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#107

RESULTS OF THE WISCONSIN DEPARTMENT OF AGRICULTURE, TRADE AND CONSUMER PROTECTION GROUNDWATER MONITORING FOR PESTICIDES

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July 1996

RECEIVED - DNR 1996 DRINKING GROUNDWATER

Purpose of the Study

The objective of this study is to determine the extent of groundwater contamination resulting from pesticide use in highly and moderately susceptible areas of Wisconsin. In this study highly susceptible areas are defined as having sandy soils, less than 25 feet to groundwater, and irrigation. Areas of moderate susceptibility are defined as having loamy soils and 15 to 50 feet to groundwater, with or without irrigation. The pesticides of interest are atrazine, alachlor, aldicarb, metolachlor, metribuzin, and several other compounds that have chemical characteristics and use patterns which make them relatively susceptible to leaching.

This study utilizes monitoring wells to evaluate the occurrence of pesticides in groundwater. Monitoring wells allow the investigation of pesticides in groundwater to be expanded beyond the limited zones of groundwater accessible by drinking water wells. This is consistent with the Wisconsin Groundwater Law which directs agencies to look at all groundwater, not just drinking water, when assessing contamination problems.

The results from this study are compared to the groundwater quality standards established in chapter NR 140 of the Wisconsin Administrative Code. A determination can then be made on which pesticides have the potential to enter groundwater at concentrations above groundwater standards. Under the Groundwater Law, the Department of Agriculture, Trade and Consumer Protection (DATCP) must adopt preventive rules, within its jurisdiction, to limit the presence of pesticide substances in groundwater. In order to fulfill this directive, DATCP must know the nature and extent of the problem.

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Materials and Methods

This study focuses on several pesticides that have a high potential to contaminate groundwater in Wisconsin based on use patterns and environmental fate characteristics. The chemical characteristics that increase the leaching potential are high water solubility, low binding to the soil and long persistence in the soil. If pesticides with these characteristics are used in susceptible areas, the potential for impacts on groundwater is relatively high.

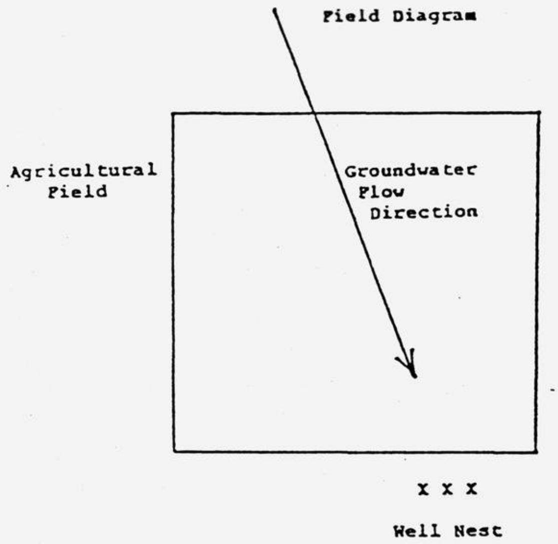
The monitoring sites are located in areas of high and moderate susceptibility throughout the state with site selection based on the following criteria: soil texture, depth to groundwater, appropriate pesticide use history, irrigation practices, and landowner cooperation. Conducting the study in highly susceptible areas is the most efficient way to identify potential problems. If certain pesticides are identified in the groundwater in highly susceptible areas, additional monitoring can then be conducted in progressively less susceptible areas to determine the range of environmental conditions that may be conducive to pesticide leaching. If, on the other hand, other pesticides are not found in susceptible areas, it is unlikely they will be found in less susceptible areas.

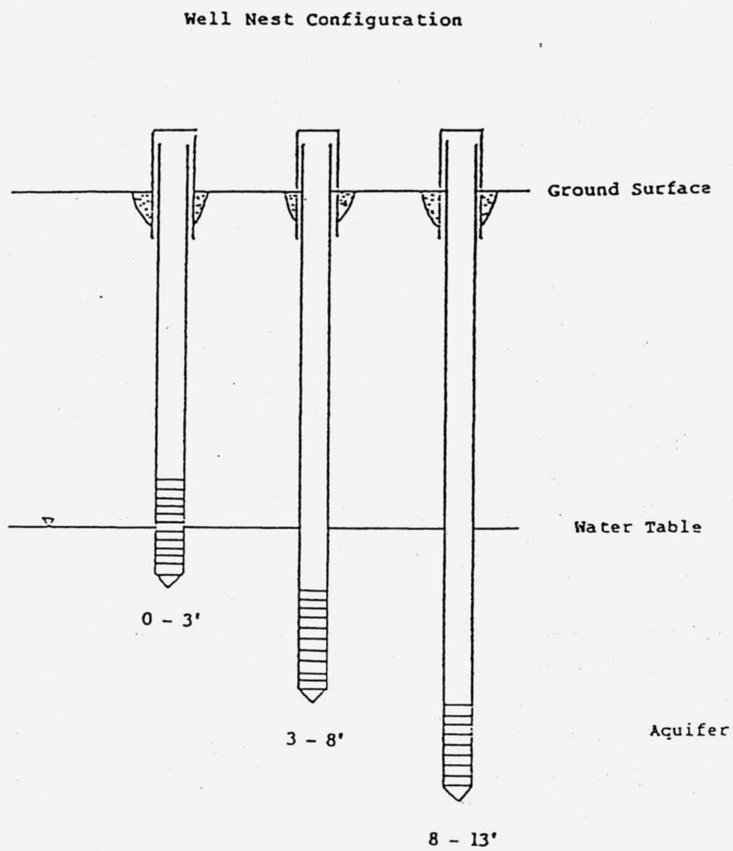
Once a monitoring site has been located, the direction of groundwater flow is determined from existing groundwater flow and water table elevation maps or from measurements in the field. Groundwater flow direction is determined in the field by installing three temporary water table observation wells in a triangular pattern, measuring the depth to the water table, leveling the measuring points, and constructing a simple water table elevation map. Groundwater flow direction is taken to be perpendicular to the water table elevation contours.

A nest of three wells is then installed just beyond the downgradient end of the field of pesticide application. The wells generally have five foot intake screens and are installed to sample the following increments below the water table: 0-3 feet, 3-8 feet, and 8-13 feet. This system provides the greatest chance of determining whether pesticides have entered the groundwater as a result of use on the adjacent field. A schematic diagram of this system is shown in Figure 1.

The monitoring wells are installed using the Wisconsin Geological and Natural History Survey drill rig. In most cases the solid stem auger is used. Before drilling, a small hole is hand dug at the bore hole site to avoid contamination with surface soil material during drilling. The bore hole is drilled to the desired depth below the water table, and after removal of the augers, the well pipe and screen are installed into the hole. An up and down pounding of the well is used to achieve the desired depth if bore hole collapse has occurred below the water table. Soil samples for particle size analysis are taken at 5 foot increments during drilling. After installation, the wells are developed by surging with a surge rod and pumping with a portable gas-powered vacuum pump until clear water is obtained.

Figure 1. Field Diagram and Well Nest Configuration





All monitoring wells are constructed to protect the integrity of the groundwater and the samples being collected. The well casing consists of schedule 40 PVC pipe with flush-threaded joints. Well screens are schedule 40 PVC with 0.006 or 0.01 inch slot size. In most cases the medium to coarse sand extracted from the borehole is used for a filter pack around the screen and extends 2 to 3 feet above the top of the screen. If finer materials are encountered during drilling, imported silica sand is used. The annular space between the well casing and the borehole is sealed with bentonite clay. A locking protective metal casing is installed over each well and anchored with a cement plug.

The monitoring wells are sampled with either a PVC bailer (sampling tube) or a Keck electric submersible pump. A pump blank is taken by transferring City of Madison tap water through the sampling device into the sample bottle. If known, the wells are sampled in order of lowest to highest concentration of pesticide. The well is purged of at least three well volumes and then a sample is transferred to the sample bottle. The full sample bottles are placed in an insulated mailer that is cooled with ice. The groundwater samples are not filtered in the field or the lab prior to analysis.

Results and Discussion

Aldicarb (Temik)

Aldicarb is a selective systemic insecticide that has been used to control certain insects and soil nematodes. In Wisconsin the only field use of aldicarb has been in potato production. In the early 1980s, approximately 75% of the potato acreage in Wisconsin was treated with aldicarb. In subsequent years, however, use declined dramatically due to groundwater problems and food safety issues. In 1990 potatoes were removed from the aldicarb label due to crop residue problems.

Groundwater contamination by aldicarb residues has occurred in Wisconsin under normal use practices. Aldicarb has the potential to leach to groundwater due in part to a relatively high water solubility (6,000 mg/l) and a relatively low soil adsorption coefficient (Kd) in the range of 0.015 to 1.55. The half-life for degradation of all toxic residues of aldicarb in the root zone is approximately 70 days for sandy soils typical of potato production areas in central Wisconsin (Cohen et al., 1984). The half-life is shorter in the finer textured and higher organic matter soils of the seed potato production areas in Wisconsin.

Twelve agricultural fields in the Central Sands area and along the lower Wisconsin River have been monitored for aldicarb residues. Eleven of 12 sites have had aldicarb residues in the groundwater equaling or exceeding the Preventive Action Limit of 2 parts per billion (ppb). Five of the sites have had aldicarb residues exceeding the Enforcement Standard of 10 ppb. The use of aldicarb on fields in the project declined after the mid-1980s due to environmental and regulatory issues. As a result, the aldicarb residues in the wells declined to the point that none have had a detectable level since 1990.

Alachlor (Lasso) and Alachlor ESA

Alachlor is a popular herbicide in Wisconsin that is used to control annual grasses in corn and soybeans. In 1985, alachlor was used on 40% of the corn acreage and 47% of the soybean acreage in Wisconsin (Wisconsin Agricultural Statistics Service, 1986). In 1990, alachlor use had declined to 24% of the corn acreage and 17% of the soybean acreage (Wisconsin Agricultural Statistics Service, 1991).

It appears that alachlor can be transported to groundwater in susceptible situations. It has a water solubility of 242 mg/l, a soil adsorption coefficient (Kd) range of 0.6-8.1 (with most values below 4), and a soil half-life in the range of 15-70 days (Cohen et al., 1984). The primary loss mechanism from soil is microbial degradation.

Alachlor has been monitored in the groundwater at 31 agricultural fields in Wisconsin with most sites located in the Central Sands area and the sandy outwash soils along the lower Wisconsin River. The alachlor residues in the groundwater samples have ranged from below detection to 1850 ppb. This very high detection is due to a point source. It is also interesting to note that most of the alachlor detects have occurred along the lower Wisconsin River valley (LWRV).

The Wisconsin Department of Natural Resources (DNR) has adopted a groundwater Enforcement Standard for alachlor of 2.0 ppb. Of the 27 sites currently being monitored for alachlor, 6 have exceeded the 2.0 ppb level. Regulations may be necessary in limited areas to reduce the potential for alachlor leaching and comply with the Groundwater Law.

Alachlor ESA is the ethane sulfonic acid metabolite of alachlor. The DATCP lab began testing for alachlor ESA in June 1993. ESA has been found in groundwater at 22 of 24 sites where parent alachlor has been used. The majority of these detections occurred in the absence of a parent alachlor detect.

In April 1994, the Wisconsin Department of Health and Social Services established an interim health advisory for alachlor ESA of 20 ppb. This number does not have the regulatory significance of an enforcement standard, but it gives guidance to well owners whose drinking water contains a contaminant until an enforcement standard is established. Four of the monitoring sites have exceeded this 20 ppb level. ESA appears to be a prevalent groundwater contaminant, but its regulatory significance will depend on the level at which an enforcement standard is established.

Atrazine and Metabolites

Atrazine is a triazine herbicide used extensively for weed control in corn. In 1985, atrazine was applied to approximately 77% of the acreage planted to corn, making it the most commonly used corn herbicide in Wisconsin (Wisconsin Agricultural Statistics Service, 1986). By 1990, Atrazine use had declined to 56% of the corn acreage (Wisconsin Agricultural Statistics Service, 1991). This decline was partially due to groundwater concerns that were discovered in this and other studies.

Due to its persistence, mobility, and extensive use, atrazine has the potential to contaminate groundwater in many areas of Wisconsin. It has a water solubility of 33 mg/l, a soil adsorption coefficient (Kd) range of 1-8, and a soil half-life in the range of 4-57 weeks (Cohen et al., 1984). Atrazine can persist in agricultural soils into the growing season following the year of application.

Atrazine has been monitored in the groundwater at 42 agricultural fields in Wisconsin, with most sites located in the sandy outwash soils along the lower Wisconsin River and in the Central Sands area. Atrazine has been found in the groundwater at 31 of 40 sites at concentrations up to 191 ppb. This high level is due to a point source. As with alachlor, most of the atrazine detects have occurred along the lower Wisconsin River valley.

In 1991, the DNR adopted a groundwater Enforcement Standard for total atrazine residues (atrazine plus 3 chlorinated metabolites) of 3.0 ppb. Around this same time, the DATCP general Laboratory began routinely analyzing all monitoring well samples for these analytes. Of the 40 sites that have been monitored for atrazine and metabolites, 16 have exceeded the 3.0 ppb level.

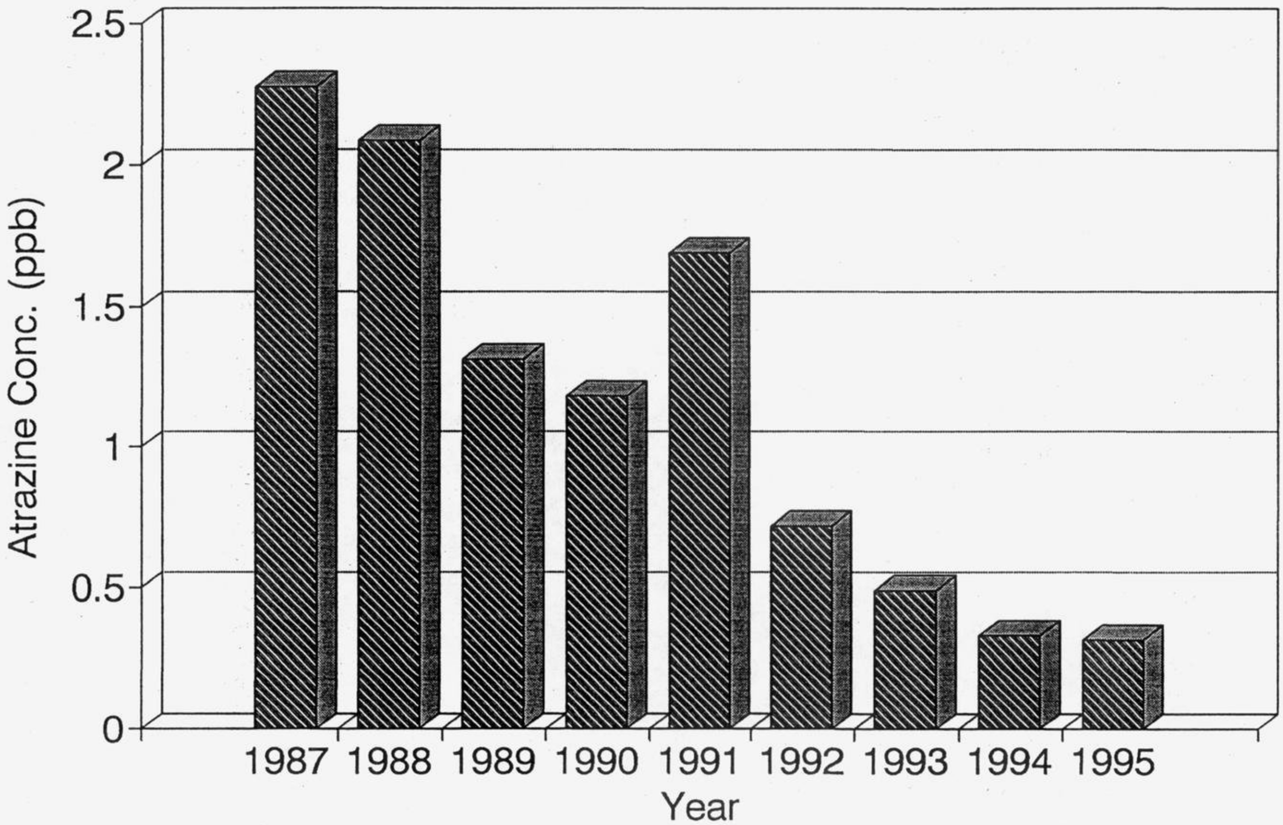
In 1991, DATCP adopted rules restricting the use of atrazine in order to protect groundwater. These rules were made subsequently more restrictive in 1992 and 1993. One of the rule provisions prohibits atrazine use in the lower Wisconsin River valley due to serious groundwater contamination. This monitoring study continues to be very valuable in tracking changes in atrazine levels in the valley over time. Current data indicate that atrazine levels in the monitoring wells in the valley are declining. The mean parent atrazine detect concentrations for the 16 sites in the Valley have shown a decline over the past nine years (Figure 2).

Metolachlor (Dual)

Metolachlor is a selective herbicide used for weed control in several crops including corn, soybeans, and potatoes. In 1985, metolachlor was used on approximately 17% of the corn acreage, 18% of the soybean acreage, and 40% of the potato acreage in Wisconsin (Wisconsin Agricultural Statistics Service, 1986). In 1990, these percentages were at 12, 4, and 10, respectively (Wisconsin Agricultural Statistics Service, 1991). These declines are likely due to the introduction of new herbicide products into the market.

Figure 2. Mean Atrazine Values

16 Monitoring Sites in the LWRV



It appears that metolachlor can leach to groundwater in certain environmental settings. It has a water solubility of 530 mg/l, a soil adsorption coefficient (Kd) value below 3, and a soil half life in the range of 2-8 weeks (Cohen and Pomerantz, 1984).

Metolachlor has been monitored at 29 sites in Wisconsin, with most sites along the lower Wisconsin River valley and in the Central Sands area. Metolachlor has been found at 15 of 29 sites in the range of 0.08-43 ppb. The Enforcement Standard for metolachlor is 15 ppb with a Preventive Action Limit of 1.5 ppb. Most of the detects fall in the range between these two levels.

Metribuzin (Sencor)

Metribuzin is a triazine herbicide used to control a number of grass and broadleaf weeds in a variety of agricultural crops including soybeans and potatoes. In 1985, metribuzin was used on approximately 78% of the potato acreage and 32% of the soybean acreage in Wisconsin (Wisconsin Agricultural Statistics Service, 1986). In 1990, metribuzin was used on 74% of the potato acres and 11% of the soybean acres (Wisconsin Agricultural Statistics Service, 1991).

Metribuzin has environmental fate characteristics that make it relatively mobile in coarse-textured soils. It has a water solubility of 1200 mg/l, a soil adsorption (Kd) of <1, and a soil half life in the range of 6-36 weeks (Cohen and Pomerantz, 1984).

Metribuzin has been monitored at 27 sites in Wisconsin, with most sites along the lower Wisconsin River and in the Central Sands area. It has been detected at 21 of 27 sites in the range of 0.03-54 ppb. The Enforcement Standard for metribuzin is 250 ppb. None of the detects in this study have approached this level. It should be noted that the only reason metribuzin is not considered to be a serious groundwater problem in the potato growing areas of Wisconsin is that the Enforcement Standard is relatively high compared to many other pesticides.

Other Pesticides

Other compounds for which data have been collected include cyanazine (Bladex), linuron (Lorox), carbofuran (Furadan), picloram (Tordon), 2,4-D, dinitro (Dinoseb), terbufos (Counter), simazine (Princep), bentazone (Basagran), nicosulfuron (Accent) and imazethapyr (Pursuit). Results for these compounds are shown in Table 1 which summarizes the results of the entire study through June 1994.

Nitrate-Nitrogen

Since 1987 many of the samples from the monitoring wells have been analyzed for nitrate-nitrogen in addition to the pesticides of interest. While nitrates can occur in groundwater from

Table 1
Summary of the Wisconsin DATCP Groundwater Monitoring Project for Pesticides through June 1996

Chemical Name	Total Sites	Sites With Detects	Highest Detect (ug/l)	Enforcement Standard (ug/l)	Sites over Standard
Atrazine	42	31	191		
Deethyl*	41	33	36		
Deisopropyl*	40	17	9.5		
Diamino*	38	13	5.7		
Total Atrazine	42	34	229	3.0	16
Alachlor	31	13	1850	2.0	5
Alachlor ESA	24	22	68	20#	4
Aldicarb	12	11	110	10	5
Metolachlor	29	15	43	15	5
Metribuzin	27	21	54	250	0
Picloram	3	3	49	500	
Linuron	8	1	2.7		
Simazine	2	1	0.26	1.7	0
Bentazon	3	1	13.1		
Carbofuran	6	1	11.4	50	0
Cyanazine	11	2	4.2	12.5	0
Butylate	9	0		67	0
EPTC	11	0		250	0
Nicosulfuron	6	0			
Imazethapyr	3	0			

* atrazine metabolite
# interim health advisory

a variety of sources, the design of this monitoring study maximizes the chance that the substances observed in the wells originated on the field being monitored. A large amount of data has therefore been compiled which reflects the effect of management and soil conditions on nitrate levels in monitoring wells at the edge of fields.

The range of nitrate-N levels in monitoring wells throughout the state is from the level of detection to 140 ppm. The 140 ppm level is in a well located next to a field that has received large amounts of poultry manure for several years. The average nitrate-N level for all the samples obtained in the study is 20 ppm. The average levels in each of the three well depths (0-3, 3-8, and 8-13 feet below the water table) are very close indicating no clear trend with depth in the top 13 feet of the aquifer. This is probably an indication of the length of time nitrogen fertilizer has been used at many of these fields since the deeper wells tend to reflect applications made longer ago and further upgradient from the wells.

The groundwater Enforcement Standard for nitrate-nitrogen is 10 ppm and the Preventive Action Limit is 2 ppm. Approximately 90% of the agricultural fields in the study have exceeded 10 ppm and all have exceeded 2 ppm. From this data it appears that significant changes in nitrogen management practices will be necessary to maintain compliance with the standards.

There are two sites in the study that have not received nitrogen fertilization and can therefore serve as background or control wells for comparison with fertilized fields. Portage County sites 4 and 5 are prairie chicken habitat preserves that are maintained in permanent grass cover. The nitrate-N levels in these wells are usually below the level of detection and have rarely been above 0.3 ppm. Any nitrate detected in these wells is likely from mineralization of soil organic matter or deposition of atmospheric nitrogen.

A regional analysis of the nitrate results indicates that the monitoring wells in the Lower Wisconsin River Valley (LWRV) have higher levels than the wells in the rest of the state. The average level for all wells in the LWRV is 24 ppm compared to 19 ppm in the Central Sands and 11 ppm for wells in the rest of the state. This trend for higher levels of groundwater contamination in the LWRV is also evident for several herbicides and seems to indicate that this area is particularly susceptible to leaching. Other trends in the nitrate data include somewhat lower levels in some of the medium textured soils in Langlade, Barron and Chippewa Counties.

Well Abandonment

During the course of the study some of the monitoring wells have been abandoned because they have been damaged or because they were producing less valuable data. The wells were abandoned by the Wisconsin Geological and Natural History Survey. Of the original 164 wells in the project, 81 have been abandoned. Table 2 shows the status of all the wells in the study.

Well	WUWN	Site	Status
AD1-1	BR000	AD1	Abandoned
AD1-2	BR001	AD1	Abandoned
AD1-3	BI087	AD1	Abandoned
AD1-4	BI088	AD1	Abandoned
AD2-1	BH954	AD2	Active
AD2-2	BH953	AD2	Active
AD2-3	BH952	AD2	Active
AD3-1	BH999	AD3	Active
AD3-2	BI000	AD3	Active
AD3-3	BI001	AD3	Active
AD4-1	BH996	AD4	Active
AD4-2	BH997	AD4	Active
AD4-3	BH998	AD4	Active
AD5-1	CL461	AD5	Active
AD5-2	CL455	AD5	Active
AD5-3	CL456	AD5	Active
AD6-1	AO390	AD6	Abandoned
AD7-1	AO391	AD7	Abandoned
BR1-1	BR273	BR1	Abandoned
BR1-2	BR274	BR1	Abandoned
BR1-3	BR275	BR1	Abandoned
BR2-1	BR276	BR2	Active
BR2-2	BR277	BR2	Active
BR2-3	BR278	BR2	Active
BR3-1	BR279	BR3	Active
BR3-2	BR280	BR3	Active
BR3-3	BR281	BR3	Active
BR4-1	BR282	BR4	Abandoned
CH1-1	BR283	CH1	Active
CH1-2	BR284	CH1	Active
CH1-3	BR285	CH1	Active
DN1-1	BR250	DN1	Damaged
DN1-10	BH994	DN1	Abandoned
DN1-2	BR251	DN1	Active
DN1-3	BR252	DN1	Active
DN1-4	BH987	DN1	Abandoned
DN1-5	BH988	DN1	Abandoned
DN1-6	BH989	DN1	Abandoned
DN1-7	BH990	DN1	Abandoned
DN1-8	BH991	DN1	Abandoned
DN1-9	BH992	DN1	Abandoned
DU1-1	AO384	DU1	Active
DU1-2	AO385	DU1	Active
DU1-3	AO386	DU1	Active
DU2-1	AO387	DU2	Active
DU2-2	AO388	DU2	Active

Well	WUWN	Site	Status
DU2-3	AO389	DU2	Active
GN1-1	BB237	GN1	Abandoned
GN1-2	BB238	GN1	Abandoned
GN1-3	BB239	GN1	Abandoned
GN2-1	BB240	GN2	Active
GN2-2	BB241	GN2	Active
GN2-3	BB242	GN2	Active
GR1-1	BR255	GR1	Damaged
GR1-2	BR256	GR1	Active
GR1-3	BR257	GR1	Active
GR2-1	BB249	GR2	Abandoned
GR2-2	BB250	GR2	Abandoned
GR2-3	BB251	GR2	Abandoned
IW1-1	BH955	IW1A	Abandoned
IW1-2	BH956	IW1A	Abandoned
IW1-3	BH957	IW1A	Abandoned
IW1-4	BR259	IW1B	Active
IW1-5	BR260	IW1B	Active
IW1-6	BR261	IW1B	Active
IW1-7	BH967	IW1B	Active
IW2-1	BR036	IW2	Active
IW2-2	BR037	IW2	Active
IW2-3	BR038	IW2	Active
IW3-1	BR286	IW3	Active
IW3-2	BR287	IW3	Active
IW3-3	BR288	IW3	Active
IW4-1	AO392	IW4	Active
IW4-2	AO393	IW4	Active
IW4-3	AO394	IW4	Active
JN1-1	BR046	JN1	Active
JN1-2	BR047	JN1	Active
JN1-3	BR048	JN1	Active
JN2-1	BR043	JN2	Abandoned
JN2-2	BR044	JN2	Abandoned
JN2-3	BR045	JN2	Abandoned
JN2-4	BH995	JN2	Abandoned
JN2-5	BH993	JN2	Abandoned
LC1-1	BB252	LC1	Abandoned
LC1-2	BB253	LC1	Abandoned
LC1-3	BB254	LC1	Abandoned
LN1-1	BH964	LN1	Active
LN1-2	BH965	LN1	Active
LN1-3	BH966	LN1	Active
LN2-1	BH958	LN2	Abandoned
LN2-2	BH959	LN2	Abandoned
LN2-3	BH960	LN2	Abandoned
LN3-1	BH961	LN3	Abandoned

Well	WUWN	Site	Status
LN3-2	BH962	LN3	Abandoned
LN3-3	BH963	LN3	Abandoned
PR1-1	BR207	PR1	Active
PR1-2	BR208	PR1	Active
PR1-3	BR209	PR1	Active
PR2-1	BR210	PR2	Abandoned
PR2-2	BR211	PR2	Abandoned
PR2-3	BR212	PR2	Abandoned
PR3-1	BR213	PR3	Abandoned
PR3-2	BR214	PR3	Abandoned
PR3-3	BR215	PR3	Abandoned
PR4-1	AS198	PR4	Abandoned
PR4-2	AS199	PR4	Abandoned
PR4-3	AS200	PR4	Abandoned
PR4-4	AS201	PR4	Abandoned
PR4-5	AS202	PR4	Abandoned
PR4-6	AS203	PR4	Abandoned
PR5-1	AS204	PR5	Abandoned
PR5-2	AS205	PR5	Abandoned
PR5-3	AS206	PR5	Abandoned
RC1-1	BR262	RC1	Damaged
RC1-2	BR263	RC1	Active
RC1-3	BR264	RC1	Active
RX1-1	BB255	RX1	Abandoned
RX1-2	BB256	RX1	Abandoned
RX1-3	BB257	RX1	Abandoned
SK1-1	BR265	SK1	Damaged
SK1-2	BR266	SK1	Active
SK1-3	BR267	SK1	Active
SK2-1	BR289	SK2	Abandoned
SK2-2	BR290	SK2	Abandoned
SK2-3	BR291	SK2	Abandoned
SK3-1	BR292	SK3	Active
SK3-2	BR293	SK3	Active
SK3-3	BR294	SK3	Active
SK4-1	BR295	SK4	Abandoned
SK4-2	BR296	SK4	Abandoned
SK4-3	BR297	SK4	Abandoned
SK5-1	BB243	SK5	Active
SK5-2	BB244	SK5	Active
SK5-3	BB245	SK5	Active
SK6-1	BB246	SK6	Active
SK6-2	BB247	SK6	Active
SK6-3	BB248	SK6	Active
SK7-1	AO381	SK7	Active
SK7-2	AO382	SK7	Active
SK7-3	AO383	SK7	Active

Table 2. Status of the Wells in the DATCP Groundwater Monitoring Project

Well	WUWN	Site	Status
WP1-1	AS234	WP1	Abandoned
WP1-2	AS235	WP1	Abandoned
WP1-3	AS236	WP1	Abandoned
WS1-1	BR139	WS1	Abandoned
WS1-2	BR140	WS1	Abandoned
WS1-3	BR141	WS1	Abandoned
WS2-1	BR242	WS2	Active
WS2-2	BR243	WS2	Active
WS2-3	BR244	WS2	Active
WS3-1	BR245	WS3	Abandoned
WS3-2	BR246	WS3	Abandoned
WS3-3	BR247	WS3	Abandoned
WS4-1	BB258	WS4	Active
WS4-2	BB259	WS4	Active
WS4-3	BB260	WS4	Active
WS4-4	BB261	WS4	Active
WS5-1	CL457	WS5	Abandoned
WS5-2	CL458	WS5	Abandoned
WS5-3	CL459	WS5	Abandoned
WS5-4	CL460	WS5	Abandoned
WS5-5	AO395	WS5	Abandoned
WS5-6	AO396	WS5	Abandoned
WS5-7	AO397	WS5	Abandoned
WS5-8	AO398	WS5	Abandoned

The general procedure for abandonment is to remove the protective metal casing and the 2 inch PVC pipe and then fill the borehole with bentonite clay. Well abandonment forms are completed and submitted to DNR.

Future Work

Future project work on the remaining 79 active wells will be aimed at the following objectives:

1) Assessing new pesticide products. There are a number of new herbicide products that have recently entered the market. Three important examples are nicosulfuron (Accent), imazethapyr (Pursuit), and acetochlor (Harness and Surpass). The DATCP General Lab has now developed methods for these compounds. In June 1993, a questionnaire was sent to participating growers to update the pesticide use records for the fields adjacent to the monitoring wells. This questionaire will be repeated in 1995. As availability of lab methods permit, groundwater samples are being analyzed for any new compounds that are being used.

2) Assessing metabolites of existing compounds. Since 1990, atrazine metabolites have been a part of the study. In June 1993 the DATCP General Lab began analyzing appropriate samples for alachlor ESA. Other metabolites will be included in the future as issues arise and lab methods become available.

3) Well abandonment. Additional wells will be abandoned if they are damaged or are no longer producing useful data. The goal will be to keep the project as efficient and cost-effective as possible.

4) Monitoring will also continue for the original compounds of interest and nitrates. The sampling schedule for some wells will be reduced if quarterly sampling is not justified.

5) Compositing samples from existing well nests. Some samples from individual wells in the well nests will be composited to save on analytical costs.

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