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Sources and Occurrences of Nonpoint-Source Chemicals in Groundwater, Jackson Purchase Region, Kentucky: Data Report

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Sources and Occurrences of Nonpoint-Source Chemicals in Groundwater, Jackson Purchase Region, Kentucky: Data Report

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Abstract

Groundwater from the Jackson Purchase Region was sampled to investigate possible contamination by nonpoint-source chemicals. Conclusions drawn from the resulting data and methodology can be found in "Sources and Occurrences of Nonpoint-Source Chemicals in Groundwater, Jackson Purchase Region, Kentucky," Kentucky Geological Survey Report of Investigations 22 (series 12), by R.S. Fisher and E.G. Beck.

Introduction

Sixty wells were selected to investigate the occurrence of nonpoint-source chemicals in groundwater of the Jackson Purchase Region, on the basis of geographic location, hydrostratigraphic unit penetrated, and well type (bored or drilled). Distances to row crops, known septic systems, and active and abandoned feedlots were recorded for each well. Groundwater samples were collected in the spring and fall of 2005 and analyzed for field measurements, water properties, major and minor solutes, nutrients, metals, pesticides, volatile organic compounds, caffeine, and bacteria. The data and methodology contained in this report are referenced in "Sources and Occurrences of Nonpoint-Source Chemicals in Groundwater, Jackson Purchase Region, Kentucky" (Fisher and Beck, 2010). Funding for this project was provided in part by a grant from the U.S. Environmental Protection Agency as authorized by the Clean Water Act Amendments of 1987, Section 319(h), Nonpoint Source Implementation Grant C9994861-99.

Methodology

Sample-Collection Methods

All samples were collected in accordance with U.S. Geological Survey guidelines for sampling and collecting (U.S. Geological Survey, 1980) and the Kentucky Division of Water's Quality Assurance Project Plan, contained in Appendix A (all appendices are available for download at kgs.uky.edu/kgsweb/olops/pub/kgs/water/IC21_12). Samples were collected from an outside faucet after the well was purged with the existing submersible pump and after field measurements (pH, temperature, conductivity, dissolved oxygen, and oxidation-reduction potential) had stabilized. Field measurements were recorded using a Horiba U-22[1] water-quality monitoring system with a flow-through chamber. The monitor was calibrated daily during sampling using procedures prescribed by the manufacturer.

Sample splits were prepared in the field and transported to the lab in sterilized bottles. Samples were filtered for dissolved-constituent analysis by using a peristaltic pump to pump water from a designated bucket through Tygon tubing and a high-capacity in-line filter (0.45-µm pore size). New Tygon tubing and a new filter were used for each sample. The bucket was rinsed once with 10 percent hydrochloric acid, three times with distilled water, and once with tap water between each filtering. If preservation was required by analysis protocol, the samples were preserved at the time of collection and kept at a temperature of 4°C until delivered to the laboratory.

For bacteria samples, the plumbing system was flushed for approximately 10 min before sample bottles were filled. Each bottle was placed on ice and delivered to the laboratory within 6 hr of collection.

All analyses, except those for bacteria and nitrogen isotopes, were performed at the Kentucky Division of

[1]The use of trade or product names is for descriptive purposes only and does not imply endorsement by the Kentucky Geological Survey.

Environmental Services Laboratory. Bacteria were analyzed in the Western Kentucky Regional Laboratory, which is administered by the Marshall County Health Department. Nitrogen isotope samples were prepared by the Kentucky Geological Survey and analyzed at the Environmental Research and Training Laboratory. Details on sample bottles, preservative, and laboratory are presented in Table 1. All laboratory analyses were performed in accordance with either EPA methods or methods widely accepted in the literature. Analytical methods used by the Division of Environmental Services are listed in Appendix B. Methods used by the Environmental Research and Training Laboratory and Western Kentucky Regional Laboratory are listed in Table 2.

Table 2. Analytical methods conducted on bacteria and nitrogen isotope samples.

Analyte	*Method*
Bacteria	Colilert (IDEXX, 2007)
Nitrogen isotope	Flatt and Heemskerk (1997)

Well and Groundwater-Quality Data

Well Data

AKGWA numbers (Assembled Kentucky Ground Water Database), county, well use, well diameter, well depth, and latitude and longitude (presented as decimal degrees and based on the North American datum of 1983) are listed for each well in Table 3.

Groundwater-Quality Data

Data presented here have been checked for accuracy, and suspect laboratory results were analyzed again for verification.

Appendix C contains field measurements (pH, electrical conductivity, dissolved oxygen, temperature, and oxidation-reduction potential) for all wells sampled. The data are sorted by spring sampling and fall sampling.

Major and minor solutes, nutrients, metals, pesticides, volatile organic compounds, and caffeine data for spring and fall sampling are presented in Appendices D and E, respectively. The "<" symbol in the Nondetect

Table 1. Sample bottles and preservatives required for each analyte. The laboratory in which analyses were performed is also specified.

Analyte	*Container Size and Type*	*Preservation Method*	*Laboratory*
Bulk Parameters Alkalinity, chloride, conductivity fluoride, nitrate-N, nitrite-N, pH, sulfate, total P, TSS, TDS, ortho-P	1,000-ml plastic cubitainer	cool to 4°C	Division of Environmental Services
NH_3/TKN/TOC	1,000-ml plastic cubitainer	H_2SO_4 cool to 4°C	Division of Environmental Services
Dissolved Metals by ICP Plus arsenic, lead, mercury, selenium	1,000-ml plastic Boston round	Filtered HNO_3 cool to 4°C	Division of Environmental Services
Total Metals by ICP Plus arsenic, lead, mercury, selenium	1,000-ml plastic Boston round	HNO_3 cool to 4°C	Division of Environmental Services
Nonpoint-source pesticides, pesticides/PCB's	1,000-ml amber glass	cool to 4°C	Division of Environmental Services
Herbicides/caffeine	1,000-ml amber glass	cool to 4°C 50% HCl	Division of Environmental Services
VOC's (trip blank required)	40-m amber glass (3)	50% HCl (3–4 drops) cool to 4°C no headspace	Division of Environmental Services
Nitrogen isotope	1,000-ml plastic Boston round	Filtered, $HgCl_2$	KGS/Environmental Research and Training Laboratory
Bacteria	120-ml polystyrene	cool to 4°C	Western Kentucky Regional Laboratory

Table 3. Well-construction and location data for each well sampled.

AKGWA	*County*	*Well Use*	*Well Diameter (in.)*	*Well Depth (ft)*	*Latitude*	*Longitude*
0000-0705	Graves	domestic	4	94	36.79854	–88.51343
0000-1201	Calloway	domestic	6	141	36.51562	–88.07293
0000-1207	Calloway	domestic	4	54	36.53103	–88.30261
0000-2553	Ballard	domestic	4	130	37.07571	–88.90475
0000-3532	Graves	domestic	24	94	36.74630	–88.49558
0000-4375	Graves	domestic	4	180	36.76512	–88.49531
0000-6541	Ballard	domestic	4	104	37.07960	–88.91751
0001-2674	Ballard	domestic	6	36	37.18752	–89.00383
0001-4369	Graves	domestic	4	95	36.93588	–88.60948
0001-5335	Graves	domestic	4	265	36.77497	–88.58583
0001-9601	Graves	domestic	4	220	36.93816	–88.64180
0002-0717	Calloway	domestic	4	60	36.53142	–88.30385
0002-8287	Ballard	domestic	4	320	37.12084	–88.92679
0003-0068	Graves	domestic	4	130	36.72990	–88.51329
0003-0806	Graves	domestic	4	65	36.74376	–88.51725
0003-1287	Calloway	domestic	4	75	36.52942	–88.30491
0003-4315	Ballard	domestic	4	170	36.97793	–88.93869
0003-5610	Graves	domestic	4	250	36.77168	–88.53688
0003-6379	Graves	domestic	4	148	36.73554	–88.51620
0004-0389	Graves	domestic	4	536	36.74477	–88.50531
0004-1894	Calloway	domestic	6	190	36.49851	–88.09679
0004-2377	Calloway	domestic	24	32	36.53311	–88.29964
0004-2386	Calloway	domestic	24	37	36.53056	–88.31084
0004-3120	Graves	domestic	4	150	36.94222	–88.65104
0004-4334	Calloway	domestic	4	101	36.52810	–88.09644
0004-4344	Calloway	domestic	4	100	36.51417	–88.30194
0004-5131	Ballard	domestic	4	80	37.17969	–88.99192
0004-5405	Marshall	domestic	24	38	36.80482	–88.46550
0004-5890	Graves	domestic	4	83	36.73353	–88.49481
0004-5920	Graves	livestock	4	200	36.74984	–88.51905
0004-5936	Marshall	domestic	4	280	36.84719	–88.41063
0004-8761	Hickman	domestic	4	260	36.71700	–88.82399
0004-9054	Graves	domestic	4	185	36.93038	–88.62839
0005-0244	Graves	domestic	4	115	36.73037	–88.51405
0005-1475	Graves	domestic	24	47	36.93635	–88.51349
0005-1481	Calloway	domestic	24	35	36.50410	–88.09928
0005-1482	Calloway	domestic	24	52	36.50506	–88.09291
0005-1801	Graves	domestic	4	75	36.78051	–88.53857
0005-1841	Graves	livestock	4	200	36.56148	–88.68908
0005-3989	Graves	domestic/livestock	4	170	36.77588	–88.51996
0005-5180	Ballard	domestic	4	80	37.18482	–88.98678

Table 3. Well-construction and location data for each well sampled.

AKGWA	*County*	*Well Use*	*Well Diameter (in.)*	*Well Depth (ft)*	*Latitude*	*Longitude*
0005-5661	Graves	domestic	4	100	36.93613	–88.61079
0005-7470	Ballard	domestic	4	220	36.97507	–88.88789
0005-7508	Ballard	domestic	4	270	37.11068	–88.94727
0005-9631	Graves	domestic	4	165	36.76473	–88.73618
0006-1181	Ballard	domestic	6	60	37.18735	–88.97867
0006-1185	Ballard	domestic	4	95	37.11205	–88.95141
0006-1186	Graves	domestic	4	250	36.77844	–88.75950
0006-1187	Graves	domestic	36	21	36.78033	–88.53763
0006-1189	Graves	domestic	4	280	36.93742	–88.51842
0006-1190	Graves	domestic	4	160	36.81121	–88.58980
0006-1241	Graves	domestic	4	172	36.85387	–88.75214
0006-1242	Calloway	domestic	4	130	36.50441	–88.09893
0006-1243	Calloway	domestic	24	42	36.52935	–88.31365
0006-1244	Calloway	domestic	24	20.3	36.52898	–88.31260
0006-1245	Graves	domestic	4	205	36.78936	–88.69186
0006-1249	Graves	domestic	4	210	36.57243	–88.67856
0006-1250	Calloway	domestic	4	140	36.50483	–88.09352
0006-2164	Graves	domestic	4	200	36.67796	–88.61316
0006-2168	Graves	domestic	4	130	36.80483	–88.51285

column indicates a concentration below the method detection limit indicated in the Result Value column. Flags used to indicate samples that were possibly compromised are listed in Table 4.

Total coliform and *E. coli* data are listed in Appendix F. Bacteria data are recorded as most probable numbers and range from less than 1 to more than 200.5. Two of the 60 wells (AKGWA numbers 51481 and 61250) were not sampled for bacteria.

Table 4. Flags used by the Division of Environmental Services Laboratory.

Flag	*Flag Description*
B	Analyte in method blank
D	Reanalyzed at a higher dilution
J	Estimated value
K	Analyte in trip blank
L	Exceeds drinking-water maximum contaminant level
N	Presumptive identification
P	Improper preservative
Q	QC limits exceeded
T	Exceeded holding time
U	Analyte not detected
X	See case narrative

References Cited

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