WISCONSIN GROUNDWATER COORDINATING COUNCIL

REPORT TO THE LEGISLATURE

August 2000

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State of Wisconsin \ GROUNDWATER COORDINATING COUNCIL

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August, 2000

To: The Citizens of Wisconsin
The Honorable Governor Tommy G. Thompson
Senate Agriculture and Environmental Resources Committee
Assembly Environment Committee
Assembly Natural Resources Committee
Secretary Terrence D. Mulcahy - Department of Transportation
Secretary Brenda J. Blanchard - Department of Commerce
Secretary Ben Brancel - Department of Agriculture, Trade and Consumer Protection
Secretary Joe Leean - Department of Health and Family Services
Secretary George E. Meyer - Department of Natural Resources
President Katharine Lyall - University of Wisconsin System
State Geologist James Robertson - Geological and Natural History Survey

This is the 2000 Groundwater Coordinating Council (GCC) Report to the Legislature. The GCC was formed in 1984 to help state agencies coordinate non-regulatory activities and exchange information on groundwater. The GCC has served as a model for interagency coordination and cooperation among state government officials, the Governor, local government and federal government. It has achieved the distinction of being one of the few groups in the nation to effectively coordinate groundwater activities in its state from an advisory position.

Excellent examples of GCC-coordinated groundwater accomplishments by your state agencies during the past year are several activities related to arsenic in drinking water:

- The Education Subcommittee of the GCC reviewed and endorsed a brochure that was produced by the DNR and DHFS to inform citizens about naturally occurring arsenic in Wisconsin's groundwater (see Appendix).
- An Arsenic Study Group was formed in 1999 consisting of staff from the various state agencies represented on the GCC as well as representatives from EPA, local county health departments, UW Extension, National Institute of Health and the Wisconsin Water Well Association. The Study Group met several times to identify data needs and recommend ways to fill gaps in the current knowledge base.
- DHFS staff, in conjunction with local DNR and health departments, are embarking on a private well-testing campaign in three counties adjacent to or contained within the Arsenic Advisory Area.
- Five new projects were funded by the GCC to address issues related to arsenic (see Table 2). These activities will allow the state to proactively understand and develop solutions for the arsenic issue and its related health impacts.
- DNR, as directed by the Arsenic Study Group, embarked on sampling 3,300 public wells for arsenic across the state.

We hope you, your staff, and the public will find this report a useful reference in protecting Wisconsin's valuable groundwater resource.

Sincerely,

Susan L. Sylvester, Chair
Groundwater Coordinating Council

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LIST OF ABBREVIATIONS AND ACRONYMS

AAA ..... Arsenic Advisory Area
ACCP ..... Agricultural Chemical Cleanup Program
ASR ..... Aquifer Storage and Recovery
BMP ..... Best Management Practices
BRRTS ..... Bureau of Remediation and Redevelopment Tracking System
CERCLA ..... Comprehensive Environmental Response Compensation Liability Act
COD ..... chemical oxygen demand
COMM ..... Department of Commerce (formerly DILHR)
CWGC ..... Central Wisconsin Groundwater Center
DATCP ..... Department of Agriculture, Trade and Consumer Protection
DHFS ..... Department of Health and Family Services
DILHR ..... Department of Industry, Labor and Human Relations
DIN ..... decision item narrative
DNR ..... Department of Natural Resources
DOT ..... Department of Transportation
EPA ..... U. S. Environmental Protection Agency
ERC ..... Environmental Resources Center
ERS ..... Division of Environmental and Regulatory Services
ES ..... Enforcement Standard
ESA ..... ethane sulfonic acid
FHWA ..... Federal Highway Administration
FSA ..... (USDA) Farm Service Agency
FSTRAC ..... Federal/State Toxicology and Risk Analysis Committee
FY ..... Fiscal Year
GCC ..... Groundwater Coordinating Council
GEMS ..... Groundwater and Environmental Monitoring System
GIS ..... Geographic Information System
GMU ..... Geographic Management Unit
GPS ..... Global Positioning System
GS ..... Groundwater Section
GRAC ..... Groundwater Research Advisory Council
GRN ..... Groundwater Retrieval Network
IPM ..... Integrated Pest Management
LUST ..... Leaking Underground Storage Tank
LWRV ..... Lower Wisconsin River Valley
mg/L ..... milligrams per liter
MOU ..... Memorandum of Understanding
NPM ..... Nutrient and Pest Management
NRCS ..... (USDA) Natural Resource Conservation Service
PAL ..... Preventive Action Limit
PCB ..... polychlorinated biphenyl
PCR ..... polymerase chain reaction
PECFA ..... Petroleum Environmental Clean-up Fund Act
PMP ..... Pesticide Management Plan
ppb ..... parts per billion
ppm ..... parts per million
RR ..... Bureau for Remediation and Redevelopment
SEWRPC ..... Southeast Wisconsin Regional Planning Commission
SLOH ..... State Laboratory of Hygiene
SMP ..... State Management Plan

SWAMP..... System for Wastewater Applications, Monitoring, and Permits
SWAP .....Source Water Assessment Program
TDS.....total dissolved solids
µg/L ..... micrograms per liter
UIC ..... Underground Injection Control
USDA ..... U.S. Department of Agriculture
UW .....University of Wisconsin
UWEX ..... University of Wisconsin Extension
UWS .....University of Wisconsin System
USGS ..... U.S. Geological Survey
VOC..... volatile organic compound
VPLE .....Voluntary Party Liability Exemption
WGNHS..... Wisconsin Geological and Natural History Survey
WHP ..... Wellhead Protection
WPDES..... Wisconsin Pollution Discharge Elimination System
WRI .....Water Resources Institute
WUWN.....Wisconsin Unique Well Number

EXECUTIVE SUMMARY

This is the Report to the Legislature by the Groundwater Coordinating Council (GCC) as required by s. 15.347, Wisconsin Statutes. The report describes the condition and management of the groundwater resource and summarizes the Coordinating Council's activities for fiscal year (FY) 2000.

In 1984, the Legislature enacted Wisconsin Act 410 to improve the management of the state's groundwater. The GCC is directed by s. 160.50, Wis. Stats., to "serve as a means of increasing the efficiency and facilitating the effective functioning of state agencies in activities related to groundwater management. The Groundwater Coordinating Council shall advise and assist state agencies in the coordination of non-regulatory programs and the exchange of information related to groundwater, including, but not limited to, agency budgets for groundwater programs, groundwater monitoring, data management, public information and education, laboratory analysis and facilities, research activities and the appropriation and allocation of state funds for research."

Membership of the GCC includes the Secretaries of the Departments of Natural Resources (DNR); Commerce; Agriculture, Trade and Consumer Protection (DATCP); Health and Family Services (DHFS); Transportation (DOT); the President of the University of Wisconsin System (UWS); the State Geologist; and a representative of the Governor. Members are listed on the inside of the front cover.

Since its last report, agency staff, coordinated by the Groundwater Coordinating Council have accomplished the following:

1. The GCC and the UWS Groundwater Research Advisory Council continued coordination of the annual solicitation for groundwater research and monitoring proposals among state agencies. Twenty-five projects were funded in FY 00 by one or more of the following agencies: UWS, DATCP, and DNR. The projects funded are listed in Table 1. The locations of the field sites for the projects are shown in Figure 1. A joint solicitation for groundwater-related monitoring and research project proposals for funding in FY 01 was distributed in October 1999. A copy of the joint solicitation is contained in the Appendix. A total of 30 project proposals were received. The UWS, DNR, and/or DATCP selected eighteen new projects for funding in FY 01 in addition to 8 projects which will carry over into the new fiscal year. The FY 01 groundwater monitoring and research projects and their funding agency are listed in Table 2. The GCC endorsed the UWS groundwater research plan for FY 01 as required by s. 160.50(1m), Wis. Stats.

2. Proposal Writing Workshop. As an attempt to improve the quality and focus of proposals submitted during the Joint Solicitation, the GCC sponsored a workshop for proposal writers on October 27th, 1999. There were 23 attendees of which half had never submitted a proposal into this process before. The mechanics of the solicitation was covered with a review of agency priorities. Emphasis was given to what reviewers look for in each proposal and tips on what makes a good proposal. A live web page demonstration was also given. Attendees commented that this workshop was well worth the 3 hours of time it took. Several of those in attendance subsequently submitted proposals and were funded in FY 01. In addition, the proposals were consistent with funding priorities.

3. Arsenic in Drinking Water. The Education Subcommittee of the GCC reviewed and endorsed a brochure that was produced by the DNR and DHFS to inform citizens about naturally occurring arsenic in groundwater of Wisconsin (see appendix). In addition, an Arsenic Study Group was formed in 1999 consisting of staff from the various state agencies represented on the GCC as well as representatives from EPA, local county health departments, UW Extension, National Institute of Health and the Wisconsin Water Well Association. The Study Group met several times to identify data needs and recommend ways to fill gaps in the current knowledge base. DHFS staff in conjunction with local DNR and health departments are embarking on a well-testing campaign in three counties adjacent to or contained within the Arsenic Advisory Area. Five new

projects were funded by the GCC to address issues related to arsenic (See Table 2). These activities will allow the state to proactively understand and develop solutions for the arsenic issue and its related health impacts.

4. Through several of its subcommittees, the GCC continued to address important data management issues. Data management activities included continuation of projects to eliminate duplicate Wisconsin Unique Well Numbers (WUWN) and make scanned images of well construction reports available to agency staff; improved access to the Groundwater Retrieval Network (GRN) by other state agencies (GRN is currently available to DNR staff on its intranet); and evaluation of minimum data elements needed for future database design and redesign.

5. The GCC has continued to work with representatives of federal agencies to promote communication and coordination of federal and state groundwater activities. Representatives from the Natural Resource Conservation Service (NRCS), the U. S. Geological Survey (USGS), and Farm Service Agency (FSA) attend GCC meetings and serve as *ex officio* subcommittee members. The groundwater activities of the USGS and NRCS are summarized in the Appendix.

A World Wide Web site for the Groundwater Coordinating Council (GCC) continues to operate (*http://www.dnr.state.wi.us/org/water/gcc/index.htm)*. The site provides information on the activities of the council, a list of members on the council and members of the subcommittees, documents in web viewable and downloadable format, and links to other relevant groundwater or related web sites.

INTRODUCTION

PURPOSE

The Groundwater Coordinating Council is required by s. 15.347, Wis. Stats., to prepare a report which "summarizes the operations and activities of the council..., describes the state of the groundwater resource and its management and sets forth the recommendations of the council. The annual report shall include a description of the current groundwater quality of the state, an assessment of groundwater management programs, information on the implementation of ch. 160, Wis. Stats., and a list and description of current and anticipated groundwater problems." This report is due each August. The purpose of this report is to fulfill this requirement for FY 00.

The section, "Summary of Agency Activities" describes groundwater management programs and implementation of ch. 160, Wis. Stats., by the individual state agencies. "Groundwater Monitoring and Research" provides information on monitoring and research activities to address groundwater issues in Wisconsin and describes the condition of the groundwater resource. The activities of the Groundwater Coordinating Council and its subcommittees are described under "Coordination Activities" and in the minutes which are contained in the Appendix. The recommendations of the Council are contained in "Directions for Future Groundwater Protection." In addition, this year we have included a brochure “Arsenic in Drinking Water,” produced by the Department of Natural Resources in cooperation with the State Department of Health and Family Services, and reviewed by the GCC Education Subcommittee.

SUMMARY OF WISCONSIN’S GROUNDWATER LEGISLATION

Wisconsin has a long history of groundwater protection. The culmination of this effort was adoption and implementation of 1983 Wisconsin Act 410, Wisconsin's Comprehensive Groundwater Protection Act, which was signed into law on May 4, 1984. The law expanded Wisconsin's legal, organizational, and financial capacity for controlling groundwater pollution. The Groundwater Protection Act created chapter 160, Wisconsin Statutes, which serves as the backbone of Wisconsin's program. Chapter 160, Wis. Stats., provides a multi-agency comprehensive regulatory approach, using two-tiered numerical standards, based on the premise that all groundwater aquifers in Wisconsin are entitled to equal protection. There are a number of major components to Wisconsin's groundwater protection program:

1) Standards. Under chapter 160, Wis. Stats., the Department of Natural Resources (DNR) must establish state groundwater quality standards based on recommendations from the Department of Health and Family Services (DHFS). Standard setting is a continuing process based on a priority list of substances detected in groundwater or having a high possibility of being detected, established by the DNR in conjunction with other state agencies. The state groundwater standards are contained in chapter NR 140, Wisconsin Administrative Code. For each substance there is an enforcement standard (ES) which determines when a violation has occurred and a preventive action limit (PAL) which is set at a percentage of the ES. The PAL serves as a trigger for possible remedial action.

2) Regulatory Programs. Once groundwater quality standards are established, all state agencies must manage their regulatory programs to comply. Each state regulatory agency must promulgate rules to assure that the groundwater standards are met and to require appropriate responses when the standards are not met. The state regulatory agencies are the DNR (solid and hazardous waste, industrial and municipal wastewater, spills, wetlands and water supply); the Department of Commerce (private sewage systems, petroleum product storage tanks); the Department of Agriculture, Trade and Consumer Protection (DATCP) (pesticide use and storage and fertilizer storage); and the Department of Transportation (DOT) (salt storage). The implementation of the groundwater standards by the state agencies is described under "Summary of Agency Activities".

3) Aquifer Classification. One of the most important features of Wisconsin's groundwater law is an item that was omitted. When Wisconsin was debating the groundwater protection legislation, the U. S. Environmental Protection Agency (EPA) tried to develop a nationwide groundwater approach. A keystone of EPA's proposal was aquifer classification - a scheme whereby each aquifer would be classified according to its potential use, value or vulnerability, and then would be protected to that classification level. This entails "writing off" certain aquifers as industrial aquifers not entitled to protection and never again usable for human water supply. Wisconsin said "no" to aquifer classification. The philosophical underpinning of Wisconsin's groundwater law is the belief that all groundwater in Wisconsin must be protected equally to assure that it can be used for people to drink today and in the future.

4) Monitoring and Data Management. At the time the groundwater legislation was created, there was concern that Wisconsin needed a groundwater monitoring program to determine whether the groundwater standards were being met. Therefore, a groundwater monitoring program was created under s. 160.27, Wis. Stats. Money from the Groundwater Account of the Environmental Fund has been used for problem-assessment monitoring, regulatory monitoring, at-risk monitoring, and management-practice monitoring, as well as establishment of a data management system for collection and management of the groundwater data. See the "Groundwater Monitoring and Research" discussion in this report for further information.

5) Research. Although all state agencies must comply with the groundwater standards, the processes by which groundwater becomes contaminated, the technology for clean-up, the mechanisms to prevent contamination, and the environmental and health effects of the contamination are often not well understood. In addition, the basic data on geology, soils, and groundwater hydrology is often not available. The UWS and the state agencies have recognized that additional efforts in these research areas are badly needed. The Governor and the Legislature included a new groundwater research appropriation for the UWS beginning with the 1989-1991 biennial budget. During the past year, the UWS, DATCP, DNR and Commerce participated in a joint solicitation for groundwater-related research and monitoring proposals for funding during fiscal year 2001. See the "Groundwater Monitoring and Research" section for more details.

6) Coordination. In establishing the groundwater law, the Legislature recognized that management of the state's groundwater resources was a responsibility divided among a number of state agencies. Therefore, the Groundwater Coordinating Council was created to advise and assist state agencies in the coordination of non-regulatory programs and the exchange of information related to groundwater. The Coordinating Council has been meeting since 1984. See the "Coordination Activities" discussion in this report.

7) Local Groundwater Management. The Groundwater Protection Act clarified the powers and responsibilities of local governments to protect groundwater in partnership and consistent with state law.

   a. Zoning authority for cities, villages, towns and counties was expanded to "encourage the protection of groundwater."

   b. Counties can adopt ordinances regulating disposal of septage on land (consistent with DNR requirements); cities, villages, or towns may do so, if the county does not.

   c. Counties can regulate (under DNR supervision) well construction and pump installation for certain private wells.

   d. Property assessors must consider the time and expense of repairing or replacing a contaminated well or water supply when assessing the market value of real property; they must consider the "environmental impairment" of the property value due to the presence of a solid or hazardous waste disposal facility.

The following report is intended to update the Legislature and Governor on the status of the state's groundwater program and the activities of the Groundwater Coordinating Council.

SUMMARY OF AGENCY ACTIVITIES

The groundwater management efforts undertaken by the member agencies of the Groundwater Coordinating Council during the past year show that Wisconsin continues to have a strong commitment to protection of its groundwater resource.

DEPARTMENT OF NATURAL RESOURCES

The DNR has statutory authority as the central unit of state government to protect, maintain and improve groundwater within the state (s. 144.025(1), Wis. Stats.). The DNR establishes the groundwater quality standards for the state under authority of s. 144.025(2)(b) and ch. 160, Wis. Stats. The DNR also has specific groundwater-related regulatory programs.

DNR regulatory programs to protect groundwater are the responsibility of four Bureaus:

1. Bureau of Drinking Water and Groundwater – Regulates public water systems and private drinking water supply wells. The Groundwater Section assists in coordinating groundwater activities of the DNR, as well as other state agencies.

2. Bureau of Waste Management - Regulates and monitors groundwater at proposed, active, and inactive solid waste facilities and landfills.

3. Bureau for Remediation and Redevelopment - Oversees clean-up actions at spills, abandoned containers, state funded responses, closed wastewater and solid waste facilities, hazardous waste corrective action and generator closures, and sediment clean-up actions.

4. Bureau of Watershed Management - Regulates, through issuance of WPDES permits, the discharge of municipal and industrial wastewater, by-product solids and sludge disposal from wastewater treatment systems and wastewater land treatment/disposal systems. The Bureau also issues WPDES permits for discharges associated with clean-up sites regulated under the responsibility of the Bureau for Remediation and Redevelopment.

Bureau of Drinking Water and Groundwater

Groundwater Section Activities

The Groundwater Section (GS) is responsible for adoption of groundwater standards contained in ch. NR 140, Wis. Adm. Code, development of an annual groundwater monitoring plan, coordination of the joint solicitation for groundwater-related monitoring and research proposals, review and management of groundwater monitoring projects, coordination of groundwater components of basin plans and of nonpoint source priority watershed projects, coordination of wellhead protection and source water assessment activities, and maintenance of a data management system for groundwater data.

Groundwater Standards. Chapter 160, Stats., requires the DNR to develop numerical groundwater quality standards, consisting of enforcement standards and preventive action limits. Chapter NR 140, Wis. Adm. Code, establishes groundwater standards and creates a framework for implementation of the standards by the DNR. On April 1, 2000, revision of the existing standards for toluene and xylene went into effect in ch. NR 140, Wis. Adm. Code. To date, 120 health-based groundwater standards have been set.

In May 2000, the DNR sent a request to the Department of Health and Family Services (DHFS) asking them for groundwater standard recommendations for alachlor ethane sulfonic acid (ESA) and molybdenum and review the existing standards for naphthalene. Additionally, in July 2000, the DNR sent a request to DHFS asking them to review the existing standards for butylate and dacthal. The DNR anticipates receiving recommendations from DHFS in late 2000.

GS staff serve on the Bureau for Remediation and Redevelopment Standards and Streamlining Team which identifies policy issues, develops guidance, and provides training regarding the implementation of chs. NR 720, 722, 724 and 726 dealing with soil cleanup standards, selecting and implementing remedial actions and case closures. The team is also responsible for developing additional NR 720 soil standards, supporting groundwater standards development and streamlining the cleanup process.

GS staff also serve on the Consistency Team which evaluates and makes recommendations promoting consistency for statewide issues affecting the DNR's Bureau for Remediation and Redevelopment. These issues include, in part, site investigations, soil and groundwater remediation, and general case closure decisions. This team's function is critical in obtaining statewide consistency in how the Bureau for Remediation and Redevelopment evaluates, addresses and closes soil and groundwater contamination sites.

GS staff serve on the PECFA (Petroleum Environmental Cleanup Fund Act) Issues Team which is working in concert with the Department of Commerce to develop joint agency rules to cleanup petroleum contaminated sites in Wisconsin. The focus is on cleaning up sites in a cost-effective manner while protecting public health and the environment. Both agencies have adopted emergency rules and are in the process of making the emergency rules permanent.

GS staff serve on the PCB (Polychlorinated Biphenyl) Soil Criteria Advisory Committee which has the charge of advising the Department in establishing rule language for PCB soil criteria protective of human and ecological health, in order to regulate land application of dredged sediments, sludges and other materials that have been contaminated with PCBs.

GS staff serve on the Federal/State Toxicology and Risk Analysis Committee (FSTRAC). This group, comprised of representatives from several states and EPA, provides a valuable format to exchange information and promote solutions to water quality, public health and drinking water issues.

In September 1996, GS staff published revisions to the DNR's Groundwater Sampling Desk Reference and Field Manual. Both the Desk Reference and the Field Manual were revised for the first time since 1987 due to numerous advances in groundwater sampling and monitoring technology in recent years. The new documents go into much greater detail on how to consistently collect high quality, representative groundwater samples and measurements. During FY 98 both the Desk Reference and Field Manual were widely distributed and well received. The two documents are available on the Bureau of Drinking Water and Groundwater's web page (*http://www.dnr.state.wi.us/org/water/dwg/gw/sample.htm*).

Groundwater Monitoring and Data Management. DNR continues its groundwater monitoring program, composed of problem assessment monitoring, at-risk monitoring, management practice monitoring, regulatory monitoring, and monitoring planning. During FY 00, $301,542 was awarded to 11 projects selected during the joint solicitation process described under "Groundwater Monitoring and Research" in this report. During FY 01, $336,713 was awarded to 10 projects for management practice monitoring. Eight projects are new studies selected during this year's joint solicitation process.

Under direction of the GCC, the UW Water Resources Institute (WRI) and GS staff continued to distribute the findings of groundwater monitoring and research funded through the joint solicitation process. In FY 95 DNR and Water Resources Center (now WRI) staff and principal investigators wrote summaries of 72 final reports. These summaries were published together in the "Wisconsin Groundwater Research and Monitoring Project Summaries" (WDNR PUBL-WR-423-95) in September 1995. In FY 97 these summaries were made available on the WRI

World Wide Web site (*http://www.wri.wisc.edu/wgrmp/wgrmp.htm*). Paper copies of all final reports and summaries continue to be distributed by the WRI and DNR.

The DNR continued to support and upgrade its well forms program that electronically captures, prints, exports, and imports all well-related information. The six forms are: Monitoring Well Construction Form 4400-113A, Monitoring Well Development Form 4400-113B, Well/Drillhole/Borehole Abandonment Form 3300-5B, Soil Boring Log Information Form 4400-122 and 122A, Groundwater Monitoring Well Information Form 4400-89, and Groundwater Monitoring Inventory Form 3300-67. The program was introduced in conjunction with special Wisconsin Unique Well Number (WUWN) tags specifically designed for monitoring wells. Over 20,000 tags have been sent out to consultants and drillers.

GS staff inspected a number of monitoring well drilling operations in FY 99. These inspections are designed to educate drillers and environmental consultants about NR 141 and to enhance compliance with the code. Efforts continue to educate operators and consultants on the proper techniques for geoprobe operation.

GS staff continue to review the application and effectiveness of new technologies for remediation. Horizontal drilling, direct push technologies and different sampling protocols are among the major items reviewed. Staff have also advised Remediation and Redevelopment, Waste and Watershed staff on well design and monitoring plans.

Wellhead Protection. The DNR is the lead state agency for developing and implementing the Wisconsin Wellhead Protection (WHP) Plan. The specific goal of Wisconsin's plan is to achieve groundwater pollution prevention in public water supply wellhead areas consistent with the state's overall goal of groundwater protection. To achieve this goal the DNR, working with other state and federal agencies and extensive citizen input, developed a two-part state WHP Program. A WHP plan must be developed for any new municipal water supply well constructed since May 1, 1992. The plan must be approved by the DNR's Public Water Systems Section. A WHP Plan is voluntary for any public water supply well approved prior to May 1, 1992; the DNR promotes and encourages but does not require wellhead protection planning for existing wells.

The DNR continues a statewide public information effort aimed at encouraging water utilities to protect their water supplies from potential sources of contamination through wellhead protection planning. Wellhead protection activities are coordinated through a Wellhead Protection Standing Team created in January of 1998. Among the activities undertaken this past year were:

- *Developing and distributing a video promoting WHP*. Production of a promotional video "An Ounce of Prevention" was completed in January. In early February, copies of the video were sent to nearly 525 water utility owners and mayors across Wisconsin to encourage them to protect their water supply through wellhead protection. The video describes wellhead protection planning through real-life community experiences in three Wisconsin communities; it also includes an introduction by Secretary George Meyer. A press release was also distributed and information on the video was added to the DNR's wellhead protection website. Two weeks after the video was sent out, a follow up letter was sent further encouraging municipalities to be proactive in safeguarding their water supply. A checklist was also included so that the water utility owners and mayors could request publications or other assistance from the Department. To date, we have sent out about 685 copies of the video and responded to over 50 returned checklists.

- *Working with local communities on WHP planning*. Three Groundwater Section staff have split up the state for purposes of assisting communities requesting assistance with WHP. In response to the video distributed in February, the three staff members have begun meeting with communities around the state. The DNR is also working with the Wisconsin Rural Water Association in providing assistance.

- *Updating WHP publications.* The DNR has revised and distributed three publications, a brochure called "Wellhead Protection – An Ounce of Prevention," "Groundwater – Wisconsin's Buried Treasure," and "A Template for Preparing Wellhead Protection Plans for Municipal Wells." Work has begun to revise a water conservation publication, "Saving Wisconsin's Water."

- *Upgrading the DNR's WHP website*. The Department continues to update its WHP website (*http://www.dnr.state.wi.us/org/water/dwg/gw/whp.htm*) as new information becomes available. It currently includes general information on WHP, an annotated bibliography, a list of contacts for more information, a list of available publications, example WHP ordinances, and past and present issues of the Wisconsin Wellhead Protection News. Several DNR WHP publications have been added to the website in viewable and downloadable formats.

- *Keeping track of wellhead protection activity*. The Department has developed a database to keep track of communities working on wellhead protection planning, whether required or voluntary. The Department completed a mandatory biennial report to the EPA in October on communities involved in wellhead protection planning.

- *Coordinating efforts with the Source Water Assessment Program.* The WHP Team continues to work closely with the Source Water Protection Team to provide consistency and continuity between the two programs. One area where the teams are working together is promoting advanced WHP Area delineations. In order to provide the most accurate information available to assist in WHP planning, the DNR has funded or is funding regional groundwater modeling studies in about 15 counties (see Source Water Assessment discussion below). In addition to providing a valuable planning tool for communities in these counties, the models will provide advanced delineations of the recharge area for each of the municipal wells in these areas. This is an important part of the WHP planning process.

Source Water Assessments. The DNR received USEPA approval of Wisconsin's Source Water Assessment Program (SWAP) Plan in November 1999. The plan was submitted to meet the requirements of the 1996 Safe Drinking Water Act Amendments. In the next four years the program will: 1) delineate source water protection areas for all public water systems in the state; 2) conduct inventories of significant potential contaminant sources within those areas; 3) perform an analysis of susceptibility for each system; and 4) make the results of the assessments available to the public.

Source water areas for the larger groundwater systems are being delineated through regional groundwater flow modeling studies. The DNR has funded or is funding groundwater modeling efforts in the Lower Fox River Valley, the 7 counties in southeast Wisconsin, Dane, Sauk, Eau Claire, Rock and La Crosse counties, and the Central Sands Area. A modeling effort in Pierce and St. Croix Counties is also being explored. For the smaller systems, calculated fixed radius or fixed radius delineations will be used. In coordination with the State's Vulnerability Assessment Program, maps of these delineations are sent to each system with a request for system operators to identify potential contaminant sources within the delineated areas.

Additionally, SWAP funding is enabling the DNR to coordinate the collection of potential contaminant source data and integration among numerous environmental programs including the DNR's Remediation and Redevelopment, Waste Management, and Watershed Management programs. This data will be used along with well construction, hydrologic, geologic, and other information to determine each system's susceptibility to contamination. Assessments for surface water systems will also use potential contaminant source information for sources located within Great Lakes and Lake Winnebago watersheds.

Coordination of groundwater components of basin plans and of nonpoint source priority watershed projects. GS staff have worked with basin planners to develop more specific groundwater reports for basin plans. This includes better baseline water quality information and inventorying of potential threats to the resource. Staff also participate on the Rock River Coalition Groundwater Issues Team. The Team has focused on cataloging data and resources, contaminant sources and karst features and promoted 6 well abandonment demonstrations.

During FY 00, Geographic Management Units (GMU) around the state began the process of developing State of the Basin reports with direction from Water Division and Land Division guidance on integrated planning. This guidance sets the framework for developing reports that identify resource conditions in GMUs, ecosystem-based

priorities and projects to restore or maintain ecosystem health for both land and water resources. These reports replace Water Quality Management (WQM) plans required under Section 208 of the Clean Water Act and NR 121, Wis. Adm. Code and will help meet strategic planning requirements for Fish and Wildlife Service grant funds.

State of the Basin (or GMU) reports provide baseline information on surface water, groundwater and land resources. Their main focus will be on priority issues that are identified by the respective GMU and their partnership group. The plans will also identify geographic priorities for the nonpoint source program. The GS is involved in integrated planning by providing basic data on groundwater for each GMU and more detailed information as is needed. The GS is uniquely suited to highlight areas in need of management based on groundwater issues and nonpoint source priority areas related to groundwater.

Other Bureau Activities

In 1999 the Bureau of Drinking Water & Groundwater established a statewide Arsenic Study Group. This Group was established because of the increased incidence of arsenic in wells; the effects of a potential federal drinking water standard change; and unresolved drilling method and construction specification issues. The Arsenic Study Group professionals have expertise in various fields that relate to naturally occurring arsenic in groundwater. The group includes DNR Drinking Water & Groundwater staff, representatives from other State agencies, EPA, the United States and the Wisconsin Geological Surveys, UW System, UW Extensions, Local County Health Departments, the National Institute of Health, and the Wisconsin Water Well Association. The group initial meetings were focused on determining informational voids that needed to be filled. This will allow the state to proactively understand and develop solutions for the arsenic issue and its related health impacts.

After several meetings the Arsenic Study Group provided approximately 20 recommendations. These recommendations included gathering existing data, analyzing for voids in data, beginning new research activities, and developing information/education materials for the citizens of the state. The Arsenic Study Group recommendations/needs list will evolve as new data provides the group additional insight to the problem. One of the first recommendations acted upon was the production of a brochure entitled “Arsenic in Drinking Water” which is included as part of this report. During FY 00 the DNR reallocated approximately $80,000 to perform raw water sampling of Municipal, Other Than Municipal, and Non Transient Noncommunity wells. In addition, 2.5 FTE from the Drinking Water & Groundwater program work duties have been reassigned to respond to citizens and take action on several of the other needs identified. Finally, through the Joint Solicitation process for FY 01, approximately $235,000 has been allocated during FY 01-02 for 4 research projects related to the arsenic issue.

The Bureau of Drinking Water and Groundwater is attempting to identify and evaluate any impacts to state groundwater quality that may arise from the use of aquifer storage and recovery (ASR) systems by public water utilities. ASR systems involve the injection of treated drinking water via a well into a suitable bedrock aquifer. The injected water is stored underground until the time it is needed to meet the needs of a utility’s customers. During a high demand event the stored drinking water is pumped back up the same injection well and recovered into the water distribution system with little need for additional treatment to remove potential drinking water contaminants.

Currently, two ASR pilot studies are anticipated. The first study is partially funded by the American Water Works Association Research Foundation and is underway in Oak Creek, Wisconsin. A proposal for the second ASR pilot study is being developed by the Green Bay Water Utility. Initial questions to be investigated include: (1) the identification of any geochemical interactions that may trigger an unwanted release of additional groundwater pollutants and (2) the potential for in-situ degradation of any chemical by-products of water treatment and disinfection processes (chloroform, bromoform, etc.) that may be found in the injected water.

New federal rules governing the underground placement of fluids took effect on April 5, 2000. Every state is expected to establish a program to control underground injection practices in a manner that is at least as stringent as the new federal rules. If a state chooses not to develop its own regulatory program, then the United States

Environmental Protection Agency (EPA) is obligated to directly implement the federal Underground Injection Control (UIC) program requirements.

The newly promulgated UIC rules clarify that the definition of an *injection well* may include any of the following structures if those structures are used to place a fluid underground:

1. a bored, drilled or driven shaft whose depth is greater than the largest surface dimension;
2. a dug hole whose depth is greater than the largest surface dimension;
3. an improved sinkhole; or
4. a subsurface fluid distribution system (i.e. septic tank and drainfield).

Only a septic system that receives solely sanitary waste and serves a single, one-family dwelling is clearly exempted from the requirements of the UIC program.

The new UIC rules also include:

- A nationwide ban on large-capacity cesspools.
- A nationwide ban on the construction of new injection wells that discharge fluid wastes generated during the repair or maintenance of motorized vehicles. All existing motorized vehicle fluid disposal wells must be closed or converted to another use by 2005.
- Regulatory agency approval of any new injection well that is to be constructed.
- Reporting requirements for owner/operators of all existing injection wells.

The DNR has maintained primacy for Wisconsin's UIC program since 1983. The DNR's Bureau of Drinking Water and Groundwater must submit a revised UIC primacy application to EPA in order for primary enforcement authority for this program to be retained by state authorities. The deadline for submittal of this application is December 29, 2000.

The Bureau of Drinking Water and Groundwater continues to operate a web site: (*http://www.dnr.state.wi.us/org/water/dwg/).* The site provides information on Public Water Supplies in Wisconsin, consumer confidence reports, frequently asked questions, wellhead protection, community water systems, well abandonment, capacity development, drinking water systems, homeowner information, groundwater information, staff listings, and well driller and pump installer information. Access to several new systems has recently been made available through a web interface. Information from the Public Drinking Water System, Well Construction System, and the High Capacity Well Data System are all available online. The groundwater information section of the site has been greatly expanded to include extensive sections on wellhead protection and source water protection. All new publications developed in the Groundwater Section are posted online for downloading, viewing or both.

Bureau of Waste Management

Over the past few years increasing numbers of residential developments have been located close to old, closed landfills. Further, it has been recently discovered that several of these landfills are impacting groundwater. In 1998 and 1999 the DHFS sampled private wells down-gradient of 19 small, closed landfills in one county. Several of the private wells had results above maximum contaminant levels. The results of this sampling showed that there might be more landfills with serious problems that have not yet been identified.

The DNR Bureaus of Waste Management, Remediation and Redevelopment, and Drinking Water and Groundwater in cooperation with the DHFS, responded to this issue in early 1999 by choosing 16 old, closed landfills – at least three from each of the five regions across the state - that have private wells nearby and may be impacting groundwater. Private wells around each of the landfills were sampled in 1999 and significant levels of contamination were found. Of the 113 wells that were tested, 31 had detects of volatile organic compounds

(VOCs). Fourteen of the homes had levels exceeding drinking water standards and have been given health advisories not to drink their water.

To recommend ways to ensure integration and communication within the DNR when addressing the problem of private wells near old, closed landfills, an ad hoc team, the Landfill Encroachment Work Group, was formed with members from the Bureaus listed above. The work group's goal was to work together to prevent people from drinking contaminated groundwater from private wells near landfills and locating homes where this may already be occurring. There are also plans to coordinate with other state agencies, local agencies and the private sector.

The work group presented its recommendations to the three different Bureau Directors in June 1999. The work group made the following recommendations to help avoid old, closed landfills from impacting private wells:

1. improve our database of the location and characteristics of active, inactive and abandoned landfills across the state;
2. provide easy access to that list through the Internet and other more traditional media for developers, realtors, planners and potential homeowners;
3. work with these external groups to determine what information would be the most valuable to them; and
4. rank unmonitored old, closed landfills to determine which of these sites should be investigated to determine if there are private wells nearby that should be sampled.

More information regarding residential encroachment and the issues faced by the different Bureaus involved can be found in the paper, "Can Wisconsin's One-of-a-Kind Environmental Monitoring System Adequately Evaluate Its Old, Closed Landfills?" by Jack Connelly and Diane Stocks, dated July 1999. Contact the Bureau of Waste Management for a copy.

The three bureaus involved in the workgroup have taken several steps to implement the recommendations listed above. Information is being collected for a GIS layer of locations for all the sites listed on the Registry of Waste Disposal Sites using Global Positioning System (GPS) and digitizing from blueprint plan sheets. Landfill characteristics are also being collected for all the Registry Sites. In the future, we hope to link the two databases and provide this information to potential homeowners, planners, realtors, etc. using a mapping interface.

The Bureau of Waste Management was also concerned staff was not aware of some old, closed landfills that are impacting groundwater. Program staff used several reports from the Groundwater and Environmental Monitoring System to do a rough screening of old, closed town, city and village landfills with monitoring wells. Fifty-five landfills were identified as needing further attention and each of the regions is currently doing a more detailed evaluation of these landfills.

The Bureau of Waste Management and the UW Stevens Point received funding from July 1999 to July 2001 to evaluate the effectiveness of chemical oxygen demand (COD) as an indicator parameter at landfills. One reason for evaluating COD is that mercury waste is generated when COD is analyzed in the laboratory. The Department's overall goal is to reduce amount of mercury that gets into the environment so eliminating COD sampling at the 400+ landfills that currently sample for it would help us meet that goal. Preliminary findings from the first year of the study indicate that there may be potential to eliminate COD monitoring. The second year of the study will evaluate alternatives to sampling for COD.

Bureau for Remediation and Redevelopment

The Bureau for Remediation and Redevelopment (RR) program implemented several actions that have influenced responses to contaminated groundwater.

- The program used the Environmental Fund to initiate or continue environmental cleanup actions at approximately 45 locations where groundwater contamination is known or suspected. The Environmental Fund

is used when contamination is significant but private parties do not undertake the cleanup because no one has legal responsibility for the contamination, the person(s) legally responsible do not have the financial ability to proceed, or the responsible person simply refuses to proceed. Private contractors conduct these cleanups with oversight by Department staff. The program spends an average of $5 million per year from the fund to address contamination at new and continuing project sites. Whenever feasible, the RR program and legal staff attempt to recover costs from responsible persons after the cleanups are undertaken.

- The RR program continues to provide redevelopment assistance at brownfield sites with groundwater contamination. RR staff assist local governments and private businesses with the cleanup and redevelopment of abandoned or under-used properties where redevelopment is hindered by contamination. In many cases these properties have groundwater contamination or contamination that poses a threat to groundwater. Staff provide technical and financial assistance. Also, the RR program continues to provide number of different assurance letters related to properties with groundwater contamination. General Liability Clarification Letters provide assurances to parties involved with voluntary cleanup sites so that they can buy or redevelop brownfield properties without concern about liability. "Off site" letters are provided to owners of property who demonstrate that the contamination under their properties did not originate on the property. These letters facilitate development of the property while the Department provides oversight of the cleanup being conducted by the person responsible for the contamination. In addition, lease letters are provided to lessees who rent properties overlying contaminated groundwater. These letters clarify the activities that lessees may undertake in order to remain free of liability for the contamination. Other assurance letters are also provided to lenders and local governments.

- The RR program also continues to assist parties with voluntary investigations and cleanups of brownfield properties through the Voluntary Party Liability Exemption (VPLE) process. After a person has conducted an environmental investigation of the property, and cleaned up soil and groundwater contamination to standards, the Department will issue a "Certificate of Completion" which provides a release from future liability for any contamination that occurred on the property prior to issuance of the certificate. Fees for the Department's review time are assessed on an hourly basis.

- The rule to implement the new Dry Cleaner Environmental Response Program, NR 169, became effective in February 2000. The program reimburses eligible costs associated with the cleanup of soil and groundwater at sites contaminated by dry cleaning solvents. Fees paid by the dry cleaning industry provide program funding. Environmental cleanup at dry cleaner sites will be conducted following the NR 700 rule series.

- At the end of 1996, the RR program began closing sites with groundwater contamination above enforcement standards under specified conditions. By the beginning of 1999, 30% of the petroleum contaminated sites in the PECFA program obtained this type of closure. PECFA reimburses eligible petroleum storage tank site owners for clean up costs. Administrative rules allowing this type of closure were first promulgated in November 1996, allowing closure after the responsible person demonstrates, on a site-specific basis, that groundwater contamination is naturally attenuating and will reach standards within a reasonable period of time. The rules require that a groundwater use restriction must be recorded with the deed for the property. The restriction requires special DNR review before a water supply well can be constructed on the property.

- Beginning in 1998, the Departments of Commerce and Natural Resources jointly developed a series of emergency cost containment rules for the PECFA program. Comm 46/NR 746 were developed in response to the 1999-2000 Biennial Budget provision that the two agencies promulgate rules on methods for determining risk to the public and to the environment posed by petroleum discharges. These rules establish risk and closure criteria to determine whether petroleum contaminated sites can be closed using natural attenuation as a final remedy for groundwater contamination. The rule establishes that sites with contamination in low permeability (clay) materials can close after a site investigation if all risk criteria are met and the groundwater contamination is stable or receding. For contamination in permeable materials, sites must meet all risk criteria and demonstrate through monitoring that groundwater contaminants are declining. Again, a groundwater use restriction must be recorded for sites closed with groundwater contamination above NR 140 enforcement

standards. Depending on the extent of soil contamination remaining at a contaminated site, a deed restriction may also be required.

- The RR program is now proposing rule revisions to implement a GIS registry of closed remediation sites. This would replace the requirement to record groundwater use restrictions at the County Register of Deeds Office. This GIS database, along with the Bureau of Remediation and Redevelopment Tracking System (BRRTS), will be available on the Internet for public access and use by the end of 2000. The GIS registry will include locational information on sites closed with residual groundwater contamination above the NR 140 enforcement standards. This database is proposed to be used with well construction requirements for private wells. Proposed rule revisions also establish a setback distance from contaminant plumes for new municipal wells. BRRTS will be available for locating potential contamination sites when evaluating new municipal well placement. These databases will make site-specific information on open and closed remediation sites much more available and accessible to the public and specific interested groups.

Bureau of Watershed Management

The Bureau of Watershed Management continued to issue WPDES permits to all communities and industrial facilities which discharge treated domestic or industrial wastewater to groundwater through land treatment/disposal systems. These systems are primarily spray irrigation, seepage cell and ridge & furrow treatment systems. WPDES permits, issued to these facilities, contain groundwater monitoring and data submittal requirements which are used to evaluate facility compliance with ch. NR 140, Wis. Adm. Code, groundwater quality standards. Permits issued to new municipal discharges to groundwater via seepage cell systems reflect the more stringent effluent limits for total nitrogen and chloride contained in ch. NR 206, Wis. Adm. Code. Groundwater monitoring systems at existing facilities are evaluated and upgraded, as necessary, at permit re-issuance.

An investigation into elevated iron and manganese concentrations in groundwater at industrial wastewater land treatment/disposal sites is expected to be completed in September 2000. The Mid-West Food Producer's Association (a trade organization representing the vegetable producing industry) is conducting this study in conjunction with the University of Wisconsin - Madison.

The Bureau of Watershed Management continues to assist unsewered communities, served by failing or inadequate individual on-site treatment systems in their efforts to construct centralized wastewater treatment facilities. Staff reviewed and provided comments to the Department of Commerce on their new design regulations for small-scale (flows less than 12,000 gallons per day) on-site wastewater treatment systems. Rules were adopted to establish the Department's authority for permitting systems with flows greater than 12,000 gallons per day. A Memorandum of Understanding (MOU) between the Department of Natural Resources and the Department of Commerce has been created to establish respective regulatory authority for on-site systems. The MOU indicates that DNR has permitting and design approval authority for large-scale systems and joint authority for systems that dispose of mixed domestic and industrial wastewater to the subsurface.

The Bureau of Watershed Management implements the regulations in chapters NR 113, NR 204 and NR 214, Wis. Adm. Code, governing the land application of wastewater sludge and by-product solids. NR 113 relates to septage management and NR 204 governs the treatment, use, and disposal of municipal wastewater treatment plant sludge. NR 113 and NR 204 incorporate federal septage and sludge disposal standards. The Bureau regulates the land application of industrial sludge and by-product solids through NR 214. Chapters NR 113, NR 204 and NR 214 contain land application site requirements and restrictions that are designed to prevent runoff to surface water or leaching of nutrients and pollutants to groundwater.

The Bureau continues to develop and implement a new statewide computer system that records and monitors treatment and disposal of municipal sludge, septage, and industrial land applied wastes. This system includes an inventory and a history of all sites used for land application. Wisconsin expects soon to be the fourth state delegated authority by EPA to implement municipal sludge regulations through it's delegated NPDES (WPDES) permit program.

The DNR's Runoff Management Program addressed six major issues in FY 00:

Priority Watershed Projects and New Runoff Management Grant Programs - All priority watershed project plans have been completed except for one, Big Wood Lake. The Department developed a new financing plan for ongoing priority watershed projects based on additional funding made available in the 1999-2001 biennial budget. The financing plan provides for cost sharing each project at a stable level from now through the end of the project, subject to future legislative appropriations. The Department is working with DATCP to see that local assistance grants continue at an adequate level to support county priority watershed project staff. Under the 1999-2001 budget bill, the local assistance funding was transferred to DATCP for administration. The Department continues to administer two new grant programs: the Targeted Runoff Management (TRM) Grants and the Urban Nonpoint Source & Storm Water Management Grants.

Animal Waste - NR 243 permitting is ongoing for 91 operations (58% dairy; 30% poultry; 12% swine & beef). Of the 91 operations, there are 87 existing permittees and 4 operations are seeking permits for the first time. Regional and central office staff just completed an effort to reduce the permits backlog to less than 10% by June 30, 2000. The trend of growing numbers of permit applications for operations with 1,000 or more animal units is expected to continue. The development of performance standards and prohibitions as part of the Nonpoint Redesign Initiative is intended to further address impacts from animal feeding operations with less than 1,000 animal units.

Storm Water – DNR has designated approximately 60 municipalities to receive a municipal storm water permit under ch. NR 216. Municipality designations include those around Madison, Eau Claire, Milwaukee, Racine, Waukesha, West Allis and Sheboygan that were identified to be significant contributors of storm water pollutants to waters of the state. About 500 auto and scrap recycling salvage yards were given coverage under an industrial permit, which allow the alternative of joining a Cooperative Compliance Program (CCP). It appears that about 40% of salvage permittees will join a CCP. The Department is developing performance standards (i.e. 80% sediment control, infiltration, peak flow, buffer requirements, etc.) that may become promulgated in fall of 2001. These standards will affect storm water permits, especially for new development. EPA phase II storm water regulations will require construction sites down to 1 acre, and many other smaller urbanized municipalities, to obtain permits by March 2003. The storm water program will be working on revised rules for performance standards and phase II rules over the next 3 years.

Nonpoint Program Redesign - The Outreach Advisory Committee (OAC) completed their review of the issues and proposals brought forth by six workgroups. The Department drafted rule language for seven different codes: NR 151 (performance standards); NR 120 (the Priority Watershed Program); NR 152 (model ordinances); NR 153 (grant programs); NR 154 (best management practices); NR 216 (storm water permit program); NR 243 (animal feeding operations permit program). The rules were taken to 11 locations around the state for public hearing in March 2000 with written comments accepted until May 5, 2000. The Department has set up four workgroups to address some of the comments received. These workgroups include members of the original OAC as well as representatives of urban and rural organizations or interests. The workgroups will meet through September to revise the rules. The four workgroups cover agricultural performance standards, agricultural implementation, urban performance standards and implementation, and transportation facilities performance standards. The request to go to public hearing a second time will likely occur at the January, 2001 Natural Resources Board meeting.

Working with other agencies - The nonpoint program continues to support 10 UWEX Basin Educators. These educators conducted 20 workshops and conferences, mostly focused on construction erosion control, stormwater management and shoreland protection/restoration. A team of NRCS, DATCP, UWEX and DNR staff developed three agricultural brochures for use by their customers. The nonpoint program participates on a multi-agency panel in the scoring and selection of EQIP educational projects. Many of these projects have a groundwater focus. The nonpoint program is a member, along with counties, their associations, DATCP and the NRCS, on the Standards Oversight Council that reviews technical standards. The program also works with

DOJ, DATCP and the Dept. of Commerce on the development and revisions to the nonpoint source redesign rules.

Nutrient Management Plans – One of the performance standards included as part of the Redesign effort was a nutrient management standard, NRCS Standard 590. Additional work is being done to further refine this standard as the redesign moves into a second round of public hearings.

For more information, contact Susan Sylvester at 608-266-1099 or *sylves@dnr.state.wi.us*, or Mike Lemcke at 608-266-2104 or *lemckm@dnr.state.wi.us*, DNR, P.O. Box 7921, Madison, WI 53707-7921.

DEPARTMENT OF AGRICULTURE, TRADE AND CONSUMER PROTECTION

Protecting Wisconsin's groundwater is a priority for the DATCP. DATCP's major activities in this area include management of pesticides, research, and funding of local soil and water resource management projects.

Under the Wisconsin Groundwater Law, DATCP manages pesticides and pesticide practices to assure that established groundwater standards for contaminants are not exceeded. This may include prohibition of certain activities including pesticide use. The agency also manages practices to "minimize" groundwater contamination to the extent "technically and economically feasible." DATCP regulates storage, handling, use, and disposal of pesticides, and the storage of bulk quantities of fertilizer.

DATCP is also responsible for coordinating the development of Wisconsin's "generic" and "pesticide-specific" state pesticide management plans (PMPs - previously known as SMPs) for protecting groundwater from pesticides. In FY 96, DATCP, in cooperation with DNR and other agencies, submitted Wisconsin's "Generic SMP for Protection of Groundwater from Pesticides" to the EPA for concurrence. EPA concurred with the Generic SMP in June 1996. According to the EPA document "Pesticides in Groundwater Strategy" (1991), when EPA determines that a pesticide presents a significant risk of leaching to groundwater in a state, it may either cancel the registration of that compound or allow the state to prepare an PMP describing how the state will manage the pesticide to protect groundwater. The generic PMP presents a comprehensive review of Wisconsin's regulatory and non-regulatory efforts to prevent groundwater contamination due to pesticides. This generic plan will serve as a framework for pesticide-specific PMPs that will be required by the EPA for four commonly used herbicides.

Enforcement standards have been established in Wisconsin for many known and potential groundwater contaminants, including over 30 pesticides. Standards for additional pesticides have been proposed. DATCP applies these standards and the Groundwater Law when addressing nonpoint and point sources of pesticide contamination in groundwater.

DATCP's primary effort related to nonpoint contamination (i.e., due to general use) of groundwater continues to involve the herbicide atrazine. In response to concerns about atrazine contamination, DATCP amended administrative rule ch. ATCP 30 in 1992 to manage the use of atrazine in an effort to reduce or eliminate the potential for further groundwater impacts. Rule revisions have been made annually in response to additional detections of atrazine in groundwater. Rule revisions for the 2000 growing season increased the number of atrazine use prohibition areas, based on groundwater sample results available as of September 1999. Information suggests that atrazine use has declined as a result of the atrazine management rule and concern about groundwater contamination.

Since the late 1980s, DATCP has also initiated a number of surveys to investigate pesticides in groundwater resulting from nonpoint sources. In FY 96, DATCP completed a re-sampling of 122 Wisconsin wells that previously exceeded a pesticide enforcement standard. This Exceedence Survey was funded by DATCP. Most of the wells in the survey had exceeded standards for atrazine. Most were also within an atrazine prohibition area. Of wells exceeding standards for atrazine, 84% declined in concentration and 16% increased. Forty-three percent of the wells tested above the atrazine enforcement standard and 57% tested below the standard. About 50% of well

owners continue to use their contaminated well and about 25% have installed new wells at an average cost of $6,300. This survey was conducted again in FY 97, FY 98, and FY 99 with similar results. DATCP hopes to conduct this survey annually to analyze contamination trends in prohibition areas.

In FY 98, DATCP began sampling monitoring wells in 17 selected fields across the state. These fields are located in prohibition areas in which atrazine has not been used since 1993. Ch. ATCP 31, Wis. Adm. Code requires DATCP to collect scientific data to show if renewed use of atrazine in prohibition areas will cause further groundwater contamination. Quarterly sampling for this project will continue for five years. Although it is too early in the project to make recommendations, 1998 and 1999 summary data showed that atrazine concentrations increased at all but one site. One or more wells at 59% of sites exceeded the enforcement standard for atrazine (3.0 parts per billion) at some time during the first 2 years of the project. The nitrate enforcement standard was exceeded at 100% of these sites over the same sampling period.

In FY 97, DATCP completed a groundwater sampling survey designed to evaluate the effectiveness of the Atrazine Rule (ch. ATCP 30, Wis. Adm. Code). The survey, required under ATCP 30, was to determine if a "statistically significant change" occurred in groundwater concentrations of atrazine and its three chlorinated metabolites between Phases 1 (1994) and 2 (1996) of the survey. The survey showed a statistically significant decline in the level of atrazine contamination in Wisconsin groundwater between 1994 and 1996. However, atrazine still reaches groundwater and in some cases exceeds the enforcement standard. The Atrazine Rule appears to be effective in reducing atrazine contamination of groundwater. During FY 01, DATCP intends to conduct a third survey to compare current groundwater quality to 1994 and 1996 results. DATCP recommends that current limits on atrazine use be continued. Further discussion of pesticide sampling survey results is contained under Condition of the Resource - Groundwater Quality.

In FY 97, DATCP also resampled 100 private wells that had a triazine immunoassay test result of 0.8 µg/ l or higher, but had never had a more comprehensive gas chromatography analysis performed. Of these 100 wells, 73 had detections of atrazine and/or its chlorinated metabolites, with the average concentration at 1.19 µg/l. Six of the 100 wells exceeded the enforcement standard for atrazine.

Previous DATCP and DNR surveys have identified significant point sources of contamination of groundwater quality at pesticide storage and handling facilities. These surveys indicated that activities at these sites continue to result in groundwater contamination, putting nearby private and, in some cases, municipal wells at risk. Surface water run-off from contaminated areas can also result in direct human and livestock exposure, property damage and/or surface water contamination.

In August 1993, section 94.73 of the Wis. Stats. was created and established the Agricultural Chemical Cleanup Program (ACCP) to address these point sources of contamination. The ACCP reimburses responsible parties for cleanup costs related to pesticide and fertilizer contamination at facilities and in nearby wells. The program may also handle point source contamination on farms. To date, 386 cases involving soil and/or groundwater remediation related to spills, misuse, and improper storage, mixing or loading have been initiated at pesticide and fertilizer handling facilities and on farms.

The ACCP also funds DATCP oversight of pesticide and fertilizer cleanup activities. Program staff investigate pesticide and fertilizer contaminated sites throughout the state. Investigations at these sites are prioritized based on suspected contamination levels, with higher levels investigated first. Investigations include discussions with facility staff or farmers to determine the most likely locations of contamination at the site. Other oversight activities include, but are not limited to, sample collection, laboratory analysis, and financial auditing.

DATCP funded four pesticide research projects during FY 00 (see Table 1 for those funded through the Joint Solicitation). DATCP's research fund, which is based on fees paid by pesticide manufacturers, provides approximately $135,000 annually to meet pesticide related research needs of the Department.

DATCP, through its land and water resource management program, provides funding primarily to counties to assist in the protection of these resources. A portion of this funding is dedicated to the development and implementation of improved nutrient and pesticide management practices. In FY 00 approximately $100,000 was provided to promote the adoption of nutrient management plans on farms to maximize profitability and to minimize excessive runoff of nutrients to surface and groundwater.

In FY 00 DATCP provided $272,000 to fund Clean Sweep projects in 27 counties for collection and disposal of waste pesticides and containers. Approximately 150,000 pounds of waste were collected from farm sites, thereby reducing the potential for inadvertent environmental damage. DATCP is requesting additional proposals from counties for the 1999 fiscal year. Approximately $560,400 will be available during FY 00 for these projects.

For further information, contact Mr. Nicholas Neher, DATCP, 2811 Agriculture Drive, P.O. Box 8911, Madison, Wisconsin, 53708-8911; phone: 608-224-4567; e-mail: *nicholas.neher@datcp.state.wi.us*. .

DEPARTMENT OF COMMERCE

Private sewage systems - A revised private sewage system code, (Comm 83), is scheduled for implementation in 2000. The new code is substantially revised from the previous drafts that went to hearing in 1997 and 1998. Major changes include the requirement that large septic systems, designed to treat more than 12,000 gallons per day will be required to obtain a WPDES permit from the DNR before Commerce will approve the plans for the system. Nine manuals for standard system designs are referenced in the code. These manuals include the following systems: conventional, mound, pressure distribution, at-grade, holding tank, three kinds of sand filters and drip line dispersal.

Research by the University of Wisconsin, small scale waste management project on sand filters and aeration units has resulted in approval of their use as replacement systems for existing failed systems and their recognition in the new code as additional treatment alternatives. One advantage of both the sand filter and aeration units is that homeowners will often be able to eliminate or reduce the size of a mound system compared to what is required under the current code. To assist county staff in becoming familiar with this new technology, Commerce has sponsored training presented by the University and manufacturers that focuses on the theory of operation and inspection services as well as maintenance.

The new code expands the tracking programs that are currently required under the provisions of the Wisconsin fund program. The new code will greatly improve the maintenance program for all installed on-site systems. All systems approved after the effective date of the code will have to include an approved management/maintenance plan. These plans will provide for mandatory system maintenance schedules and reporting of maintenance events over the life of the system. As existing systems are identified, they too will be added to the tracking programs to insure that regular inspection, maintenance and servicing is provided.

Petroleum Product and Hazardous Substance Storage Tanks - Flammable and combustible liquids which have a flash point of less than 200°F are regulated by the State Administrative Code Chapter Comm 10. The regulatory authority for the storage tank program is within the Division of Environmental and Regulatory Services (ERS) in the Department of Commerce. The ERS Division has three bureaus: Bureau of Storage Tank Regulation, Bureau of Retail Petroleum Services, and the Bureau of PECFA.

The ERS division continues to maintain regulatory oversight of the Federal EPS Underground Storage Tank (UST) upgrade compliance deadline that was December 22, 1998. Systems that did not meet the upgrade requirements after the deadline were "red-tagged" and taken out of service. Some facilities were placed in a “temporary-out-of-service” status and given one additional year to upgrade or be permanently closed. Prior to October 1999 Wisconsin State Statute did not designate or authorize the department regulatory authority for the non-flammable/combustible hazardous substance tanks included in the federal rule. Hazardous substance tanks have

been brought into regulatory authority by 1999 Wisconsin Act 9, but, have not at this time been implemented through administrative rule, which is currently under revision.

Since 1991 the database inventory of petroleum product tanks regulated under Comm 10 has increased from 143,681 to 173,552 tanks as previously unregistered tanks have become registered. In 1991 the database included 68,056 tanks classified as federally regulated with 51,088 of those tanks in use. As of June 28, 2000 the database reflects 78,011 federally regulated tanks with only 13,544 tanks in use. In order to maintain a federally regulated tank in use, the tank must have a valid "use permit," which is complimented by an annual inspection. Annual inspections involve verification of leak detection, spill and overfill protection, and record keeping. Permit renewal administrative review includes compliance assessment of the owner's financial responsibility.

Program initiatives have resulted in identifying a larger population of underground tanks, reducing the number of underground tanks in use, and upgrading those in use to meet the 1998 federal upgrade requirements. The closure of federally regulated tanks will continue, but at a slower pace than experienced over the past few years. Closure of out-of-service residential heating fuel tanks is continuing at a strong pace as realtors and lenders recognize the potential problems and liability.

The closure of underground storage tanks is being supplanted by private fueling moving to retail fueling and some operators moving storage tanks to above ground. Residential heating fuel has not been significantly impacted, as the closures are generally associated with the conversion to natural gas or liquid propane gas (LPG). Aboveground bulk storage facilities are being evaluated for compliance with release prevention upgrade requirements due in 2001.

Educational outreach efforts and annual inspections by the department and its agents should result in a high level of regulatory compliance, and a reduction of system failures and environmental contamination. Wisconsin's progress continues to reflect very favorably with the US EPA.

Petroleum environmental cleanup fund act (PECFA) - The PECFA program from August 1989 through May 2000 has reimbursed petroleum storage tank system owners approximately $917.7 M to remediate petroleum contamination both in the soil and groundwater. The program, in addition to auditing owner invoices and authorizing payments, performs technical reviews for site investigations exceeding $40K, comparisons of remedial options, and grants closures for 65% of the State's LUST sites.

The 1999-2000 Budget Bill passed in late October authorized a $270 M bond to "pay down" the backlog of audited claims awaiting payment. This bond and annual spending authority ($94 M) has resulted in the payment of over 5,000 claims in Fiscal Year 2000. In anticipation of the bond the PECFA Claims Section reduced the time that a regular claim is in house before a review decision is completed from approximately 11 months to 3 months. The petroleum inspection fee supports PECFA's spending authority.

Another provision contained within the Budget Bill is authorization for increasing the use of competitive bidding for cleanup activities at contaminated sites. All sites which will cost the PECFA program more than $60,000 must be competitively bid (exemptions available) through case closure. Competitive bidding allows environmental consulting firms to review the site investigation report and in compliance with the bid specifications submit a cost through case closure. This bidding process establishes the lowest cost cleanup and a cost cap through case closure. Additionally, the site owners understand more clearly what remedial efforts are necessary to obtain closure. Commerce in conjunction with the DNR has revised the competitive bidding process since the Budget Bill became effective to provide greater detail of what remedial efforts are necessary to obtain closure. The DNR and Comm have completed the bidding process for 33 sites.

Comm 46/NR 746 currently is an Emergency Rule and the latest version become effective May 2000. These identical rules incorporate additional risk based elements into the remediation and site closure process. This was encouraged so as to move the PECFA program to the point where the level of remediation funding spent on a site

more directly reflected the environmental risk of the site. In doing this, scarce resources would be used most effectively and be available for those remediations which were most critical.

For more information, contact Mr. John Alberts, Department Of Commerce, P. O. Box 7839, Madison, Wisconsin 53707-7839, phone: 608-266-9403, fax: 608-267-0592; e-mail *alberjo@mail.state.wi.us.*

DEPARTMENT OF HEALTH AND FAMILY SERVICES

Chapter 160, Wis. Stats., directs the DHFS to recommend health-based enforcement standards for substances found in groundwater and specifies the protocol for developing the recommended standards. Recommended standards are sent to the DNR and are submitted through the rule-making process as amendments to ch. NR 140, Wis. Adm. Code. DHFS staff recently began work in response to a request for additional groundwater enforcement standards and the modification of existing enforcement standards.

DHFS staff are the primary resource for information about the health risks posed by drinking water contaminants, and are charged with investigating suspected cases of water-borne illness. Toxicologists, public health educators, and epidemiologists employed in the Department's Division of Public Health present this information to the public at public meetings and conferences, and provide direct assistance to Wisconsin families via home visits, letters to well owners, and telephone consultations. DHFS staff review correspondence sent to well owners by DNR representatives. The agency provides additional advice to owners of wells that are seriously contaminated with volatile substances such as benzene and vinyl chloride. Follow-up letters sent by DHFS explain the health effects of the specific contaminant and suggest strategies for reducing exposure until a safe water supply can be established. DHFS also prepares and distributes a wide variety of informational materials.

DHFS staff have been active in research and outreach activities relating to naturally-occurring arsenic in groundwater in Winnebago, Outagamie and Brown Counties. Long-term exposure to arsenic in drinking water has been shown to contribute to increased risk of skin, lung and bladder cancers, as well as a number of cardiovascular and dermatological problems. Other conditions that may be related to arsenic exposure include diabetes and adverse reproductive outcomes. DHFS staff received a grant from the GCC to conduct a follow-up investigation on the relationship between exposure to inorganic arsenic in water and health outcomes. As part of this research effort, local health departments, DNR staff, town clerks and others have made plans to conduct well sampling campaigns in townships in the affected counties. It is hoped that this sampling will increase awareness of arsenic in well water as a potential health concern.

Recent groundwater-related publications and presentations by DHFS staff:

Knobeloch, L., B. Salna, A. Hogan, J. Postle and H. Anderson. Blue babies and nitrate-contaminated well water. Environmental Health Perspectives, vol. 108, no. 7, July 2000.

Knobeloch, L., and C. Warzecha. Cancer Incidence among Consumers of Arsenic-Contaminated Groundwater. Poster presented at the 4th International Conference on Arsenic Exposure and Health Effects, June 2000.

For more information, contact Henry Anderson, Lynda Knobeloch or Mark Werner, 1414 E. Washington Ave., Rm. 96, Madison, Wisconsin, 53703-3044; phone: 608-266-1253 (Henry) or 608-266-0923 (Lynda), or 608-266-7480 (Mark).

WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY

The WGNHS performs basic and applied groundwater research and provides technical assistance, maps, and other information and education to aid in the management of groundwater resources. The WGNHS groundwater program

is complemented by geology, soils, and climate programs that provide maps and research-based information essential to the understanding of groundwater recharge occurrence, quality, and movement. WGNHS personnel are currently preparing groundwater-related maps (such as water table or aquifer maps) at a scale of 1:100,000 for Dane, Polk, Green Lake, and Buffalo Counties.

In FY 00, the WGNHS continued to respond to requests for information and assistance from other local, state, and federal agencies, consultants, students, and the public. These requests ranged from the simple, "What will I find underground if I dig or drill here?" to more complex questions about groundwater flow, contaminant transport, or wellhead protection.

Public information, records, and research results that the WGNHS stores and disseminates save the considerable expense of gathering the same geologic or groundwater information several times for different purposes, or "re-discovering" the same information over time. To help this service, the WGNHS continues to review, sort and catalog about 18,000 well construction reports per year (in cooperation with the DNR), measure monthly groundwater levels in a monitoring network of 145 wells (in cooperation with the USGS), collect, and describe geologic samples from 300 wells per year.

Beginning in 1999 the WGNHS began a new initiative to carry out computer scanning and basic database entry for all well construction reports in the WGNHS files to support DNR's source water assessment program. This project is expected to be complete within two years. The result will be a computer-searchable database of all well construction reports, which should be of major benefit to all state agencies, consulting firms, and private well owners.

Groundwater-related digital data will continue to be collected for statewide programs and local projects during FY 01. The Well-Constructor's Report database is currently the most active and contains information from locatable and representative domestic wells. Wells will continue to be added to the database from our county and regional studies. Checking and correcting well locations is an important continuing program that is necessary before the drillers' reports can be used with confidence in a geographic information system. Development of a statewide database for approximately 36,000 geologic logs and drill holes that have more complete lithologic information will be continued.

Geologic and groundwater studies at the county scale continue to be an important part of WGNHS programs. During FY 01 the Survey will complete the publication of a new hydrogeologic report (including a water-table map) and new bedrock geologic map for Dane County. Both publications will be as WGNHS bulletins, with maps at a scale of 1:100,000. In addition, the Survey will publish a report on the Dane County groundwater flow model. In Dane County the completed groundwater model is being widely used for evaluating future pumping, well placement, and wellhead protection scenarios. The model is also being used as a basis and framework for the additional study of important springs in several parts of the county (Token Creek, Pheasant Branch Creek, and Nevin Fish Hatchery). During FY 01 the WGNHS will assist with these spring investigations, which are being undertaken by UW-Madison and USGS personnel.

In response to the DNR's request for assistance with source-water protection studies, the WGNHS initiated, with cooperation from the USGS, new county groundwater studies in Sauk, Rock, and La Crosse counties during FY 00; these studies will continue during FY 01. Each of these studies will develop a countywide groundwater model and will delineate zones of contribution for municipal wells in the counties.

In FY 98, the WGNHS began a surficial materials study of Green Lake County, with the goal of developing improved maps of sand and gravel resources potential. During FY 01 we will continue to work on this project, with the addition of water-table and depth-to-bedrock maps for the county at a scale of 1:100,000.

The WGNHS is also undertaking major studies of the hydrogeology of southeastern Wisconsin in cooperation with the Southeastern Wisconsin Regional Planning Commission and the DNR. Southeastern Wisconsin includes the cities of Milwaukee, Racine, and Kenosha, and recent population increases in this area have stressed local

groundwater resources. As part of this effort the WGNHS began a detailed investigation of the hydrogeologic properties of the Maquoketa Formation, an important regional aquitard in southeastern Wisconsin. The shaley Maquoketa lies between the Silurian dolomite and Cambrian sandstone aquifers in southeastern Wisconsin, and limits the exchange of water between them. However, the hydraulic properties of the Maquoketa are poorly known. In 1997 the WGNHS obtained the first of two continuous rock cores through the entire Maquoketa section. This is the first continuous core of the Maquoketa ever obtained in southeastern Wisconsin. The resulting hole has been instrumented with a multilevel sampling system for acquisition of water samples and water level data. The geochemical and hydraulic head information should be invaluable for improving our understanding of the regional hydrogeology of southeastern Wisconsin. During FY 00 and 2001 the WGNHS is continuing to investigate the Maquoketa, and is conducting detailed hydraulic tests of the properties of the shale.

Carbonate rocks (limestone and dolomite) underlie much of Wisconsin, and form important aquifers over large parts of the state. Groundwater in carbonate rocks often moves through fractures and solution features. Groundwater velocities in such rocks can be unusually high, and the rocks usually have very low ability to attenuate contaminants. Consequently, carbonate rocks are very vulnerable to groundwater contamination. Predicting groundwater flow in fractured carbonate rocks is challenging because these aquifers tend to develop two-component flow systems: rapid flow through small, discrete fractures and slower flow, but significant storage, in the matrix blocks. Work by the WGNHS on carbonate aquifers in eastern Wisconsin suggests that detailed stratigraphic analysis, coupled with geophysical and hydrogeologic data, may help predict the hydraulic properties of these complex and vulnerable aquifers.

Over the past few years, the WGNHS has developed a program of research and public education on groundwater movement in carbonate rocks, and has provided assistance to various agencies facing carbonate-rock problems. Examples of recent work include completion of a wellhead protection project for the City of Sturgeon Bay, completion of a project characterizing the hydrostratigraphy of the Sinnipee dolomite, assistance to the DNR in selected regulatory issues, including the proposed expansion of the Superior Meadows landfill in Jefferson County, advice and assistance to county officials concerned with the expansion of large manure pits in Door County and in southwest Wisconsin, and advice to the committee revising the state-wide NRCS technical guidance document on manure storage facilities.

In September 1998 the WGNHS hosted a major professional conference on fluid flow in carbonate rocks, with participants from across the United States as well as several foreign countries.

In the past few years, arsenic and other trace metal contaminants have been detected in numerous private wells in northeastern Wisconsin. Beginning in early 1999 and continuing in 2000, Survey personnel have assisted DNR and other officials regarding the problems of elevated trace metals in these wells and also elevated dissolved solids, particularly sulfate and chloride, in deep municipal wells in eastern Wisconsin. During FY 01 the WGNHS will continue to devote appropriate staff time to these problems, with the goals of compiling existing geologic, hydrogeologic, and geochemical information, developing investigative priorities for focusing further study, and identifying possible solutions or mitigation strategies. In addition, the Survey will carry out geophysical logging of problem wells at the DNR's request.

The WGNHS, with DNR support, is carrying out research on the source(s) and geochemical characteristics of arsenic contamination in water-supply wells in northeastern and southeastern Wisconsin. In FY 00 the WGNHS collected rock and groundwater samples in the Lake Geneva area. During FY 01 the WGNHS will present the results of this work and begin a field experiment in the Fox River Valley

The WGNHS has also been actively assisting the DNR in its review of the proposed massive sulfide mine near Crandon, WI. This review includes development and testing of groundwater flow and contaminant transport models being used to evaluate the potential effects of the mine on local groundwater and surface-water features.

Research projects completed this year or in progress include:

1. Hydrogeology of Sauk County
2. Hydrogeology of Rock County.
3. Hydrogeology of La Crosse County
4. Field verification of well capture zones for the City of Sturgeon Bay
5. Hydrogeologic properties of the Maquoketa Shale.
6. Hydrostratigraphy of Southeast Wisconsin.
7. Regional groundwater flow model of Southeast Wisconsin
8. Hydrogeology of Dane County
9. Investigation of arsenic contamination of groundwater in northeastern Wisconsin
10. Development of new methods for determining groundwater recharge rates
11. Review of material submitted regarding proposed mine near Crandon, Wisconsin.

For more information, contact Ken Bradbury or Ron Hennings, WGNHS, 3817 Mineral Point Road, Madison, Wisconsin, 53705-5100; phone: 608-263-7389.

Recent WGNHS Publications

Bulletin 92: Pleistocene geology of Polk County, Wisconsin, M.D. Johnson, 2000, 69 p. + I color map (scale 1:100,000).

Bulletin 98: Numerical simulation of groundwater flow in Dane County, Wisconsin, J.T. Krohelski, K.R. Bradbury, R.J. Hunt, and S.K. Swanson, 31 p.

Educational Series 15: Groundwater levels in Wisconsin Annual Summary, 1999. A. Zaporozec, 2000, 4 p.

Miscellaneous Map 48: Water-table elevation of Polk County, Wisconsin, 2000, M.A. Muldoon (scale 1:100,000)

Open-File Report 1999-02: Characterization of the hydrostratigraphy of the deep sandstone aquifer in southeastern Wisconsin, T.T. Eaton, K.R. Bradbury, and T.J. Evans, 1999, 30 p. + 15 color p.

Open-File Report 1999-03: Numerical simulation of groundwater flow in Dane County, Wisconsin, J.T. Krohelski, K.R. Bradbury, R.J. Hunt, and S.K. Swanson, 2000, 48 p.

Open-File Report 1999-04: Hydrogeology of Dane County, Wisconsin, K.R. Bradbury, S.K. Swanson, J.T. Krohelski, and A.K. Fritz, 1999, 66 p. + 2 color plates.

Open-File Report 1999-05: Quaternary geology in the vicinity of the Bend Deposit, Taylor County, Wisconsin, John W. Attig, 1999, 16 p.

Open-File Report 1999-06: Stratigraphic controls on distribution of hydraulic conductivity in carbonate aquifers, Maureen A. Muldoon, Diane L. Stocks, and Juan Antonio (Toni) Simo, 1999, iv + 61 p.

DEPARTMENT OF TRANSPORTATION

The DOT regulates the storage of highway salt (ss. 85.17 and 85.18, Wis. Stats.) to protect the waters of the state from harm due to contamination by dissolved chloride. DOT is also responsible for potable well sampling at 31 rest areas and 116 waysides. Other DOT groundwater related activities include: road salt research; hazardous material and waste investigation or remediation; wetland compensation and research; and storm water management and research. Various divisions and sections in DOT are involved with these activities:

- Salt Storage - Bureau of Highway Operations and District Highway Operations

- Salt Research - Bureau of Highway Construction (Geotechnical Section)
- Hazardous Materials (petroleum) - Bureau of Environment and District Environmental Coordinators
- Hazardous Waste - Division of Business Management (Risk & Safety Management Section)
- Wetlands - Bureau of Environment and District Environmental Coordinators
- Erosion Control and Storm Water Management - Bureau of Environment and District Environmental Coordinators.
- Potable Well Sampling - Bureau of Highway Operations

Salt Storage and Road Application - Highway salt is stored statewide by suppliers, counties, cities, villages, and private companies. Annual inspections and reports are made of salt storage sites to insure that storage practices are in accordance with ch. Trans 277, Wis. Adm. Code (Highway Salt Storage Requirements). The intent of the Code is to help prevent entry of highway salts into waters of the state from storage facilities. A pilot project for a contractor to perform storage facility inspections was recently completed. The cost benefit of contractor inspections is being evaluated.

All salt must be covered and stored on an impermeable base. The base for stockpiles is required to function as a holding basin and to prevent runoff. The covers must consist of impermeable materials or structures to prevent contact with precipitation. State funded facilities are being added to the DOT salt storage program so that more indoor storage is available. This will improve groundwater protection and it creates greater flexibility for scheduling salt purchase at optimal prices.

Current policy in the State Highway Maintenance Manual restricts the spreading of deicer salts to a maximum of 300 pounds per lane mile per application. Electronic controls for salt spreader trucks are continually tested to record and verify application rates and coverage effectiveness. New technology equipment (zero-velocity spreaders and liquid, onboard pre-wetting units) has been installed on county highway patrol trucks to help keep a greater percent of the salt applied to the roadway on the pavement surface. Additional efforts to minimize and conserve salt applications are being pursued by use of an in situ weather monitoring system. This system consists of temperature sensors and remote processing units, which determine and record temperatures of road pavements at 52 separate statewide locations along major highway routes. The pavement temperature information helps determine the sand and salt application rates. Annual training for proper snowplowing and salt spreading techniques is provided for county snowplow operators, and the counties provide weekly reports of salt usage.

During the 1997-98 winter season several counties began using alternative anti-icing and deicing chemicals on test sections in an effort to reduce the amount of chlorides applied to pavement and impacts on groundwater. Use of pro-active anti-icing techniques should result in lower chemical usage and reduce total winter maintenance costs.

During the 1998-99 winter season: 7 counties used liquid $MgCl_2$ as direct spray on pavements and bridge decks for anti-icing; 2 counties used Ice Ban M-50 (50% corn based by-product and 50% $MgCl_2$) as direct spray on bridge decks; 13 counties used Ice Ban M-50 as a pre-wetting solution for road salt applications; and 6 counties used $MgCl_2$ as a pre-wetting solution for road salt applications.

During the 1999-00 winter season: 22 counties used liquid $MgCl_2$ for pre-wetting or anti-icing; 8 counties used Ice Ban M-50 for pre-wetting or anti-icing; 9 counties used M50 Road Deicer (50% sugar based by-product and 50% $MgCl_2$) for pre-wetting or anti-icing; and 10 counties used salt brine for pre-wetting. The result of these changes was a decline in statewide salt use for highways. Salt use for the winter of 1999-2000 (state trunk highway system) was approximately 376,000 tons compared to the previous 5-year average of 395,000 tons.

Salt Research - Since 1970, DOT has investigated potential road salt impacts on the environment adjacent to highways. Early investigations (1970s to early 80s) were focused on evaluating road salt impacts to surface water runoff, vegetation, and soils. In the last several years DOT has conducted limited investigations evaluating road salt impacts to groundwater (1 or 2 shallow monitoring wells per site). To date approximately 20 sites throughout the state have been studied. In general, each site is monitored quarterly for a period of 5 years. The monitoring consists of analyzing soil, water, or vegetation samples for calcium, sodium, chloride, and electrical conductivity.

Approximately 5 sites are currently monitored, and future groundwater monitoring plans are being evaluated (i.e., longer monitoring periods and multiple well arrangements per site). Results from the studies are discussed in 5 separate DOT progress reports entitled: Investigation of Road Salt Content of Soil, Water and Vegetation Adjacent to Highways in Wisconsin (1972, 1975, 1979, 1989 and 1996).

Hazardous Materials (Petroleum) and Hazardous Waste - As part of the highway improvement program, DOT performs an estimated 25 to 75 environmental assessments annually along right-of-way where potential sources of petroleum or hazardous waste contamination may occur. Assessments consist of standard environmental audits of properties, environmental drilling, and sampling to identify or delineate the extent of soil or groundwater contamination. Numerous contaminated sites are identified as part of the environmental assessment process. This information is shared with DNR so appropriate enforcement and remedial action is taken to protect groundwater resources. In addition, DOT works with DNR and COMM on 15 to 25 sites per year where underground storage tank removal or other remedial actions are necessary to accomplish highway improvement (e.g., managing the removal, treatment, and disposal of contaminated soils or groundwater). DOT manages about 10,000 to 30,000 tons of contaminated soil per year and about 10 million gallons of contaminated water per year.

Wetlands - Compensatory wetland mitigation is required under section 404 of the Clean Water Act for transportation projects. DOT completed a cooperative study with the U.S. Geological Survey on groundwater of three wetland compensation projects. The final report on this study, *Hydrogeological, Geomorphological, and Vegetative Investigations of Select Wetland Creation and Restoration*, was completed February 1999, and is available. DOT has several ongoing wetland monitoring projects which evaluate wetland hydrology, water quality and biotic response to constructed mitigation sites.

Since July 1993, DOT has an interagency approved wetland mitigation banking program. Currently wetland loss due to highway, bridge and airport may be compensated through the bank system. As of December 31, 1999, there have been 1,602 wetland acres lost to 797 DOT construction projects throughout the state since 1990. This loss was compensated by 2,249 acres of wetland restoration and creation. Thirty wetland bank sites have been planned and constructed. There are 20 constructed bank sites containing 1,110 available wetland acres and four bank sites in planning and design that should produce 581 wetland acres. Six bank sites containing 391 acres have been closed. Wetland compensation using bank sites is currently 61%, while remaining compensation is done on or near specific transportation projects.

Erosion Control and Storm Water Management - DOT has established erosion control standards for airport, railroad, and highway construction projects as well as maintenance projects administered by DOT. These standards were created to minimize on-site erosion damage and to minimize adverse impacts to waters of the state resulting from sediment or pollutant accumulation. Construction projects must adhere to best management practices, performance standards, and erosion control implementation as stated in ch. Trans. 401 Wis. Adm. Code. Best management practices, given in Chapter 10 of DOT's Facilities Development Manual, include devices and procedures employed to minimize erosion. Best management practices were developed in consultation with the DNR, Federal Highway Administration (FHWA) and the road building industry.

Chapter 10 of the Facilities Development Manual has been revised to include management of storm water runoff from transportation facilities. The revised Manual contains interim storm-water management policy. Currently, storm-water best management practices are being incorporated into projects on a case-by-case basis.

Other Groundwater-Related Research and Projects - DOT is currently participating in a FHWA study investigating methods for treatment of highway runoff which flows directly into karst sinkholes for the purpose of protecting groundwater resources in karstic hydrogeologic settings (e.g., Door County or SW Wisconsin). Another effort to improve water quality from highway runoff includes a research project to evaluate the effectiveness of high efficiency street sweepers for pollutant reduction and participating in a study sponsored by the Civil Engineering Research Foundation to verify the effectiveness of various storm water treatment devices. Finally, DOT is proactively monitoring several sites to evaluate the effectiveness of natural attenuation as a remedial option for petroleum contaminated groundwater. This information will be shared with the DNR.

For more information, contact Ms. Carol Cutshall, Director, Bureau of Environment, Room 451, P. O. Box 7965, Madison, Wisconsin 53707-7965; phone: 608-266-9626, or e-mail *carol.cutshall@dot.state.wi.us.*

UNIVERSITY OF WISCONSIN SYSTEM

The UWS has research, teaching and information/education responsibilities. These three missions are integrated through cooperation and joint appointments of teaching, research, and extension personnel who work on groundwater issues.

Research

During FY 00 the UWS directed a wide-ranging program of priority groundwater research consisting of 13 projects. The projects included short-term and long-term studies, and may be either of a fundamental or applied nature. They provide a balanced program of laboratory, field, and computer modeling studies and applications aimed at preserving or improving groundwater quality. The groundwater problems investigated include:

- Assessment of the sedimentology, stratigraphy, and porosity-conductivity relations of the Silurian aquifer in Ozaukee County;
- Obtaining an improved understanding of the dynamics of groundwater flow and heat transport in wetland systems;
- Using a probabilistic approach to assess how uncertainties in hydrogeologic conditions, reaction rates, and wall emplacement conditions affect the reliability of permeable reactive walls (PRWs);
- Development of methods for evaluating the distribution and activity of methanotrophic bacteria in relation to bioremediation of contaminated groundwater;
- Determination of hydraulic conductivity and specific storage of the Maquoketa shale;
- Evaluation of two agricultural management and fertilization practices on nitrogen levels in groundwater;
- Assessing macropore flow as means for enhancing groundwater recharge or as a potential source of groundwater contamination;
- Investigating the use of waste foundry sands in reactive walls for remediating groundwater;
- Identifying the hydrologic factors which have caused historical changes in groundwater recharge rates in southeastern Wisconsin;
- Investigating the degradation of chlorinated contaminants by zero valent iron (ZVI) under the catalysis of sorbed surfactant admicelles;
- Assessing the compatibility of lining system materials and mine waste liquids with the intent of determining if materials used for lining systems will function as intended in the presence of mine waste liquids;
- Integrating an artificial neural network (ANN) model in combination with a geographic information system (GIS) and a groundwater quality database to assess nitrate contamination from nonpoint sources at a watershed scale; and

- Using the Time Domain Electromagnetic (TEM) method to map the thickness of the aquifer and the three-dimensional distribution of saline groundwater from the surface in eastern Waukesha County and selected locations.

The 13 funded projects provided training in several disciplines for post-doctoral research associates, graduate student research assistants, and undergraduate students at UW-Madison, UW-Milwaukee, UW-Stevens Point, and UW-Parkside.

The UWS selected seven new groundwater research projects from this year's Joint solicitation for support during FY 01 (July 1, 2000 – June 30, 2001) (see Table 2). Seven projects, selected from the previous year Joint Solicitation, will receive continuation support during FY 01. New projects are centered at UW-Madison and UW-Stevens Point.

Teaching

The UWS institutions continue to offer courses and programs at the undergraduate and graduate levels that focus on diverse aspects of groundwater resources. In addition, several campuses offer credit, field-oriented water curriculum courses for middle school and high school teachers during summer sessions. Specifically, the WRI views education as an important component of its total program. At the American Water Resources Association-Wisconsin Section Annual Meeting this year the WRI co-sponsored *Careers in Water Resources: 2000 and Beyond*. This cost-free symposium on water-related jobs featured a panel discussion by professionals in various fields followed by breakout sessions with individual panel members and other experts. The importance of K-12 education is also recognized as a basic component of the WRI's training program. To address this issue, the WRI distributes its two publications--*Local Watershed Problem Studies-Elementary Activities* and *Local Watershed Problem Studies-Middle and High School Curricula Guide*--on request. These two curricula guides were produced to assist educators in the development and dissemination of curricula concerning soil and water resources.

Information Transfer

Results of WRI-supported research are published in a variety of forums. Much of the WRI research ultimately appears in refereed professional journals, although results of WRI research can also be accessed as technical reports, conference proceedings and abstracts, book chapters, or as dissertations and theses. A list of all publications resulting from WRI-supported research is maintained and will be added to the WRI web site over the next year. Copies of the publications housed at the WRI are distributed upon request. A highlight during the past year was the production of the Wisconsin Water Resources Institute Program Directory. This directory provides a brief history of the Wisconsin WRI program, briefly describes all research projects supported through the WRI, and gives a general overview of the WRI program. During the next fiscal year the WRI will begin publishing a newsletter. Each issue will feature a noteworthy research project, announce recently funded research, post new and noteworthy water-related web sites, list significant acquisitions to the WRI Library, and provide a forum for announcing relevant local, regional or national water-related news.

Water Resources Institute Web Site. The WRI has maintained a Web site since 1995 to provide an efficient means for the transfer of water-related information. The WRI Library originally developed the web site on the University of Wisconsin General Library System server, but it has now been greatly expanded and transferred to WRI's own on-site server. The site provides information about WRI programs and staff, water resources funding opportunities, conference information, project summaries, links to other water-related sources, and extensive information about the WRI Library. In addition, The Directory of Water Resources Personnel in Wisconsin, a comprehensive listing of more than 800 water professionals in Wisconsin, has been added to the WRI web site and is searchable by last name of expert, area of expertise, and/or research interest. The address of the WRI web site is *http://www.wri.wisc.edu*. Use of the web site has steadily increased from February 1999 through February 2000.

Conferences, Meetings and Presentations. The Wisconsin Water Resources Institute co-sponsored the American Water Resources Association -- Wisconsin Section Annual Meeting on March 23 and 24, 2000 in Green Bay, Wisconsin. This meeting provided a forum for nearly 50 papers that covered a variety of water-related subjects and were presented during six technical sessions and a poster session. This meeting is unique because it especially encourages students to present papers or posters describing their original research. Students funded by the Joint Solicitation are asked to present results of their research at this forum. At this year's meeting, WRI co-sponsored a session entitled "Careers in Water Resources: 2000 and Beyond," a panel discussion featuring water professionals from the public and private sector. The WRI librarian in cooperation with Steenbock Agricultural Library staff made a presentation on "Finding a Water-Related Job on the Web".

Water Resources Institute Library. The Water Resources Institute Library maintains a specialized collection of over 21,000 water-related publications in hard copy and microfiche, more than 35 journals, and more than 135 newsletters. The collection covers all major topics in water resources, including the water cycle, water conservation, water management, water quality and quantity, point and nonpoint water pollution sources, water law, and aquatic life. The collection is particularly strong in Wisconsin and Great Lakes water resources issues, groundwater protection, wetland issues, and the impacts of agricultural chemicals. The Water Resources Institute Library serves Institute staff, University of Wisconsin faculty, staff, and students, Wisconsin state government, businesses, and industry, and other Wisconsin residents. The Library will lend documents to non-Wisconsin residents, but provides other services only as time and resources permit.

The WRI Library is one of only two water resources libraries established under the State Water Resources Research Institutes Program. The Library collection, electronic resources and services are built upon and the result of long-term cooperation and coordination with other University of Wisconsin and area libraries. Library staff participate in campus library groups, the Wisconsin Chapter of the Special Libraries Association, the Wisconsin Library Association, and other library organizations. Through this coordination, the librarian builds a unique collection that does not duplicate the collections of other area libraries. WRI Library contributions help make Water Resources Abstracts available online to the UW-Madison campus. In turn, the Library depends on the UW Electronic Library for access to other online water resources indices, databases and full text journals and documents. The UW General Library System partially supports WRI Library participation in MadCat, the University online catalog. The Wisconsin Department of Natural Resources (DNR) Library also depends on WRI Library to collect water-related technical reports. To this end, the WDNR contributes funds each year to support the purchase of such materials.

During FY 00, the Library expanded its Web site at *http://wri.wisc.edu/library* and increased the scope of its monthly "Recent Acquisitions" list. In addition to redesigning the Web site, the following new features were added:

- "A Guide to Finding Water-Related Information on the Web"
- "A Guide to Finding a Water-Related Job on the Web"
- "A Guide to Searching MadCat for WRI Library Documents"

The librarian has expanded the monthly "Recent Acquisitions" list to include "Web Sites of Interest" to water resources professionals and students.

Since August 1990 the Library has circulated and served as a depository for the reports of the WDNR Groundwater Management Program Monitoring Project. The Library has added these reports to MadCat, listed them in the Recent Acquisitions list, and provided staff to put summaries of these projects on the World Wide Web.

Use of the WRI Library by faculty, students, federal agencies, private consulting firms, and others interested in water has grown greatly over the last several years. Book circulation has increased more than 51% and requests for information more than 63% from FY 99 to FY 00. Since adding the collection to MadCat, the University of Wisconsin online catalog, in the summer of 1995, student use has increased significantly.

During FY 00, the library staff responded to 1,238 requests for individual titles and subject searches. More than 691 UW-Madison faculty, staff, and students, WDNR staff, private consulting organizations, and members of the public contacted the WRI Library last year.

Information/Education - The UWS institutions and county-based staff continue involvement in groundwater education activities. In cooperation with other state and federal agencies, groups and individuals, innovative problem-solving educational programs on groundwater resources are provided to the State's citizens through publications, meetings, teleconferences, satellite programs, water testing, and other forms of assistance. Activities of several specific programs follow.

The UWS Farm Assessment System (Farm*A*Syst) and Home Assessment System (Home*A*Syst) programs help farmers and rural non-farm residents assess water pollution risks related to their structures, management practices, and site characteristics. The system is available statewide and has been integrated into a number of Wisconsin Watershed projects. It is being used as an educational tool for Environmental Quality Incentive Programs and county conservation planning. Commodity organizations are increasingly using Farm*A*Syst as a basis for developing voluntary environmental management assessment systems. For example, the Wisconsin Milk Marketing Board is working to develop a dairy environmental assessment system based on Farm*A*Syst. In Wisconsin, at least 3 Native American nations are using elements of these programs to assist with their efforts to protect and manage natural resources.

Project evaluation shows Farm*A*Syst to be an effective, voluntary program which increases knowledge and, most importantly, leads to changes in practices. The expanded, national project is working with all 50 states, several Canadian provinces, Australia, and Mexico in adopting this system. This is a cooperative project funded by the U.S. Department of Agriculture (USDA) Cooperative State Research Education Extension Service, the NRCS, and the EPA. Recent materials available through the national program are listed under publications. Extensive information is available on the Internet at *http://www.wisc.edu/farmasyst/.*

The UW Environmental Resources Center (ERC) provides development and national coordination of a number of youth leader water education materials related to groundwater education. The ERC also provides a national database of youth water education materials, allowing individuals to choose a curriculum appropriate to education goals by searching on approximately 100 water topics and 100 youth education and water education topics. The ERC continues to provide national coordination for Give Water a Hand. Give Water A Hand goals are to protect and improve local water quality by encouraging youth to investigate local issues, and plan and complete a service project with assistance from a local natural resource expert to address a problem they identify. Program materials, available through UW Extension Publications, consist of an Action Guide for youth, with step by step instructions for addressing local watershed concerns, and a Leader Guidebook to assist teachers and youth leaders in facilitating youth projects. New projects include a gap analysis of youth water curricula for source water education and riparian education resources, to help meet goals of the Clean Water Action Plan. We also developed a Leader Institute and Guide for Latino water education and completed an evaluation of USGS water education materials to assist with USGS education program development decisions.

The UW Nutrient and Pest Management (NPM) program mainly serves Wisconsin farmers and the other agricultural professionals who assist them in making management decisions. The primary focus of NPM programs in 1999-00 was improved nutrient management practices to save money and reduce the potential for nonpoint source pollution. The program continued its focused neighborhood approach that works one-on-one with farmers in priority watershed or other critical areas. In a new approach, NPM and partners wrote and produced a nutrient management curriculum that is being used in sixteen counties in 1999-2000. The curriculum combines on-farm consultation with two workshops and developing a whole-farm nutrient management plan with participants. Water quality concerns are emphasized throughout the process.

A parallel NPM focus was increasing educational programs on integrated pest management to assist farmers moving beyond pesticide-dependent cropping systems. Activities included hands-on IPM training for farmers, publications, and field research and demonstration projects. NPM expanded its work to the Central Sands this year.

Building from collaboration activities with Wisconsin Potato and Vegetable Growers (WPVGA) and World Wildlife Fund (WWF), a new EPA-funded project will work with potato growers to reduce their reliance on most toxic pesticides, increase use of biointensive IPM, conduct economic analysis of practices, and pilot an environmental label for fresh market potatoes.

The UWS cooperates with other state agencies involved with water resources and natural resource issues. In 1998, UW-Extension entered into a new partnership with the DNR and USDA-NRCS in Wisconsin. This new partnership provides land and water resources education in the state's 22 major river basins. In 1998 seven, multi-agency supported river basin educators were hired. In 1999, two additional positions were added providing educational assistance to approximately 13 basins. The Basin Educators work collaboratively with three publication/editorial specialists, two evaluation experts, and one coordinator who works on volunteer-based issues. Collectively this river basin focus works to support other local conservation professionals such as county Extension agents, Land Conservation Department staff, and NRCS staff. This focus on river basins includes drinking water fact sheets, newsletter articles about groundwater, and in some instances, specific watershed studies that address unique water quality problems.

Extension's Environmental Resources Center publishes a bimonthly newsletter, Keeping Current, which brings information about water issues to more than 1,500 agency staff throughout the state.

UW-Extension coordinates the Multi-Agency Land and Water Education Grant Program which funded five groundwater-focused projects between July 1, 1999, and June 30, 2000. These projects, which totaled over $98,000 in educational assistance funds, examined the effects of intensive rotational grazing on groundwater quality, provided well testing for rural landowners, and conducted Farm*A*Syst assessments to help farmers identify and address groundwater contamination on their property.

The Central Wisconsin Groundwater Center's (CWGC) mission is to provide groundwater education and technical assistance to the citizens and governments of Wisconsin. Programs range in breadth from answering citizen questions (e.g., Is my water safe? How deep should I drill my well? Where is this nitrate coming from?) to helping communities with wellhead protection planning, and describing the extent and causes of groundwater nonpoint pollution in Wisconsin. The Center frequently works through county Extension faculty in program delivery.

In 1999, the Center assisted 3,950 households in having their water tested in conjunction with county Extension offices and the UW - Stevens Point Environmental Task Force Lab. Of these, 10% exceeded drinking water standards for nitrate-nitrogen. Sixteen percent were unsafe because of coliform bacteria. Twenty-two percent had moderate to severe corrosivity indexes. Sixteen education programs helped 1715 well users in 14 counties understand potential remedies for these problems and the relationship of land use practices to groundwater quality.

The Center has been active in the nonpoint source pollution program redesign, and a leader in education and research into nonpoint problems. It has provided assistance in many of the projects undertaken by the Education Subcommittee in the last year, such as groundwater education at Farm Progress Days, and preparation of supplementary educational materials on Consumer Confidence Reports. The Center's main Web site is at *http://www.uwsp.edu/cnr/gndwater/*.

Center staff are highly involved with agencies and private organizations. These include the Wisconsin Potato and Vegetable Growers Association Nonpoint Pollution subgroup; DATCP Atrazine Technical Advisory Committee; Golden Sands Resource Conservation and Development Area Water Resources Committee; and Extension Nutrient Management Self-Directed Team. Involvement with local watershed based groups includes the Wolf River Basin Partnership and Pigeon River Partnership. The Center has also provided technical assistance to the Portage County Citizens Groundwater Advisory Committee and its subcommittees.

For more information on research or information transfer contact Dr. Anders W. Andren, Director, UW-Madison Water Resources Institute, 1975 Willow Drive, Madison, WI 53706; phone (608) 262-0905, Fax (608) 263-2063, or email *awandren@seagrant.wisc.edu*. For teaching and information/education, contact Jim Peterson, UW

Environmental Resources Center, 1450 Linden Drive, Madison, WI 53706-1562, phone (608) 262-3799, fax (608) 262-2031, or email *jopeters@facstaff.wisc.edu*.

Groundwater-Related Publications and Presentations of UWS Faculty and Staff during FY 00

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NPM Publications FY 00

Nutrient Management Farmer Education Program Curriculum

Know How Much You Haul!

Soil Testing Basics

IPM Quick Guide – Corn Insect Pests of Wisconsin

GROUNDWATER MONITORING AND RESEARCH

CONDITION OF THE RESOURCE - GROUNDWATER QUALITY

As part of 1983 Wisconsin Act 410, the Groundwater Account of the Environmental Fund was created to support groundwater monitoring by state agencies to determine the extent of groundwater contamination in Wisconsin and identify the sources of contamination. Groundwater monitoring has found that the primary contaminants of concern are volatile organic compounds (VOCs), pesticides and nitrate. Each is discussed below, in addition to sections on biological hazards, natural groundwater quality, and arsenic.

Volatile Organic Compounds

VOCs volatilize under normal temperatures and pressures. Examples of VOCs include gasoline and industrial solvents, paints, paint thinners, drain cleaners, air fresheners, and household products (such as spot and stain removers). Many VOCs are suspected carcinogens when exposure is long term. In the short term, high concentrations of VOCs can cause nausea, dizziness, tremors, or other health problems.

Sources of VOCs in Wisconsin's groundwater include landfills, underground storage tanks, and hazardous substance spills. The DNR requires monitoring at state Environmental Repair Fund sites, abandoned facilities, Comprehensive Environmental Response Compensation Liability Act (CERCLA- Superfund), LUST, and spill sites. Thousands of wells have been sampled for VOCs. Fifty-nine different VOCs have been found in Wisconsin groundwater. Trichloroethylene is the VOC found most often in Wisconsin's groundwater.

Wisconsin has 90 active, licensed solid waste landfills, all of which are required to monitor groundwater. In addition, the DNR currently tracks more than 17,800 LUST sites, approximately 4,000 waste disposal facilities, and approximately 1,400 high priority Environmental Repair sites. Many of these sites have been identified as sources of VOCs. Facilities include: gas stations, bulk petroleum and pipeline facilities, plating, dry cleaning, industrial facilities, and abandoned non-approved unlicensed landfills.

Landfills. Two studies conducted over a four-year period revealed that out of 45 unlined municipal and industrial landfills, 27 (60%) had VOC contamination in groundwater. All of these landfills are currently closed. Six landfills with liner and leachate collection systems were also sampled and no confirmed VOCs were detected. VOCs contaminated groundwater at 21 (81%) of the 26 unlined municipal solid waste landfills included in the two studies. While 20 different VOCs were detected overall, 1,1 – Dichloroethane was the most commonly occurring VOC at all solid waste landfills. The two DNR publications – "Volatile Organic Compounds in Groundwater and Leachate at Wisconsin Landfills", dated February 1988, and "VOC Contamination at Selected Landfills – Sampling Results and Policy Implications", dated June 1989 – further describe the research results. In a follow-up VOC study conducted from July 1992 through July 1994, the DNR reviewed historical data and sampled groundwater at 11 closed, unlined landfills and at six older, lined landfills. VOC levels have decreased after closure at all but two of the unlined landfills, though at many sites VOC levels do not show continued decline. Also, the level of contamination remains high at many closed sites. No VOC contamination was attributable to leachate migration at any of the six older, lined landfills.

Over the past few years increasing numbers of residential developments have been located close to old, closed landfills. Further, it has been recently discovered that several of these landfills are impacting groundwater. In 1998 and 1999 the DHFS sampled private wells down-gradient of 19 small, closed landfills in one county. Several of the private wells had results above maximum contaminant levels. The results of this sampling showed that there may be more landfills with serious problems that have not yet been identified.

The DNR Bureaus of Waste Management, Remediation and Redevelopment, and Drinking Water and Groundwater in cooperation with the DHFS, responded to this issue in early 1999 by choosing 16 old, closed landfills – at least three from each of the five regions across the state - that have private wells nearby and may be impacting groundwater. Private wells around each of the landfills were sampled in 1999 and significant levels of contamination were found. Of the 113 wells that were tested, 31 had detects of VOCs. Fourteen of the homes had levels exceeding drinking water standards and have been given health advisories not to drink their water.

Underground storage tanks. Wisconsin requires underground storage tanks with a capacity of 60 gallons or greater to be registered with Commerce. This registration program has identified a total of 173,552 tanks as of June 28, 2000 of which 78,011 tanks are regulated by the federal underground storage tank program. Only 13,544 regulated tanks are currently in use, and 64,467 tanks have been removed. A federally regulated tank is any tank, excluding exempt tanks, that is over 110 gallons in size, has at least 10 percent of its volume underground, and is used to store a regulated substance. Exempt tanks include: farm or residential tanks of 1,100 gallons or less; tanks storing heating oil for consumptive use on the premises where stored; septic tanks; and storage tanks situated on or above the floor of underground areas, such as basements and cellars.

Underground storage tanks over 110 gallons have been federally regulated since 1988. As of June 1, 2000, DNR records indicate there are 6,900 active underground storage tank contamination cleanups and approximately 10,900 sites. The contaminants most commonly associated with leaks from petroleum underground storage tanks are benzene, toluene, ethyl benzene, and xylene (BTEX compounds). More than 5,000 LUST sites have BTEX groundwater standards exceedances. Drinking water at more than 300 households has been contaminated by leaks from underground storage tanks.

Hazardous substance spills. Hazardous waste treatment storage and disposal facilities are another VOC source. The DNR Bureau for Remediation and Redevelopment is investigating or remediating contamination at 27 sites. Approximately 140 sites statewide are subject to corrective action authorities. However, only a small percentage will follow the corrective action process because of minimal contamination at the site or jurisdiction under other regulatory authorities.

Generators improperly managing hazardous waste are another source of VOC contamination. All new generator remediation cases statewide and many existing actions are to be addressed in accordance with the NR 700 Wis. Adm. Code series.

The Hazardous Substance Spill Law, ch. NR 292.11 Wis. Adm. Code, formerly section 144.76, Wis. Stats, requires immediate notification when hazardous substances are discharged, as well as taking actions necessary to restore the environment to the extent practicable. Approximately 1000 discharges are reported annually to the DNR, and of those, approximately 65% are petroleum related, with another 15% being agrichemicals. The NR 700 Wis. Adm. Code series contains the requirements for notification and for taking immediate and/or interim actions when releases occur. Groundwater monitoring is performed when necessary to delineate the extent of contamination. The spills program has also developed outreach materials to minimize spills from home fuel oil tanks, which can lead to significant releases of fuel oil to the ground and surface waters.

Pesticides

Pesticide contamination of groundwater results from field applications (i.e., nonpoint sources), pesticide spills, misuse, or improper storage and disposal (i.e., point sources). Serious concerns about nonpoint sources of pesticide contamination in Wisconsin were first raised in 1980 when aldicarb was detected in groundwater near Stevens Point. The DNR, DATCP, and other agencies responded to these concerns by implementing monitoring programs and conducting groundwater surveys.

DNR expanded its sampling programs in 1983 to include analysis of pesticides commonly used in Wisconsin. Federal and state groundwater quality standards for many of these compounds were also adopted, and, to date, standards for over 30 pesticides are included in ch. NR 140, Wis. Adm. Code.

Pesticide and Groundwater Impacts Study - DATCP began a study in 1985 to determine if normal field application and use of pesticides and fertilizer was causing groundwater contamination problems. What began as a two-year study is now entering its 15th year as DATCP's *Monitoring Well Program*. Currently, 25 monitoring sites are sampled annually for nitrate and common corn herbicides in highly susceptible areas of the state (e.g., Central Sands and Wisconsin River Valley). In 1999, 72% of these sites exceeded the enforcement standard (ES) of 10 mg/L for nitrate-nitrogen. The mean nitrate concentration at these sites was 24 mg/L, more than twice the enforcement standard. Alachlor ESA, total atrazine and Metribuzin were the top three most commonly detected pesticides in 1999. Atrazine, its total chlorinated residuals or breakdown products (TCR), and alachlor ethane sulfonic acid (ESA - a breakdown product of alachlor) exceeded their respective enforcement standards and Interim Health Advisory levels at 8 %, 4 % and 4 % of the monitoring well locations.

Exceedence Survey - This program re-samples wells that previously exceeded a pesticide enforcement standard. From 1995-1999 DATCP has conducted an annual sampling program called the *Exceedence Survey*. 148 wells have been re-sampled in this program for atrazine, deethylatrazine, deisopropylatrazine, diaminoatrazine, alachlor, alachlor ESA, cyanazine, metolachlor, metribuzin, and nitrate-nitrogen. Most wells are in atrazine prohibition areas. About 2/3 of the wells have had a decrease in atrazine concentration from 1995 to 1999. About 50% of the well owners who had a well with an ES exceedence still use their well for drinking water. This report is available by contacting the DATCP.

Monitoring Reuse of Atrazine in Prohibition Areas - In FY 98, DATCP began monitoring the limited reuse of the herbicide atrazine in selected areas of Wisconsin where its use has been prohibited since 1993 due to groundwater contamination. Chapter ATCP 31, Wis. Adm. Code, requires DATCP to gather scientific data to show if renewed atrazine use in these areas will cause further groundwater contamination. DATCP will test groundwater under 17 monitored fields (10-40 acres in size) quarterly for 5 years. Growers planted corn in the first year of the study and must plant corn in at least two other years, with atrazine applied to corn. Products containing cyanazine or simazine cannot be used on the monitored field during the study, but other pesticides and fertilizers can be applied as needed. Growers choose the tillage and pesticide application methods best suited for their operations. The monitoring wells will be removed at the end of the project. Although it is too early in the project to make recommendations, summary data for the first two years shows that atrazine concentrations have increased at 13 of the 17 sites since atrazine use has resumed. Atrazine concentrations have been detected over the preventive action limit of 0.3 µg/L at 16 of the 17 sites and over the enforcement standard of 3.0 µg/L at 10 of the 17 sites. Nitrate has been detected above the enforcement standard of 10 mg/L at all 17 sites.

Atrazine Rule Evaluation Survey - DATCP conducted this survey to evaluate the restrictions on the use of atrazine in Wisconsin. The purpose of the survey was to determine how levels of atrazine and its metabolites in groundwater were changing three and five years after the atrazine rule was put into place. The survey was conducted in two phases: phase one in 1994 and phase 2 in 1996. A total of 567 samples were collected from 429 wells (138 wells were sampled in both phases.) DATCP made statistical estimates of several atrazine properties in groundwater including the percent of Wisconsin groundwater containing a detectable amount of atrazine residues, and the concentration of atrazine and metabolites in wells with detectable levels. The results show a significant decline in atrazine concentrations in Wisconsin between 1994 and 1996. The average atrazine plus metabolite concentration in wells with detections declined from 0.96 to 0.54 ppb in the two year period, a 44% decrease. The percent of contaminated wells, however, did not show a significant decline.

Triazine Screen - Beginning in January of 1991, the Wisconsin State Laboratory of Hygiene (SLOH) initiated a testing program for the public based on the immunoassay screening test for triazine-based compounds. The triazine immunoassay screen is a test that uses specific antibodies (proteins produced by an immune system in response to the presence of a foreign substance) designed to selectively bind to target compounds present at low concentrations. Tests continue to be available to the public via a toll free telephone number and a small fee. The DNR is funding a part time staff position at the SLOH to assist in the quality control process for data collection from triazine screening samples.

Since the start of this program, DNR groundwater databases have amassed more than 14,000 individual results for drinking water wells from the triazine screen analysis. Data received from the SLOH indicates that approximately 42 percent of the samples indicated detection of a triazine-based compound. Approximately 13 percent of the samples have a result that exceeds the PAL for atrazine of 0.3 ppb, and approximately 1.6 percent have exceeded the ES of 3.0 ppb. Comparison to the ES and PAL is used only for reference since the immunoassay triazine analysis screens for ten compounds other than atrazine specifically, and does not detect two of the three atrazine metabolites included in the groundwater standard. Comparison to the ES and PAL for atrazine has some reference value because atrazine has been so heavily used in Wisconsin, and there have been few detects of the other triazine-based compounds in groundwater.

The SLOH can now screen for many other pesticides and has expanded the immunoassay screening program to include other pesticides as requested.

Nitrate

Nitrate-nitrogen is the most common contaminant found in Wisconsin's groundwater. Detections of nitrate in private water supplies frequently exceed the state drinking water standard of 10 milligrams/liter (mg/L). A 1994 study by WGNHS and DHFS estimated that 9 to 14% of private water wells in Wisconsin exceed the nitrate standard. Consumption of water that contains high concentrations of nitrate by infants under 6 months of age can induce a condition called methemoglobinemia or "blue baby syndrome." This condition occurs when red cell hemoglobin is oxidized to a form that is unable to carry oxygen to the body's tissues. All infants are at risk of nitrate poisoning, but those suffering from gastrointestinal illnesses appear to be more sensitive than healthy infants. DHFS staff completed a summary of two cases from southern Wisconsin where infants showed symptoms of methemoglobinemia, one of which required hospitalization. This report was published in *Environmental Health Perspectives* in July 2000 (see p. 23 for complete reference).

The chronic health effects of nitrate exposure are not well understood; however, many experts believe that long-term exposure may increase the risk of cancer. This theory is supported by some scientific studies. For example, in 1996 researchers in the Netherlands found that residents who consumed water that was high in nitrate had higher levels of cancer-causing nitroso compounds in their urine. These researchers also found that genes in the blood cells of these individuals had higher numbers of mutations. Two years earlier, these same researchers had reported a link between consumption of high-nitrate water and the incidence of thyroid disorders. In 1996, a study conducted jointly by the National Cancer Institute, the University of Nebraska, and Johns Hopkins University found an association between nitrate-contaminated water and Non-Hodgkin's lymphoma. A large cohort study conducted jointly by the University of Iowa, Mayo Clinic and the University of Minnesota found a positive association between nitrate levels in municipal water supplies and the incidence of bladder and ovarian cancer among adult women.

Currently, DHFS and the DNR recommend testing of all newly constructed private wells and wells that have not been tested during the past five years. Due to the concern over nitrate, the GCC endorsed a resolution in 1989 recommending that newly constructed water supply wells be sampled for nitrate in addition to coliform bacteria. Testing is recommended for wells used by pregnant women and is essential for wells that serve infants less than 6 months of age.

Nitrate contamination of groundwater and surface water is difficult to prevent. Commerce continues to evaluate state-of-the-art septic system designs for nitrate removal. In addition, DATCP has been evaluating the need for regulation of nitrogen-based fertilizers. DATCP proposed regulatory authority for fertilizer use in the FY 96-97 budget but the proposal was not approved. A new nutrient management budget initiative was proposed in FY 97 that would give DATCP the authority to promulgate regulatory and non-regulatory rules related to nutrient management.

Biological Hazards

The DNR is aware of several areas in Wisconsin where biological contamination of the aquifer is common. Biological agents include bacteria, viruses, and parasites. These agents can cause acute illness and result in life-threatening conditions for some population groups. Approximately 23% of well water samples statewide test positive for total coliform bacteria, an indicator species of other biological agents. Approximately 3% of well water samples test positive for *E. coli*, an indicator of water borne disease that originates in the mammalian intestinal tract. The DNR recommends that well owners test for biological quality annually or when there is a change in taste, color, or odor of the water.

Natural Groundwater Quality

Natural groundwater quality varies greatly throughout Wisconsin. Undesirable constituents commonly found in Wisconsin groundwater include iron, manganese, sulfate, arsenic, and radioactive materials. High levels of iron have been detected throughout the state. High levels of manganese, arsenic, and sulfates are less commonly found and are more localized in extent (see discussion of arsenic below).

Naturally occurring radioactivity in groundwater, including uranium, radium and radon, has become a concern in Wisconsin in recent years. The state has initiated programs to test groundwater for radioactivity. Recent sampling has identified radionuclides in groundwater in north central Wisconsin. High levels of radium have also been found in water supplies in eastern Wisconsin. Studies have been initiated to examine the occurrence and extent of these naturally occurring contaminants.

Arsenic

Arsenic in Wisconsin's Groundwater - Naturally occurring arsenic has been detected in wells throughout the State of Wisconsin. Department of Natural Resources historic data show that 3,386 public wells and 1,821 private wells have detectable levels of arsenic. These samples were taken randomly over the years with more public well water being tested for arsenic than private well water. The problem is especially prevalent in northeastern Wisconsin where increased water use has likely mobilized arsenic into the groundwater. In a portion of Outagamie, Shawano, Winnebago, and Brown Counties approximately one out of three private drinking water wells sampled have arsenic detects. The highest concentration of arsenic detected in a private well in Wisconsin is 15,000 µg/L.

Arsenic bearing geologic units exist across the state. It is found in the igneous rocks of the Precambrian shield, the Paleozoic sedimentary rock, and within glacial deposits. The highest concentrations are present in the sedimentary bedrock. Arsenic has been detected in public well water samples in every county in Wisconsin. An area in northeastern Wisconsin has very high levels of arsenic in its private wells related to the oxidation of a mineral rich zone, mobilizing the arsenic, within its sedimentary rock aquifer.

History of Arsenic Contamination – In northeastern Wisconsin arsenic contamination of groundwater was first identified in 1987 during a routine feasibility study for a proposed landfill to be located just northwest of Oshkosh. As part of this study, drinking water wells in the vicinity of the proposed landfill were sampled for background inorganic chemicals. In five of the eight wells tested, arsenic was detected above 5 µg/L. Sample analytical results from additional wells in the area surrounding this site indicated a similar trend of arsenic contamination. These results pointed toward naturally occurring deposits as the most likely source of the arsenic.

Further information relating to the arsenic problem came from a DNR investigation of a problem well in the Seymour area, just west of Green Bay. The owner had originally complained of declining water quality and reported that laundry washed in the well water literally fell apart. The DNR investigator noted that metal plumbing fixtures in the house showed evidence of significant corrosion. Water sample results indicated a very low pH, at less than 2.5. The arsenic concentration of this water was 5,900 µg/L.

Over time several other wells in this area exhibited similar water quality problems. Many of these wells also produced elevated levels of iron, sulfate and other heavy metals, including cobalt, molybdenum, vanadium, cadmium, chromium, copper and nickel.

Potential Cause of Arsenic Contamination in Northeastern Wisconsin – The results from several DNR studies indicate the geochemical phenomena causing the elevated levels of arsenic in groundwater are associated with oxidation of sulfide-mineralized zones within the bedrock aquifers. The main zone of mineralization extends some ten feet below the base of the Platteville Dolomite, which is part of the main upper bedrock formation of this region. If the St. Peter Sandstone is present within the geologic sequence, it lies directly below the Platteville Dolomite and the arsenic-rich mineralized zone then extends about ten feet into this sandstone. Although it is certain that this is the main mineralized zone, experts believe that there are other lateral and vertical occurrences of arsenic-rich strata.

Arsenic's Primary Release Mechanism – Since the 1950s, groundwater consumption in northeastern Wisconsin has risen significantly due to an increase in population and per capita water use. Thousands of new private wells have been constructed in this region. Municipal and industrial groundwater use has increased. As a result, regional groundwater levels in the sedimentary bedrock aquifers of northeastern Wisconsin have shown a steady long-term decline. The decline has averaged as much as three to four feet per year in the Green Bay area and as much as two to three feet per year in the Fox Cities area surrounding the City of Appleton.

The increased levels of arsenic in this region may be related to the increased groundwater consumption. In many areas, increasing concentrations of arsenic may be a result of the water table dropping to levels at or just below the sulfide rich mineralized zone and then fluctuating up and down across this layer. This fluctuation can allow oxygen in the air to come in contact with and oxidize the sulfide minerals in this layer. This initial oxidation can then trigger a complex set of geochemical reactions that can eventually release arsenic into the groundwater. Once this reaction has been initiated it is likely to continue.

Arsenic Advisory Area - Studies conducted by DNR led to the delineation of the extent of the arsenic contaminated area. This delineation led to the establishment of an "Arsenic Advisory Area" in the early 1990s. The worst contamination was found within an area along a southwest to northeast trend, generally following the ground surface delineation of the buried surface ("the subcrop") of the St. Peter Sandstone. For this area, DNR developed special well construction specifications, more stringent than the minimum Private Well Code requirements. These specifications were recommended, but not required, for new wells constructed within the "Arsenic Advisory Area". The specifications, when followed, will increase the likelihood of installing a well free of arsenic. This area includes the strip of land five miles either side of the bedrock subcrop of the St. Peter Sandstone, extending in a northeasterly trend, from a location just southwest of Oshkosh, to a location just west of Green Bay.

Health Effects – National health experts agree that consuming water containing arsenic has many adverse health effects. Wisconsin Department of Health and Family Services' toxicologists have reviewed the existing toxicological information and have produced an "Arsenic in Drinking Water" brochure documenting the potential health problems linked to consuming water containing arsenic. The brochure informs the public that drinking arsenic contaminated water has been associated with skin cancer; internal cancers (bladder, prostate, lung and other sites); thick rough skin on hands and feet; unusual skin pigmentation; numbness in the hands and feet; circulatory disorders; tremors; and stomach pain, nausea, and diarrhea.

The current Federal Drinking Water Standard, for public water supply wells, is 50 micrograms/liter (µg/L). At that level the risk of cancer is 1 to 1.5 in 1,000, higher than normally allowed for substances in drinking water. The Environmental Protection Agency (EPA) was required by the 1996 revisions to the Safe Drinking Water Act to propose a revision to that standard by January 1, 2000 to lower the cancer risk. EPA did not meet that deadline but in May 2000 proposed a standard of 5 micrograms per liter. They are currently seeking public comment on the proposed standard, as well as standards at the 3 and 20 µg/L levels. At these lower levels Wisconsin will have many private and public water consumers having to treat or look elsewhere for water to protect themselves from the risk of getting cancer.

CONDITION OF THE RESOURCE - GROUNDWATER QUANTITY

Groundwater quantity and water withdrawal issues received more than usual attention in FY 00, prompted by the interest of Perrier in locating a high capacity well near two spring sites. The Department of Natural Resources is continuing to address the potential impacts of the proposed wells in anticipation of formal permit applications. This project highlighted the limited authority that the state has in regulating groundwater withdrawals that may affect surface water resources.

The GCC anticipated some of these issues in a report entitled "Status of Groundwater Quantity in Wisconsin" published in April 1997. The full report is available from the DNR and may be downloaded from the World Wide Web at: *http://www.dnr.state.wi.us/org/water/dwg/gw/Pubdwnld.htm*. The Executive Summary is printed here.

Purpose of Report

In August of 1994, the Wisconsin Groundwater Coordinating Council (GCC) suggested that the Wisconsin Department of Natural Resources (DNR), in cooperation with the GCC and other interested parties, prepare a report describing groundwater quantity problems and issues in Wisconsin. The Groundwater Section of the DNR's Bureau of Drinking Water and Groundwater prepared this report with the assistance of a Technical Advisory Committee (TAC). The objectives of this report are to summarize what we know about Wisconsin's groundwater quantity problems; discuss information that is available on groundwater quantity and where more information is needed; and discuss potential options for addressing groundwater quantity issues.

Findings

Despite a general abundance of groundwater in Wisconsin, there is a growing concern about the overall availability of good quality groundwater for municipal, industrial, agricultural, and domestic use and for adequate baseflow to our lakes, streams, and wetlands. Groundwater quantity problems have occurred naturally and from human activities. Natural shortages of groundwater have occurred due to weather conditions (e.g., drought) and geologic setting (e.g., crystalline bedrock aquifer with low yields).

Human activities such as groundwater withdrawal and land use activities may also cause groundwater quantity problems. The effects of groundwater withdrawals are well documented on a regional scale in the Lower Fox River Valley, southeastern Wisconsin, and Dane County. There are substantial declines in groundwater levels in these three areas.

Localized effects from groundwater withdrawals are not as well documented as the regional effects. Cases exist around the state where wells, springs, and wetlands have gone dry; lake levels have dropped; streamflow has been reduced; and contamination has prevented installation of new wells.

The availability of groundwater may also be affected by groundwater quality. The presence of naturally-occurring substances in groundwater (e.g., iron, sulfate, arsenic) or human-caused contamination has limited groundwater use in some areas.

Information from the U. S. Geological Survey (USGS) indicates water use in Wisconsin has increased steadily since 1950. Groundwater use grew from 570 to 754 million gallons per day (Mgal/d) from 1985 to 1995.

Groundwater withdrawals can affect both groundwater and surface water. Declining groundwater levels from pumping may increase pumping costs due to the need to pump water from a greater depth, dewater or mine an aquifer until it no longer meets water supply needs, dry up nearby shallow wells (e.g., domestic wells), decrease baseflow (i.e., natural groundwater discharge) to lakes, streams, and wetlands, and cause surface water to recharge a depleted aquifer. A loss of baseflow may harm fisheries or wildlife habitat.

There is an ongoing effort by state and federal agencies and university staff to gather data and information on

groundwater quantity issues. The Wisconsin Geological and Natural History Survey (WGNHS) and the USGS maintain a statewide groundwater-level observation network to evaluate short-term changes and long-term trends in groundwater levels. The USGS also maintains a network of streamflow gauging stations across the state to record surface water flow. Historical groundwater-level and streamflow data is valuable as we look at the relationship between surface water and groundwater.

Historically in Wisconsin, only a few research studies have focused on groundwater quantity issues. Currently, groundwater quantity studies are underway in Dane County, the Little Plover River Basin, the Lower Fox River Valley, and the Driftless Area. Because of the many factors involved, gathering definitive data on the effects of groundwater withdrawals is complex, time-consuming, and expensive. Additional information is needed to increase our understanding of groundwater-surface water interactions, identify areas with groundwater quantity problems, and determine the impacts of groundwater withdrawals.

Under Wisconsin Law, chapter 281, Wis. Stats. (formerly ch. 144), the DNR is the "central unit of government to protect, maintain, and improve the quality and management of the waters of the state, ground and surface, public and private." The DNR carries out these responsibilities through its Drinking Water and Groundwater, Watershed Management, Waste Management, and Fisheries Management and Habitat Protection programs. The DNR regulates high capacity wells and surface water diversions. Other agencies involved in groundwater quantity issues include the WGNHS, Central Wisconsin Groundwater Center, GCC, Public Service Commission, the USGS, local units of government and water utilities.

Groundwater quantity will continue to be an issue of concern in Wisconsin. A coordinated effort is needed to determine appropriate management options for addressing groundwater withdrawals, to prioritize information needs, and to implement information and education programs. Funding is needed for additional data collection and research to address groundwater quantity management issues.

COORDINATION OF GROUNDWATER MONITORING AND RESEARCH

Four state agencies have had up to $750,000 available each year for groundwater-related monitoring or research. Approximately $9.7 million has been spent through FY 00 on 259 different projects dealing with groundwater or related topics (see Table 3 in Appendix). The sources of money and purposes of monitoring or research include:

1. DNR Management Practice Monitoring - The DNR has had approximately $300,000 available each year since FY 86 to support groundwater monitoring studies evaluating existing design and/or management practices associated with potential sources of groundwater contamination. Through FY 00, the DNR has spent approximately $4.7 million on 163 monitoring projects. Eight projects have been co-funded with DATCP, five projects have been co-funded with the UW, and one project has been funded by DNR, DATCP and UWS. The money has come from the Groundwater Account of the Environmental Fund (which is funded by various fees). The intent of these studies is to reduce the impacts of potential sources of contamination by changing the way land activities that may impact groundwater are conducted.

2. UWS Groundwater Research - The UWS has received funding since FY 90 for groundwater research. The money is part of the base UWS budget. They received $200,000 in FY 90 and $300,000 annually since then. Through FY 00, the UWS has spent $3.2 million on 87 groundwater research projects. Five of the 87 projects have been co-funded with DATCP, five have been co-funded with the DNR and one project was jointly funded by DNR, DATCP and UWS.

3. DATCP Pesticide Research - Since 1989, DATCP has had approximately $125,000 available annually as a result of the pesticide law to fund research on pesticide issues of regulatory importance. The money comes from fees paid by pesticide manufacturers to sell their products in Wisconsin. Through FY 00, DATCP has spent about $1.2 million on 24 pesticide projects. Five have been co-funded with the UWS, eight have been co-funded with the DNR, and one project was jointly funded by DNR, DATCP and UWS.

4. DILHR/Commerce Private Sewage System Research - DILHR received a special GPR appropriation of $50,000 from 1990 to 1993 to fund research on alternatives to current private sewage system technology (s. 145.20(5), Stats.) In 1994, when the appropriation expired, $75,000 generated through plan review and licensing fees became available each year for research on private sewage systems. Through FY 00, DILHR/Commerce has spent approximately $550,000 on six projects.

The GCC provides consistency and coordination among the four state agencies in funding groundwater monitoring and research to meet state agency needs. In 1988, the GCC requested that the UWS create a Groundwater Research Advisory Council (GRAC) to establish a long-range groundwater research plan and develop a groundwater research decision item narrative (DIN) for inclusion in the University's biennial budget. The GRAC consists of university, state agency, and public representatives.

Statutory language requires that there be agreement between the UWS and the GCC on the use of the UWS research funds before the funds can be released by the Department of Administration. To expedite this agreement, a MOU was signed in 1989 by representatives of the GCC, the GRAC, and the UWS on use of the UWS groundwater research funds. The MOU spells out the procedures for establishing priorities and selection of projects for funding of UW groundwater research. The MOU recognizes that the GCC has a substantive role in establishing research priorities and an advisory role in project selection to minimize overlap and duplication.

During the summer of 1990, the GRAC and GCC developed and endorsed a plan to coordinate the solicitation of projects for funding in FY 92 and subsequent years. The joint solicitation provides for only one submittal of project proposals, rather than four as had been the case. The intent of the plan is to determine the most appropriate funding source for a particular project.

FY 00 Joint Solicitation

The joint solicitation for FY 00 was distributed in October 1998. A total of 24 project proposals were submitted in response to the joint solicitation. To assist in the review process, a joint meeting of the Monitoring & Data Management and Research Subcommittees of the GCC was held in January 1999 to review and rank the projects that were submitted for funding. As a result of the subcommittee meeting, the GRAC meeting in March, and review of the proposals by agency staff, 14 new projects were selected for funding in FY 00. Eleven on-going projects were carried over into FY 00. A total of 25 projects were funded through the joint solicitation at a cost of approximately $650,000 (see Table 1).

FY 01 Joint Solicitation

A joint solicitation for project proposals by the UW System, DNR, DATCP and Commerce was distributed in October 1999 for funding in FY 01. The deadline for proposals was November 29, 1999. The joint solicitation package contains a listing of the priorities for each of the agencies (see Appendix). The Monitoring & Data Management and Research Subcommittees of the GCC and DNR staff reviewed the priority needs for the DNR's management-practice monitoring program for FY 01. The two subcommittees met in January to rank the 30 proposals submitted. Eighteen of the 30 proposals received will be funded in full or in part through the joint solicitation process. The projects to be funded in FY 01 are listed in Table 2.

In FY 96, the GCC began compiling information about other groundwater research programs within and outside of Wisconsin. To this end, groundwater-related research projects funded through the Fertilizer Research Council in FY 00 and 01 are listed in the Appendix. In addition, the GCC continues to contact other states with groundwater research programs to prevent research duplication and to make efficient use of limited research funds. The strategy for interstate coordination of groundwater research consists of identifying groundwater research program contacts in each neighboring state and sending each contact information on the GCC, the joint solicitation process, the state groundwater monitoring and research programs, and the project summaries.

Table 1 - Groundwater Projects Funded through the Joint Solicitation for FY 00

(Map numbers are for locating projects on the State map in Figure 1. * denotes continued project)

DNR Projects

*Acute and Chronic Toxicity of Nitrate to Brook Trout (*Salvelinus fontinalis*). R. Crunkilton $35,230

*Maquoketa Shale as Radium Source to the Cambro-Ordovician Aquifer System. T. Grundl $29,987

*Mechanical Controls on Fracture Development in Carbonate Aquifers: Implications for Groundwater Flow Systems. M. Cooke $27,967 (Map #3)

*Analysis of Microbiological and Geochemical Processes Controlling Biodegradation of Aromatic Hydrocarbons in Anaerobic Aquifers. W. Hickey $45,198 (Map #4)

*Viral Contamination of Household Wells near Disposal Sites for Human Excreta. M. Borchardt/W. Sonzogni $48,384 (Map #5)

Refinement of two methods for estimation of groundwater recharge rates. K. Bradbury, M. Anderson and K. Potter $27,365

Field verification of capture zones for municipal wells at Sturgeon Bay, Wisconsin. K. Bradbury, T. Rayne, M. Muldoon $11,879 (Map #7)

Improvement of Wisconsin's groundwater monitoring network. Alex Zaporozec $9,880 (Map #8)

Evaluating options for changing groundwater and leachate monitoring requirements for landfills to reduce mercury used by laboratories. J. Connelly, R. Stephens and B. Shaw $22,950

The total cost for all projects funded by the DNR through the FY 00 joint solicitation process is $301,542.

DNR/UWS Co-funded Project

Remediating groundwater using reactive walls containing waste foundry sands. C. Benson and G. Eykholt DNR $27,496, UWS $7,000

DNR/DATCP Co-funded Project

A groundwater model for the Central Sands of Wisconsin: Assessing the environmental and economic impacts of Irrigated agriculture. Martha Anderson, W. Bland and G. Kraft DNR $15,751, DATCP $15,751

UWS Projects

*Sedimentology, Stratigraphy, and Porosity-Conductivity Relations of the Silurian Aquifer of Ozaukee County, Wisconsin. M. Harris $24,206

*A Rational Design Approach for Permeable Reactive Walls. C. Benson $26,282

*Groundwater Flow and Heat Transport in Wetlands: Transient Simulations and Frequency-Domain Analysis. H. Bravo $21,781 (Map #14)

*Monitoring and Evaluation of the Abundance, Diversity, and Activity of Methanotroph Populations in Groundwater. M. Collins $ 25,898

Hydraulic Conductivity and Specific Storage of Maquoketa Shale. H. Wang $27,150 (Map #16)

Macropore flow: A means for enhancing groundwater recharge or a potential source of groundwater contamination. K. Potter and P. Bosscher $5,941

Development of neural network models for predicting nitrate concentration in well water. H. Lin and B. Shaw $26,193

Time domain electromagnetic induction survey of eastern Waukesha County and selected locations. J. Jansen and R. Taylor $26,035

Field monitoring of drainage and nitrate leaching from managed and unmanaged ecosystems. J. Norman and K Brye $29,974 (Map #20)

Compatibility of containment systems with mine waste liquids. T. Edil and C. Benson $23,812

Causes of historical changes in ground-water recharge rates in southeastern Wisconsin. D. Cherkauer $31,609

Admicelle-catalyzed reductive dechlorination of PCE by zero valent iron. Z. Li $18,552

The total cost for all projects funded by the UWS through the FY 00 joint solicitation process is $283,266

DATCP Projects

* Using Geographic Information Systems and Soil Landscape Models to Predict Critical Sites for Nonpoint Source Pollution. B. Lowery $22,950 (Map #24)

* Assessing and Reducing Leaching of Agricultural Chemicals on Silt Loam Soils under Different Farming Systems. K-J. Kung $25,000 (Map # 25)

The total cost for all projects funded by the DATCP through the FY 00 joint solicitation process is $63,701.

Figure 1 – Locations of Groundwater Projects Funded through the Joint Solicitation in FY 00

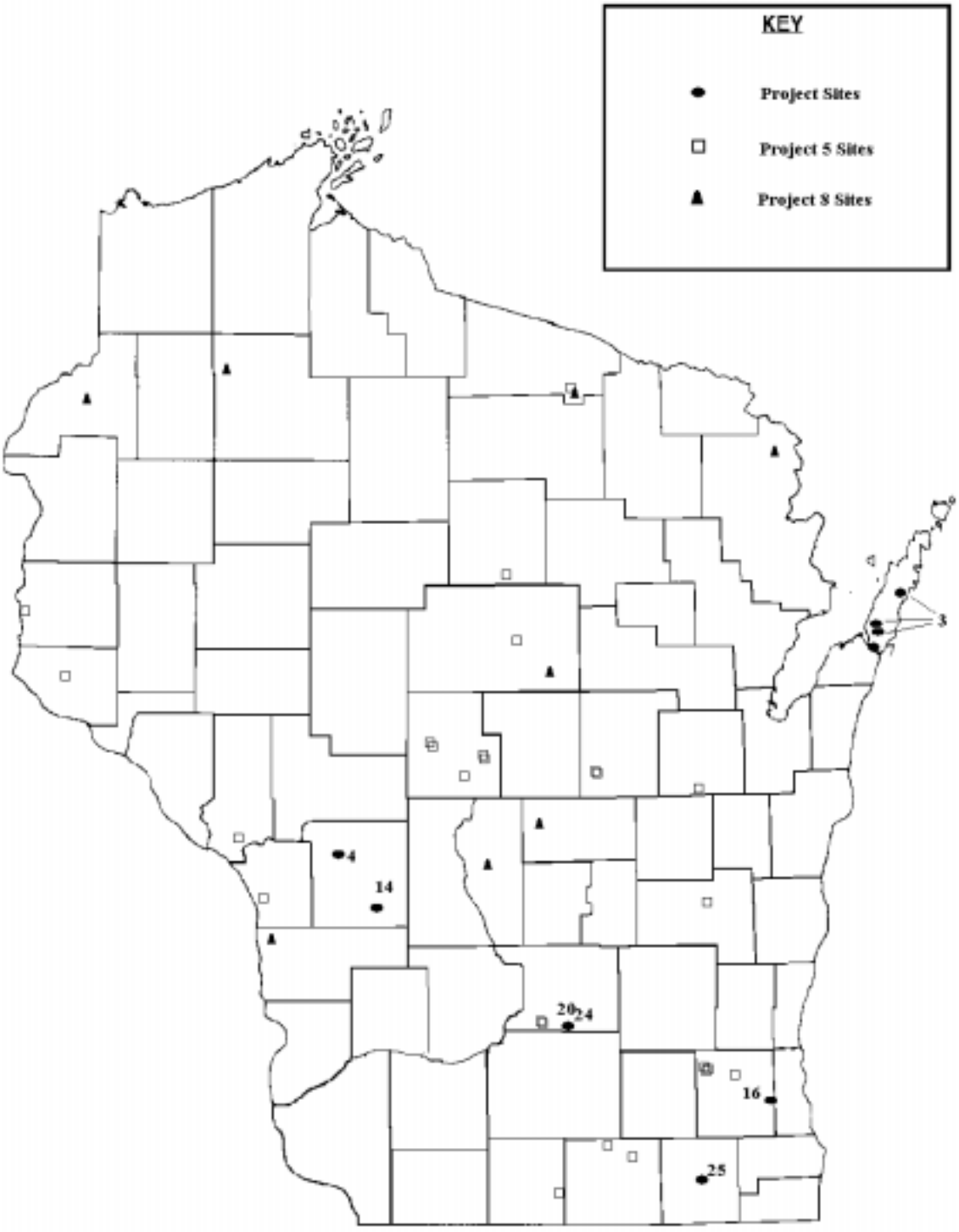

Figure 1 - Location of Groundwater Project Field Sites Funded Through the Joint Solicitation for FY 2000

Table 2 - Groundwater Projects to be Funded through the Joint Solicitation for FY 01

DNR Continuing Projects

Evaluating options for changing groundwater and leachate monitoring requirements for landfills to reduce mercury used by laboratories. J. Connelly, R. Stephens and B. Shaw $31,283

The total cost for all continuing projects funded by the DNR through the FY 01 joint solicitation process, including the co-funded project below is $60,623.

DNR New Projects

Geologic and geochemical controls on arsenic in groundwater in northeastern Wisconsin. M. Gotkowitz, T. Simo, D. Krabbenhoft, M. Schreiber, and R. Hunt $68,133

VOC trend analysis of WI solid waste landfill monitoring data: A preliminary analysis of the natural attenuation process. J. Connelly, J. Battista, and T. Hegeman $21,845

Development of analytical methods for comprehensive chemical and physical speciation of arsenicals in groundwater. J. Aldstadt $29,989

New approaches to the assessment of microbes in groundwater: application to monitoring bioremediation and detection of pathogens. M. Collins $33,244

An analysis of arsenic replacement wells to determine validity of current DNR well construction guidance. K. O'Connor and K. Lauridsen $17,780

Verification and characterization of a fracture network within the Maquoketa shale confining unit, SE Wisconsin. T. Eaton, K. Bradbury, and H. Wang. $20,117

Public health impacts of arsenic contaminated drinking water – L. Knobeloch, L. Hanrahan, H. Anderson, and M. Weisskopf. $32,244

A study of microbiological testing of well water quality in Door County and incidence of illness in humans. L. Braatz and D. Battigelli $52,739

The total cost for all new projects funded by the DNR through the FY 01 joint solicitation process is $276,090

The total cost for all projects funded by the DNR through the FY 01 joint solicitation process is $336,713.

DNR/UWS Continuing Co-funded Project

Remediating groundwater using reactive walls containing waste foundry sands. C. Benson and G. Eykholt DNR $29,340, UWS $6,100

UWS Continuing Projects

Macropore flow: A means for enhancing groundwater recharge or a potential source of groundwater contamination. K. Potter and P. Bosscher $9,370 (*)

Development of neural network models for predicting nitrate concentration in well water. H. Lin and B. Shaw $28,202

Field monitoring of drainage and nitrate leaching from managed and unmanaged ecosystems. J. Norman and K Brye $15,050 (*)

Compatibility of containment systems with mine waste liquids. T. Edil and C. Benson $9,275 (*)

Causes of historical changes in ground-water recharge rates in southeastern Wisconsin. D. Cherkauer $34,140

Admicelle-catalyzed reductive dechlorination of PCE by zero valent iron. Z. Li $16,724

The total cost for all continuing projects funded by the UWS for FY 01, including the co-funded project above and $18,000 for FY 01 administrative costs, is $136,861.

(*) In addition, the USGS, through UW-WRI, provided an additional $46,702 to co-fund three of these projects.

UWS New Projects

Removal of As(III) and As(V) in contaminated ground water with thin-film microporous oxide adsorbents. M. Anderson $25,499

A basin-scale denitrification budget for a nitrate contaminated Wisconsin aquifer: A study at the groundwater/ surface water interface. B. Browne, G. Kraft, and D. Saad $29,104

The spatial and temporal variability of ground water recharge. M. Anderson and K. Potter $20,564

Groundwater modeling: Semi-analytical approaches for heterogeneity and reaction networks. G. Eykholt $23,289

Importance of groundwater in production and transport of methyl mercury in Lake Superior tributaries. D. Armstrong, D. Krabbenhoft, K. Rolfhus, and L. Cleckner $25,234

Effect of clean and polluted groundwater on *Daphnia* reproduction and development. S. Dodson $28,923

The total cost for all new projects funded by the UWS through the FY 01 joint solicitation process including the co-funded project below is $169,102

The total cost for all projects funded by the UWS through the FY 01 joint solicitation process is $305,963

The total cost including USGS co-funding is $352,665.

UWS/DATCP Co-funded New Project

Remediation of soil and groundwater using effectively and ineffectively nodulated alfalfa. N. Turyk, B. Shaw, and M. Russelle UWS $13,753, DATCP $4,080

DATCP New Projects

Pesticide and nitrate leaching in soils receiving manure. B. Lowery, F. Arriaga, and D. Stoltenberg $16,695

Screening of agricultural and lawn care pesticides for developmental toxicity using the mouse embryo assay. A. Greenlee $36,381

Effectiveness of phytoremediation and hydrogeologic response at an agricultural chemical facility in Bancroft, WI W. DeVita and M. Dawson $21,725

The total cost for all projects funded by DATCP through the FY 01 joint solicitation process, including the co-funded project above is $78,881

BENEFITS FROM MONITORING AND RESEARCH PROJECTS

Table 3 (see Appendix) is a list of groundwater-related monitoring and research projects funded by state agencies since enactment of Wisconsin's comprehensive groundwater protection legislation (1983 Wisconsin Act 410) in 1984. Those agencies that have funded projects are the DNR, DATCP, DILHR/Commerce, and the UW System. There are 259 projects listed. One hundred-sixty-four of these projects have been funded through the joint solicitation process that began in FY 92. The remaining projects were funded by the above agencies through separate solicitation processes prior to 1992. The table includes the project title, principal investigator or investigators, the years the project was funded, the funding agency or agencies, and the project number if assigned.

Many projects have provided valuable information to evaluate existing regulatory programs and determine if there is a need for additional regulations. Numerous studies have increased the knowledge of the movement of contaminants in the subsurface. A number have provided valuable information regarding the state's groundwater resources. Others have developed new methods for groundwater evaluation and protection. The following discussion highlights some of the areas that have been the focus of research and monitoring projects and illustrates how agencies have used the project results to improve the management of the state's groundwater resources. Citations refer to the projects listed in Table 3.

The Atrazine Rule - The development of the Atrazine Rule (ATCP 30, Wis. Adm. Code) illustrates how the benefits of state-funded research and monitoring can build on one another. In the mid-1980s the corn herbicide atrazine was first detected in monitoring wells and private drinking water wells in Wisconsin. The first systematic well sampling program to characterize atrazine contamination on a statewide basis was the 1988 DATCP Grade A Dairy Farm Well Water Quality Survey (LeMasters, 1989). This state-funded well survey estimated that atrazine was present in 12% of the Grade A Dairy Farm Wells in the State.

This study left many questions regarding the sources, groundwater susceptibility, and the presence of pesticides other than atrazine unanswered. Without better information on these and other questions, it was challenging for DATCP, the agency charged with groundwater protection related to agricultural chemicals, to develop a plan of action. It was obvious that a concerted information gathering program was needed. Over the next several years, before and during the development of the DATCP atrazine rule, the Wisconsin Groundwater and Pesticide Research Program played an essential role in providing the needed information. Research and monitoring were conducted on several topics that played a direct role in the evolution of the atrazine rule.

The state research and monitoring program funded several key projects to better understand the sources of atrazine contamination. When atrazine was first found in groundwater, an argument had been made that this was the result of point sources such as spills and mishandling. One of the most important findings that allowed DATCP to begin developing the atrazine rule was that normal agricultural applications of atrazine could lead to groundwater contamination. The DATCP groundwater monitoring project (Postle, 1986-96) for pesticides used monitoring wells located next to agricultural fields to study groundwater contamination by atrazine and other pesticides. This study showed that atrazine from field use on sandy soils could cause contamination, often above the 3 µg/L ES. The UW Water Resources Center conducted a detailed hydrogeologic study (Chesters, 1990-91) at a farm in Dane County and showed conclusively that atrazine contamination could result from both field applications and mixing/loading practices. With the knowledge that nonpoint contamination of groundwater by atrazine was indeed occurring, DATCP could develop ways to reduce this contamination.

State-funded research was essential in showing that atrazine contamination did not follow simplistic notions of groundwater contamination susceptibility. One of the most important findings was that the Central Sands and the Lower Wisconsin River Valley (LWRV), two areas that appear similar in soils and agricultural practices, had significantly different susceptibility to contamination. These differences were pointed out in several research projects conducted by the UW Soil Science Department (Daniel, 1991; Lowery, 1991; McSweeney, 1991; Lowery, 1992-3). This information had a direct influence on the atrazine rule in that there is now a use prohibition in the LWRV and managed use in the Central Sands.

Another key finding related to the susceptibility of groundwater to atrazine contamination was that many of the areas with high frequency of detections had medium textured (loamy) soils. It had previously been thought that these areas were less susceptible to leaching and groundwater contamination than areas with sandy soils. State-funded research and monitoring efforts, however, showed that the intensity of atrazine use, in addition to soil and geologic conditions, played an important role in the contamination. This finding helped to explain why many areas in south central Wisconsin, with medium textured soil and high corn production, had many wells contaminated with atrazine. This knowledge allowed DATCP to adopt management strategies for reducing atrazine contamination in these areas.

When atrazine was first discovered in Wisconsin's groundwater in the mid 1980s, DATCP was interested in managing its use based on predictive modeling of contamination processes. Modeling activities funded by the state research program, however, indicated that the behavior of atrazine and other contaminants in the environment was complex and could not be reliably predicted by modeling. In response to this finding, DATCP adopted a more empirical approach to identifying management areas. Actual well results were plotted on maps and, together with an analysis of soils and geology, management areas were delineated.

When monitoring and rule making efforts for atrazine first started, parent atrazine was the only compound that was considered. As more research was conducted, however, it was discovered that three metabolites (breakdown products) of atrazine were present in groundwater and were of health concern (Chesters, 1990-91; LeMasters, 1990; Cowell, 1990; Cates, 1991). State-funded sampling programs showed that due to the presence of atrazine metabolites, the groundwater problems were more serious than previously considered. This knowledge allowed DNR to strengthen the groundwater standard for atrazine in 1992 and allowed DATCP to strengthen the atrazine rule in 1993 and extend required use reductions to the entire state.

It is interesting to try to envision how DATCP's atrazine rule would look if it did not have the benefit of the intensive research and monitoring efforts. It is safe to say that it would not have been developed on as good an understanding of the behavior of atrazine in the environment or the geographic patterns of contamination. It is possible that without the intensive monitoring efforts, the full extent of the problem would not have been discovered and atrazine use would not have been reduced. On the other hand, it is possible that with inadequate knowledge a "broad brush" approach would have been taken. This could have resulted in unfair regulations that were not tailored to the different geographic areas of the state.

Two important aspects of environmental regulation that promote its acceptance are that it is based on science and that it is fair. Good research is necessary to achieve these two characteristics. The Atrazine Rule has experienced a relatively high degree of acceptance due to the effort that was put into its development.

Groundwater Monitoring at Solid Waste Disposal Sites - The DNR's Solid Waste Management (SWM) program received project funding eight times from 1985 to 1995 through the joint solicitation process. These projects have benefited the program in many ways, primarily, impacting regulations and monitoring practices.

The first two studies (Friedman, 1985-87; Battista, 1988-89) revealed for the first time that groundwater around many Wisconsin landfills was contaminated by VOCs. The studies also showed that VOC contamination of groundwater was more common at unlined municipal solid waste landfills than at other types of landfills. A follow-up VOC study (Connelly 1993-94) showed that VOC levels have decreased at most of the unlined landfills, though at many of the sites VOC levels do not show continued decline. There was no VOC contamination definitely attributable to leachate migration at any of the older, engineered landfills that confirmed that these sites are performing as SWM program staff had hoped. The results of the three VOC studies have been used to establish requirements for VOC sampling at new and existing landfills. These studies have also indicated that inorganic compounds could be useful in predicting VOC contamination at landfills. Therefore, until recent EPA rules required VOC monitoring, the SWM program allowed sites to sample for inorganic parameters as part of routine monitoring and not sample VOCs until inorganics were elevated. The VOC studies provided valuable data that was used to convince EPA to reduce the number of VOCs required for monitoring at municipal solid waste landfills in Wisconsin. This reduction in monitoring (the use of inorganics and the reduced number of VOCs when they are

required) allowed landfill owners considerable cost savings while maintaining equivalent environmental protection. Additionally, the VOC data was used to require responsible parties to define the degree and extent of contamination and remediate groundwater contamination at their landfills.

Research on methods of assessing groundwater quality data and data quality control completed in the third VOC study has been helpful to SWM program staff and consultants in interpreting groundwater quality data from landfills and other facilities. This study also showed the need to require laboratories to report data between the limit of detection and the limit of quantitation.

An assessment of Wisconsin's Groundwater Monitoring Plan program (Pugh, 1992) for active non-approved landfills provided the documentation of a set procedure for selecting monitoring sites. This information has been useful in recent meetings with municipalities held to convince municipalities that they have not been singled out for further evaluation of groundwater contamination and to demonstrate that the process used for selecting landfills for monitoring is objective.

Three studies from 1991 to 1994 on the potential groundwater impacts at deer pits, yard waste sites, and construction and demolition landfills (Pugh, 1992-3; Pugh, 1994) were conducted because little or no data existed on the potential impact to groundwater from these sites. Research has provided the information necessary to revise rules and establish policy regarding monitoring and siting of construction and demolition (C/D) landfills, deer pits, and yard waste sites in Wisconsin. The groundwater study of deer pits showed that impacts were minimal and helped the SWM program to decide not to require liners and to loosen some construction and reporting requirements. Similarly, the yard waste site study showed only minor groundwater impacts, which led the SWM program to encourage active management of these sites rather than stiffen regulations. The study of construction and demolition landfills showed some groundwater impacts at large sites but little or no impacts at smaller sites. These findings led to new regulations (effective June 1996) allowing lined intermediate size C/D landfills, which can provide the economic benefits of a large site without the potential negative impacts of very large sites. Based on the research, the regulations were written to require groundwater monitoring of inorganic parameters at small size C/D landfills but only require VOC sampling when establishing background. Since these studies have been conducted, many states and the EPA have contacted the SWM program about the information collected.

A more recent DNR-funded study undertaken by the SWM program (Connelly, 1994) was a comparison of groundwater sampling methods for collecting metals samples at monitoring wells. The study was in response to EPA's October 1991 ban on field filtering of groundwater samples that became effective in October 1994. The SWM program opposed this ban because many Wisconsin monitoring wells produce very turbid water which can lead to false positive results for metals if samples are not filtered. Additionally, the new EPA-recommended procedure, low-flow pumping, requires a significant amount of additional equipment. The study showed that the low-flow pumping method was appropriate in many circumstances but could not be used to sample slowly recovering wells. The results showed that turbidity was the best indicator that a well has been sufficiently purged. The results of the investigation are being used to revise groundwater sampling procedures required by the SWM program. Additionally, the study helped establish Wisconsin as one of two leading states playing a major role in advising EPA on revisions to their groundwater sampling requirements at municipal solid waste landfills.

A follow up study by the SWM program (Svavarsson, 1995) compared low flow pumping and bailing for VOC groundwater sampling at landfills. The study indicated that, in contrast to what some were claiming, there was very little difference in the results when using the two different methods. These findings were incorporated into the new groundwater sampling code and allowed the use of either method for sampling VOCs. This reduced the cost that landfill owners would otherwise have had to bear to purchase and operate low flow pumping equipment.

Monitoring for Naturally Occurring Compounds (e.g. Arsenic) - Wisconsin is also a leader in groundwater monitoring for naturally occurring compounds. Two projects in the DNR Lake Michigan District (Stoll, 1992; 1994) identified the existence of lead and arsenic contamination in groundwater. Homeowners were alerted through direct mailings, public meetings and mass media news releases. Over 72,000 people were unaware of their exposure to the substances in their drinking water. In one case, the sources of metals in these drinking water

supplies were given priority for removal (Door County Lead Arsenate Mixing Sites). In an Arsenic Advisory Area (AAA), well construction criteria were defined to avoid arsenic associated with a mineralized zone located at the contact between the St. Peter Sandstone and the Galena-Platteville Dolomite. The DNR coordinated with the DHFS to conduct health surveys on individuals consuming locally contaminated water supplies and made appropriate health recommendations. Local County Health Departments in affected areas are also actively monitoring groundwater quality and are providing assistance to homeowners. In FY 01, DHFS staff received additional funding to conduct a follow-up investigation on the relationship between exposure to inorganic arsenic in water and health outcomes. As part of this research effort, local health departments, DNR staff, town clerks and others have made plans to conducting well sampling campaigns in townships in the affected counties.

Ongoing research indicates that casing off the upper parts of the St. Peter Sandstone is usually effective in eliminating or reducing the presence of arsenic in drinking water. DNR guidance recommends the installation of 80 feet of casing through the sandstone contact for drinking water wells in the AAA. A current study appears to indicate that shorter casing lengths (~40 feet) may also be effective in reducing the risk of arsenic exposure. However, in an effort to save costs, the majority of wells constructed are not following the recommendations. Over the last several years, some wells that were not constructed according to guidance have exhibited increasing arsenic concentrations over time and have required replacement or reconstruction. In addition, follow-up testing on 50 replacement wells found that arsenic levels are exceeding standards in at least 5 cases where initially they had been below. Additional sampling of replacement wells will occur over the next 2 fiscal years to test whether current guidelines are adequate at lowering arsenic concentrations.

Including the two studies mentioned above, a total of five GCC-funded projects will address issues related to arsenic in FY 01. Additional studies include an analysis of the geologic and geochemical controls on arsenic in groundwater and two studies related to analytical methods for detection and remediation of arsenic compounds. These studies will help provide needed information about the occurrence, health risks, and remediation of arsenic in drinking water supplies.

Groundwater Movement in Fractured Dolomite - Door County has been the site of four research projects by the WGNHS to develop a framework for studying the complex groundwater flow regime in fractured rock found in many parts of the state. The first project (Bradbury, 1986-90) started as a nonpoint source watershed project investigating the hydrogeology and groundwater geochemistry in the shallow fractured dolomite aquifer in Door County. Groundwater quality was found to vary widely over time with bacteriological contamination common. The second study (Bradbury, 1992) showed that modeling results obtained from a discrete fracture model varied considerably from results produced by a continuum model for groundwater movement. The discrete fracture model estimated capture zones, groundwater flow paths, and groundwater travel times by using mathematical representations of fractures digitized from aerial photos. The third study (Bradbury, 1993-94) used a tracer for characterization of groundwater movement and contaminant transport. It revealed that hydraulic conductivity can vary widely in the same well depending on what depth interval is tested.

A fourth study applied the discrete fracture flow model above to wellhead protection at the City of Sturgeon Bay. The project, carried out by the WGNHS, was funded jointly by the City and by DNR Management Practice Monitoring moneys. Municipal wells at Sturgeon Bay draw groundwater from a series of horizontal fracture planes in Door County's dolomite aquifer, and delineating wellhead protection areas in such environments is extremely challenging. This complex project has required hydrogeologic information and analytical tools developed through the three Door County groundwater research projects above which targeted processes and models for groundwater movement in fractured rocks. Without the knowledge and experience gained through these previous projects the Sturgeon Bay Wellhead Protection Project could not have been accomplished.

During 1999, Bradbury and others began a follow-up project to attempt to verify the results of the Sturgeon Bay wellhead protection project using natural groundwater tracers. This research is measuring the natural seasonal variations in temperature, electrical conductivity, and oxygen and hydrogen isotopes of groundwater and precipitation in order to verify the sources and velocities of groundwater moving toward Sturgeon Bay's wells. The use of such tracers is attractive because they are naturally present in the environment.

Developing New Tools for Groundwater Protection - Applications of a wide variety of tools for gathering and working with hydrogeologic and groundwater quality data have been funded. Projects involving one of the most promising tools in environmental management, Geographic Information Systems (GIS), have been funded in the DNR's Northeast Region (NER) and in Dane County. The funding agencies hope to continue to develop improved methodologies to make groundwater quality and contaminant source data more readily available.

Geographic information management in DNR's Northeast Region. An environmental inventory utilizing GIS was created in the DNR's former Lake Michigan District (Carlson, 1992-93; Stoll, 1994). Computerized maps were created which link all potential groundwater impact site locations with their respective data. This project has resulted in numerous map products showing potential groundwater contamination source/receptor relationships in a rapidly retrievable, highly summarized fashion. Many consultants, county agencies, state agencies and realtors have utilized this information for environmental management and land transactions. The chief benefits to the public have been the rapidly accessible information and greater purchasing confidence when buying property. Landowners also experience increased responsibility for the land they reside on, as they become aware of how readily available this information is. In this way, use of GIS has heightened awareness of the importance of wise land use.

A subsequent project gathered relevant geologic and hydrogeologic data from case files and entered them into one single relational database (Stoll, 1996-97). This database is joined in a GIS with the previously located site information. This combination provides an easily accessible wealth of information that can be used for queries and analysis. In addition, a program was developed utilizing Environmental Systems Research Institute (ESRI) Avenue for ArcView language to query data the DNR Region has gathered. For instance well driller construction logs which are in a File Maker Pro software database are linked in an ArcView Project to be readily viewed by selecting an area on screen. Also, summary reports can be prepared of local conditions prior to investigating contamination sites in the field by selecting an area on screen.

GIS work conducted in NER has provided the seed for the growth of GIS and GPS source and receptor locational work statewide. In 1998, NER mapped the location of over 2000 public water supply wells utilizing GPS methods with differential correction. From that work, wellhead vulnerability radii are assigned to each well to provide the basis for Wellhead Vulnerability determinations relative to that well and its local potential contaminant sources.

Dane County model. Previous support of county-wide groundwater inventory studies and of modeling methodologies (Potter, 1992-93; Anderson, 1997) has given WGNHS and USGS personnel the hydrogeologic databases and analytical tools needed for the construction of regional groundwater models such as the recently completed Dane County groundwater model. This computer model, which covers all of Dane County, simulates current and future groundwater conditions and is being used to evaluate how current and future groundwater pumping affects regional water levels and also how groundwater use affects shallow lakes, streams, and wetlands. In addition, this model has been used to delineate groundwater capture zones for all municipal wells in Dane County (Bradbury 1996).

The Dane County model, which provides a modern hydrogeologic framework for groundwater movement in Dane County, has stimulated a number of significant research projects by other investigators (Mickelson 1994-95; Bradbury et al., 2000). These investigators are using the model as a starting point for more detailed flow models of specific problems or areas of the county. One of the most significant of these is the award of a multi-year USEPA STAR grant to a team of DNR, UW-Madison, USGS, and WGNHS investigators who are investigating the water-resources impact of different land-use strategies on Madison's urban fringe. This research will support several graduate students and is will provide an integrated assessment of the hydrological, ecological, and institutional impacts of urbanization and land-use change. This research is focused on the Pheasant Branch watershed just west of Madison. Other research projects are investigating the sources of groundwater supplying important springs in the Nine Springs and Token Creek watersheds, with the goal of determining how nearby development and groundwater use could affect the springs.

The Dane County model has now become a prototype for regional groundwater models in other parts of Wisconsin. In FY 00 the WGNHS, USGS, and SEWRPC began a cooperative project to develop a similar model for the entire seven-county SEWRPC area of southeast Wisconsin. Other modeling projects are taking place in Sauk, Rock, and La Crosse Counties. Such models are critical tools in the planning process, and allow water managers to evaluate the impacts of various future water management and land use alternatives in order to make well-informed land-use decisions.

Prevention and Remediation of Groundwater Contamination – Twenty-four research projects emphasizing new technologies for prevention or remediation of groundwater contamination have been supported by the State of Wisconsin through the UWS Water Resources Institute (formerly Water Resources Center). Many of these projects have been completed. Final technical reports are published or in press. The reports and studies in progress provide information or products that will be important for future efforts aimed at controlling or attenuating groundwater contamination in Wisconsin. The findings cover a wide range of technologies including:

- New and enhanced physicochemical or biological methods to renovate waters contaminated by pesticides and volatile organic carbon compounds (Li, 2000), (Benson and Eykholt, 2000), (Benson, 1997-2000), (Hoopes, 1997-99), (Park, 1997-98), (Collins, 1997-98), (Bahr, 1996-98), (Hickey, 1994-96), (Anderson, 1994-95), (Chesters and Harkin, 1991), (Harris and Hickey, 1991-92);
- Enhancements in the ability to control, monitor, and predict the movement of landfill and mine waste contaminants to groundwater (Edil and Benson, 2000), (Edil 1997), (Benson, 1995-96), (Edil and Park, 1992-93);
- Improvements in the predictability of pump-and-treat remediation applications to contaminated aquifers (Bahr, 1994-95);
- Innovative agricultural practices designed to reduce groundwater contamination by pesticides and nitrate (Bundy, 1993-94, 1997-98), (Shinners, 1995-96), (Newenhouse, 1995), (Harrison, 1992-93), (Bahr, 1991-92); and
- Development of new technologies for evaluating the integrity of water supply well and exploration borehole seals (Edil, 1996, 1998-99), (Edil and Benson, 1997-98).

Biological Effects of Groundwater Contaminants – The GCC has solicited research projects during the last several years that deal with biological aspects of groundwater contamination.

Two projects dealt with cooperative biological effects among chemical contaminants. This is a subject of widespread current interest because synergistic interactions among chemical contaminants can often greatly enhance or diminish the toxicity of individual components of a mixture. Warren Porter of the UW-Madison Department of Zoology has completed an evaluation of interactions between endocrine disrupters (PCBs, phthalates, etc.) and a common groundwater contaminant (nitrate). Gordon Chesters and Harry Read of the UW-Madison Water Resources Center (now WRI) completed a DATCP supported project that focuses on biological interactions between different herbicides and the modulation of these interactions by common agricultural chemicals (e.g., nitrate). There is a great deal of current interest in these types of interactions because environmental toxicologists have heretofore focused exclusively on evaluations of the biological effects of individual chemicals which does not effectively encompass the environment of these compounds in the real world.

Several projects have focused on developing new techniques for detecting, quantifying, and monitoring microorganisms in groundwater and soils. William Hickey, of the UW-Madison Soil Science Department, developed a rapid molecular method using the polymerase chain reaction (PCR) to assay soils for the presence of specific sewage-borne pathogens. PCR-based methods eliminate the need to culture organisms for detection, and remedy shortcomings of traditional techniques by allowing rapid, sensitive, and specific identification of the pathogens of concern rather than indicator organisms. The PCR protocol he developed was designed to detect DNA originating from *Escherichia coli*, which is one of the major species of bacteria associated with human waste. With this method he could distinguish *E. coli* DNA from that of its closest relative, *Shigella*. The method allowed the detection of DNA equivalent to about 20 cells. Currently, he is testing the PCR method for tracking of *E. coli* in the environment.

Because they have the capacity to co-metabolize a wide variety of organic chemicals, including halogenated compounds, methanotrophic bacteria have significant potential for bioremediation. Mary Lynne Perille Collins of the UW-Milwaukee Department of Biological Sciences has completed a 2-year project in FY 00 that developed methods for quantification of methanotrophs in groundwater. These methods, that include competitive PCR and direct PCR, will provide approaches to monitoring bioremediation and natural attenuation. In addition, this work has provided the basis of a new study initiated in July 2000 that will apply direct PCR to the detection of pathogens in groundwater.

Mark Borchardt, of the Marshfield Medical Research Foundation, has investigated the association of pathogenic viruses and bacteria in private wells with incidences of infectious diarrhea and indicators of well water contamination in a series of studies from 1997-2000. In general, infectious diarrhea was not associated with drinking from private wells, nor was it associated with drinking from wells positive for total coliform. However, wells positive for enterococci were associated with children having diarrhea of unknown etiology, which was likely caused by calciviruses. Preliminary results indicate that the incidence of virus contamination in private wells is similar or lower than that of community wells.

Finally, two projects have assessed the toxicity of agricultural chemicals on biota in surface waters:

William Karasov of the UW-Madison Department of Wildlife Ecology recently completed a study of the possible relationship between common agricultural chemicals and Wisconsin's declining and endangered amphibian population. The researchers tested the effects of atrazine and nitrate on northern leopard frog (*Rana pipiens*) larvae in the laboratory. Neither atrazine, nor nitrate, nor their interaction had a significant effect on development rate, percent metamorphosis, time to metamorphosis, percent survival, mass at metamorphosis, or hematocrit. Nitrate slowed growth of larvae; however, this growth inhibition was not thought to be biologically important when compared to natural variation in the environment. Thus, the authors concluded that concentrations of atrazine and nitrate commonly found in the environment do not appear to pose a significant threat to *R. pipiens* larvae through direct toxicity.

Ron Crunkilton, of the UW-Stevens Point College of Natural Resources, received funding in FY 99-00 for a study of the acute and chronic toxicity of nitrate to brook trout embryos and larvae. Results will be made available during FY 01.

GROUNDWATER DATA MANAGEMENT

Department of Natural Resources

The collection and coordination of groundwater data exchange within the DNR and with outside agencies is a continuing priority. The Department continues to focus on the collection and retrieval of groundwater data to meet inter-agency responsibilities and cooperative agreements.

In the last two years, many of DNR's data systems have been undergoing a conversion to a web-based interface. DNR's groundwater data retrieval system, the Groundwater Retrieval Network (GRN) has undergone a web interface conversion. A World Wide Web version is available at *http://www.dnr.state.wi.us/org/water/dwg/*. The GRN system currently has access to information from over 235,000 wells. These represent public and private water supply wells, piezometers, monitoring wells, non-potable wells, and groundwater extraction wells. Enhancements to the system, suggested by regional and central office staff, are implemented annually, to improve system functionality and ease of use. GRN links to data systems in the Bureaus of Waste Management and Drinking Water and Groundwater for retrieval. Training can be provided upon request.

A statewide Geographic Information System (GIS) coverage of well locations is maintained through an update link with GRN. An option on the GRN program menu allows users to extract well and sample information in Microsoft Excel format, comma or tab delimited text format. Using ArcView (a desktop GIS software package produced by the makers of ARC/INFO), GRN data can be used to create a well GIS "layer" on a personal computer for viewing and querying purposes. Data can also be provided in other GIS formats upon request through the use of ARC/INFO.

An internal project solicitation to allocate groundwater programming hours for two full time programming staff is conducted each year. This is done to continue to integrate existing systems, develop new groundwater systems, databases, and applications. The solicitation develops a list of projects and expected completion hours for the following fiscal year starting in July. Four bureaus participate in the solicitation process within the Department. Staff from outside DNR is contacted each year for project ideas to enhance existing groundwater related systems.

Two years ago, the Department launched an initiative to begin labeling monitoring wells with the Wisconsin Unique Well Number. Peel and stick labels were developed similar to the existing drinking water well label. Along with the labeling initiative, Groundwater staff developed a computer program to allow entry, editing, printing, and data sharing from six Department well-related forms. The program provides a way of electronically entering, managing, and sharing information with DNR staff and others using the software. Work is beginning this fiscal year to use the electronic data derived from submittals to develop a statewide database of monitoring wells. This database will be made accessible through a World Wide Web interface.

The Bureau for Remediation and Redevelopment (RR) has developed a web interface for its tracking system database BRRTS. The public and our other customers will be able to obtain timely and concise information about the status of contaminated properties in Wisconsin without having to download a large number of complex files. The Bureau is also GEO locating its sites and is developing a mapping application designed to show various types of contaminated properties in a mapped format.

The Bureau of Waste Management is beginning to explore the issue of providing a web interface to some of their Groundwater and Environmental Monitoring System (GEMS) data. The bureau has successfully implemented electronic submittal of environmental monitoring data via diskette from landfill owners, labs and consultants. A 6-month pilot program allowing four facilities to submit environmental monitoring data via e-mail will be completed this summer. The Bureau also plans to explore the development of data submittal through the World Wide Web, by allowing entry directly online.

The Bureau of Watershed Management is completing work on its new database system, designated System for Wastewater Applications, Monitoring, and Permits (SWAMP). This database system is designed to manage information on wastewater treatment facilities and Wisconsin Pollutant Discharge Elimination System (WPDES) permitting. The system contains current information on facility permit requirements, wastewater outfall monitoring and biosolids treatment/management. Historical sampling data from facility monitoring wells is available through the system and current sample results are added on a monthly basis. The SWAMP system also tracks land application (landspreading) of municipal sludge, septage and industrial sludge, by-product solids and wastewater.

Several groundwater-related data initiatives were initiated through the State's Source Water Assessment Program. In FY 00 the DNR's Drinking Water and Groundwater program began coordinating efforts to integrate and expand data on significant potential contaminant sources that may threaten public drinking water sources from the Remediation and Redevelopment, Waste Management, and Watershed Management programs. These sources include known groundwater contamination sites, landfills, large confined animal feedlot operations and many others. Locational data for these sites is being gathered from existing files and from on-site visits. Additionally the WGNHS and DNR are producing a searchable index of scanned images of the approximately 350,000 well construction reports available at the WGNHS. DNR staff will use these reports to help determine the susceptibility of public water systems to contamination.

Department of Agriculture, Trade and Consumer Protection

DATCP needs up-to-date, reliable data about pesticide and nitrate-N contamination of groundwater. DATCP uses these data to develop substance specific rules about pesticide use, such as DATCP's "Pesticide Product Restrictions" (Chapter ATCP 30, Wis. Adm. Code), to respond to citizen requests on groundwater quality data for specific locations, and to initiate timely investigations of pesticide contamination of groundwater. DATCP ensures the quality of its database by carefully checking and cross-referencing paper lab slips and computerized data received from DNR, DATCP's laboratory, and other sources. This scrutiny is important, because DATCP uses these data for regulatory purposes. DATCP also works closely with other local and state agencies to coordinate groundwater data collection and to improve the integrity of groundwater data in Wisconsin.

DATCP maintains two groundwater sample databases: the *Drinking Water Well System* and the *Monitoring Well System*. The *Drinking Water Well System* contains contact and location information, well characteristics, and pesticide and nitrate sample results for private and public drinking water wells. The *Monitoring Well System* contains similar information for monitoring wells, and also tracks specific pesticide use history, soils, crop history, well construction, and precipitation and irrigation at monitored sites.

DATCP's *Drinking Water Well System* currently contains information for over 36,000 wells and over 208,000 pesticide and nitrate-N results. These data represent samples analyzed by DATCP, SLOH, and other public and private laboratories. The *Drinking Water Well System* was converted from a Paradox to Access97/SQL Server application in FY 99 to: (1) meet state database and operating system (Windows NT) standards, (2) improve compatibility of data with other established database systems, and (3) begin improving links between these databases and our geographic information system (GIS) tools. The *Monitoring Well System* will be converted to Access97/SQL Server in FY 01. Members of DATCP's Groundwater Protection Unit and its Containment and Remediation Unit access the database.

DATCP uses geographic information system (GIS) tools to analyze groundwater data and prepare maps for public hearings, DATCP board meetings, presentations, and other uses. DATCP prepares and maintains ArcInfo and ArcView data layers of well locations, atrazine concentrations, atrazine prohibition areas, and other pesticide and nitrate-N data. These GIS layers and associated database information are used to generate maps of statewide pesticide and nitrate-N detections in wells, as well as maps for chapter ATCP 30, Wis. Adm. Code (the "Atrazine Rule"). Other GIS analyses involve identifying groundwater wells that may be impacted by point sources of pesticide and nitrate-N contamination. DATCP also uses global positioning system (GPS) receivers to locate and map wells and other features, such as agrichemical facilities and spill sites, that may affect groundwater quality.

Wisconsin Geological and Natural History Survey

The University of Wisconsin-Extension Geological and Natural History Survey has responsibility for geologic mapping, collection and analysis of basic data, and survey and research on Wisconsin's groundwater resources. Products from the Survey geologic mapping program support land-use planning and groundwater quality management and protection. County-wide inventories of groundwater resources are supported through cooperative agreements with county governments. Through analysis and integration of data from subsurface records and water quality sampling programs, these studies develop water table elevation maps and other products, providing planners and educators with a good foundation of information for groundwater quality management and protection. Detailed research and monitoring of groundwater movement and quality are undertaken on a project basis. Maps, publications, and presentations are developed for groundwater education and outreach.

Computerized groundwater databases have generally been developed on a project basis to support on-going research and inventory efforts. Many of these data have been incorporated into the Geographic Information Systems (GIS) software. The Survey is continuing initiatives to better integrate, standardize and document their data holdings, which are currently on a variety of personal computers, media and software systems. This effort will improve access and use of our existing and future groundwater and geologic data.

Department of Commerce

Commerce has embarked on an information technology initiative, the purpose of which is data integration. With regard to groundwater protection, Commerce will, at the completion of this project, be able to identify sites that have underground petroleum storage tank systems, groundwater and soil remediation and private sewage systems. Sanitary permit information will ultimately be combined with a database that will track maintenance and/or inspection of all private sewage systems.

University of Wisconsin System

The Central Wisconsin Groundwater Center maintains a database of private well testing data from the Environmental Task Force Regional Laboratory at UW-Stevens Point, and Drinking Water Education Programs conducted through the Center. There are currently nearly 295,000 individual test results for approximately 43,500 samples covering the state. Chemistry data includes pH, conductivity, alkalinity, total hardness, nitrate-nitrite, chloride, saturation index, and coliform bacteria. In 1998, a new sampling program for iron, sodium, potassium, copper, lead, calcium, magnesium, manganese, zinc, and triazine was also initiated. The database primarily covers the period 1985 to the present. The database is PC-based and can be easily queried to be a significant source of information for local communities and groundwater managers. Thirty-nine counties are represented by 100 or more samples in the databases, and 23 counties are represented by 500 or more samples.

Department of Transportation

The DOT is in the process of entering salt storage facility records into a new database. Detailed inventories of salt use are kept by each county and updated monthly. A record of facility inventories, inspections, repairs and improvements is included in the database.

The DOT maintains records of hazardous material investigation and remediation for highway projects. These records include information regarding groundwater contamination and groundwater use restrictions.

Groundwater monitoring is also performed for several DOT wetland mitigation projects. These records contain information on groundwater elevation and gradients as it relates to a wetland restoration or creation project (surface water and groundwater interaction).

Department of Health and Family Services

DHFS does not maintain a centralized database on groundwater data. The Department relies on other state agencies for computerized groundwater information.

COORDINATION ACTIVITIES

GROUNDWATER COORDINATING COUNCIL

The Groundwater Law, 1983 Wisconsin Act 410, established the GCC to advise and assist state agencies in coordinating non-regulatory programs and exchanging groundwater information. The GCC consists of the heads of all state agencies with some responsibility for groundwater management plus a Governor's representative. The agency heads have appointed high-level administrators who have groundwater responsibilities to sit on the Council. The state agencies include the DNR, Commerce, DHFS, DATCP, DOT, WGNHS, and the UWS. Additionally the DNR has one permanent position with half of its responsibilities related to coordination of the GCC. The GCC had four meetings during the past year. The meeting minutes are included in the Appendix.

The focus of the GCC's activities during the past year changed as past goals were attained and future goals were refined. Accomplishments came as a response to new opportunities for groundwater management.

- The GCC and the UWS GRAC continued coordination of the annual solicitation for groundwater research and monitoring proposals among state agencies. Twenty-five projects were funded in FY 00 by one or more of the following agencies: UWS, DATCP, and DNR. The projects funded are listed in Table 1. The GCC approved the FY 01 joint solicitation package for groundwater research and monitoring to meet state needs described in a previous section. The package was sent out in October 1999 and is contained in the Appendix. A total of 30 project proposals were received. A comprehensive review process ensued that resulted in the selection of 18 new projects for funding for FY 01. The new projects selected by the UWS, DNR, and/or DATCP for funding in FY 01 are in addition to 8 projects that were carried over from FY 00. At their February 18, 2000, meeting the GCC unanimously approved the proposed UWS groundwater research plan as required by s. 160.50(1m), Wis. Stats. The UWS will fund 7 continuing and 7 new projects in FY 01. The FY 01 groundwater monitoring and research projects are listed by funding agency in Table 2.

- Proposal Writing Workshop. As an attempt to improve the quality and focus of proposals submitted during the Joint Solicitation, the GCC sponsored a workshop for proposal writers on October 27th, 1999. There were 23 attendees of which half had never submitted a proposal into this process before. The mechanics of the solicitation was covered with a review of agency priorities. Emphasis was given to what reviewers look for in each proposal and tips on what makes a good proposal. A live web page demonstration was also given. Attendees commented that this workshop was well worth the 3 hours of time it took. Several of those in attendance subsequently submitted proposals and were funded in FY 01. In addition, the proposals were consistent with funding priorities.

- Arsenic in Drinking Water. The Education Subcommittee of the GCC reviewed and endorsed a brochure that was produced by the DNR and DHFS to inform citizens about naturally occurring arsenic in groundwater of northeastern Wisconsin (see appendix). In addition, an Arsenic Study Group was formed in 1999 consisting of staff from the various state agencies represented on the GCC as well as representatives from EPA, local county health departments, UW Extension, National Institute of Health and the Wisconsin Water Well Association. The Study Group met several times to identify data needs and recommend ways to fill gaps in the current knowledge base. DHFS staff in conjunction with local DNR and health departments are embarking on a well-testing campaign in the Arsenic Advisory Area. Five new projects were funded by the GCC to address issues related to arsenic (See Table 2). These activities will allow the state to proactively understand and develop solutions for the arsenic issue and its related health impacts.

- Through several of its subcommittees, the GCC continued to address important data management issues. Data management activities include:
  - ◊ Continuation of a project to eliminate duplicate Wisconsin Unique Well Numbers (WUWN);

- ◊ Further progress toward making scanned images of well construction reports available to agency staff by the end of 2000;
- ◊ Improved access to the Groundwater Retrieval Network (GRN) by other state agencies (GRN is currently available to DNR staff on its intranet);
- ◊ Evaluation of minimum data elements needed for upcoming database design and redesign.

- The GCC continued to promote communication, coordination, and cooperation between the state agencies through its quarterly meetings. The GCC received briefings and heard presentations on:
  - ◊ Subcommittee activities (see below)
  - ◊ FY 01 Joint Solicitation
  - ◊ FY 1999 GCC Report to the Legislature
  - ◊ Source Water Assessment Program
  - ◊ UWS FY 01 Groundwater Research Plan
  - ◊ Road salt management
  - ◊ Arsenic in groundwater in the Fox River Valley
  - ◊ Proposal writing workshop for FY 01 Joint Solicitation
  - ◊ Proposed storm-water infiltration requirements
  - ◊ Integrated pest management for Wisconsin fresh-market vegetable growers
  - ◊ Ideas for improving FY 02 Joint Solicitation
  - ◊ Wellhead Protection Video
  - ◊ Case study to assess the association of acute infectious diarrhea with drinking water
  - ◊ Aquifer Storage and Recovery
  - ◊ Nonpoint Source Program Redesign
  - ◊ Pesticide metabolites in groundwater
  - ◊ New (Cycle 8) NR140 Groundwater Standards
  - ◊ Future of groundwater management

- The GCC has continued to work with representatives of federal agencies to promote communication and coordination of federal and state groundwater activities. Representatives from the NRCS, FSA, and the USGS attend GCC meetings and serve as *ex officio* subcommittee members. The Appendix contains a summary of USGS and NRCS groundwater activities.

A World Wide Web site for the Groundwater Coordinating Council (GCC) continues to operate (*http://www.dnr.state.wi.us/org/water/gcc/index.htm)*. The site provides information on the activities of the council, a list of members on the council and members of the subcommittees, documents in web viewable and downloadable format, and links to other relevant groundwater or related web sites.

SUBCOMMITTEE ACTIVITY SUMMARIES

Research Subcommittee

In September 1999 the Research Subcommittee met to review and revise the priorities for the DNR's groundwater management practice monitoring program for FY 01. The revised priorities were included in the joint solicitation distributed by the UWS, DNR, Commerce, and DATCP in October 1999.

The subcommittee met with the Monitoring and Data Management Subcommittee in January, 1999 to review 30 proposals which had been received as a result of the joint solicitation. Subcommittee members made recommendations that were used by the three agencies and the UWS in deciding which groundwater-related proposals to fund for FY 01. The projects to be funded in FY 01 are listed in Table 2.

Monitoring & Data Management Subcommittee (MDMS)

The MDMS reviewed the priorities for the DNR's groundwater management practice monitoring program for FY 01. The subcommittee met with the Research Subcommittee in September 1999 to revise the priorities to be included in the joint solicitation distributed by the UWS, DNR, Commerce, and DATCP in October 1999. The subcommittee met with the Research Subcommittee in January to review the research and monitoring proposals that had been received in response to the joint solicitation. Subcommittee members made recommendations that were used by the three agencies and the UWS in deciding which groundwater-related proposals to fund for FY 01. The projects to be funded in FY 01 are listed in Table 2.

MDMS members continued to work individually or in small groups on action items targeted by the subcommittee in FY 99. Progress was made on the following issues:

- Minimum data elements have been evaluated by a workgroup. Their recommendations will be helpful in upcoming database design and redesign.
- A DNR project made progress in eliminating duplicate Wisconsin Unique Well Numbers (WUWNs). Additionally, WUWNs were assigned to many public wells that had been without.
- Work was done to improve access to the Groundwater Retrieval Network (GRN) by other state agencies. GRN is currently available to DNR staff on its intranet.
- File maintenance was accelerated on GRN data. Suggestions for improvements to GRN are being considered.
- The DNR and the WGNHS are working together to electronically scan all well construction reports on file at the WGNHS. The scanned images will be available electronically to agency staff by the end of 2000.
- The FY 00 Groundwater Monitoring Plan was published.
- The DNR revised its well/drillhole/borehole abandonment, and well construction report forms. These forms, as well as the monitoring well development, soil boring log information, monitoring well information, and groundwater monitoring well inventory forms are available digitally for electronic submission.

The subcommittee is scheduled to meet in September 2000 to discuss the above and other issues. Of particular interest are: recent guidance on global positioning system technology, an updated DNR locational data policy, potential contaminant source data collection for DNR's source water assessment program, and the Wisconsin Privacy Bill's implications on data confidentiality. A continuing goal for the MDMS is to catalogue each program's monitoring programs and goals to prevent duplication and increase the utility of monitoring results.

Planning and Mapping Subcommittee (PMS)

The PMS did not meet during FY 00. However, subcommittee members continued their FY 99 work to develop a coordinated approach for locating and describing karst features across Wisconsin. The PMS developed a draft form based upon DOT's recent karst mapping projects that all state agency staff could use to describe karst features encountered during field work. WGNHS will be the repository for completed forms and the database developed with this information, and will be responsible for further research of karst features and areas once they are identified. DNR Groundwater Section staff made some revisions to the form and began using it on a trial basis in Dodge County during FY 00. The subcommittee intends to distribute the final form in the fall of 2000 and will evaluate its progress in FY 01.

Education Subcommittee

The Education Subcommittee met four times during the past year. Its mission is to review public information and education materials, coordinate educational messages among agencies, and serve as a forum to identify groundwater education needs, ideas and concerns.

The subcommittee completed a public education strategy for Consumer Confidence Reports. Major efforts were made by DNR and UW-Extension with advice from the other agencies. The subcommittee subsequently noted that there seemed to be limited public response, though some areas of the state reported more activity. The

subcommittee also coordinated activities for Farm Progress Days, Drinking Water Week, and Public Health Week. It became informed on agency activities related to arsenic in groundwater and reviewed a new arsenic brochure. It also invited a representative from the State Lab of Hygiene to participate in the subcommittee. At each meeting, representatives shared information about current agency activities related to groundwater.

Local Government Subcommittee (LGS)

The LGS was formed in 1993 to represent local units of government and organizations representing local units of government. The subcommittee did not meet in fiscal year 2000.

DIRECTIONS FOR FUTURE GROUNDWATER PROTECTION

PRIORITY ISSUES

- **Promote consistency between the agencies on data management issues:** Through the recent update of the Directory of Groundwater Databases and redesign of the DNR's groundwater computer system, state and local government agencies now have more convenient access to groundwater data. This effort must be maintained by continuing to identify what data needs exist. Data consistency must be promoted by use of translatable geolocational coordinate systems and consistent data elements for use in a GIS environment. The GCC will continue to provide leadership and communication on data management through its subcommittees. This continued effort displays the GCC's commitment to management of the resource through sound scientific methods.

- **Research on land use management and its impact on the groundwater resource:** Additional research is needed on the effect of various land uses (e.g. urbanization) on groundwater quality and quantity. Several projects that study the impacts of land use on groundwater have been and continue to be funded through the joint solicitation. These projects must be managed in such a way as to maximize their relevance to state land use problems. This issue crosses agency lines and promises to be an important issue for years to come.

- **To act as a coordinating and facilitating mechanism for the publication and distribution of information and educational materials on groundwater related issues:** The public has benefited from the consistent educational messages that have been endorsed by the Education Subcommittee. The Education Subcommittee will continue to provide its leadership and assistance to state agencies providing educational materials to the public.

- **Distribution of findings from groundwater research or monitoring projects:** There has been considerable progress in preparing summaries of the results of groundwater-related monitoring and research projects funded through the joint solicitation process. In FY 96 the DNR and UW Water Resources Center (now WRI) published a document containing 72 of these summaries. All 72 of these summaries are now available on the UW-WRI web site maintained by UW-WRI. The rate of response to the web site posting of research findings has been very encouraging so far. To maintain and enhance this response it will be important to add new summaries annually as they become available, create a more visually appealing set of front-end pages for the site, and publicize the web site location and content more widely. More work needs to be done to target interested audiences and distribute summaries and final reports more widely.

- **Identify tools that can be used to better predict Wisconsin's groundwater susceptibility to contamination:** Studies have demonstrated the need for developing statewide data layers that would facilitate better groundwater vulnerability assessments. These data layers include land use, soils, regional groundwater flow, hydrogeologic characteristics such as aquifer materials, and potential point sources of contamination such as underground storage tanks and pesticide spills. The studies also illustrate the importance of locational data for contaminant sources. The GCC's Planning & Mapping and Monitoring & Data Management Subcommittees have prioritized, promoted, and helped facilitate the development of data layers as part of a larger data integration initiative. Through the DNR's Source Water Assessment Program, which will be implemented by 2003, this work will continue and will result in improved predictive capabilities.

- **Continued evaluation of alternatives to onsite sewage systems:** Although the DNR and Commerce have funded monitoring projects in this area, additional work is needed to find state-of-the-art private sewage system technologies that provide efficient, cost-effective options and protect groundwater resources.

- **Investigation of the causes and effects of nitrate in groundwater:** The GCC will support the agencies and the UWS in obtaining information pertinent to the human health implications of consuming nitrate

contaminated groundwater and the effect of discharge of this groundwater on surface waters and their ecosystems. In addition, it will continue to facilitate consistent education to provide a clear message on the many causes and effects of nitrate in groundwater for urban and rural citizens.

- **Solutions to groundwater nonpoint pollution problems:** A 1997 DATCP report indicates that 8.5% of Wisconsin's wells still contain detectable atrazine residues. In addition, 10% exceed the nitrate standard. These rates are substantially higher in agricultural areas. Agriculture is the major source of these pollutants. More work is needed to determine how far Wisconsin groundwater will deteriorate without a substantial change in farming practices, and what practices will sustain both agriculture and groundwater quality.

- **Improved communication between local and state government:** The Local Government Subcommittee to the GCC was created in February 1993 to provide a line of communication between local and state governmental entities. However, subcommittee members are often concerned with regulatory issues that affect their communities while the GCC is a non-regulatory body limited to making recommendations to the appropriate regulatory agencies regarding groundwater issues. To increase the responsiveness of state agencies to local government needs, local government needs must be communicated to the GCC and relayed to the appropriate agencies. An effort must be made by the GCC to increase interest in the GCC by local governments, and to offer opportunities to communicate concerns to regulatory agencies. In FY 01, the Planning and Mapping Subcommittee plans to actively seek input from local governments about future groundwater management needs through a series of local listening sessions and a statewide workshop.

- **Investigation of adverse impacts from groundwater withdrawals:** In FY 97, DNR staff with help from the Groundwater Quantity Technical Advisory Committee completed a report on the groundwater quantity issue (see "Condition of the Resource - Groundwater Quantity" for the Executive Summary of this report). In the report, localized areas with groundwater quantity problems are identified and the effects of groundwater withdrawals on surface waters and long-term groundwater availability are discussed. There is a need to further quantify hydrographic relationships of surface and groundwater. The GCC should continue to encourage research efforts that will provide information useful in addressing this issue.

- **Investigation of recently discovered groundwater contaminants:** Recent research conducted in Europe and the U.S. indicates that traces of pharmaceuticals (including antibiotics and hormones) and pesticide breakdown products are common contaminants found in groundwater and surface water. Current testing methods do not allow adequate detection of these possible contaminants. Research is needed to determine whether these substances pose a threat to Wisconsin's groundwater resource. There is also a need to evaluate the sources, fate, transport, and chemistry of p-Isopropylbenzene (cumene), aluminum, molybdenum and strontium (non-radioactive form) in groundwater; evaluate existing databases; and sample at-risk potable wells for these contaminants.

- **Investigation of naturally occurring substances in groundwater:** Recently we have learned of continued problems of elevated arsenic, low pH, and other water quality problems in domestic wells over large areas of northeast Wisconsin. DNR needs more information about the extent and causes of these problems in order to give advice to homeowners and well drilling contractors. Additionally elevated sulfate and total dissolved solids have been found in some new deep municipal wells in the Lower Fox River Valley making the wells unusable. In some other existing deep wells as far south as Milwaukee the total dissolved solids have been steadily increasing over the years. These sulfate and TDS levels pose a problem for local water managers, and the origin of the dissolved solids is not completely understood.

APPENDIX

Wisconsin Groundwater Coordinating Council
MEETING MINUTES – AUGUST 27, 1999

Members Present: Susan Sylvester (DNR), James Robertson (WGNHS), Anders Andren for Fran Garb (UWS), Bob Pearson for Carol Cutshall (DOT), Nick Neher (DATCP), Henry Anderson (DHFS), and Eric Scott for John Alberts (COMM)

Others Present: Chuck Warzecha (DHFS), Jim Hurley (WRI), Lisa Morrison (DATCP), Ron Hennings (WGNHS), Tom Martinelli (DOT), Liz Heinen, Mike Lemcke and Jeff Helmuth (DNR).

The meeting was held in Room 233 of the Department of Health and Family Services Building in Madison, beginning at noon.

1. **General Business -** Introductions were made. The minutes from the May 21st meeting were approved as written.

2. **Planning and Mapping Subcommittee Report** – Lisa Morrison reported on the following activities:
   - Karst Feature Inventory – Maureen Muldoon has almost completed a karst brochure for general distribution. This brochure will accompany the "Wisconsin Sinkhole or Other Karst Feature Reporting Form" being developed by the subcommittee. The reporting form is almost complete. The subcommittee is working on a letter and article to explain the purpose of the form and why voluntary reporting is needed. The subcommittee also needs to define karst features so that people can more easily decide if they should fill out the form. Lisa listed a number of state people that will receive the form. Jamie Robertson suggested that the NRCS and Forest Service should be included as well. Henry Anderson added that homeowner concerns should be addressed as well. WGNHS and DATCP are developing a simple database to store and reference information from the form. WGNHS will be responsible for data entry and distribution, and will ultimately coordinate more in-depth investigation of the features.
   - Soil Survey Mapping and Digitization – Lisa reported on a budget initiative to complete mapping, digitization, and certification of soil surveys for the entire state by the end of 2004. The initiative will be funded through $4.2 million from the Wisconsin Land Information Program, DNR, DOT, and the Board of Commissioners of Public Lands and $8 million from federal sources. Lisa handed out a proposal summary for the state work to complete foundational elements, which include initial soil survey mapping in 9 northwest counties and digitization and/or certification of soil surveys in 38 counties.

3. **Monitoring and Data Management Subcommittee Report** – Jeff Helmuth reported on the following activities:
   - Groundwater Retrieval Network (GRN) access - A consultant was hired to work on problems associated with DATCP and State Lab of Hygiene (SLOH) access to GRN. Other agencies will be connected, as they desire. WGNHS and DOT are working on memoranda of agreement for access. The long-term intent is to eliminate the access problems by putting the data on the web.
   - Lab Disclosure – DATCP is currently rewriting a lab disclosure pamphlet to include the open records law reference and others. The subcommittee will research lab disclosure and develop a strategy to consistently inform the public on this issue.
   - Triazine Language – A letter recommending specific analytic procedures to insure higher metabolite recovery was sent to laboratories. Language to be sent out with SLOH results clarifying results and follow-up options was finalized. The SLOH has developed a method for metabolite analysis but it still needs to be published for it to be considered by EPA as an approved method. There is also a need for a screening test for metabolites but the demand for the screening test is not yet large enough for it to be offered commercially. Efforts will be made to provide a consistent message from the DNR and county health departments on this issue.
   - Confidentiality – The group found that all state groundwater data is open to the public unless it is specifically stated in the statutes that it is not. The committee will try to make data users aware that the data should not be misused and that the originators of the data should be contacted before its use. The

subcommittee will produce example disclaimer language that can be used to acknowledge limitations of data.

- Minimum Data Elements – A workgroup will meet to come up with a standard set of data fields collected and field sizes. A potential next step would be to define data fields and propose data quality standards.

4. **Education Subcommittee Report** – Ron Hennings reported on the following subcommittee activities:
   - Arsenic in groundwater - The subcommittee has offered to review materials to be used to inform people about arsenic in groundwater. James Robertson noted that a growing national awareness of arsenic problems in drinking water has led to the creation of a national arsenic information clearinghouse. Additionally, each state has designated a point person for the topic. Madeline Gotkowitz (WGNHS) is Wisconsin's point person. Madeline is also a member of an interagency group that is addressing arsenic problems in the Northeast part of the state.
   - Report to the Legislature - The subcommittee made significant contributions to the GCC's annual report.
   - Farm Progress Days – This year's event was in Grant Co. Over 250 water samples were tested. 20-25 exceeded the nitrate standard and a few were over 40 mg/l. Groundwater hats were given away to people who completed a survey on their groundwater attitudes and beliefs.
   - *Buried Treasure* Natural Resources magazine insert - Subcommittee members contributed to publication that was completed in time for distribution at the State Fair.
   - Consumer Confidence Report brochure – The brochure, which explains CCRs to public water consumers, was produced and is now available. Fact sheets on the 20 most common contaminants found in drinking water are being collected and made available to those likely to get questions stemming from the reports which are due by October 19, 1999.

5. **1999 Report to the Legislature** – With one typographical error corrected, the GCC unanimously approved the annual report. Jeff Helmuth will finalize and deliver the document to the Legislators and other recipients.

6. **FY 01 Joint Solicitation** – Jeff Helmuth handed out a timeline for the upcoming joint solicitation process. The solicitation package will (did) go out on October first with a November 29th proposal deadline. This year there will be more communication with other groundwater research funding groups such as the Fertilizer Research Council and the Wisconsin Vegetable Growers Association in order to provide opportunities for proposal sharing. Additionally a few new researchers will be invited to the joint subcommittee meeting to rank proposals in January. Jim Hurley added that each principal investigator is asked to provide four names of professionals that they feel are qualified to review the information within their proposal. These names may be used for their specific proposal or for others.

7. **Road Salt Management** – Tom Martinelli (DOT) illustrated the magnitude of the issue by showing how much salt is used in Wisconsin. Over 30 million tons per year are used on state roads alone. Each lane mile requires 13 – 18 tons. There are around 1200 salt storage sheds in the state. Tom explained some of the new, more efficient, de-icing technologies that DOT has studied in recent years. These techniques include prewetting, groundspeed control, "salt miser", infrared pavement temperature sensors, roadway weather information towers for anti-icing application before snowfalls, and magnesium chloride. Tom described a new product, "Ice-Ban", a by-product of corn fermentation as having lower toxicity than sodium or calcium chlorides but more expensive. Sodium chloride is still the most economical choice. DOT regulates salt storage in 1800 facilities through TRANS 277 and trains staff to inspect these facilities.

   Bob Pearson discussed the environmental impacts of road salt. Seawater is approximately 19,000 mg/l Cl. Typical Wisconsin groundwater from shallow aquifers has < 25 mg/l Cl. Adjacent to highways, groundwater may approach 1000 mg/l, but is usually less with concentrations decreasing with distance from pavement (e.g., background water quality conditions achieved within 100 to 200 ft from roadway). DOT continues to monitor Cl and Na concentrations at several statewide test site locations on roadways. Two new sites are proposed to

monitor 3D distance from pavement concentrations. Since 1986 there have been several reported incidents of groundwater contamination from salt storage facilities. Chloride concentrations in nearby potable wells ranged between 495 to 2400 ppm (exceeding groundwater standards). Ron Hennings added that water softeners are another significant contributor of Cl in groundwater, and there are deeper regional aquifers that have naturally high levels of chlorides and other total dissolved solids. Bob also mentioned that there are a variety of other sources for chloride contamination (e.g., landfills, industrial discharge, sanitary systems, etc.). And there are other salt storage entities that are not necessarily regulated by DOT's Trans 277 (e.g., paper companies). In addition to water quality concerns, high chlorides can have impacts on some biologic resources (e.g., vegetation, aquatic species, etc.).

8. **Arsenic in Groundwater in the Fox River Valley** – Liz Heinen from DNR's Northeast Region gave an overview of the serious arsenic problem occurring in East Central Wisconsin. Arsenic levels in the Lower Fox River Valley are the highest in the world. One well has 12,000 ppb arsenic. The first detect was in the Neenah area. This arsenic is naturally occurring and probably originates from a sulfide layer at the top of the St. Peter Sandstone ("black sandstone" on well construction reports). Exposure to oxygen resulting from groundwater level drawdowns causes the arsenic to become soluble. The problem has accelerated due to deeper wells going in and more pumpage. Health studies have linked arsenic to skin and other cancers. The EPA has set 50 ppb as a Maximum Contaminant Level but will likely lower that standard to 10 ppb.

   DNR well construction guidance recommends grouted casing through the top of the sandstone, or avoiding the sandstone entirely. Only about 15% of recent wells have been constructed according to the guidance. Wells constructed not following the guidance may allow widespread arsenic oxidation. Improper grouting of the municipal well's annular seal and other well construction problems could also be a factor.

   Many questions remain unanswered. These questions include: 1) What is the exact chemistry of the reaction and how long will it go on? 2) Are wells in carbonate rock also at risk? 3) Will water conservation help and if so can it be implemented? 4) Will following the recommendations of the USGS Pumping Optimization study exacerbate the problem? Liz is working with a group of internal and external experts that is trying to determine how the arsenic is mobilized, what advice the DNR should be giving to homeowners, what research needs to be done, and how can we best protect the health of citizens in the area.

The meeting adjourned at 3:15. The next meeting is scheduled for 12 noon on November 12th at the Department of Agriculture, Trade, and Consumer Protection, at 2811 Agriculture Drive in Madison.

Respectfully submitted,

Jeff Helmuth, Hydrogeologist
Department of Natural Resources

Wisconsin Groundwater Coordinating Council
MEETING MINUTES – NOVEMBER 12, 1999

Members Present: Susan Sylvester (DNR), Jack Metcalf (Governor's Rep), James Robertson (WGNHS), Fran Garb (UWS), Carol Cutshall (DOT), Nick Neher (DATCP), Henry Anderson (DHFS), and Eric Scott for John Alberts (Commerce)

Others Present: Jim Hurley (WRI), Gary Lueck (WRWA), Karen Delahaut (UW Dept. of Entomology), Jill Jonas, Mike Lemcke and Roger Bannerman (DNR).

The meeting was held in the Board Room of the Department of Agriculture, Trade, and Consumer Protection Building in Madison, beginning at noon.

1. **Introductions** - Introductions were made. A special introduction was made of Jill Jonas the new Director of the Bureau of Drinking Water & Groundwater within the DNR.

2. **General Business** - The minutes from the August 27th meeting were approved with the corrections suggested by DOT on Road Salt Management. No agenda repairs were made.

3. **Education Subcommittee** - Mike Lemcke reported on the following subcommittee activities:

   - The Consumer Confidence Report is now on the internet. Curiously enough there has been very little public reaction. The limited reaction may be due to the limited public health information included in the brochure.

   - Arsenic will undoubtedly be an important issue for public health protection in the future. The committee asks the departments as they put information and education material together that they be allowed to review it.

   - Farm Progress Days in Grant County had a very low attendance this year. This was due to the extreme temperatures prevalent during that time period. The DHFS had a tent for the first time this year. 119 surveys on groundwater beliefs and attitude were filled out.

   - This next subcommittee meeting has been tentatively scheduled for December 13th, 1999.

4. **Research and Monitoring & Data Management Joint Subcommittee** - Mike Lemcke reported that the Subcommittees had a joint meeting on September 21, 1999. The meeting had the following outcomes:

   - A significant revision of the DNR Management Practice Monitoring Priorities, which identified new "Emerging Issues" for targeting of research, was completed for the FY 01 Joint Solicitation Package.

   - There was also strong support and commitment from the members to host a Proposal Writing Workshop.

   - There was limited support for inviting new investigators to the proposal review meeting.

   - The Council was surprised by the lack of support for inviting new investigators to the proposal review. They then directed Mike to make sure that one or two new investigators were invited to participate in the review meeting in each of the upcoming years.

5. **FY 2001 Joint Solicitation and Proposal Writing Workshop** - Jim Hurley reported that the workshop was held on October 27th, 1999. There were 23 attendees of which half had never submitted a proposal into this process before. The mechanics of the solicitation was covered with a review of agency priorities. Emphasis

was given to what reviewers look for in each proposal and tips on what makes a good proposal. A live web page demonstration was also given. Attendees commented that this workshop was well worth the 3 hours of time it took.

6. **Source Water Assessment Program (SWAP) Update -** Mike Lemcke reported that EPA had requested several clarifications to Wisconsin's SWAP submittal and that the DNR had provided clarifications that met with their approval. EPA then approved Wisconsin's program. The SWAP is very extensive and hour intensive and will extend to May 6th, 2003. Much of the work will be in getting existing information into usable formats. This information exists within different agencies and different divisions within agencies. EPA continues to coordinate between the Great Lake states a method for assessing the water used by surface water intakes in the Great Lakes.

7. **Proposed Stormwater Infiltration Requirements** - Roger Bannerman reported that the budget bill required setting of performance standards for agricultural and non-agricultural practices relating to stormwater infiltration. He explained that this was no simple task and that everyone needed to work together to accomplish its goal. He handed out a draft of ch. NR 151.12, Wis. Adm. Code, which is an attempt at defining the "Post-construction performance standard for new development and redevelopment". Roger explained that we do not want to repeat the East and West Coast mistakes by not taking infiltration seriously. Less infiltration means increased overland flow reaching streams and a decreasing groundwater recharge by potentially inches per storm. This in turn relates to lower water quality in streams. Roger relates that to make progress on this topic more research needs to be completed, evaluation of cost, evaluation of current practices, and other information needs to be considered.

Roger agreed to put the GCC members on a mailing list to provide them Information and Educational material, as it becomes available.

8. **Integrated Pest Management for Wisconsin Fresh-Market Vegetable Growers** - Karen Delahaut reported that from 1995 to 1997, DATCP had helped fund initiatives relating to Fresh-Market Vegetable Growers. The goal of the combined programs developed was to provide clean fresh produce to the public by reducing pesticide application, while keeping Wisconsin's Fresh-market Vegetable Growers profitable. One of the first initiatives was developing a school for beginning market Gardeners. It provided them in field experience, a forum for networking with other growers and more. Another initiative was working on SBNMs or Smelly Brown Nondescript Moths. Much of the work related to diageneses, developing pest specific scouting traps, and then providing seminars and publications to get the word out. This greatly assists the growers in that it allowed them to reduce the amount of pesticide used on any given crop in certain areas of the state. Another initiative was on "A Worm is a Worm or is it?" For this initiative training was developed for farmers on how to distinguish which worms were really the pests. Special traps were created for trapping the worms and plans for building these traps were disseminated. Information was distributed to the growers through the "Pest Survey Bulletin" on which worms were being found and where. Growers saved up to $200/acre when they did not have to spray for pests.

9. **Set Meeting Schedule for 2000 and adjourn** - Dates and hosts were set for the year 2000. The upcoming meetings are scheduled for: February 18th at WRI, May 12th at Dodgeville, August 25th at DNR, and November 10th at WGNHS. The meeting adjourned at 3:00.

Thanks to Mike Lemcke for preparing these meeting minutes.

Respectfully submitted,

Jeff Helmuth, Hydrogeologist
Department of Natural Resources

Wisconsin Groundwater Coordinating Council
MEETING MINUTES – FEBRUARY 18, 2000

Members Present: Susan Sylvester (DNR), James Robertson (WGNHS), Anders Andren for Fran Garb (UWS), Carol Cutshall (DOT), Nick Neher (DATCP), and Eric Scott for John Alberts (Commerce)

Others Present: Jim Hurley (WRI), Robert Langstroth (Commerce), Mike Lemcke (DNR) and Barb Lynch (NRCS).

The meeting was held in the Second Floor Conference Room of the Water Resources Institute Building, in Madison, beginning at noon.

1. **Introductions** - Introductions were made.

2. **Agenda Repair** – No agenda repair was needed.

3. **General Business** - The minutes from the November 12th meeting were approved as written.

4. **Education Subcommittee –** Ron Hennings reported that the subcommittee had met on February 17th, 2000. Highlights included:

   - The proposal writing workshop for the solicitation had gone well. There were about 20 attendees with several of them submitting proposals. The attendees gave feedback to the workshop organizers that it was well worth their time.
   - Public Health week is scheduled for April 3-9.
   - The September 9, 1999 revision to the SLOH publication " Making Sure Your Water is Safe " was distributed.
   - The subcommittee asked that the GCC ask the SLOH to participate in the Education Subcommittee meetings due to its involvement in groundwater activities. The council directed Mike Lemcke to contact Bill Sonzogni to determine their interest.
   - May 8-13 has been designated by AWWA as "Drinking Water Week". In addition, the NGWA has designated this week as "National Groundwater Week".
   - July 11-13 is Farm Progress Days. The subcommittee is discussing how best to use the agency's resources to assist in the annual event.
   - A brochure for arsenic in drinking water is being developed.
   - Byron Shaw of the UW Stevens Point has announced his retirement and will be retiring in June of 2000. With this retirement the College will be shifting the organizational structure and staff within the campus. It is unclear at this time but it appears that George Kraft the Director of the Central Wisconsin Groundwater Center will be taking on the additional responsibilities of operating the Groundwater Task Force Lab. The subcommittee is concerned that the strong groundwater presence that Stevens Point has shown over the past decades will be diminished if indeed the 2 positions get turned into one. After discussion the GCC asked that a formal invitation be given to the Dean or Chancellor of the College to one of the next 2 meetings so that s/he could have the opportunity to tell of Stevens Point's vision for the college. The Council would also be providing a cohesive front on their view on the importance of Stevens Point and groundwater protection. Anders will speak with Fran and invite the appropriate person from Stevens Point.

5. **Arsenic Workgroup Update and Arsenic Brochure** - Mike Lemcke reported that a team of experts have been assembled to determine the occurrence of arsenic in Wisconsin's groundwater; determine how it gets there; develop information for the public; determine treatment options; and determine options for the citizens who live in areas likely to be high in arsenic. This initiative was prompted by a potential proposed revision of the federal MCL for arsenic and on finding extremely high levels of arsenic in several wells in Northeastern Wisconsin. The experts have provided us initial recommendations on what and where are the informational

gaps that need to be filled. Their recommendations will provide us with important guidance that will enable us to respond to the proposed MCL change and provide effective alternatives to consumers of Wisconsin's water. One of the products identified by the group was to develop a brochure on arsenic in drinking water. Staff from the various agencies worked very hard on putting a tri-fold flyer together. The GCC Education subcommittee has endorsed the brochure. The GCC reviewed the brochure and made some helpful suggestions that were implemented prior to printing.

6. **FY 01 Joint Solicitation Process** – Jim Hurley reported that the process went very well this year. The quality of the proposals seems to have improved since last year. The proposal writing workshop was a success with several of those in attendance submitting proposals and being on the slate to be funded. In addition, the proposals were consistent with funding priorities. Jim noted that the universities have a new agreement with the union that represents the research assistants and this may effect the fringe or salary lines of the FY 01 projects. It is unclear at this time what the effect will be. The Water Resources institute is working very hard at improving their online database of this research.

After review of this year's Joint Solicitation funding process the council voted unanimously to fund the project proposals. Jack Metcalf *in abstentia* voted to approve the proposals but encourages emphasis on nitrate contamination in the future. Current application practices are counter-productive and getting out of hand.

7. **Improvements/Ideas for FY 2002 Joint Solicitation Process**- Jim suggested for future solicitations the $25,000 level for proposals submittals be raised to $35,000. Anders sees the need to move the solicitation dates up to allow the Institute to more effectively leverage the state to federal funding dollars. The council directed Jim to work with the new GCC staff person to develop and implement a new schedule if appropriate.

8. **Wellhead Protection Video –**A new 16-minute video on Wellhead Protection (WHP) that was produced by the DNR was shown. The video describes Wellhead Protection and provides many examples of communities within the state that are implementing WHP. The community leaders are interviewed and they describe how financially beneficial it is to participate in WHP. The videos have been distributed to every community in the state that do not already have WHP initiatives started.

9. **A Case-Study to Assess the Association of Acute Infectious Diarrhea with Drinking Groundwater –** Mark Borchardt, from the Marshfield Medical Research Foundation, Marshfield, WI, presented a case-control study he recently completed on the association between ground water consumption and infectious diarrhea in children. A case was defined as an acute diarrheal illness with $\geq$ 3 loose stools in 24 hours. Children < 1 year old and those with chronic diarrhea, immuno-suppression, or recent antibiotic use were excluded. Control children were randomly selected from the Marshfield Epidemiologic Study Area population with frequency matching (2:1) by age and gender. Case and control parents completed a structured telephone interview regarding risk factors for enteric infection. Water samples were collected from households with private wells and analyzed for total coliform, fecal enterococci, and common bacterial pathogens. Stool specimens from case children were analyzed for bacterial pathogens, *Cryptosporidium*, *Giardia*, rotavirus, and adenovirus 40/41.

   After exclusions 153 cases and 274 controls were eligible for analysis. A bacterial pathogen was identified in 16% of 131 stool specimens, and a viral pathogen was identified in 14%. The most commonly identified pathogen was *Cryptosporidium* (16/131, 12%). In 76 stool specimens (58%) no pathogen could be identified (i.e. diarrhea of unknown etiology). Out of 191 wells sampled 44 (23%) were positive for total coliform, 7 (4%) positive for fecal enterococci, 2 (1%) positive for *E. coli*, and 1 (0.5%) positive for a pathogenic bacterium, namely *Yersinia intermedia*. Infectious diarrhea was not associated with drinking from private wells nor was it associated with drinking from wells positive for total coliform. However, wells positive for fecal enterococci were associated with children having diarrhea of unknown etiology, which was likely caused by caliciviruses.

10. **Adjourn** – The meeting was adjourned at 3pm.

Thanks to Mike Lemcke for preparing these meeting minutes.

Respectfully submitted,

Jeff Helmuth, Hydrogeologist
Department of Natural Resources

Wisconsin Groundwater Coordinating Council
MEETING MINUTES – MAY 12, 2000

Members Present: Susan Sylvester (DNR), Jack Metcalf (Governor's Rep), James Robertson (WGNHS), Fran Garb (UWS), Carol Cutshall (DOT), Nick Neher (DATCP), Henry Anderson (DHFS), and Eric Scott for John Alberts (Commerce)

Others Present: Jim Hurley (WRI), Bruce Rheineck (DATCP), Tim Asplund, Mike Lemcke, Rich Roth, and Russ Rassmussen (DNR).

The meeting was held in the Conference Room of the Department of Natural Resources Service Center in Dodgeville, beginning at noon.

1. **General Business** – Introductions were made. The agenda was revised to omit George Kraft's update on the Central Wisconsin Groundwater Center and Environmental Task Force Laboratory and to substitute Bruce Rheineck for Jim VandenBrook's presentation on pesticide metabolites. The minutes from the February 18th meeting were approved as written.

2. **Subcommittee Status**- Tim Asplund reported that no subcommittees had met since the last GCC meeting. The Education Subcommittee will be meeting on May 17th. Tim will be convening at least 2 of the other subcommittees prior to the next GCC meeting in August. Tim reported that the Department of Public Instruction (DPI) representative had resigned from the Education Subcommittee. Susan Sylvester directed Tim to send a letter under her signature to DPI asking them to appoint a replacement. Jamie Robertson indicated his support for continuing Lisa Morrison's involvement with GCC subcommittees, despite her recent switch from DATCP to DNR. Mike Lemcke will pursue getting approval for her to continue on as Planning and Mapping Chair.

3. **Arsenic Update (not on agenda)** –

- Mike Lemcke handed out the final "Arsenic in Drinking Water" brochure recently published by DNR and DFHS, and indicated that county officials are pleased and glad to have it in hand.
- Jim Hurley reported that there is a new Fact Sheet on Arsenic put out by USGS (available on the internet at *http://co.water.usgs.gov/trace/arsenic/*) that includes a map of the U.S. indicating arsenic occurrences. Jamie Robertson indicated that the data used to produce the map might be questionable and incomplete. Mike Lemcke echoed this and said that it does not accurately portray the scope of the problem in Wisconsin.
- Jim also informed everyone of the **International Conference on Heavy Metals in the Environment** to occur in Ann Arbor, MI on 6-10 August, 2000, that would have many papers on arsenic as well as mercury. More details can be found at *http://www.sph.umich.edu/eih/heavymetals/*.
- Susan Sylvester noted that the GCC is funding several arsenic projects in FY01 and requested that a PI be invited to make a presentation to the GCC as soon as there was data available to report on.
- Nick Neher reported that DATCP is working with DNR to produce a GIS map of former orchards that made use of a pesticide containing lead-arsenate. Areas targeted include Door County and Gays Mills area. The goal is to be able to notify developers of possible groundwater contamination and mechanisms to contain and minimize exposure.

4. **Update on FY 2001 Joint Solicitation** - Mike Lemcke reported that DNR is still finalizing the funding for projects to begin on July 1, 2000. There are still questions regarding fringe benefits for both LTEs and graduate students, including tuition remission in light of recent contract negotiations. Jim Hurley reported that the UWS projects are finalized, except for a project to be funded jointly with DATCP. Jim will communicate with Nick Neher to finalize this project. A complete list of all funded projects for FY 2001 will be made available on the WRI web site in the near future (*http://www.wri.wisc.edu/Projects/Joint_Solicitation_FY01_funding.htm*). In addition, project investigators will be able to check on and update the status of their projects on-line, including a monthly update of the expenses incurred and remaining funds. Eventually final reports will be available

electronically. Jim indicated that project summaries for 1997 – 2000 are not yet on-line but that he will be contacting project leaders to move this forward. Jim mentioned that the Water Expertise Database, which profiles 790 water resources professionals in the state, is now on the WRI web site. Jim also reported that the WRI 2000-2001 Program Directory was mailed to all GCC and GRAC members and that he has extra copies for anyone interested.

5. **Plans for FY 2002 Joint Solicitation** – Jim Hurley reported that a few things are in the works for the next round of Joint Solicitation. A proposal writing workshop will be held again, as it appeared to improve the quality and focus of the proposals. Jim and Anders Andren would like to see the JS process moved up at least 2 weeks to allow more time for pursuing federal dollars and to give more time to reviewers over the holidays. Jim proposed a mid-November deadline. Jim also reported that he and Tim Asplund would be working on providing a means for electronic submission of proposals. This would ease some of the time constraints in getting the proposals out to reviewers and cut down on mailing and printing costs. Susan Sylvester recommended that the RFP include language that strongly encourages people to submit their proposals electronically.

6. **2000 GCC Report to Legislature** – Tim Asplund handed out an outline for the 2000 Report to the Legislature (RTL), due in August, and noted that the only changes from last year would be inclusion of the "Arsenic in Drinking Water" brochure rather than the other attachments. No other changes were suggested. Tim will be starting the process of revising the RTL at the end of May, at which time he will be sending relevant sections from last year's report to the GCC members and/or their designees. He hopes to have a first draft done by early to mid-July for review by the GCC and its subcommittees.

7. **Aquifer Storage and Recovery** – Rich Roth updated the GCC on the DNR's involvement with a pilot project to evaluate the use of Aquifer Storage and Recovery (ASR) to augment drinking water supplies. The basic idea of ASR is to allow a water utility to store treated drinking water underground during times of low demand and to pump it back to the surface in response to seasonal, emergency, or long-term needs. The primary benefit of such a technique would be reduced cost compared to expansion of treatment facilities or above-ground storage tanks. There are 30 such systems in use in the U.S. and 50 more under development, primarily in New Jersey, Florida, and California. In Wisconsin, Oak Creek has been experimenting with an ASR system and is now seeking approval to begin delivering water to its distribution system. One other ASR pilot study is proposed for the Green Bay area. Issues that still need to be addressed include:

   Environmental Issues: disinfection by-products, including total trihalomethanes (TTHMs), and how they are regulated; contamination of the injected water by radium or other contaminants in the aquifer; aquifer transformations, e.g. release of potential contaminants such as arsenic due to altered nature of groundwater; and fate of pathogens from surface water supplies.
   Operational Issues: sizing of treatment capacities and demand management (permitees could be asked to submit a water conservation plan as condition of permit); monitoring of ASR systems, requiring deep wells; permitting requirements (currently regulated under Part C of the Safe Drinking Water Act of 1974 as Class V injection wells).
   Legislative Issues: point of standard application of WI Groundwater Law (i.e. would it apply at point of injection or withdrawal?); ownership of stored water; storage beyond property boundaries.

   Susan Sylvester and Jill Jonas have briefed representatives of various environmental groups on ASR issues but have not received a formal response. DNR legal staff are researching legislative issues. DNR is also forming two advisory groups (one internal and one external) to assist with review of issues associated with ASR. GCC members expressed concerns about ASR, including the precedence this would set for other communities and even private well owners, the need for emphasizing conservation practices to meet demand, and the possible impact on groundwater flowpaths and hydrogeology. Mike Lemcke expressed his opinion that ASR would provide some immediate cost benefits, but that over the long term most communities would have to expand their systems to accommodate the population growth. Susan reiterated that each proposed ASR would be reviewed on a case by case basis and that it would be cost-prohibitive for private well owners to consider such a technique of dealing with contamination issues.

8. **Non-point Source Program Redesign** – Nick Neher updated everyone on the comments received during DATCP's recent hearings regarding the proposed changes to the nonpoint source pollution program. A total of 846 people participated in the hearings, and 1487 people submitted written comments. Three-fourths of the people that filled out appearance cards at the hearings indicated that they attended for information purposes only. Over 1000 of the written comments were supportive of the proposed redesign, but many of these included identical copies of the same post card. Nick reviewed some of the major concerns of the agricultural community that emerged from the hearings and written comments. These included concerns about the nutrient management provisions (especially related to regulation of phosphorus (P) and the adoption of 590 standards as rules); confusion regarding inconsistencies between DNR and DATCP's proposed rules (e.g. 1/2 or 1/3 T in water quality management (WQM) areas); concerns about cost of implementing the program; concern that the definition of the WQM area affected too much land area; and support of greater local control of program implementation. Proponents of the rules generally supported the concept of 1/3 T, but felt that the rules did not go far enough in addressing P loading of surface waters. Nick felt that while some of the hearings were heated, in general the disagreements were in how to go about making changes in the nonpoint source program, not in the overall goals of the redesign.

Russ Rasmussen gave an overview of the DNR's proposed changes to the nonpoint source program. At the heart of the changes are new agricultural performance standards (including manure management provisions), non-agricultural performance standards (including provisions for construction sites, post-construction stormwater management plans, and developed urban areas), and standards for transportation facilities. Other parts of the redesign include model ordinances, a runoff management grant program, best management practice (BMP) technical standards, a revised priority watershed and lakes program, stormwater discharge permitting, and clarifications to the regulation of animal feeding operations. The DNR attracted over 2000 people to their hearings and received a 4-ft stack of written comments that are in the process of being compiled. Next steps include 1) rule revisions by late summer/fall, along with the possible re-formation of work groups to address certain issues; 2) revised rules to Natural Resource Board by winter; 3) the possibility of more hearings in the spring of 2001; and 4) submission to the legislature. More information can be found at *http://www.dnr.state.wi.us/org/water/wm/nps/index.htm*.

Nick pointed out that DATCP is waiting for DNR to complete process at this point, as it cannot make further changes to its technical standards until the DNR has finalized their performance standards. Carol Cutshall commented that the DOT had proposed their own version of Subchapter II of NR151 relating to regulation of transportation facilities, working closely with local governments, and appreciated the opportunity that the DNR provided to resolve issues through the hearings and potential work groups. Russ suggested to Nick that there be a "conference committee" established to resolve inconsistencies between DNR and DATCP.

9. **Pesticide metabolites in groundwater** – Bruce Rheineck gave a progress report on a study of acetanalide degradates funded by DNR under the direction of DATCP. In particular, DATCP has sampled for ethane sulfonic acid (ESA) and oxanilic acid (OA) degradates of Acetochlor, Alachlor, and Metolachlor in 73 wells in Wisconsin. Wells sampled included 27 monitoring wells located on fields that have had alachlor applied in the past or had detects in the well, 23 water supply wells which had detects of alachlor ESA, and 23 municipal supply wells selected either because of pesticide detects, proximity to agricultural areas, or because they were one of 7 biggest systems in the state.

Monitoring wells had detects ranging from 9 of 27 for acetochlor ESA to 22 of 27 for Alachor ESA. Private wells varied from 2 of 22 for acetochlor OA to 20 of 22 for metolachlor and alachlor ESA. Municipal well data has not been analyzed. Concentrations ranged widely, with many wells exceeding current enforcement standards for alachlor (2 µg/l), but below the interim standard for alachlor ESA (20 µg/l). In summary, detects were common in the wells that were sampled, but concentrations were variable. Bruce noted that these wells were not randomly selected, but represent worse case scenarios – places where you would most expect to detect the metabolites.

Table 1. Numbers of detects (#) and maximum concentrations in µg/l of acetalanide degradates found in 27 monitoring (MW) and 23 private (PW) wells.

Metabolite	#(MW)	conc.	#(PW)	conc.	Reporting Limit
ACETOCHLOR ESA	9	6.37	3	3.35	0.05 ug/l
ACETOCHLOR OA	5	1.75	2	1.9	0.05 ug/l
ALACHLOR ESA	22	32.63	20	8.95	0.05 ug/l
ALACHLOR OA	11	14.69	16	33.9	0.05 ug/l
METOLACHLOR ESA	21	42.1	20	18.06	0.05 ug/l
METOLACHLOR OA	17	32.44	19	22.79	0.05 ug/l

10. **Update on New (cycle 8) NR 140 Groundwater Standards** – Mike Lemcke gave a brief overview of the process used to add new standards to Chapter NR 140. There are currently 121 standards on the books, and new ones have been added at the rate of about 12 per year. In the new cycle, 10 substances were initially considered, based on criteria such as presence in groundwater, health issues, or new toxicological information. Three substances were ultimately selected for further standard development:
    - alachlor ESA, a degradation product of the pesticide alachlor;
    - molybdenum, an industrial chemical found in 93 wells in the state, some at levels greatly exceeding a suggested enforcement standard of 50 ppb;
    - naphthalene, which already has an enforcement standard of 40 ppb, but may be revised to 200 ppb in light of new toxicological information.

This list of suggested substances has been sent to DHFS for their recommendations on standard levels to protect human health. Mike also mentioned that new standards for xylene and toluene have recently gone into effect, but that the review of information for a proposed standard for ammonia is still ongoing.

11. **Groundwater Management – Next Steps II** – Mike Lemcke pointed out that it has been almost 10 years since the GCC convened a broad group of people to come up with a vision for groundwater management in the state. Much progress has been made on the recommendations from the 1991 Next Steps document, but many issues are still being addressed. The goal would be to bring together a broad spectrum of players in groundwater management in the state, perhaps at a conference, to help the GCC to target issues that need to be addressed and to build up a groundwater constituency in the state. Mike has made a preliminary list of who to invite and wants to target local governments and players. Nick Neher stressed that care needs to be taken in who to invite and how any meeting or conference is packaged in order to enable the gathering of meaningful results. Henry Anderson suggested that such a conference might be a good opportunity to showcase what has been done in the area of groundwater management to date and what issues are on the horizon in order to demonstrate the need for the Groundwater Law. Mike will be bringing the idea to the Planning and Mapping Subcommittee this summer and will report back to the GCC at the August meeting. Carol Cutshall asked that such a process not involve extensive input from the agencies, as staff resources are limited.

The meeting adjourned at 3:05. The next meeting is scheduled for 12 noon on August 25th in room 774b at the Department of Natural Resources in Madison.

Respectfully submitted,

Tim Asplund, Water Resources Specialist
Department of Natural Resources

Joint Solicitation of Groundwater and Related Research/Monitoring Proposals

October, 1999

The University of Wisconsin System (UWS) and the Wisconsin Departments of Natural Resources (DNR); Agriculture, Trade, and Consumer Protection (DATCP); and Commerce; are participating in a joint solicitation of research/monitoring proposals dealing with groundwater and/or pesticides. The three state agencies have a total of approximately $710,000 available for groundwater-related monitoring or research. Approximately $320,000 of that total will be available for new projects in fiscal year 2001 (FY 01). The three monitoring/research programs are summarized as follows:

1. UWS Groundwater Research - The UWS, through its UW-Madison Water Resources Institute (WRI), has received funding since FY 90 for groundwater research. They will have $300,000 to fund research in FY 01. Through FY 99, the UWS has spent $2.9 million on 79 groundwater research projects. Four of the 79 projects have been co-funded with DATCP, five co-funded with DNR, two co-funded with WRI through the US Geological Survey, and one project was funded by the DNR, DATCP and UWS.

2. DNR Management Practice Monitoring - The DNR has been funding groundwater management practice monitoring projects since FY 86. The DNR has approximately $150,000 available for FY 01 to support groundwater monitoring studies evaluating existing design and/or management practices associated with potential sources of groundwater contamination. The intent of these studies is to reduce the impacts of potential sources of contamination by changing the way land activities which may impact groundwater are conducted. The money comes from the Groundwater Account of the Environmental Fund (which is funded by various fees). Through FY 99, the DNR has spent approximately $4.3 million on 154monitoring projects. Three projects have been co-funded with the DATCP, five were co-funded with the UWS, and one project was funded by the DNR, DATCP and UWS.

3. DATCP Pesticide Research - Since 1989, the DATCP has had approximately $135,000 available annually to fund research on pesticide issues of regulatory importance. The money comes from fees paid by pesticide manufacturers to sell their products in Wisconsin. Through FY 98, the DATCP has spent about $1.1 million on 23 pesticide projects. Four were co-funded with the UWS, three were co-funded with the DNR, and one project was funded by the DNR, DATCP and UWS.

4. Department of Commerce Private Sewage System Research – The Division of Safety & Buildings (formerly in the Department of Industry, Labor, and Human Relations) received an annual appropriation of $50,000 from 1990 to 1993 to fund research on alternatives to current private sewage system technology. In 1994, when the appropriation expired, $75,000 generated through plan review and licensing fees became available each year for research on private sewage systems. Through FY 96, the DILHR has spent $412,600 on four projects. As of July 1, 1996, the Division of Safety & Buildings including the private sewage system research program was transferred from DILHR to the newly created Department of Commerce. Commerce will have $25,000 for new research projects in FY 01. Through FY 98, the DILHR/Commerce has spent approximately $530,000 on six projects.

The Wisconsin Groundwater Coordinating Council (GCC) provides consistency and coordination among the four state agencies in funding groundwater monitoring and research to meet state agency needs. The reasons for this solicitation to be made jointly are to:

- Facilitate proposal writing
- Streamline the review process
- Curtail duplication
- Improve coordination among agencies and researchers

- Enhance communication between the agencies and between principal investigators (P.I.)

Joint funding of some projects may be appropriate, but joint funding is not the purpose of this solicitation because each agency has its own designated mission and priorities. Contributors to this solicitation and their roles are:

- The UWS, through its Water Resources Institute (WRI), with oversight from the UWS Groundwater Research Advisory Committee Council, has approximately $160,000 available in FY 01 to fund new projects. The remainder of the UWS groundwater research funds has been committed to ongoing continuation projects for FY 00. The funds are restricted for use by faculty within the UW System or by academic staff who has achieved nomination to P.I. status (see Application Requirements on p. 10). Projects of fundamental and applied research will be supported on all matters relating to groundwater including natural science, engineering, social science and law. Funding decisions are based on ratings by GCC subcommittees and reviews solicited from an international list of experts in the field of the proposed work. The Groundwater Research Advisory Council (GRAC), which consists of university, state agency, and public representatives, meets as a body to discuss the results of the review process and thereupon to recommend a priority list of projects that the UWS should strive to fund in accordance with budgetary resources. A suitable UWS Groundwater Research Program is then assembled by the WRI and submitted to the GCC for approval before the Department of Administration can release UWS research funds upon passage of a State budget. UWS projects will be considered for one or a MAXIMUM of two years during a solicitation cycle. Projects that appear to be continuations of a previously funded project with two years of UWS support and projects that have been twice rejected will not be considered. The UWS also strives to avoid funding situations where a P.I or co-P.I.'s name appears on more than two UWS projects during any given fiscal year.

- The DNR has approximately $100,000 available in FY 01 to fund new groundwater monitoring projects. About $50,000 has been allocated for ongoing monitoring or related projects. The monitoring will establish and improve management practices which will allow the state to meet the groundwater quality standards enumerated in NR 140, Wisconsin Administrative Code. Funding decisions are made by the DNR Bureau of Drinking Water and Groundwater with input from other DNR staff, GCC subcommittee members, and experts in the field. Funds are restricted to use by UWS and state agency contractors. Contracts will be approved on an annual basis.

- The DATCP has approximately $85,000 available for FY 01 to fund new projects. Investigators should note that the focus of the DATCP program is on pesticide research, which includes but is not limited to groundwater issues. Proposals may be submitted by any college or university, research foundation or individual having a demonstrated capacity in pesticide or other applicable research. Funding decisions are made by the DATCP Secretary based on recommendations by the Bureau of Agrichemical Management staff who receive input from GCC subcommittee members and experts in the field.

- The Department of Commerce will administer $25,000 for FY 01 to support research on performance of onsite wastewater treatment systems. All of the funds will be available for new projects.

For investigators who are not affiliated with the state and therefore not eligible for funding by UWS or DNR, a willing UWS faculty member or state agency staff member may be added as a co-principal investigator to attain eligibility.

Please read the solicitation carefully; it contains a description of the priorities for each agency program and other pertinent information, some of which has changed since last year. Capital items may not be purchased with these funds, and faculty salaries plus fringe benefits will be limited to a maximum of

10% of an individual grant (e.g., for a $20,000 grant, a maximum of $2,000 can be allotted to faculty salaries and fringe benefits).

A cover page and proposal format have been agreed upon and are contained in this package. The cover page should indicate a primary contact. Although all proposals received will be distributed to each agency, each investigator is asked to identify the agency whose mission and priorities best match their project.

Attached is the description of each agency's guidelines, the outline for a cover page, and a detailed format for the proposal. **Proposals should be no longer than 20 pages.** All pages should be 8.5" x 11" and single sided. The project summary, narrative, curriculum vitae, and budget should start on a new page, be double-spaced (except for Figure and Table legends), and use no smaller than 11-point font. All margins should be no less than 0.75 inches. All except the cover page must be consecutively paginated on the bottom of the page. Include literature citations in the proposal where appropriate (single spaced within, double spaced between). Any section of a proposal which exceeds the maximum page limits specified in the table below will be grounds for returning the proposal to the author.

Section	Maximum Pages
Cover Page	1
Project Summary	2
Narrative and supplements	10
Curriculum vitae	4
Budget	3

These revised proposal guidelines were first established in conjunction with the FY 97 Joint Solicitation package to enhance efficiency of the time-consuming review process. Compliance to stated proposal guidelines will be part of the criteria used in both acceptance and scoring of proposals. Proposals that severely disregard these guidelines will be returned to investigators. An example of a funded proposal in compliance with these guidelines will be made available to investigators upon a request made to the contact person for the primary state agency to which the proposal is directed. These contacts are listed below. Investigators who are new to this program are encouraged to solicit an example proposal. A compliance check list is also provided on page 9 to assist proposal authors.

The deadline for submittal of proposals is November 29, 1999. No proposals will be accepted after the close of WDNR business at 4:30 PM on November 29, 1999 unless they are postmarked on November 26, 1999 or earlier. **In past years, project proposals covering more than one topic or project area may have had more success in obtaining funding if they had been split into two projects. Likewise, two or more similar proposals may have been more successful if they had been combined. To facilitate this splitting and joining we ask that proposal authors seeking consideration for splitting or joining submit their proposals by 4:30 PM, November 18th, 1999 to allow time for splitting or joining of proposals.**

No facsimiles of proposals and no hand-written proposals will be accepted. Special attachments (maps, brochures, etc.) will be accepted, noted, and kept on file, but will not be included in the package of materials submitted to reviewers. The UW Water Resources Institute conducts an external peer review of all proposals. A minimum of four written reviews will be solicited from an international list of experts in the field of each proposal. Therefore, we request that investigators provide the names and addresses (Email also) of three suggested reviewers with expertise in the field of the proposal. One name may be from Wisconsin. Proposals are also evaluated and ranked by the Research and Monitoring & Data Management Subcommittees of the Wisconsin Groundwater Coordinating Council, by the Groundwater Research Advisory Council, and by targeted State Agency personnel before the final ranking is established and subsequent project selections are made. Funding decisions will be made in March 2000. Proposals which give rise to funded projects become the property of the granting Wisconsin State Agency.

A principal investigator with unfinished Joint Solicitation-funded final reports that are significantly overdue (in the case of UWS by more than one year) with respect to initially specified or understood completion dates will not be eligible for new funding. Extenuating circumstances may be considered by the Groundwater Coordinating Council on a case-by-case basis.

Proposals that are not chosen for funding through this solicitation may be referred to other potential funding sources for their consideration. Investigators will be notified of any such referrals. Likewise, other funding organizations may refer proposals to the funding agencies involved in this solicitation. Those proposals may be considered for funding.

If you have questions please call the following appropriate agency contacts.

James P. Hurley, University of Wisconsin-Madison (608) 262-1136
Jeff Helmuth, Wisconsin Department of Natural Resources (608) 266-5234
Jeff Postle, Wisconsin Department of Agriculture, Trade and Consumer Protection (608) 224-4503
Harold Stanlick, Wisconsin Department of Commerce (414) 548-8604

Please submit the original and three copies of each separate proposal to:

Jeff Helmuth, DG/2
Wisconsin Department of Natural Resources
101 S. Webster St.
P.O. Box 7921
Madison, WI 53707-7921

PROPOSAL FORMAT (Original and three collated copies)

Deadline for Submission: November 29, 1999.

Cover Letter – Include the names of 3 possible reviewers.

Proposal.

A. Cover Page--Sample copy is appended.

B. Project Summary (begin on new page, **not to exceed 2 double-spaced pages**)

1. Specific groundwater or related problem addressed by research/monitoring proposal.
2. What will findings contribute to problem solution or understanding?
3. Project objectives.
4. Project approach to achieve objectives including methods and procedures.
5. Users of project findings.

C. Proposal Narrative (begin on new page, **not to exceed 10 double-spaced pages**)

1. Objectives.
2. Background information describing prior research/monitoring relevant to objectives; references to ongoing projects and how they relate to proposed investigation; information gaps which will be filled by the proposed project.
3. Project plan outlining experimental design and schedule.
4. Methods detailed enough to convince the reviewer that the investigators are up-to-date on modern techniques; a general statement alluding to techniques is not acceptable.
5. Relevance to groundwater and related problems.
6. Citations
7. Training support (if any) provided by the project and information dissemination plan.

D. Principal Investigators

Include curriculum vitae (including recent publications) of each investigator and state the time each will spend on the project. A recent reprint or offprint of a key publication should be submitted if appropriate and available.

E. Budget using order shown in sample form

1. Salaries and wages

2. Fringe benefits (include percentage of grant to be used for faculty salaries, wages, and benefits)
3. Supplies and publication costs: list office, laboratory, computer and field supplies separately.
4. Travel to support field operations only. Travel to meetings is excluded because of the limited funding.
5. Other costs: e.g., equipment maintenance and fabrication, subcontracts, rentals, etc.
6. Total direct costs.

SAMPLE COVER PAGE

Project Title

(Maximum of 100 characters)

PRINCIPAL INVESTIGATOR (designate primary contact if more than one):

Name
Title, Affiliation, and complete mailing address including ZIP
Telephone FAX
email address if available

CO-PRINCIPAL INVESTIGATOR(S):

Name
Title, Affiliation, and complete mailing address including ZIP
Telephone FAX
email address if available

Location of Research

Desired Start-up Date and Duration of Project:

Amounts Requested:

FIRST YEAR	SECOND YEAR	TOTAL
$$$$$	$$$$$	$$$$$

Check agency(ies) to which this proposal is targeted:

[If appropriate for more than one agency rank highest (1) to lowest (3)]

UWS ( ) DNR ( ) DATCP ( ) Commerce( )

Date of Submittal:

SAMPLE BUDGET PAGE

Budget Period from July 1, 2000 to June 30, 2001

(Make a separate page for each year of support)

1. Salaries and Wages — Time, % — Cost, $

   Name and title if known

   a.

   b.

   c.

   d.

2. Fringe Benefits

   % of which salaries

   % of grant to be used for faculty salaries, wages, and fringe benefits

3. Supplies and Publication Costs

   a. Office

   b. Laboratory

   c. Field

   d. Computer

   e. Publication Costs

4. Travel only for support of field operations. Detail transport, meals, hotels and number of persons involved.

5. Other Costs.

6. Total Direct Costs

7. On a separate sheet, indicate the level of current or pending support. See attached example.

PROPOSAL GUIDELINE CHECKLIST

GENERAL PRESENTATION		
ITEM	**GUIDELINE**	**THIS PROPOSAL**
Font	Minimum of 11 point	
Margins	Minimum of 0.75”	
PAGE LIMITATIONS		
Cover Letter	***Include names of 3 possible reviewers***	
Cover Page	1 page	
Project Summary	Maximum of 2 pages	
Narrative and supplements	Maximum of 10 pages	
Curriculum Vitae	Maximum of 4 pages total and 2 for 1 P.I.	
Budget	Maximum of 3 pages	
Entire Proposal	Maximum of 20 pages	
PAGINATION		
Cover Page	Page 1 but do not paginate	
Project Summary	Begin on new page, paginate as 2 and 3	
Narrative and supplements	Begin on new page, paginate starting at 4	
Curriculum Vitae	Begin on new page, paginate consecutively	
Budget	Begin on new page, paginate consecutively	
LINE SPACING		
Cover Page	Refer to sample on Page 7	
Project Summary	Double spaced	
Narrative Body	Double spaced	
Figure Legends	Single spaced	
Tables / Titles	Single spaced	
Citations	Single within, double between	
Training and Info Transfer	Single	
Curriculum Vitae	No specific guidelines	
Budget	Refer to Sample on Page 8, single if needed	

UNIVERSITY OF WISCONSIN SYSTEM (UWS)
PROJECTS FUNDED
THROUGH THE GROUNDWATER RESEARCH ADVISORY COUNCIL

As part of the joint solicitation for groundwater research proposals, the UWS, through its Water Resources Institute (WRI) and its Groundwater Research Advisory Council, seeks projects of a fundamental or applied nature on any aspect of groundwater research in the natural sciences, engineering, social sciences or law. Projects funded in the current cycle are listed on the WRI web site at www.wri.wisc.edu.

Application Requirements: Most often the principal investigator will be a faculty member on any campus in the UWS. However, academic staff who has achieved nomination to P.I. status by endorsement of the relevant academic dean may serve in this capacity.

Budgetary Considerations: About $160,000 will be available for new grants in FY 01. Projects will not be approved in any one budget cycle for a period of more than two years and then contingent on satisfactory progress. No capital equipment (more than $5,000 per item) may be purchased. **Travel for attendance at scientific meetings will not be accepted.** Faculty salaries and fringe benefits to be paid from any project may not exceed 10% of the total individual grant (including fringe benefits). Overhead costs are not allowed. Supplies should not exceed 20% of individual grant.

UWS Groundwater Research Priorities:
(Presented in no particular order of importance.)

- Chemical and biological degradation of pollutants in surface soils, subsoils, and groundwater, including identification, toxicity, and persistence of degradation products.

- Transport of pollutants in soil and groundwater, including elucidation of soil and hydrologic factors controlling movement and development or validation of predictive models.

- Impact of waste, and agricultural (including agricultural feeding operations), industrial, or municipal management practices on groundwater quality.

- Characterization of geologic factors affecting groundwater movement, contamination, and aquifer recharge.

- Interactions of groundwater and surface water including chemical transformations in the hyporheic zone.

- Land-use impacts on wetland quality and the interaction of groundwater with wetlands.

- Examination of the social and economic impacts of groundwater contamination and groundwater protection policies.

- Investigations on the development, understanding, improvement, cost-effectiveness, or utility of innovative biological, chemical or physico-chemical technologies for remediation of contaminated soils and/or groundwater.

- Biological, ecosystem, and human health effects of common groundwater pollutants and development or evaluation of surrogate, cost-effective bioassay systems for risk assessment.

- Field validation of effects of new technologies for on-site waste treatment (septic systems) on groundwater quality.

Proposal Format: The proposal format is fully outlined on pages two through eight of this joint solicitation package. Most recent literature citations are absolutely required for all proposals seeking support from the UWS.

Review: Each project will be reviewed and ranked as outlined on page 3.

DEPARTMENT OF AGRICULTURE, TRADE AND CONSUMER PROTECTION (DATCP)
PESTICIDE RESEARCH PROGRAM

RESEARCH GRANT PROGRAM FOR FY 01 - SOLICITATION OF APPLICATIONS

Applications are invited for grant awards focusing on regulatory issues associated with pesticide use and control. This program is administered by the Agricultural Resource Management Division of DATCP. Under this program, the Department may award grants not to exceed three years for research projects on the program priorities outlined below. Proposals may be submitted by any college or university, research foundation or individual having a demonstrated capacity in pesticide or other applicable research.

DATCP RESEARCH PRIORITIES FOR FY 01

1) **Evaluation of the Environmental Fate Investigation Strategies and Remediation Alternatives for Contaminated Soil and Water at Pesticide Spill Sites.**

Research should investigate the degradation and movement of pesticides at spill sites, develop criteria on the need for and appropriate extent of remedial actions, and evaluate various methods for investigation and remediation of contaminated soil and water.

2) **Development of Methods for Cleaning Pesticide Mixing/Loading Pads and Disposing of Pesticide Rinsates.**

Projects should evaluate methods of decontaminating pesticide mixing/loading pads and disposing of or treating pesticide-contaminated rinsate water.

3) **Refinement of Application Methods for Pesticides with High Drift Potential to Reduce Environmental and Public Health Problems.**

The research should focus on how different application methods and environmental conditions affect the potential for drift of pesticides such as metham sodium or clomazone.

4) **Evaluation of Factors Influencing the Patterns of Groundwater Contamination by Pesticides and Pesticide Metabolites in Wisconsin.**

This topic involves examining factors which influence pesticide leaching to determine areas of the state that are susceptible to groundwater contamination by specific pesticides.

5) **Use Related Monitoring of Pesticides and Pesticide Metabolites in Groundwater.**

This project should study groundwater contamination by field application of pesticides in key environmental settings such as fractured bedrock areas.

6) **Identification of the Sources of Pesticide Contamination in Groundwater in Rural Wisconsin.**

Methods should be developed and investigations conducted at contaminated well sites to determine if the contamination is due to field use (nonpoint source) or spills or mishandling (point source) of pesticides.

7) **Evaluation of the Economic Feasibility of Various Chemical and Non-Chemical Weed Control Practices.**

This project should develop a methodology for evaluating the economic feasibility of modifying weed control practices and apply it to examples where practices are changed to reduce impacts on groundwater.

8) **Pesticide Use Surveys.**

These projects should conduct detailed pesticide use surveys that complement other data gathering efforts, such as ground and surface water monitoring, to improve the understanding of pesticide related issues.

9) **Use Related Monitoring of Pesticides in Surface Water and the Effect of Management Practices on Contaminant Levels.**

Projects on this topic should determine the impacts of pesticide use practices on surface water quality and evaluate the ability of various management practices, such as stream setbacks, to reduce contamination.

10) **Evaluation of the Effect of Pesticide Use on Endangered Species and their Habitat.**

This topic should explore how the use of specific pesticides affects the habitat and survival of endangered species in Wisconsin and how alternative pest control methods could reduce problems.

11) **Evaluation of Health and Environmental Risks from Commonly Used Lawn Care Pesticides**

This project should evaluate the health risks following applications of lawn care pesticides such as pendimethalin, 2,4-D, dicamba, and MCPP.

12) **Development of Pest Management Techniques that Lead to Efficient Use of Pesticides and Reduce Impacts on the Environment.**

This project should look at ways of reducing pesticide use through integrated pest management, use of alternative pest control strategies, best management practices, or other techniques that promote efficient pesticide use and minimize environmental problems.

DEPARTMENT OF COMMERCE

RESEARCH OBJECTIVES

The Department of Commerce supports research focused on the performance of onsite sewage system designs, products, and management practices that can be incorporated into the administrative rules regulating onsite sewage systems. These designs, products, or management practices must be:

- Directed toward protecting groundwater and surface water quality;
- Result in onsite sewage treatment that is consistent with the provisions of the Groundwater Protection Law;
- Be affordable by the average owner of an onsite sewage system; and
- Be practical for the climate and soils of Wisconsin.

Application Requirements: Anyone may apply for research funds. Applicants will be required to demonstrate education, training, and experience consistent with research objectives.

Budgetary Constraints: The Department is limited to a budget of $25,000 per year, and existing projects may receive continued funding for another year. Applicants are encouraged to seek additional funding from the DNR, or other sources, where projects also meet funding priorities of other agencies.

Proposal Format: The proposal format is outlined in the joint solicitation.

Review: Each project will be reviewed individually.

WISCONSIN DEPARTMENT OF NATURAL RESOURCES
GROUNDWATER MANAGEMENT PRACTICE MONITORING PROGRAM

Management practice monitoring is defined as groundwater monitoring or support activities associated with groundwater monitoring, such as laboratory technique development or geologic resource description, for establishing or improving management practices necessary to meet the state groundwater quality standards of NR 140, Wis. Adm. Code.

Applicant Requirements

Funds are restricted to use by UWS and state agency contractors. Others may submit proposals if they include a state-affiliated co-principal investigator.

Budget Considerations

Monitoring proposals will be considered for a maximum of two years. Projects costing less than $35,000 annually will be given greater consideration than more expensive projects. Management practice monitoring projects are funded solely by state funds; there are no federal funds involved. Budget items to be identified should include such things as personnel costs, supplies, equipment, necessary travel, and other appropriate items. The management practice monitoring funds cannot support indirect costs or the purchase of capital equipment.

A number of projects which are being funded in FY 00 will continue into FY 01. As a result, some money will be set aside to fund continuing projects. Approximately $100,000 will be available to fund new monitoring projects in FY 01 (July 1, 2000 through June 30, 2001).

In preparing the budget be aware of the following contractual requirements.

Contractual Requirements

All monitoring wells installed shall meet DNR regulations and approved procedures for installation, construction and documentation (Chap. NR 141, Wis. Adm. Code.)

For each new monitoring well, a soil boring form (Form 4400-122), a well construction report (Form 4400-113A), and a monitoring well development form (Form 4400-113B) shall be submitted on paper or in a computer format supplied by the DNR.

For all groundwater sample points (monitoring wells, piezometers, and private water supplies), an inventory form (Form 4400-89) supplied by the DNR shall be completed and submitted.

For any water supply well that is sampled, the contractor shall determine if a well construction report was prepared. A copy of the well construction report, if available, shall be attached to the inventory form.

All groundwater quality monitoring data shall be submitted in a computer format compatible with the state Groundwater Retrieval Network and shall be reported to the DNR within two weeks after the contractor has received the data. The contractor shall verify computerized data.

All groundwater samples shall be analyzed by a laboratory certified in Wisconsin for that purpose under Chapter NR 149, Wis. Adm. Code.

The contractor shall request and use labels with Wisconsin Unique Well Numbers from the DNR for wells constructed and/or sampled to allow identification of wells.

Abandonment of monitoring wells shall be the responsibility of the contractor. Wells shall be abandoned in accordance with DNR regulations (Chap. NR 141, Wis. Adm. Code) and approved procedures upon completion of the project, unless alternative prior arrangements have been made with the DNR. A well abandonment report shall be submitted on a form (Form 3300-5B) or in a computer format supplied by the DNR.

Quarterly project status reports shall be submitted to the project manager within 30 days of the end of each quarter. A final report and a project summary shall be submitted to the project manager within 60 days of the end of the contract period. The final report shall be submitted unbound. The project summary shall be submitted in electronic format in an outline form provided by the project manager. If reports are not received, investigators will be ineligible for future solicitations until contractual obligations are met.

Review of Proposals

All proposals will be reviewed and rated by DNR staff, and the Monitoring & Data Management and Research Subcommittees of the Groundwater Coordinating Council.

Two important criteria in evaluating each proposal are: 1) whether the proposal addresses an emerging issue or a priority monitoring topic as listed below; and 2) whether the project involves either groundwater monitoring or activities conducted to support groundwater monitoring. Support functions can include, among other things, laboratory analysis technique development, well drilling and construction methodology development, data management and definition of geologic and hydrogeologic conditions for groundwater management purposes. Other criteria for funding include project cost, proposed timeline, whether the proposed project methodology meets the stated objectives, whether the resources requested are adequate to carry out the project, and whether the project investigators have the abilities to complete the proposed project.

In making final funding decisions, the DNR's Groundwater Section will formulate its recommendations based on: 1) input from all project reviewers and; 2) available funds. The Director of the DNR's Bureau of Drinking Water and Groundwater will make the final funding decisions.

In September, 1999, the Research and Monitoring & Data Management Subcommittees of the Wisconsin Groundwater Coordinating Council identified the following emerging issues as being of the highest importance for groundwater monitoring and research in the state. Unlike the more general priority monitoring topics that follow the emerging issues, these are specific ideas for projects that state groundwater experts see an immediate need for.

Emerging Issues

Arsenic in Groundwater – Serious arsenic problems exist in Wisconsin, especially in the Lower Fox River Valley. Suggested projects: 1) define the lateral and vertical extent of the arsenic contamination as well as other associated metals and water quality problems; 2) improve understanding of the system geochemistry, including reaction triggers and the mobility of the contaminants released; 3) find solutions to drinking water problems such as well construction/reconstruction options and treatment; and 4) conduct toxicological and risk assessment studies that may be needed to determine impacts on human health and the environment. Further information on this issue may be obtained by contacting Dave Johnson (608-266-6421).

Water Quality in the Deep Sandstone Aquifer - Elevated sulfate and total dissolved solids (TDS) have been found in some new deep municipal wells in the Lower Fox River Valley making the wells unusable. In some other existing deep wells as far south as Milwaukee the TDS have been increasing over the years. Naturally occurring radium is also a problem in many of these wells. At present the sources of these dissolved substances and the hydrogeologic and geochemical mechanisms for mobilizing them are unclear. The source, extent, and hydrogeology of these problems must be defined in order for water managers to find economic sources of water. Research is needed to define the extent of these water-quality problems, to determine the sources of the dissolved constituents, to determine the hydrogeologic processes responsible for mobilizing the constituents, and for developing advice for the design and placement of new wells and the remediation of older wells. Further information on this issue may be obtained by contacting Ken Bradbury (608-263-7921).

Contaminants of Concern - p-Isopropylbenzene (cumene), aluminum, molybdenum and strontium (non-radioactive form) have been found in groundwater and potable wells throughout the state. There is a need to evaluate the sources of these contaminants in groundwater; their fate, transport and chemistry in groundwater; evaluate existing databases; and sample at-risk potable wells for these contaminants. Further information on this issue may be obtained by contacting Steve Karklins (608-266-5240).

Onsite Wastewater System Performance – Currently proposed revisions to onsite wastewater system regulations allow reduced soil depths if the applied wastewater is treated to a higher quality than conventional septic effluent. There is a need to evaluate new onsite wastewater treatment performance as a function of pretreatment; soil depth, texture and structure, and other factors. Treatment performance should be assessed relative to currently allowed onsite systems and for compliance with Wisconsin groundwater standards, particularly those of public health concern. Further information on this issue may be obtained by contacting Mike Lemcke (608-266-2104).

New Pesticides – Evaluation the impacts on groundwater of new pesticides such as those in the sulfonylurea class of herbicides. Determination of the presence of metabolites of acid acetanilide herbicides (metolachlor, acetochlor, dimethenamid) in groundwater. Development of laboratory analytical methods to detect and quantify new compounds in groundwater. Further information on this issue may be obtained by contacting Jeff Postle (608-224-4503).

Antibiotic and Hormones - Research is needed to determine whether antibiotics and hormones are entering Wisconsin's groundwater. Antibiotics and hormones are widely used in medicine. Certain drugs are also used to enhance the health of livestock, swine and poultry. Pharmaceuticals can enter the environment via municipal sewage effluent, private septic tanks, and animal feedlots. Research proposals should address at least one of the following questions: 1) Can commonly used drugs be detected in groundwater? 2) How do antibiotics and hormones behave in the environment, e.g. do they leach, how quickly do they breakdown? and 3) What are the most cost-effective analytical methods for antibiotics and hormones in water? Further information on this issue may be obtained by contacting Lynda Knobeloch (608-266-0923).

Microbial Pathogens – Research is needed to develop and test cost-effective screening tools that indicate the presence of, and/or quantify, microbial pathogens in groundwater. Further information on this issue may be obtained by contacting Don Swailes (608-266-7093).

Nitrogen Contamination - Conduct a site-specific study to evaluate the effectiveness of the new statewide nutrient management standard. Further information on this issue may be obtained by contacting Jim Vanden Brook (608-224-4501).

Up-Land Cranberries – Conduct site-specific studies of up-land cranberries related to pesticide use impacts on groundwater quality and evaluation of surface water/ groundwater interactions. Further information on this issue may be obtained by contacting Jeff Postle (608-224-4503).

Priority Monitoring Topics

For state FY 2001, the following priority topics for groundwater management practice monitoring have been selected based on input from the Research and Monitoring & Data Management Subcommittees of the Wisconsin Groundwater Coordinating Council, a number of state agency staff, and university researchers to meet state needs. The list of priorities is not in any specific order.

Nitrogen Contamination - Evaluation of the extent of impacts of nitrate contamination on groundwater quality. Examples: monitoring and evaluation of the impacts of large-herd, high-density animal operations on groundwater; evaluating the effectiveness of Best Management Practices (BMPs) in reducing nitrogen levels in groundwater. Compare tools that can be used to evaluate what farming systems are currently doing to groundwater and how do we evaluate the economic and water quality impacts of alternative farming systems.

Data Management/Data Integration - Improving existing state methods for managing and integrating groundwater monitoring data. Examples: working with state agencies to identify existing archives of data related to groundwater quality and management practice monitoring; conducting a survey to identify data elements common to management practice monitoring projects.

Microbial Contaminants - Investigation of the incidence, analytical and monitoring techniques and infective dosages of microbial contaminants, including parasites, bacteria, and viruses in groundwater.

Groundwater - surface water interaction - Monitoring of surface and groundwater flow to determine hydrologic connections and pathways between them to assess the potential movement and fate of contaminants from one hydrologic regime to another. Examples: investigation of the occurrence and causes of aquifer drawdowns that affect surface water features such as springs, streams and wetlands; identification of areas of the state sensitive to groundwater withdrawals; quantification of environmental, social and economic impacts of groundwater withdrawals; impact of induced flow of surface water to groundwater.

Health Effects of Groundwater Contaminants - Research is needed to better characterize the impact of contaminated groundwater on public health. Proposals should focus on contaminants that are commonly encountered in public and private drinking water supplies at levels of health concern. Pathogenic microorganisms and toxic chemicals (both naturally-occurring and synthetic) are of interest.

Groundwater remediation - Evaluation of current or developing remediation technologies, emphasis on natural attenuation. Examples: comparing the effectiveness of pump & treat versus natural attenuation through modeling by running sensitivity analysis on permeability, electron acceptor availability, contaminant mass in smear zone, and extraction well location; and identifying geobiochemical parameters for cost effective evaluation of natural attenuation at petroleum contaminated sites;

Pesticide Management - Evaluation of pesticide use impacts on groundwater quality. Examples: monitoring to determine if changes in pesticide application procedures and/or tillage practices have significant potential for reducing pesticide impacts on groundwater; evaluation of the extent of groundwater contamination from agricultural and nonagricultural pesticide use and handling in various geologic settings; monitoring at pesticide loading facilities to evaluate the effectiveness of the facility to

protect the surrounding soils and groundwater from contamination; monitoring to identify the soil and geologic conditions under which pesticide contamination is likely to occur.

Wellhead Protection/Source Water Assessments - Delineation of wellhead protection areas in karst and confined geologic settings. Evaluation of methods and planning strategies used to protect groundwater in wellhead protection areas. Investigators should be familiar with the state Wellhead Protection and Source Water Assessment Plans.

Landfill Regulation - Evaluation of current or innovative landfill design, operation or monitoring criteria in relation to compliance with groundwater quality standards. Investigation of groundwater impacts of closed landfills.

Wastewater treatment/disposal - Monitoring to evaluate the extent to which current and alternative on-site wastewater (private sewage) systems comply with state groundwater quality standards. Example: Nitrogen and phosphorus monitoring near lakeshore communities. Also monitoring of different types of wastewater land application and land spreading practices. This would include the landspreading of wastewater byproduct solids, such as sludges and septage, as well as the land application of industrial, agricultural and municipal wastewaters.

Urban nonpoint pollution - Evaluation of sources and methods of controlling urban nonpoint source contamination. Examples: monitor the impact of stormwater infiltration on groundwater quality including organic compounds, metals, bacteria, and viruses to evaluate DNR performance standards for infiltration basins; identify sources of nutrient contamination from urban lawn care and turf (e.g., golf course) activities and characterize nutrient management practices related to these activities; evaluate the effectiveness of Best Management Practices (BMPs) in reducing nutrient contributions from lawn care and turf activities.

Non-regulated Groundwater Contaminants – Evaluate sources, fate, transport and risk to potable wells from contaminants detected in groundwater that do not have NR 140 groundwater standards. This includes review and evaluation of existing groundwater databases; identification and sampling of at-risk potable wells; and correlation of land-use and hydrogeology with risk to potable wells from contaminants. Contaminants detected in groundwater that require an evaluation include rhodamine (used as tracer), p-isopropylbenzene, strontium (non-radioactive) and aluminum.

Naturally occurring substances - Evaluation of the distribution and seasonal fluctuation of naturally occurring substances such as arsenic, fluoride, or manganese.

New technology - Development of new laboratory or field technology (or new applications of existing technologies) for determining the characteristics of groundwater and geologic formations for management purposes, including downhole monitoring techniques.

Resource definition - Studies to better describe the geologic, hydrogeologic, and geochemical conditions that affect the groundwater quality and quantity in an area of the state. Example: Evaluation of groundwater flow and/or contaminant transport in karst areas.

Table 3 - State of Wisconsin Groundwater Monitoring/Research Projects 1986-2000
(Sorted by principal investigator within initial funding year)

Title	Principal Investigator(s)	Years Funded	Funding Agency	Project # (if assigned)
1986				
Hydrogeological Investigation of VOC Contaminated Private Wells Near Hudson, Wisconsin	Anklam	1986	DNR	31b
Treatment of Cheese Processing Wastewater by Ridge and Furrow Disposal - Nitrogen Transformations	Boyle	1986	DNR	23
A Case Study of Nitrogen Transformations at a Rapid Infiltration System Used for the Disposal of Food Processing Wastewater	Boyle, Hoopes	1986	DNR	17b
Volatile Organic Compounds in Small Community Wastewater Disposal Systems Using Soil Absorption	Boyle, Sonzogni	1986	DNR	5
Investigation of Hydrogeology and Groundwater Geochemistry in the Shallow Fractured Dolomite Aquifer in Door County, Wisconsin	Bradbury	1986-90	DNR	12
Hydrogeology of the Wisconsin River Valley in Marathon County, Wisconsin	Bradbury	1986	DNR	22
The Prediction of Nitrate Contamination Potential Using Known Hydrogeologic Properties	Cherkauer	1986-87	DNR	10
The Effect of Construction, Installation and Development Techniques on the performance of Monitoring Wells in Fine-Grained Glacial Tills	Cherkauer, Palmer	1986	DNR	16
Volatile Organic Compounds in Groundwater and Leachate at Wisconsin Landfills	Friedman	1985-87	DNR	4a
Barron County Nitrate Study	Hanson	1986-87	DNR	37
Field Investigation of Groundwater Impacts from Absorption Pond Systems Used for Wastewater Disposal	Hoopes	1985-86	DNR	17a
A Simple Stochastic Model Predicting Conservative Mass Transport Through the Unsaturated Zone into Groundwater	Hoopes	1986	DNR	1
The Use of Groundwater Models to Predict Groundwater Mounding Beneath Proposed Groundwater Gradient Control Systems for Sanitary Landfill Designs	Hoopes	1986	DNR	6
Evaluation Techniques for Groundwater Transport Models	Hoopes	1986	DNR	7

Title	Principal Investigator(s)	Years Funded	Funding Agency	Project # (if assigned)
The Occurrence of Volatile Organic Compounds in Wastewater, Sludges and Groundwater at Selected Wastewater Treatment Plants in Wisconsin	Hunger	1985-90	DNR	18
Groundwater Quality Monitoring - Long Term Effects of Intensive Farming and Sprinkler Irrigation on Groundwater Quality	Kammerer	1986	DNR	15
Fate of Aldicarb Residues in A Groundwater Basin near Plover, Wisconsin	Kraft	1986-87	DNR	3
Monitoring of Volatile Organic Compounds in Tomah, Wisconsin	Krohn	1986, 1989	DNR	31a
Fate and Mobility of Radium-226 in Municipal Wastewater Sludge Following Agricultural Landspreading	Portle	1986	DNR	19
Groundwater Monitoring for Pesticides	Postle	1986-97	DNR	2
Graphical and Statistical Methods to Assess the Effect of Landfills on Groundwater Quality	Potter	1986-87	DNR	14a
Groundwater Quality and Laundromat Wastewater: Summit Lake, Wisconsin	Saltes	1986-88	DNR	29
Filtration Preservation Study of Groundwater Samples	Sauer	1984	DNR	21a
West Bend Road Salt Use and Storage Study	Sucht	1986-91	DNR	8
Environmental Investigation of the City of Two Rivers Landfills, Manitowoc County, Wisconsin	Van Biersel	1986-87	DNR	24
Volatile Organic Compound Contamination of Private Water Supplies Adjacent to Abandoned Landfills in Marathon County	Wittkopf	1986-89	DNR	41
1987				
Plover Area Nitrate Study	Bailey	1987-88	DNR	48
Characterization of Groundwater Impacts at an Above Ground Petroleum Storage Terminal	Becker, Ham	1987	DNR	43
Research and Data Analysis of Groundwater Contamination from Municipal Rapid Infiltration Land Disposal Systems	Boyle, Hoopes, Potter	1987-88	DNR	56

Title	Principal Investigator(s)	Years Funded	Funding Agency	Project # (if assigned)
Downward Movement of Water Below Barnyard Grass Filter Strips - Case Studies	Bubenzer, Converse	1987-89	DNR	39
1987 Volatile Organic Compound Testing Project in Rock County, Wisconsin	Holman	1987	DNR	40
Flambeau Paper Sulfite Lagoon Site Contamination Study	Lantz	1987	DNR	30
Groundwater Survey of Bacterial Contamination Near Rapid Infiltration Wastewater Treatment System	Norenberg, Standridge	1987	DNR	21b
Investigation of Large Scale Subsurface Soil Absorption Systems	Peerenboom	1987	DNR	42
Hydrogeologic Investigation and Groundwater Quality Assessment (Havenswood Landfill)	Singh	1987	DNR	28
Nitrate Contamination in West-Central Wisconsin with Emphasis on Mill Run First Edition Subdivision	Tinker	1987-90	DNR	11
Lead Migration from Contaminated Sites - Door County, Wisconsin	Wiersma, Stieglitz	1987-88	DNR	13
1988				
A Ground Penetrating Radar Study of Water Table Elevation in a Portion of Wisconsin’s Central Sand Plain	Anderson (Mary), Bentley	1988	DNR	50
VOC Contamination at Selected Wisconsin Landfills - Sampling Results and Policy Implications	Battista	1988-89	DNR	4b
Assessment of Geologic Controls on Groundwater Flow and Distribution in Precambrian Bedrock, Central Wisconsin, Using Remote Sensing and Geophysical	Brown, Davidson Jr.	1988	DNR	49
Digital Simulation of Solute Transport to Green Bay and Lake Michigan by Groundwater from Door County, Wisconsin	Cherkauer	1988-91	DNR	57
Degradation of Atrazine, Alachlor, Metolachlor in Soils and Aquifer Materials	Chesters	1988-90	DNR	52
Radionuclides in Drinking Water of North central Wisconsin	Dobbins, Fitzgerald	1988-89	DNR	54
Sealing Characteristics of Sodium Bentonite Slurries for Water Wells	Edil	1988	DNR	34

Title	Principal Investigator(s)	Years Funded	Funding Agency	Project # (if assigned)
Mutagenic Effects of Selected Toxicants Found in Wisconsin's Groundwater	Meisner, Belluck	1988-89	DNR	38
Mineralogical and Geophysical Monitoring Naturally Occurring Radioactive Elements in Selected Wisconsin Aquifers	Morsky, Taylor	1988	DNR	51
Evaluation of the Effect of Stormwater Disposal on Groundwater	Nienke, Shaw	1988-89	DNR	53
Methods for Determining Compliance with Groundwater Quality Regulations at Waste Disposal Facilities	Potter	1988-89	DNR	14b
Analytical Determination of Atrazine Alachlor and Their Selected Degradation Products in Contaminated Groundwater: Implication for Wisconsin Groundwater	Sonzogni	1988-89	DNR	47
Lead Contamination Study of Door County	Stoll	1988	DNR	44
Freedman Creek Hydrogeologic Baseline Report	Wilson	1988-89	DNR	45
1989				
Effect of Soil Type on Atrazine and Alachlor Movement Through Unsaturated Zone	Daniel	1989	DATCP	66
Effects of Volatile Organic Compounds on Clay Landfill Liner Performance	Edil, Berthouex, Park, Sandstrom	1989	DNR	61
Grade A Dairy Farm Water Well Quality Survey	LeMasters, Doyle	1989	DNR	58
Groundwater Quality Investigation of Selected Townships in Jefferson County, Wisconsin	Madison	1989	DNR	60
Designs for Wellhead Protection in Central Wisconsin	Osborne, Sorenson, Knaak, Mechenich,	1989	DNR	63
Pesticide Migration Study	Shaw	1989-90	DNR	55
Optimum Manure Application Rate - Corn Fertility Management and Nitrate Leaching to Groundwater in Sandy Soils	Shaw	1989-90	DNR	71
Subdivision Impacts on Groundwater Quality	Shaw, Ameson, VanRyswyk	1989	DNR	67

Title	Principal Investigator(s)	Years Funded	Funding Agency	Project # (if assigned)
Demo of Low Input Strategies for Potato/Vegetable Production in Irrigated Sands	Shaw, Curwen, Kraft, Osborne	1989-90	DNR	59
1990				
A Field Evaluation of Drainage Ditches as Barriers to Contaminant Migration	Bahr, Chambers	1990-91	DNR	75
Incorporation of County Groundwater Inventory Data into the DNR Groundwater Information Network (GIN)	Bohn	1990	DNR	68
Atrazine Contamination of Groundwater in Dane County, Wisconsin	Bradbury, McGrath	1990-91	DATCP	64
Sources and Extent of Atrazine Contamination of Groundwater at a Grade A Dairy Farm in Dane County, Wisconsin	Chesters, Levy	1990-91	DATCP	65
Follow Up to the Grade A Dairy Farm Well Water Quality Survey	Cowell, LeMasters	1990	DATCP	70
Report on Bacteriological Water Quality Monitoring of Door County Variance and Special Casing Approval Wells	Hutchinson	1990-91	DNR	72
DNR and DATCP Rural Well Survey	LeMasters	1990	DATCP	69
Variation in Hydraulic Conductivity in Sandy Glacial Till: Site Variation Versus Methodology	Mickelson, Bradbury, Rayne	1990-92	DNR/U	74
Analytical Determination of Pesticide Metabolites and Carrier Chemicals in Wisconsin Wells	Sonzogni, Eldan, Lawrence	1990	DNR	77
Nitrogen Isotope Monitoring at Unsewered Subdivisions	Tinker	1990	DNR	76
Volatile Organic Chemical Attenuation in Unsaturated Soil Above and Below an Onsite Wastewater Infiltration System	Tyler, Peterson, Sauer	1990-91	DNR/U	73
1991				
Integrated Decision Support for Wellhead Protection	Adams, Bensen	1991	UWS	
Role of Mobile Colloids in the Transport of Chemical Contaminants in Groundwaters	Armstrong, Shafer	1991-93	UWS	
On-site Nitrogen Removal Systems Research Demonstration Project: Phase I	Ayers & Assoc.	1991	DILHR	
Evaluation of Potential Phytotoxicity and Crop Residues when Using Sprayer Rinsate as a Portion of the Diluent in	Binning	1991	DATCP	

Title	Principal Investigator(s)	Years Funded	Funding Agency	Project # (if assigned)
Pesticide Spray Mixtures				
To Expand Groundwater Sampling in the Lower Wisconsin River Valley	Cates, Madison, Postle	1991	DNR	78
Renovation of Pesticide Contaminated Rinse Waters	Chesters, Harkin	1991	UWS	
In-situ Removal of Fe, Mn, and Ra from Groundwater	Christensen, Cherkauer	1991	UWS	
Reactions of Chlorohydrocarbons on Clay Surfaces	Fripiat	1991	UWS	
The Biological Impact of Landfill Leachate on Nearby Surface Waters	Geis, Sonzogni, Standridge	1991	DNR	83
Chemical Transport Across a Sediment-Water Interface	Green	1991-92	UWS	
Adsorptive Behavior of Atrazine and Alachlor in Organic-Poor Sediments	Grundl	1991	UWS	
Effect of Complex Mixtures of Leachate on the Transport of Pollutants in Groundwater	Grundl, Cherkauer	1991-92	UWS	
Bioremediation of Herbicide-Contaminated Soil and Water	Harris, Armstrong	1991	UWS	
Near-Source Transport of Contaminants in Heterogeneous Media	Hoopes	1991-92	UWS	
Design of a Small Scale Transportable Mixing/Loading System	Kammel	1991	DATCP	
Municipal Wastewater Project	Kopecky	1991	DNR	85
Dependence of Aldicarb Residue Degradation Rates on Groundwater Chemistry in the Wisconsin Central Sands	Kraft, Helmke	1991-92	DNR	84
Using Ground Penetrating Radar to Predict Preferential Solute Movement and Improve Contaminant Monitoring in Sandy Soils	Kung, Madison	1991	UWS	
Nitrate Movement Through the Unsaturated Zone of a Sandy Soil in the Lower Wisconsin River Valley	Lowery, Kussow	1991-93	UWS	
Effect of Soil Type, Selected BMPs, and Tillage on Atrazine and Alachlor Movement Through the Unsaturated Zone	Lowery, McSweeny	1991	DATCP	62

Title	Principal Investigator(s)	Years Funded	Funding Agency	Project # (if assigned)
A Study of the Response of Nitrate and Pesticide Concentrations to Agricultural BMPs in Sandy Corn Fields	Madison, Cates	1991-94	DNR	81
Facility Plan Amendment for Wastewater Collection for Green Lake Sanitary District, Green Lake, WI	McMahon & Assoc.	1991	DILHR	
Contamination Attenuation Indices for Sandy Soils: Tools for Information Transfer	McSweeney, Madison	1991	UWS	
Tracking Contaminant Pathways in Groundwater Using a Geologically Based Computer Code for Outwash	Mickelson, Anderson	1991-92	UWS	
A Tracer Technique for Measuring Regional Groundwater Velocities from a Single Borehole	Monkmeyer	1991	UWS	
The Economic Effects of Groundwater Contamination on Real Estate	Page	1991	UWS	
Prediction of Organic Chemical Leachate Concentrations from Soil Samples	Park	1991	UWS	
Crop Rotations Effects on Leaching Potential and Groundwater Quality	Posner, Bubenzer, Madison	1991-92	DNR	80
Barnyard Management Practices: Effect on Movement of Nitrogen Through Soils and Impact on Groundwater Quality	Shaw	1991-92	DNR	9
A Comparative Study of Nitrate-N Loading to Groundwater from Mound, In Ground Pressure and at Grade Septic Systems	Shaw, Turyk	1991-92	DNR	82
Waupaca County Groundwater Project: Towns of St. Lawrence and Little Wolf	Wilson, Blonde	1991	DNR	79a
1992				
Effects of Transient Cross-Stratification Flow on Contaminant Dispersion	Bahr	1992-93	UWS	
Geographical Information System for Subsurface Characterization	Bosscher, Adams	1992-93	UWS	
Distribution of Radionuclides in Wisconsin Groundwater	Bradbury, Mudrey	1992	DNR	91
Evaluation of NURE Hydrogeochemical Groundwater Data for Use in Wisconsin Groundwater Studies	Bradbury, Mudrey, Shrawder	1992	DNR	90

Title	Principal Investigator(s)	Years Funded	Funding Agency	Project # (if assigned)
Preliminary Comparison of a Discrete Fracture Model with a Continuum Model for Groundwater Movement in Fractured Dolomite	Bradbury, Muldoon	1992	DNR	89
GIS Mapping of Groundwater Contaminant Sources, Quality and Contamination Susceptibility for Door County	Carlson, Stoll, Hronek	1992-93	DNR	93
Distribution, Transport and Fate of Major Herbicides and Their Metabolites	Chesters	1992-93	UWS/	
Dane County Atrazine/Land Management Project	Conners, Bohn, Madison, Muldoon, Richardson	1992	DATCP	99
Use of Tire Chips to Attenuate VOCs	Edil, Park	1992-93	UWS	
Municipal Wastewater Absorption Pond Renovation for Enhanced Nitrogen Removal	Gilbert	1992-93	DNR	97
Living Mulch Systems for Nitrate Trapping in Vegetable Production	Harrison	1992-93	UWS	
Remediation of Soils Contaminated by Leaking Underground Storage Tanks by Vapor Extraction and In-situ Biostimulation	Hickey, Jacobsen, Bubenzer	1992-93	DNR	96
Herbicide and Nitrate Movement in a Sandy Soil in the Lower Wisconsin River Valley	Lowery, McSweeney	1992-93	UWS/	
Spatial Attributes of the Soil-Landscape-Groundwater System of the Lower Wisconsin River Valley	McSweeney, Madison, Attig, Bohn, Falk	1992-93	DNR	88
Nitrogen Removal from Domestic Wastewater in Unsewered Areas	Otis, Converse	1992-96	DILHR	
New Approaches to Measuring Biologic Effects of Groundwater Contaminants	Porter	1992	UWS	
Estimating the Spatial Distribution of Groundwater Recharge Rates Using Hydrologic, Hydrogeologic and Geochemical Methods	Potter	1992-93	UWS/	
Investigation of Potential Groundwater Impacts at Demolition Landfills and Deer Pits	Pugh, Connelly	1992-93	DNR	98a

Title	Principal Investigator(s)	Years Funded	Funding Agency	Project # (if assigned)
Assessment of Wisconsin's Groundwater Monitoring Plan Program for Active Non-Approved Landfills (1985-1990)	Pugh, Gear	1992	DNR	92
Evaluation of Denitrification Systems for Improving Groundwater from On-Site Waste Disposal Systems	Shaw	1992-93	DNR	95a
Arsenic as a Naturally Elevated Parameter in Water Supply Wells in Eastern Winnebago and Outagamie Counties	Stoll	1992	DNR	87
Waupaca County: Towns of Lebanon and Scandinavia	Wilson, Blonde	1992	DNR	79b
1993				
Urban Stormwater Infiltration: Assessment and Enhancement of Pollutant Removal	Armstrong	1993-94	DNR	102
Trace Metal Transport Affected by Groundwater Stream Interactions	Bahr	1993-94	UWS	
Tracer Study for Characterization of Groundwater Movement and Contaminant Transport in Fractured Dolomite	Bradbury, Muldoon	1993-94	DNR	101
Evaluation of Five Groundwater Susceptibility Assessments in Dane County, Wisconsin	Bridson, Bohn	1993-94	DNR	100
Management of Sweet Corn Processing Wastes to Protect Groundwater Quality	Bundy	1993-94	UWS	
Impact of Tunnel Dewatering on Surface Water Bodies in Milwaukee County	Cherkauer	1993-94	UWS	
A Further Study of Organics at Wisconsin Municipal Solid Waste Landfills	Connelly	1993-94	DNR	104
Ultrasonic Verification Technique for Evaluating Well Seals	Edil	1993-94	UWS	
Long-Term Transformation and Fate of Nitrogen with Mound Type Soil Absorption Systems for Septic Tank Effluent	Harkin	1993-94	DNR	103
Field Evaluation of Near Source Transport of Contaminants in Heterogeneous Media	Hoopes	1993-94	UWS	
Variability of Hydraulic Conductivity in Supraglacial Sediments	Mickelson	1993-94	UWS	

Title	Principal Investigator(s)	Years Funded	Funding Agency	Project # (if assigned)
The Impact of Atrazine Management Areas Designation on Weed Control Strategies in Wisconsin Corn Production	Nowak	1993	DATCP	
1994				
Photocatalytic degradation of volatile organic carbon	Anderson (Marc)	1994-95	UWS	94REM2B2
Photocatalytic Degradation of Volatile Organic Carbon	Anderson, Marc, Hill	1994	UWS	
Improved design of pump and treat systems for heterogeneous aquifers	Bahr	1994-95	UWS	94REM3B2
Improved Design of Pump and Treat Systems for Heterogeneous Aquifers	Bahr, Anderson	1994	UWS	
Herbicide Contamination of Soil and Groundwater at a Mixing-Loading site	Chesters	1994	UWS/	
Herbicide contamination of soil and groundwater at a mixing and loading site	Chesters	1994-95	UWS/	94PES2B2
An Investigation of Field-Filtering and Low-Flow Pumping When Sampling for Metals	Connelly	1994	DNR	106
Mineral Phase Sorption of Selected Agrochemicals to Wisconsin Soils	Grundl	1994	UWS	
Mineral phase sorption of selected agrichemicals to Wisconsin Soils	Grundl	1994-95	UWS	94PES1B2
Stratigraphy, Sedimentology and Porosity Distribution of the Silurian Rocks of the Door Peninsula, WI	Harris	1994	UWS	
Stratigraphy, sedimentology, and porosity distribution of the Silurian rocks of the Door Peninsula, Wisconsin	Harris	1994-95	UWS	94HGE2B2
Using "Predict" to Reduce Herbicide Usage and Improve Groundwater Quality	Harvey	1994	UWS	
Using ’PREDICT’ to reduce herbicide usage and improve groundwater quality	Harvey	1994-95	UWS	94PES6B2
Comparative Evaluation of Biostimulation Approaches for Enhancing in Situ TCE Degradation in Contaminated Aquifers	Hickey	1994	UWS	
Comparative evaluation of biostimulation approaches for enhancing in situ TCE degradation in contaminated aquifers	Hickey	1994-95	UWS	94REM6B2

Title	Principal Investigator(s)	Years Funded	Funding Agency	Project # (if assigned)
Leaching Potential of Imazethapyr and Nicosulfuron in Sparta Sand	Lowery	1994	DATCP	
Cover Crops to Limit Herbicide Use on Sweet Corn	Newenhouse	1994	DATCP	
Groundwater Hydrogeology of an Agricultural Watershed	Potter	1994-95	DATCP	109
Investigation of Potential Groundwater Impacts at Yard Waste Sites	Pugh, Connelly	1994	DNR	98b
Optimization of Two Recirculating Sand Filters for Nitrogen and Organic Chemical Removal from Domestic Wastewater	Shaw	1994	DNR	95b
Factors Affecting the Determination of Radon in Groundwater	Sonzogni	1994	DNR	111
Integrated Computerized Mapping of Point Source Contaminants and Physical Environmental Characteristics to Protect and Manage Groundwater Quality	Stoll	1994	DNR	105
The Further Incidence of Native Arsenic in Eastern Wisconsin Water Supply Wells; Marinette, Oconto, Shawano and Brown Counties	Stoll	1994	DNR	110
Groundwater Survey of Alachlor and ESA its Polar Metabolite in Southern Wisconsin	Vanden Brook, Postle	1994	DATCP	112
The Use of Peat as an Absorptive Medium	Wiersma, Stieglitz	1994	DATCP	
1995				
Evaluating the Effectiveness of Landfill Liners	Benson	1995-96	UWS	
Tracer Study for Characterization of Groundwater Movement and Contaminant Transport in Fractured Dolomite	Bradbury	1995-96	UWS	
Application of a Discrete Fracture Flow Model for Wellhead Protection at Sturgeon Bay, Wisconsin	Bradbury, Muldoon	1995-96	DNR	113
Direct and Residual Effects of Land-applied Sweet Corn Processing Wastes on Nitrate Loss to Groundwater	Bundy	1995-96	DNR	120
Integration of Hydraulics and Geology into a Hydrostratigraphic Model for the Paleozoic Aquifer of Eastern Dane County, Wisconsin	Cherkauer	1995	UWS	

Title	Principal Investigator(s)	Years Funded	Funding Agency	Project # (if assigned)
A Comparison of Low Flow Pumping and Bailing for VOC Sampling	Connelly	1995	DNR	114
A Low-Input Crop Management Plan for Wisconsin Fresh-Market Vegetable Growers	Delahaut	1995	DATCP	
Use of Heavy Nitrogen to Study Nitrate Flux from Septic Systems	Harkin	1995-96	UWS/	
Agrichemical Impacts to Groundwater Under Irrigated Vegetables in the Central Sand Plain	Kraft	1995-96	DNR	116
Vertical and Horizontal Variability of Hydrogeologic Properties in Glaciated Landscapes	Mickelson	1995	DNR	119
Synergistic Effects of Endocrine Disrupters in Drinking Water	Porter	1995-96	UWS	
Development and Demonstration of an Accurate Manure Spreading System to Protect Water Quality, Improve Waste Management and Farm Profitability	Shinners	1995-96	UWS	
Geologic Constraints on Arsenic in Groundwater with Applications to Groundwater Modeling	Simo	1995	UWS	
Characterization of E. Coli and Total Coliform Organisms Isolated from Wisconsin Groundwater and Reassessment of their Public Health Significance	Sonzogni	1995	DNR	117
Evaluation of Enzyme-linked Immunosorbent Assay for Herbicide Analysis of Wisconsin Soil in Comparison to Gas Chromatography	Sonzogni	1995	UWS	
An Evaluation of Long-term Trends and a Mineralogical Interpretation of Naturally Occurring Metals Contamination and Acidification of the	Weissbach	1995-96	DNR	115
Collection of Hydraulic and Geologic Data to Improve the Quality of the Wisconsin Groundwater Monitoring Network	Zaporozec	1995-96	DNR	118
1996				
Bioremediation of Hydrocarbons Influenced by Air Sparging: A Multi-model Approach to Assess Contaminant Mass Removal	Bahr	1996	UWS	

Title	Principal Investigator(s)	Years Funded	Funding Agency	Project # (if assigned)
Delineation of Capture Zones for Municipal Wells in Dane County, Wisconsin	Bradbury	1996	DNR	121
Responses of Biological Toxicity Tests to Mixtures of Pesticides and Metabolites	Chesters	1996-97	UWS	
Evaluation of Well Seals Using an Ultrasonic Probe	Edil	1996	UWS	
Iron-based Abiotic Destruction of Chlorinated Solvents and Pesticides in Groundwater	Eykholt	1996	DATCP	
Biostimulation of Trichloroethylene Degradation in Contaminated Aquifers	Hickey	1996	UWS	
Optimum Management of Ground-water Resources in the Lower Fox River Valley	Krohelski	1996-97	DNR	122
Variability of Nitrate Loading and Determination of Monitoring Frequency for a Shallow Sandy Aquifer, Arena, Wisconsin	Madison	1996-97	DNR	123
Characterization of the Role of Evapotranspiration on Groundwater Movement and Solute Chemistry in Groundwater-fed Wetlands	Potter	1996-97	UWS	
Ground-water Recharge and Contamination in Wisconsin’s Driftless Area	Potter	1996	DATCP	
Land Use Effects on Groundwater and Streamwater Quality in the Little Plover River Watershed	Shaw	1996-97	DATCP	
Stratigraphic Controls on the Mobilization and Transport of Naturally Occurring Arsenic in Groundwater: Implication for Wellhead Protection in	Simo	1996	UWS	
Evaluation of Shallow-soil Absorption Fields Associated with Advanced On-site Disposal System	Stieglitz	1996-97	DNR/U	125
Evaluation of Shallow-Soil Absorption Fields Associated with Advanced On-site Disposal System	Stieglitz	1996-97	COMM	
GIS as a Tool to Prioritize Environmental Releases, Integrate their Management, and Alleviate their Public Threat	Stoll	1996-97	DNR	126

Title	Principal Investigator(s)	Years Funded	Funding Agency	Project # (if assigned)
The Use of Azimuthal Resistivity & Self Potential Measurements to Delineate Groundwater Flow Direction in Fractured Media	Taylor	1996	UWS	
An Integrated Approach to the Management of Insects in Sweet Corn Grown for Fresh Market	Wedberg	1996-97	DATCP	
1997				
Improved Estimation of Groundwater Recharge Rates	Anderson (Mary)	1997	UWS	
Hydrogeochemical and Microbiological Studies for Enhanced Ground Water Bioremediation	Bahr	1997-98	UWS	
In situ Air Sparging: Air Plume Characterization and Removal Effectiveness	Benson	1997-98	UWS	
Groundwater Protection by Application of Modern Portfolio Theory to Microbiotesting Strategies	Blondin	1997	UWS	
Holding Tank Effluent and Fecal-Contaminated Groundwater: Sources of Infectious Diarrhea in Central Wisconsin?	Borchardt	1997-98	COMM	
Development of a Variable Rate Nitrogen Application Approach for Corn	Bundy	1997-98	UWS	
Groundwater Bioremediation: Monitoring with MMO Probes	Collins	1997-98	UWS	
Experimental Verification of Models Used to Evaluate Landfill Liner Effectiveness	Edil	1997	UWS	
Stratigraphy, sedimentology, and Porosity Distribution of the Silurian Aquifer of Ozaukee County, Wisconsin	Harris	1997	UWS	
Molecular Techniques for Detection and Identification of Sewage-Borne Human Pathogens in Soils	Hickey	1997-98	COMM	
Nitrate-Contaminated Drinking Water Followback Study	Kanarek	1997	DNR	131
Fate of Nicosulfuron in Sparta Sand	Lowery	1997	DATCP	
Treatment of Groundwater Contaminated with Chlorinated Aliphatics Using a Silicone Tubing Supported	Park	1997-98	UWS	

Title	Principal Investigator(s)	Years Funded	Funding Agency	Project # (if assigned)
Methanotrophic Biofilm Reactor				
Evaluation of the Use of DUMPSTAT to Detect the Impact of Landfills on Groundwater Quality	Potter	1997	DNR	130
Stratigraphic Controls on Distribution of Hydraulic Conductivity in Carbonate Aquifers	Simo	1997-98	DNR	129
Improved Detection Limits for Ground Water Monitoring	Sonzogni	1997	DNR/U	128
Determining Compatibility Between Herbicide Release and Habitat for Karner Blue Butterfly in Red Pine Plantations	Sucoff	1997	DATCP	
A Study of Well Construction Guidance for Arsenic Contamination in Northeast Wisconsin	Weissbach	1997-98	DNR	127
1998				
Assessment of Impacts on Groundwater/Lake and Wetland Systems	Anderson (Mary)	1998	UWS	
Groundwater-Surface Water Interactions in the Nine Springs Watershed	Bahr	1998-99	DNR	137
Evaluation of the Confining Properties of the Maquoketa Formation in the SEWRPC Region of Southeastern Wisconsin	Bradbury	1998	DNR	138
Watershed-Scale Nitrate Contamination and Chloroflurocarbon Ages in the Little Plover Basin: A Study at the Groundwater/Surface Water Interface	Browne	1998-99	UWS	
Determining Ground-Water Recharge Rates in Southern Washington County	Cherkauer	1998-99	UWS	
Characterization of the Hydrostratigraphy of the Deep Sandstone Aquifer in Southeastern Wisconsin	Eaton	1998-99	DNR	134
Further Evaluation of Well Seals Using an Ultrasonic Probe	Edil	1998	DNR	136
Evaluation of Exploration Borehole Seals Using Time Domain Reflectometry (TDR)	Edil	1998-99	UWS	
Fate of Metalochlor, Alachlor, and Nitrate in Granular Iron/Soil/Water Systems,	Eykholt, Davenport, Wonsettler	1998	DATCP	
Investigation of Air Sparging: Numerical Modeling, Laboratory	Hoopes	1998-99	UWS	

Title	Principal Investigator(s)	Years Funded	Funding Agency	Project # (if assigned)
Verification and Design Guidelines				
The Direct Effect of Agricultural Chemicals on Wisconsin^s Declining and Endangered Amphibians	Karasov	1998-99	UWS/	
Relationships Between Water Quality in Stream Base Flow and Private Wells and Land use in the Tomorrow/Waupaca River Watershed	Shaw	1998-99	DNR	132
Impact of Ginseng Production on Groundwater Quality,	Shaw, De Vita	1998	DATCP	
Northeast Region Public Water Supply Location Utilizing Geographic Information Systems and Global Positioning Systems	Stoll	1998	DNR	133
Effects of Fosamine, Picloram, and Triclopyr on Reducing Aspen in Prairie Bush Clover Habitat,	West	1998	DATCP	
Evaluation of Geology and Hydraulic Performance of Wisconsin Ground-Water Monitoring Wells	Zaporozec	1998	DNR	135
1999				
On-line SFE/GC for Improved Detection of Trace Organic Pollutants in Ground Water Monitoring	Armstrong	1999	UWS/	
A Rational Design Approach for Permeable Reactive Walls	Benson	1999-2000	UWS	
Viral Contamination of Household Wells Near Disposal Sites for Human Excreta	Borchardt, Sonzogni	1999-2000	DNR	144
Groundwater Flow and Heat Transport in Wetlands: Transient Simulations and Frequency-Domain Analysis	Bravo	1999-2000	UWS	
Monitoring: Evaluation of the Abundance, Diversity, and Activity of Methanotroph Populations in Groundwater	Collins	1999-2000	UWS	
Mechanical Controls on Fracture Development in Carbonate Aquifers: Implications for Groundwater Flow Systems	Cooke	1999-2000	DNR	142
Acute and Chronic Toxicity of Nitrate to Brook Trout (Salvelinus fontinalis)	Crunkilton	1999-2000	DNR	140
Maquoketa Shale as Radium Source to the Cambro-Ordovician Aquifer System	Grundl	1999-2000	DNR	141

Title	Principal Investigator(s)	Years Funded	Funding Agency	Project # (if assigned)
Sedimentology, Stratigraphy, and Porosity-Conductivity Relations of the Silurian Aquifer of Ozaukee County, Wisconsin	Harris	1999-2000	UWS	
Analysis of Microbiological and Geochemical Processes Controlling Biodegradation of Aromatic Hydrocarbons in Anaerobic Aquifers	Hickey	1999-2000	DNR	143
Assessing and Reducing Leaching of Agricultural Chemicals on Silt Loam Soils under Different Farming Systems	Kung	1999-2000	DATCP	
Using Geographic Information Systems and Soil Landscape Models to Predict Critical Sites for Nonpoint Source Pollution	Lowery	1999-2000	DATCP	
Water and Land Use: Interpretation of Existing Data to Foster Constructive Public Dialogue and Policy Formulation	Read	1999	UWS	
Natural Attenuation of Fuel and Related Groundwater Contaminants - A Measurement Method	Sonzogni	1999	UWS	
Fate of the Herbicides Atrazine, Cyanazine, and Alachlor and Selected Metabolites	Stoltenberg	1999	DATCP	
Hydraulic Conductivity and Specific Storage of Maquoketa Shale	Wang	1999	UWS	
2000				
A groundwater model for the Central Sands of Wisconsin: Assessing the environmental and economic impacts of Irrigated agriculture	Anderson (Martha), Bland, Kraft	2000	DATCP	146
Remediating groundwater using reactive walls containing waste foundry sands	Benson, Eykholt	2000	DNR/U	147
Field verification of capture zones for municipal wells at Sturgeon Bay, Wisconsin	Bradbury, Rayne, Muldoon	2000	DNR	148
Refinement of two methods for estimation of groundwater recharge rates	Bradbury, Anderson, Potter	2000	DNR	150
Causes of historical changes in ground-water recharge rates in southeastern Wisconsin	Cherkauer	2000	UWS	
Evaluating options for changing groundwater and leachate monitoring	Connelly, Stephens, Shaw	2000	DNR	151

Title	Principal Investigator(s)	Years Funded	Funding Agency	Project # (if assigned)
requirements for landfills to reduce mercury used by laboratories				
Compatibility of containment systems with mine waste liquids	Edil, Benson	2000	UWS	
Time domain electromagnetic induction survey of eastern Waukesha County and selected locations	Jansen, Taylor	2000	UWS	
Admicelle-catalyzed reductive dechlorination of PCE by zero valent iron	Li	2000	UWS	
Development of neural network models for predicting nitrate concentration in well water	Lin, Shaw	2000	UWS	
Field monitoring of drainage and nitrate leaching from managed and unmanaged ecosystems	Norman, Brye	2000	UWS	
Macropore flow: A means for enhancing groundwater recharge or a potential source of groundwater contamination	Potter, Bosscher	2000	UWS	
Hydraulic Conductivity and Specific Storage of Maquoketa Shale	Wang	2000	UWS	
Improvement of Wisconsin groundwater monitoring network	Zaporozec	2000	DNR	149

WISCONSIN FERTILIZER RESEARCH COUNCIL RESEARCH

The Wisconsin Fertilizer Research Program was a pioneering idea to obtain research support from the private sector which would improve agricultural profitability and, at the same time, protect our natural resources. As state and federal research monies continues to decline, funds from fertilizer sales will become even more important in terms of helping farmers make wise decisions regarding fertilizer use in Wisconsin.

Each year, the State of Wisconsin collects fees from the sale or distribution of fertilizer, persuant to Chapter 273, State Laws of 1977. This includes a $0.10 per ton fee that is earmarked for research. At the end of each year, these moneys are forwarded to the University of Wisconsin system to be used for research on soil management, soil fertility, plant nutrition problems and for research on surface water and groundwater problems which may be related to fertilizer usage; for dissemination of the results of the research; and for other designated activities tending to promote the correct usage of fertilizer materials. Research is conducted by investigators within the University of Wisconsin system. These investigators submit proposals for research to the Fertilizer Research Council for funding consideration. If the University of Wisconsin system is unable to carry on the projected research, the Council may recommend other appropriate nonprofit research institutions or agencies for receipt of funds. Projects funded in FY 00 and projects selected in FY 01 for funding in FY 01 are listed in the following tables.

RESEARCH PROJECTS FUNDED BY THE FERTILIZER RESEARCH COUNCIL FOR FY 00

Project Number	Project title	Lead Project Investigator	Affiliation	FY 00 Funding
172-99	Effect of Tillage and timing on legume N mineralization and N credit to small grains	Dr. Keith Kelling	UW- Madison Soil Science Dept	$9,790
173-99	Characterization of nitrogen uptake efficiency of new commercial apple rootstocks and scions	Dr. Teryl Roper	UW- Madison Dept of Horticulture	$4,000
175-99	Nitrogen application effects on residue decomposition and no-till corn yields	Dr. LG Bundy	UW- Madison Soil Science Dept	$9,400
177-99	Phosphorus losses in runoff from Wisconsin soils	Dr. LG Bundy	UW- Madison Soil Science Dept	$8,000
178-99	Using airborn remote sensing to evaluate nutrient stress and crop performance in large crop production fields	Dr. Ronald Schuler	UW-Madison Biological Systems Engineering Dept	$7,800
180-99	Evaluation of soil test levels in grid sampled fields treated with variable-rate fertilizer applications	Dr. Richard Wolkowski	UW- Madison Soil Science Dept	$6,325
183-99	Evaluating a standard field method for	Dr. J M Norman	UW- Madison Soil Science Dept	$8,875

	measuring nitrogen mineralization			
184-99	Interaction of soil pH and rate of topdressed K on alfalfa forage mineral levels, yield and quality	Dr. Keith Kelling	UW- Madison Soil Science Dept	$10,416
185-99	Investigations into improved nitrogen use efficiency of potatoes	Dr. Keith Kelling	UW- Madison Soil Science Dept	$8,000

RESEARCH PROJECTS FUNDED BY THE FERTILIZER RESEARCH COUNCIL FOR FY 01

Project Number	**Project title**	**Lead Project Investigator**	**Affiliation**	**FY 00-01**
186-00	*Evaluating Benefits from Over-Winter Cover Crops*	Larry Bundy	UW- Wisconsin Madison Soil Science Department	$11,620
187-00	*Plant Availability of Phosphorus from Manure Differing in Phosphorus Concentration Compared With Other Phosphorus Sources*	Larry Bundy	UW- Wisconsin Madison Soil Science Department	$6,340
188-00	*Use of surfactant modified zeolite as fertilizer additive to control nitrate, sulfate, and phosphate release*	Zhaoui Li	UW-Parkside	$8,122
189-00	*Effect of stand age on alfalfa response to N and/or S and confirmation of alfalfa S needs in Wisconsin*	Keith Kelling	UW- Wisconsin Madison Soil Science Department	$7,522
190-00	*Evaluation of dairy manure use in potato production systems*	Keith Kelling	UW- Wisconsin Madison Soil Science Department	$9,600
172-99	Effect of Tillage and timing on legume N mineralization and N credit to small grains	Dr. Keith Kelling	UW- Madison Soil Science Dept	$9,800
175-99	Nitrogen application effects on residue decomposition and no-till corn yields	Dr. LG Bundy	UW- Madison Soil Science Dept	$9,700
177-99	Phosphorus losses in runoff from Wisconsin soils	Dr. LG Bundy	UW- Madison Soil Science Dept	$8,320
184-99	Interaction of soil pH and rate of topdressed K on alfalfa forage mineral levels, yield and quality	Dr. Keith Kelling	UW- Madison Soil Science Dept	$10,500
185-99	Investigations into improved nitrogen use efficiency of potatoes	Dr. Keith Kelling	UW- Madison Soil Science Dept	$8,500
165-97	Improving Alfalfa yields in northwest Wisconsin with sulfur fertilization	Keith Kelling,	UW- Madison, Soil Science	$2,000
114-90	Evaluation of certain non-conventional soil additives for improving crop yields in WI	Keith Kelling,	UW-Madison, Soil Science	$4,000

166-98	The Lancaster Experiment: Crop Rotations for the Unglaciated Soils of the Upper Mississippi Valley	Roger Higgs,	UW-Platteville, Agriculture	$7,900
167-98	Dynamic Simulation of Soil Nitrate for N Fertilizer Management	Bill Bland,	UW-Madison, Soil Science	$11,000
171-98	Effect of Subsoiling on Soil Physical Properties and Crop Growth in Several Wisconsin Soils	Dick Wolkowski,	UW-Madison, Soil Science	$5,190
TOTAL				$156,091.15

GROUNDWATER ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY WATER RESOURCES DIVISION - WISCONSIN DISTRICT

The mission of the U.S. Geological Survey-Water Resources Division is to provide the hydrologic information and understanding needed for the optimum utilization and management of the Nation's water resources for the overall benefit of the people of the United States. This mission is accomplished, in large part, through cooperation with other Federal, State and local agencies, by:

* Collecting, on a systematic basis, data needed for the continuing determination and evaluation of the quantity, quality, and use of the Nation's water resources.

* Conducting analytical and interpretive water-resource appraisals describing the occurrence, availability, and physical, chemical, and biological characteristics of surface water and ground water.

* Conducting supportive basic and problem-oriented research in hydraulics, hydrology, and related fields of science to improve the scientific basis for investigations and measurement techniques and to understand hydrologic systems sufficiently well to quantitatively predict their response to stress.

* Disseminating the water data and the results of these investigations and research through reports, maps, computerized information services, and other forms of public releases.

* Coordinating the activities of Federal agencies in the acquisition of water data for streams, lakes, reservoirs, estuaries, and ground water.

* Providing scientific and technical assistance in hydrologic fields to other Federal, State, and local agencies, to licensees of the Federal Energy Regulatory Commission, and to international agencies on behalf of the U.S. Department of State.

The Wisconsin District is currently conducting cooperative projects that have a significant groundwater component with the DNR, WGNHS, Southeast Wisconsin Regional Planning Commission (SEWRPC), LaCrosse, Dane and Sauk Counties and the Menominee Tribe of Wisconsin, and the Bad River Band of Lake Superior Chippewa. In addition, several projects are funded by Federal agencies: EPA-Region V and USGS. On going projects that have a significant ground-water component are listed below.

On going projects with State and local agencies

1. Ground-water observation well network (WGNHS)
2. Wisconsin water-use data file (DNR)
3. Southeast Wisconsin Hydrologic Study (SEWRPC, DNR, WGNHS)
4. Hydrologic studies to mitigate future North Fork Urbanization impacts on the Pheasant Branch Watershed in the Lake Mendota Priority Watershed (DNR).
5. LaCrosse, Dane and Sauk County Groundwater Studies
6. Characterization of part of the aquifer flow system in the vicinity of the Bad River Indian Reservation (Bad River Band)
7. Hydrologic review of proposed zinc-copper mine near Crandon (DNR)
8. Delineation of zones of contribution for several Menominee towns (Menominee Tribe)

On going projects with Federal agencies

1. Superfund remedial response support (EPA)

2. Hydrologic and biogeochemical budgets in temperate lakes and their watersheds, Northern Wisconsin (USGS)
3. Western Lake Michigan Drainages National Water-Quality Assessment (USGS)
4. Groundwater/surface water Interaction – Mississippi River, Pool 8 (USGS-Biological Resources Division)

A summary of the Wisconsin District projects and listing of publications is published annually in "Water-Resources Investigations in Wisconsin." Copies of the summary are available at the Wisconsin District Office or by calling 608/821-3801. For more information please contact Jim Krohelski, USGS, 8505 Research Way, Middleton, Wisconsin, 53562-3581 (608/821-3850), jtkrohel@usgs.gov or visit the Wisconsin District web page (wi.water.usgs.gov).

Groundwater Activities of the Natural Resources Conservation Service

The Natural Resources Conservation Service (NRCS) is a federal agency within the U.S. Department of Agriculture. The NRCS, formerly the Soil Conservation Service, works with private landowners to promote conservation of natural resources. The agency protects groundwater by providing technical assistance to landowners through the following ongoing conservation practices and programs:

- nutrient management: management of the amount, form, placement and timing of nutrients applied to the soil so that the amount applied is only what is needed to produce optimum crop yield. This reduces the potential for applied nutrients to pollute surface and groundwater.
- animal waste storage: proper waste storage siting and design is imperative to protect groundwater from contamination by nutrients in animal waste.
- Farm*A*Syst Program: a site assessment program to determine areas of possible groundwater contamination on a farm or rural home - enables individuals to apply management practices to their own property. http://www.wisc.edu/farmasyst
- Wetland Reserve Program - restores wetlands through permanent or 30-year easements or 10-year contracts.
- Environmental Quality Incentives Program - provides cost sharing for conservation practices on agricultural land. 1999 statewide priorities include groundwater protection practices such as well decommissioning and nutrient and pesticide management and prescribed grazing.
- well decommissioning: proper decommissioning is essential to prevent contaminants from entering groundwater through abandoned wells, which are direct conduits to the groundwater.
- Conservation Reserve Program: participants establish permanent vegetative cover on agricultural lands in return for guaranteed rental payments.

The agency also provides leadership in the following:

- Interagency committee to find improved joint sealers for concrete animal waste storage structures. These sealers are critical to the groundwater protection provided by these structures.
- Interagency Committee to revise NRCS Conservation Practice Standards. Practice Standards benefit the public by helping to protect groundwater. For example NRCS Practice Standard Code 313 - Waste Storage Facility was recently completed. This revision enhances groundwater protection by increasing the distance between the base of a waste storage structure and the water table, and minimizing the number of joints allowed in concrete structures.

To find out more information about NRCS, go to the home page at http://www.wi.nrcs.usda.gov or contact Renae Anderson at 608-276-8732 ext. 227.

STATUTORY LANGUAGE RELATING TO THE GCC

SECTION 2. 15.347 (13) of the statutes is created to read:

15.347 (13) Groundwater Coordinating Council. (a) *Creation*. There is created a groundwater coordinating council, attached to the department of natural resources under s. 15.03. The council shall perform the functions specified under s. 160.50.

(b) *Members.* The groundwater coordinating council shall consist of the following members:
1. The secretary of natural resources.
2. The secretary of industry, labor and human relations.
3. The secretary of agriculture, trade and consumer protection.
4. The secretary of health and social services.
5. The secretary of transportation.
6. The president of the university of Wisconsin.
7. The state geologist.
8. One person to represent the governor.
9. ~~One person who is a member of a local health department under s. 149.09, appointed by the governor to represent local health departments.~~ (Vetoed in part)

c) *Designees*. Under par.(b), agency heads may appoint designees to serve on the council, if the designee is an employe or appointive officer of the agency who has sufficient authority to deploy agency resources and directly influence agency decision making.

d) *Terms*. Members appointed under par. (b) 8 ~~and 9~~ shall be appointed to 4-year terms. (Vetoed in part)

e) *Staff*. The state agencies with membership on the council and its subcommittees shall provide adequate staff to conduct the functions of the council.

f) *Meetings*. The council shall meet at least twice each year and may meet at other times on the call of 3 of its members. Section 15.09 (3) does not apply to meetings of the council.

g) *Annual report*. In August of each year the council shall submit to the head of each agency with membership on the council, the members of appropriate standing committees of the legislature and the governor, a report which summarizes the operations and activities of the council during the fiscal year concluded on the preceding June 30, describes the state of the groundwater resource and its management and sets forth the recommendations of the council. The annual report shall include a description of the current groundwater quality in the state, an assessment of groundwater management programs, information on the implementation of ch. 160 and a list and description of current and anticipated groundwater problems. In each annual report, the council shall include the dissents of any council member to the activities and recommendations of the council.

Non-statutory provisions: Natural Resources

(9) GROUNDWATER COORDINATING COUNCIL: INITIAL APPOINTMENTS. (a) Notwithstanding section 15.347 (13)(d) of the statutes, as created by this act, the initial member appointed to the groundwater coordinating council under section 15.347 (13) (b) 8 of the statutes, as created by this act, shall be appointed for a term ending on July 1, 1987~~ and the initial member appointed to the groundwater coordinating council under section 15.347 (13) (b) 9 of the statutes as created by this act, shall be appointed for a term ending on July 1, 1985.~~ (Vetoed in part)

(b) Following initial appointments under paragraph (a), members appointed to the groundwater coordinating council under section 15.347 (13) (b) 3 and 4 of the statutes, as created by this act, shall serve for the terms prescribed under section 15.347 (13) (d) of the statutes as created by this act.

160.50 Groundwater coordinating council. (1) GENERAL FUNCTIONS. The groundwater coordinating council shall serve as a means of increasing the efficiency and facilitating the effective functioning of state agencies in activities related to groundwater management. The groundwater coordinating council shall advise

and assist state agencies in the coordination of nonregulatory programs and the exchange of information related to groundwater, including, but not limited to, agency budgets for groundwater programs, groundwater monitoring, data management, public information and education, laboratory analysis and facilities, research activities and the appropriation and allocation of state funds for research.

(2) SUBCOMMITTEES. The groundwater coordinating council may create subcommittees to assist in its work. The subcommittee members may include members of the council, employes of the agencies with members on the council, employes of other state agencies, representatives of counties and municipalities and public members. The council shall consider the need for subcommittees on the subjects within the scope of its general duties under sub. (1) and other subjects deemed appropriate by the council.

(3) REPORT. The groundwater coordinating council shall review the provisions of 1983 Wisconsin Act…(this act) and report to the legislature concerning the implementation of the act by January 1, 1989.