



# Wisconsin Ground Water Association Newsletter

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## President's Message

### *An Unexpected Gift*

As we move toward the pleasant warm, relaxing days of summer, with all the attendant emphasis on the wonderful outdoor recreation activities offered in all parts of Wisconsin, it is not inappropriate, in our reveries, to reflect a bit on the water-resource profession. Only time will tell, of course, but when we look back on it, the present time is one we might be thankful for, one which presents many of us with the gift to learn the lessons of the decade just past, and what it might mean for our collective future.

The majority of Wisconsin's ground-water professionals have spent the better part of that decade working on problems related to the cleanup of petroleum spills from leaking underground and above-ground tank systems. While that work is hardly complete, certainly it is winding down. If one wants to continue to survive as a ground-water resources management professional, one had better find something else to do than work on PECFA projects!

Finding “that something else to do” has become so much of a problem for many 1990s hydrogeologists, that they have left the profession in droves. WGWA is not immune to this phenomenon; with a membership less than three quarters the size of its heyday in the mid-1990s. Nor is WGWA the only organization affected. Leaders of other groups, such as AIPG, AEG, AWRA, and even NGWA, tell us the same thing is true in those organizations.

But that is to be expected, I suppose. The UST remediation frenzy of the 1990s artificially inflated the ranks of hydrogeologists and other environmental professionals. Now that the peak of that frenzy is behind us, it is to be expected that the ranks will be deflated.

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The newsletter is published four times per year. If you have any suggestions or submissions, please contact us at: Wisconsin Ground Water Association, c/o Marilyn Weiss, WGWA Treasurer, P.O. Box 8593, Madison, Wisconsin 53708-8593. Email: [wgwainfo@wgwa.org](mailto:wgwainfo@wgwa.org); Web site: <http://www.wgwa.org>. The deadline for submissions to the summer newsletter is August 16, 2002.

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So why is this phenomenon a gift? What possibly could be a silver lining in all this?

By the time you are reading this, those of you who are NGWA members might already have read the editorial in the July-August issue of the *Journal of Ground Water*. The title, “The Lost Tribe of Hydrogeologists?,” you may recognize from a *WGWA Note* I wrote back on February 13, advertising the then upcoming joint WGWA/AWRA conference in the Dells. In that note, plus in the *Journal* editorial, I bemoan the fact that remediation professionals have become almost totally divorced from the essential goal of remediation: protection of the public health. Those of you who are students of history and who have been paying close attention to what has been going on since the onset of the PECFA program in 1989, know exactly what I mean. The “gift” of which I speak is the lesson history teaches us—if only we’re willing to pay it heed.

Never again, ought we, as professionals, be willing to sit back, and not constantly consider the “big-picture” significance of the professional activities in which we participate. The gross misspending of many billions of dollars, nationwide, on a frenzy of so-called cleanups of petroleum leaks which, with only a relatively few exceptions, never did anything to advance the protection of the public health or the environment, while many other environmental problems perhaps truly worthy of the expenditure of public funds went, and continue to go, begging, ought to be a major source of embarrassment to all of us.

What are these other “problems truly worthy of the expenditure of public funds”? Here are a few examples.

- In this water-rich state, we have somehow managed to develop ground-water shortage problems in such areas as Brown and Waukesha counties.

- It is automatically assumed that bottled water plants and mines are bad for ground water.
- In the “Arsenic Belt” to the west of Lake Winnebago in Outagamie and Winnebago counties, tens of thousands of people are drinking water so laced with arsenic that it may end up causing many to die of cancer, and
- As you will see in this and future issues of our newsletter, other problems attendant to viruses, pharmaceuticals, and endocrine disruptors in drinking- water supplies are beginning to rear what seems to many a very ugly head.
- These are all important issues. And there doubtless are many more. In my opinion, some are truly “worthy” and some are bogus. Do you have an opinion? If so, what are you going to do about it? (If not, why are you running around pretending to be an environmental professional?)
- The lessons, I believe, we must learn from the PECFA debacle include:
  - We owe it our fellow citizens to do whatever we can, as knowledgeable professionals, to make certain that these problems are—this time around—addressed with intelligent public policies.
  - We owe it to our fellow citizens to do our best to see that the solutions to these problems are focused on protection of the public health and the environment, and nothing else—least of all compliance with a generic set of numerical standards applied arbitrarily across the board, in all situations, without regard to site-specific considerations.
  - We owe it to our fellow citizens to do our best to educate them in the necessary fundamentals of hydrogeology, so that, for example (and doubtless you could think of many others), they can understand why a high-capacity well might be hugely problematic in one location but not be problematic in another.

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I want to be very careful here. I do not mean to engage in consultant-bashing. I didn't spend three years in grad school, followed by nearly 29 years in the private sector as an environmental consulting hydrogeologist to spew vitriol on the profession I love, and plan to pursue to my dying breath. After all, anyone, or any collection of "ones," is entitled to make a mistake. The collection that is all of us made one. OK. However, what were are NOT entitled to do, is to ignore that mistake, not learn from it, and repeat it, over and over again!

WGWA, and the other professional organizations to which you may belong, can be a venue for you to throw your hat in the ring to effect necessary changes in the ways in which we manage our valuable water resources, and thus solve the problems that confront us, as they come up.

For those of you who consider what it is you do to be something more than "just a job," there's never been a better time to set a professional agenda for yourself, and help bring "The Lost Tribe of Hydrogeologists" back in from the cold!

**- Boyd Possin - WGWA President**

### **Editors Note: Issue on Viruses and Bacteria**

A few years ago, well maybe quite a few years ago, while I was a hydrogeologist with the New Jersey Department of Environmental Protection, a colleague and I were assigned to investigate complaints of malfunctioning septic systems and its possible link to an outbreak of hepatitis in northern New Jersey. Much of northern New Jersey is characterized by ridges of Precambrian meta-granites, with very little soil cover due to the efficient scraping action of the glaciers.

About a dozen families had contracted hepatitis in a subdivision of 50 homes. Each home had a well for potable water and an individual septic system for waste water disposal. The "official" explanation for the outbreak of hepatitis was that all the

affected families had attended the same Tupperware party. However, before lunch of our first day at the site my colleague and I had found the "smoking gun." A septic system, designed to accommodate no more than 6 people, was receiving waste-water from a home occupied by 10 people. The first case of hepatitis in the subdivision had been reported at this house after one family had attended a "clambake." The septic system, obviously malfunctioning, was overflowing. The untreated waste water formed a continuously running rivulet down the driveway that was clogged with algae.

But that didn't explain why families throughout the subdivision had contracted hepatitis. For that we only needed to look at the design and construction records of the septic systems to notice that many of them had been built directly on bare, fractured rock, or under water, or with the laterals sloped upgrade. It seemed obvious that a Tupperware party or casual neighbor contact was not the route of transmission for the hepatitis virus. The circumstantial evidence was clear – improperly installed septic systems on top of fractured rock provides a hydrologic expressway for transmission of all sorts of contaminants, including viruses and bacteria.

This issue of the Newsletter focuses on the occurrence and mobility of bacteria and viruses in ground water. This is probably a topic most of us have never given much thought – much less had an opportunity to explore as a project. Our awareness of pathogens (any organism that can cause disease) in the Milwaukee area was brought to a crystal clear focus in 1993 with an outbreak of gastrointestinal disease caused by the *Cryptosporidium* protozoan. More than 400,000 people became ill and more than 100 people died. More recently, the anthrax attacks following the terrorist attacks of September 11<sup>th</sup> have called attention to the vulnerability of our institutions in a free society – including public water supplies.

If bacteria are found in your ground water, then it is assumed that viruses are present also. This is

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because bacteria, being relatively large (0.5 to 3.0 microns) compared to viruses (0.07 to 0.7 microns), are usually filtered out in an aquifer within a few meters. If bacteria are able to migrate through the ground water, then it is assumed that viruses can also. The oocysts (protective shells) of *Cryptosporidium*, at 6 to 10 microns, are more than twice as large as bacteria. Bacteria are used as an indicator parameter of biological contamination because the required sample size is small (no more than a few liters) and they can be grown in the laboratory on inexpensive substrate. On the other hand, to test positively for viruses requires thousands of liters of sample and they must be grown in monkey kidneys or other suitable living material.

A fair number of pathogens are capable of spreading through surface water, such as polio, cholera, and typhoid. Transmission in ground water, due to the filtering capacity of aquifer material, is much less common. But as the above example from New Jersey shows, it can happen.

*by: Wayne Hutchinson, Editor  
Delta Environmental Consultants*



## **WGWA Board Meeting**

**March 7-8, 2002—Chula Vista Resort,  
Wisconsin Dells, WI**

Persons present: Margy Blanchard, Boyd Possin, Kristen Gunderson, Marilyn Weiss, Tom Riewe, Kevin Olsen, and attendees of the joint AWRA-WGWA conference

1. Call to order about 11:05am on Thursday, March 7, 2002.
2. Election Results – Vote was held via paper ballot for proposed by-law changes. The proposed changed passed 61-0.
3. Welcome to the new WGWA officers elected this winter: Marilyn Weiss – Treasurer, Margy Blanchard – President-Elect (as well as serving as Past President), and Tom Riewe – At-Large Board Member (appointed position).
4. Next major WGWA event will be a field trip sometime in September. The Board is looking for suggestions for locations and topics.
5. Meeting adjourned about 11:10am.

**A joint Board Meeting was held on Friday, March 8, 2002 with the AWRA Board and WGWA Boards present.**

WGWA representatives present: Margy Blanchard, Boyd Possin, Kristen Gunderson, Tom Riewe, and Kevin Olsen

1. Call to order about 7:05am.
2. AWRA Business
3. Joint Business:
  - a. Student Awards – WGWA contributed \$100 to AWRA for student awards. WGWA's donation will double the number of awards given to 2 for papers and 2 for posters.
  - b. Discussion of future conferences.
4. Next WGWA meeting is tentatively set for May.

Meeting adjourned about 8:15am.

*Respectfully submitted,*

***Kristen Gunderson  
Secretary***

## **I. Introduction**

Understanding the transport and fate of microorganisms through the ground-water environment is essential for maintaining a safe drinking water supply. However, protection of ground water from viral and bacterial pathogens is significantly restricted at this time by limited data on the movement and fate of ground-water pathogens at the field scale. According to DeBorde and others (1977), existing studies have also focused primarily on virus and bacteria in the aqueous phase and not that portion bound to the aquifer matrix, which may account for over 90% of the total microbes in a contaminated aquifer. These bound microorganisms have slower die-off or inactivation rates than microorganisms in ground water and represent a major source of pathogens for continued contamination of a ground-water supply. Therefore, there is a persistent risk to human health, especially considering that one infectious dose could be as small as one to a few viruses or bacteria. This article will present some fundamental concepts on pathogen survival and transport in ground water and some insight on how to evaluate fate and transport with mathematical models.

## **II. Pathogen Survival and Transport**

The organisms most responsible for water-borne diseases include bacteria such as Salmonella and Vibrio, viruses such as Hepatitis A and Poliovirus, and protozoa such as Cryptosporidium (remember that one Milwaukeeans!) and Giardia (Teutsch and others, 1991). Potential indicators of the presence of fecal contamination in ground water (but not pathogens themselves) include coliforms, fecal coliforms, and coliphage. Major sources for pathogens in ground water include defective and improperly designed or installed septic tanks, sewage sludge land applications, intentional ground-water recharge with sewage, undetected sewage system leakage, and improperly maintained or closed landfill sites.

According to Teutsch and others (1991) and Abu-Ashour and others (1994), whether ground water is

contaminated with pathogens depends on the survival and transport rate of the specific pathogens in the system. Pathogen survival and transport rate are influenced by the physical and chemical properties of the system's ground water and soil as well as the identity and physical state of the organisms. The transport of pathogens is also affected by the hydrology of the ground-water system. One important characteristic of organisms is their ability to compete for substrate and nutrients (Fallon and Perri, 1996). Pathogens survive longer in ground water and soil where organic matter is readily available. Ground water is also the means for substrate and nutrient transport as well as organism transport. On the other hand, an organism will have a shorter survival time in the presence of its predators or competing organisms, which will limit available nutrients. Toxic organic matter such as antibiotics will also decrease the survival rate of the microorganisms. Survival rates for floc-forming organisms are higher because of the protection and opportunity to share resources within the floc. Microorganism transport will also be influenced by the size of other members of the population by limiting the pore spaces that the organism is able to move through without encountering blockage (Teutsch and others, 1991; Abu-Ashour and others, 1994).

The pH of the environment is an important factor and affects the solubility of compounds and the charge distribution in the system, which affects the adsorption of organisms onto soil. The advantages of soil adsorption, similar to the floc formation advantages, include protection and nutrient/substrate sharing by the organisms (Fallon and Perri, 1996). Other environmental characteristics that affect microorganism survival and transport include temperature and hydrology. Temperature affects the die-off rates of the organisms, especially in viruses. Higher temperatures increase the die-off rate while organisms in lower temperatures have a lower die-off rate. An increase in temperature will also cause an increase in molecular diffusion. Finally, the characteristics of the aquifer (*e.g.*, hydraulic conductivity, soil/rock structure) will affect

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the velocity and direction of pathogen transport in ground water.

### III. Using Models to Assess Pathogen Transport

Although few in number, mathematical models that are used to predict microbial fate and transport in aquifer soil and ground water are generally based on two transport mechanisms: advection and dispersion. Advection refers to the movement of organisms by ground water in the direction of flow, and is controlled by the average linear velocity of ground water. Dispersion is the movement and spreading of organisms in ground water by molecular diffusion (which is the migration of solutes from regions of higher to lower concentration) and mechanical mixing (which is a function of the variation in aquifer media pore size, path lengths, and pore friction). However, according to Harvey (1991), an important control on the extent of bacte-

rial movement in sandy aquifers is the interaction between the bacteria and solid surfaces, which can involve a number of complex and interactive processes that are difficult to describe mathematically. Small-scale, forced-gradient experiments have shown that immobilization of bacteria-sized microspheres was inversely related to size, suggesting that sorption and not straining (*i.e.*, physical heterogeneities) was the important control over the extent of transport. The objective of these studies was to evaluate the use of filtration theory in mathematical descriptions of bacteria transport through sandy aquifers.

As stated in Fallon and Perri (1996), mass conservation equations that are used to model the fate of microorganisms in the subsurface include Monod kinetics to represent the growth of organisms; first-order functions to represent filtration of organisms through medium; and linear, Freundlich, or Langmuir isotherms to represent adsorption to particles. According to Abu-Ashour and others (1994), the typical assumptions in these models include: 1) homogeneous and isotropic soil, 2) Darcy's Law, 3) steady, one-dimensional flow, and 4) thermodynamic equilibrium between sorbed and aqueous states. However, there are problems with these assumptions. The models assume that organisms behave as a dissolved contaminant while their behavior is closer to a colloidal model (small particles [such as microorganisms] suspended in ground water). The models also do not include changes in porosity and permeability due to the presence of organisms.

In addition, studies rely on dye traces that may not provide accurate representation of organism flow as pathogens may travel faster or slower than the average flow velocity of ground water. Studies by Harvey and George (1989) found that, in the absence of chemical gradients, unattenuated bacteria may be transported more quickly than a conservative tracer simply on the basis of bacterial size. Faster transport relative to a chemical tracer has also been observed in experiments involving microorganisms not indigenous to aquifers. As examples (Harvey and George, 1989), hydrogen sulfide producing strains of *Escherichia coli* were

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found to move through a New Zealand aquifer more quickly than rhodamine WT dye, and it has been observed that nonadsorbed viruses appear to travel through aquifer soils approximately 1.5-1.9 times faster than halide tracers.

Some pathogens also get around by another mode of travel that we don't have to consider with typical organic/inorganic contaminants – THEY SWIM! In this regard, research has focused on the swimming behavior of individual bacteria through porous media in well-defined experimental systems. Complexities associated with the natural subsurface environment are then added to the controlled system. Mathematical modeling and sophisticated computational methods (such as Monte Carlo analysis) are coupled to the experimental work and are used to develop framework equations for bacterial swimming patterns and transport at the field-scale.

Pollution of drinking-water aquifers by organic contaminants has led to considerable interest in using nonindigenous or waste-adapted bacteria for bioremediation of organically contaminated aquifers. A study by Harvey and Barber (1992) investigated the association of free-living bacteria (FLB) and dissolved organic contaminants in a 4-kilometer long plume of sewage-contaminated ground water. It has been assumed that the smaller, unattached segment of the bacterial population in an aquifer contributes little to bioremediation, since a majority of the bacteria in contaminated aquifer soils are reported to be attached to solid surfaces (Harvey and others, 1984). However, it has been shown that subsurface bioremediation rates do not necessarily correlate with microbial density (Hickman and Novak, 1989) and, in one study, most of the degradation potential appeared to be associated with FLB and not the attached population. Therefore, due to their potential importance, the role of FLB in the breakdown of organic ground-water contaminants should be given greater attention in fate and transport models.

## IV. Final Comments

Similar to transport modeling of organic and inorganic solutes, it is apparent that “one model does not fit all” with respect to pathogen behavior in ground water. A sound understanding of physical heterogeneities in the system is also critical in investigative interpretation of microbial behavior in ground water and when compared to conservative solutes. Studies also indicate that physical variability over relatively short distances can also lead to changes in apparent dispersion and retardation between microorganisms and conservative tracers. As a result, it is clear that many important questions and studies remain both in the micro- and macro-environments in understanding pathogen survival and transport in ground water.

**By: Dave Nader**  
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*The editorial board is soliciting WGWA and non-WGWA members to provide modeling articles and reviews for Model Speak. To submit articles or provide suggestions for articles you would like to see, please contact Deborah Kerr (deb\_kerr@urscorp.com) at URS Corporation (262-782-7281).*

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## **“Special Well Casing Depth Area”**

### **Established In Winnebago County for Arsenic Contamination**

Effective April 22, 2002, new wells constructed within portions of the Towns of Algoma and Omro must be constructed, grouted and disinfected according to stringent standards. These new standards go well beyond both the minimum requirements of the State Private Well Code (NR 812) and the construction specifications of the “Arsenic Advisory Area” of northeastern Wisconsin. On April 22<sup>nd</sup> the Bureau of Drinking Water & Groundwater (Bureau) established this “Special Well Casing Depth Area”, a roughly rectangular area located along the western suburban fringe of the City of Oshkosh. (Figure 1).

This area has the highest density of arsenic-contaminated wells of any area located within the much larger “Arsenic Advisory Area” (“AAA”) established by the Bureau in 1993. The “AAA” is approximately 10 miles wide and extends diagonally through Winnebago and Outagamie Counties. Some wells in the Town of Algoma have produced water containing some of the highest concentrations of arsenic ever found in the world.

Since 1993 the Wisconsin Department of Natural Resources (WDNR) has recommended new wells constructed within the “AAA” be cased and grouted to a depth at least 80 below the main sulfide mineralized layer known as the “Sulfide Cement Horizon” (SCH). This roughly 10-foot thick layer exists in the bedrock sequence found throughout the “AAA”. WDNR researchers think this layer is the main ‘culprit’ that releases arsenic into the groundwater. When this layer is completely cased off, wells are much less likely to produce water containing significant concentrations of arsenic.

Constructing wells to these new more stringent standards in the “Special Casing Depth Area” within the Towns of Algoma and Omro will involve alternate drilling methods and the installation of casing pipe to a depth even deeper than the recommendations of the “AAA”. These deeper casing settings will allow new wells to withdraw

water from deeper bedrock formations that produce water with little or no arsenic, radioactivity or heavy metal contaminants.

To be able to withdraw water from below arsenic producing zones, wells in this area must now be constructed with cement grouted casing extending to the top of the Cambrian Sandstone. In this area Cambrian Sandstone lies below either the St. Peter Sandstone or the Prairie du Chien Dolomite, whichever of these two formations happens to overlie the Cambrian Sandstone at any given property. In most cases these specifications will necessitate extending grouted casing to a depth anywhere from about 200 to 260 feet below the ground surface. Since the sequence of the formations can be somewhat complicated and variable, the Bureau has provided geological cross-sections to the Licensed Well Drillers who work in this area. This information should help them determine if their proposed casing depth settings will extend all the way to the top of the Cambrian Sandstone.

This is the first area of this type established within the “AAA”. The Bureau based the decision on the severity of naturally-occurring arsenic contamination affecting many existing wells in this area. Results of recent extensive sampling surveys in northeastern Wisconsin indicated a high percentage of wells produce water containing high levels of arsenic. Of 1,273 existing wells recently sampled in the Town of Algoma, 513 (40.3 %) exceeded the new drinking water standard of 10 micrograms/liter ( $\mu\text{g}/\text{l}$ ). Ten percent of these wells (127 of 1,273 wells) produced water with arsenic exceeding the previous drinking water standard of 50  $\mu\text{g}/\text{l}$ . [Dave Johnson, Personal Communication]

Over a lifetime, the risk of developing cancer from consuming well water containing elevated concentrations of arsenic are very high when compared to potential risks from other water contaminants.

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Scientific estimates of the risks of developing cancer from drinking water with arsenic exceeding 50 µg/l range from one in 1,000 to one in 100. These risks are very high compared to risks associated with ground-water contaminants like volatile organic chemicals (VOCs) or pesticides, which typically have risk factors in the range of one in a million to one in 100,000.

Although the specifications recommended for the “AAA” have worked adequately for most of this large area, two problems with these specifications prompted the establishment of this new “Special Casing Depth Area”. First, the well specifications for the “AAA” are recommendations only. Thus, until recently, in the Towns of Algoma and Omro wells could be legitimately constructed to the minimum casing depth standards of the well code. In fact, due to cost considerations, most new wells were constructed to these minimum code standards. This allowed wells to be constructed with only 40 feet of casing or casing extending only to the top of the first bedrock. These wells typically have bedrock drillholes that extend through and are open to the SCH, so they are much more likely to produce water with elevated levels of arsenic. This is because when the SCH becomes exposed to the air within the well, the minerals become oxidized and more soluble.

Secondly, within the last year large housing subdivisions were planned for this suburban area just west of Oshkosh. Within the next 20 years, as many as seventeen hundred living units are planned for these subdivisions to be located just west and south of the area that has a very high density of arsenic-contaminated wells exist. Many new private wells are likely to be constructed for these proposed living units. If special casing depth requirements had not been established for this area, most of these new wells would be constructed to only meet the minimum standards of the Private Well Code. Such wells would be open to the mineral-laden bedrock horizon within the bedrock. Researchers think oxidation of these minerals eventually causes arsenic to be released into the well water and the surrounding ground water.

Fortunately, there is a provision in our Well Code [s. NR 812.12(3)] that allows the Bureau to establish ‘Special Casing Depth Areas’ anywhere in the State. Within such designated areas we can require more stringent well construction specifications, including deeper casing settings to extend below and beyond the contaminated formations. Since the 1950s the Drinking Water Program has established about 55 of these areas throughout the State. Over the years the provisions of these ‘special areas’ have been very successful in providing for the construction of wells that produce contaminant-free water.

This new “Special Well Casing Depth Area” includes approximately 16 square miles situated just west of the City of Oshkosh. This roughly square area is bounded on the north by Lake Butte Des Morts, on the east by Highway 41, on the south by County Highway K, and on the west by County Highway FF. The area extends west to County Highway FF in order to include the “Galena-Black River Escarpment” where the sulfide-cement horizon could be present in the subsurface. Identifiable landmarks and roads delineate this area so the boundaries will be easily recognizable to Licensed Well Drillers, Town of Algoma and Omro residents and WDNR program personnel (See Figure 1 on Page 11).

Within this ‘Special Well Casing Depth Area,’ private wells must be constructed with alternate construction methods and more stringent standards for construction, grouting and disinfection methods. Some of the more important specifications include the following:

- The upper-enlarged drillhole must be constructed using rotary mud-circulation methods. Rotary-air methods are not allowed for this purpose because circulation of vast volumes of compressed air through the sulfide mineralized zones of the bedrock can oxidize these minerals. Oxidation converts them to more soluble forms that can be more easily release arsenic into the ground water.

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## Special Well Casing Pipe Depth Area Towns of Algoma & Omro, Winnebago Co.

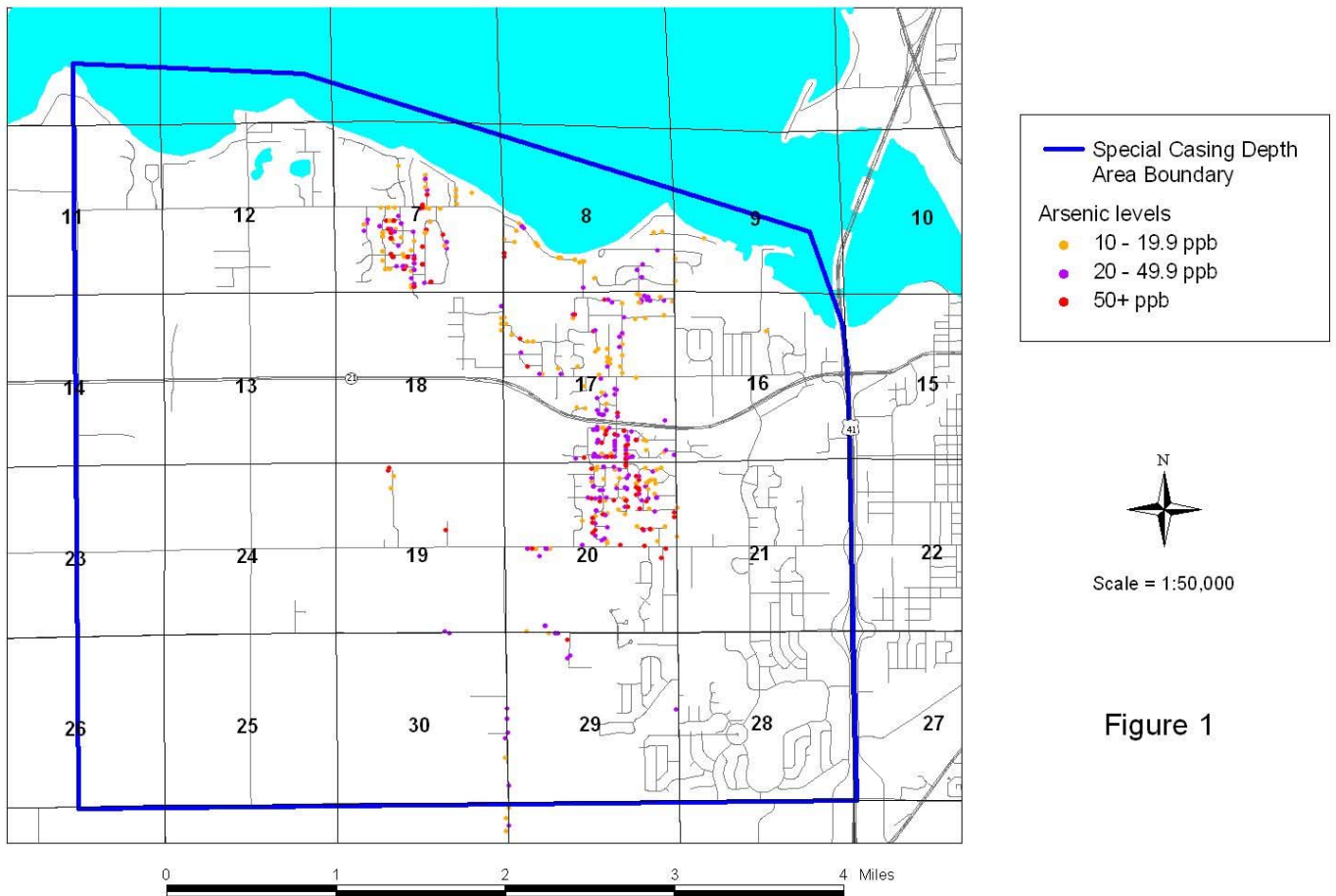


Figure 1

- The cement grout must be pumped into the annular space using either the 'Bradenhead or the 'Grout Shoe' grouting method according to the requirements of Private Well Code (NR 812.20).
- The lower open bedrock drillhole must be drilled using rotary-mud or "rotary-wash" drilling methods (rotary water-circulation methods). Rotary-air methods may **not** be used for this purpose.

Upon completion of the well, an approved additive-free liquid chlorine (sodium hypochlorite) product must be used to disinfect the well.

- Dry calcium hypochlorite products (granular or pellet type) are **not** allowed for disinfection because they increase the chances for oxidation of the sulfide mineralization zones, a process that can also release arsenic into the ground water. The chlorine solution may **not** have a concentration greater than 100 milligrams per liter (mg/l), and may not have a contact time in the well of more than 30 minutes.

After this time has elapsed, the solution must be thoroughly flushed out of the well with water, **not** with air.

Fortunately this newly established "Special Casing Depth Area" is located within the larger "Arsenic Advisory Area" where the WDNR has, for almost ten years, recommended that new wells be constructed using more stringent well construction and disinfection specifications. Thus, the newly required specifications will not be a totally new concept for the residents of this area or for the Licensed Well Drillers. Since April 22<sup>nd</sup> several wells have been constructed to these much more stringent specifications within this area. Not only have these wells been successfully completed, but they are also producing water with little or no arsenic.

For more information on this topic and arsenic in general, please go to [www.dnr.stat.wi.us/org/water/dwg/arsenic/Recommend.htm](http://www.dnr.stat.wi.us/org/water/dwg/arsenic/Recommend.htm)

by: *Tom Riewe*  
*Bureau of Drinking Water and Groundwater*  
*Wisconsin Department of Natural Resources*

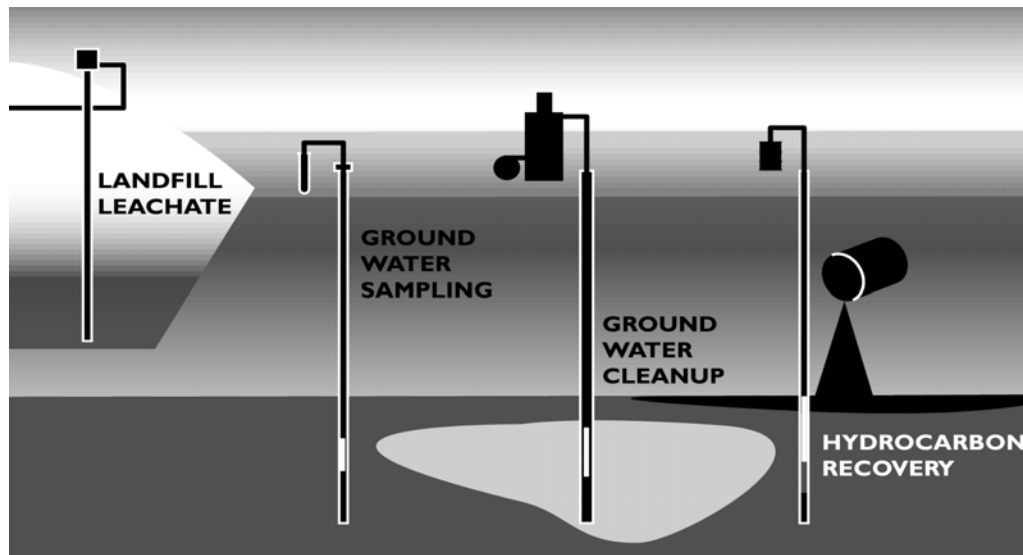


Wisconsin's Ground Water Specialists

## TCL Process Technologies

*Tom & Chris Lawn*

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## WGWA/AIPG Fall 2002 Field Trip

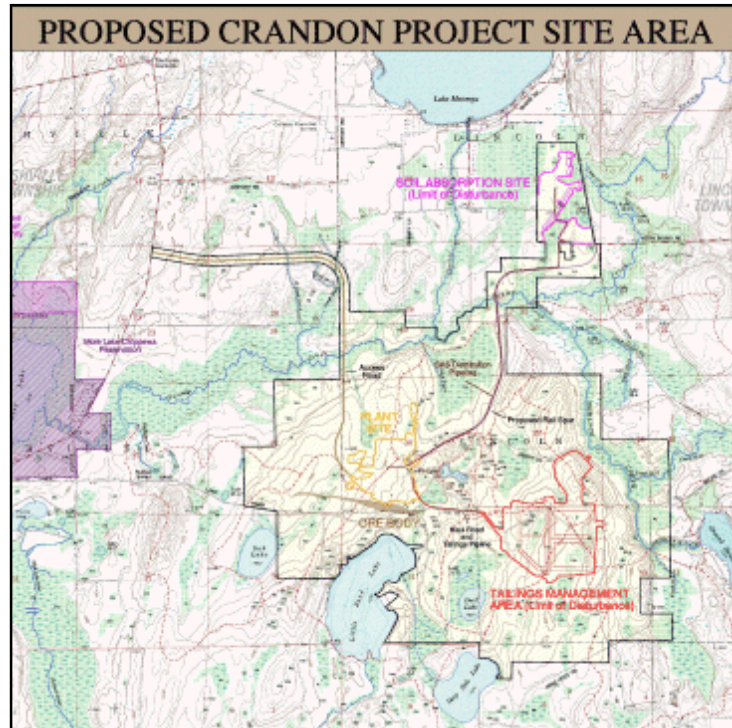
Mark your calendars! September 27 and 28, 2002 will be days you want to set aside for an informative, though enjoyable and fun, trip to the colorful Northwoods! The boards of directors of WGWA and AIPG have teamed up to organize a field trip to the proposed site of the Crandon Mine and tour the abandoned underground Caledonia Copper Mine in the Upper Peninsula (UP) of Michigan.

The general agenda of the trip involves meeting in Rhineland at Holiday Acres Resort at noon on Friday, September 27, 2002. At 12:30 PM our coaches leave Holiday Acres for the Crandon Mine. We have reserved two coaches (*not* school buses!) to drive us to our stops. We will have commentary along the way by hard-rock geologists and glacial geologists.

On Friday, we will see the Crandon Mine, Precambrian outcrops at Monico, and the mine Core Shack back in Rhineland. The coaches will bring us back to Holiday Acres for a buffet dinner. Friday evening entertainment will consist of a presentation on the geology of northern Wisconsin and the UP.



On Saturday morning we will board coaches to take us to Caledonia Copper Mine in the UP—a 2-hour drive from Rhineland. Geologic commentary will be provided along the way. We will enjoy a tour of the mine and a Copper Miners lunch of pasties. The coaches will return us to our vehicles at Holiday Acres in Rhineland in the late afternoon.



The trip will cost \$110 for adults and \$75 for children and students. Meals and coach transportation is included in the cost, but lodging is not. You must make your own arrangements for lodging. However, WGWA has negotiated a per room cost (including taxes and regardless of the number of persons sharing a room—most have two queen-size

beds—including tax, for only \$82! Note, though, that rooms throughout the Northwoods on that weekend will be at a premium. That weekend is the first official weekend of the Fall Color Season! So call the Holiday Acres Resort at 1-800-261-1500 to reserve early and save a spot!

A registration form for the field trip is included on the next page of this newsletter, please don't delay in signing up, this is one trip you don't want to miss!



**2002 AIPG/WGWA Fall Field Trip Reservation Form**  
**Friday, September 27 and Saturday, September 28, 2002**

Fill out this form, and mail it along with a check in the appropriate amount, made out to "Wisconsin Ground Water Association," and mail both to:

**WGWA**  
**P. O. Box 8593**  
**Madison, WI 53708-8593**

Primary Attendee: \_\_\_\_\_ Phone: \_\_\_\_\_  
 Affiliation: \_\_\_\_\_  
 Mailing Address: \_\_\_\_\_  
 City: \_\_\_\_\_ State: \_\_\_\_\_ ZIP: \_\_\_\_\_ E-Mail: \_\_\_\_\_

You may attend one day, or both days of the trip. On Friday we visit Nicolet Minerals' proposed mine facility in the Crandon Area. Saturday we will visit the Caledonia Mine, an abandoned underground copper mine in the UP.

**INSTRUCTIONS: Enter number of persons in each category, and compute cost. Enter computed cost in right hand column, and the total at the bottom. If you do not wish to partake of the entire trip, then use the "ala carte" options to indicate in which portions of the trip you will participate.**

Feature	Adult Cost	Student/Child Cost	Total
Entire Trip (includes two buffets and Saturday Lunch)	____@ \$110	____@ \$75	\$

(ala carte)

Friday Crandon Mine Tour	____@ \$25	____@ \$15	\$
Saturday Copper Mine Tour (includes miner's pasty lunch)	____@ \$65	____@ \$55	\$
Friday Evening Buffet	____@ \$15		\$
Saturday Morning Buffet	____@ \$10		\$
<b>Total Enclosed</b>			\$

The full trip will include three meals. Friday evening and Saturday morning will be buffets at the Holiday Acres Resort near Rhinelander. Saturday's lunch will be an authentic miner's pasty lunch, served on-site at the Caledonia Mine.

**The above fees DO NOT INCLUDE accommodations on Friday evening.** However, WGWA has reserved a block of hotel rooms at the Holiday Acres Resort, at the rate of \$80.10, including tax, and without regard to the number of persons sharing the room (the rooms have two double beds). The Resort also has several dozen multi-bed cabins available, which you can reserve at WGWA's 10% discounted rate. Contact the Holiday Acres Resort, toll-free, at 1-800-261-1500. Tell them you are part of the WGWA Fall Field Trip to get the special room or cabin rate.

Questions? E-mail them to WGWA President, Boyd Possin, at [wgwanotes@wgwa.org](mailto:wgwanotes@wgwa.org), or give him a call at 920-434-5023.

**Account Summary**  
**April 1, 2002 to June 30, 2002**

<b>BEGINNING BALANCE April 1, 2002</b>	<b>\$16,151.45</b>
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	DEPOSITS	WITHDRAWALS	BALANCE
<b>Membership</b>			
2002 Membership Dues	1050.00		
2002 Membership Refunds			
Mailings			
<b>Subtotal</b>	<b>1050.00</b>	<b>0.00</b>	<b>17201.45</b>

<b>Fall Field Trip (2002)</b>			
Deposit		1922.40	
Miscellaneous Costs		155.19	
<b>Subtotal</b>	<b>0.00</b>	<b>2077.59</b>	<b>15123.86</b>

<b>2002 AWRA/WGWA Conference</b>	<b>0.00</b>	<b>0.00</b>	<b>15123.86</b>
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<b>Summer 2001 Newsletter</b>	<b>0.00</b>	<b>0.00</b>	<b>15123.86</b>
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<b>Fall 2001 Newsletter</b>	<b>0.00</b>	<b>0.00</b>	<b>15123.86</b>
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<b>Winter 2002 Newsletter</b>			
Web Services		400.00	
<b>Subtotal</b>	<b>0.00</b>	<b>400.00</b>	<b>14723.86</b>

<b>Web Site</b>			
Internet Provider			
Web Site Updates			
<b>Subtotal</b>	<b>0.00</b>	<b>0.00</b>	<b>14723.86</b>

<b>Miscellaneous</b>			
Bank Charges			
Office Supplies		13.00	
Post Office Box			
State Incorporation Filing			
<b>Subtotal</b>	<b>0.00</b>	<b>13.00</b>	<b>14710.86</b>

	DEPOSITS	WITHDRAWALS	BALANCE
<b>ENDING BALANCE June 1, 2002</b>	<b>\$1,050.00</b>	<b>\$2,490.59</b>	<b>\$14,710.86</b>



## Wayne's Web World

### ***“Bacteria and Viruses”***

For the past twenty-five years, the occurrence and transport of biological agents in ground water has received little attention compared to ground-water contamination by metals and organic compounds. Health departments routinely require that new drinking-water wells be tested for coliform bacteria, and most research regarding bacteria transport centered on the filtering efficiency of sand beds at water treatment plants.

The outbreak of *Cryptosporidium* in the Milwaukee area in 1993 focused attention on the vulnerability of the nation's water supply to water-borne diseases. The terrorist attacks of September 11<sup>th</sup> have heightened awareness of our vulnerability – including drinking-water sources throughout the nation.

Websites focusing on viruses and bacteria are often clearinghouses for information and research on a particular infectious disease. However, a couple websites contain information on a variety of viruses and the United States Geological survey maintains a website specifically for subsurface microbiology. Interestingly, bacteria are not discussed in any detail on any of the websites reviewed. Websites devoted to microbiological research or transport include:

#### **Virology on the Net**

<http://www.virology.net/>

This website includes many links to information on viruses available on the Internet, including virology and research, information on specific viruses, extensive information about Acquired Immune Deficiency Syndrome (AIDS), plant viruses, vaccines and treatments, and organizations and groups focusing on virus research.

Information on general virology information is also available for biological warfare and from the Centers for Disease Control (CDC). A very complete listing of national and international virus websites is included, as well as a picture book of viruses, on-line virology courses, and Virology News.

#### **Viruses – From Structure to Biology**

<http://medicine.wustl.edu/~virology/>

This website is more like an encyclopedia on viruses. It includes articles on general virus structure, influenza, polio, and plant viruses. An extensive historical timeline of virus research and discoveries is a unique feature of this website.

#### **USGS – Subsurface Microbiology Research**

[http://www.brr.cr.usgs.gov/projects/EC\\_bacteria/](http://www.brr.cr.usgs.gov/projects/EC_bacteria/)

The United States Geological Survey (USGS) maintains a website devoted to subsurface microbiological research. The opening page of the website includes clickable icons for Project Descriptions, Publications and Data, Research Information, Collaboration, Education, and Facilities.

An active link is provided to the upcoming International Symposium on Subsurface Microbiology (ISSM) 2002 being held in Copenhagen, Denmark in September 2002. The first ISSM was held in Orlando, Florida in 1990. A separate ISSM website is under development at <http://www.issm.net/default.htm>.

Topics covered by the ISSM traditionally have included biological degradation of organic compounds, microbiology on the deep seafloor, microbiology in caves and mines, and viral transport. Numerous complete research papers available as Adobe pdf or Microsoft Word files under Publications and Data. A link to a listing of websites that discuss bioterrorism will probably grow substantially in the coming months.

Check out the websites noted above for a little information on viruses and subsurface biological transport – topics that most hydrogeologists do not study or confront in their careers.

*by: Wayne Hutchinson*

*Delta Environmental Consultants*

## A Message from the Wisconsin Wetlands Association

Wisconsin Wetlands Association (WWA), in collaboration with the Wisconsin Department of Natural Resources, county conservationists, UW Extension and various other organizations, is seeking CITIZEN VOLUNTEERS to participate in a purple loosestrife survey of all Wisconsin Great Lakes counties this summer.

We have organized orientation and training sessions throughout the region for citizens interested in surveying our coastal counties for the invasive wetland plant, purple loosestrife. This activity is open to people of all ages. The data that volunteers gather will be useful in identifying infestations of this invasive species, and will be posted in an Internet-accessible GIS at [www.glifwc-maps.org](http://www.glifwc-maps.org), the web site of the Great Lakes Indian Fish and Wildlife Commission, one of our collaborators. The DNR will use the information for building its volunteer biological control program for purple loosestrife that includes releasing a loosestrife-eating beetle into target areas.

More information about the survey is posted at our web-site: [www.wiscwetlands.org](http://www.wiscwetlands.org).

Individuals interested in the surveys can contact Derek Strohl at (608) 250-9971 or [derek@wiscwetlands.org](mailto:derek@wiscwetlands.org).

Purple Loosestrife Volunteer Training Workshops  
[A brief presentation and slide show will preface the sign-up. Refreshments will be served!!]

Kenosha County  
Bristol, Monday July 8, 7:30 PM, Pringle Nature Center

Racine County  
Racine, Tuesday July 9, 7:30 PM, Riverbend Nature Center

Milwaukee County  
Milwaukee, Wednesday July 10, 7:00 PM, Urban Ecology Center

Ozaukee County  
Saukville, Tuesday July 9, 5:30 PM, UW-Milwaukee Field Station

Sheboygan County  
Sheboygan Falls, Tuesday July 16, 7:00 PM, Agriculture Office

Manitowoc County  
Manitowoc, Thursday July 18, 7:00 PM, County Office Complex

Kewaunee County  
Kewaunee, Thursday July 11, 7:30 PM, Dana Farm Ski Chalet

Brown County  
Green Bay, Wednesday July 10, 5:00 PM, Brown County Extension Building

Door County  
Sturgeon Bay, Wednesday July 17, 8:00 PM, Courthouse  
Egg Harbor, Thursday July 18, 8:00 PM, Egg Harbor Public Library

Oconto County  
Peshtigo, Friday July 26, 7:30 PM, DNR Service Center

Marinette County  
Crivitz, Saturday July 27, 9:00 AM, Village Hall

Douglas County  
Superior, Monday July 22, 6:30 PM, Courthouse  
Solon Springs, Tuesday July 30, 6:30 PM, Community Center

Bayfield County  
Cable, Tuesday July 23, 5:30 PM, Community Center  
Ashland, Tuesday July 23, 7:30 PM, Northern Great Lakes Visitors' Center

Wisconsin Wetlands Association  
222 S. Hamilton St., Ste. 1  
Madison, WI 53703  
(608) 250-9971  
[derek@wiscwetlands.org](mailto:derek@wiscwetlands.org)  
[www.wiscwetlands.org](http://www.wiscwetlands.org)

## Calendar of Events

**What:** Comm 47 (PECFA) Code Advisory Committee Meeting. The main topic of discussion at this meeting will be issues having to do with the bidding of site remediations.

**When:** Wednesday, July 24, 2002, from 9:00 AM to 3:00 PM

**Where:** 1st Floor Conference Room, 201 West Washington Avenue, Madison. (The meeting possibly might be moved to the large 3rd floor conference room--check with Dennis Legler.)

**Cost:** Free

**Contact:** Dennis Legler, PECFA Program, [dlegler@commerce.state.wi.us](mailto:dlegler@commerce.state.wi.us)

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**What:** NR 700 Consultant Focus Group Meeting. This will be a joint meeting with the RR Program's NR 700 Implementation Team, led by Sally Kefer. This team is responsible for evaluating how our administrative rules and technical procedures are implemented in the regions. Each of our regions has a member on this team. This joint meeting should be an interesting dialogue between the consultants and the NR 700 Team.

**When:** Monday, August 12, 1:00 PM to 3:30 PM

**Where:** LOWELL CENTER, 610 Langdon Street, in Madison. The Lowell Center is about 2 blocks east of the Memorial Union on the UW Campus (building # 71 on the map (see link below). The map also shows parking areas. We are scheduled for the Lowell lower lounge, but please check the marquee when you arrive in case we are moved to a different room. We can use the room until 4:00. <http://conferencing.uwex.edu/graphics/gifs/campuscloseup.gif>

**Cost:** Free

**Contact:** Laurie Egge, DNR, [egrel@dnr.state.wi.us](mailto:egrel@dnr.state.wi.us)

**What:** DNR/Commerce/USEPA--Videoconference on Available Brownfields Dollars. Interested in getting your fair share of brownfields grant and loans? The Wisconsin Department of Natural Resources (DNR), the Wisconsin Department of Commerce and the U.S. Environmental Protection Agency (EPA) are holding a free videoconference on 7 state and federal brownfield grant programs worth \$160 million. The training will be held at 14 locations across the state. This information will be helpful for towns, villages, cities, counties, tribes, non-profits, community development authorities, redevelopment authorities, housing authorities, developers, and trusts as they investigate, cleanup and reuse their brownfield properties.

**When:** August 21, 2002, 8:30 AM - 12:30 PM

**Where:** Eau Claire, Green Bay, Janesville, Kenosha, La Crosse, Madison (Conference Headquarters), Milwaukee, Oshkosh, Platteville, Rhinelander, Sheboygan, Spooner, Stevens Point, and Superior. (See web site below for detail on locations).

**Cost:** Free

**Contact:** Pre-registration is required. For registration information and site location information, go to: <http://www.dnr.state.wi.us/org/aw/rr/rbrownfields/index.htm#register>

*(Continued from page 18)*

**What:** Comm 47 (PECFA) Code Advisory Committee Meeting. (Agenda to be announced.)

**When:** Wednesday, August 21, 2002, from 9:00 AM to 3:00 PM

**Where:** 1st Floor Conference Room, 201 West Washington Avenue, Madison.

**Cost:** Free

**Contact:** Dennis Legler, PECFA Program, [dlegler@commerce.state.wi.us](mailto:dlegler@commerce.state.wi.us)

**What:** Comm 47 (PECFA) Code Advisory Committee Meeting. (Agenda to be announced.)

**When:** Wednesday, September 18, 2002, from 9:00 AM to 3:00 PM

**Where:** 1st Floor Conference Room, 201 West Washington Avenue, Madison.

**Cost:** Free

**Contact:** Dennis Legler, PECFA Program, [dlegler@commerce.state.wi.us](mailto:dlegler@commerce.state.wi.us)

**What:** NR 700 Focus Group (Entire committee. Agenda items to be announced.)

**When:** October 14, 2002, 1:00 to 4:00 PM

**Where:** GEF 2 (WDNR Headquarters), Madison (Room 611A)

**Cost:** free

**Contact:** Laurie Egge - WDNR, 608-267-7560, [egrel@dnr.state.wi.us](mailto:egrel@dnr.state.wi.us)

**What:** Comm 47 (PECFA) Code Advisory Committee Meeting. (Agenda to be announced.)

**When:** Wednesday, October 16, 2002, from 9:00 AM to 3:00 PM

**Where:** 1st Floor Conference Room, 201 West Washington Avenue, Madison.

**Cost:** Free

**Contact:** Dennis Legler, PECFA Program, [dlegler@commerce.state.wi.us](mailto:dlegler@commerce.state.wi.us)

**What:** Waters of Wisconsin Fall Forum. (From conference web site: At this statewide public forum, we will gather to share information about the status and long-term sustainability of Wisconsin's waters and issue a formal report with recommendations. Through fieldtrips and the arts, participants will also celebrate water as we enjoy it in all aspects of our lives. Please join us for this important event on October 21-22, 2002 at the Monona Terrace Convention Center in Madison, Wisconsin. The Waters of Wisconsin Forum is being developed with the guidance of a Forum Planning Committee made up of representatives from water communities across the state. Members of the Forum Planning Committee were selected from the Waters of Wisconsin Committee, the Waters of Wisconsin Advisory Network, and the Wisconsin Academy Board.)

**When:** October 21-22, 2002

**Where:** Monona Terrace Convention Center, Madison, Wisconsin

**Cost:** TBA

**Contact:** Amanda Okopski, Forum Director, at 608/263-1692, ext. 22 or [aokopski@facstaff.wisc.edu](mailto:aokopski@facstaff.wisc.edu).

**What:** NR 700 Consultant Focus Group Meeting. (Agenda to be announced.)

**When:** Monday, November 11, 1:00 PM to 3:30 PM

**Where:** GEF 2 (WDNR Headquarters), Madison (Room 611A)

**Cost:** Free

**Contact:** Laurie Egge, DNR, [egrel@dnr.state.wi.us](mailto:egrel@dnr.state.wi.us)

**What:** Comm 47 (PECFA) Code Advisory Committee Meeting. (Agenda to be announced.)

**When:** Wednesday, November 13, 2002, from 9:00 AM to 3:00 PM

**Where:** 1st Floor Conference Room, 201 West Washington Avenue, Madison.

**Cost:** Free

**Contact:** Dennis Legler, PECFA Program, [dlegler@commerce.state.wi.us](mailto:dlegler@commerce.state.wi.us)



# Join the Wisconsin Ground Water Association Today!

Please take a few moments and become a member of WGWA. Annual dues are \$15 for students, \$30 for individuals, and \$150 for corporate members, and are payable to WGWA. Corporate memberships allow companies to register six members at a discounted rate.

For new members, just complete the following form and send to: Wisconsin Ground Water Association, Attn: Marilyn Weiss, WGWA Treasurer, P.O. Box 8593, Madison, WI 53708-8593.

**INDIVIDUAL MEMBERSHIP:**      **Regular Member:**  \$30      **Student Member:**  \$15

Name: \_\_\_\_\_ Firm: \_\_\_\_\_

Position: \_\_\_\_\_

Mailing Address: \_\_\_\_\_

City    State    ZIP Code (9 digits)    \_\_\_\_\_

Telephone Number: (\_\_\_\_\_) \_\_\_\_\_ Fax: (\_\_\_\_\_) \_\_\_\_\_

E-mail: \_\_\_\_\_

Are you interested in participating in any WGWA Committees?

- Newsletter     Membership     Web Site
- Legislation     Program & Education
- Special Interests: \_\_\_\_\_
- Please check if you do not wish to be listed in a WGWA membership directory.

**CORPORATE MEMBERSHIP:**  \$150

Firm: \_\_\_\_\_

Mailing Address: \_\_\_\_\_

City    State    ZIP Code (9 digits)    \_\_\_\_\_

Telephone Number: (\_\_\_\_\_) \_\_\_\_\_ Fax: (\_\_\_\_\_) \_\_\_\_\_

E-mail: \_\_\_\_\_

Corporate Members:

- 1) \_\_\_\_\_
- 2) \_\_\_\_\_
- 3) \_\_\_\_\_
- 4) \_\_\_\_\_
- 5) \_\_\_\_\_
- 6) \_\_\_\_\_

Please check if your company does not wish to be listed in a WGWA membership directory.