

Groundwater Monitoring Well Network

The Illinois Department of Agriculture (IDA), under authority of the Illinois Pesticide Act (415 ILCS 60/1 et seq.) and a performance partnership grant agreement with US EPA regarding the Federal Insecticide, Fungicide and Rodenticide Act, is the state lead agency for the regulation of pesticide use in Illinois. The IDA is responsible for managing pesticide use to prevent adverse effects to human health and the environment.

US EPA's approach for addressing concerns about pesticides in groundwater is the nationwide regulation of pesticide use, supported by strong state and tribal roles in the local management of pesticide use to protect groundwater. Illinois, like many states, is voluntarily implementing the US EPA-recommended provisions of pesticide management plans to protect groundwater. In June 2000 under the leadership of the IDA, the Pesticide Subcommittee of the ICCG approved the [*Illinois Generic Management Plan for Pesticides in Groundwater*](#). The management plan, which was revised in 2006 (IDA 2006), describes the framework to be used by the state of Illinois for addressing the risks of groundwater contamination by pesticides.

The Illinois management plan relies on the IDA's groundwater monitoring well network and the Illinois EPA's public water supply well pesticide-monitoring sub-network to determine the occurrence of pesticides in groundwater and whether there are significant, spatial or temporal trends in pesticide concentrations. The management plan requires action by the IDA when pesticides are reported at concentrations greater than 10 percent of the groundwater reference value (or the minimum reporting level (MRL) if 10 percent of the reference value is less than the MRL). If pesticides are present at concentrations greater than the "action level", the IDA will conduct, with assistance from the Interagency Committee on Pesticides, the ICCG, the registrant, and other state and federal agencies, an evaluation to determine the appropriate course of action. At the very least, the presence of a pesticide in groundwater in concentrations greater than the action level would initiate an investigation of cause. The components of the response plan in the [*Illinois Generic Management Plan for Pesticides in Groundwater*](#) that apply to the groundwater monitoring network are:

- Notify pesticide registrant;
- Identify cause;
- Perform vulnerability assessment and define response areas;
- Expand monitoring;
- Encourage adoption of voluntary best management practices;
- Impose use restrictions; and
- Prohibit use.

The [*Illinois Generic Management Plan for Pesticides in Groundwater*](#) targets areas where aquifer materials occur within 50 feet of land surface (Figure 1). These aquifers have been demonstrated to be vulnerable to contamination by pesticides as a result of labeled uses (Goetsch, Bicki and McKenna 1992; Schock and others 1992). As described by McKenna and Keefer (1991), the distinction between aquifer materials and aquifers is that aquifer materials have the hydrogeologic characteristics to be classified as aquifers, but the materials may not be saturated. Aquifers, as defined in the IGPA, are saturated. In Illinois, the water table generally occurs within 20 feet from ground surface. Below this depth, aquifer materials are generally saturated and capable of yielding water to a well. Sand and gravel greater than 5 feet thick, sandstone greater than 10 feet thick and fractured carbonates (limestone and dolomite) greater than 20 feet thick are considered to be aquifer materials. Loess, glacial till, shale, and non-fractured carbonate rocks have relatively low hydraulic conductivities and generally will not provide a sufficient volume of water to a drilled well and are not considered aquifer materials.

In 1995, the IDA contracted with the ISGS and the ISWS to construct a statewide dedicated groundwater monitoring well network for use with future pesticide management plans. The monitoring well network is designed to provide statistically reliable estimates on the occurrence of selected pesticides in groundwater within shallow aquifers (depth to the top of aquifer material less than 50 feet below land surface) in areas of corn and soybean production. Occurrence is defined as the presence of a specific pesticide at a concentration above the MRL.



The network was designed to determine the regional impacts of pesticide leaching from non-point sources, not the impacts of site-specific point sources. The network is not a research program, but a tool for the management of pesticides in Illinois. Consequently, the pesticides selected as analytes are those with high use in Illinois that were previously detected in groundwater in Illinois or other Midwestern states. Also reflecting the management tool approach is the decision to set MRLs at a maximum of 5 percent of the groundwater reference value when possible, but not to expend limited laboratory resources on determining the presence of pesticides at very low concentrations. The monitoring well network and the IDA's pesticide laboratory operate in compliance with U.S. EPA-approved quality assurance project plans.

The network currently consists of 141 shallow groundwater-monitoring wells located throughout the state (Figure 2) at well depths varying from 10 to 81.5 feet. Wells are constructed of 2-inch inside diameter polyvinyl chloride well casing. Most wells have a 5-foot long slotted well screen. All wells are located in public rights-of-way adjacent to row-crop fields, and are installed in areas where aquifer materials occur within 50 feet of land surface.



Each well in the network is sampled once during a two-year period. The ISGS and ISWS conducted a one-time sampling of the network beginning in the fall of 1998 and sampled the network from September 2000 through June 2001. IDA assumed responsibility for all sampling in July 2001.

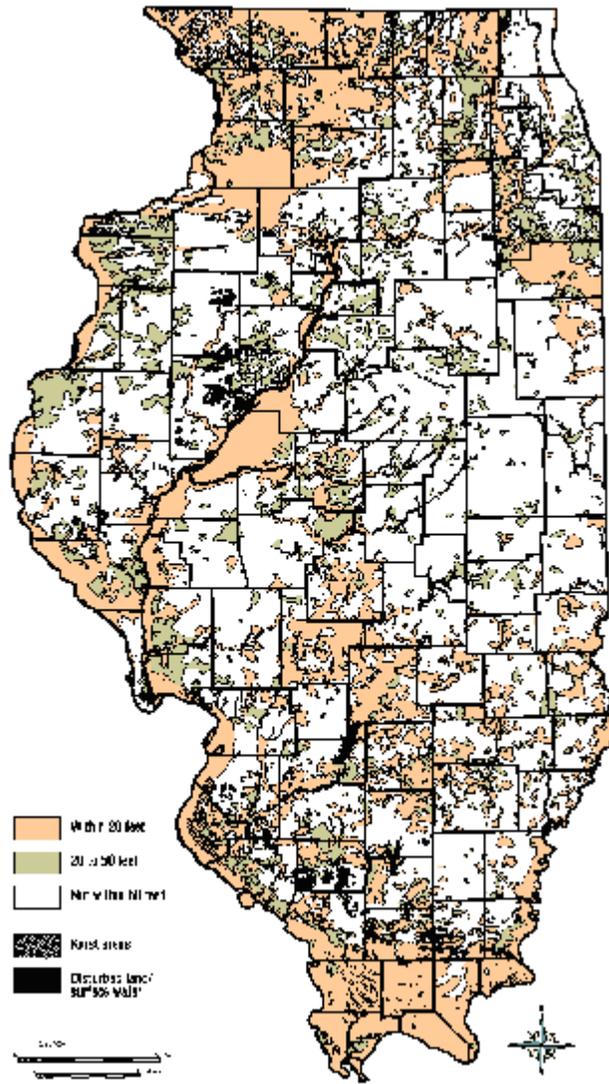


Figure 1. Depth to uppermost aquifer within 50 feet of land surface (Keefer 1995)

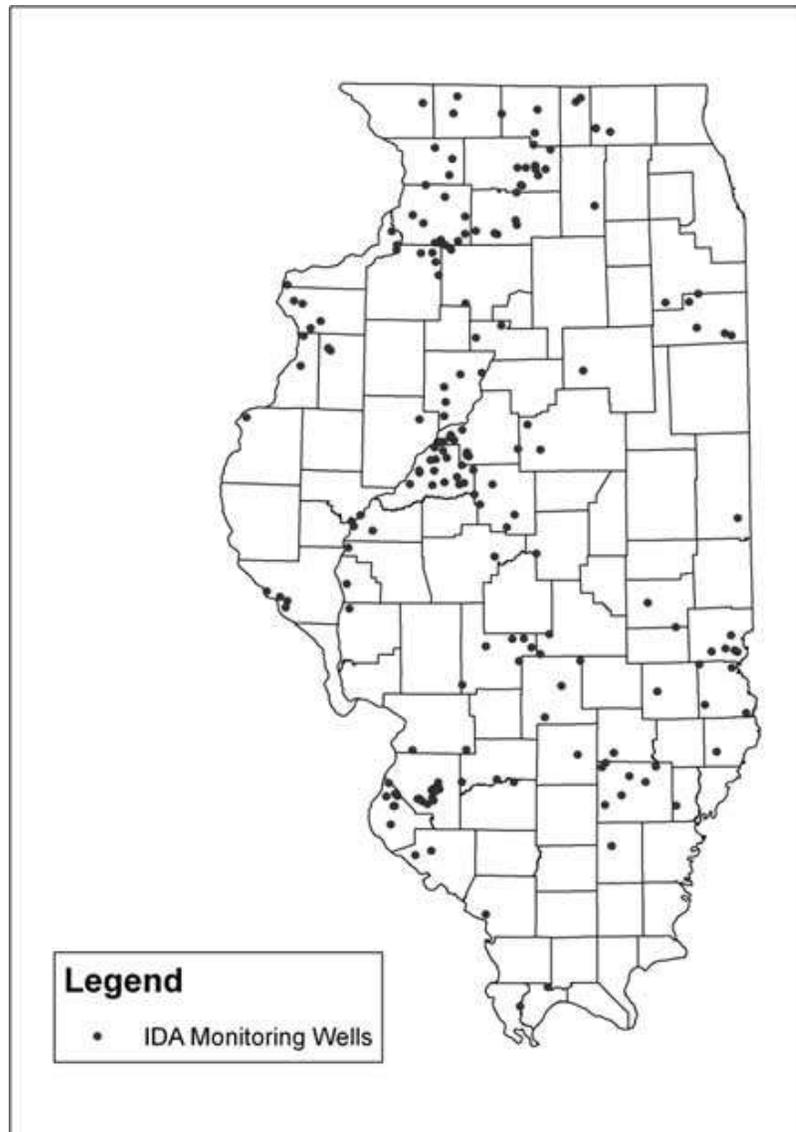


Figure 2. Location of Illinois Dept. of Agriculture Dedicated Pesticide Monitoring Wells.

Six rounds of sampling of the monitoring wells have been completed (Table 1). During these periods, MRLs have varied. In order to allow comparison between the sampling periods, the data on the frequency of occurrence reflect the presence of a pesticide at or above the MRLs used in the most recent sampling round (Table 2). The overall frequency of occurrence refers to the presence of any pesticide, or multiple pesticides, from a single groundwater sample. For example, the occurrence of two pesticides present in a single well sample at concentrations above the MRL is considered a single detection above the MRL.

Sampling period	Parent pesticides	Atrazine metabolites	Chloroacetanilide metabolites
1998-1999	6.3±3.8	N/A	N/A
2000-2002	3.4	N/A	N/A
2002-2004	2.1	18.4±6.4	N/A
2004-2006	5.8±3.9	14.5±5.9	58.0±8.2
2006-2008	3.0	11.9±5.5	58.5±8.3
2008-2010	7.9±4.7	19.0±6.9	53.8±8.5

Table 1. Summary of Frequency of Occurrence of Pesticides with 95% Confidence Intervals

Analyte	Minimum reporting level (ug/L)	Frequency of occurrence and 95% C.I.	Maximum concentration (ug/L)	Groundwater reference value (ug/L)
acetochlor	0.10	0.8	0.10	
acetochlor ESA	0.30	5.3±3.8	4.4	
acetochlor OXA	0.30	0.8	0.61	
alachlor	0.10	0	--	2 ¹
alachlor ESA	0.30	19.7±6.8	8.9	
alachlor OXA	0.30	0	--	
atrazine	0.15	4.0±3.4	0.50	3 ¹
desethylatrazine (DEA)	0.15	12.7±5.8	0.68	
desisopropylatrazine (DIA)	0.15	3.2	0.99	
desethyl-desisopropylatrazine (DEDIA)	0.15	15.9±6.4	1.7	
metolachlor	1.0	2.3	18	700 ²
metolachlor ESA	0.30	47.0±8.5	65	
metolachlor OXA	0.30	11.4±5.4	71	
metribuzin	1.0	0	--	70 ²
prometon	1.0	0	--	100 ²
simazine	.40	0.8	1.5	4 ¹
total chlorotriazines	NA	19.0±6.9	2.7	37.5 ^{3,4}

(Note: Confidence interval not calculated if frequency of occurrence is less than 3.6%.)

Table 2. Minimum Reporting Levels, Frequency of Occurrence with 95% Confidence Intervals, Maximum Concentrations, and Groundwater Reference Values for Analytes during 2008-2010

(Note: Confidence interval not calculated if frequency of occurrence is less than 3.6%.)

1. Groundwater Quality Standards for Class I: Potable Resource Groundwater, Illinois Administrative Code Part 620.410
2. US EPA lifetime health advisory level. An HA is an estimate of acceptable drinking water levels for a chemical substance based on health effects information; a health advisory is not a legally enforceable federal standard, but serves as technical guidance to assist federal, state and local officials.
<http://www.epa.gov/waterscience/drinking/standards/dwstandards.pdf>
3. U.S. EPA Office of Pesticide Programs
4. Total chlorotriazines are reported as the sum of the concentrations of atrazine, DEA, DIA, DEDIA and simazine.

Results of the most recent sampling period (132 samples collected from October 2008 through September 2010) indicate that parent pesticides were detected in ten of the samples (7.9 percent). Atrazine was detected in five samples, metolachlor was detected in three samples, and acetochlor and simazine were each detected in one sample. Three of those samples had concentrations above levels of concern. One or more of the atrazine degradation products was present above the MRL in 19.0 percent of the samples. One or more of the metabolites of the chloroacetanilide herbicides was detected in 53.8 percent of the samples. None of those samples had concentrations above levels of concern.

Pesticides are more likely to be present in monitoring wells in areas where aquifer materials occur within 20 feet of the land surface than in areas where aquifer materials are more than 20 feet below land surface (Figure 3).

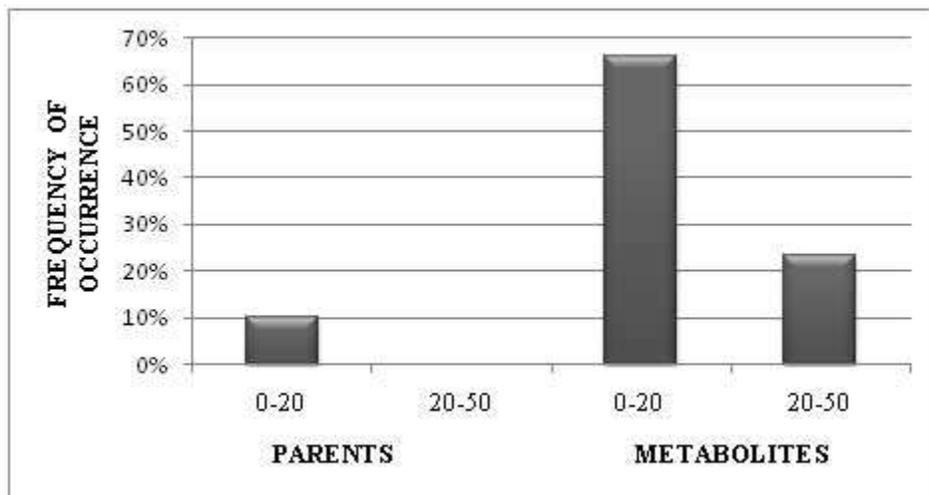


Figure 3. Comparison of the Effect of Depth to Aquifer Materials on the Frequency of Occurrence of Parent Pesticides and Metabolites (2008-2010)

The *Illinois Generic Management Plan for Pesticides in Groundwater* requires the IDA to conduct an investigation of the cause if pesticides are detected at concentrations greater than the action level. If selected, pesticides for which preventive notification is required under the IGPA are detected in groundwater, e.g., atrazine, the IDA is required to resample the well within 30 days of receipt of laboratory results. Since U.S. EPA concurrence with the Pesticide Management Plan in February 2001, four monitoring well samples have contained a pesticide at a concentration greater than the action level (atrazine parent compound and simazine). The IDA re-sampled the wells and found the concentrations to be less than the action level. The IDA also notified the registrant and conferred with the IDPH.

IDA intends to continue to follow the sampling and analysis plan laid out in the generic management plan and the quality assurance project plan for the foreseeable future.

Appendix I. References Cited by the Illinois Department of Agriculture

Goetsch, W.D., T. J. Bicki and D.P. McKenna. 1992. *Statewide Survey for Agricultural Chemicals in Rural, Private Water-Supply Wells in Illinois*. Illinois Department of Agriculture, Springfield, IL, 4 p.

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Keefer, D.A. 1995. *Potential for agricultural chemical contamination of aquifers in Illinois: 1995 Revision*. Illinois State Geological Survey Environmental Geology 148, 28 p.

McKenna, D.P. and D.A. Keefer. 1991. *Potential for Agricultural Chemical Contamination of Aquifers in Illinois*. Illinois State Geological Survey Open File Series 1991-7R. 16 p.

Mehnert, E., D.A. Keefer, W.S. Dey, H.A. Wehrmann and S.D. Wilson, C. Ray, University of Hawaii. June 29, 2001. *Illinois Statewide Monitoring Well Network for Pesticides in Shallow Groundwater- Network Development and Initial Sampling Results, Draft Final Contract Report*. 55p.

Schock, S.C., E. Mehnert, M.E. Caughey, G.B. Dreher, W.S. Dey, S. Wilson, C. Ray, S.F.J. Chou, J. Valkenburg, J.M. Gosar, J.R. Karny, M.L. Barnhardt, W.F. Black, M.R. Brown, and V.J. Garcia. 1992. *Pilot Study: Agricultural chemicals in rural, private wells in Illinois*. Illinois State Geological Survey and Illinois State Water Survey Cooperative Groundwater Report 14, 80 p.