computer Applications
- Legal/Policy Issues
- Groundwater Recharge
- Geophysical Applications
- Groundwater Education/Planning

For further information; Don Miller, Missouri Department of Natural Resources, Division of Geology and Land Survey, PO Box 250, Rolla, MO 65401-0250. Phone (314)368-2192; FAX (314)368-2111.

Great Lakes Environmental Directory

The National Environmental Directory Project creates regional environmental directories which together form a comprehensive national environmental directory database. Each regional directory lists and describes nonprofit organizations, government agencies and other organizations concerned with environmental education and action.

The first edition of the Great Lakes Environmental Directory covers Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin. It includes over 3170 listings in a 566-page soft cover book (\$25.00). The directory is also available on diskette (\$100.00). A geographic index is available for \$3.00.

To order by phone, call (406)543-3359, or mail order and payment to Environmental Directory Project, 8850 O'Brien Creek Road, Missoula, MT 59801.

Newsletter Advertising Policy for 1995

Advertising space is available in this newsletter to businesses and organizations. Display ads are charged by fractional page:

Quarterly Newsletter

Size	inches H x V	Annual Rate
Business Card	3.5 x 2.3	\$60
Quarter Page	3.5 x 4.8	\$110
Half Page	7.5 x 4.8	\$205
Full Page	7.5 x 9.75	\$385

1996 Membership Directory

Size	inches H x V	Annual Rate
Business Card	3.5 x 2.3	\$45
Quarter Page	3.5 x 4.8	\$90
Half Page	7.5 x 4.8	\$170
Full Page	7.5 x 9.75	\$325
Inside Cover	7.5 x 9.75	\$360

The Advertising Editor has final determination on the acceptance of materials submitted. There are no commissions on ads. Advertising copy must be received by the publications deadlines: February 15, May 15, August 11, or November 10. Since we do not do any art or camera work ourselves, and we reuse copy from issue to issue, your copy should be a photostat of your art work at the exact insertion size. Photostats give the highest quality print reproduction. MGWA will have the photostat made for a one-time extra charge of \$25 for ads submitted on plain paper unless 4 copies of the ad (one for each issue) are supplied.

Please send your copy, accompanied by a check payable to the Minnesota Ground Water Association, to the Advertising Editor (address below).

For questions on advertising orders, rates, and policy, please call Jan Falteisek, Advertising Editor, MGWA Publications, Minnesota DNR, Waters Division, 500 Lafayette Road, St. Paul, MN 55155, Phone: (612)297-3877, Fax: (612)296-0445, E-mail: jan.falteisek@dnr.state.mn.us.

Professional Geoscientist Registration Bill Passes

On May 22, 1995, Governor Carlson signed a bill to require registration of professional geoscientists in Minnesota. The bill had been introduced in both houses of the legislature as SF1170 and HF1666. Geologists will now be represented on the state board which registers other professions such as architecture, engineering & surveying.

Passage of the bill is the culmination of several years of effort by an ad hoc committee of geologists, engineers and other professionals. One of the first tests will be to develop rules to allow the bill to be implemented and determine how Minnesota's program will interface with the new national registration examination developed by ASBOG (Association of State Boards of Geology) (see MGWA Newsletter, March 1995).

GERAGHTY & MILLER, INC. *Environmental Services*



**INVESTIGATION
ENGINEERING
REMEDiation**

For more information call (612) 339-9434

A Heidemij Company

LEGGETTE, BRASHEARS & GRAHAM, INC. Professional Ground-Water Consultants

Providing Ground-Water Expertise Since 1944

- UST, RCRA, CERCLA
- Remedial Design & Implementation
- Remedial Investigations/ Feasibility Studies
- Environmental Site Assessments
- Water Supply
- Water Rights
- Computer Modeling
- Soil & Water Sampling
- Agri-Chemical Contamination Investigations
- Wellhead Protection Studies
- Petrofund Reimbursement Coordination
- Soil Gas Surveys
- Geophysics
- Dewatering & Depressurization

Northpark Corporate Center
1210 W. County Road E - Suite 700
St. Paul, Minnesota 55112
(612) 490-1405

OFFICES LOCATED NATIONWIDE

COMSTOCK & DAVIS, INC. *Civil Engineers & Land Surveyors*

Engineering

- Municipal Planning & Design
- Sewage Collection & Treatment
- Water Distribution & Treatment
- Streets & Highways
- Mobile Home & R.V. Parks
- Storm Sewer & Ponding Design
- Site Planning & Design
- Wetland Services
- Construction Management

Land Surveying

- Subdivision Planning & Design
- Residential Plats
- Industrial Plats
- Alta Surveys
- Lot & Boundary Surveys
- Topographic Surveys
- Cemetery Design & Platting
- Remonumentation Services
- GPS & GIS Services

Serving your needs statewide

Minneapolis 612-784-9346	St. Paul 612-776-6211	Grand Rapids 218-326-5325	Hutchinson 612-587-4789
Brainerd 218-829-1751	Moose Lake 218-485-4811	Lake Elmo 612-777-0024	Little Falls 612-632-2504
Bemidji 218-751-2520	St. Cloud 612-654-9556	Wadena 218-631-1859	Baudette 218-634-3050

FOR ALL YOUR WELL SUPPLY NEEDS!

- *Sta-Rite Pumps*
- *Pressure Tanks*
- *Stainless Steel & Plastic Casing*
- *Galvanized & Black Well Casing*
- *Cut Lengths & Threading of Pipe*
- *Bentonite (Baroid and Wyo-Ben)*
- *Monitor and Whitewater Pitless*
- *Valves, Fittings & Well Accessories*
- *Johnson Water Well & Monitoring Screens*



GOODIN COMPANY

PLUMBING • HEATING • AIR CONDITIONING • PIPE • VALVES • INDUSTRIAL AND WELL SUPPLIES

Minneapolis • St. Paul • Duluth • Detroit Lakes • St. Cloud • Brainerd • Medina

IN ST. PAUL

ask for Wes Vossler, Al Smith, John Voss or Vince Lewis

612/489-8831

Wats: 1-800/246-6346

PROVIDING ANALYTICAL SERVICES WITH THE QUALITY AND FLEXIBILITY THAT OUR CLIENTS DEMAND.



- ◆ SOILS
- ◆ WATER
- ◆ SOLID WASTE
- ◆ WASTE WATER
- ◆ HAZARDOUS WASTE
- ◆ PETROLEUM CONTAMINATED SOIL & WATER

**SPECTRUM
LABS INC**

ANALYTICAL ENVIRONMENTAL SERVICES

301 West County Rd. E2 St. Paul, MN 55112
Phone (612) 633-0101 Fax (612) 633-1402
or (800) 447-5221



A member of the Marmon Group of companies



**Recovery
Equipment Supply Inc.**

9060 Zachary Lane North • Suite 116
P.O. Box 322
Maple Grove, MN 55369

DAVID L. KILL, P.E.
SALES MANAGER

TEL 612-493-4818 • FAX 612-493-4812 • WATS 800-541-0518

Products for groundwater monitoring and remediation



LABORATORIES, Inc.

P.O. Box 249
NEW ULM, MN 56073-0249

Independent laboratory services, specializing in testing of groundwater, soil, hazardous wastes, sludges and drinking water.

On site sampling services available

Call: (800-782-3557)

**MALCOLM
PIRNIE**

Environmental Engineers, Scientists & Planners

Minneapolis, Minnesota

(612) 591-1394

Offices Nationwide

**GEOPROBE &
LABORATORY
SERVICES**

Serving Environmental Consultants and Industry with:

GEOPROBE SERVICES

- 4 x 4 Truck Mounted Geoprobe Model 5400
- Field Portable GC Capabilities

FULL SERVICE CERTIFIED ANALYTICAL LABORATORY

- VOC-465D
- DRO/GRO/BTEX
- Metals
- Inorganics
- Pick-up Services (Twin Cities, Duluth/Superior, Iron Range)

ENVIRONMENTAL FIELD SERVICES

- Landfill & Industrial Site Monitoring
- Groundwater and Soil Sampling
- Landfill Gas Monitoring
- Leachate and Wastewater Treatment Operations & Services

MATERIAL TESTING SERVICES

- Field and In-SITU Testing
- ASTM Laboratory Testing Services

SERVING THE STATES OF MINNESOTA, WISCONSIN, IOWA AND THE DAKOTAS

Offices in Virginia and Duluth, MN

For quotes, scheduling availability and additional services call
(800)569-4179



**rieke
carroll
muller
associates, inc.**
engineers • architects • land surveyors

minnetonka • gaylord •
st. cloud • grand rapids

10901 red circle drive, minnetonka, mn 55343
612-935-6901



SOIL ENGINEERING TESTING, INC.



*A Comprehensive Soil Mechanics
Testing Laboratory Facility For
Engineering Disciplines, Environmental
And Hydrological Applications.*

9301 Bryant Ave. So. • Bloomington, MN 55420-3436
Tel: (612) 884-6833 Fax (612) 884-6923

Geologic/hydrogeologic investigations Remedial investigations
Groundwater & contaminant transport modeling
Wetland delineation and mitigation
Landfill permitting & design Water and wastewater treatment system design



408 Board of Trade Building
Duluth, Minnesota 55802
Phone (218) 722-3915
Fax (218) 722-4548
Toll Free (800) 777-7380

**Providing Engineering & Environmental
Consulting to the Upper Midwest Since 1970**

PGI

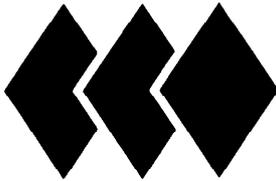
*Geotechnical Engineering Support for
Geological and Environmental Projects*

- Geotechnical site assessment
- Subsurface exploration for buildings and other structures
- Analysis: bearing capacity, settlement, slope stability
- Ground improvement and deep foundations
- Soils, bedrock, fill, waste materials
- Problem soils: organic, shrink-swell, frost-susceptible
- Field observation: excavations, drilled piers, piling
- Engineering soil classification and logging
- Geotechnical maps and cross-sections

Pendergast GeoEngineering, Inc.
Robert E. Pendergast, P.E., C.P.G., President

16 Neptune Street, St. Paul, MN 55115
Phone (612) 426-3507
Fax (612) 426-2718

612-424-4803



MATRIX
Technologies, Inc.

We provide Geoprobe sampling and analytical services to consultants

- Collection of soil core, soil vapor, ground water and air samples
- Immediate on-site analysis
- Hewlett-Packard GC equipped with purge & trap, FID PID and ECD detectors
- Petroleum hydrocarbon, chlorinated solvent and ag-chem analysis
- Leak detection

Ideal for plume definition, source identification, EA work, preliminary investigations, emergency response, and treatment system monitoring.

Call for bids. phone: 612-424-4803 fax: 612-424-9452

"Serving the Environmental Consulting Community"

Terracon

Environmental, Inc.

3535 Hoffman Road East
White Bear Lake, MN 55110

Phone 612•770•1500
Fax 612•770•1657

- regulatory compliance audits
- environmental assessments
- monitoring systems design
- remediation process design
- remediation management
- field services

40 locations serving the central and western United States — 100% employee-owned



Bay West

Environmental Consulting, Contracting, Emergency Preparedness & Response



*Supporting the Minnesota
Ground Water Association*

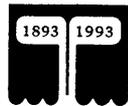
5 Empire Drive, Saint Paul, MN 55103
(612) 291-0456, (800) 279-0456

THEIN WELL

Metro
445-9380

Statewide
800-450-8000

Over 100 Years of Service



WELL CO.

- Soil Borings
- Rock Coring
- Monitoring Wells
- Remediation Wells
- Production Wells
- Well Televising
- Gamma/E-Logging
- Angle Drilling
- Well Rehabilitation
- Well Abandonment



**Certified Master
Groundwater Contractor**



RE MED IATION INC. ENGINEERING

Gary Gilbert, P.E. Senior Engineer

12333 165th Avenue
Becker, MN 55308
(612) 261-5474

- Experienced registered engineers
- Remediation system design
- Specializing in air sparging, soil vapor extraction, and fluid extraction systems
- Technology assessment field tests



Consultants in the Environmental and Applied Earth Sciences

1900 SILVER LAKE ROAD
NEW BRIGHTON, MINNESOTA 55112
(612) 631-8838

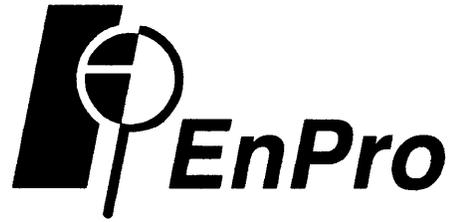


MJ ENVIRONMENTAL CONSULTANTS INC
101 W. 2nd Street, Suite 205
Duluth, MN 55802

Groundwater Investigation and Remediation
Wellhead Protection Programs
Groundwater Flow Monitoring
Aquifer Testing and Analysis
Environmental Assessments

"Investigating and Solving Environmental Concerns"

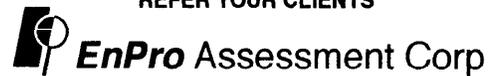
218.722.5880 800.424.9821 FAX 218.722.5764



OVERLOADED? CONFLICT OF INTEREST?

Choosing an environmental consulting firm is much like choosing a business partner. A good partnership is built on shared goals, confidence in capabilities and mutual trust.

REFER YOUR CLIENTS



Contact Client Services

821 Raymond Ave., Suite 330
St. Paul, MN 55114-1525

(612) 645-6330
Fax 645-5747

Environmental Assessments and Audits for Property Transfer and Business Acquisition

INTEGRATING ENGINEERING AND ENVIRONMENTAL EXPERTISE



Remedial investigation
Remedial action design
Environmental assessments
Permitting
Computer modeling
Hydrogeologic evaluation
Water supply and treatment
Wellhead protection

Barr
Engineering Company

8300 Norman Center Drive
Minneapolis, MN 55437-1026

555 West 27th Street
Hibbing, MN 55746

Phone: 612/832-2600
Toll free: 800/632-2277

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



**100%
recycled**

Made from over 50% Recycled Fiber
including 20% Post-Consumer Waste

Bulk Rate
US Postage
PAID
St. Paul, MN
Permit # 7122