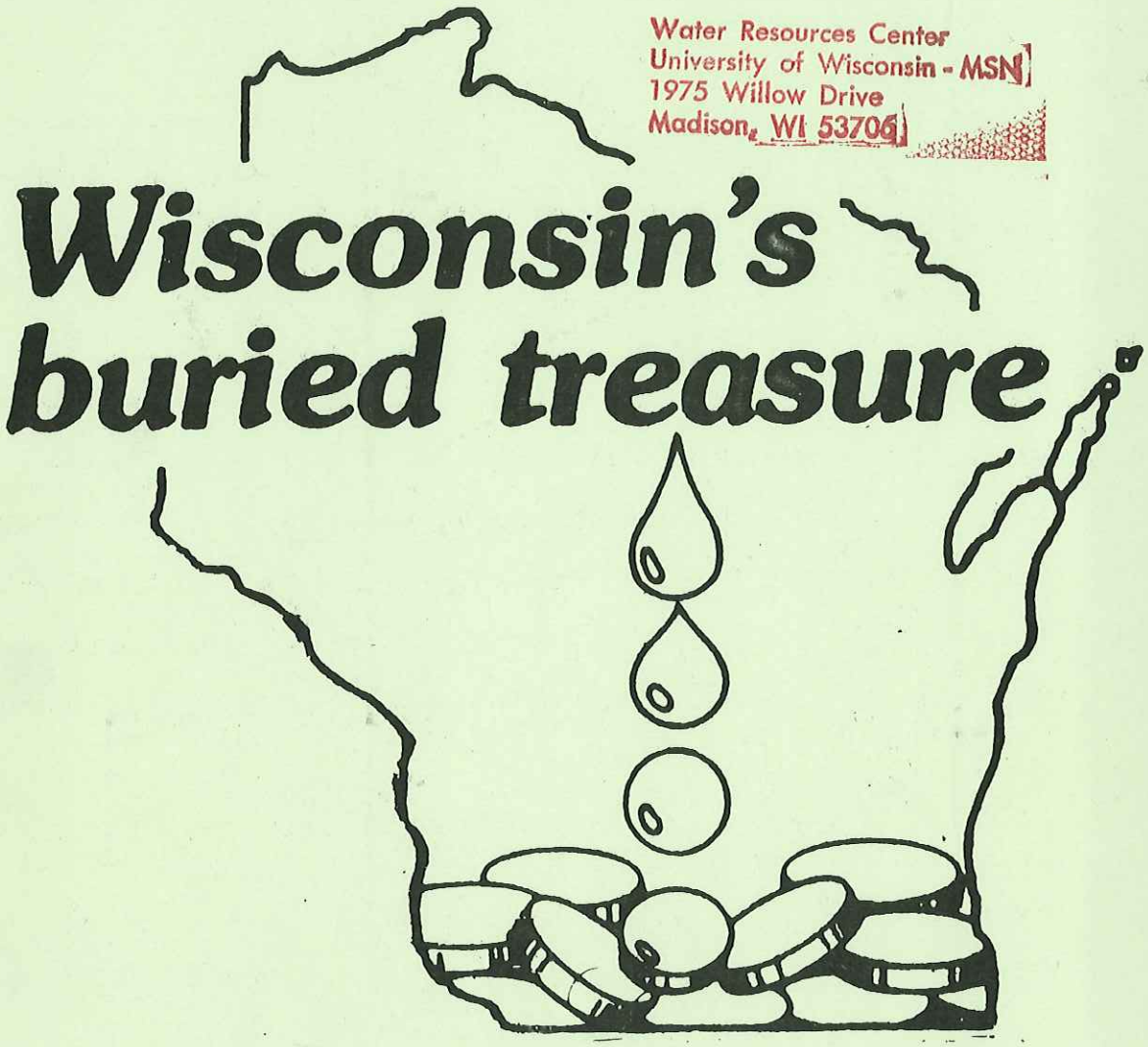
WISCONSIN GROUNDWATER COORDINATING COUNCIL



Wisconsin's buried treasure

REPORT TO THE LEGISLATURE

AUGUST 1989

GROUNDWATER COORDINATING COUNCIL MEMBERS

Department of Natural Resources - Lyman Wible (Chair)
Department of Agriculture, Trade and Consumer Protection - Orlo R. Ehart
Geological and Natural History Survey (State Geologist) - Meredith Ostrom
Governor's Representative - John Metcalf
Department of Health and Social Services - William Schmidt
Department of Industry, Labor and Human Relations - William Norem
Department of Transportation - Theodore Stephenson
University of Wisconsin - Dallas Peterson/Ruth Robertson

Subcommittee Members

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Department of Agriculture, Trade and Consumer Protection - Jeff Postle
Department of Health and Social Services - David Belluck/Henry Anderson
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Department of Public Instruction - Dave Engleson
Vocational Education - Bill Rockwell

Approved by the Groundwater Coordinating Council

Lyman F. Wible

BY: Lyman F. Wible, Chair

9/15/89

Date

State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES

Carroll D. Besadny
Secretary

BOX 7921
MADISON, WISCONSIN 53707

August 31, 1989

File Ref: 3230

The Honorable Governor Tommy G. Thompson
Assembly Natural Resource Committee
Assembly Environmental Resources and Utilities Committee
Senate Urban Affairs, Energy, Environmental Resources and Elections Committee
Senate Transportation, Tourism and Conservation Committee
Secretary Ronald R. Fiedler - Department of Transportation
Secretary Gerald Whitburn - Department of Industry, Labor and Human Relations
Secretary Howard C. Richards - Department of Agriculture, Trade and Consumer Protection
Secretary Patricia Goodrich - Department of Health and Social Services
Secretary Carroll D. Besadny - Department of Natural Resources
President Kenneth A. Shaw - University of Wisconsin
State Geologist Meredith Ostrom - Wisconsin Geological and Natural History Survey

Enclosed is the 1989 Groundwater Coordinating Council Report to the Legislature as required by state law (s. 15.347(13), Wis. Stats.). The Council was formed to help state agencies coordinate non-regulatory activities and the exchange of information related to groundwater. This Report is intended to alert Wisconsin's leaders to the state of our groundwater resource and its management and protection. We hope that you, as heads of state agencies and leaders of this state, will direct your staffs to review this report and use it as a decision-making tool. Our groundwater is an invaluable resource and its proper management requires the coordinated efforts of our leaders.

Included with this report is a copy of the recently completed publication "Groundwater: Protecting Wisconsin's Buried Treasure." This publication was prepared by the Department of Natural Resources with assistance from several state agencies and provides an excellent summary of groundwater conditions in Wisconsin and programs to protect Wisconsin's groundwater.

Additional copies of this report are available from the Department of Natural Resources, Bureau of Water Resources Management, Second Floor, State Natural Resources Building (State Mail) or P. O. Box 7921, Madison, Wisconsin 53707 (U. S. Mail). We hope you, your staff, and the public will find the Report useful in protecting groundwater: Wisconsin's Buried Treasure.

Sincerely,

Lyman F. Wible

Lyman F. Wible, Chair
Groundwater Coordinating Council

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EXECUTIVE SUMMARY

This is the Report to the Legislature by the Groundwater Coordinating Council as required by s. 15.347, Wis. Stats. The report describes the condition of the groundwater resource and its management and summarizes the Council's activities from August, 1988 through August, 1989.

In 1984, the Legislature enacted Wisconsin Act 410 with the intention of improving the management of the state's groundwater. The Council is directed by ch 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 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."

Membership of the Groundwater Coordinating Council includes the Secretaries of the Departments of Natural Resources; Industry, Labor and Human Relations; Agriculture, Trade and Consumer Protection; Health and Social Services; Transportation; the President of the University of Wisconsin System; the State Geologist; and a representative of the Governor. Members are listed on the inside of the front cover.

Since its last report, the Groundwater Coordinating Council has taken the following major actions:

1. The Council continued to work with the University of Wisconsin (UW) System to evaluate budgetary needs and to establish priorities for groundwater research. The UW appointed a Groundwater Research Advisory Council (GRAC) which prepared a groundwater research decision item narrative (DIN) for the UW biennial budget. The DIN was endorsed by the Coordinating Council. An appropriation for groundwater research by the UW was included in the Governor's budget and was passed by the Legislature. A Memorandum of Understanding has been developed to specify the procedures for establishing priorities and selecting projects for funding of UW groundwater research. Coordination of UW, DATCP and DNR monitoring and research projects is being developed.

2. The Council endorsed a resolution supporting the use of the Wisconsin Groundwater Information Network standard format for well data and well sample results and recommending the attachment of a label with a Wisconsin Unique Well Number to wells which are sampled by state agencies.

3. The Council endorsed a resolution recommending that newly constructed water supply wells be analyzed for nitrate nitrogen in addition to coliform bacteria.

4. The Council endorsed a conference on groundwater policy to be held in Wisconsin in late 1990. The objectives will be to document what Wisconsin has done since passage of the groundwater law in 1984 and to discuss the need for additional groundwater management. Council agencies will assist in planning for this conference.

OVERVIEW

WHAT IS WISCONSIN'S GROUNDWATER PROGRAM AND HOW DOES IT WORK ?

Wisconsin is heavily dependent on groundwater. Two thirds of our population obtains it's daily drinking water supply from wells. Wisconsin's groundwater is of good natural quality and all our aquifers are used as drinking water sources. We have also historically protected our groundwater through a variety of laws and state and local programs.

1983 Wisconsin Act 410, Wisconsin's comprehensive Groundwater Protection Act was signed into law on May 4, 1984.. This law greatly 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. There are a number of major components to our groundwater protection program:

1) Standards. Under Chapter 160, Stats., the Department of Natural Resources is to establish the state groundwater quality standards based on advice from the Department of Health and Social Services. Standard setting is a continuing process based upon a priority list established by the state agencies. The state groundwater standards are contained in Chapter NR 140, Wisconsin Administrative Code. Once standards are established, all state agencies must manage their regulatory programs to comply. See "Groundwater Standards" discussion in this report.

2) Regulatory Programs. Each state regulatory agency must have rules to assure that the groundwater standards are met and to require appropriate responses in case the standards are not met. The state regulatory agencies are the Department of Natural Resources (solid and hazardous waste, industrial and municipal wastewater, spills); the Department of Industry, Labor and Human Relations (septic systems, petroleum product storage tanks); the Department of Agriculture, Trade and Consumer Protection (pesticide use, pesticide storage, fertilizer storage); and the Department of Transportation (salt storage).

3) Monitoring and Data Management. At the time the legislation was created, there was concern that Wisconsin needed a groundwater monitoring program to determine whether the groundwater standards were being met. Therefore, the groundwater monitoring program was created

under s. 160.27, Stats. Money from the Groundwater 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 "Monitoring and Data Management" discussion in this report.

4) 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 University of Wisconsin and the state agencies have recognized that additional efforts in these research areas are badly needed. The Governor and the Legislature have recently included a new groundwater research appropriation in the 1989-1991 budget.

5) 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.

WHAT MAKES THE GROUNDWATER PROGRAM WORK? There are three main factors that contribute to the effectiveness of Wisconsin's program for management of groundwater:

Emphasis on Prevention. Wisconsin's groundwater standards and regulatory programs emphasize prevention of contamination since groundwater cleanup is much more expensive, can take decades, and may be technologically infeasible. Our "two-tiered" standards approach (which utilizes preventive action limits) assures that facilities, activities and management practices are stringently designed and that remedial action is triggered as early as possible. This approach has been used as a model by the federal government and other states.

Multi-Agency Approach. Wisconsin's groundwater program doesn't attempt to rely upon a single state agency to implement all of the components of the state program. Rather, specific responsibilities are assigned to a number of different state agencies. Coordination of the non-regulatory portions of the state program is accomplished through the Groundwater Coordinating Council.

The groundwater standards law, Chap. 160, Wis. Stats., assures that regulatory programs have the same goals and criteria.

Comprehensive Standards. The Wisconsin laws don't allow for one set of standards and performance criteria for one agency or set of activities and a different set of standards for other agencies. For example, once the standards for a particular pesticide are established, those same standards are used by the Department of Agriculture, Trade and Consumer Protection to regulate the use and storage of the compound and the Department of Natural Resources to regulate spills and waste disposal practices.

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

GROUNDWATER STANDARDS

The backbone of Wisconsin's groundwater protection program is ch. 160, Wisconsin Statutes, created by 1983 Wisconsin Act 410. That law required the adoption of state groundwater quality standards. These standards are to be based upon recommendations from the Wisconsin Department of Health and Social Services (DHSS). A one-page flowchart of the groundwater standard setting process is attached at the end of this discussion.

The standards adopted under ch. 160, Stats., provide the backbone for Wisconsin's groundwater protection program because the standards are comprehensive. That is, the groundwater standards apply to all groundwater in the state and must be utilized by all state agencies in their regulatory programs. The state programs for landfills, hazardous wastes, spills, wastewater sludge, septic tanks, salt storage, fertilizer storage, pesticides, and underground storage tanks must comply with the standards. The standards allow a uniform level of protection for the valuable groundwater resources of Wisconsin.

Each regulatory agency must identify substances already detected in the groundwater or substances that have a reasonable probability of entering the groundwater that result from activities the agencies regulate. Groundwater protection standards are established for those substances on a two-tiered basis. For each substance identified, an "enforcement standard" and a "preventive action limit" (PAL) will be set.

Standards are established for substances of health concern as well as for substances that might cause taste, color, odor, or other "public welfare" concerns. The Department of Health and Social Services recommends enforcement standards and preventive action limits for those substances that are determined to be a public health concern. The Department of Natural Resources (DNR) develops standards for those substances considered to be a public welfare concern. Federal drinking water standards called "Maximum Contaminant Levels" or other federal numbers are utilized in accordance with a specified methodology. DNR adopts, by rule, all standards for each substance.

The preventive action limit represents a lesser concentration of the substance than the enforcement standard. The PAL is either 10%, 20%, or 50% of the enforcement standard as specified by statute based on the health-related characteristics of the particular substance. Ten percent is used for cancer-causing substances, 20% for substances with other health effects and 50% for substances having aesthetic or other public welfare concerns. The preventive action limit serves two purposes. First, the PAL must be used in design codes for facilities (eg., landfill design) and management practices (eg., pesticide use regulations) so that

contamination is prevented through use of stringent designs. Regulatory agencies are required to review their existing design code regulations to assure that they conform to the PALs to the extent technically and economically feasible.

The second purpose of the PAL is to serve as a "trigger" for remedial actions. Exceeding a preventive action limit creates the possibility that some regulatory response may be necessary. Where a preventive action limit is attained or exceeded, the regulatory agency is required to evaluate the situation and take action necessary to maintain the concentration of the substance below the preventive action limit or at the lowest concentration feasible. When preventive action limits are exceeded, a regulatory agency may prohibit continuation of the activity, which is the source of the problem. However, to do so the agency would be required to meet specific statutory requirements. Preventive action limits are intended to provide regulatory agencies with time to take preventive measures to ensure that the enforcement standard is not attained or exceeded.

Enforcement standards define when a violation has occurred. When a substance is detected in the groundwater in concentrations equal to or greater than its enforcement standard, the activity, practice or facility that is the source of the substance is subject to immediate enforcement action.

Unlike a PAL, when an enforcement standard has been attained or exceeded, a regulatory agency must prohibit the continuation of the activity from which the substance came, unless it is demonstrated to the agency that an alternative response will achieve compliance with the enforcement standard.

The Department of Natural Resources (DNR) is required to adopt, by rule, standards for each substance for which the DHSS makes recommendations. The first state standards were established in Chapter NR 140, Wis. Adm. Code, in 1985. Chapter NR 140 adopted groundwater standards for 36 substances of health concern and 10 substances of welfare concern. In 1988, ch. NR 140 was amended to add standards for 14 additional health-related substances. Amendments are presently being considered to add groundwater standards for 12 additional substances and modify groundwater standards for 6 substances based on recommendations from DHSS. Additional standards will be adopted as new substances are found in groundwater.

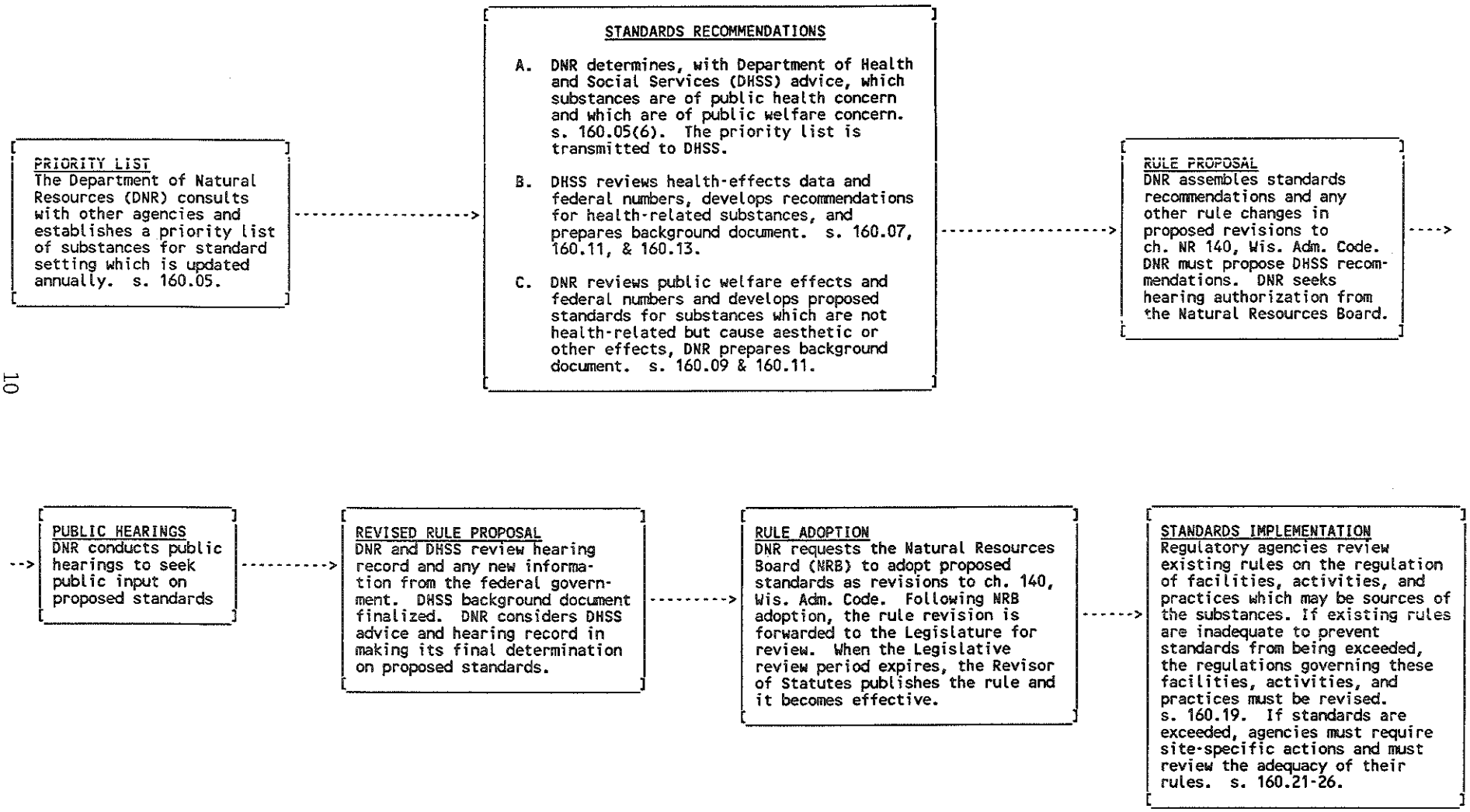
As discussed previously, all state agencies that regulate sources of groundwater contamination are required to make sure facilities, practices and activities they regulate meet the groundwater standards once standards are established in NR 140. Since the groundwater standards were first adopted in 1985, several state agencies have adopted rules to ensure compliance with the groundwater standards. The Department of Agriculture, Trade and Consumer Protection (DATCP) adopted Ag 161, 162, and 163, Wis. Adm. Code, to regulate bulk storage of fertilizers and pesticides.

The DNR adopted the 500 series of administrative codes to regulate solid waste disposal, modified hazardous waste regulations and is currently considering amendments to existing wastewater codes for land disposal facilities.

The Department of Transportation (DOT) adopted administrative code TRANS 277 to regulate the storage of highway salt. The Department of Industry, Labor and Human Relations (DILHR) is working on amendments to rules that regulate underground petroleum storage tanks and septic systems.

Wisconsin Groundwater Standards Process

Chapter 160, Wisconsin Statutes



THE WISCONSIN GROUNDWATER FUND

Background

The Groundwater Fund was created in Section 25.48 of the Statutes in 1984 as part of the Groundwater Bill, 1983 Wisconsin Act 410. The intent of the Groundwater Fund was to provide revenues to implement Chapter 160, Wisconsin Statutes, which was created under this law. In developing the legislation, there was no effort to establish a correlation between the sources of revenue and the program areas where appropriations were made. All of the revenue sources were established as surcharges on existing fees so that new programs would not have to be established to collect the fees. There was discussion at the time about including a groundwater research component in the legislation; however, the Legislature decided that there were not adequate funds available. Therefore, use of the groundwater fund was limited to implementation of the groundwater standards and monitoring provisions of Chapter 160, Statutes. The Governor and the Legislature have recently included a new groundwater research appropriation for the University of Wisconsin in the 1989-1991 budget.

Revenue Sources

The Groundwater Fund receives monies transferred to it annually from general purpose revenues. In addition, fees are collected from eight sources as follows:

1. A fertilizer fee of $0.10 per ton for fertilizers sold or distributed in Wisconsin (s. 94.64(4)(an), Stats.).

2. A soil and plant additive fee of $0.10 per ton for soil or plant additives distributed in Wisconsin (s. 94.65(6)(a)4., Stats.).

3. A pesticide fee of $100 annually per license, plus supplementary fees and surcharges for pesticide manufacturers and labelers (s. 94.68(4)(b), Stats.).

4. A petroleum product storage tank fee of $100 per petroleum storage tank approval (s. 101.14(5), Stats.).

5. A solid and hazardous waste fee of $0.10 per ton of waste generated (s. 144.441(7), Stats.).

6. A private sewage system fee of $25 per septic system permit (s. 145.19(6), Stats.).

7. A septage hauler fee of $50 per septage hauler license (s. 146.20(4s)(d), Stats.).

8. A wastewater and sludge disposal fee of $100 per permittee for each permittee who disposes of wastewater or sludge on the land (s. 147.033(1), Stats.).

The amount of revenues provided to the Groundwater Fund for Fiscal Year 1989 are tabulated below. The total amount of revenue was $2.69 million.

TABLE 1

Wisconsin Groundwater Fund
Revenue
F.Y. 1989

Revenue Source	Acct. No.	Revenue Amount	%
General Purpose Revenue Transfer	0900	$ 866,800.00	32.18
Soil & Plant Additives Fee	9097	$ 37.27	<.01
Fertilizer Sales Fee	9181	$ 138,819.62	5.15
Pesticide Sales Fee	9182	$ 502,407.40	18.65
Petroleum Bulk Tank Fee	9183	$ 35,275.00	1.31
Septic System Permit Fee	9184	$ 360,275.00	13.38
Solid Waste Generator Fee	9185	$ 593,710.88	22.05
Septage Hauler Fee	9186	$ 32,700.00	1.22
Wastewater Permit Fee	9187	$ 86,800.00	3.22
Investment Income	9800	$ 76,422.43	2.84
TOTAL		$2,693,247.60	100%

Uses of the Groundwater Fund

The Legislature makes appropriations to state agencies for use of monies from the Groundwater Fund to implement Chapter 160 of the Statutes. Monies are spent in the following areas:

1. DNR Solid Waste Management - Regulation of landfills for compliance with groundwater standards; Plan approval; Review of monitoring data; Regulatory monitoring. Major costs are for staff.

2. DNR Wastewater Management - Regulation of municipal and industrial wastewater disposal facilities which dispose of effluent on land; Review of monitoring data; Permit issuance; Regulatory monitoring. Major costs are for staff.

3. DNR Water Resources Management - Groundwater standards development; Coordination; Management practice monitoring; Data management. Major costs are for management practice monitoring contracts and data management.

4. DNR Water Supply - Groundwater monitoring, including problem assessment monitoring and at-risk well monitoring; Contamination incident investigation; Well owner complaints. Major costs are staff and laboratory contracts.

5. DNR Technical Services, Environmental Enforcement and Support Services - Soils consulting; Enforcement; Legal services; Information management and district management support. Major costs are for staff.

6. Department of Agriculture, Trade and Consumer Protection (DATCP) - Regulation of pesticide use; Pesticide bulk storage and fertilizer bulk storage to comply with groundwater standards. Major costs are staff and support.

7. Department of Health and Social Services (DHSS) - Development of health-related groundwater standards recommendations. Consultation on health-related issues. Major costs are for staff.

The following tables show a total of $2.79 M in spending during Fiscal Year 1989. The amount shown for spending exceeds the amount of revenue by approximately $0.1 million because of carry-over of previous encumbrances.

TABLE 2

Wisconsin Groundwater Fund

F.Y 1989 Spending *

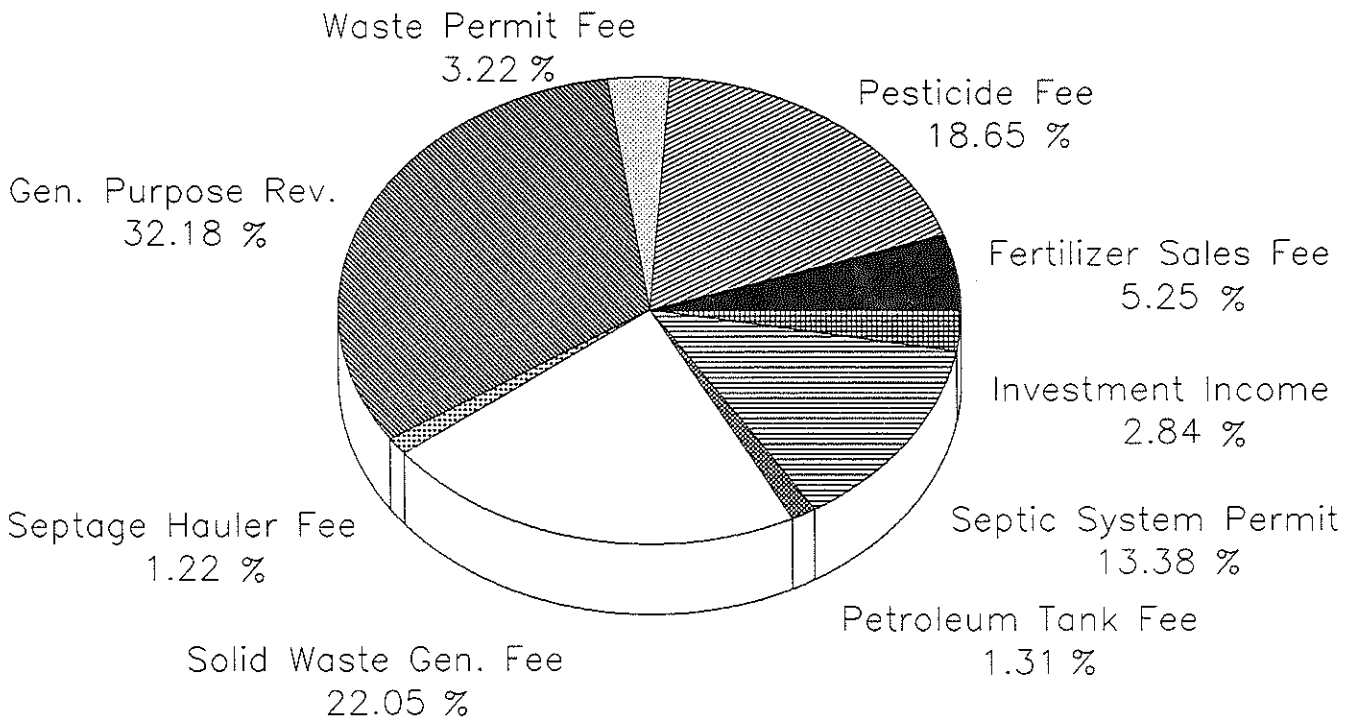
DNR Solid Waste Management	$ 371,489.63	13.28%
DNR Wastewater Management	$ 192,025.23	6.87%
DNR Water Resources Management	$ 806,013.90	28.82%
DNR Water Supply Management	$ 789,110.97	28.21%
DNR Technical Services	$ 55,859.59	2.00%
DNR Environmental Enforcement	$ 36,622.96	1.31%
DNR Support Services	$ 185,192.69	6.62%
DATCP	$ 213,394.22	7.63%
DHSS	$ 147,270.00	5.26%
TOTAL	$2,796,979.19	100%

* Includes actual expenditures through 6/30/89 plus encumbrances. F.Y. 1989 expenditures submitted after 6/30/89 are not included.

Wisconsin Groundwater Fund

Revenue for F.Y. 1989

(In Percent of Total)



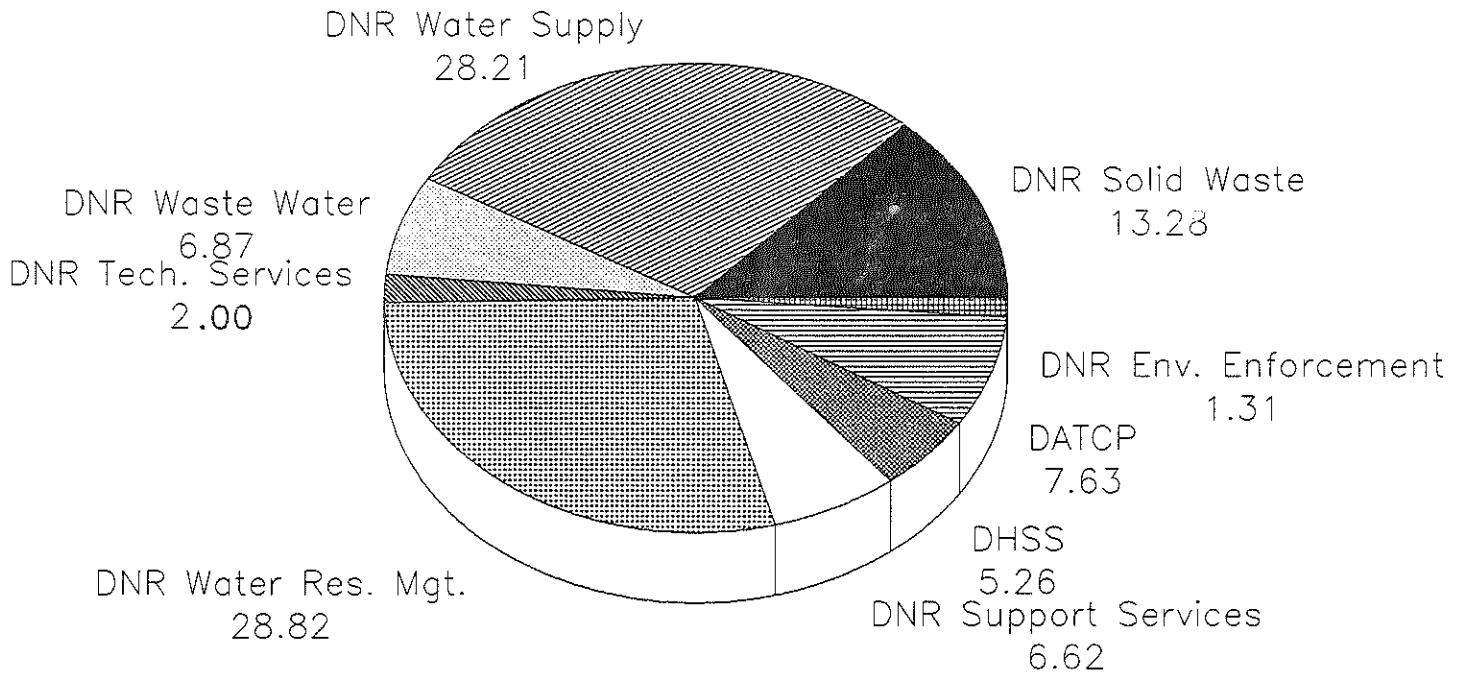
% OF $2.7M TOTAL REVENUE

Source: DNR 7/89

F.Y. 1989 SPENDING

Wisconsin Groundwater Fund

(In Percent of Total)



% OF $2.8M TOTAL SPENDING

Includes actual expenditures through 6/30/89 plus encumbrances. F.Y. 89 expenditures after 6/30/89 not included.

Source: DNR 7/89

COORDINATION ACTIVITIES

The Groundwater Law established the Wisconsin Groundwater Coordinating Council to advise and assist state agencies in coordinating nonregulatory programs and exchanging groundwater information. The Groundwater Coordinating Council consists of the heads of all state agencies with some responsibility for groundwater management plus a Governor's representative. The state agencies include the Departments of Natural Resources; Industry, Labor and Human Relations; Health and Social Services; Agriculture, Trade and Consumer Protection; Transportation; State Geologist (Geological and Natural History Survey) and the University of Wisconsin.

The Groundwater Coordinating Council met 5 times during the past year. The meeting minutes are included as appendices. Much of the focus of the Coordinating Council's activities has been related to the groundwater research decision item narrative (DIN) prepared by the UW Groundwater Research Advisory Council (GRAC) and submitted as part of the UW budget request. The UW established the GRAC in early 1988 to advise the UW in the development of a groundwater research DIN and a long-range research plan. The GRAC includes representatives from the UW system, appropriate state agencies and the private sector.

The Coordinating Council Research Subcommittee reviewed the DIN last summer and discussed its comments at the August 26 meeting of the Coordinating Council. The DIN was revised by the UW and was endorsed by the GCC at its October 14 meeting. Mr. Orlo Ehart, Department of Agriculture, Trade and Consumer Protection and Chair of the GRAC Committee appeared before the UW Board of Regents in November to support the DIN. The Regents approved the groundwater DIN which was included in the UW biennial budget request.

An appropriation for groundwater research by the UW was included in the Governor's budget and was passed by the Legislature as part of the state budget. A total of $500,000 is available for the biennium. The budget requires that there be agreement between the UW and the GCC on the use of the funds before they can be released by the Department of Administration. To comply with this requirement, a Memorandum of Understanding has been signed between the GCC, the GRAC and the UW identifying the procedures for establishing priorities and selection of projects for funding of UW groundwater research.

Work has begun to coordinate the groundwater monitoring and research programs being carried out in the state. At the present time, the DNR administers a fund for management practice monitoring, DATCP administers a fund for pesticide research and the UW administers the groundwater research money. The UW and GCC are working to establish a single mechanism for soliciting proposals and identifying the appropriate agency for possible funding.

One of the major cooperative efforts of the past year was publication of a report, "Nutrient and Pesticide Best Management Practices for Wisconsin Farms." Agencies involved in preparing the report included DATCP, UW, DNR and the Wisconsin Geological and Natural History Survey (WGNHS). The report identifies agricultural best management practices to minimize nutrient and pesticide contamination of Wisconsin's groundwater.

The GCC passed a resolution which endorses the use of the Wisconsin Groundwater Information Network standard format for well data and well sample results by agencies conducting groundwater monitoring and recommends that agencies conducting groundwater monitoring attach an identifying label with a Wisconsin Unique Well Number to wells sampled. The GCC also endorsed a resolution recommending that newly constructed water supply wells be sampled for nitrates in addition to coliform bacteria.

The GCC endorsed a groundwater policy conference to be held in Wisconsin in 1990. The conference will be designed to document what Wisconsin has done since passage of the groundwater law in 1984 and to discuss what additional management steps are needed. Council agencies will assist in the conference planning.

GROUNDWATER MONITORING AND DATA MANAGEMENT

Extent of Contamination in Wisconsin

As part of 1983 Wisconsin Act 410, the Groundwater 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 chemicals (VOCs), pesticides and nitrates. Each are discussed below.

Volatile Organic Chemicals

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

To date, the Department of Natural Resources has sampled 5,000 wells for VOCs. The 50 different VOCs found in Wisconsin groundwater to date are listed in Table 3 at the end of this discussion. Also included in Table 3 are the groundwater quality standards (both preventive action limits and enforcement standards) for 23 of the VOCs, the number of wells that have had VOCs detected in them, and the number of detections that have exceeded groundwater quality standards.

The major VOC sources, where sources could be identified or tentatively pinpointed, are leaking underground gasoline storage tanks, landfills, and hazardous waste storage and handling facilities. Volatile organic chemicals disperse quickly in groundwater and often spread over a large distance (2-3 miles) in relatively uniform concentrations. Therefore, when various VOC sources are present in an area, it is oftem difficult to identify the specific source of contamination.

Pesticides

Pesticides were first found to be a problem in Wisconsin when aldicarb was detected in groundwater near Stevens Point in 1980. Aldicarb has not been sold in Wisconsin for the past three years. The chemical persists in the groundwater of the Central Sands though the number of wells impacted is beginning to decline.

The pesticide sampling program was expanded in 1983 to sample for various pesticides (in addition to aldicarb) used in Wisconsin. The pesticides tested for and detected in groundwater since 1983 are identified in Table 4. Table 4 also identifies the groundwater quality standards for the 22 pesticides for which

standards have been adopted.

The Department of Agriculture, Trade and Consumer Protection conducted random sampling of Grade A farm wells from August, 1988 to February, 1989 to help determine the extent of pesticide contamination in Wisconsin groundwater. Water samples were collected from 534 farm wells and analyzed for 44 pesticides. The proportion of wells on Grade A farms that contain detectable levels of pesticides is estimated with 95 percent confidence to be between 10 and 16 percent. Between 5 and 9 percent of the wells contain atrazine above the preventive action limit of 0.35 ug/l (LeMasters, 1989).

A major problem identified through the pesticide sampling program is the handling and storage of pesticides. To date, about 30 sites in Wisconsin have been identified where the improper handling of pesticides contaminated groundwater. Investigations initially focused on sites that were suspected of having contamination problems. The Department of Natural Resources has initiated a project to determine how widespread the problem is by investigating 30 randomly selected sites across the state.

Nitrates

Nitrate is the most commonly found groundwater contaminant, but it is not as toxic as VOCs or pesticides. Nitrate is not usually harmful to adults or older children. However, nitrates can cause methemoglobinemia or "blue baby syndrome" in infants under six months by reducing the blood's ability to transport oxygen.

Nitrates can enter groundwater from many sources, including nitrogen-based fertilizers, animal waste storage and feedlots, municipal and industrial wastewater, refuse disposal areas, and septic systems. County groundwater assessments conducted by the Wisconsin Geological and Natural History Survey have found that approximately 10% of the private water supply wells in the state contain nitrate nitrogen above the groundwater enforcement standard of 10 milligrams/liter (mg/l). This number was confirmed by the nitrate sampling that was done in conjunction with the DATCP Grade A farm well survey.

Because of the concern with nitrates, the Groundwater Coordinating Council endorsed a resolution recommending that newly constructed water supply wells be sampled for nitrates as wells as coliform bacteria.

Management Practice Monitoring

The Department of Natural Resources has approximately $300,000 available each year 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 are conducted.

Table 5 is a list of the 17 projects to be funded in FY 90. These projects were selected from nearly 60 proposals submitted requesting a total of over $1.2 million. Members of the Monitoring and Research Subcommittees of the Groundwater Council assisted in establishing the priority needs for monitoring studies and in evaluating the proposals submitted.

Groundwater Monitoring Data Management

Wisconsin Statutes require DNR to "coordinate the collection of groundwater monitoring data and the exchange of these data among state agencies...". In October, 1988, the DNR completed a computer system called the Groundwater Information Network (GIN) to help meet its statutory responsibility. The Groundwater Information Network provides a standard format for well and well sampling data that includes a Wisconsin Unique Well Number assigned to wells in the computer system. The DNR instituted a program whereby the Wisconsin Unique Well Number is assigned and permanently attached at the well site for newly constructed wells and wells sampled by DNR staff or individuals or agencies that are required by or contract with the DNR to construct and/or sample wells. The DNR is currently working with other state agencies on inputting data from other agencies and promote widespread use of GIN.

The Groundwater Coordinating Council passed a resolution in April, 1989 that:

1) endorsed the use of the Wisconsin Groundwater Information Network standard format for well data and well sample results by agencies conducting groundwater monitoring.

2) recommended that agencies conducting groundwater monitoring attach an identifying label with a Wisconsin Unique Well Number to wells sampled.

GIN promises to be a valuable tool for all state agencies in assessing groundwater quality in Wisconsin.

TABLE 3 - SUMMARY OF GROUNDWATER VOC MONITORING
FOR PERIOD OF RECORD .

CHEMICAL CODE	CHEMICAL NAME	TOTAL NO. OF WELLS	WELLS WITH DETECTS	ENFORCEMENT STANDARD (UG/L)	WELLS EXCEEDING ENF. STD.	PREVENTIVE ACTION LIMIT (UG/L)	WELLS EXCEEDING PAL	HIGHEST DETECTION LEVEL (UG/L)
39180	TRICHLOROETHYLENE	4955	367	1.80000	291	0.180000	354	56000
34475	TETRACHLOROETHYLENE	4938	302	1.00000	258	0.100000	294	20000
34501	1,1-DICHLOROETHYLENE	4811	138	0.24000	138	0.024000	138	1700
34235	BENZENE DISS	4384	137	0.67000	137	0.067000	137	14000
34531	1,2-DICHLOROETHANE	4313	125	0.50000	121	0.050000	125	450
39175	VINYL CHLORIDE	4699	78	0.01500	78	0.001500	78	4280
77651	ETHYLENE DIBROMIDE	572	52	0.01000	52	0.001000	52	150
81551	XYLENE, ORTHO AND PARA	4661	183	620.00000	31	124.000000	53	510000
34481	TOLUENE DISS	4397	144	343.00000	25	68.600000	40	19000
34506	1,1,1-TRICHLOROETHANE	4914	374	200.00000	20	40.000000	61	22000
34546	1,2-DICHLOROETHYLENE	4833	180	100.00000	17	20.000000	40	8800
34010	TOLUENE	520	102	343.00000	14	68.600000	24	74000
34511	1,1,2-TRICHLOROETHANE	4726	22	0.60000	10	0.060000	22	7.15
81607	TETRAHYDROFURAN	4469	14	50.00000	10	10.000000	14	11000
34423	METHYLENE CHLORIDE	758	132	150.00000	5	15.000000	22	783
34371	ETHYL BENZENE	4332	98	1360.00000	3	272.000000	15	2000
34496	1,1-DICHLOROETHANE	4804	214	850.00000	1	85.000000	7	857
32106	CHLOROFORM	4807	153	NONE	0	NONE	0	29700
34488	TRICHLOROFLUOROMETHANE	4687	98	3490.00000	0	698.000000	0	590
34311	CHLOROETHANE	4766	63	NONE	0	NONE	0	677.2
32101	BROMODICHLOROMETHANE	4727	42	NONE	0	NONE	0	1500
34571	1,4-DICHLOROBENZENE	4666	39	750.00000	0	150.000000	0	9.299999
32105	DIBROMOCHLOROMETHANE	4709	31	NONE	0	NONE	0	1400
34301	CHLOROBENZENE	4749	24	NONE	0	NONE	0	410
32102	CARBON TETRACHLORIDE	4760	22	NONE	0	NONE	0	6

TABLE 3 - SUMMARY OF GROUNDWATER VOC MONITORING
FOR PERIOD OF RECORD

CHEMICAL CODE	CHEMICAL NAME	TOTAL NO. OF WELLS	WELLS WITH DETECTS	ENFORCEMENT STANDARD (UG/L)	WELLS EXCEEDING ENF. STD.	PREVENTIVE ACTION LIMIT (UG/L)	WELLS EXCEEDING PAL	HIGHEST DETECTION LEVEL (UG/L)
34536	1,2-DICHLOROBENZENE	4676	21	1250.00000	0	125.000000	0	43
32104	BROMOFORM	4755	19	NONE	0	NONE	0	1000
34418	CHLOROMETHANE	339	16	NONE	0	NONE	0	11
34566	1,3-DICHLOROBENZENE	4682	16	1250.00000	0	125.000000	0	23
34576	2-CHLOROETHYL VINYL ETHER	4721	15	NONE	0	NONE	0	25
34413	BROMOMETHANE	4716	13	NONE	0	NONE	0	50
34668	DICHLORODIFLUOROMETHANE	210	12	NONE	0	NONE	0	11.6
34516	1,1,2,2-TETRACHLOROETHANE	4714	11	NONE	0	NONE	0	3
34699	1,3-DICHLOROPROPENE, TRANS	4732	11	NONE	0	NONE	0	2.5
34704	1,3-DICHLOROPROPENE, CIS	4720	11	NONE	0	NONE	0	2.5
77128	STYRENE	4480	8	NONE	0	NONE	0	22.5
81611	TRICHLOROTRIFLUOROETHANE	4449	6	NONE	0	NONE	0	76
71880	FORMALDEHYDE	7	5	NONE	0	NONE	0	0.3
77041	CARBON DISULFIDE	4446	5	NONE	0	NONE	0	5
81595	METHYL ETHYL KETONE	4463	5	NONE	0	NONE	0	1080
77135	XYLENE, O	68	4	NONE	0	NONE	0	4.799999
77223	ISOPROPYLBENZENE	4231	3	NONE	0	NONE	0	2.4
34210	ACROLEIN	4287	2	NONE	0	NONE	0	50
34215	ACRYLONITRILE	4278	2	NONE	0	NONE	0	20
77161	1,2-DICHLOROPROPENE, TRANS	4268	2	NONE	0	NONE	0	2
77189	BUTYL ACETATE	4236	2	NONE	0	NONE	0	0.5
77562	1,1,1,2-TETRACHLOROETHANE	4462	2	NONE	0	NONE	0	3
81555	BROMOBENZENE	4447	2	NONE	0	NONE	0	4
77222	1,2,4 - TRIMETHYLBENZENE	1	1	NONE	0	NONE	0	1.4
77224	PROPYLBENZENE N	1	1	NONE	0	NONE	0	4

TABLE 3 - SUMMARY OF GROUNDWATER VOC MONITORING
FOR PERIOD OF RECORD

CHEMICAL CODE	CHEMICAL NAME	TOTAL NO. OF WELLS	WELLS WITH DETECTS	ENFORCEMENT STANDARD (UG/L)	WELLS EXCEEDING ENF. STD.	PREVENTIVE ACTION LIMIT (UG/L)	WELLS EXCEEDING PAL	HIGHEST DETECTION LEVEL (UG/L)
77443	1,2,3-TRICHLOROPROPANE	50	1	NONE	0	NONE	0	1
85795	TEST NAME UNKNOWN	1	1	NONE	0	NONE	0	4.299999
34391	HEXACHLOROBUTADIENE	20	0	NONE	0	NONE	0	0
34551	1,2,4-TRICHLOROBENZENE	55	0	NONE	0	NONE	0	0
38760	1,2-DIBROMO-3-CHLOROPROPANDBCP	4270	0	0.05000	0	0.005000	0	0
77093	1,2-DICHLOROETHYLENE CIS	27	0	100.00000	0	10.000000	0	0
77168	1,1-DICHLOROPROPENE	27	0	NONE	0	NONE	0	0
77173	1,3-DICHLOROPROPANE	27	0	NONE	0	NONE	0	0
77275	O-CHLOROTOLUENE	4267	0	NONE	0	NONE	0	0
77277	P-CHLOROTOLUENE	4267	0	NONE	0	NONE	0	0
77596	DIBROMOMETHANE	60	0	NONE	0	NONE	0	0
81575	DICHLOROIODOMETHANE	4122	0	NONE	0	NONE	0	0

TABLE 4 - SUMMARY OF GROUNDWATER PESTICIDE MONITORING
FOR PERIOD OF RECORD

CHEMICAL CODE	CHEMICAL NAME		TOTAL NO. OF WELLS	WELLS WITH DETECTS	ENFORCEMENT STANDARD (UG/L)	WELLS EXCEEDING ENF. STD.	PREVENTIVE ACTION LIMIT (UG/L)	WELLS EXCEEDING PAL	HIGHEST DETECTION LEVEL (UG/L)
39053	ALDICARB, TOTAL	TEMIK	1545	372	10.00000	126	2.000000	287	111
01051	LEAD PB,TOT		926	287	50.00000	80	5.000000	237	210000
39033	ATRAZINE	AATREX	688	149	3.50000	62	0.350000	134	1500
46317	ALACHLOR	LASSO	742	66	0.50000	55	0.050000	66	3000
77651	ETHYLENE DIBROMIDE		572	52	0.01000	52	0.001000	52	150
01042	COPPER CU,TOT		304	130	1000.00000	47	500.000000	52	300000
01034	CHROMIUMCR,TOT		539	129	50.00000	27	5.000000	84	51000
01002	ARSENIC AS,TOT		708	117	50.00000	18	5.000000	87	555000
39356	METOLACHLOR	DUAL	434	54	15.00000	15	1.500000	40	230
81287	DINOSEB	DINITRO	229	9	13.00000	4	2.600000	7	2100
39740	2,4,5-T WHL SMPL		23	4	10.00000	4	2.000000	4	170
77780	CYANIZINE	BLADEX	271	25	12.50000	3	1.250000	22	110
39730	2,4-D WHL SMPL	2,4-D	96	5	100.00000	0	20.000000	1	100
81405	CARBOFURAN	FURADAN	163	1	50.00000	0	10.000000	1	15
81408	METRIBUZIN	SENCOR	258	63	NONE	0	NONE	0	940
81410	BUTYLATE	SUTAN	72	10	67.00000	0	6.700000	0	4.9
34361	ENDOSULFAN I		18	9	NONE	0	NONE	0	0.0048
82052	DICAMBA	BANVEL	61	9	NONE	0	NONE	0	350
39055	SIMAZINE	PRINCEP	65	6	2150.00000	0	215.000000	0	15
81894	EPTAM	ERADICANE	162	6	250.00000	0	50.000000	0	2.9
77700	CARBARYL	SEVIN	224	5	NONE	0	NONE	0	45
39720	PICLORAM	TORDON	20	3	NONE	0	NONE	0	8
39770	DACTHAL	DCPA	9	2	NONE	0	NONE	0	760
38477	LINURON	LOROX	146	1	NONE	0	NONE	0	34

TABLE 4 - SUMMARY OF GROUNDWATER PESTICIDE MONITORING
FOR PERIOD OF RECORD

CHEMICAL CODE	CHEMICAL NAME		TOTAL NO. OF WELLS	WELLS WITH DETECTS	ENFORCEMENT STANDARD (UG/L)	WELLS EXCEEDING ENF. STD.	PREVENTIVE ACTION LIMIT (UG/L)	WELLS EXCEEDING PAL	HIGHEST DETECTION LEVEL (UG/L)
46314	DIMETHOATE	DIMETHOATE	22	1	NONE	0	NONE	0	1.5
82051	CHLORAMBEN	AMIBEN	51	1	NONE	0	NONE	0	50
82088	TERBUFOS	COUNTER	139	1	NONE	0	NONE	0	52
82576	ALDICARB SULFOXIDE		1	1	NONE	0	NONE	0	9.099999
82587	ALDICARB SULFONE		1	1	NONE	0	NONE	0	13
34356	ENDOSULFAN II		13	0	NONE	0	NONE	0	0
34621	2,4,6-TRICHLOROPHENOL		22	0	NONE	0	NONE	0	0
38486	MCPB		1	0	NONE	0	NONE	0	0
38491	MCPP	MECOPROP	1	0	NONE	0	NONE	0	0
38730	METAM-SODIUM	VAPAM	33	0	NONE	0	NONE	0	0
38760	1,2-DIBROMO-3-CHLOROPROPAN	DBCP	4270	0	0.05000	0	0.005000	0	0
38815	HEXAZINONE	VELPAR	1	0	NONE	0	NONE	0	0
38865	OXAMYL	VYDATE	5	0	NONE	0	NONE	0	0
38872	TOLBAN (PROFLURALIN)		2	0	NONE	0	NONE	0	0
39002	BENEFIN	BALAN	1	0	NONE	0	NONE	0	0
39051	METHOMYL	LANNATE	20	0	NONE	0	NONE	0	0
39075	BHC GAMMA		14	0	NONE	0	NONE	0	0
39151	MCPA	AGROXENE	3	0	NONE	0	NONE	0	0
39300	DDT P,P		21	0	NONE	0	NONE	0	0
39305	DDT O,P		8	0	NONE	0	NONE	0	0
39310	DDD P,P		9	0	NONE	0	NONE	0	0
39315	DDD O,P		8	0	NONE	0	NONE	0	0
39320	DDE P,P		9	0	NONE	0	NONE	0	0
39330	ALDRIN, WHL WATER SMPL		27	0	NONE	0	NONE	0	0
39348	CHLORDANE, ALPHA		6	0	NONE	0	NONE	0	0

TABLE 4 - SUMMARY OF GROUNDWATER PESTICIDE MONITORING
FOR PERIOD OF RECORD

CHEMICAL CODE	CHEMICAL NAME		TOTAL NO. OF WELLS	WELLS WITH DETECTS	ENFORCEMENT STANDARD (UG/L)	WELLS EXCEEDING ENF. STD.	PREVENTIVE ACTION LIMIT (UG/L)	WELLS EXCEEDING PAL	HIGHEST DETECTION LEVEL (UG/L)
39350	CHLORDANE		8	0	NONE	0	NONE	0	0
39380	DIELDRINWHL SMPL		39	0	NONE	0	NONE	0	0
39390	ENDRIN WHL WATER SMPL		29	0	0.20000	0	0.020000	0	0
39398	CHLORPYRIFOS	LORSBAN	29	0	NONE	0	NONE	0	0
39410	HCHLR WHL SMPL		18	0	NONE	0	NONE	0	0
39480	METHOXYCHLOR		11	0	100.00000	0	20.000000	0	0
39530	MALATHN WHL SMPL		2	0	NONE	0	NONE	0	0
39540	PARATHION		23	0	NONE	0	NONE	0	0
39570	DIAZINON	DIAZINON	31	0	NONE	0	NONE	0	0
39580	AZINPHAS-METHYL (GUTHION)		1	0	NONE	0	NONE	0	0
39600	METHYL PARATHION		8	0	NONE	0	NONE	0	0
39640	CAPTAN		1	0	NONE	0	NONE	0	0
39760	SILVEX WHL SMPL	SILVEX	24	0	10.00000	0	2.000000	0	0
39800	PHOSMET		1	0	NONE	0	NONE	0	0
39810	CHLORDANE, GAMMA		6	0	NONE	0	NONE	0	0
46291	LINDANE, GAMMA BHC		6	0	0.02000	0	0.002000	0	0
46313	THIMET	THIMET	158	0	NONE	0	NONE	0	0
46325	DDE O,P		8	0	NONE	0	NONE	0	0
70314	CHLOROTHALONIL	BRAVO	11	0	NONE	0	NONE	0	0
78657	NONACHLOR, TRANS		1	0	NONE	0	NONE	0	0
78885	DIQUAT		1	0	NONE	0	NONE	0	0
78917	ISOFENPHOS	AMAZE	1	0	NONE	0	NONE	0	0
78922	NONACHLOR, TRANS		5	0	NONE	0	NONE	0	0
78923	NONACHLOR, CIS		1	0	NONE	0	NONE	0	0
78924	NONACHLOR, CIS		5	0	NONE	0	NONE	0	0

TABLE 4 - SUMMARY OF GROUNDWATER PESTICIDE MONITORING
FOR PERIOD OF RECORD

CHEMICAL CODE	CHEMICAL NAME		TOTAL NO. OF WELLS	WELLS WITH DETECTS	ENFORCEMENT STANDARD (UG/L)	WELLS EXCEEDING ENF. STD.	PREVENTIVE ACTION LIMIT (UG/L)	WELLS EXCEEDING PAL	HIGHEST DETECTION LEVEL (UG/L)
79190	PENDIMETHALIN		1	0	NONE	0	NONE	0	0
79191	PERMETHRIN, CIS		5	0	NONE	0	NONE	0	0
81284	TRIFLURALIN	TREFLAN	7	0	NONE	0	NONE	0	0
81294	FONOFOS	DYFONATE	73	0	NONE	0	NONE	0	0
81316	PENTACHLORONITROBENZENE (PPCNB		9	0	NONE	0	NONE	0	0
81888	DISULFOTON	DISYSTON	139	0	NONE	0	NONE	0	0
82198	BROMACIL	HYVAR	3	0	NONE	0	NONE	0	0
82416	PARAQUAT	PARAQUAT	11	0	NONE	0	NONE	0	0

Table 5 - Summary of Funded Projects for F.Y. 1990

Project Number	Initial Project Title	Project Contact	Amount Committed	GWM Contact
64	Field Study of Pesticide Contamination of Groundwater at Grade A Dairy Farms In Dane County, Wisconsin	Ken Bradbury	$22,473.00	Lulloff
65	Sources and Extent of Atrazine Contamination of Groundwater at Grade A Dairy Farms in Dane County, Wisconsin	Gordon Chesters	$22,490.00	Clark
2	DATCP Pesticide Field Study for the Lower Wis. River Testing for Atrazine, with additional study in Dunn and Trempealeau Counties	Jeff Postle	$15,600.00	Lindorff
47	Analytical Determination of Pesticide Metabolites and Carrier Chemicals in Wisconsin Well Water	William Sonzogni	$25,000.00	Lindorff
68	Effects of Soil Type, Selected BMPs, and Tillage on Atrazine and Alachlor Movement Through the Unsaturated Zone: Model Calibration and Validation	Birl Lowery Kevin McSweeney	$20,000.00	Lindorff
69	Unsewered Subdivision Impacts on Groundwater Quality	Byron Shaw	$21,800.00	Lulloff
70	A Demonstration of Low-Input Strategies for Potato/ Vegetable Production on Irrigated Sands	Thomas Osborne	$7,200.00	Clark
71	Incorporation of County Groundwater Inventory Data into the Groundwater Information Network (GIN)	Mike Bohn	$11,416.00	Clark
72	DATCP/DNR Pesticide Sample Collection, Well Labeling, and Nitrate Analysis for up to 1000 Wells	Bob Krill	$27,000.00	Lulloff
73	DATCP Grade A Follow-up with Pesticide & Nitrate Analysis for Neighboring Wells with Detects	Bob Krill	$20,000.00	Lulloff
11	Monitor Pine Grove-Deer Park, Lowes Creek, Briarwood, Sandy Knolls, and Oak Park Subdivisions for Nitrogen Isotopes	John Tinker	$9,309.00	Lulloff
12	Door County Small Basin Study	Ken Bradbury	$4,510.00	Lulloff
44	Door County Lead Study Continuation - Lead Transport Characterization	Rick Stoll	$25,038.00	Lulloff
76	Development and Evaluationm of Optimum Manure Application Rates for Crop Production and GW Protection	Byron Shaw	$20,901.00	Clark
77	Water Quality Monitoring of Wells Constructed in Door County Under Special Written Variances	Bruce Urban	$10,000.00	Clark
38	Mutagenic Effects of Selected Toxicants Found in Wisconsin's Groundwater	L. Meisner	$7,500.00	Lindorff
78	Volatile Organic Chemical (VOC) Attenuation in Unsaturated Soil Above and Below an Onsite Infiltration System	Jerry Tyler	$20,780.00	Clark
		TOTAL COSTS	$291,017.00	

GROUNDWATER RESEARCH NEEDS

The Groundwater Coordinating Council recognized early the importance of groundwater research to allow state agencies to better meet their groundwater management responsibilities. The Coordinating Council created a research subcommittee to identify needs and coordinate research efforts.

The Research Subcommittee identified two types of research to help meet their agency needs. Basic research seeks to define the distribution, movement and chemistry of Wisconsin's groundwater. Applied research, which relies on a strong foundation of basic groundwater knowledge, is directed toward specific problem solving and the development or improvement of methods, products and materials used in groundwater management.

There are two sources of money for groundwater research:

1. Pesticide research monies administered by the Department of Agriculture, Trade and Consumer Protection. Although not all pesticide research relates to groundwater, a significant portion of those monies have been used on groundwater-related issues.
2. Groundwater research monies administered by the University of Wisconsin, Water Resources Center.

Beginning in 1989, DATCP has approximately $125,000 available annually through fees from pesticide manufacturers as a result of the pesticide law to fund research on pesticide issues of regulatory importance. A committee was established in 1988 to identify and prioritize pesticide research needs. The top six needs identified were:

1. Factors influencing the leaching of pesticides in Wisconsin.
2. Identification of sources of contamination in groundwater at grade A dairy farms.
3. On-farm pesticide spill containment systems.
4. Maintenance of pesticide bulk storage containment systems.
5. Use-related monitoring of pesticides in groundwater.
6. Evaluation of irrigation management and the effect of irrigation on pesticide contamination in groundwater.

Projects were solicited in early 1989 and 12 proposals were submitted. Five projects were selected for funding and are listed in Table 6 below. The first three projects below are at least partially co-funded by DNR management practice monitoring money. All five projects began June 1, 1989.

Table 6 - Summary of DATCP Research Projects for FY 1990

Project Title (Principal Investigator)	Year 1 costs
Sources and Extent of Atrazine Contamination of Groundwater at Grade A Dairy Farm in Dane County (G. Chesters, UW-Madison)	$22,490
Field Study of Pesticide Contamination of Groundwater at Grade A Dairy Farms in Dane County (K. Bradbury, WGNHS)	$22,473
Effect of Soil Type, Selected Best Management Practices, and Tillage on Atrazine and Alachlor Movement Through the Unsaturated Zone: Model Calibration and Validation (B. Lowery and K. McSweeney, UW-Madison)	$37,000
Design of a Small Scale Transportable Mixing/ Loading System (D. Kammel and R. Straub, UW-Madison)	$33,700
Pesticide Concentration in the Prairie du Chien Formation, Big River Basin, Pierce County, Wisconsin (S. Huffman, UW-River Falls)	$6,043

At the request of the Groundwater Coordinating Council, the UW in 1988 created a Groundwater Research Advisory Council (GRAC) to establish a long-range 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. The UW also identified the Water Resources Center as the central coordinating body for UW groundwater research activities.

The Water Resources Center, in conjunction with GRAC, prepared a groundwater research (DIN) for inclusion in the University's biennial budget request. The Coordinating Council endorsed the DIN at its October 14, 1988 meeting. A copy of the DIN and the resolution endorsing the DIN are attachments to this section of the report. The DIN was included in the governor's budget and was approved by the Legislature at a level of $500,000 for the biennium for groundwater research.

The Water Resources Center, as the central coordinating body for UW groundwater research, sent out a request for groundwater proposals in March of this year to meet the research priorities identified in the DIN. Those research priorities are:

1. Pollutant transformations in groundwater
2. Pollutant transport in groundwater
3. Impact of waste management practices on groundwater contamination
4. Agricultural management practices as they effect groundwater
5. Characterization of geologic factors affecting groundwater movement
6. Examination of the economic impact of groundwater contamination
7. Evaluation of policy alternatives for controlling contamination

A total of 45 pre-proposals were submitted. A screening committee identified 11 of the proposals as apparently outside the scope and intent of the DIN. It is anticipated that projects will be selected for funding for the 1990 fiscal year later this summer.

The new budget requires that there be agreement between the UW and the Coordinating Council on the use of the UW research funds before they can be released by the Department of Administration. To expedite this agreement, a Memorandum of Understanding (MOU) has been signed by representatives of the Groundwater Coordinating Council, the GRAC and the University of Wisconsin on use of the UW groundwater research funds. The MOU (attached to this report) spells out the procedures for establishing priorities and selection of projects for funding of UW groundwater research. The Coordinating Council has a substantive role in establishing research priorities and an advisory role in project selection to minimize overlap and duplication.

In order to provide consistency and coordination among the three state agencies (DATCP, DNR and UW) in identifying and funding monitoring and research needs, plans are being made to coordinate the solicitation of funds in 1990 and future years. It is hoped that a mechanism can be developed so that there will be a need for only one submittal of project proposals, rather than three as is now the case. A system will be established to review each proposal and determine which of the three funding sources is most appropriate to consider for funding that particular project.

APPENDICES

Groundwater Coordinating Council
Meeting Minutes
August 26, 1988

Members Present: Lyman Wible (DNR); Meredith Ostrom (WGNHS); Al Beaver for Dallas Peterson (UW); Richard Meyer for William Norem (DILHR); O. R. Ehart (DATCP); John Metcalf (Governor's Representative); David Vieth for Ted Stephenson (DOT); Bill Schmidt (DHSS).

Others Present: Eugene Trani, John Harkin, Gordon Chesters, and Gary Jackson (UW); David Belluck (DHSS); Ron Hennings (WGNHS); Nick Neher and David Jelinski (DATCP); Sam Rockweiler (DILHR); Marty Olle (DOA); Terry Lohr, Randell Clark, Kevin Kessler and David Lindorff (DNR).

1. Report to the Legislature

The first item on the agenda was the 1988 Groundwater Coordinating Council Report to the Legislature as required by 1983 Wisconsin Act 410. David Lindorff (DNR) presented the draft report. Representatives from DHSS and DOT suggested minor editorial changes in the text. The report was then approved unanimously for transmittal to the Legislature.

Kevin Kessler (DNR) led a discussion on the need to update the list of subcommittee members. It was agreed that the Report to the Legislature will maintain the same names as the 1986 Report to the Legislature. However, each Council representative will contact David Lindorff by September 2 regarding subcommittee membership. It was agreed that Council representatives can have more than one representative on a particular subcommittee. The Council agreed to include the agenda for the August 26 meeting in the Report but not the minutes, since there would be no opportunity to approve the minutes before transmitting the report.

2. Agricultural Management Practices for Groundwater Protection

David Jelinski (DATCP) presented a discussion of current activities by the DNR and DATCP to develop nutrient and pesticide management practices (see attachment). A Technical Advisory Committee has been established consisting of representatives of the UW, SCS, DNR, DATCP, and other interest groups. The present timetable calls for development of a technical bulletin by early 1989. A strong information and educational effort will be needed to promote the recommended management practices.

3. State Groundwater Plan - Reports 5 and 6

Kevin Kessler and Terry Lohr (DNR) presented reports five and six (draft) of the State Groundwater Plan to the Council for endorsement. Report five (Groundwater Contamination Susceptibility Map and Evaluation) is the second report of the state groundwater plan to be published; it was endorsed unanimously. Since report six (Assessment of Groundwater Management Programs in Wisconsin) did not contain a list of reviewers, the Coordinating Council

endorsed the report subject to final review by the state agencies. Final comments are to be sent to Terry Lohr by September 7, 1988. Mr. Lohr will make any necessary changes and then the report will be published with a list of acknowledgements.

4. UW Groundwater Research DIN

The next presentation was by Dr. Eugene Trani (UW), regarding the UW Groundwater Research Decision Item Narrative (DIN). Based on a meeting with the Coordinating Council last year the UW formed a Groundwater Research Advisory Council (GRAC) to:

1. Prepare a groundwater research DIN

2. Prepare a long-range groundwater plan.

Part of the focus for seeking groundwater funds from the Legislature is to have matching money available for federal research grants. The UW is now preparing the budget to present to the Board of Regents in October. The budget proposes $6.2 million in research and public service funding; $1 million is earmarked for groundwater research (down from $2.9 million in the earlier DIN proposal). The UW wants the Coordinating Council endorsement for the Groundwater Research DIN.

Lyman Wible (DNR) congratulated Dr. Trani and the UW on their efforts to prepare the DIN and their commitment to groundwater research. The minutes of the Research Subcommittee meeting of August 10, 1988 were handed out along with state agency's comments on the DIN. Mr. Wible discussed the following major comments and recommendations of the Research Subcommittee:

1. The DIN and its appendices are very poorly written and should be reorganized, shortened, and written with less jargon.

2. The DIN should have a research emphasis and the research should pertain directly and specifically to groundwater.

3. The groundwater research should also relate directly and specifically to Wisconsin.

4. The proposed groundwater research needs to be prioritized.

5. The Groundwater Coordinating Council should have a primary role in selecting research priorities.

6. The Groundwater Coordinating Council should be involved in selecting individual research projects for funding.

The Research Subcommittee did not recommend the unconditional endorsement of the DIN in its present form. The Subcommittee did recommend a resolution endorsing the DIN but requiring a Groundwater Coordinating Council primary role in research priority setting and an advisory role on individual projects.

Mr. Trani expressed strong reservations with giving the primary responsibility (for the groundwater research money) to state agencies. He noted that the money would be part of the UW budget; but the University cannot responsibly relinquish the important decisions about the application of these monies to high-quality scientific research. Mr. Trani indicated that he had talked with the Council last year about a joint DIN, but there had been little interest on the part of other state agencies. He further noted the restrictions on the UW (by state agencies) would limit the Water Resource Center's ability to leverage the UW money to obtain greater support from the federal government or other sources.

Robert Ehart (DATCP) indicated that the intent of the GRAC is to look for money both from Wisconsin and from outside the state. The intent was not to restrict the use of funds only for Wisconsin research. It is also important to have a broad view of what is included in groundwater research (e.g., health considerations).

Mr. Trani said it wasn't decided yet who would set the priorities and review research proposals. A different committee than the GRAC may very well set priorities. There is likely to be some out-of-state peer review of research proposals. Therefore, UW will not operate by itself.

Gordon Chesters (UW) talked about how the DIN was organized and emphasized that the UW plans to do research. He said the UW recognizes that they do not have responsibility for policy development and they have no intentions of developing policy on groundwater issues. Rather, he indicated that the University's role in policy development was strictly limited to advising state agencies.

Mr. Wible then suggested closure be pursued by answering four questions regarding the DIN.

1. "Are the state agencies asking the UW to turn over their groundwater research budget to state agency control?" Mr. Wible said they are not and Mr. Trani agreed.

2. "Will the UW seek the input of the Groundwater Coordinating Council in establishing research priorities?" Mr. Trani responded that they definitely would.

3. "Does the UW respect and acknowledge the different statutory roles and legitimacy of state agency concerns in offering advice on priorities?" Mr. Trani responded in the affirmative and was bolstered in this response by Dr. Chesters.

4. "Can the Groundwater Coordinating Council craft a resolution of support?"

Bill Schmidt (DHSS) offered a fifth question. "Can some editing be done to the DIN and appendices to remove the negative language they contain?" After some discussion, it was agreed that the Research Subcommittee would meet and prepare suggested changes to the DIN and the appendix. The Research Subcommittee will meet on September 9, 1988 to consider changes in the DIN. Mr. Schmidt, Mr. Wible and Mr. Ehart will then meet with Mr. Trani, Mr. Beaver and/or Dr. Chesters to discuss the recommended changes.

John Metcalf (Governor's Representative) offered some remarks before he had to leave. He had met with the Governor and his aides. They were very supportive of the Groundwater Coordinating Council and its efforts. They were particularly supportive of groundwater research to identify problems and education to promote management practices to prevent groundwater contamination, including sustainable agriculture.

Discussion then centered on the draft resolution endorsing the UW DIN. Several changes were made and the resolution was endorsed unanimously (see attached). The resolution will be signed by Mr. Wible and transmitted to Mr. Trani.

Mr. Ehart (DATCP) said that the appendix will be the starting point for long-range groundwater research plan which will be developed this fall.

5. Meeting Minutes

The meeting minutes from the last meeting (October 5, 1987) were approved unanimously.

6. Next Meeting of the Coordinating Council

Agreement was reached that the next meeting will be Friday afternoon, October 14. Topics for discussion will include agency reports and budgets, status of the GRAC, the Board of Regents' discussion of the groundwater DIN, and the UW-Water Quality Education Program. The meeting was then adjourned.

Respectfully submitted,

David E. Lindorff

David E. Lindorff
Groundwater Management Section
Department of Natural Resources

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Resolution of the Wisconsin Groundwater Coordinating Council
Endorsing Groundwater Research Initiative

August 26, 1988

Whereas the Groundwater Coordinating Council (GCC) has previously urged the University of Wisconsin to place a high priority on groundwater research needs and to seek and assemble the resources necessary to fund the groundwater research needed by state agencies; and

Whereas the University of Wisconsin, with the assistance of an advisory committee, has assembled a Groundwater Research Decision Item Narrative (DIN) and has transmitted that DIN to the Groundwater Coordinating Council for review and advice; and

Whereas the Groundwater Coordinating Council is created under s. 15.347(13), Wis. Stats., to include the President of the University of Wisconsin and Secretaries of the other state agencies or their designees with responsibilities for groundwater management; and

Whereas the Groundwater Coordinating Council is required by s. 160.50(1), Wis. Stats., to "advise and assist state agencies...in the coordination of nonregulatory programs...including...research activities and the appropriation and allocation of state funds for research"; and

Whereas the Groundwater Coordinating Council understands that the DIN requests state funds in addition to those that support current state agency groundwater activities;

Now, therefore, be it resolved that:

1. The Groundwater Coordinating Council endorses the DIN concept which has been prepared by the University of Wisconsin for groundwater research and urges the University to include this item in its biennial budget request for inclusion in the executive budget; and

2. In recognition of the need to develop research priorities and in accordance with its duties under s. 160.50(1), Stats., the Groundwater Coordinating Council must have a substantive role in the development of the long range research plan and the recommendation of research priorities; and desires an advisory role on individual projects, where appropriate, to assure that the needs of state agencies are met.

Dated at Madison, Wisconsin, this 26th day of August, 1988.
Groundwater Coordinating Council.

By: Lyman F. Wible

Lyman F. Wible, Chairman

Groundwater Coordinating Council
Meeting Minutes
October 14, 1988

Members Present: Lyman Wible (DNR); Meredith Ostrom (WGNHS); Al Beaver for Dallas Peterson (UW); Sam Rockweiler for Bill Norem (DILHR); O.R. Ehart (DATCP); Bill Schmidt (DHSS).

Others Present: Gary Jackson (UW); Ron Hennings and Ken Bradbury (WGNHS); Gary LeMasters and Jeff Postle (DATCP); Henry Anderson and David Belluck (DHSS); Pat Robinson, Roberta Jortner, Gwen Porus and Eric Dott (UW WRM students); Kevin Kessler and David Lindorff (DNR).

1. Approval of Minutes

Item 4 of the minutes of the August 26, 1988 meeting was amended to insert Mr. William Schmidt's name along with Messrs. Wible and Ehart's names as proposed to meet with UW representatives regarding the revised DIN. The minutes were then approved unanimously.

2. Endorsement of Subcommittee Membership

Gary LeMasters' (DATCP) name was added to the Monitoring and Data Management Subcommittee (to replace Jeff Postle) and the Education Subcommittee. Gary Jackson suggested Ms. Chris Mechenich's (UW) name for addition to the Education Subcommittee. After some discussion, it was agreed that the UW would consider the idea for future nomination. With the addition of Gary LeMasters, the list was approved unanimously (see attached current list).

Mr. Ehart (DATCP) suggested that a committee be formed to look at the objectives and membership of the Groundwater Coordinating Council Subcommittees. The Council members have, to date, not had an active involvement in subcommittee activities and perhaps should be more involved. After some discussion, a resolution was adopted unanimously to set up a committee to look at the membership and roles of the subcommittees. Mr. Ehart (chair), Mr. Ostrom, Mr. Henry Anderson and the subcommittee chairs will make up the committee. Mr. Ehart will set up the first meeting.

3. Presentation of "Managing Pesticides in Groundwater"

Two students of the Water Resources Management program at the UW (Pat Robinson and Roberta Jortner) presented a summary of the report prepared by the Water Resources Management seminar this summer to assist the DATCP in regulating pesticides. The focus of their effort was on pesticide use rather than handling. The students developed a policy evaluation framework using four criteria (technical feasibility, administrative feasibility, economic impacts and equity) and evaluated three alternative policies using this framework. The students did not recommend a preferred pesticide management policy.

Council members expressed interest in sharing the results of the study with others to get additional input, perhaps through a one day conference. A committee will be formed to explore this option. Membership will include Mr. Nick Neher (DATCP), Mr. Jeff Postle (DATCP), Mr. Kevin Kessler (DNR), Mr. Al Beaver (UW), Mr. Ron Hennings (WGNHS), Erhard Joeres (UW), and at least one student representative.

A motion was suggested by Mr. Wible to compliment Mr. Steve Born, head of the WRM program for the excellent job done by the WRM students in preparing this report. The motion was passed unanimously.

4. Presentation of "A New Water Quality Educational Strategy for University of Wisconsin-Extension"

Mr. Gary Jackson presented a summary of the report prepared this summer by UW-Extension staff. The recommendations of the report are:

1) to create an inter-agency Water Quality Educational Center for Pesticide and Nutrient Management,

2) to restructure the UW-Extension to improve the educational capabilities, and

3) to develop a new county-level water quality information delivery system to help farmers.

After some discussion, it was agreed that the Information and Education Subcommittee will consider whether to include an endorsement of the Educational Center concept in report seven of the State Groundwater Plan. Report seven will be published around the first of the year. The Strategy publication will also be reviewed internally by the UW-Administration.

5. Status of UW DIN and Long-range Research Plan

Mr. Al Beaver (UW) handed out the most recent version of the UW Decision Item Narrative (DIN). The DIN has been modified to reflect changes suggested by the GCC Research Subcommittee. A few minor changes have been made to the last version which GCC representatives had seen. The DIN will be presented to the Board of Regents at their November meeting. The resolution adopted by the Coordinating Council at its August 1988, meeting was modified to support the DIN, not just the DIN concept, and was approved unanimously (see attached resolution).

Mr. Ehart indicated that Dr. Colin Jeffcoate is the head of a subcommittee to draft a long-range research plan and select research priorities. It was suggested that Drs. Jeffcoate and Gordon Chesters arrange for a final meeting of the UW Groundwater Research Advisory Council to consider the research plan.

6. Agency Reports/Budgets

a. UW - Mr. Beaver (UW) indicated that the UW budget related to groundwater was entirely included in the discussion under item 5.

b. WGNHS - Dr. Ostrom indicated that the Survey budget will be tight this year. A new drill rig is badly needed.

c. DNR - Mr. Wible highlighted several proposed DNR budget initiatives relating to groundwater.

1. A fee rate of $.10 per 1,000 gallons of groundwater withdrawn for use is proposed, a portion of which would be used to implement the Safe Drinking Water Act.

2. The Department is requesting $5 million for a water supply grants program for remedial action for contaminated public water supplies.

3. The Department is requesting additional staff to implement the environmental repair and response program.

4. The Department is requesting an increase in the landfill tipping fee to make sure that the Waste Management Fund for long term care remains solvent.

d. DATCP-Mr. Ehart indicated that there has been some shifting of some staff responsibilities but that the groundwater program is largely unchanged. DATCP has requested additional money for research and to cost-share pesticide analysis with farmers.

A meeting has been scheduled for October 25 to discuss pesticide handling facilities. The outcome of the meeting will influence revision of Chapter AG 29, Wis. Adm. Code. The results of the Grade A dairy sampling to date show 28 out of 180 wells with atrazine detects and 3 out of 180 wells with alachlor detects. Some of the detects seem related to mixing or handling.

e. DHSS - Dr. Anderson indicated that the DHSS would have a maintenance budget for groundwater activities. No new positions were included in the budget.

f. DILHR - Mr. Rockweiler reported that DILHR has requested a limited number of new positions, but would have basically a maintenance budget.

7. Meeting Schedule

Mr. Wible proposed that our next coordinating council meeting be held January 13, 1989 in Dodgeville so that Mr. Metcalf (Governor's Representative) won't have to travel so far. The rest of the Council members agreed subject to concurrence from Mr. Metcalf. The meeting was then adjourned.

Respectfully Submitted

David E. Lindorff
Groundwater Management Section
Department of Natural Resources

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Resolution of the Wisconsin Groundwater Coordinating Council
Endorsing Groundwater Research Initiative

October 14, 1988

Whereas the Groundwater Coordinating Council (GCC) has previously urged the University of Wisconsin to place a high priority on groundwater research needs and to seek and assemble the resources necessary to fund the groundwater research needed by state agencies; and

Whereas the University of Wisconsin, with the assistance of an advisory committee, has assembled a Groundwater Research Decision Item Narrative (DIN) and has transmitted that DIN to the Groundwater Coordinating Council for review and advice; and

Whereas the Groundwater Coordinating Council is created under s. 15.347(13), Wis. Stats., to include the President of the University of Wisconsin and Secretaries of the other state agencies or their designees with responsibilities for groundwater management; and

Whereas the Groundwater Coordinating Council is required by s. 160.50(1), Wis. Stats., to "advise and assist state agencies...in the coordination of nonregulatory programs...including...research activities and the appropriation and allocation of state funds for research"; and

Whereas the Groundwater Coordinating Council understands that the DIN requests state funds in addition to those that support current state agency groundwater activities;

Now, therefore, be it resolved that:

1. The Groundwater Coordinating Council endorses the University of Wisconsin DIN presented to it on October 14, 1988 for groundwater research and urges the University to include this item in its biennial budget request for inclusion in the executive budget; and

2. In recognition of the need to develop research priorities and in accordance with its duties under s. 160.50(1), Stats., the Groundwater Coordinating Council must have a substantive role in the development of the long range research plan and the recommendation of research priorities; and desires an advisory role on individual projects, where appropriate, to assure that the needs of state agencies are met.

Dated at Madison, Wisconsin, this 14th day of October, 1988.
Groundwater Coordinating Council.

By: Lyman F. Wible

Lyman F. Wible, Chairman

GROUNDWATER COORDINATING COUNCIL MEMBERS

Department of Natural Resources - Lyman Wible (Chair)
Department of Health and Social Services - William Schmidt
Department of Agriculture, Trade and Consumer Protection - Orlo R. Ehart
Department of Transportation - Theodore Stephenson
University of Wisconsin - Dallas Peterson
Department of Industry, Labor and Human Relations - William Norem
Geological and Natural History Survey (State Geologist) - Meredith Ostrom
Governor's Representative - John Metcalf

Subcommittee Appointees

Research

Geological and Natural History Survey (State Geologist) -
Ron Hennings (Chair) and Ken Bradbury
Department of Natural Resources - David Lindorff
University of Wisconsin - William Fetter and David Armstrong
Department of Agriculture, Trade and Consumer Protection - Jeff Postle
Department of Health and Social Services - David Belluck
Department of Industry, Labor and Human Relations - Sam Rockweiler

Monitoring and Data Management

Department of Natural Resources - Al Lulloff (Chair)
Department of Transportation - Bob Patenaude
Geological and Natural History Survey (State Geologist) - Mike Bohn
Department of Agriculture, Trade and Consumer Protection - Gary LeMasters
Department of Industry, Labor and Human Relations - Sam Rockweiler
University of Wisconsin - Byron Shaw

Planning and Mapping

Department of Natural Resources - Steve Skavroneck (Chair)
Geological and Natural History Survey (State Geologist) - Ron Hennings and
Meredith Ostrom
University of Wisconsin - Steve Born
Department of Agriculture, Trade and Consumer Protection - Jeff Postle

Education

University of Wisconsin - Gary Jackson (Chair)
Department of Natural Resources - Rudy Teschan
Geological and Natural History Survey (State Geologist) - Ron Hennings
Department of Agriculture, Trade, and Consumer Protection - Gary LeMasters
Governor's Office - John Metcalf
Department of Public Instruction - Dave Engleson
Vocational Education - Bill Rockwell

Approved by the Groundwater Coordinating Council

BY: Lyman F. Wible, Chair _____ Date _____

GO3002B

Groundwater Coordinating Council
Meeting Minutes
January 13, 1989

Members Present: Lyman Wible (DNR); Meredith Ostrom (WGNHS); Sam Rockweiler for William Norem (DILHR); Ted Stephenson (DOT); Bill Simmons for O. R. Ehart (DATCP); David Belluck for William Schmidt (DHSS); and Jack Metcalf (Governor's Representative).

Others Present: Gary Jackson and Sue Jones (UW); Ron Hennings (WGNHS); and Richard Wedepohl, Alan Lulloff and David Lindorff (DNR).

1. Introduction

After each person introduced themselves, Mr. Metcalf expressed his gratitude for holding the Groundwater Coordinating Council meeting at Dodgeville.

2. Approval of Minutes

The minutes of the October 13, 1988 Council meeting were approved as written.

3. Groundwater Information Network

Mr. Alan Lulloff (DNR) discussed the Groundwater Information Network (GIN) system being implemented presently by the DNR, including typical outputs from the system. All data generated or required by the DNR will go into GIN. Eventually, the intent is to get groundwater data from other state agencies into GIN as well. Mr. Lulloff also discussed the DNR plan to label all wells with data in GIN and showed examples of labels presently being used. It should be possible for other state agencies to get access to GIN data. Ted Stephenson (DOT) volunteered to work to get DOT's wells into GIN.

4. On-Site Farm Pollution Survey

Mr. Gary Jackson and Ms. Sue Jones of U.W. Extension described their project to get information on groundwater quality issues to farmers. They intend to prepare a series of fact sheets on potential sources of groundwater contamination on the farm to help farmers identify potential pollution problems. Also included will be a resource inventory to identify soils, geology and groundwater conditions on individual farms which may be susceptible to groundwater contamination. Once the materials have been prepared, an information and education effort will be made to educate farmers on these issues and encourage individual farm surveys.

5. Monitoring and Data Management Subcommittee Report/Monitoring Plan

Mr. Lulloff summarized the meeting of the Monitoring and Data Management Subcommittee held January 10. Mr. Lulloff made a presentation on the status of the GIN system at the meeting. The Subcommittee then identified sources of groundwater data being generated; the two major sources

besides the DNR are the Wisconsin Geological and Natural History Survey and the Central Wisconsin Groundwater Center in Stevens Point.

The Subcommittee also discussed the fiscal year 1990 Groundwater Monitoring Plan for problem assessment monitoring and management practice monitoring. A date of February 20 was set to send out the request for proposals for management practice monitoring projects to the UW, state agencies and other interested persons, and a deadline of March 31 was set for project submittals.

6. Status of UW DIN/Groundwater Research Plan

Mr. Wible (DNR) indicated that Mr. Ehart's presentation to the UW Board of Regents in November had gone well. The groundwater DIN was part of the UW budget request. Mr. Ehart and Mr. Wible have been asked to talk to the Board of Regents about groundwater issues at their February 10 meeting.

Mr. Dallas Peterson (UW) was unable to attend the meeting, but had given Dr. Ostrom (WGNHS) a revised version of the DIN attachment which was distributed. It was agreed that the attachment be referred to the Research Subcommittee for review. The Research Subcommittee will meet to discuss and provide comments for Messrs. Wible and Ehart to take to the Board of Regents Meeting in February.

7. Groundwater Coordinating Council Organization

Mr. Wible (DNR) reported that, due to a reorganization at (DATCP) Mr. Ehart had not yet scheduled a meeting to consider the relationship between the Coordinating Council and the Subcommittees. A meeting will be held before the next meeting of the Coordinating Council.

8. Agency Reports

a. DHSS: Mr. Belluck indicated that DHSS is working on the latest round of groundwater standards to assist DNR in amendments to NR 140. The agency has spent approximately $70,000 on various groundwater-related efforts.

b. DNR: Mr. Wedepohl indicated that, in addition to the GIN and the Fiscal Year 1990 Groundwater Monitoring Plan mentioned previously, the DNR has been working with the EPA on pesticides and other groundwater issues. The agency has been working with other state agencies on animal waste concerns, the Nutrient/Pesticide Management Plan and a rewrite of "Wisconsin's Buried Treasure." The DNR is preparing to request Board Approval in February for hearings on additional groundwater standards for NR 140 and hopes to get final Board approval on NR 141 (monitoring well requirements) this spring.

c. DOT: Mr. Stephenson indicated that DOT is completing its second annual inspection of some 1,400 salt storage sheds. Several million dollars has been spent to build adequate salt storage facilities around the state. The DOT has made an inventory of hazardous waste stored at DOT facilities. They have also collected 2,4,5-T from across the state and are presently attempting to find a proper, legal method of destruction or disposal.

d. DILHR: Mr. Rockweiler reported that the Department is working on a new administrative code for large septic systems and is looking at code revisions for unsewered subdivisions. The agency is also working on the issue of petroleum tanks.

e. DATCP: Mr. Simmons indicated that DATCP has been working with other agencies on the Nutrient/Pesticide Management Plan, animal waste and proposed revision to Ag 29. DATCP is now soliciting proposals for pesticide research; they will award approximately $210,000 this spring. The agency has awarded grants for sustainable agriculture projects for the second year.

f. WGNHS: Dr. Ostrom indicated that the Survey is about to issue their first quadrennial report. They are involved in 34 groundwater projects, 20 of which are county investigations. The Survey needs a drill rig badly. After some discussion, it was agreed to review the issue again at a Coordinating Council meeting later this year.

g. UW: Mr. Jackson indicated that money has been designated for one year to establish a Nutrient/Pesticide Management Center on the Madison campus.

9. Meeting Schedule

It was agreed that the next three meetings of the Coordinating Council would be held on April 21, August 18 and November 10, all starting at noon. Mr. Metcalf indicated that he had heard good reports on the Lower Wisconsin River Plan. There appears to be good cooperation between the DNR and the Legislature. He again thanked the Coordinating Council for meeting in Dodgeville. The meeting was adjourned.

Respectfully submitted,

David Lindorff

David Lindorff
Groundwater Management Section
Department of Natural Resources

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Groundwater Coordinating Council
Meeting Minutes
April 21, 1989

Members Present: Lyman Wible (DNR); Meredith Ostrom (WGNHS); Sam Rockweiler for William Norem (DILHR); O. R. Ehart (DATCP); William Schmidt (DHSS); Jack Metcalf (Governor's Representative) and Dallas Peterson (UW).

Others Present: Steve Born and Doug Yanggen (UW); Ken Bradbury (WGNHS); David Belluck (DHSS); William Morrissey (DILHR); Jeff Postle and Gary LeMasters (DATCP); and Bruce Baker, Kevin Kessler, Alan Lulloff and David Lindorff (DNR).

1. Introductions/Agenda Repair

Each person introduced themselves. Then a new agenda item was added: a summary of the DATCP Grade A dairy survey.

2. Approval of Minutes

The minutes of the January 13, 1989 Council meeting were approved as written.

3. Status of ILHR 10

Mr. William Morrissey of DILHR (Safety and Buildings) summarized the status of draft Chapter ILHR 10, Wis. Adm. Code, dealing with petroleum storage tanks. ILHR 10 will include both Federal rules and state regulations for tanks not covered by Federal rules (e. g. farm and residential tanks). Mr. Morrissey indicated that a committee will meet in May to work on the draft rule. DILHR hopes to be able to hold public hearings this summer.

Mr. Wible (DNR) distributed copies of an April 9 letter from DILHR to Charles Kell, Portage County Planning Department, responding to a request for locational coordinates for underground storage tanks. Mr. Morrissey explained DILHR's position that getting this information would be a significant additional burden on facilities, DILHR doesn't need the locational coordinates and there are higher priorities in DILHR related to underground storage tanks. After some discussion, the issue and the letter from Mr. Kell were referred to the Monitoring and Data Management Subcommittee to see if there were issues of concern regarding the location of other facilities or pollutant sources that ought to be addressed in the same context. The Monitoring and Data Management Subcommittee is to report back to the Council at its next meeting.

4. Conference on groundwater policy education

Dr. Doug Yanggen (UW) described a proposal developed by Dr. Steve Born (UW) and himself to hold a 2-day groundwater conference in Wisconsin late next year. The objectives would be to document what Wisconsin has done since passage of the groundwater law in 1984 and to discuss the needs for additional steps in groundwater management in Wisconsin. The conference would be aimed at in state as well as out of state audiences. Money is hopefully coming from the Kellogg Foundation to take care of most expenses. A motion to endorse this proposed conference was adopted unanimously. Each agency will designate an agency contact to help organize the conference and notify Dr. Yanggen by June 15.

5. Status of GRAC

Mr. Dallas Peterson (UW GCC representative) provided an update on the University's Groundwater Research Advisory Council (GRAC) and their request for research proposals. The GRAC Research Subcommittee put a request for proposals (RFP) together which was sent out in March. Mr. Peterson distributed copies of the RFP and a tabulation of the 44 project proposals received.

There was concern raised by Messrs. David Belluck and Bill Schmidt (DHSS) that DHSS did not get a copy of the RFP until after the deadline had passed. Mr. Bruce Baker (DNR) asserted that the University's efforts in publicizing the call for proposals was sincere, but indicated that the working task force (Baker, Gordon Chesters and Nick Neher) may have failed to extend the RFP distribution broadly enough. Mr. Wible (DNR) apologized for any failure on his part to further distribute to GCC members the call for proposals which he received.

After some discussion, there was agreement that the distribution procedure for this first effort had been imperfect and that there will be a greater effort to be more inclusive in the future. The intent for the future is to coordinate the RFP's between the UW, DATCP and the DNR.

Mr. Peterson handed out copies of a draft Memorandum of Understanding (MOU) between the DNR, DATCP and the UW which lays out procedures for review and selection of UW research proposals and the release of Department of Administration (DOA) funds. Mr. Peterson highlighted the major provisions of the MOU. Anyone with comments on the MOU is to get them to Mr. Wible by April 28. Mr. Wible will send GCC comments to Mr. Peterson by May 1.

6. Grade A Dairy Survey

Gary LeMasters (DATCP) handed out copies of the recently released report on sampling of Grade A dairy wells in Wisconsin. Mr. LeMasters summarized the findings of the report. A total of 534 wells were sampled; 71 contained detectable concentrations of 1 or more pesticides. Atrazine was found in 66 of the 71 wells. Ten percent of the wells had nitrate concentrations over 10 mg/l. There was a high correlation between wells with high nitrates and detectable levels of pesticides.

7. Report to the Legislature

Mr. Wible proposed that the GCC Annual Report to the Legislature be written so that it was more readable and less bureaucratic. A draft outline for the report was handed out for review. It was suggested that the DNR work with our information and education staff to make the report easier to understand. The members agreed to this proposal and to their active role in editing a DNR draft. Any suggestions on the draft outline are to be sent to David Lindorff (DNR). DNR will write a draft report and circulate it to other GCC members for comment.

8. Report of Research and Monitoring and Data Management Subcommittees Meeting of April 13, 1989

Mr. Alan Lulloff (DNR) presented 2 resolutions which had been approved at the April 13 meeting of the Monitoring and Data Management Subcommittee. The first resolution states that the GCC endorses the use of the Groundwater Information Network (GIN) standard format for well data and sample results and recommends that agencies conducting groundwater monitoring label wells with the Wisconson Unique Well Number.

It was agreed that the most important effort was to get data into the GIN system and coordinate use of the data. Use of labels showing the Unique Well Number was recommended, but not mandatory. Mr. Rockweiler (DILHR) stated that Mr. Bill Norem (DILHR) endorsed the resolution with the idea of identifying wells as to whether they are monitoring or water supply wells. Mr. Lulloff (DNR) indicated that other information could be printed to attach to the well label besides just the Unique Well Number. A motion to adopt the resolution with some minor editorial comments was passed unanimously. The resolution is attached and incorporated as part of these minutes.

The second resolution states that the GCC recommends that Administrative Code NR 112 be revised to require newly constructed water supply wells be analyzed for nitrate nitrogen in addition to coliform bacteria. Mr. Lulloff

indicated that NR 112 is now being revised and the DNR Water Supply program is supportive of proposing this change to the rule.

Mr. Ehart (DATCP) raised some concerns about the impact of this action. Will DNR take enforcement action if there is a nitrate exceedance? Will drillers start drilling deeper wells, which would cost homeowners more money? What options will the homeowner have if his new well has high nitrates? Are there other ways to get this information? Mr. Rockweiler said that Bill Norem had similar concerns and suggested that the nitrate sampling be a recommendation, not a requirement. The emphasis, according to Mr. Norem, should be on education.

Mr. Wible indicated that all the above issues would be part of the rule making process and would be fully explored in making a decision on specific rule requirements. The resolution was amended to indicate that new wells <u>should</u> be sampled for nitrates. The provisions of the proposed resolution dealing with the well code regulations in NR 112, Wis. Adm. Code, were deleted. With this revision, the resolution was adopted unanimously. The resolution is attached and incorporated as part of these minutes.

Mr. Lulloff also indicated that the two subcommittees had discussed 45 project proposals which had been received by the DNR. The input from the subcommittees would be used to prioritize the projects and decide which monitoring proposals would be funded for the 1990 fiscal year.

9. <u>Geological Survey Drill Rig</u>

Dr. Ostrom indicated that he had had some preliminary discussions with DOT regarding their drill rigs because of the age of the Geological Survey drill rig. He agreed to put a memo together indicating his concerns and options for resolution of the problem so that the Geological Survey could continue to install monitoring wells for state agencies. Dr. Ostrom will report back at the next GCC meeting.

With a reminder that the next meeting of the Coordinating Council will be held on August 18 at noon in the DNR Dodgeville Area Office, the meeting was adjourned at 3:00 pm.

Respectfully submitted,

David E. Lindorff

David E. Lindorff
Groundwater Management Section
Department of Natural Resources

Resolution of the Wisconsin Groundwater Coordinating Council Endorsing Use of Wisconsin Unique Well Number

April 21, 1989

Whereas the Groundwater Coordinating Council is created under s. 15.347(13), Wisconsin Statutes, to include the President of the University of Wisconsin and the Secretaries of state agencies or their designees with reponsibilities for groundwater management; and

Whereas the Wisconsin Department of Natural Resources is required by s. 160.27(4), Wisconsin Statutes, to "coordinate the collection of groundwater monitoring data and the exchange of these data among agencies ..." and to "insure the technical accuracy of the monitoring data used in the administration of this chapter" (the administration of groundwater quality standards); and

Whereas the Wisconsin Department of Natural Resources has developed a computer system called the Wisconsin Groundwater Information Network to fulfill the afore mentioned requirements of s. 160.27(4); and

Whereas the Wisconsin Groundwater Information Network provides a standard format for well and well sampling data; and

Whereas the Wisconsin Department of Natural Resources has developed a program whereby a Wisconsin Unique Well Number is assigned and permanently attached at the well site for newly constructed wells and wells sampled by Department of Natural Resources staff or individuals or agencies that are required by or contract with the Department to construct and/or sample wells;

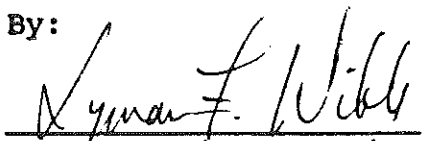
Now, therefore be it resolved:

1. **The Groundwater Coordinating Council endorses the use of the Wisconsin Groundwater Information Network standard format for well data and well sample results by agencies conducting groundwater monitoring; and**

2. **The Groundwater Coordinating Council recommends that agencies conducting groundwater monitoring attach an identifying label with a Wisconsin Unique Well Number to wells which are sampled.**

Dated at Madison, Wisconsin, this 21st day of April, 1989. Groundwater Coordinating Council.

By:



Lyman F. Wible, Chair

Resolution of the Wisconsin Groundwater Coordinating Council
Endorsing Revision of NR 112 Requiring
Nitrate Sampling for Newly Constructed Wells

April 21, 1989

Whereas the Groundwater Coordinating Council is created under s. 15.347(13), Wisconsin Statutes, to include the President of the University of Wisconsin and the Secretaries of state agencies or their designees with reponsibilities for groundwater management; and

Whereas nitrate nitrogen (NO_3-N) has been identified as the contaminant that most frequently exceeds groundwater quality and drinking water standards in Wisconsin; and

Whereas newly constructed wells are sampled for coliform bacteria; and

Whereas newly constructed wells are automatically assigned Wisconsin Unique Well Numbers allowing data associated the well to be entered into the Wisconsin Department of Natural Resources groundwater data management system; and

Whereas the majority of samples for newly constructed wells are analyzed at the Wisconsin State Laboratory of Hygiene which has an automated laboratory data management system that allows sample results to be transmitted automatically to the Wisconsin Department of Natural Resources groundwater data management system; and

Whereas the Wisconsin Laboratory of Hygiene will analyze samples from wells for nitrate nitrogen at a cost of $7.00 per sample;

Whereas the Monitoring Subcommittee of the Groundwater Coordinating Council has identified the need to establish a statewide nitrate data base to determine the extent of nitrate contamination and specific areas of concern.

Now, therefore, be it resolved that:

The Groundwater Coordinating Council recommends that newly constructed water supply wells should be analyzed for nitrate nitrogen in addition to coliform bacteria.

Dated at Madison, Wisconsin, this 21st day of April, 1989.
Groundwater Coordinating Council.

By: Lyman F. Wible

Lyman F. Wible, Chair

The University of Wisconsin System
Vice President for Academic Affairs
1624 Van Hise Hall, 1220 Linden Drive
Madison, Wisconsin 53706
(608) 262-8778
Fax: (608) 263-2046

July 10, 1989

Mr. James R. Klauser
Secretary, Department of Administration
Post Office Box 7864
Madison, Wisconsin 53707

Dear Mr. Klauser,

Enclosed is a copy of the recently signed Memorandum of Understanding which establishes the procedural guidelines for the prioritization of groundwater research and the selection of research proposals to be funded through the 1989-91 appropriation to the University of Wisconsin System for groundwater research. It also establishes the coordinative relationship between the University of Wisconsin Groundwater Research Advisory Council and the State Groundwater Coordinating Council as it relates to groundwater research and identifies the procedures to be followed in seeking release of the unallocated reserves appropriated for this purpose which are being held by the Department of Administration.

Lyman Wible, Orlo Ehart, and I are very pleased with the outcome of the extended discussions related to groundwater research and the need for a cooperative and coordinated approach in addressing the critically important, complex problems Wisconsin is faced with, both in the immediate and long-term context. We are committed to seeing the process work and with general agreement on the research priorities and a focussing of resources on those targets, we believe that a more systematic and productive Statewide effort will result.

We are not so naive as to assume that all territorial interests have been subjugated for the good of the whole or that additional procedural protocols will not be called for but we are firmly convinced that what has been accomplished is a first in Wisconsin. It has great potential and must be encouraged in its developmental and maturing stages. We strongly urge you and your agency to be supportive of these efforts and of our subsequent request for release of funds.

We would not be serving the best interests of the citizens of this State if we left you or them with the mis-impression that the amount appropriated by the Legislature for groundwater research will be adequate in preventing further erosion in the quality of our water resources, or in restoring the quality of that precious resource where it has already reached unacceptable levels of contamination. At the

same time, we want to assure you, the Governor, and the Legislature of our deep sense of appreciation for the commitment being made to groundwater research through the 1989-91 biennial budget. An investment in the area of water quality may, in the long run, be a greater stimulus to economic development in Wisconsin than most of the initiatives supported to date. On the other hand, if ignored, it is a verity that continued pollution and contamination with their multifaceted and negative effects on plant, animal, and human life will result in economic ruin.

Thanks again to you, the Governor, and the Legislature for supporting our budget request, and our appreciation to the members of the Groundwater Coordinating Council and the UW Groundwater Research Advisory Council for endorsing the concepts and procedures contained within the Memorandum of Understanding.

Sincerely,

Eugene P. Trani
Vice President
for Academic Affairs

Enclosure

cc: Governor Tommy Thompson
Members of the Wisconsin State Senate
Members of the Wisconsin State Assembly
Howard Richards, Secretary of the Department of Agriculture, Trade and Consumer Protection
Carroll Besadny, Secretary of the Department of Natural Resources
Patricia Goodrich, Secretary of the Department of Health and Social Services
Ronald R. Fiedler, Secretary of the Department of Transportation
President Kenneth A. Shaw
Executive Vice President Katharine C. Lyall
Chancellors
Vice Chancellors
State Groundwater Coordinating Council
UWS Groundwater Research Advisory Council

4355L

MEMORANDUM OF UNDERSTANDING
on the use of
UNIVERSITY OF WISCONSIN SYSTEM
GROUNDWATER RESEARCH FUNDS

I. PURPOSE

The purpose of this agreement is to establish procedural guidelines for the prioritization of groundwater research and the selection of research proposals to be funded through the 1989-91 biennial $500,000 appropriation to the University of Wisconsin System (UWS) for groundwater research; and to establish the coordinative relationship between the University of Wisconsin Groundwater Research Advisory Council (GRAC) and the Groundwater Coordinating Council (GCC) and the procedure to be followed in seeking release of funds being held in an unallocated reserve in the Department of Administration consistent with legislative and gubernatorial intent.

II. BACKGROUND

Included in the Governor's 1989-91 biennial budget as a major budget recommendation for the University of Wisconsin System was a base biennial appropriation of $500,000 to support groundwater research activities. It is the Governor's intent to support groundwater research to at least this level on a continuing basis and it is the UW System's intent to assure that these resources be used for groundwater research consistent with statewide priorities.

An important part of the Governor's recommendation was the caveat that these funds "be held in an unalloted reserve pending joint agreement between the UW and the Groundwater Coordinating Council on the use of the funds." Under Section 325 of the Biennial Budget Bill, 20.285 (1) (a), Wisconsin Statutes, is amended to include the statement that "The board of regents may not expend or encumber amounts appropriated under this paragraph for groundwater research without the approval of the secretary of administration." And, under Section 2418 of the Biennial Budget bill, s.160.50 (1m) is created to read, "The groundwater coordinating council shall advise the secretary of administration on the allocation of funds appropriated to the board of regents of the university of Wisconsin system under s. 20.285 (1) (a) for groundwater research."

In 1984, the Legislature enacted Wisconsin Act 410 with the intention of improving the management of the state's groundwater. The Groundwater Coordinating Council (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 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."

In October of 1986, the GCC unanimously endorsed a resolution which requested that "the University System establish a committee with broad representation from appropriate campuses and disciplines involved in groundwater protection". This committee was expected, among other things, to: a) review the proposed groundwater research Decision Item Narrative (DIN) and other proposals; b) establish priorities for research in collaboration with and for consideration by the Groundwater Coordinating Council, to include regulatory agencies' priorities as well as basic and applied research needs; c) establish a proposed plan for undertaking research needs; d) develop a DIN for research; and, e) submit it to the Groundwater Coordinating Council for possible endorsement. At that time, the GCC also noted that the University, in its role as the major research arm of the state, is best qualified to present the GCC with its interpretation of the groundwater protection research priorities for review and discussion. And, that a unified priority listing of the research needs from the highly qualified and diverse water specialists of the University System in conjunction with identified priority needs of the other state agencies would allow the GCC to establish a coordinated research agenda for the state.

In response to the resolution passed by the GCC in October 1986, the President of the University of Wisconsin System charged UW-Madison Chancellor Donna Shalala with the responsibility of establishing a UW System Groundwater Research Advisory Council (GRAC). In January 1988, such a council was appointed with membership from five UW institutions, four state agencies, and four private organizations. To enhance communication with the Groundwater Coordinating Council, four members of that body were appointed to GRAC as members or ex-officio members.

Research needs and interests have been identified through sub-committees of GRAC and GCC and GRAC's sub-committee on research is working on research prioritization. The UW System groundwater research DIN included in the 1989-91 biennial budget was based on these research needs and was reviewed and endorsed by the GCC. GRAC is now in the process of defining more specifically the research priorities within which project proposals will be submitted and reviewed and for future research activities. To improve coordination, the chair of the GCC research sub-committee will be a member of the GRAC sub-committee on research.

Several existing agency processes for solicitation and review of research proposals have been reviewed and discussed as possible models and it was recommended that some parallelism be developed with respect to the research funding being made available in the UW System budget.

Further, there was general consensus that it would be in the best interest of all parties involved, as well as the state, if a process could be developed wherein all project funding, such as the DNR's management practices monitoring funds (approximately $350,000 annually), DATCP's funds for managing pesticides (approximately $125,000 annually), and the new UWS groundwater research funds (approximately $250,000 annually) could be coordinated. This would eliminate potential duplication, improve coordination, enhance complementarity, permit a more focussed approach to critical issues, and provide better direction to potential proposal writers. It has also been agreed that all aspects of research through the spectrum from applied to basic is needed to address existing groundwater problems, to minimize the impact of pollution, and to provide guidance on future practices and usages in order to reduce, if not eliminate, further degradation of our water resources. A working sub-committee of GRAC has been appointed to develop such a process.

III. PROCEDURAL AGREEMENT

Unless there is specific legislative action in future biennial budgets to amend the appropriation, the University of Wisconsin System will allot, under conditions stated above, $500,000 per biennium for groundwater research. Within the context of the background description, it is agreed that the following procedural steps will be followed in assuring a coordinated, prioritized groundwater research thrust and in meeting the review and approval process specified by statutory language.

A. Following the development of research priorities by GRAC through its sub-committee on research, those priorities will be shared and discussed with the GCC.

B. Upon agreement between the UWS and the GCC on the list of groundwater research priorities, GRAC will proceed with the formalization of procedures for selection of research projects and the call for pre-proposals.

C. A research oversight committee (appointed by GRAC) will screen the pre-proposals for compatibility with pre-determined groundwater research priorities. Full proposals would be requested when such compatibility has been established.

D. The research oversight committee would assure that each proposal has been submitted for peer evaluation by at least two individuals.

E. Based on the peer reviews, the research oversight committee would rank the proposals into three categories: 1) those with highest rating and worthy of being funded, 2) those which have an intermediate rating and would be funded only if specific project is ranked high within this group and if funds were available, 3) those with lowest rating and which should not be funded.

F. Upon completion of this categorization, the category 1 list and any proposals recommended for funding from the category 2 list would be submitted to GRAC and then shared with the GCC, along with a clear statement on how each relates to the research priorities previously agreed upon. Upon implementation of the inter-agency (UWS, DNR, DATCP) coordinated process for project funding the GCC would have available at least three lists of projects to be funded and they would then be able to make observations on possible overlap, duplication, etc. The GCC would not be empowered to approve or disapprove specific proposals but a very important coordinative function will have been performed.

G. Assuming that no serious inter-agency problems exist, that the set of projects being proposed is consistent with the priorities agreed upon, and that the total funding level is within the approved budget, the GCC and the UW System shall jointly submit a request to DOA for release of the funds being held for support of groundwater research.

H. An annual summary of research progress and findings shall be provided to all interested parties. This report will be written in a manner which will permit a broad spectrum of the lay public to understand the issues, the relationship of these issues to the public good, and any recommendations or results emanating from the research. Provisions must be made, therefore, for a skilled, professional writer with a scientific background who can work with the principal investigators on their individual reports and then synthesizes and collates each into a final report which provides to the reader the elements cited above.

IV. EFFECTIVE DATE

This agreement is effective when signed by all authorized representatives of the parties to this agreement.

V. AMENDING AND TERMINATING THE AGREEMENT

The GCC, the GRAC, or the UWS may propose an amendment to this agreement by notifying the other parties. Either the UWS or GCC may rescind the agreement upon 30 days written notice to the other party.

Lyman F. Wible

Lyman F. Wible, Chair
State Groundwater Coordinating Council (GCC)

7/6/89
Date

Orlo R. Ehart

Orlo Robert Ehart, Chair
UWS Groundwater Research Advisory Council (GRAC)

7/6/89
Date

Eugene P. Trani

Eugene P. Trani, Academic Vice President
University of Wisconsin System (UWS)

7/7/1989
Date

GROUNDWATER COORDINATING COUNCIL MEETING

Noon on August 18, 1989

Conference Room, DNR Dodgeville Area Office

1. Introductions
2. Minutes from April 21, 1989 meeting
3. List of Subcommittee Members
4. Annual Report to the Legislature
5. Needs assessment for WGNHS drill rig - Ron Hennings
6. Representatives for 1990 conference on groundwater policy
7. Status of monitoring/research projects - DNR, UW, DATCP
8. Status of NR 140 amendments and NR 141 - David Lindorff and Kevin Kessler
9. Groundwater Fund audit - Kevin Kessler
10. UW Center for Pesticide/Nutrient Management - David Jelinski
11. Agency Reports
12. Next meeting November 10, 1989 in Madison

Groundwater

Protecting Wisconsin's buried treasure

CONTENTS

Written by Maureen Mecozzi

Technical assistance:
Wisconsin Geological and Natural History Survey: Ron Hennings, Ken Bradbury
Central Wisconsin Groundwater Center: Chris Mechenich
Wisconsin Department of Natural Resources: Kevin Kessler, Bill Rock, Al Lulloff, Lee Boushon, Paul Huebner, Rudy Teschan, Cathy Cliff, Dennis Yockers, David L. Sperling, W. Jeffrey Smoller
Department of Agriculture, Trade and Consumer Protection: Jeff Postle

Thanks to the United States Geological Survey; Wisconsin Department of Industry, Labor and Human Relations Office of Division Codes & Applications; Wisconsin Association of Conservation Districts; National Wildlife magazine; National Well Water Association; Wisconsin Department of Agriculture, Trade and Consumer Protection agricultural statistics staff; and the authors of "Groundwater — Wisconsin's buried treasure" for information used in this publication.

FRONT COVER: Photo of a flowing artesian well in Door County by Ken Bradbury.

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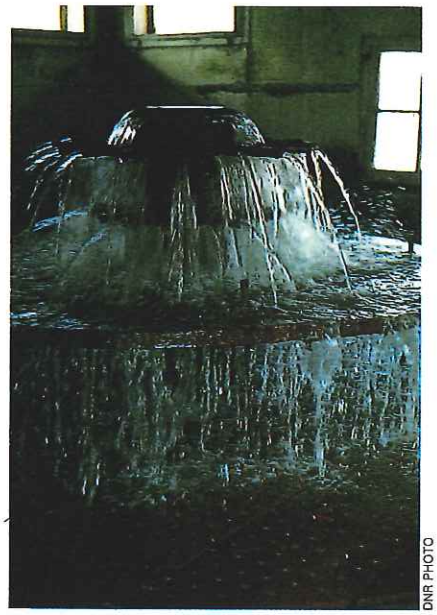


DNR PHOTO

Walk on water? Difficult if you're not divine. Yet it's something you do every day.

Under the sidewalk, below the garden path, beneath the baseball diamonds, hiking trails, the front lawn and the back 40, there is water: *groundwater* — about two quadrillion (2,000,000,000,000,000) gallons, give or take a pint, under Wisconsin alone. If that water were solid gold, it'd be one heck of a buried treasure.

Maybe standing above all that liquid is making you wish life preservers were standard equipment on humans. May we suggest a glass of water to keep your head above...you know.

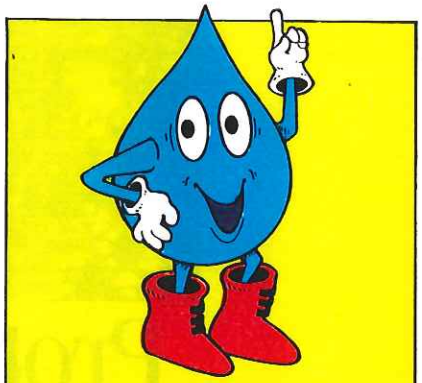
Open the tap and fill your cup. It's probable that you're sipping groundwater drawn from a private or public well: Nearly 75 percent of Wisconsinites rely on groundwater for drinking. It's a plentiful and cheap source of potable water.

Perhaps a juicy cheeseburger and crisp french-fried potatoes would hit the spot. Before you take a bite, remember that nearly every drop of water used to irrigate Wisconsin crops, plus a great deal used in milk and beef production, comes from groundwater reserves. Agriculture, manufacturing, brewing and a host of other industries depend on reliable, pure groundwater.

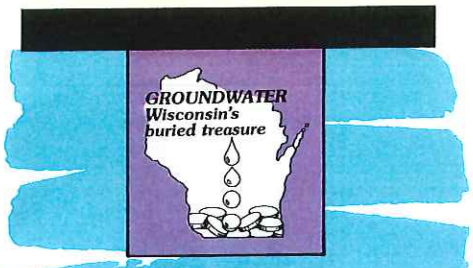
Wisconsin's famed lakes, rivers, streams and wetlands attract people from all over the world, so it's no surprise that tourism is an important part of our economy. Without groundwater, however, some of those water bodies wouldn't be as appealing and others would cease to exist. You can't fish, swim, ski, sail or canoe on mud or dry land.

As you go about your daily activities — taking out the garbage, preparing supper, filling the car's gas tank — consider the liquid treasure buried below your feet. It's a vulnerable resource, susceptible to hazards such as leaking underground gasoline tanks, chemicals misapplied on farm fields, and poorly constructed, mismanaged landfills.

Protecting groundwater from these and other dangers is everybody's responsibility. In 1983, Wisconsin Natural Resources published "Groundwater: Wisconsin's buried treasure" to introduce this valuable resource. We've returned to the subject in "Groundwater: Protecting Wisconsin's buried treasure" to let you know what is being done to safeguard groundwater and what you can do to help. Each of us in Wisconsin is a beneficiary of the groundwater treasure; we must learn to be its guardian.



Look for the water drop, your guide to the truth about 10 common groundwater myths!



Using groundwater

Wisconsin is water-rich...

Welcome to Wees-kan-san — Chippewa for "gathering of waters." Each year about 29 trillion gallons of water fall as rain or snow on Wisconsin's 36 million acres. Some is consumed, some returned to the atmosphere by evaporation or transpiration by plants and the rest flows into rivers, lakes and streams or seeps into the soil.

KEN BRADBURY

Freed by a well, water once trapped in layers of rock and soil spurts to the surface. Wisconsin has a plentiful supply of groundwater, but it's distributed unequally across the state.

If you could somehow pour all the water below ground on top, you'd need to trade in your ranch house for a houseboat: Wisconsin's bountiful groundwater could cover the whole state to a depth of 30 feet!

Every day, Wisconsinites withdraw about 570 million gallons of this seemingly endless resource from private and public wells. Our wells seldom go dry because groundwater is replenished at the rate of six to 10 inches per year.

So why be concerned about groundwater? There's plenty, more than we could possibly use, right? There'll always be pure, clean groundwater for drinking and food processing, for livestock and paper production, for beer-making, car-washing, two showers a day, ice cubes, soda, mineral water, swimming pools and birdbaths, right?

Read on.

...but the quality and quantity of groundwater varies from place to place

In Wisconsin, there's a difference in groundwater abundance from west to east and areas in between. The difference is caused mostly by geology, as you'll discover later in this publication. But here's an example to tide you over:

Cities and towns in the north central and northeastern third of Wisconsin receive the most precipitation in the state. But they are underlain by crystalline bedrock, a type of rock formation notorious for yielding only small quantities of water. Even though there may be plenty of surface water, finding spots here that hold enough groundwater to supply large-capacity wells can be difficult.

Shallow wells can be affected by seasonal changes in the amount of rainfall and may go dry during times of drought. Deeper wells often tap aquifers, or layers of water-bearing rock, where the quantity of water remains relatively constant.

At last estimate, there were about 700,000 private wells operating in the state. Even though there are areas where soil or rock yield water very slowly, you can drill a hole just about anywhere in Wisconsin and find a dependable water supply.

The supply may be dependable, but that doesn't mean it's drinkable. Groundwater can be contaminated in a number of ways. Leachate from poorly constructed landfills trickles

into groundwater. Pesticides may pass through the soil and into the groundwater in low but sometimes toxic concentrations. Improperly managed fertilizer and farm animal wastes increase nitrate levels in rural wells. Septic systems built too close together can cause nitrate problems in subdivision wells. Naturally-occurring contaminants such as radium may render groundwater unfit to drink. Road salt can taint the groundwater supply. Drop by drop, gasoline and fuel oil stored in rusting underground storage tanks pollute this abundant resource all over the state.

ICONOGRAPHIC COLLECTION, STATE HISTORICAL SOCIETY OF WISCONSIN

Beckey Spring near Eau Claire (French for clear water) refreshed Chippewa Valley residents for many years.

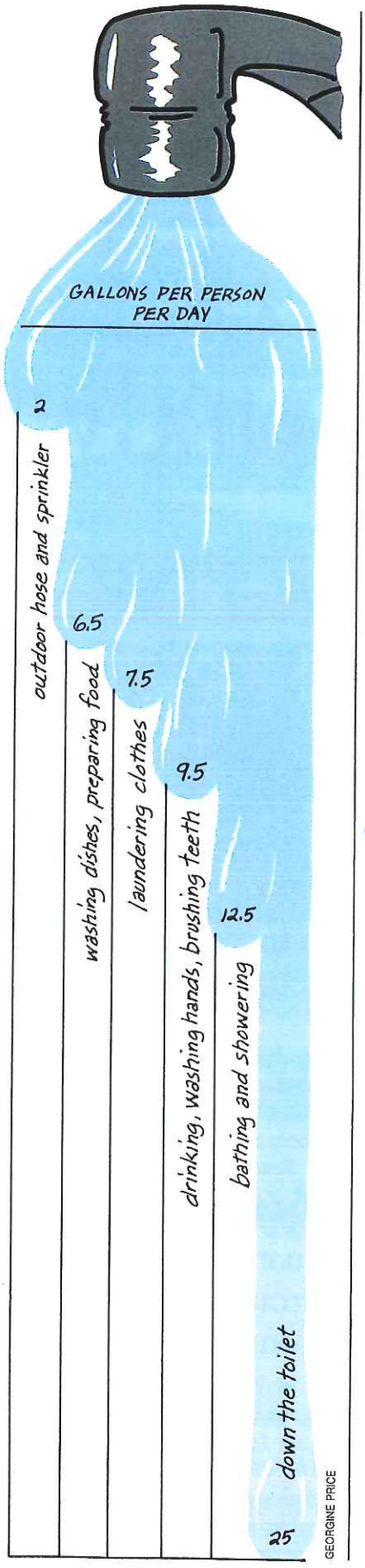
Stricter laws and improvements in technology have advanced the state of groundwater protection; you'll read about them here. And you'll find out how you can take action at home as well.

On the home front

About three-fourths of Wisconsin's residents draw nearly 222 million gallons of groundwater daily at home to slake thirsts, scrub pots, boil spaghetti, rinse hair, soak socks and fill balloons.

Per person, that's 63 gallons of groundwater per day.

How do you use Wisconsin's ample buried treasure? Take a look at the faucet.



GEORGINE PRICE

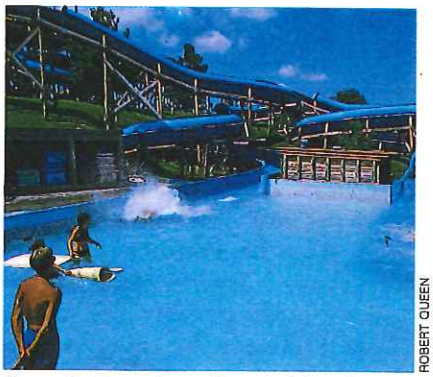
Sixty-three gallons of groundwater per person per day may not seem like much, considering the depth of our underground coffers. To some folks, conserving water seems about as sensible as spitting into the Pacific Ocean to raise the water level. What difference does it make?

There are hidden costs for excessive water use. Your community may have to install new wells or water and sewer pipes to accommodate increasing demand. Pumping more water requires more energy, which costs more money. Treating wastewater to stringent standards of purity strains every budget, private or municipal. You can take a real bath on your property taxes when the bill for new sewers arrives!

The less water you use, the fewer new water-related facilities you or your community will need to build and the longer good, pure groundwater will remain affordable. (On page 25, you'll find details on drinking water quality and tips for water conservation.)

Thirsty cities

It's used to fight fires, clean streets, fill the local pool, sprinkle golf courses and parks, drench dry boulevard trees, supply commercial customers and satisfy the needs of thirsty residents at home or at innumerable bubblers (drinking fountains, to non-Wisconsinites) around town. Ninety-seven percent of Wisconsin's cities and villages count on groundwater to provide basic water-related services often taken for granted.


ROBERT QUEEN

Groundwater makes a big splash in cities and villages statewide.

Wisconsin's municipal groundwater tab: A cool 275 million gallons per day. The top counties and main users: Dane County (Madison) 42 million gallons per day; La Crosse County (La Crosse), 20 million gallons per day; Rock County (Janesville and Beloit), 19 million gallons per day.

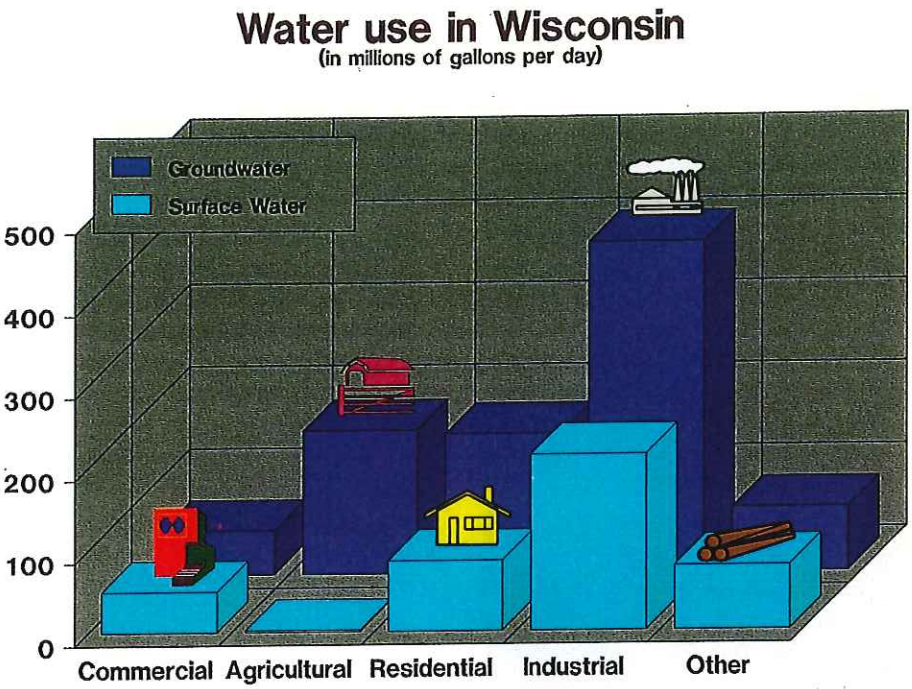
Average daily cost to a family of four in 1989: Less than 50 cents.

A fluid economy

Water is vital to the health of Wisconsin's economy. It's part of countless manufacturing processes, from metal fabrication to paper production to leather tanning. When water purity isn't critical to the final product, companies located near larger bodies of water have the option of using surface water. But some of our most important industries — fruit and vegetable processing, cheesemaking, dairy farming, meat processing and brewing — need pure, clean groundwater to make the goods for which Wisconsin is nationally renown.

We'd never be able to remain leaders in producing canned snap beans and sweet corn or in cheese and butter production without groundwater. There's no way Wisconsin breweries could have produced 15,066,979 barrels of beer in 1988 without ample groundwater resources.

The big operators aren't the only ones who need this valuable resource. Consider your local laundromat and car wash, the soft-drink bottlers, restaurants, health clubs, hairdressers....



data from "Water Use in Wisconsin, 1985"
U.S. Geological Survey and Wisconsin DNR

ROBERT QUEEN

The beverage that made Wisconsin famous couldn't be brewed without good groundwater. This vat at Middleton's Capital Brewery is being filled with water to begin the next batch of beer.

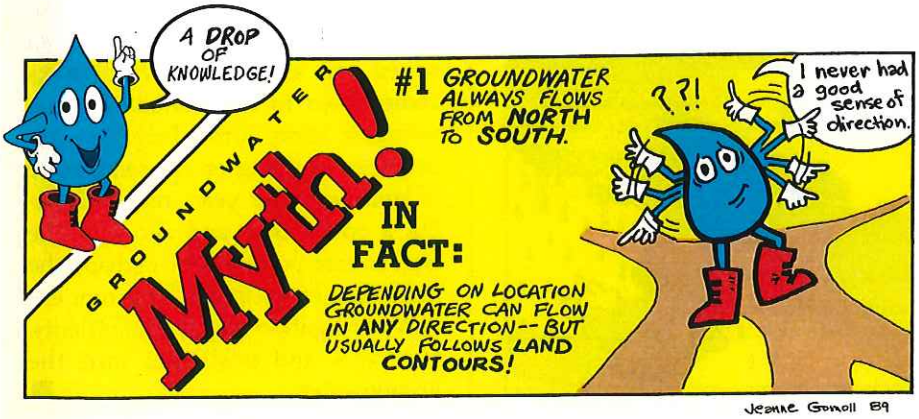
Commercial and industrial companies draw over 40 million gallons of groundwater each day from their own wells and use about 150 million gallons more provided by municipal water systems. Groundwater supplies nearly one-third of Wisconsin's business and industrial water needs — an important partner in Wisconsin's economic stability and future.

Wet and wild

2,444 trout streams.
5,002 warmwater streams.
14,949 inland lakes.
5,331,392 acres of wetlands.

These figures add up to a $4 billion boost to Wisconsin's economy, provided by thousands of tourists who visit the state each year to enjoy, among other things, our fabulous water resources. What they don't see is our most fabulous water resource of all: Groundwater.

After seeping through the soil and rock, groundwater discharges in low places where the water table meets the land surface — streams, lakes and wetlands. That favorite fishing hole or secret pond, the expanse of cattails perfect for observing herons and singing along with the frogs, those wild rapids waiting to devour the raft



or roll the kayak — most are replenished by groundwater.

It's Wisconsin's invisible natural resource.

GERARD STEPHANEK

Copper Falls near Mellen: Like most rivers in Wisconsin, the Bad River is replenished with groundwater. Here it plunges over hard basalt, creating a spectacular sight.

Aquaculture?

Take a short test: A dairy cow producing 100 pounds of milk daily slurps 45 gallons of water each day to wet her whistle. There are roughly 1,840,000 cows in the state. How much water will they drink in a year?

If you said 30,222,000,000 gallons, you pass. For extra credit, how much of that water was groundwater?

Ninety-six percent? Good guess!

Wisconsin's dairy and cattle farms use about 90 million gallons of groundwater a day to water stock, maintain a high level of sanitation in the milkhouse and all-around cleanliness on the farm. Dairy farmers know that bringing a quality product to market means starting with quality materials — wholesome, nutritious feed and pure, clean water.

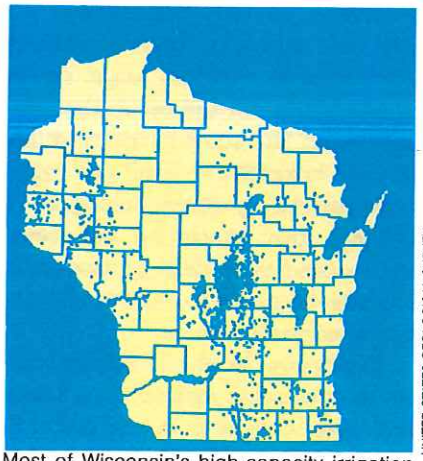
DNR PHOTO

Wisconsin's irrigated acreage has nearly doubled in the past 20 years. Irrigation may ensure a successful crop, but excessive watering can leach fertilizers and pesticides into groundwater.

The demand for groundwater on the farm continues to rise as increasing numbers of farmers install irrigation systems to make the risky business of farming more certain. In 1969, 105,526 acres of Wisconsin farmland were irrigated; by 1987, that figure rose to 284,637 acres.

Irrigation equipment withdraws about 84 million gallons per day during the growing season, almost all of it groundwater.

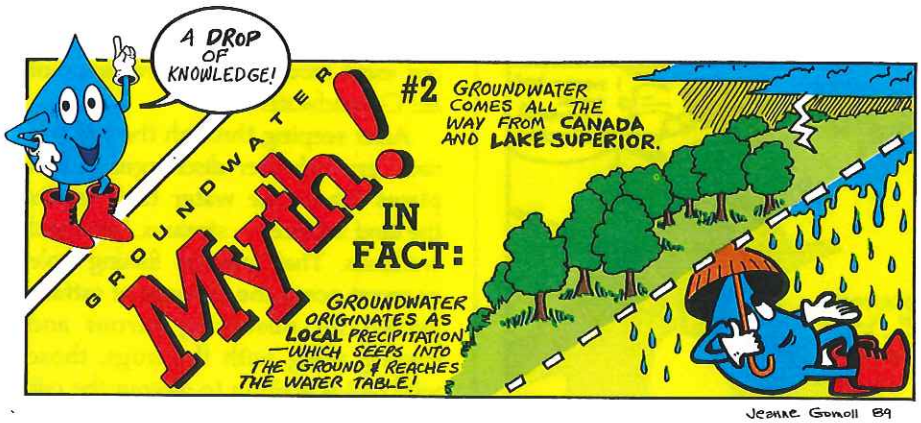
Much of Wisconsin's irrigated acreage is in the relatively flat 10-county Central Sands area, where the potato is king. The tuber grows well in the sandy, loose soil, which needs less plowing and seedbed preparation than heavier soils and makes for an easy harvest. Water quickly seeps into this permeable soil and drains away almost as fast, allowing the plant roots to breathe and preventing rot. But the sandy soil doesn't hold water well, so irrigation is almost essential to ensure a good crop.

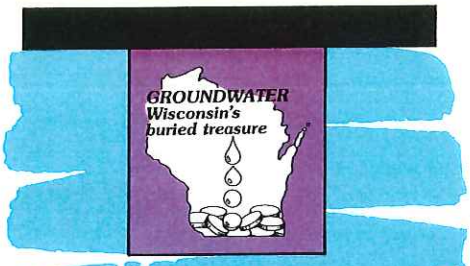


UNITED STATES GEOLOGICAL SURVEY

Most of Wisconsin's high-capacity irrigation wells are clustered in the 10-county Central Sands area and other areas with permeable sand and gravel aquifers.

While irrigation has helped formerly marginal lands turn a profit, there is a cost. Increased irrigation can speed soil erosion as windbreaks come down to accommodate wide-swinging spray arms. Irrigation encourages cropping on the same piece of land year after year, instead of using a cover crop and allowing the land to rest periodically. Perhaps the most dangerous in the long run: excessive irrigation may leach nutrients, fertilizers and pesticides into the groundwater. ■





Understanding the resource

The water cycle

Water might be called our most recycled resource. The water you showered in this morning, for example, may have contained the same water molecules that caused a dinosaur's hide to glisten in the prehistoric sun or carried the *Nina, Pinta* and *Santa Maria* across the Atlantic. The distribution of the earth's total supply of water changes in time and space, but the quantity has remained constant.

Uneven water distribution is governed by a phenomenon known as the hydrologic cycle, which is kept in motion by solar energy and gravity.

Pick a bursting cloud as the start of the cycle. As the rain it sheds falls to earth, some flows downhill as runoff into a stream, lake or ocean. Some evaporates; some is taken up by plants. The rest trickles down through surface soil and rock formations, traveling through pore spaces and open cracks. This water eventually reaches the top of a water-saturated layer of soil or rock called the water table. The water contained in the saturated layer below the water table is called groundwater.

Groundwater seeps from upland to lowland areas and is released, or discharged, in lakes, streams and wetlands — low places where the water table meets the land surface. The sun releases energy, causing evaporation from surface waters. The process that returns water to the atmosphere from water and land surfaces and by the activity of living plants is called evapotranspiration. When water vapor accumulates in the atmosphere and clouds begin to form, the hydrologic cycle begins anew.

Wisconsin receives an average of 30 to 32 inches of precipitation per year. Seventy-five percent of that precipitation evaporates or transpires through plants and never reaches surface or groundwaters. The six to 10 inches that do not evaporate immediately or get used by plants run off into surface waters or soak into the ground, depending on local topography, soil, land use and vegetation. For every one inch of water that runs off the land to a stream or lake in gently rolling Dane County, two inches seep down to the water table; in the sandy plains of Portage County, nine inches are able to seep into the ground for each inch running off the land.

All groundwater moves continually toward an area of discharge, but the rates of movement vary greatly.

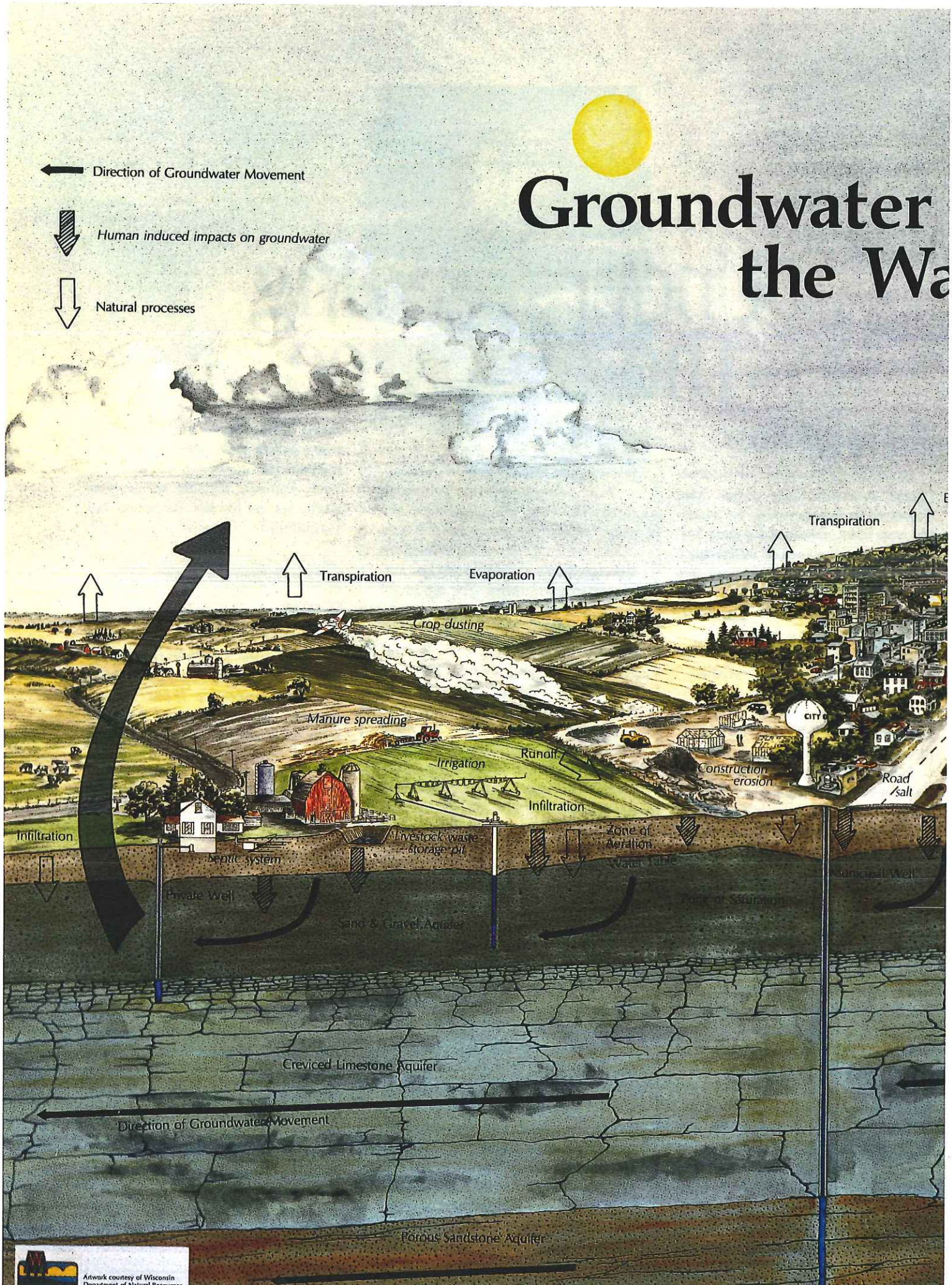
The reason for this variability is a matter of geology. The size of the cracks in rocks, the size of the pores between soil and rock particles and whether the pores are connected contribute to the rate of movement to, through and out of the saturated zone.

Water generally moves more quickly into, through and out of coarse sand, sometimes as much as several feet per day. Openings between the grains are large and interconnected, resulting in high permeability. Very fine-grained material like clay has many pores where water can be stored, but the pores are so small that moving water through or out is difficult. Clay formations are relatively impermeable — water may move only a few inches a year. Permeability in limestone, on the other hand, primarily depends not on pore spaces but on the size, frequency and distribution of fractures and cracks.

Groundwater on the move

As groundwater moves through the water cycle, it follows the slope of the water table. In Wisconsin, the natural movement is from upland recharge areas to lowland discharge areas. Most precipitation seeping into the soil moves only a few miles to the point where it is discharged; in the vast majority of cases, it stays within the same watershed.

Perhaps you've wondered why some streams continue to flow during dry periods and in winter, when there's no rainfall. Winter stream flow is largely groundwater discharge (called base flow), which remains at a relatively constant temperature year 'round — about 50° F. Streams, and most lakes and wetlands, are constantly replenished during the winter by groundwater from the surrounding uplands. The water table steadily lowers during the winter discharge period, and it is not until the following spring thaw that water can once again infiltrate the soil to recharge the groundwater and thus cause the water table to rise. By the way — that same 50° F groundwater base flow is the reason trout streams stay icy cold in summer.


Direction of Groundwater Movement
Human induced impacts on groundwater
Natural processes
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Transpiration
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Crop dusting
Manure spreading
Irrigation
Runoff
Construction erosion
Road salt
Infiltration
Infiltration
Livestock waste storage pit
Septic system
Zone of Aeration
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Private Well
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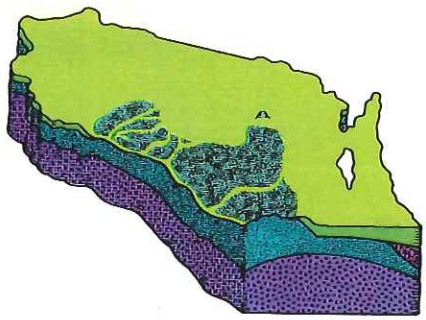
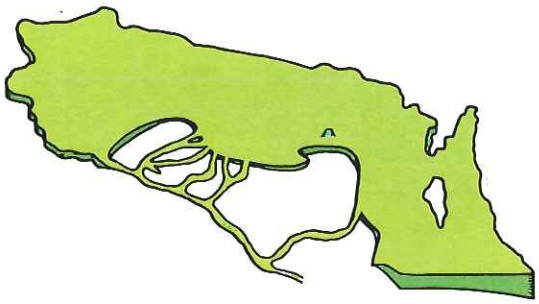
Direction of Groundwater Movement
Porous Sandstone Aquifer
Artwork courtesy of Wisconsin

ıd Land Use in r Cycle





Sand and gravel aquifer

The sand and gravel aquifer is the surface material covering most of the state except for parts of southwest Wisconsin. It is made up mostly of sand and gravel deposited from glacial ice or in river floodplains. The glacial deposits are loose, so they're often referred to as soil — but they include much more than just a few feet of agricultural loam. These deposits are more than 300 feet thick in some places in Wisconsin. Groundwater collects and moves in the pores and open spaces in between the grains of sand and gravel.

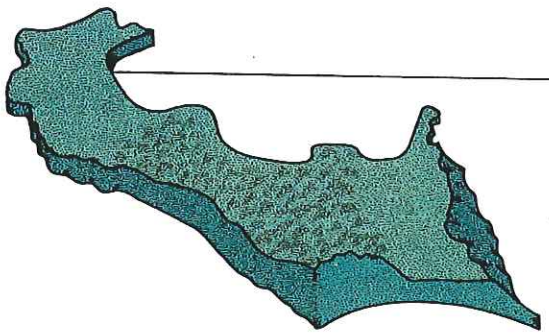
The glaciers, formed by the continuous accumulation of snow, played an interesting role in Wisconsin's geology. The snow turned into ice, which reached a maximum thickness of almost two miles. The ice sheet spread over Canada, and part of it flowed in a general southerly direction toward Wisconsin and neighboring states. This ice sheet transported a

Eastern dolomite aquifer

The eastern dolomite aquifer occurs in eastern Wisconsin from Door County to the Wisconsin-Illinois border. It consists of Niagara dolomite underlain by Maquoketa shale.

These rock formations were deposited 400 to 425 million years ago. Dolomite is a rock similar to limestone; it holds groundwater in interconnected cracks and pores. As a result, the water yield from a well mostly depends on the number of fractures the well intercepts. Closely spaced wells, therefore, can vary greatly in the amount of water that can be pumped.

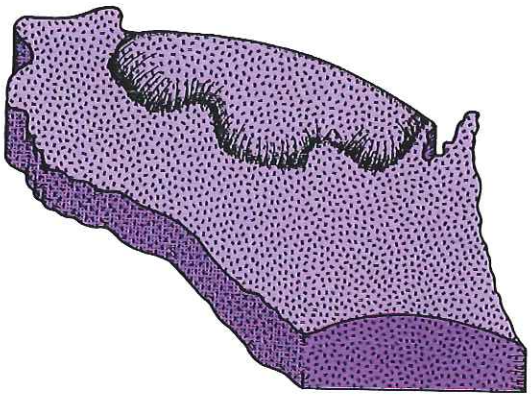
Where the fractured dolomite bedrock occurs at or near the land surface, the groundwater in shallow por-



Sandstone and dolomite aquifer

The sandstone and dolomite aquifer consists of layers of sandstone and dolomite bedrock that vary greatly in their water-yielding properties. In dolomite, groundwater mainly occurs in fractures. In sandstone, water occurs in pore spaces between loosely cemented sand grains. These formations can be found over the entire state, except in the north central portion.

In eastern Wisconsin, this aquifer lies below the eastern dolomite aquifer and the Maquoketa shale layer. In other areas, it lies beneath the sand



Crystalline bedrock aquifer

The crystalline bedrock aquifer is composed of a variety of rock types formed during a geologic time called the Precambrian Era, which lasted from the time the earth cooled more than 4,000 million years ago, until about 600 million years ago, when the rocks in the sandstone and dolomite aquifer began to be formed. During this lengthy period of 3,400 million years, sediments, some of which were rich in iron and now form iron ores, were deposited in ancient oceans; volcanoes spewed forth ash and lava; mountains were built and destroyed, and molten rocks from the earth's core flowed up through cracks in the upper crust.

The rocks that remain today have a granite-type crystalline structure. These are the "basement" rocks that underlie the entire state. In the north

Wisconsin's aquifers

A rock or soil formation that can store or transmit water efficiently is called an aquifer. The state's groundwater reserves are held in thick, permeable layers of soil and rock. These layers are our four principal aquifers: the sand and gravel aquifer, the eastern dolomite aquifer, the sandstone and dolomite aquifer, and the crystalline bedrock aquifer.

great amount of rock debris called "drift."

As the ice melted, large amounts of sand and gravel were deposited, forming "outwash plains." Pits were formed in the outwash where buried blocks of ice melted; many of these pits are now lakes. The sand and gravel aquifer was deposited within the past million years.

The sand and gravel outwash plains now form some of the best aquifers in Wisconsin. Many of the irrigated agricultural lands in central, southern and northwestern Wisconsin use the glacial outwash aquifer. Other glacial deposits are also useful aquifers, but in some places, large glacial lakes were formed and over time, accumulated thick deposits of clay. These old lake beds of clay do not yield or transmit much water.

Because the top of the sand and gravel aquifer is also the land surface for most of Wisconsin, it is highly susceptible to human-induced and naturally-occurring pollutants.

tions of the eastern dolomite aquifer can easily become contaminated. In those areas (such as parts of Door, Dodge and Waukesha counties), there is little soil to filter pollutants carried or leached by precipitation. Little or no filtration takes place once the water reaches large fractures in the dolomite. This has resulted in some groundwater quality problems, such as bacterial contamination from human and animal wastes. Special care is necessary to prevent pollution.

The Maquoketa shale layer beneath the dolomite is a rock layer formed from clay that doesn't transmit water easily. Therefore, it is important not as a major water source, but as a barrier or shield between the eastern dolomite aquifer and the sandstone and dolomite aquifer.

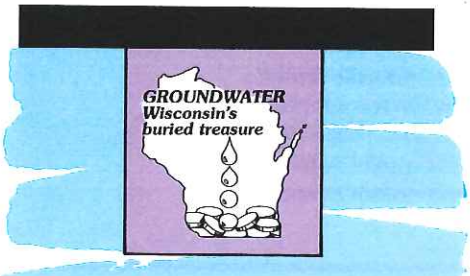
and gravel aquifer. These rock types gently dip to the east, south and west, away from north central Wisconsin, becoming much thicker and extending to greater depths below the land surface.

The rock formations that make up the sandstone and dolomite aquifer were deposited between 425 and 600 million years ago. The sandstone and dolomite aquifer is the principal bedrock aquifer for the southern and western portions of the state. In eastern Wisconsin, most users of substantial quantities of groundwater, such as cities and industries, tap this deep aquifer to obtain a sufficient amount of water.

central region, they are the only rocks occurring beneath the sand and gravel aquifer.

The cracks and fractures storing and transmitting water in these dense rocks are not spaced uniformly; some areas contain numerous fractures while others contain very few. To obtain water, a well must intersect some of these cracks; the amount of water available to a well can vary within a single homesite. The crystalline bedrock aquifer often cannot provide adequate quantities of water for larger municipalities or industries.

Many wells in the crystalline bedrock aquifer have provided good quality water. However, most of these wells do not penetrate deeply into the rock. Water samples from deep mineral exploration holes near Crandon and deep iron mines near Hurley have yielded brackish water exceeding mineral concentrations in sea water. ■



Threats to groundwater

ROBERT QUEEN

When spilled, even small quantities of liquids like gasoline can contaminate groundwater in neighboring wells.

You name it — gasoline, fertilizer, paint thinner, bug spray — if it's used or abused by humans in large enough quantities and dissolves in water or soaks through soil, it's capable of showing up in Wisconsin groundwater at some place or time.

Dealing with contaminants once they get into the groundwater is no small feat. Sometimes it's nearly impossible to figure out where the pollution is coming from; in some cases, the source of the contaminants may never be found. Isolating the source of a groundwater contaminant is a complicated puzzle involving a combination of chemistry, hydrogeology and old-fashioned trial-and-error, process-of-elimination sleuthing.

If a specific source is found, there's no guarantee that the person or company responsible for the pollution will be willing or able to clean it up, nor that the contaminants can be removed economically. And, as you'll discover in this section, groundwater contamination can often be the end result of the normal, day-to-day activities of you, your family and your neighbors. Remember: What we do on top of the ground affects the water lying beneath it.

The use and misuse of pesticides

Insecticides, herbicides and fungicides have been a mainstay of Wisconsin agriculture for years; they've been perennial topics in the news as well. Aldicarb, atrazine, alachlor — it doesn't take long for agricultural chemicals to become household words once the problem of drinking water contamination hits home.

These aids to modern farming trickle into the groundwater in a number of ways. Use Farmer Brown as an example. He purchases his agrichemicals from a pesticide dealer. At the dealership, the chemicals have been stored in an outdoor shed, where undiluted product may leak from a few damaged or corroded containers and seep into the ground. That's one route of contamination.

Back at the farm, Farmer Brown mixes a batch of pesticide in a spray

Department of Agriculture, Trade and Consumer Protection specialists are investigating the impact of pesticide use on groundwater in vulnerable areas of the state.

DEAN TVEDT

tank. By accident, he sloshes some down the side of the tank; it runs into the soil. Route two.

To get an extra measure of protection for his crops, Farmer Brown adds a couple more ounces of pesticide concentrate to his spray tank, exceeding the recommended proportions. When he applies the mixture, he doesn't realize that the worn nozzles on his sprayer are releasing too much pesticide on the fields. That afternoon, there's a heavy rainstorm; the excess chemical soaks into the ground and works into the groundwater. Route three.

Route four: When he's done spraying, Farmer Brown rinses his tanks and hoses, letting the liquid soak into his fields without knowing how much chemical residue is filtering into his soil. Then, he takes the empty containers and tosses them into the town dump. But they're not totally empty. Since he neglected to triple-rinse the bottles or cans before disposal, they still contain concentrated pesticide, which eventually leaches into the water table. Route five.

Once they hit the ground, some ag chemicals are absorbed by plants; others are consumed by bacteria and rendered harmless. However, it's possible for others to slip past the bacteria and plants and enter the groundwater, where they may stay unchanged for an indefinite period of time, or break down into different, perhaps more toxic, compounds.

In the early '80s, researchers discovered traces of aldicarb, the preferred chemical for controlling potato pests, in Central Wisconsin wells. Aldicarb was the first pesticide found leaching into Wisconsin groundwater, from normal, routine application rather than accidental spills. While aldicarb use has been curtailed, the issue of its effect on human health is controversial and continues to be debated.

Farmers in the sandy heart of the state aren't alone in knowing groundwater contamination first-hand. A 1989 study of 534 wells on Grade A dairy farms around Wisconsin found levels of atrazine, a widely-used corn herbicide, in 66 wells. Although most of the levels were below the state's groundwater enforcement standard, there's still cause for concern: Atrazine has been classed by the U.S. Environmental Protection Agency as a possible carcinogen. Pesticide contamination isn't exclusively a rural problem: The lawn and garden pesticides used in urban areas can leach into municipal water supplies.

There's a lot we don't know about the physiological effects of drinking water from wells contaminated with agricultural chemicals: How much contamination causes harm? Are the health problems immediate or long term? Are children affected more than adults? Consequently, when contamination is found that exceeds groundwater standards, well owners may be advised to drink bottled water.

Landfills

As a society, we've just begun to appreciate the benefits of recycling, of viewing wastes as resources to be used and reused. But we'll always produce some waste. By storing all the wastes we can't recycle in properly sited, designed, constructed and maintained landfills, we can minimize the possibility that leachate (the foul, sewage-like substance that forms when water percolates through solid waste) will contaminate groundwater near homes and wells.

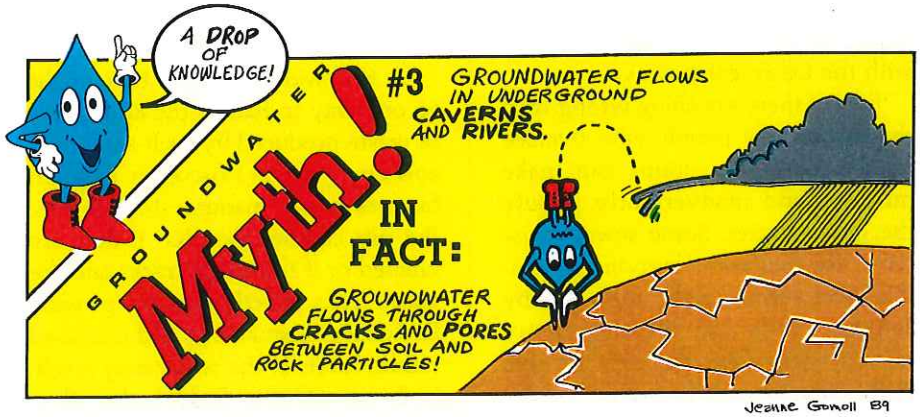
That's the ideal. There are about 150 such "engineered," licensed landfills operating in Wisconsin; most do a good job of protecting groundwater. Another 200 licensed landfills are required to monitor groundwater. But over 700 unengineered dumps "grandfathered" when landfill regulations were developed can't meet strict leachate collection standards. Many are slated to close within the next decade; until then, and for decades to come, unengineered landfills will allow toxic fluids to seep into groundwater.

DNR PHOTO

Closed after numerous violations, this poorly operated landfill may taint groundwater for years to come.

Poorly operated landfills contribute to groundwater contamination. Careless owners neglect maintenance schedules. Unscrupulous owners may take in waste they are not licensed to dispose of; unscrupulous customers may sneak in toxic or hazardous wastes underneath the usual load of trash. The result: Groundwater is sullied and rendered useless.

In addition, there are 2,700 known abandoned dumps in the state. Deserted before stiff regulations went into effect in the 1970s, these sites continue to leach contaminants into the groundwater. There are countless other hidden dumps in Wisconsin,



which often are discovered only after nearby wells are found to be polluted.

Ponds, lagoons and land disposal of wastewater

Municipal, industrial and private businesses use ponds, lagoons and other methods to store, treat and dispose of wastewater on their property. A familiar example is the common small community sewage plant, where a lagoon may be used as the final step in treatment before purified wastes are released into rivers or streams.

DNR PHOTO

Sewage treatment lagoons like this one near Barneveld in Iowa County need to be sealed to protect the underlying groundwater.

Lagoons are sealed with compacted clay soils or plastic liners. Nevertheless, old or malfunctioning lagoons can leak anyway. As inspections turn up these imperfect systems, they are repaired or replaced. Open-air lagoons also are subject to wet and cold weather, which can interfere with the treatment process.

Even if there's nothing wrong with the lagoon, the people who oversee lagoon sewage systems can make mistakes and inadvertently pollute the groundwater. Some sewage systems use treatment lagoons to oxidize and settle solids, followed by seepage cells for filtering away treated wastewater through the soil. If the lagoons are improperly maintained or treatment is not complete, poorly treated wastewater can wind up in groundwater.

Some industries dispose of their wastewater in lagoons, by using it on irrigated farm fields near the plant, or by constructing a "ridge and furrow" system. This method directs wastewater down a one-foot wide, one-foot deep trench that looks like a long, ruffled potato chip. Some water is taken up by plants on ridges between the furrows and some evaporates, but most is filtered through the soil. No matter what the method, if the system is poorly managed, the operator fails to compensate for weather, or if more water is applied than the land can filter, the groundwater can be harmed.

Fertilizer and manure storage and application

A statewide cow-chip toss might be one way to handle the 80 pounds of waste produced by each adult milk cow every day in Wisconsin. Modern farmers prefer manure storage pits. But pits can be "the pits" if they are unlined or if the lining cracks and the waste leaks directly into the ground. Bacterial contamination and increased nitrate levels in the water may result, perhaps with the farmstead well as the first casualty. Neighboring farm water supplies could be harmed as well.

Excessive or improper application of manure and fertilizer to farm fields is Wisconsin's leading source of nitrate contamination in groundwater. Fertilizers used on urban lawns, gardens, parks and golf courses contribute to the problem, too.

LARRY BUNDY

Applying too much nitrogen fertilizer to crops can reduce farm profits and cause nitrate contamination in groundwater.

Nitrates — compounds of nitrogen and oxygen — get into groundwater with a little help from nature and a lot of help from people.

Plants completing their life cycle by rotting in soil add nitrates to groundwater. But so do failing septic tanks, wastewater from cities and industries, leaky landfills and manure storage pits, and heavy applications of manure or nitrogen fertilizers to fields and lawns. Overall, about 10 percent of Wisconsin drinking water wells exceed the state groundwater nitrate standard.

The good news is that nitrates are not usually harmful to adults or older children. In fact, we consume a great deal every day in our food. The bad news is that drinking water high in nitrates does threaten infants under the age of six months. Their stomach acid isn't strong enough to kill certain types of bacteria capable of converting nitrates to harmful nitrites. Nitrites bind hemoglobin in the blood, preventing oxygen from getting to the rest of the body; the baby may lose its natural color and turn blue. The result is methemoglobinemia, or "blue baby syndrome," which can cause suffocation.

The condition can be prevented by using bottled water during the child's first six months.

Septic systems

Private septic systems are used to treat human waste in areas not served by community sewage treatment facilities; nearly a half million septic systems are in use in Wisconsin. Here's how they work: Wastewater and solids flow from the house to a settling tank, then liquids continue out to an absorption field. Bacteria decompose solid waste in the tank, and as the wastewater passes into the absorption field, any suspended solids cling to soil particles and dissolved nutrients become available to plants.

Malfunctioning systems can cause wastewater to back up into the home, "pond" on the soil surface, or move directly into the water table without adequate purification. When a system fails, bacteria, nitrates, viruses, synthetic detergents, household chemicals, and chlorides may contaminate groundwater.

Septic systems may fail due to poor siting, design, or construction; sometimes, it's the owner who's at fault for neglecting important operating and maintenance guidelines. (Check page 26 for tips on operating a safe septic system.)

Hoisting the lid of a septic tank to see if it's time to pump out the sludge. Even properly maintained systems may pollute groundwater if they're built too close together or in areas where the water table is near the surface.

LISBETH QUADE

DNR PHOTO

An abandoned well is a direct line to groundwater. Old, unused wells should be filled in and sealed before bacteria or other contaminants get in.

Abandoned and drainage wells

Years ago, wells were dug by hand with picks and shovels, then lined with bricks, boards or stones. Dug wells were gradually replaced by "well pits" — a six- to 10-foot-deep hole through which a point was driven or a well drilled. The temperature in the underground pit remained relatively constant and kept the pump and pipes from freezing in the winter.

Although thousands of dug wells and well pits are still in use, many have been abandoned. If not properly filled, these forgotten wells give surface water a direct channel to groundwater; should the well seal leak, bacteria and other contaminants can get into nearby water supplies. Well pits — used or unused — tend to fill with surface water in the spring. And old dug wells offer a tempting place to throw refuse that can cause pollution.

Drainage wells are used to draw water off sections of wet ground by piercing a clay layer, allowing surface water to run directly into the groundwater. These wells have been prohibited in Wisconsin since 1936, but they do turn up occasionally, often when a nearby well owner discovers a problem with his or her water supply.

Spills and illegal dumping of industrial and commerical chemicals

Paint thinners, degreasers, electroplating solutions, dry cleaning fluids — they're the blood of industry and commerce. But when these solvents and fluids trickle into groundwater, they can contaminate the precious liquid that keeps us all alive.

Accidents happen — over 1,000 spills of toxic or hazardous materials are reported each year in Wisconsin. Luckily, many of those spills are small and can be cleaned up quickly, before an unwanted substance penetrates groundwater.

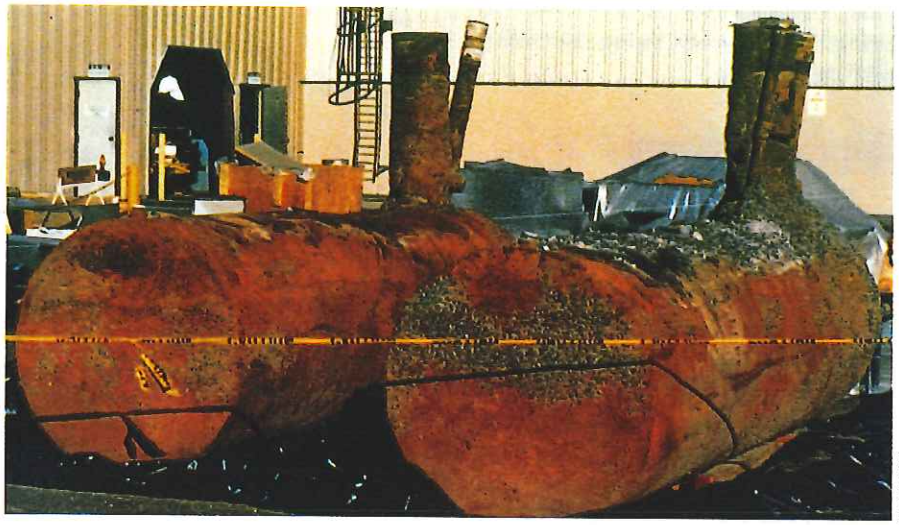
Oftentimes, the first people on the scene of a spill don't know how to deal with the problem. Their first reaction is to flush the area with water and dilute the offending chemical, washing it into the ground and perhaps into the groundwater.

An undetermined number of additional spills go unreported, their presence a secret until area wells become polluted. Although there are strict regulations governing the transport and storage of toxic and hazardous wastes, illegal dumping of dangerous compounds continues.

DNR PHOTO

Cleaning up groundwater is a big, expensive job. At this site, contaminated groundwater will run through gravel-filled trenches, then be pumped out and treated.

The threat to groundwater from these toxic products is so grave that cleaning up spills, abandoned chemical dumps and sites where industrial chemicals have been improperly stored or disposed of has become a national priority. In Wisconsin, 32 sites have qualified for Superfund, a federal source of cleanup funds established in the 1970s. We rank 8th in the nation in Superfund sites; another 300 sites in the state are up for Superfund consideration.



EPA PHOTO

Rust and LUST: Corroding underground storage tanks leak gas, fuel oil and chemicals into the soil and eventually, groundwater.

Leaking underground storage tanks

People in the hazardous waste business call it LUST; for all of us, it spells trouble. Leaking underground storage tanks, most used to hold gasoline, diesel and fuel oil, are slowly corroding, releasing their contents into the soil and contaminating groundwater.

Thousands of Wisconsin's 140,000 underground tanks are leaking or have leaked in the past. More are found every year. Why? Many have exceeded their 20 to 30 year lifespan and have begun to rust as time and the elements take their toll. Even if a tank is carefully monitored, small leaks can go undetected for weeks, months or years, releasing thousands of gallons of liquid. It only takes a little gasoline in water to make it undrinkable; larger quantities seeping into wells or basements can cause explosions.

DNR PHOTO

Dye poured on the surface demonstrates how contaminants can move through soil to groundwater.

Sources of natural contamination

Minerals existing naturally in soils and rocks dissolve in groundwater, giving it a particular taste, odor, or color. Radium, radon gas, uranium, barium, fluoride, lead, zinc, iron, manganese and sulfur can be found at varying levels in Wisconsin wells.

The problem posed by most natural contaminants typically isn't one of safety, but aesthetics. High levels of iron in drinking water are found in

hundreds of places statewide. The iron stains plumbing fixtures and laundry, and gives drinking water an unpleasant taste and odor. Excess levels of fluorides, manganese, sulfur and lead are less common and more localized.

Natural contaminants lending a foul taste to drinking water may be confused with human-produced pollutants. Bacteria that digest iron, for instance, give off as a waste product a harmless slime that looks and smells like gasoline spilled on water.

Radium is present in some deep municipal wells in eastern Wisconsin; it's radioactive, and thus poses a risk for cancer. When levels exceed the drinking water standards set by the federal Safe Drinking Water Act, consumers are notified and advised to take precautions. Water softeners remove radium from water, but will increase sodium levels and the potential for leaching lead from solder into the water supply.

Radon, a naturally occuring radioactive gas, has been found in wells around Wisconsin. In many cases, the concentration of radon has been high enough to cause concern; the Environmental Protection Agency plans to set a standard for radon levels in water in 1990. Radon can easily be dispersed through aeration of water.

Groundwater cleanup

As you've read, groundwater contamination is often detected by a foul odor or taste in somebody's drinking water. An attempt is made to track down and stop the source of contamination and establish a new supply of drinking water if necessary.

It's usually impossible, however, to completely remove all traces of a groundwater contaminant and clean up the aquifer to a usable condition. The cost of even a partial groundwater cleanup can be enough to empty even the deepest of pockets.

One cleanup technique is to drill a recovery or extraction well. The contaminant seeps in with the groundwater, which is pumped out and treated. One well can cost thousands of dollars to drill; it may be necessary to drill scores of wells to handle a single site.

Another approach is to restrict use of the aquifer until natural dilution and organic processes purify the water — a slow method that may take years and prove unsuccessful if the site's hydrogeologic makeup is not thoroughly understood.

AL BROWN

Taking inventory of abandoned chemicals stored in leaky barrels at a bankrupt lubricant company in West Allis. Millions of dollars have been spent in Wisconsin in an attempt to clean up similar problems.

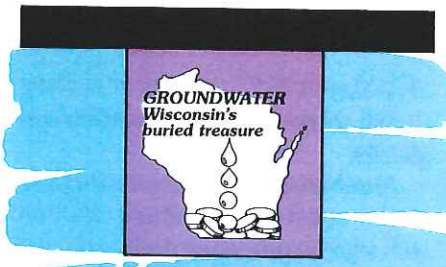
Who pays the bills for cleaning up groundwater? Who pays for repairing the facilities, drilling and casing deeper wells, extending municipal water lines and pumping out recovery wells? Who picks up the tab for bottled water and decreased property values resulting from contaminated groundwater? And who can put a price on the stress and worry engulfing families and communities whose once-reliable source of drinking water has been polluted?

Logically, the owner or operator of the contaminant source is the person who should pay for the cleanup. When a gasoline tank truck overturns, spill cleanup costs are paid by the owner. But in the case of abandoned dump sites, the original owners may be bankrupt, out of business, or dead. Pinpointing individual sources of sewage, pesticides, fertilizers and other widely-used or produced groundwater contaminants is a difficult, nearly impossible task. Who pays then?

You do — as a taxpayer and a consumer. Companies may charge higher prices for goods to cover pollution cleanup costs. Serious cases of groundwater pollution may be eligible for federal Superfund or LUST Fund money, which is supported mainly by taxes collected from producers of petroleum and chemicals. A portion of the taxes you pay also are earmarked for those funds.

Federal funds are used as enforcement funds, meaning that the owners, generators, transporters and operators involved with a contaminated site are subject to lawsuits to recover the cost of cleanup if they won't do it themselves. Funds from the federal programs enable the Department of Natural Resources to start site cleanups more quickly, before more damage is done; if the person or group responsible can pay, the money that's recouped can be used on other contaminated areas.

Not all Wisconsin sites are eligible for federal funds. That's why the Wisconsin Legislature created the Environmental Repair Fund (ERF), funded by your taxes and fees paid by industrial chemical users, producers and others. DNR staff use ERF to handle hazardous substance spills, pick up abandoned containers holding toxic products, investigate sites and undertake whatever monitoring and repairs are necessary. As of 1989, ERF has enabled the Department of Natural Resources to begin the cleanup process at 40 sites. ■



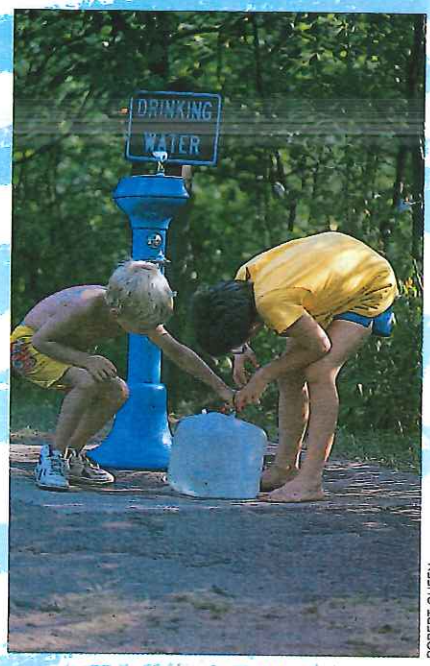
Protecting the resource

No doubt about it — it's easier and cheaper to prevent groundwater contamination than to clean up a polluted aquifer. Just as the threats to groundwater are many and varied, so are the methods used to protect groundwater. They range from tough laws to techniques you can use in your own home.

The GCC

When you think about all the diverse activities and events that can affect groundwater, it should come as no surprise that the responsibility for managing this buried treasure is delegated to many different government agencies. Cooperation is the key — and the Groundwater Coordinating Council (GCC) is the group turning that key.

Representatives from the departments of Natural Resources; Industry, Labor and Human Relations; Agriculture, Trade and Consumer Protection; Health and Social Services; Transportation; the University of Wisconsin; the Wisconsin Geological and Natural History Survey and the Governor's office serve on the council. Together, they've established a statewide management program to guide their groundwater protection efforts. The agencies distribute funds for groundwater research; set up groundwater monitoring programs; evaluate existing groundwater policies and programs and establish groundwater standards; exchange and catalog information related to groundwater; and seek to increase knowledge of the groundwater resource through public conferences, classes and educational materials.



ROBERT QUEEN

Protecting groundwater is easy when you've got a PAL

In Wisconsin, you can't dispose of wastes by injecting them down a well. Septic systems may only be put in by licensed installers; the soil must be tested first to make sure the system will work and a county inspector must approve and permit the project. Rules like these protect the health of water users and the water itself; they are continually reviewed, expanded and strengthened.

To extend the scope of rules governing groundwater protection, Wisconsin's comprehensive Groundwater Standards Law was enacted in May, 1984. It applies to all groundwater in the state and must be used by all state agencies involved with the resource. State programs for landfills, hazardous wastes, spills, wastewater sludge, septic tanks, salt storage, fertilizer storage, pesticides and underground storage tanks must comply with the standards.

Under the law, two standards — an "enforcement standard" (ES) and a "preventive action limit" (PAL) — are established for every substance already detected in groundwater or with the potential to reach groundwater. The substances may have an effect on health, or may simply cause taste, odor, color or other "public welfare" problems. As of 1989, standards for 50 substances of health concern and 10 of welfare concern have been established. The Department of Health and Social Services recommends ESs and PALs for substances related to health concerns; the De-

partment of Natural Resources develops standards for substances affecting public welfare.

ESs and PALs represent the concentration of a substance in groundwater. The PAL is either 10 percent, 20 percent or 50 percent of the ES, based on the effect the substance may have on health. Ten percent is used for cancer-causing substances, 20 percent for substances with other health effects and 50 percent for substances causing aesthetic or public welfare concerns.

For instance, the enforcement standard for perchloroethylene is 1.8 parts per billion (ppb); the preventive action limit is 0.18 ppb, or 10 percent of the ES. For nitrates the ES is 10 parts per million; the PAL is 2 ppm, or 20 percent of the ES. For iron, the ES is .3 ppm; the PAL is .15 ppm, or 50 percent of the ES.

The PAL serves two purposes. It's used to establish the codes for facility design (a landfill, for example) and set up rules for using certain products (such as pesticides) to prevent contamination right from the start.

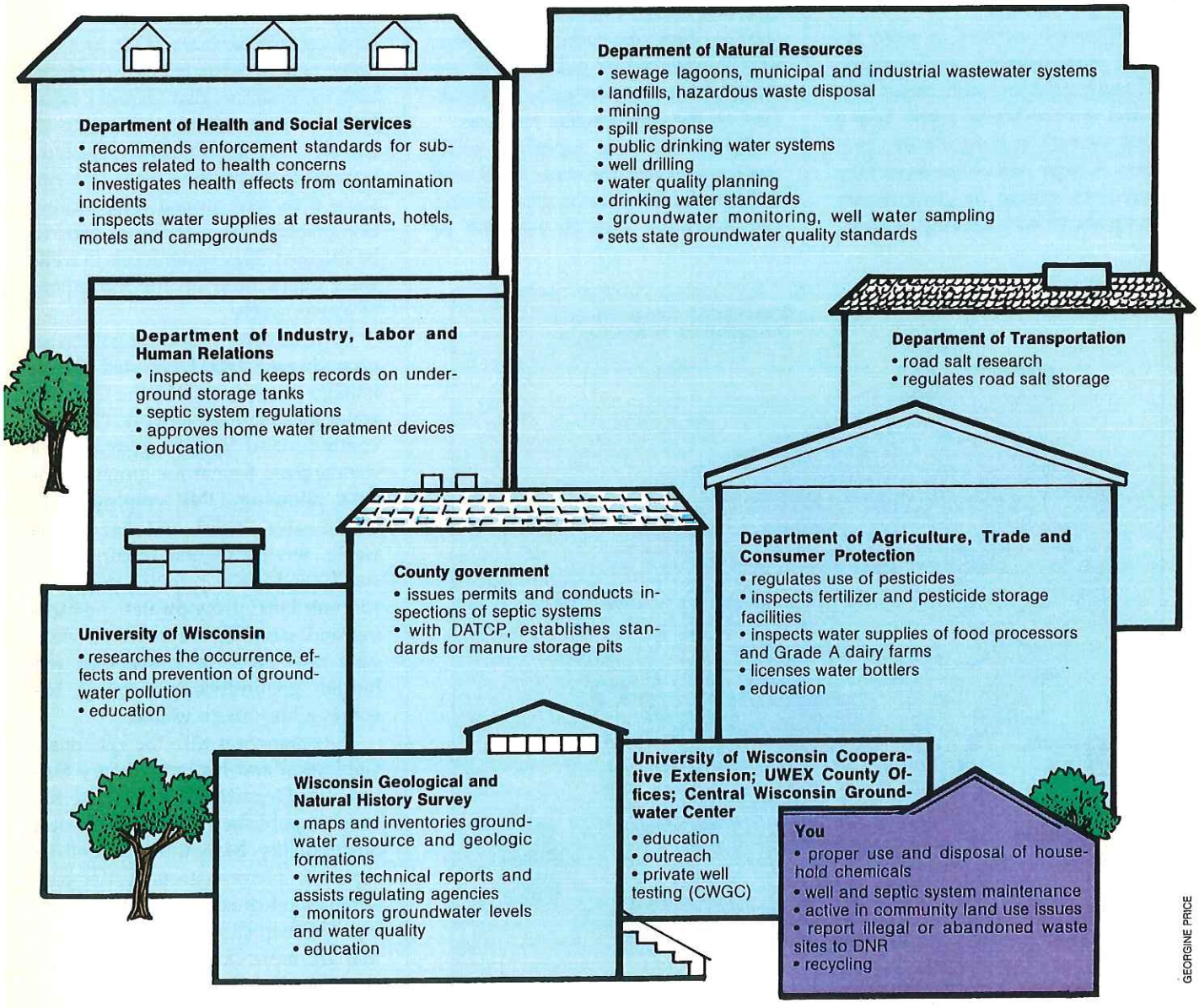
The second purpose of the PAL is to serve as an early-warning system. The red lights and buzzers go off to let state agencies know low levels of pollution are developing and that some action may be necessary to prevent those levels from increasing. PALs provide regulatory agencies with time to take preventive measures to ensure that the offending substance does not reach or exceed the enforcement standard.

If a substance has attained or exceeded its ES, the regulatory agency must stop the activity that's releasing the substance into the groundwater unless a way can be found to quickly bring the pollution level below the ES.

Committed to the resource

There's plenty of activity going on under the umbrella of the state

Who's in charge of groundwater protection?



GEORGINE PRICE

groundwater program, as you'll discover in this section: The regulatory agencies involved are committed to protecting Wisconsin's buried treasure now and for the future.

Department of Natural Resources

It's only natural that a resource like groundwater receives a lot of attention from the Department of Natural Resources. Everyday activities like solid waste specialists reviewing a site plan for a new landfill, wastewater technicians discussing water treatment options with a paper mill owner, foresters planting pine seedlings to rejuvenate an eroded slope, have an effect on the quality of Wisconsin's groundwater.

DNR people working in water resource management, wastewater, solid and hazardous waste, water supply and environmental repair take a special interest in groundwater protection. A large part of the work they do involves spying on groundwater from up above with the help of wells.

JIM ESCALANTE

DNR PHOTO

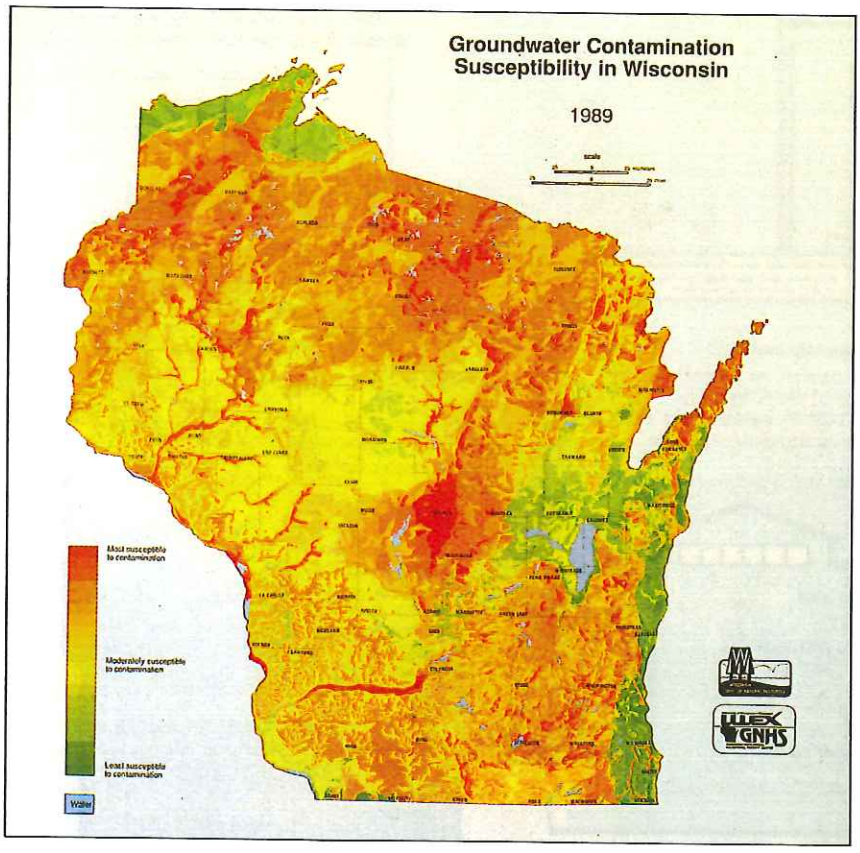
DNR employees on groundwater duty: Collecting water samples from a monitoring well in a landfill (left); testing leachate for conductivity to determine the amount of dissolved solids (right).

Specially drilled monitoring wells are used to check on a particular problem; existing private or public wells are sampled regularly to gather information on the groundwater resource.

By periodically sampling wells scattered around the state, DNR staff collect valuable data on groundwater contamination used to establish or adjust PALs and ESs. Wells reveal what contaminants are in the groundwater and at what levels — important information that dictates what kind of action will be necessary to alleviate a contamination problem. Data from monitoring wells also can show if current groundwater protection practices are working or need to be changed. Plus, water levels in wells yield information on the movement of groundwater.

To relax after collecting gallons of groundwater data, DNR staff like to indulge in a nip of GIN: the Groundwater Information Network. GIN is a computerized system providing a standardized format for groundwater data, allowing DNR employees in wastewater, solid and hazardous waste, environmental repair, water supply and water resource programs to contribute groundwater monitoring and sampling information. With each new piece of knowledge, the hidden groundwater resource becomes a little more visible.

In conjunction with the Wisconsin Geological and Natural History Survey, the Department of Natural Resources published the Groundwater Susceptibility Map, a useful tool designed to prevent groundwater contamination from occurring or worsening. The map shows areas of the state that are more (and less) sensitive to contamination because of the materi-



als overlying the groundwater. Soil characteristics, type of bedrock, depth to bedrock, depth to the water table and other data are incorporated into the map. By knowing the areas where groundwater is vulnerable, the state regulatory agencies can better plan groundwater protection activities and set priorities for action.

Wisconsin Geological and Natural History Survey

The Survey, the principal source for maps and records about Wisconsin's groundwater resources and related geology, supplies the state regulatory agencies with technical assistance and a wealth of information.

CENTRAL WISCONSIN GROUNDWATER CENTER

A technician decontaminates and rinses the bailer that will be inserted into a monitoring well to sample water for volatile organic chemicals in Wausau.

In addition to publishing the susceptibility map, the Wisconsin Geological and Natural History Survey has worked with the Department of Natural Resources to: locate the water table and map shallow aquifers using ground-penetrating radar, study the effects of drainage ditches on groundwater flow in central Wisconsin, and examine the movement of groundwater in fractured rock in Door County. WGNHS helped the Department of Agriculture, Trade and Consumer Protection by installing 45 monitoring wells for a recent pesticide study and assisted the Department of Industry, Labor and Human Relations in evaluating permit requirements for private sewage systems.

The Survey houses a collection of well cuttings and rock samples from around the state — "hard" evidence of what's hidden below the ground you walk on. County studies of geology and groundwater are produced by the survey for use by anyone interested in the hydrology of a specific area. Survey geologists and cartographers are mapping Wisconsin's bedrock and collecting data to present a clearer picture of the glacial geology of the state.

Department of Transportation

To keep Wisconsin from slipping on a wintertime source of groundwater pollution, the Department of Transportation has set standards for the storage of road salt. Storage sites must have an impermeable base with adequate drainage as well as an impermeable cover; a holding basin must be nearby to contain any runoff. All salt storage facilities are owned by county government; the DOT works side-by-side with county road crews to prevent stockpiled road salt from leaching in concentrated amounts into the groundwater.

DEAN TVEDT

Uncovered mountains of salt are a thing of the past in Wisconsin. The Department of Transportation and county governments work together to prevent stockpiled salt from leaching into groundwater.

Department of Industry, Labor and Human Relations

Ensuring that underground storage tanks of all kinds don't leak keeps staff at the Department of Industry, Labor and Human Relations busy. The agency keeps records on over 130,000 tanks used to store gasoline, fuel oil, pesticides and other products; some tanks are inspected regularly. More tanks are added to the inventory every week.

DILHR has an interest in another kind of tank — septic tanks. The

agency writes and revises Wisconsin's plumbing code, an important part of which deals with private septic systems. With the help of county government officials, who are responsible for issuing septic tank permits and conducting regular inspections, DILHR keeps Wisconsin citizens healthy and Wisconsin's groundwater safe.

WENDY WOJNER

These spanking-new fiber glass underground fuel tanks were installed at the Janesville Oasis in 1988. The tanks will not rust and are less likely to leak than their old metal counterparts.

Department of Health and Social Services

Recommending ESs and PALs for substances in groundwater that can cause health problems is one way the Division of Health, Department of Health and Social Services works to protect groundwater and the people who drink it. Division of Health staff analyze data from toxicological (the harmful actions of substances on biological tissue) and epidemiological (the incidence and distribution of a disease within a given population) research to determine "how much is too much."

DHSS also inspects water supplies at restaurants, hotels, motels and campgrounds once every 12 to 18 months to ensure that they comply with safe drinking water standards.

SUSAN BERGQUIST

A barnyard with a series of terraces to channel animal wastes for proper storage. Sensible farm practices keep the bacteria and nitrates found in manure out of groundwater.

Department of Agriculture, Trade and Consumer Protection; University of Wisconsin-Extension

Agriculture depends on clean groundwater. To guard Wisconsin's buried treasure, the Department of Agriculture, Trade and Consumer Protection regulates the bulk storage of fertilizer and pesticides and conducts frequent inspections of storage facilities. DATCP works with county governments to establish standards for manure storage pits. Food processors and dairies come under close scrutiny from this department; they are inspected regularly for water purity and proper waste disposal methods.

Groundwater monitoring is a continuing process at DATCP; identifying the effects on groundwater from normal field application of fertilizers and pesticides is of particular interest.

To keep nutrients and pesticides out of groundwater, DATCP developed a technical bulletin entitled "Best Management Practices for Wisconsin Farms" with the help of the University of Wisconsin-Extension. This important bulletin offers recommendations to farmers on how and when to apply pesticides, nitrogen fertilizers and manure for maximum results with a minimum of groundwater contamination. Crop rotation, crop selection, scouting for weeds and pests and other non-polluting

DNR PHOTO

Students get a tour of a state-of-the-art landfill that is sealed and has a leachate collection system to keep contaminants out of groundwater.

farm management techniques are included in the text.

The UW-Extension works at the county and state level, offering lectures, demonstrations and seminars on groundwater protection to the people of Wisconsin.

Wisconsin's institutions of education

In the long run, education is the most important tool we can use to safeguard groundwater, a fact recognized by the University of Wisconsin and other schools and colleges. Through traditional and interdisciplinary coursework, students absorb the background necessary to pursue careers in research, hydrogeology, wastewater management, soil science and other disciplines vital to groundwater protection. Environmentally safe methods of farming can be explored in UW agricultural "short courses" and classes on sustainable agriculture.

Groundwater education doesn't stop at Wisconsin's schools. People from all the agencies participating in the groundwater management plan know their jobs are only half done if you don't know what they've been doing. They also know that groundwater is too big and too important a resource to be handled alone. They need your help.

That's why they attend town meetings to talk about local groundwater issues. That's why you'll find groundwater exhibits at fairs and farm progress days. That's why there are "Clean Sweep" toxic waste collection days, and brush-up classes for county soil inspectors, and booklets on how to take care of private septic systems and wells.

If you've got any questions, just ask!

Research: A closer look at groundwater

Getting a good idea of what's going on underground isn't easy when you're stuck up above — that's why research is crucial to groundwater protection. The collected facts and figures now available paint only a partial portrait of the groundwater resource; it's difficult to make important decisions about groundwater use with limited knowledge. As new information from surveys, tests and experiments filters in, the picture becomes more complete.

State agencies involved with groundwater protection are conducting two kinds of research. *Basic research* seeks to define the distribution, movement and chemistry of Wisconsin's groundwater. *Applied research*, which relies on a strong foundation of basic groundwater knowledge, is directed toward solving specific problems and developing or improving methods, products and materials used in groundwater management.

KEN BRADBURY

Wells are the "eyes" of groundwater researchers. Mike Lembcke of the Wisconsin Geological and Natural History Survey pierces the soil with a drilling rig; the new well will reveal another drop of knowledge about groundwater.

The broad category of "contaminant transport" — how pollutants move and change in groundwater — has been the agencies' top priority for basic research in recent years. Understanding how contaminants move around underground and how they may be altered by minerals and organisms in the soil and groundwater will aid future cleanup efforts.

Researchers are especially curious about the vadose zone, the area of soil and rock just above the water table. Most all contaminants must move through the soil to reach groundwater; the chemical and physical processes occurring in the vadose zone determine which pollutants will leach through. As our knowledge of the vadose zone increases, we'll be able to improve groundwater protection techniques.

The University of Wisconsin plays a lead role in organizing and conducting groundwater research. UW soil scientists are studying the movement of nitrates, Wisconsin's most common groundwater pollutant, in the vadose and saturated zones. The transport of volatile organic chemicals (VOCs), which can have both short- and long-term health effects, is challenging staff at the UW and the departments of Natural Resources and Health and Social Services. Researchers at the Department of Agriculture, Trade and Consumer Protection and the UW are tracking the paths of aldicarb and other pesticides found in Wisconsin groundwater.

The information gleaned from basic research will help the Department of Natural Resources design better techniques for treating contaminated groundwater. The research also can be applied to the design, construction and operation of safer landfills; the development of regulations to govern the proper use and storage of pesticides; better measures to handle hazardous waste spills; and other methods to reduce or stop pollution at the source.

The Department of Agriculture, Trade and Consumer Protection wants to know if chemical residues are leaching into groundwater in nonirrigated areas at rates similar to irrigated areas. DATCP is investigating high-capacity irrigation wells to see if the wells are capable of changing groundwater flow and drawing contaminants down into lower zones of the aquifer.

Department of Industry, Labor and Human Relations researchers are examining the changes in groundwater quality and quantity under seepage beds of large wastewater disposal systems; the effects on groundwater from the use of perforated pipe for storm sewer drainage; and better methods of purifying home drinking water.

The biggest challenge facing the Department of Health and Social Services is determining the health effects of single and multiple contaminants in drinking water. Studies at DHSS focus on how atrazine and alachlor, two common pesticides, change or break down in groundwater and the effects the pesticides and their breakdown products have on human health.

The Wisconsin Geological and Natural History Survey conducts research on groundwater recharge processes in Wisconsin, soil characteristics that govern infiltration and recharge, the hydrogeology of glacial materials, and the flow of water in fractured crystalline rock aquifers and other geologic formations.

The Survey also is investigating the value of wellhead protection, a groundwater protection method that has been used successfully in Europe for years and is gaining popularity in the U.S. The method consists of restricting activities that have the potential to contaminate groundwater from areas near wells, well fields, and the recharge areas of the aquifers supplying water to the wells. The wellhead protection study will be conducted in two areas: over a fractured dolomite aquifer in Door County, where the focus will be on wellhead protection for farmers and rural homeowners, and over a fractured crystalline rock aquifer in Portage County, for a small community receiving groundwater from a single municipal well.

If you care about groundwater, but also like highways that are in "good winter driving condition" you'll be glad to know that the Department of Transporation is conducting research on de-icers to replace the sodium and calcium chlorides usually used on Wisconsin roads. Calcium magnesium acetate, a noncorrosive chemical manufactured from limestone and a mild acid, is one candidate that's been tested with good results.

A barnyard drains into this crevice in Door County's limestone bedrock. Monitoring wells have been installed to document changes in water quality from improvements in animal waste management practices on the farm.

AL LULLOFF

How to protect the groundwater you drink and use

You've read about what government and industry are doing to guard groundwater. Now, it's your turn.

Examine your own habits. Everyday activities can affect groundwater quality. Think about the ways you use water at home. If you've always considered pure, clean water to be a cheap, unlimited resource, chances are you're accustomed to wasting water and haven't been concerned about what you pour down the drain.

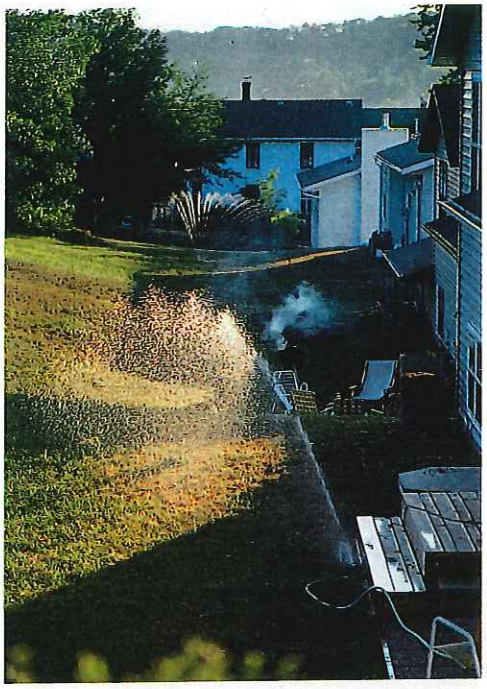
A little common sense will go a long way toward keeping Wisconsin's groundwater clean. Here are some ways to cut back on water use and protect groundwater:

1. *Household toxic wastes.* Don't use household drains as ashtrays, wastebaskets or garbage disposals! Toilets (and kitchen sinks, garage drains and basement washtubs) are not the places to discard old varnish, paint stripper, fats, oil, antifreeze, leftover crabgrass killer or any other household chemicals. Just because it's down the drain doesn't mean it's gone! These products may end up in your water supply, especially if you have a private septic system. Store your toxic products in tightly sealed containers in a safe, dry spot, share them with others who can use them, or bring them to the annual Clean Sweep event in your community (call your DNR district office for details.)

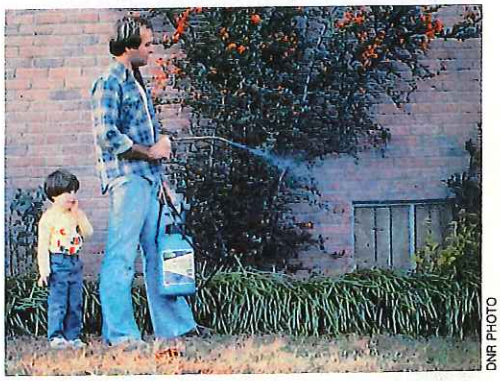
2. *Lawns.* Reduce or eliminate the use of lawn pesticides and fertilizers. Depending on your soil type, a significant amount of these chemicals can reach groundwater.

Water your lawn slowly, thoroughly and as infrequently as possible. Excess water can leach lawn chemicals into the groundwater. Water at night to minimize evaporation and help reduce high demands on water supplies during the day. Consider reducing the size of your lawn by adding trees, shrubs and ground covers.

3. *Recycle!* Reuse or recycle plastic bags and containers, aluminum cans, tin cans, glass, cardboard, newspaper, paper bags and other paper products. Don't dump waste oil down the drain or on the ground — bring it to community collection tanks where it will be picked up and reprocessed. Recycling conserves landfill space. Less garbage in the landfill means less harmful leachate that could contaminate groundwater.



ROBERT QUEEN



DNR PHOTO

If you water your lawn, don't overdo it. If you use yard fertilizers and pesticides, carefully apply the minimum amount necessary to achieve the desired results. Overwatering or heavy rains can leach lawn chemicals into groundwater.

DAN WILSON

These household products contain volatile organic chemicals. Follow label directions for use and if there are leftovers, dispose of them properly -- not down the drain or with the garbage, but at a Clean Sweep collection day.

ROBERT QUEEN

Pure, clean groundwater delights the neighborhood kids on a steamy summer day. By protecting Wisconsin's buried treasure today we can ensure its quality for future generations.

4. *Biodegradable soaps and cleansers.* Go easy on groundwater! Use soaps and household cleansers that are nontoxic and biodegradable. Or try these environmentally friendly alternatives: Baking soda on a damp cloth to scrub sinks, appliances and toilet bowls; a mixture of white vinegar and water for cleaning ceramic tile floors, windows and other glass surfaces; pure soap flakes and borax for washing clothes.

5. *Look for and fix leaks.* A dripping faucet can waste 20 or more gallons of water a day; a leaking toilet, several thousand gallons a year. An inexpensive washer is usually all you need to fix a leaky faucet. Toilet leaks can often be stopped by adjusting or replacing the inexpensive float arm or plungerball.

6. *Bathing and showering.* Turn off the water while soaping up during a shower to save extra gallons. Bathers should put the stopper in the drain before running the water, then mix cold and hot for the right temperature.

7. *Dishwashing.* Use the minimum amount of detergent needed to clean plates, glasses and silverware satisfactorily. If you wash dishes by hand, don't leave the water running while rinsing them.

Rinse dishes before stacking them in an automatic dishwasher. Make sure the dishwasher is full before you turn it on; it takes as much water and energy to wash a half-load as it does to wash a full load.

8. *Automatic washing machine.* Always set the fill level to match the size load you are washing. Remember: Full loads save water because fewer loads are necessary.

9. *Garbage disposals.* They're noisy, use a lot of water and electricity, and increase the amount of waste in the water going to the wastewater plant or septic system. Dispose of scraps in garbage cans. Better yet, compost your kitchen waste and use it as a mulch around yard plants to keep moisture in the soil.

10. *Use water-saving devices and appliances.* Toilet dams or inserts placed in the toilet tank retain water during flushing and can save up to three gallons per flush. A plastic bottle weighted with washed pebbles makes a good insert.

— a water-saving shower head can cut the amount of water used to about three gallons per minute without sacrificing the feeling of a good drenching.

— low-flow faucet aerators mix water with air and reduce the amount of water flowing from your sinks. Aerators are designed for either inside or outside threaded faucets, and use about 40% less water than a standard aerator.

Take care of your septic system. Even permitted and properly constructed septic systems can fail if the soil is highly permeable or the water table is close to the surface. Nature notwithstanding, you can keep a septic system in good working order by following these tips:

1. *Have your septic tank inspected once a year* to find out the level of scum and sludge that has built up; the tank should be pumped when the sludge and scum occupy one-third of the tank's liquid capacity. NEVER go into a septic tank — it may be full of toxic gases.

2. *Hire only licensed septic tank pumpers to clean out your tank.* They should pump through the manhole and inspect inlet and outlet baffles for any damage. County sanitarians will have the names of reliable septage haulers in your area.

3. *There are no known chemicals, yeasts, bacterial preparations, enzymes or other additives for septic tanks that will eliminate the need for periodic cleaning.*

4. *Be cautious about what you put in your septic system.* Ordinary amounts of bleaches, lyes, soaps, detergents and drain cleaners will not harm the system, but household chemicals like paint thinner, solvents, gasoline, oil and pesticides should NEVER be drained into a septic system. Once released in the absorption field, these toxic products can leach into groundwater and into your water supply.

5. *Never flush bones, coffee grounds, disposable diapers, sanitary napkins, cigarette butts or other materials that do not break down easily into a septic tank.*

6. *Avoid dumping grease down the drain.* It can build up in the tank and clog the inlet or the soil absorption field.

Properly locate and construct wells. Wells can be a safe, dependable source of water if sited wisely and built correctly.

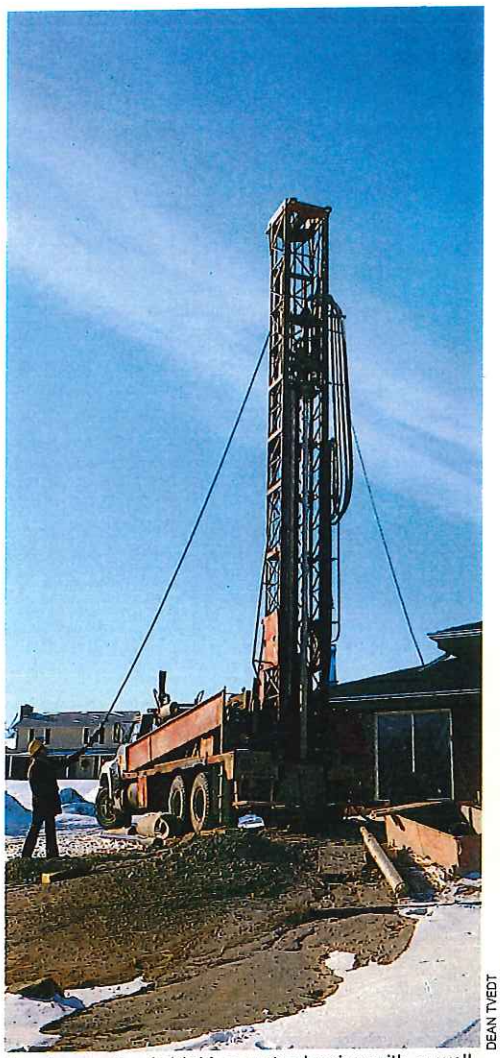
1. *Ask questions if you plan to drill a new well or intend to purchase property with an existing well.* Talk to your neighbors: Do they have any problems with their wells? How deep are wells in the area? Were there ever any contaminated wells in the area? How was the contamination taken care of? How was the land where you want to drill the well used in the past?

Talk to local government officials: What are the local laws governing private water supplies? Are housing densities low enough to ensure enough water for everyone's needs? Are there zoning restrictions limiting certain types of land use? What current land and water uses — irrigation, a quarry — in the area might affect your water quality or quantity?

2. *Consult the Wisconsin well code.* Established in 1936, the Wisconsin well code is administered by the Department of Natural Resources, which sets standards for well construction. The code lists the distances required between the well and septic tanks, sewage drainfields or dry wells, sewer lines, farm feedlots, animal yards, manure pits, buried fuel tanks, fertilizer and pesticide storage sites, lakes, streams, sludge disposal and other potential sources of contamination. Wells should always be located up the groundwater gradient and as far from these potential sources of contamination as possible.

3. *Hire reputable, experienced, licensed installers.* Wells should be drilled only by people registered with the Department of Natural Resources and holding current well driller permits. Pumps may be installed only by people holding DNR pump installer permits. No license is required if you construct your own well or install your own pump. However, state law requires that the work be done according to the state well code.

The well driller is responsibile for flushing the well, test pumping it, disinfecting it, collecting a water sample for bacteriological tests, sending a well constructor's report to the Department of Natural Resources and



DEAN TVEDT

A safe supply of drinking water begins with a well-built well.

DNR PHOTO

Encourage your local officials to sponsor Clean Sweep programs to collect and dispose of household hazardous wastes in your community.

ANNE SHORT

A picturesque hazard. Old wells allow contaminants to seep into groundwater; fill them in before problems begin.

DNR PHOTO

Attend meetings and hearings on land use and waste disposal issues affecting groundwater where you live.

providing the owner with a copy. This document contains a record of the soil and rock layers penetrated by the well and lists the work performed and materials used — important information to have on hand if your well is ever found to be contaminated. Reports collected over a period of time in one area can give researchers an idea of what's going on underground in a particular place.

A pump installer, if different from the driller, must disinfect the well and collect a water sample to check for bacteria.

4. *How often should I have my well tested?* Have your well tested for bacteria and nitrates annually, and at any other time if a change in odor, taste, color or clarity causes you to suspect contamination. Check for nitrates when infants use the water. (See side story, "How safe is my drinking water?")

5. *How do I fill in an old, unused well?* Fill and seal unused wells with concrete or bentonite, a type of clay. Your DNR district water supply staff, county sanitarian or local well driller can show you how to close off the old well to prevent groundwater pollution.

For copies of "You and Your Well" and "Rural Property: Protecting Your Investment and Wisconsin's Environment," write DNR Bureau of Information and Education, Box 7921, Madison, WI 53707.

Report illegal or abandoned waste sites or incidents of improper waste disposal. Your DNR water supply specialist relies on you to be the lookout for potential groundwater pollution. Don't hesitate to call DNR environmental response and repair staff if you see someone dumping waste illegally or find an old dump site with rusting, leaky barrels.

Get involved in groundwater management. Wisconsin has a good system of public hearings and reviews where you can express your opinions and learn more about local and statewide groundwater issues. Call DNR Dialog at (608) 267-7787 for a taped schedule of hearings.

Keep up with local land use and waste disposal issues. Increased housing density, commercial development, highway construction, landfills and other signs of modern progress may have an adverse effect on groundwater quality if not carefully planned and constructed. City, town or county governments may need to institute zoning regulations or prohibit or restrict activities that could endanger groundwater. Find out what the land-use issues are in your community and stay informed; encourage your neighbors to do the same. Attend community meetings and let your elected officials and utility operators know that provisions to protect groundwater must be the first step in any local land use or waste disposal proposal.

Who can answer my questions about groundwater?

There are people all over the state who want to help you understand Wisconsin's buried groundwater treasure.

DNR PHOTO

1. DNR water supply specialists at the six district offices can tell you more about the Wisconsin Well Code, show you how to disinfect your well, explain sources of contamination, sample wells, give advice on drinking water problems and the proper disposal of toxic household products.

Southern District
3911 Fish Hatchery Rd.
Fitchburg, WI 53711
(608) 275-3266

Southeast District
2300 N. Dr. Martin Luther King, Jr. Dr.
Milwaukee, WI 53212
(414) 562-9500

Lake Michigan District
1125 N. Military Ave.
Green Bay, WI 54307
(414) 497-4040

Western District
1300 Clairemont Ave.
Eau Claire, WI 54702
(715) 839-3700

North Central District
107 Sutliff Ave.
Rhinelander, WI 54501
(715) 362-7616

Northwest District
Highway 70 West, Box 309
Spooner, WI 54801
(715) 635-2101

2. The Wisconsin Geological and Natural History Survey has maps and other information on aquifers and rock strata. For a list of WGNHS publications, write: Wisconsin Geological and Natural History Survey, 3817 Mineral Point Road, Madison, WI 53705.

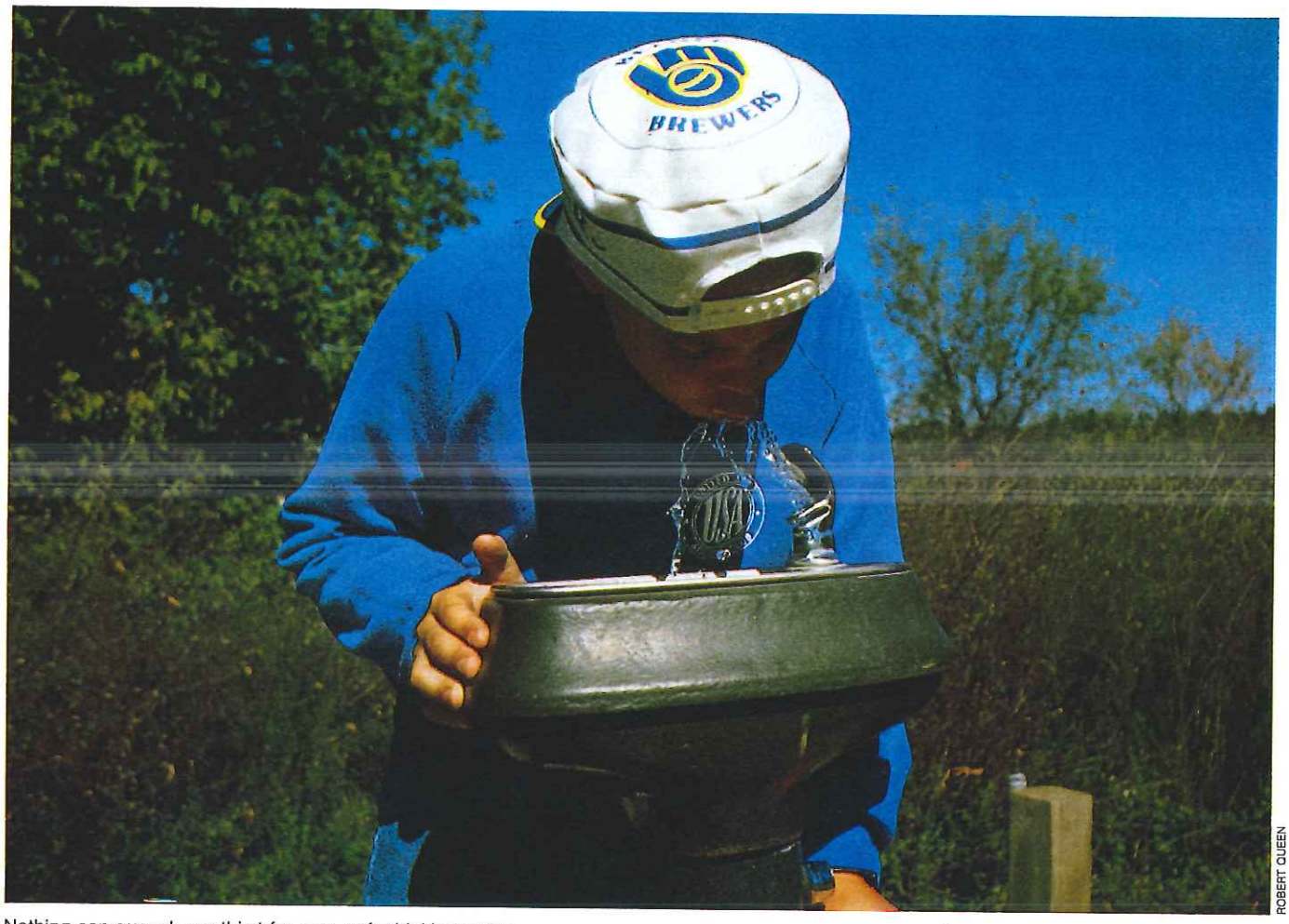
3. Your county University of Wisconsin-Extension office can help plan safe, functional farmyards and rural homesites. Call or write your extension office for booklets on safe drinking water, groundwater protection, best management practices for pesticide and fertilizer use and other topics. Look for the address and phone number under the county listing in the phone book white pages.

4. The Department of Industry, Labor and Human Relations has the details on proper septic system operation. Write DILHR, Office of Division Codes & Applications, P.O. Box 7969, Madison, WI 53707 and ask for publication SBD-7009, "Is the grass greener over your septic system?"

5. The Department of Agriculture, Trade and Consumer Protection offers information on best management practices for farms. Write DATCP, 801 W. Badger Rd., Madison, WI 53708.

6. The Central Wisconsin Groundwater Center is a clearinghouse for information on groundwater issues in Wisconsin's Central Sands area. The Center tests private wells, maintains a data base of private wells in the area and offers educational materials. Write CWGC, Room 010, Student Services Center, University of Wisconsin-Stevens Point, Stevens Point, WI 54481.

How safe is my drinking water?



ROBERT QUEEN

Nothing can quench our thirst for pure, safe drinking water.

Many Wisconsinites, urban and rural, are concerned about the quality of the water they drink, with good reason. As you've read in the preceding pages, threats to a pure water supply exist everywhere, the result of our daily activities. How do you know if your water is safe to drink?

If your water is supplied by a community water system, you can call your water system manager or DNR public water supply specialist and ask if the water quality meets state drinking water standards. Systems are required by law to keep data going back at least five years on bacterial counts, and 10 years for levels of organic and inorganic compounds and other water contaminants. System owners collect bacteria samples monthly and the Department of Natural Resources checks chemical and radiological quality every three to five years to ensure compliance with clean drinking water standards. When standards are exceeded, the system owner is required to give public notice to water consumers.

If you use a private well, the State Laboratory of Hygiene will test your drinking water for bacteria, nitrate or fluoride. The 1989 price is $7 for each test. The bacteria, nitrate and fluoride tests can be made from the same sample bottle of water. For a test kit, call the lab at (608) 262-1293 or write the State Laboratory of Hygiene, 456 Henry Mall, Madison, WI 53706. Private labs will also do these tests.

If you have reason to believe that your water has been contaminated by chemicals, contact your DNR private water supply specialist to investigate. Tests for chemical contaminants, such as volatile organic compounds or pesticides, must be done by private laboratories. Check the yellow pages under "laboratories" or "water analysis" or ask your DNR private water supply specialist for the phone number of a certified lab in your area.

DNR PHOTO

If you have a well, you should periodically collect a water sample and have it tested at a certified lab for bacteria and nitrates. Test kits with instructions are available for a small fee.

The cost will range from $30 to $1,000, depending on the number and type of chemicals analyzed and the lab's test methods.

If bacterial contamination has occurred, check for flooded well pits, broken seals, improperly abandoned wells in the area, especially old dug wells, quarries, any physical changes to the surrounding area, such as housing developments or landfills, or spills or dumping of wastes.

Wells can be disinfected by displacing all the water in the well with a mixture of bleach (containing at least 5 percent chlorine) and water or by dropping chlorine tablets or powder down the well. Constant chlorination is prohibited; the well must be replaced or reconstructed instead. (Write DNR Bureau of Water Supply, P.O. Box 7921, Madison, WI 53707 for literature on private well operation.)

If high nitrates are the problem, the well construction and location should be checked. Use bottled water or water low in nitrates for infants under six months old.

Wells can sometimes be deepened to get past the contamination. Inadequate well installations may be upgraded. Wells located in pits, for example, can be extended above ground and the pit filled in. These are costly options, however; it's best to have the work done properly in the beginning to avoid problems later. Your DNR private water supply specialist can give you advice on obtaining a safe drinking water supply.

If your water utility or a lab test alerts you to the presence of high levels of chemicals in your drinking water, you may be advised to drink bottled water or drill a new well. But what about low levels of contaminants? Will small quantities of benzene, a major component of gasoline, or perchloroethylene (PCE), a chemical used in dry-cleaning solvents, make your water undrinkable?

The answer is no. That's not to say, however, that the water is totally safe to drink. For instance, the Environmental Protection Agency estimates that one part per billion of PCE in drinking water could lead to one or two additional cases of cancer in a population of one million people who drink such water over a 70-year lifetime.

Contamination of drinking water, even at very low levels, should not be taken lightly, nor should the risks be exaggerated. To keep the risk of contamination as low as possible, public agencies and private citizens must continue to make tough decisions on what's worth the risk and what's not.

DNR PHOTO

New laboratory technology has allowed us to find contaminants in water at very low concentrations. As a result, we're now able to discover pollution problems that once were undetectable.

Groundwater glossary

Aquifer: A rock or soil layer capable of storing, transmitting and yielding water to wells.
Artesian: A condition referring to groundwater under sufficient pressure to rise above the aquifer containing it. Sometimes it produces flow at the surface.
Coliform bacteria: A group of bacteria found in animal feces or sewage whose presence in well water may indicate contamination carried by surface water to groundwater. Water containing high levels of coliform bacteria should not be consumed.
Dolomite: Calcium magnesium carbonate, a common rock-forming mineral. Many rocks in Wisconsin generally referred to as limestone are actually dolomite.
Aesthetic contaminant: A substance that gives water an objectionable appearance, taste or odor, but which does not by itself present a threat to health.
Evaporation: The process by which water is changed from a liquid or solid into vapor.
Evapotranspiration: Water returned to the atmosphere by evaporation from water and land surfaces, and by the activity of living plants.


DNR PHOTO

Geology: The science dealing with the origin, history, materials and structure of the earth, together with the forces and processes operating to produce change within the earth and on its surface.
Glacial drift: Sediment transported or deposited by glaciers or the water melting from a glacier.
Groundwater: Water beneath the surface of the ground in a saturated zone.
Hardness: Dissolved calcium and magnesium salts in water. Compounds of these two elements are responsible for most scaling in pipes and water heaters. Hardness is usually reported in milligrams per liter (mg/l). Zero to 60 mg/l is soft, 61 to 120 mg/l is moderately hard, 121 to 180 mg/l is hard and more than 180 mg/l is very hard water. For household water softening, hardness is usually expressed as grains per gallon.
Hydrogeology: The study of groundwater and its relationship to the geologic environment.


ALLEN F. HILLERY

Hydrologic cycle: The complete cycle through which water passes from the atmosphere to the earth and back to the atmosphere.
Hydrology: The science encompassing the behavior of water as it occurs in the atmosphere, on the land surface and underground.
Impermeable: Having a texture that does not permit water to move through quickly.
Infiltration: The movement of water into and through a soil.


DNR PHOTO

Leachate: A liquid formed by water percolating through soluble waste material. Leachate from a landfill has a high content of organic substances and dissolved minerals.
Limestone: A sedimentary rock consisting chiefly of the mineral calcite (calcium carbonate).
Oxidize: To combine with oxygen.
Permeability: The capacity of rock or soil to transmit a fluid, usually water.
pH value: A measure of alkalinity or acidity. The pH scale runs from 0 to 14, 7.0 being the neutral point. Numbers below 7.0 indicate acidity; numbers above 7.0 indicate alkalinity.
Potable: Fit to drink.
Risk assessment: Estimating the degree of harm people will face if exposed to a particular level or quantity of a substance.
Risk management: Balancing the physical, economic, social and political costs of reducing or eliminating a hazard to human health and the environment.
Runoff: Precipitation not absorbed by the soil.
Saturated zone: That part of a water-bearing layer of rock or soil in which all spaces, large or small, are filled with water.

Septic tank: A sewage settling tank in which organic solids are separated from wastewater flowing through the tank. The solids in the settled sludge on the bottom of the tanks are decomposed by bacterial action and the overflowing wastewater is dispersed into the soil through a drainage field.
Sludge: Sediment remaining after wastewater has been treated.


ROBERT KELLER

Spring: Natural discharge of groundwater at the surface.
Vadose zone: The area of soil and rock just above the water table.
VOC: Volatile organic chemicals. Commonly-used chemicals that evaporate rapidly when exposed to air but remain suspended in water. VOCs are found in fuels, grease removers, solvents, polishes, dry cleaning solutions and other products.
Water table: The level below which the soil or rock is saturated with water, sometimes referred to as the upper surface of the saturated zone.


DNR PHOTO

Well: A vertical excavation that taps an underground liquid-bearing rock formation. In Wisconsin, wells are drilled to obtain water, to monitor the quality of groundwater or to determine the depth of the water table.