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Water-Quality Data, Huron County, Michigan 2004

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By Joseph W. Duris and Sheridan K. Haack

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U.S. Department of the Interior
U.S. Geological Survey

U.S. Department of the Interior
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Conversion Factors and Datum

Multiply	By	To obtain
	Length	
inch (in.)	2.54	centimeter (cm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
mile, nautical (nmi)	1.852	kilometer (km)
yard (yd)	.9144	meter (m)
	Area	
acre	4,047	square meter (m2)
acre	.004047	square kilometer (km2)
square mile (mi2)	2.590	square kilometer (km2)
Volume		
gallon (gal)	3.785	liter (L)
gallon (gal)	.003785	cubic meter (m3)
	Flow rate	
cubic foot per second (ft3/s)	0.02832	cubic meter per second (m3/s)
	Application rate	
pounds per acre per year [(lb/acre)/yr]	1.121	kilograms per hectare per year [(kg/ha)/yr]

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as follows:

°F=(1.8×°C)+32

Vertical coordinate information is referenced to the North American Vertical Datum of 1927 (NAVD 27).

Horizontal coordinate information is referenced to the North American Datum of 1927 (NAD 27).

Water-Quality Data, Huron County, Michigan 2004

By Joseph W. Duris and Sheridan K. Haack

Introduction

The U.S. Geological Survey (USGS) conducted a survey of water quality and quantity in Huron County, Michigan from 1988-1990 (Sweat, 1992). In that study atrazine, a widely-used agricultural herbicide with possible endocrine-disrupting effects was detected in 9 of 9 surface-water samples. Metolachlor, metribuzin, prometone, simazine, 2,4-dichlorophenoxyacetic acid (2,4-D), and dichlorprop (2,4-DP) were also detected at some surface-water sites. One pesticide, 2,4,5-trichlorophenoxyacetic acid (2,4,5-T), was detected in two monitoring wells. Additionally, routine USGS monitoring through the early 1990's indicated the Pigeon River in Huron County to have some of the highest levels of nitrate-nitrogen and dissolved solids of any monitored river in Michigan (Blumer and others, 1992). Recently, new methods of chemical and biological analysis have been developed that allow better evaluation of the nature and source of contamination of water. Eleven Huron County townships have passed a resolution calling for evaluation of water quality in Huron County. In 2004 Huron County desired a survey of current water quality in their county. In cooperation with Huron County, the USGS collected water samples for analysis of microbiological, chemical and physical constituents from the Pinnebog and Pigeon River watersheds in Huron County from April through November, 2004 to assess the current state of Huron County's water quality.

Background

Pesticides and pesticide metabolites at low concentrations in surface and ground water have been detected across the United States (Kolpin and others, 2000, Kolpin and others, 2002). However, there are regulatory standards for only a few pesticides (Kolpin and others, 2002). Personal-care products (pharmaceuticals, antibiotics, etc.) that may arise from both human and agricultural land uses may also be present in surface and ground waters (Kolpin and others, 2000). The occurrence and distribution of these compounds is of intense national interest (Kolpin and others, 2002).

New microbiological parameters are also being used to evaluate water quality. Deoxyribonucleic Acid- (DNA) based methods are used to evaluate the type and potential source of bacteria in surface waters (Rose and Grimes, 2001). These methods are also used to identify the likely presence of microbial pathogens in surface waters (Rose and Grimes, 2001, Duris and others, 2003).

Using an array of such methods provides information that could allow a more comprehensive understanding of water-quality issues, and add new tools for determining the sources of contamination. Data from new methods is especially useful when coupled with historical data for comparison. Huron County has committed resources to the past evaluation of its surface- and ground-water quality and quantity, and these new data could be useful to evaluate potential trends that are occurring in the County's water.

Purpose and Scope

This report documents the procedures used to collect water-quality data and the analytical methods used to evaluate the data. It provides the results from the physical, chemical, and microbiological analyses conducted in the Pigeon and Pinnebog watersheds in Huron County, Michigan from April through November, 2004.

Study Area Description

Huron County, like much of Michigan, is a largely agricultural county (U.S. Department of Agriculture, 2001). Like

many Michigan counties, Huron County has an extensive Great Lakes shoreline that affords numerous recreational and natural-resource amenities. Huron County offers two state parks, seven county parks, and numerous other private parks and campgrounds. Marinas, ports, and riverside canoe liveries rely on the quality of water for the fishing and recreation industries. Huron County currently has approximately 36,000 residents. In 2000, the county supported 190 milk-producing operations and 68,000 non-dairy cattle and calves. In addition, there were 605,000 hens and pullets of laying age and 65,500 hogs and pigs (U.S. Department of Agriculture, 2001). The factors that could influence water quality in Huron County are similar to those in numerous counties in the southern half of the Lower Peninsula of Michigan. These factors include agricultural practice, municipal and domestic waste treatment, and stormwater runoff.

The sites sampled are representative of the County. Figure 1 shows the locations of the sampling sites within each watershed and table 1 presents a list of sampling locations. Table 2 presents summary land-use data for the surface water sites. Site 04158495 is on the Pigeon River at Maxwell Road, near Canboro Road, and is surrounded by agricultural fields and rural homes. Site 04159000 is on the Pigeon River at South Caseville Road, south of the town of Pigeon and is surrounded by agricultural fields and an orchard. Site 04159010 is on the Pigeon River at Kinde Road east of the town of Caseville. Site 041590107 is on the Pigeon River within the town of Caseville, about 50 meters (m) upstream of Port Austin Road and about 2 miles downstream of the Caseville wastewater treatment facility. Site 041590114 is on the Pinnebog River at Moore Road and is surrounded by agricultural fields and rural homes. Site 041590117 is on the Pinnebog River at Richardson Road, about 1600 m downstream of the town of Elkton and about 800 m downstream of the Elkton wastewater treatment facility. Site 04159045 is on the Pinnebog River at Limerick Road and is surrounded by agricultural fields and a church. Site 04159064 is on the Pinnebog River in Port Crescent State Park, about 100 m downstream of the confluence with Taft Drain and is surrounded by parkland. Wells H-14 and H-20 are described in Sweat, 1992. Well H-14 is completed in the Marshall Formation and is 100 feet deep; Well H-20 is completed in the Saginaw Formation and is 60 feet deep.

Methods

Water-quality data collected falls into one of three major categories: physical, microbiological, and chemical. The analysis of samples for various constituents was conducted on one or multiple occasions throughout the study as indicated in table 3.

Field Physical and Water-Quality Measurements

Stream discharge measurements were made under high- and low-flow conditions by a USGS hydrologic technician in May and August as described in Rantz and others (1982). Field water-quality parameters (temperature, pH, specific conductance, and dissolved oxygen concentration) were measured at a minimum of three sections across each stream using a multiparameter water-quality probe. Nutrients, iron, and sulfide were measured using a Hach (Hach Company, Loveland, CO) multiparameter field lab and test kits for ammonium, nitrate, reactive phosphorus, iron, and sulfide. Samples were processed according to manufacturer's instructions. Samples were also analyzed for total suspended solids according to American Public Health Association (1998), method 2540D.

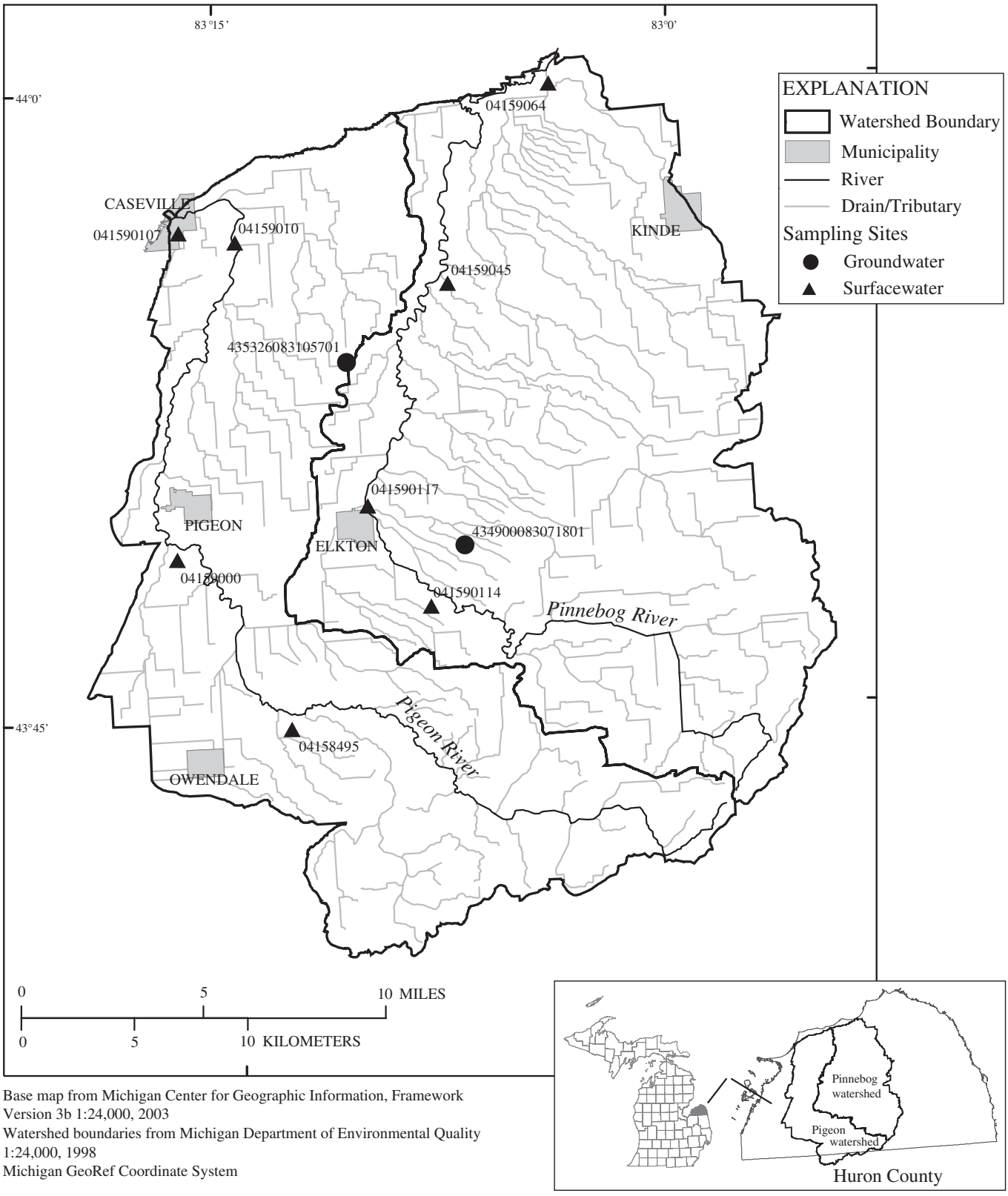
Microbiological Water Quality

Sampling and processing protocols for the U.S. Environmental Protection Agency- (USEPA) recommended recreational water quality indicator bacteria *Escherichia coli* and enterococci followed standard procedures as outlined in U.S. Environmental Protection Agency, 2000a, and American Public Health Association, 1998, as well as the standard field procedures documented by the USGS in the National Field Manual (Myers, 2004). One-liter grab samples were collected in sterile bottles at each site. Each sample was evaluated for fecal coliform (FC) bacteria using mFC medium, *Escherichia coli* (*E. coli*) using NA-MUG medium, and enterococci bacteria using mEI medium. Evaluation of the presence of pathogenic *E. coli* was performed with three independent methods.

FC bacteria from the membrane filter with the most growth for each site and date were collected and suspended in 1 milliliter (mL) of Lauria-Bertani broth with a final concentration of 15% glycerol and preserved by freezing at -80 degrees Celsius (°C). This FC bacteria preparation was used for all subsequent analysis for pathogenic *E. coli*.

Each FC preparation was evaluated using the standard culture-based method for the determination of *E. coli* O157:H7 (Chapin and Lauderdale, 2003). Briefly, a known volume of FC preparation was inoculated onto cefexime tellurite sorbitol MacConkey (CT-SMAC) agar. The culture was incubated at 37 degrees Celsius for 24 hours and then assessed for growth characteristic of *E. coli* O157:H7.

The Reveal for *E. coli* O157:H7 test kit (Neogen Inc., Lansing, Mi.), was used as a confirmation for the presence of *E. coli* O157. This method uses antibodies that are specific for surface antigens expressed only on the O157 subtype of *E. coli* cells. This immunological test is an Association of Official Analytical Chemists (AOAC) Official Method routinely used by U. S. Department of Agriculture Food Safety Inspection Service and others for the detection of *E. coli* O157 in food and environmental samples (Bird and others, 2001).



Base map from Michigan Center for Geographic Information, Framework Version 3b 1:24,000, 2003
Watershed boundaries from Michigan Department of Environmental Quality 1:24,000, 1998
Michigan GeoRef Coordinate System

Figure 1. Map showing surface-water and ground-water sampling locations in Huron County, Michigan

Table 1. USGS sites and wells sampled in Huron County, Michigan, April through November, 2004

[NAD27, North American Datum, 1927; km^2, square kilometers; NA, Not applicable]

Station number	Station name	Latitude (NAD27)	Longitude (NAD27)	Drainage area (km^2)
04158495	Pigeon River at Maxwell Road near Rescue, MI.	43.74557110 N	83.21939580 W	132.8
04159000	Pigeon River near Pigeon, MI.	43.81418194 N	83.27912190 W	213.2
04159010	Pigeon River near Caseville, MI.	43.93945860 N	83.24162300 W	334.2
041590107	Pigeon River at Caseville, MI.	43.94390306 N	83.27273580 W	406.7
041590114	Pinnebog River at Moore Road near Elkton, MI.	43.79260000 N	83.14068000 W	109.0
041590117	Pinnebog River at Richardson Road near Elkton, MI.	43.83334830 N	83.17356250 W	155.3
04159045	Pinnebog River at Limerick Road near Pinnebog, MI.	43.92057000 N	83.12550670 W	321.8
04159064	Pinnebog River near Port Crescent, MI.	43.99862528 N	83.06661639 W	479.9
434900083071801	Huron County USGS Well H-14	43.8166816 N	83.12133791 W	NA
435326083105701	Huron County USGS Well H-20	43.8905701 N	83.18245288 W	NA

Table 2. Land-use statistics for stations sampled in Huron County, Michigan

Station number	Station name	Percent land-use[1]						
		Urban	Agricultural	Open	Forest	Open water	Barren	Wetland
04158495	Pigeon River at Maxwell Road near Rescue, MI.	3.02	74.25	4.03	9.95	0.01	0.06	8.69
04159000	Pigeon River near Pigeon, MI.	3.28	77.14	3.34	8.75	0.02	0.07	7.39
04159010	Pigeon River near Caseville, MI.	3.82	82.30	2.30	5.98	0.02	0.10	5.48
041590107	Pigeon River at Caseville, MI.	3.77	82.06	2.10	5.33	0.11	0.09	6.55
041590114	Pinnebog River at Moore Road near Elkton, MI.	5.04	66.25	4.20	9.69	0.10	0.11	14.61
041590117	Pinnebog River at Richardson Road near Elkton, MI.	4.98	72.14	3.42	8.28	0.07	0.18	10.93
04159045	Pinnebog River at Limerick Road near Pinnebog, MI.	4.95	76.05	2.99	7.29	0.08	0.14	8.50
04159064	Pinnebog River near Port Crescent, MI.	4.50	77.63	2.70	6.62	0.06	0.12	8.38

[1]1:24,000 NLCD (National Land Cover Data set)

Table 3. Sampling schedule and analytes

[SW, All surface-water sites analyzed; GW, All ground-water sites analyzed; --, not analyzed]

Analyte	April	May	August	November
Antibiotics	SW	--	SW & GW	--
Bacteria	SW	SW	SW & GW	SW
Field Measurements	SW	SW	SW & GW	SW
Corn & Soybean Pesticides	--	SW	SW & GW	--
Discharge	--	SW	SW	--
Nutrients	SW	SW	SW & GW	SW
Polar Pesticides and Metabolites	--	SW	SW & GW	--
Wastewater Compounds	--	SW	SW & GW	--
Quality Assurance Samples	--	SW	SW	--

The FC preparations were also analyzed using two multiplex polymerase chain reaction (PCR) methods. DNA was extracted from a known volume of the FC preparations in proportion to the concentration of FC cells in the preparation, using the Qiagen DNeasy DNA extraction kit (Qiagen, Valencia, CA). The manufacturer's instructions were followed for DNA extraction from bacterial cultures, using a 3-hour proteinase K/sodium dodecyl sulfate lysis time. DNA was collected in two 200 µL volumes of elution buffer and stored at –20°C until analysis.

One microliter (µl) of DNA extract representing 3-160 nanograms (ng) of DNA was used to conduct all PCR analyses. Samples were analyzed for the genes responsible for the O157 and H7 types as described by Osek (2003). The genes targeted by this assay are the genes responsible for the production of the specific antigens found on the surface of an *E. coli* O157:H7 cell.

The samples were also analyzed for pathogenic *E. coli* toxin genes, following Fagan and others (1999) and Sabat and others (2000). The genes targeted by this assay are those required to confirm the presence of enterohemorrhagic *E. coli* in clinical samples (Chapin and Lauderdale, 2003; Fagan and others 1999; Nataro and Kaper, 1998). This method was modified to include analysis for a gene common to all *E. coli*, both pathogenic and non-pathogenic, which was used as an internal control to confirm the presence of *E. coli*.

All enumeration procedures followed standard procedures as outlined in U.S. Environmental Protection Agency, 2000a, American Public Health Association, 1998, as well as the standard field procedures documented by the USGS in the Field Manual (Myers, 2004). Enumeration procedures included dilutions and blanks.

The immunological test method reports a positive or negative result, features a built-in control for reaction quality, and has a detection limit of 1 cell per volume of material tested. Selected tests from different lot numbers of reagents were evaluated using a non-pathogenic strain of *E. coli* O157:H7 (American Type Culture Collection strain number 700728). A matrix spike was also analyzed for the immunological test.

All gene-based methods followed standard protocols (e.g., Akkermanns and DeBruijn, 2000; Chapin and Lauderdale, 2003). Method blanks, reagent blanks, calibration standards, positive controls with a standard bacterial culture (DNA of *E. coli* ATCC 35150), and internal controls for reaction quality were performed for every gene-based analysis. A matrix spike was also analyzed for gene-based tests. In addition, gene-based procedures entailed independent analysis of multiple dilutions of the same sample. Dilution results provided an internal quality control check.

Chemical Water Quality

Organic and inorganic water-quality samples were collected using depth and width integrated (DWI) sampling procedures employing a DH-81 sampler as described in Wilde and others, 1999. Samples were processed in the field and prepared for shipment to analytical laboratories as outlined in Wilde and others, 2004. Equipment was cleaned in the laboratory prior to sampling and field cleaned during sampling according to Wilde, 2004. The USGS National Water Quality Laboratory (NWQL) analyzed samples for wastewater components (laboratory schedule 1433) according to Zaugg and others, 2002, and polar pesticides and metabolites (laboratory schedule 2060) according to Zaugg and others, 1995. The USGS Organic Geochemistry Research Laboratory analyzed samples for antibiotics (laboratory schedule LCAN) according to Scribner and others, 2002, and corn- and soybean-use herbicides and their metabolites (laboratory schedule GCS) according to Kish and others, 2000, Scribner and others, 2002, and Zimmerman and Thurman, 1999.

In order to maintain consistent data collection and processing, the USGS developed the National Field Manual, which describes all aspects of water-quality sample collection procedures, procedures for determination of field parameters such as pH or dissolved oxygen concentration, procedures for field processing of samples, procedures for packaging and shipping samples, quality assurance and quality control requirements for field parameter data, and specific concerns for specific sampling protocols. The USGS National Field Manual (NFM) can be accessed on line at: http://water.usgs.gov/owq/FieldManual. All procedures followed those outlined in the NFM. Field blanks were collected on two dates during the study. Blank samples were collected and processed according to Wilde and others, 2004. An equipment blank was collected on one date and processed according to Wilde and others, 2004. All blanks were analyzed for wastewater compounds according to Zaugg and others, 2002.

Internal quality control procedures are part of all analyses performed by the two USGS laboratories that provided chemical analyses: the USGS National Water-Quality Laboratory (NWQL) and the Organic Geochemistry Research Laboratory. These procedures included method blanks, reagent/preparation blanks, calibration standards, internal standards, and surrogate standards. These procedures were followed each time a chemical sample was analyzed. In addition, matrix spikes, specific calibration check standards, and laboratory duplicate/replicate analysis may have been analyzed quarterly or more frequently. Additional information on quality control procedures for the NWQL is provided in Pritt and Raese, 1995.

Results of Data Collection

Physical and chemical properties of the water that were determined in the field are reported in table 4. Water pH ranged from 6.6 to 8.7 pH units with an average of 7.7 pH units. Dissolved oxygen concentrations ranged from 0.1 to 13.2 milligrams per liter (mg/L) with an average of 7.4 mg/L. Water temperatures ranged from 8.2 to 23.7°C with an average temperature of 14.4°C. Specific conductance ranged from 637.7 to 2048.0 microsiemens per centimeter (µS/cm) with an average value of 870.8 µS/cm.

Table 4. Field parameters, nutrients, total suspended solids and discharge data for Huron County, Michigan, April through November, 2004

[Temp., temperature; Phosphate, reactive phosphorus (orthophosphate); Nitrate, nitrate nitrogen; Ammonia, ammonia as nitrogen; Sulfide, as sulfide; TSS, total suspended solids; °C , degrees Celsius; µS/cm, microsiemens per centimeter; mg/L, milligrams per liter; PO_4^{3-}, phosphate; N, nitrogen; m^3/s, cubic meters per second; nm, not measured; NA, not applicable]

			Temp.	Dissolved oxygen	Specific conductance
Station number	Station name	Date	°C	mg/L	µS/cm
04158495	Pigeon River at Maxwell Road near Rescue, MI.	4/23/2004	12.96	11.32	746.1
04158495	Pigeon River at Maxwell Road near Rescue, MI.	5/17/2004	13.00	7.85	748.5
04158495	Pigeon River at Maxwell Road near Rescue, MI.	8/25/2004	18.53	7.81	637.7
04158495	Pigeon River at Maxwell Road near Rescue, MI.	11/3/2004	8.81	8.64	724.0
04159000	Pigeon River near Pigeon, MI.	4/23/2004	13.80	9.83	748.2
04159000	Pigeon River near Pigeon, MI.	5/17/2004	17.06	5.46	747.1
04159000	Pigeon River near Pigeon, MI.	8/25/2004	22.82	7.58	683.5
04159000	Pigeon River near Pigeon, MI.	11/3/2004	9.34	6.24	735.0
04159010	Pigeon River near Caseville, MI.	4/22/2004	14.41	9.74	858.4
04159010	Pigeon River near Caseville, MI.	5/17/2004	15.53	7.38	792.1
04159010	Pigeon River near Caseville, MI.	8/25/2004	21.04	7.35	731.0
04159010	Pigeon River near Caseville, MI.	11/3/2004	8.59	5.84	726.0
041590107	Pigeon River at Caseville, MI.	4/22/2004	14.68	9.16	863.0
041590107	Pigeon River at Caseville, MI.	5/20/2004	nm	nm	868.0
041590107	Pigeon River at Caseville, MI.	8/26/2004	22.53	5.97	694.5
041590107	Pigeon River at Caseville, MI.	11/3/2004	9.22	3.42	968.0
041590114	Pinnebog River at Moore Road near Elkton, MI.	4/22/2004	12.82	10.25	793.0
041590114	Pinnebog River at Moore Road near Elkton, MI.	5/17/2004	15.46	8.65	796.4
041590114	Pinnebog River at Moore Road near Elkton, MI.	8/25/2004	17.80	4.87	672.0
041590114	Pinnebog River at Moore Road near Elkton, MI.	11/3/2004	8.37	8.43	661.4
041590117	Pinnebog River at Richardson Road near Elkton, MI.	4/23/2004	12.05	9.97	899.7
041590117	Pinnebog River at Richardson Road near Elkton, MI.	5/17/2004	17.05	9.06	807.7
041590117	Pinnebog River at Richardson Road near Elkton, MI.	8/25/2004	23.74	7.01	1070.7
041590117	Pinnebog River at Richardson Road near Elkton, MI.	11/3/2004	8.15	10.09	771.2
04159045	Pinnebog River at Limerick Road near Pinnebog, MI.	4/22/2004	14.06	13.23	874.6
04159045	Pinnebog River at Limerick Road near Pinnebog, MI.	5/20/2004	nm	nm	850.0
04159045	Pinnebog River at Limerick Road near Pinnebog, MI.	8/26/2004	20.36	6.70	1033.3
04159045	Pinnebog River at Limerick Road near Pinnebog, MI.	11/3/2004	8.54	4.99	1364.0
04159064	Pinnebog River near Port Crescent, MI.	4/22/2004	11.40	6.73	811.0
04159064	Pinnebog River near Port Crescent, MI.	5/20/2004	nm	nm	810.0
04159064	Pinnebog River near Port Crescent, MI.	8/26/2004	22.94	6.30	743.6
04159064	Pinnebog River near Port Crescent, MI.	11/3/2004	8.92	8.56	760.0
434900083071801	Huron County USGS Well H-14	8/26/2004	11.73	0.08	1570.4
435326083105701	Huron County USGS Well H-20	8/27/2004	11.65	.08	2048.0

Table 4. Field parameters, nutrients, total suspended solids and discharge data for Huron County, Michigan, April through November, 2004—Continued

[Temp., temperature; Phosphate, reactive phosphorus (orthophosphate); Nitrate, nitrate nitrogen; Ammonia, ammonia as nitrogen; Sulfide, as sulfide; TSS, total suspended solids; °C , degrees Celsius; µS/cm, microsiemens per centimeter; mg/L, milligrams per liter; PO_4^{3-}, phosphate; N, nitrogen; m^3/s, cubic meters per second; nm, not measured; NA, not applicable]

		pH	Phosphate	Nitrate	Ammonia	Sulfide	Total iron	TSS	Discharge
Station number	Date	pH units	mg/L as PO_4^{3-}	mg/L as N	mg/L as N	mg/L	mg/L	mg/L	m^3/s
04158495	4/23/2004	7.20	0.23	3.2	0.02	nm	nm	22.00	nm
04158495	5/17/2004	6.80	.07	5.7	.01	nm	nm	55.00	1.30
04158495	8/25/2004	7.93	.07	0.1	.01	nm	nm	27.33	0.07
04158495	11/3/2004	7.60	.01	.3	.00	nm	nm	20.67	nm
04159000	4/23/2004	7.71	.13	3.6	.00	nm	nm	18.00	nm
04159000	5/17/2004	8.31	.06	7.5	.01	nm	nm	19.00	1.99
04159000	8/25/2004	7.89	.11	.6	.01	nm	nm	30.00	.05
04159000	11/3/2004	7.29	.12	.4	.00	nm	nm	10.00	nm
04159010	4/22/2004	8.21	.02	5.2	.01	nm	nm	30.00	nm
04159010	5/17/2004	8.29	.09	4.9	.01	nm	nm	39.00	3.62
04159010	8/25/2004	7.98	.10	.6	.01	nm	nm	34.00	.03
04159010	11/3/2004	7.18	.99	.0	.01	nm	nm	16.67	nm
041590107	4/22/2004	8.34	.02	3.2	.03	nm	nm	33.00	nm
041590107	5/20/2004	7.85	.08	5.0	.01	nm	nm	34.00	5.15
041590107	8/26/2004	7.92	.04	.7	.04	nm	nm	28.67	1.78
041590107	11/3/2004	7.13	.55	.0	.01	nm	nm	20.67	nm
041590114	4/22/2004	8.64	.05	3.2	.04	nm	nm	29.00	nm
041590114	5/17/2004	8.11	.03	5.9	.01	nm	nm	26.00	1.13
041590114	8/25/2004	7.61	.07	.8	.03	nm	nm	116.00	.02
041590114	11/3/2004	7.16	.01	.9	.01	nm	nm	5.33	nm
041590117	4/23/2004	7.90	1.72	3.4	.07	nm	nm	28.00	nm
041590117	5/17/2004	8.74	.08	6.0	.01	nm	nm	48.00	1.43
041590117	8/25/2004	7.60	.08	.6	.03	nm	nm	62.67	.01
041590117	11/3/2004	7.33	.05	1.8	.09	nm	nm	9.33	nm
04159045	4/22/2004	8.09	.62	4.9	.11	nm	nm	38.00	nm
04159045	5/20/2004	7.58	.13	6.6	.03	nm	nm	39.00	3.40
04159045	8/26/2004	7.92	.05	1.1	.02	nm	nm	28.67	.07
04159045	11/3/2004	7.17	.74	.9	.02	nm	nm	10.67	nm
04159064	4/22/2004	7.16	.37	4.1	.01	nm	nm	25.00	nm
04159064	5/20/2004	7.54	.14	4.4	.01	nm	nm	92.00	5.47
04159064	8/26/2004	7.97	.00	.3	.03	nm	nm	44.67	2.06
04159064	11/3/2004	7.27	.02	1.0	.01	nm	nm	18.00	nm
434900083071801	8/26/2004	7.31	.06	.0	.45	0.54	0.111	nm	NA
435326083105701	8/27/2004	6.56	.04	1.3	.20	1.68	.203	nm	NA

A description of microbiological analytes and data from microbiological analysis of samples are presented in tables 5 and 6, respectively. FC bacteria concentrations ranged from non-detect to 2700 colony forming units per 100 milliliters (CFU/100 ml) with an average value of 328 CFU/100 ml FC. *E. coli* bacteria concentrations ranged from non-detect to 2000 CFU/100 ml with an average value of 237 CFU/100 ml. The enterococci ranged from non-detect to 2200 CFU/100 ml with an average value of 204 CFU/100ml. Multiple indications of *E. coli* O157 were found at three sites, while indications of Shiga toxin producing *E. coli* (STEC) were found at all sites.

Pesticide analytes and method information for this study are presented in table 7. Data from the pesticide analyses conducted by USGS laboratories are presented in tables 8 and 9. Atrazine and the atrazine metabolites deethylatrazine and 2-hydroxyatrazine were detected on at least one occasion at all surface water sites. Bentazon and metolachlor and 2,4-D were also frequently detected in surface water samples.

Organic wastewater constituents measured during the study and analytical method information are presented in table 10. Wastewater compounds that were detected and their respective concentrations are presented in table 11. The fragrances and solvents which include, benzophenone, indole, skatol, methyl salicylate, isophorone, were often detected in water samples. The fire retardants such as tri (2-butoxyethyl) phosphate and tri (2-chloroethyl) phosphate, were detected infrequently.

Antibiotic analysis method information and data are presented in tables 12 and 13 respectively. Antibiotics detected included erythromycin, trimethoprim, and ofloxacin, the animal use antibiotics sulfadimethoxine, sulfamethazine and sulfamethoxazole and the human use antibiotics ciprofloxacin. These antibiotics were detected on various dates at various surface water sites, but were never detected in ground water.

Available water-quality criteria and standards for parameters analyzed in this study are presented in table 14. Table 15 presents relevant historical data and new data collected under similar flow conditions at similar times of the year.

Tables 8, 11 and 15 contain some values with an “E” (estimated) remark code. An “E” remark code identifies an estimated concentration. The identification of the compound is confirmed, but the concentration is estimated for one of the following reasons: (1) the calculated concentration is less than the laboratory reporting level (LRL); (2) the calculated concentration is greater than the highest calibration standard; or (3) the compound is categorized as a “permanent E” compound in the method due to inconsistent performance; or (4) the value is below the long term method detection limit. The reporting procedures used to determine whether to assign an estimated concentration, and the possible significance to the user of these estimated concentrations is described in Childress and others, 1999.

Table 5. Description of microbiological analytes

[*E. coli*, *Escherichia coli*; CT-SMAC, cefexime-tellurite sorbitol MacConkey medium; NA, Not Applicable]

Analyte	Category	Gene product	Importance
Fecal coliform	Indicator group	NA	Commonly used group of fecal indicator organisms
E. coli	Indicator group	NA	Commonly used species of fecal indicator organisms
Enterococci	Indicator group	NA	Commonly used group of fecal indicator organisms
*eae*A	gene	Intimin	Product causes tight binding of pathogenic *E. coli* to intestinal cells
*stx*1	gene	Shiga toxin 1	Product causes intestinal cell death.
*stx*2	gene	Shiga toxin 2	Product causes intestinal cell death.
EC	gene	16S ribosomal nucleic acid	Common to all *E. coli*, pathogenic and non-pathogenic
*rfb*O157	gene	O157 surface protein	Gene is marker for *E. coli* O157 subtype
*fliC*H7	gene	H7 flagellar protein	Gene is marker for *E. coli* H7 subtype
Immunological test	surface protein	NA	Immunological test for *E. coli* O157 cells
CT-SMAC	growth assay	NA	*E. coli* O157 cells have characteristic appearance

Table 6. Microbiological data for samples collected in Huron County, Michigan, April through November, 2004

[CT-SMAC, cefexime tellurite-sorbitol MacConkey agar; *E. coli*, *Escherichia coli*; *E. coli* genes, *Escherichia coli* genes; NA, not applicable; +, present; -, absent; ND, non-detect]

			Colony-forming units per 100 ml water		
Station number	Station name	Date	Fecal coliforms	*E. coli*	Enterococci
04158495	Pigeon River at Maxwell Road near Rescue, MI.	4/23/2004	29	28	19
04158495	Pigeon River at Maxwell Road near Rescue, MI.	5/17/2004	230	200	68
04158495	Pigeon River at Maxwell Road near Rescue, MI.	8/25/2004	420	300	380
04158495	Pigeon River at Maxwell Road near Rescue, MI.	11/3/2004	33	14	186
04159000	Pigeon River near Pigeon, MI.	4/23/2004	17	16	17
04159000	Pigeon River near Pigeon, MI.	5/17/2004	111	64	53
04159000	Pigeon River near Pigeon, MI.	8/25/2004	1427	1100	200
04159000	Pigeon River near Pigeon, MI.	11/3/2004	2145	2000	2200
04159010	Pigeon River near Caseville, MI.	4/22/2004	33	30	15
04159010	Pigeon River near Caseville, MI.	5/17/2004	83	65	35
04159010	Pigeon River near Caseville, MI.	8/25/2004	900	620	200
04159010	Pigeon River near Caseville, MI.	11/3/2004	13	10	42
041590107	Pigeon River at Caseville, MI.	4/22/2004	32	30	10
041590107	Pigeon River at Caseville, MI.	5/20/2004	27	27	57
041590107	Pigeon River at Caseville, MI.	8/26/2004	536	210	290
041590107	Pigeon River at Caseville, MI.	11/3/2004	23	23	440
041590114	Pinnebog River at Moore Road near Elkton, MI.	4/22/2004	87	78	35
041590114	Pinnebog River at Moore Road near Elkton, MI.	5/17/2004	47	40	49
041590114	Pinnebog River at Moore Road near Elkton, MI.	8/25/2004	330	170	84
041590114	Pinnebog River at Moore Road near Elkton, MI.	11/3/2004	50	ND	270
041590117	Pinnebog River at Richardson Road near Elkton, MI.	4/23/2004	96	49	10
041590117	Pinnebog River at Richardson Road near Elkton, MI.	5/17/2004	72	46	41
041590117	Pinnebog River at Richardson Road near Elkton, MI.	8/25/2004	845	600	270
041590117	Pinnebog River at Richardson Road near Elkton, MI.	11/3/2004	41	37	85
04159045	Pinnebog River at Limerick Road near Pinnebog, MI.	4/22/2004	109	110	33
04159045	Pinnebog River at Limerick Road near Pinnebog, MI.	5/20/2004	95	110	59
04159045	Pinnebog River at Limerick Road near Pinnebog, MI.	8/26/2004	2700	1500	1327
04159045	Pinnebog River at Limerick Road near Pinnebog, MI.	11/3/2004	64	48	300
04159064	Pinnebog River near Port Crescent, MI.	4/22/2004	280	250	77
04159064	Pinnebog River near Port Crescent, MI.	5/20/2004	260	260	40
04159064	Pinnebog River near Port Crescent, MI.	8/26/2004	27	25	28
04159064	Pinnebog River near Port Crescent, MI.	11/3/2004	ND	ND	10
434900083071801	Huron County Well H-14	8/26/2004	ND	ND	14
435326083105701	Huron County Well H-20	8/27/2004	ND	ND	ND

Table 6. Microbiological data for samples collected in Huron County, Michigan, April through November, 2004—Continued

[CT-SMAC, cefexime tellurite-sorbitol MacConkey agar; *E. coli*, *Escherichia coli*; *E. coli* genes, *Escherichia coli* genes; NA, not applicable; +, present; -, absent]

				E. coli genes					
Station number	**Date**	**CT-SMAC**	**Immunological test**	**eaeA**	**stx2**	**stx1**	**EC**	***rfb* 0157**	***fliC* H7**
04158495	4/23/2004	-	-	+	+	-	+	-	+
04158495	5/17/2004	-	-	+	+	-	+	-	+
04158495	8/25/2004	-	-	+	-	-	+	-	+
04158495	11/3/2004	-	-	+	+	+	+	-	+
04159000	4/23/2004	-	-	+	+	-	+	-	-
04159000	5/17/2004	-	-	+	+	-	+	-	+
04159000	8/25/2004	+	+	+	+	-	+	+	+
04159000	11/3/2004	+	+	+	-	-	+	+	+
04159010	4/22/2004	-	-	+	-	-	+	-	+
04159010	5/17/2004	+	-	+	+	-	+	-	+
04159010	8/25/2004	-	-	+	+	-	+	-	+
04159010	11/3/2004	-	-	+	-	-	+	-	+
041590107	4/22/2004	-	-	+	+	-	+	-	+
041590107	5/20/2004	+	-	+	+	-	+	-	+
041590107	8/26/2004	+	+	+	-	-	+	-	+
041590107	11/3/2004	-	-	+	-	-	+	-	+
041590114	4/22/2004	-	-	+	-	-	+	-	+
041590114	5/17/2004	-	-	+	+	-	+	+	+
041590114	8/25/2004	+	-	+	-	+	+	-	+
041590114	11/3/2004	-	-	-	-	-	+	-	-
041590117	4/23/2004	-	-	+	-	+	+	-	+
041590117	5/17/2004	-	-	+	+	-	+	+	+
041590117	8/25/2004	-	-	+	-	-	+	-	+
041590117	11/3/2004	-	-	+	-	+	+	-	+
04159045	4/22/2004	-	-	+	+	-	+	-	+
04159045	5/20/2004	-	-	+	-	-	+	-	+
04159045	8/26/2004	-	-	+	+	-	+	-	+
04159045	11/3/2004	-	-	+	+	+	+	-	+
04159064	4/22/2004	-	-	+	-	-	+	-	+
04159064	5/20/2004	+	+	+	+	-	+	+	+
04159064	8/26/2004	-	-	+	+	-	+	-	-
04159064	11/3/2004	NA	NA	NA	NA	NA	NA	NA	NA
434900083071801	8/26/2004	NA	NA	NA	NA	NA	NA	NA	NA
435326083105701	8/27/2004	NA	NA	NA	NA	NA	NA	NA	NA

Table 7. Description of pesticide analytes and method information

[Compounds listed in bold were detected, all others were below detection limit. Sources for primary crop and use category, Miller (2005), ChemFinder Webserver (2004), U.S. Department of Agriculture (2005). Abbreviations: CAS, Chemical Abstract Service; RL, Reporting Level; mrl, minimum reporting level; irl, interim reporting level; F, fungicide; H, herbicide; HM, herbicide metabolite; I, Insecticide; IM, insecticide metabolite; R.O.W., used to control weeds on right of way; NA, Not Applicable]

Analyte	Synonym	CAS number	RL	Unit	RL type	Primary crop	Use
Polar Pesticides and Metabolites							
2,4-D		**94-75-7**	**0.0218**	**µg/L**	**irl**	**Corn**	**H**
2,4-D methyl ester		1928-38-7	.0086	µg/L	irl	NA	HM
2,4-DB		94-82-6	.016	µg/L	irl	Alfalfa	H
2-Chloro-4-isopropylamino-6-amino-s-triazine	**Deethylatrazine**	**6190-65-4**	**.0282**	**µg/L**	**irl**	**NA**	**HM**
2-Chloro-6-ethylamino-4-amino-s-triazine	**Deisopropylatrazine**	**1007-28-9**	**.01**	**µg/L**	**irl**	**NA**	**HM**
2-Hydroxy-4-isopropylamino-6-ethylamino-s-triazine	**2-hydroxyatrazine**	**2163-68-0**	**.008**	**µg/L**	**irl**	**NA**	**HM**
3(4-Chlorophenyl)-1-methyl urea		5352-88-5	.0242	µg/L	irl	NA	HM
3-Hydroxycarbofuran		16655-82-6	.0058	µg/L	irl	NA	IM
3-Ketocarbofuran		16709-30-1	.014	µg/L	irl	NA	IM
Acifluorfen		**50594-66-6**	**.0066**	**µg/L**	**irl**	**Soybeans**	**H**
Aldicarb		116-06-3	.04	µg/L	irl	Soybeans	I
Aldicarb sulfone		1646-88-4	.02	µg/L	irl	NA	IM
Aldicarb sulfoxide		1646-87-3	.0082	µg/L	irl	NA	IM
Atrazine		**1912-24-9**	**.009**	**µg/L**	**irl**	**Corn**	**H**
Bendiocarb		22781-23-3	.0252	µg/L	irl	Sugarbeets	I
Benomyl		**17804-35-2**	**.0038**	**µg/L**	**irl**	**Dry beans, Sugarbeets**	**F**
Bensulfuron-methyl		83055-99-6	.0158	µg/L	irl	NA	H
Bentazon		25057-89-0	.011	µg/L	irl	Beans	H
Bromacil		**314-40-9**	**.033**	**µg/L**	**irl**	**Rangeland, R.O.W.**	**H**
Bromoxynil		1689-84-5	.017	µg/L	irl	Corn	H
Caffeine		**58-08-2**	**.0096**	**µg/L**	**irl**	**NA**	**NA**
Carbaryl		63-25-2	.0284	µg/L	irl	Cotton	I
Carbofuran		1563-66-2	.0056	µg/L	irl	Field crops	I
Chloramben, methyl ester		7286-84-2	.018	µg/L	irl	Vegetables	H
Chlordiamino-s-triazine	Deethyl desisopropyl atrazine	3397-62-4	.044	µg/L	irl	NA	HM
Chlorimuron-ethyl		90982-32-4	.0096	µg/L	irl	Soybeans	H
Chlorothalonil		1897-45-6	.035	µg/L	irl	Vegetables	F
Clopyralid		**1702-17-6**	**.0138**	**µg/L**	**irl**	**Sugarbeets**	**H**
Cycloate		1134-23-2	.013	µg/L	irl	Sugarbeets	H
Dacthal monoacid		887-54-7	.0116	µg/L	irl	NA	HM
Dicamba		**1918-00-9**	**.0128**	**µg/L**	**irl**	**Corn**	**H**
Dichlorprop	**2,4-DP**	**120-36-5**	**.0138**	**µg/L**	**irl**	**Turf**	**H**

Table 7. Description of pesticide analytes and method information — Continued

[Compounds listed in bold were detected, all others were below detection limit. Sources for primary crop and use category, Miller (2005), ChemFinder Webserver (2004), U.S. Department of Agriculture (2005). Abbreviations: CAS, Chemical Abstract Service; RL, Reporting Level; mrl, minimum reporting level; irl, interim reporting level; F, fungicide; H, herbicide; HM, herbicide metabolite; I, Insecticide; IM, insecticide metabolite; R.O.W., used to control weeds on right of way; NA, Not Applicable]

Analyte	Synonym	CAS number	RL	Unit	RL type	Primary crop	Use
Dinoseb		88-85-7	0.012	µg/L	irl	Soybeans	H
Diphenamid		957-51-7	.0264	µg/L	irl	Vegetables	H
Diuron		330-54-1	.015	µg/L	irl	Alfalfa	H
Fenuron		101-42-8	.0316	µg/L	irl	Sugarbeets	H
Flumetsulam		98967-40-9	.011	µg/L	irl	Corn	H
Fluometuron		2164-17-2	.031	µg/L	irl	Cotton	H
Imazaquin		81335-37-7	.016	µg/L	irl	Soybeans	H
Imazethapyr		81335-77-5	.017	µg/L	irl	Soybeans	H
Imidacloprid		138261-41-3	.0068	µg/L	irl	Apples, grapes	I
Linuron		330-55-2	.0144	µg/L	irl	Carrots	H
MCPA		94-74-6	.0162	µg/L	irl	Cereals	H
MCPB		94-81-5	.015	µg/L	irl	Cereals	H
Metalaxyl		**57837-19-1**	**.02**	**µg/L**	**irl**	**Vegetables**	**F**
Methiocarb		2032-65-7	.008	µg/L	irl	Non-crop	I
Methomyl		16752-77-5	.0044	µg/L	irl	NA	IM
Metsulfuron methyl		74223-64-6	.025	µg/L	irl	Cereals	H
Neburon		555-37-3	.012	µg/L	irl	Non-crop	H
Nicosulfuron		111991-09-4	.013	µg/L	irl	Corn	H
Norflurazon		27314-13-2	.016	µg/L	irl	Vegetables	H
Oryzalin		19044-88-3	.0176	µg/L	irl	Fruits	H
Oxamyl		23135-22-0	.0122	µg/L	irl	Apples	I
Picloram		6607	.0198	µg/L	irl	Non-crop	H
Propham		122-42-9	.0096	µg/L	irl	Vegetables	H
Propiconazole		60207-90-1	.021	µg/L	irl	Fruit	F
Propoxur		114-26-1	.008	µg/L	irl	Fruit	I
Siduron		1982-49-6	.0168	µg/L	irl	Non-crop	H
Sulfometuron-methyl		74222-97-2	.0088	µg/L	irl	Non-crop	H
Tebuthiuron		**34014-18-1**	**.0062**	**µg/L**	**irl**	**Rangeland, R.O.W.**	**H**
Terbacil		5902-51-2	.0098	µg/L	irl	Fruit	H
Tribenuron-methyl		101200-48-0	.0088	µg/L	irl	Cereals	H
Triclopyr		**55335-06-3**	**.0224**	**µg/L**	**irl**	**R.O.W., aquatic weeds**	**H**
Corn and Soybean Herbicides							
Acetochlor		**34256-82-1**	**0.05**	**µg/L**	**mrl**	**Corn**	**H**
Alachlor		15972-60-8	.05	µg/L	mrl	Corn, soybeans	H
Ametryn		834-12-8	.05	µg/L	mrl	Corn	H
Atrazine		**1912-24-9**	**.05**	**µg/L**	**mrl**	**Corn**	**H**

Table 7. Description of pesticide analytes and method information — Continued

[Compounds listed in bold were detected, all others were below detection limit. Sources for primary crop and use category, Miller (2005), ChemFinder Webserver (2004), U.S. Department of Agriculture (2005). Abbreviations: CAS, Chemical Abstract Service; RL, Reporting Level; mrl, minimum reporting level; irl, interim reporting level; F, fungicide; H, herbicide; HM, herbicide metabolite; I, Insecticide; IM, insecticide metabolite; R.O.W., used to control weeds on right of way; NA, Not Applicable]

Analyte	Synonym	CAS number	RL	Unit	RL type	Primary crop	Use
Corn and Soybean Herbicides—Continued							
Cyanazine		21725-46-2	0.05	µg/L	mrl	Corn	H
Cyanazine amide		--	.05	µg/L	mrl	NA	HM
2-Chloro-4-isopropylamino-6-amino-s-triazine	**Deethylatrazine**	**6190-65-4**	.05	**µg/L**	**mrl**	**NA**	**HM**
2-Chloro-6-ethylamino-4-amino-s-triazine	Deisopropylatrazine	1007-28-9	.05	µg/L	mrl	NA	HM
Dimethenamid		**87674-68-8**	.05	**µg/L**	**mrl**	**Corn**	**H**
Flufenacet		142459-58-3	.05	µg/L	mrl	Corn, soybeans	H
Metolachlor		**51218-45-2**	.05	**µg/L**	**mrl**	**Corn and others**	**H**
Metribuzin		21087-64-9	.05	µg/L	mrl	Tomatoes, asparagus	H
Pendimethalin		**40487-42-1**	.05	**µg/L**	**mrl**	**Corn, onions, soybeans**	**H**
Prometon		1610-18-0	.05	µg/L	mrl	Roadways	H
Prometryn		7287-19-6	.05	µg/L	mrl	Cotton, celery	H
Propachlor		1918-16-7	.05	µg/L	mrl	Corn	H
Propazine		139-40-2	.05	µg/L	mrl	Sweet sorghum	H
Simazine		**122-34-9**	.05	**µg/L**	**mrl**	**Corn, fruit**	**H**
Terbutryn		886-50-0	.05	µg/L	mrl	Winter wheat	H

Table 8. Polar pesticides and metabolites data for Huron County, Michigan, April though November, 2004

[E, estimate; --, nondetect]

Station number	Station name	Date	Atrazine	Deethylatrazine	Deethyl desisopropyl atrazine	2-hydroxyatrazine
04158495	Pigeon River at Maxwell Road near Rescue, MI.	5/17/2004	0.013	E0.016	--	E0.063
04158495	Pigeon River at Maxwell Road near Rescue, MI.	8/25/2004	E0.005	--	--	E0.030
04159000	Pigeon River near Pigeon, MI.	5/17/2004	.014	E0.016	--	E0.070
04159000	Pigeon River near Pigeon, MI.	8/25/2004	E0.008	--	--	E0.055
04159010	Pigeon River near Caseville, MI.	5/17/2004	.017	E0.015	--	E0.066
04159010	Pigeon River near Caseville, MI.	8/25/2004	.166	E0.037	--	E0.117
041590107	Pigeon River at Caseville, MI.	5/20/2004	E0.028	E0.018	--	E0.083
041590107	Pigeon River at Caseville, MI.	8/26/2004	.104	E0.020	--	E0.130
041590114	Pinnebog River at Moore Road near Elkton, MI.	5/17/2004	.024	E0.019	--	E0.068
041590114	Pinnebog River at Moore Road near Elkton, MI.	8/25/2004	.028	--	--	E0.072
041590117	Pinnebog River at Richardson Road near Elkton, MI.	5/17/2004	.014	E0.017	--	E0.076
041590117	Pinnebog River at Richardson Road near Elkton, MI.	8/25/2004	.041	--	--	E0.086
04159045	Pinnebog River at Limerick Road near Pinnebog, MI.	5/20/2004	E0.090	E0.023	--	E0.098
04159045	Pinnebog River at Limerick Road near Pinnebog, MI.	8/26/2004	.018	--	--	E0.091
04159064	Pinnebog River near Port Crescent, MI.	5/20/2004	E0.140	E0.034	--	E0.116
04159064	Pinnebog River near Port Crescent, MI.	8/26/2004	.033	E0.009	E0.0090	E0.117
434900083071801	Huron County USGS Well H-14	8/26/2004	--	--	--	--
435326083105701	Huron County USGS Well H-20	8/27/2004	--	--	--	--

Table 8. Polar pesticides and metabolites data for Huron County, Michigan, April though November, 2004 — Continued

[E, estimate; --, nondetect]

Station number	Date	2,4-d	Acifluorfen	Benomyl	Bentazon	Bromacil	Caffeine	Clopyralid	Dicamba	Dichlorprop
04158495	5/17/2004	0.030	--	--	E0.025	--	--	--	0.027	--
04158495	8/25/2004	--	--	--	E0.019	--	0.017	--	--	--
04159000	5/17/2004	.023	--	--	E0.026	--	.023	0.045	--	--
04159000	8/25/2004	--	--	--	E0.060	--	.022	--	--	0.016
04159010	5/17/2004	.034	--	--	E0.026	--	.028	.096	.044	--
04159010	8/25/2004	--	--	--	E0.063	--	.023	--	--	--
041590107	5/20/2004	.042	--	--	E0.024	--	E0.092	--	--	--
041590107	8/26/2004	.067	--	--	E0.143	--	.278	--	--	--
041590114	5/17/2004	--	--	--	E0.065	--	.027	.042	--	--
041590114	8/25/2004	--	--	--	E0.171	--	--	--	--	--
041590117	5/17/2004	E0.018	--	--	E0.048	--	.023	.038	--	--
041590117	8/25/2004	--	--	--	E0.114	--	--	--	--	--
04159045	5/20/2004	.056	--	--	E0.040	--	E0.017	--	--	--
04159045	8/26/2004	--	--	0.020	E0.111	E0.012	.031	--	--	--
04159064	5/20/2004	.128	--	--	E0.039	--	E0.047	--	--	--
04159064	8/26/2004	--	0.064	--	E0.421	--	.019	--	--	--
434900083071801	8/26/2004	--	--	--	--	--	--	--	--	--
435326083105701	8/27/2004	--	--	--	--	--	--	--	--	--

Table 8. Polar pesticides and metabolites data for Huron County, Michigan, April though November, 2004 — Continued

[E, estimate; --, nondetect]

Station number	Date	Diuron	Flumetsulam	Metalaxyl	Tebuthiuron	Triclopyr
04158495	5/17/2004	--	--	E0.007	--	0.042
04158495	8/25/2004	--	--	--	--	.043
04159000	5/17/2004	--	--	E0.008	--	--
04159000	8/25/2004	--	--	E0.005	--	.051
04159010	5/17/2004	--	--	E0.006	--	.023
04159010	8/25/2004	--	--	--	E0.003	--
041590107	5/20/2004	--	--	--	--	--
041590107	8/26/2004	0.041	--	--	--	.381
041590114	5/17/2004	--	--	--	--	.032
041590114	8/25/2004	--	--	--	--	--
041590117	5/17/2004	--	--	--	--	--
041590117	8/25/2004	--	--	--	--	--
04159045	5/20/2004	--	--	--	--	--
04159045	8/26/2004	--	E0.014	--	--	.341
04159064	5/20/2004	--	--	--	--	--
04159064	8/26/2004	--	--	--	--	--
434900083071801	8/26/2004	--	--	--	--	--
435326083105701	8/27/2004	--	--	--	--	--

Table 9. Corn and soybean herbicides data for Huron County, Michigan, April through November, 2004

[--, nondetect]

Station number	Station name	Date	Acetochlor	Atrazine	Deethylatrazine	Deisopropylatrazine	Dimethenamid	Metolachlor	Pendimethalin	Simazine
04158495	Pigeon River at Maxwell Road near Rescue, MI.	5/17/2004	--	--	0.08	--	--	--	--	--
04158495	Pigeon River at Maxwell Road near Rescue, MI.	8/25/2004	--	--	--	--	--	--	--	--
04159000	Pigeon River near Pigeon, MI.	5/17/2004	--	--	.09	--	--	--	--	--
04159000	Pigeon River near Pigeon, MI.	8/25/2004	--	0.07	.08	--	0.08	0.06	0.11	--
04159010	Pigeon River near Caseville, MI.	5/17/2004	--	.05	.09	--	--	--	--	--
04159010	Pigeon River near Caseville, MI.	8/25/2004	--	.25	.12	0.09	.05	.05	--	0.06
041590107	Pigeon River at Caseville, MI.	5/20/2004	--	.05	.09	--	--	.05	--	--
041590107	Pigeon River at Caseville, MI.	8/26/2004	--	.18	.10	--	.05	.07	--	--
041590114	Pinnebog River at Moore Road near Elkton, MI.	5/17/2004	0.05	.06	.10	--	--	.06	--	--
041590114	Pinnebog River at Moore Road near Elkton, MI.	8/25/2004	--	.07	--	--	--	--	--	--
041590117	Pinnebog River at Richardson Road near Elkton, MI.	5/17/2004	--	.07	.09	--	--	.66	--	--
041590117	Pinnebog River at Richardson Road near Elkton, MI.	8/25/2004	--	.09	.06	--	--	--	--	.06
04159045	Pinnebog River at Limerick Road near Pinnebog, MI.	5/20/2004	.06	.10	.09	--	--	.24	--	--
04159045	Pinnebog River at Limerick Road near Pinnebog, MI.	8/26/2004	--	.06	.06	--	--	.06	--	--
04159064	Pinnebog River near Port Crescent, MI.	5/20/2004	.09	.14	.10	--	--	.27	--	--
04159064	Pinnebog River near Port Crescent, MI.	8/26/2004	--	.09	.07	--	.05	.07	--	--
434900083071801	Huron County USGS Well H-14	8/26/2004	--	--	--	--	--	--	--	--
435326083105701	Huron County USGS Well H-20	8/27/2004	--	--	--	--	--	--	--	--

Table 10. Description of wastewater analytes and method information

[Compounds listed in bold were detected, all others were below detection limit. Sources for possible use or sources section, Zaugg and others, 2001. Abbreviations: CAS, Chemical Abstract Service; RL, Reporting Level; mrl, minimum reporting level; irl, interim reporting level]

Analyte	Synonym	CAS number	RL	Unit	RL type	Possible use or sources
1,4-Dichlorobenzene		**106-46-7**	0.5	**µg/L**	**irl**	**Moth Repellant, fumigant, deodorant**
17-beta-estradiol		50-28-2	5	µg/L	mrl	Estrogen replacement therapy, estrogen metabolite
1-Methylnaphthalene		**90-12-0**	.5	**µg/L**	**irl**	**2-5% of gasoline, diesel fuel or crude oil, pesticide adjuvant**
2,6-Dimethylnaphthalene		581-42-0	.5	µg/L	irl	Present in diesel/kerosene (trace in gasoline)
2-Methylnaphthalene		**91-57-6**	.5	**µg/L**	**irl**	**2-5% of gasoline, diesel fuel or crude oil, pesticide adjuvant**
3-beta-Coprostanol		360-68-9	2	µg/L	irl	Carnivore fecal indicator
3-Methyl-1(H)-indole	**Skatole**	**83-34-1**	1	**µg/L**	**irl**	**Fragrance, stench in feces and coal tar**
3-tert-Butyl-4-hydroxy anisole	BHA	25013-16-5	5	µg/L	irl	Antioxidant, general preservative
4-Cumylphenol		599-64-4	1	µg/L	irl	Nonionic detergent metabolite
4-n-Octylphenol		1806-26-4	1	µg/L	irl	Nonionic detergent metabolite
4-tert-Octylphenol		140-66-9	1	µg/L	irl	Nonionic detergent metabolite
5-Methyl-1H-benzotriazole		136-85-6	2	µg/L	irl	Antioxidant in antifreeze and deicers
Acetophenone		98-86-2	.5	µg/L	irl	Fragrance in detergent and tobacco, flavor in beverages
Acetyl hexamethyl tetrahydronaphthalene	AHTN	21145-77-7	.5	µg/L	irl	Musk fragrance (widespread)
Anthracene		120-12-7	.5	µg/L	irl	Wood preservative, component of tar, diesel or crude oil
9,10-Anthraquinone		84-65-1	.5	µg/L	irl	Manufacturing of dye/textiles, seed treatment, bird repellant
Benzo[a]pyrene	Benz[a]pyrene	50-32-8	.5	µg/L	irl	Regulated PAH, used in cancer research
Benzophenone		**119-61-9**	.5	**µg/L**	**irl**	**Fixative for perfumes and soaps**
beta-Sitosterol		83-46-5	2	µg/L	irl	Plant sterol
beta-Stigmastanol	Stigmastanol	19466-47-8	2	µg/L	irl	Plant sterol
Bisphenol A		80-05-7	1	µg/L	irl	Manufacturing of polycarbonate resins, antioxidant, flame retardant
Bromacil		314-40-9	.5	µg/L	irl	Herbicide, noncrop usage
Tribromomethane	Bromoform	75-25-2	.5	µg/L	irl	Wastewater ozonation byproduct, military/explosives
Caffeine		**58-08-2**	.5	**µg/L**	**irl**	**Beverages, diuretic**
Camphor		**76-22-2**	.5	**µg/L**	**irl**	**Flavor, odorant, ointments**
Carbaryl		63-25-2	1	µg/L	irl	Insecticides, crop and garden use, persistent
Carbazole		86-74-8	.5	µg/L	irl	Insecticide, manufacturing of dyes, explosives and lubricants
Chlorpyrifos		2921-88-2	.5	µg/L	irl	Insecticide, domestic pest control

Table 10. Description of wastewater analytes and method information — Continued

[Compounds listed in bold were detected, all others were below detection limit. Sources for possible use or sources section, Zaugg and others, 2001. Abbreviations: CAS, Chemical Abstract Service; RL, Reporting Level; mrl, minimum reporting level; irl, interim reporting level]

Analyte	Synonym	CAS number	RL	Unit	RL type	Possible use or sources
Cholesterol		57-88-5	2	µg/L	irl	Fecal indicator, plant sterol
Cotinine		486-56-6	1	µg/L	irl	Primary nicotine metabolite
Diazinon		**333-41-5**	0.5	**µg/L**	**irl**	**Insecticide, ants and flies**
Dichlorvos		62-73-7	1	µg/L	irl	Insecticide, pet collars
Nonylphenol, diethoxy- (total)		**26027-38-2**	5	**µg/L**	**irl**	**Nonionic detergent, pesticide adjuvant**
Octylphenol, diethoxy-		26636-32-8	1	µg/L	irl	Nonionic detergent
d-Limonene		5989-27-5	.5	µg/L	irl	Fungicide, antimicrobial, antiviral, fragrance
Equilenin		517-09-9	5	µg/L	mrl	Hormone replacement therapy drug
Estrone		53-16-7	5	µg/L	mrl	Biogenic hormone
Ethynyl estradiol		57-63-6	5	µg/L	mrl	Oral contraceptive
Fluoranthene		**206-44-0**	.5	**µg/L**	**irl**	**Component of coal tar and asphalt**
Hexadydrohexamethyl-cyclopentabenzopyran	HHCB	1222-05-5	.5	µg/L	irl	Musk fragrance
Indole		**120-72-9**	.5	**µg/L**	**irl**	**Pesticide inert ingredient, fragrance in coffee**
Isoborneol		124-76-5	.5	µg/L	irl	Fragrance in perfume
Isophorone		**78-59-1**	.5	**µg/L**	**irl**	**Solvent for lacquer, plastic, oil, silicon and resin and some pesticides**
Isopropylbenzene	Cumene	98-82-8	.5	µg/L	irl	Manufacturing of phenol/acetone, fuels and paint thinner
Isoquinoline		119-65-3	.5	µg/L	irl	Flavors and fragrances
Menthol		89-78-1	.5	µg/L	irl	Cigarettes, cough drops, liniment, mouthwash
Metalaxyl		57837-19-1	.5	µg/L	irl	Herbicide, fungicide, general use pesticide
Methyl salicylate		**119-36-8**	.5	**µg/L**	**irl**	**Liniment, food, beverage, sun block**
Metolachlor		**51218-45-2**	.5	**µg/L**	**irl**	**Herbicide**
Octylphenol, monoethoxy-		26636-32-8	1	µg/L	irl	Nonionic detergent metabolite
N,N-diethyl-meta-toluamide	**DEET**	**134-62-3**	.5	**µg/L**	**irl**	**Insect repellant, urban use on mosquitoes**
Naphthalene		**91-20-3**	.5	**µg/L**	**irl**	**Fumigant, moth repellent, component of gasoline**
4-Nonylphenol	**para-Nonylphenol (total)**	**84852-15-3**	5	**µg/L**	**irl**	**Nonionic detergent metabolite, pesticide adjuvant**
p-Cresol		**106-44-5**	1	**µg/L**	**irl**	**Wood preservative**

Table 10. Description of wastewater analytes and method information — Continued

[Compounds listed in bold were detected, all others were below detection limit. Sources for possible use or sources section, Zaugg and others, 2001. Abbreviations: CAS, Chemical Abstract Service; RL, Reporting Level; mrl, minimum reporting level; irl, interim reporting level]

Analyte	Synonym	CAS number	RL	Unit	RL type	Possible use or sources
Pentachlorophenol		87-86-5	2	µg/L	irl	Herbicide, fungicide, wood preservative, termite control
Phenanthrene		85-01-8	0.5	µg/L	irl	Manufacturing of explosives, component of tar, diesel and crude oil
Phenol		**108-95-2**	**.5**	**µg/L**	**irl**	**Disinfectant, used in the manufacturing of many products**
Prometon		1610-18-0	.5	µg/L	irl	Herbicide, noncrop, prior to blacktop
Pyrene		**129-00-0**	**.5**	**µg/L**	**irl**	**Component of coal tar and asphalt**
Tetrachloroethylene	PCE	127-18-4	.5	µg/L	irl	Solvent, degreaser, veterinary anthelmintic
Tri(2-butoxyethyl)phosphate	**Tris (2-butoxyethyl) phosphate**	**78-51-3**	**.5**	**µg/L**	**irl**	**Flame retardant**
Tri(2-chloroethyl)phosphate	**Tris (2-chloroethyl) phosphate**	**115-96-8**	**.5**	**µg/L**	**irl**	**Plasticizer, flame retardant**
Tri(dichlorisopropyl)phosphate	Tris (dichlorisopropyl) phosphate	13674-87-8	.5	µg/L	irl	Flame retardant
Tributyl phosphate		**126-73-8**	**.5**	**µg/L**	**irl**	**Antifoaming agent, flame retardant**
Triclosan		3380-34-5	1	µg/L	irl	Disinfectant, antimicrobial
Triethyl citrate	Ethyl citrate	77-93-0	.5	µg/L	irl	Cosmetics and pharmaceuticals
Triphenyl phosphate		**115-86-6**	**.5**	**µg/L**	**irl**	**Plasticizer, resin wax, roofing paper**

Table 11. Wastewater compounds data for Huron County, Michigan, April through November, 2004

[E, estimate; --, nondetect]

Station number	Station name	Date	1,4-dichlorobenzene	1-methylnaphthalene	2-methylnaphthalene	3-methyl-1h-indole (skatol)	Benzophenone	Caffeine
04158495	Pigeon River at Maxwell Road near Rescue, MI.	5/17/2004	E0.050	--	--	--	E0.070	--
04158495	Pigeon River at Maxwell Road near Rescue, MI.	8/25/2004	E0.052	--	--	--	--	E0.056
04159000	Pigeon River near Pigeon, MI.	5/17/2004	E0.064	E0.0250	E0.057	--	E0.082	E0.077
04159000	Pigeon River near Pigeon, MI.	8/25/2004	E0.023	--	--	--	--	--
04159010	Pigeon River near Caseville, MI.	5/17/2004	E0.080	E0.0220	E0.044	--	--	E0.078
04159010	Pigeon River near Caseville, MI.	8/25/2004	E0.033	--	--	--	--	--
041590107	Pigeon River at Caseville, MI.	5/20/2004	--	E0.0470	E0.080	--	--	E0.160
041590107	Pigeon River at Caseville, MI.	8/26/2004	E0.036	--	--	--	--	E0.210
041590114	Pinnebog River at Moore Road near Elkton, MI.	5/17/2004	E0.040	--	--	--	--	E0.087
041590114	Pinnebog River at Moore Road near Elkton, MI.	8/25/2004	E0.041	--	--	--	--	--
041590117	Pinnebog River at Richardson Road near Elkton, MI.	5/17/2004	E0.095	E0.0210	E0.042	--	--	E0.086
041590117	Pinnebog River at Richardson Road near Elkton, MI.	8/25/2004	E0.032	--	--	E0.0260	--	--
04159045	Pinnebog River at Limerick Road near Pinnebog, MI.	5/20/2004	E0.059	E0.0410	E0.066	--	E0.110	E0.100
04159045	Pinnebog River at Limerick Road near Pinnebog, MI.	8/26/2004	E0.039	--	--	--	E0.066	E0.058
04159064	Pinnebog River near Port Crescent, MI.	5/20/2004	E0.070	E0.0560	E0.092	--	E0.120	E0.130
04159064	Pinnebog River near Port Crescent, MI.	8/26/2004	E0.026	--	--	--	--	--
434900083071801	Huron County USGS Well H-14	8/26/2004	E0.021	--	--	--	E0.062	--
435326083105701	Huron County USGS Well H-20	8/27/2004	E0.021	--	--	--	E0.072	--
04159010	Field Blank	5/17/2004	E0.110	E0.0390	E0.078	--	E0.097	--
423952084321400	Field Blank	8/26/2004	E0.038	--	--	--	--	--
423952084321400	Equipment Blank	8/30/2004	E0.082	--	--	--	--	-

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Table 11. Wastewater compounds data for Huron County, Michigan, April through November, 2004 — Continued

[E, estimate; --, nondetect]

Station number	Date	Camphor	Diazinon	Diethoxynonylphenol (total)	Fluoranthene	Indole	Isophorone	Methyl salicylate	Metolachlor	n,n-diethyl-meta-toluamide (deet)
04158495	5/17/2004	--	--	--	--	--	--	--	E0.071	--
04158495	8/25/2004	--	--	--	--	--	--	E0.028	E0.066	--
04159000	5/17/2004	--	--	E5.700	--	--	E0.058	--	E0.074	--
04159000	8/25/2004	--	--	--	--	--	--	--	E0.067	E0.073
04159010	5/17/2004	--	--	E5.200	--	--	E0.049	E0.044	E0.087	--
04159010	8/25/2004	--	--	--	--	--	E0.018	E0.023	E0.085	E0.083
041590107	5/20/2004	--	--	E3.800	--	--	E0.150	--	E0.088	E0.110
041590107	8/26/2004	E0.010	--	--	E0.056	--	E0.016	--	E0.100	E0.100
041590114	5/17/2004	--	--	--	--	--	--	--	E0.100	--
041590114	8/25/2004	--	--	--	--	E0.016	E0.015	E0.024	E0.074	E0.076
041590117	5/17/2004	--	--	--	--	--	E0.085	--	E0.110	--
041590117	8/25/2004	E0.014	--	--	--	E0.021	E0.017	--	E0.071	E0.073
04159045	5/20/2004	--	E0.1000	E3.100	--	--	E0.180	--	E0.230	E0.110
04159045	8/26/2004	E0.012	--	--	--	--	E0.023	E0.020	E0.950	E0.098
04159064	5/20/2004	--	E0.1000	E4.000	--	--	E0.140	--	E0.250	E0.110
04159064	8/26/2004	--	--	--	--	--	--	--	E0.098	E0.079
434900083071801	8/26/2004	--	--	--	--	--	--	--	--	E0.074
435326083105701	8/27/2004	--	--	--	--	--	--	--	--	E0.093
04159010	5/17/2004	--	--	E7.900	--	--	--	--	--	E0.076
423952084321400	8/26/2004	--	--	--	--	--	--	--	--	--
423952084321400	8/30/2004	--	--	--	--	--	--	--	--	--

Table 11. Wastewater compounds data for Huron County, Michigan, April through November, 2004 — Continued

[E, estimate; --, nondetect]

Station number	Date	Naphthalene	Para-nonylphenol (total)	Para-cresol	Phenol	Pyrene	Tributyl phosphate	Ttriphenyl phosphate	Tris (2-butoxyethyl) phosphate	Tris (2-chloroethyl) phosphate
04158495	5/17/2004	E0.036	--	--	--	--	--	--	--	--
04158495	8/25/2004	--	--	--	1.400	--	--	--	--	--
04159000	5/17/2004	E0.064	E1.500	--	--	--	--	E0.068	--	--
04159000	8/25/2004	--	--	--	--	--	--	--	--	--
04159010	5/17/2004	E0.041	--	--	E0.280	--	--	--	--	--
04159010	8/25/2004	--	--	--	1.200	--	--	--	--	--
041590107	5/20/2004	E0.070	--	--	--	--	--	E0.066	--	--
041590107	8/26/2004	--	--	--	--	E0.062	--	--	0.940	--
041590114	5/17/2004	E0.035	--	--	--	--	--	--	--	--
041590114	8/25/2004	--	--	E0.065	--	--	--	--	--	--
041590117	5/17/2004	E0.047	--	--	--	--	--	--	--	--
041590117	8/25/2004	--	--	--	1.100	--	--	--	--	--
04159045	5/20/2004	E0.063	--	--	--	--	--	E0.065	--	--
04159045	8/26/2004	--	--	--	--	--	E0.039	--	--	E0.090
04159064	5/20/2004	E0.084	--	--	--	--	--	E0.068	--	--
04159064	8/26/2004	--	--	--	--	--	--	--	--	--
434900083071801	8/26/2004	--	--	--	--	--	--	--	--	--
435326083105701	8/27/2004	--	--	--	--	--	--	--	--	--
04159010	5/17/2004	E0.110	--	--	E0.320	--	--	E0.061	--	--
423952084321400	8/26/2004	--	--	--	--	--	--	--	--	--
423952084321400	8/30/2004	--	--	--	--	--	--	--	--	--

Table 12. Description of antibiotic analytes and method information

[Compounds listed in bold were detected, all others were below detection limit; H, human use; A, animal use; CAS, Chemical Abstract Service; RL, reporting level; mrl, minimum reporting level]

Analyte	Primary use	CAS number	RL	Unit	RL type
Beta Lactams					
Amoxicillin		61336-70-7	0.01	µg/L	mrl
Ampicillin		69-53-4	0.01	µg/L	mrl
Cefotaxime		63527-52-6	0.01	µg/L	mrl
Cloxacillin		61-72-3	0.01	µg/L	mrl
Oxacillin		66-79-5	0.01	µg/L	mrl
Penicillin G		61-33-6	0.01	µg/L	mrl
Penicillin V		87-08-1	0.01	µg/L	mrl
Macrolides					
Anhydro-erythromycin		**--**	**0.01**	**µg/L**	**mrl**
Erythromycin	**H,A**	**114-07-8**	**0.01**	**µg/L**	**mrl**
Lincomycin		154-21-2	0.05	µg/L	mrl
Ormetoprim		6981-18-6	0.05	µg/L	mrl
Roxithromycin		80214-83-1	0.01	µg/L	mrl
Trimethoprim	**H,A**	**738-70-5**	**0.05**	**µg/L**	**mrl**
Tylosin		1401-69-0	0.01	µg/L	mrl
Virginiamycin		11006-76-1	0.01	µg/L	mrl
Quinolines					
Carbadox		6804-07-5	0.05	µg/L	mrl
Ciprofloxacin	**H**	**85721-33-1**	**0.05**	**µg/L**	**mrl**
Clinafloxacin		105956-97-6	0.05	µg/L	mrl
Flumequine		42835-25-6	0.05	µg/L	mrl
Lomefloxacin		98079-51-7	0.05	µg/L	mrl
Norfloxacin		70458-96-7	0.05	µg/L	mrl
Ofloxacin	**H,A**	**83380-47-6**	**0.01**	**µg/L**	**mrl**
Oxolinic Acid		14698-29-4	0.05	µg/L	mrl
Sarafloxacin		98105-99-8	0.01	µg/L	mrl
Sulfonamides					
Sulfachlorpyridazine		80-32-0	0.05	µg/L	mrl
Sulfadiazine		68-35-9	0.05	µg/L	mrl
Sulfadimethoxine	**A**	**122-11-2**	**0.05**	**µg/L**	**mrl**
Sulfamerazine		127-79-7	0.05	µg/L	mrl
Sulfamethazine	**A**	**57-68-1**	**0.05**	**µg/L**	**mrl**
Sulfamethoxazole	**H,A**	**723-46-6**	**0.05**	**µg/L**	**mrl**
Sulfathiazole		72-14-0	0.05	µg/L	mrl
Tetracyclines					
Chlorotetracycline		57-62-5	0.01	µg/L	mrl
Anhydrochlorotetracycline		4497-08-9	0.01	µg/L	mrl
Demeclocycline		64-73-3	0.01	µg/L	mrl
Doxycycline		564-25-0	0.01	µg/L	mrl
Minocycline		10118-90-8	0.01	µg/L	mrl
Oxytetracycline		79-57-2	0.01	µg/L	mrl
Tetracycline		64-75-5	0.01	µg/L	mrl
Anhydro-tetracycline		13803-65-1	0.01	µg/L	mrl

Table 13. Antibiotics data for Huron County, Michigan, April through November, 2004

[--, nondetect]

Station number	Station name	Date	Erythromycin	Anhydro-erythromycin	Trimethoprim	Ciprofloxacin	Ofloxacin	Sulfadimethoxine	Sulfamethazine	Sulfamethoxazole
04158495	Pigeon River at Maxwell Road near Rescue, MI.	4/23/2004	--	--	--	--	--	--	--	--
04158495	Pigeon River at Maxwell Road near Rescue, MI.	8/25/2004	--	--	--	0.022	0.009	--	--	--
04159000	Pigeon River near Pigeon, MI.	4/23/2004	--	--	--	--	--	--	--	--
04159000	Pigeon River near Pigeon, MI.	8/25/2004	--	--	--	--	--	--	--	--
04159010	Pigeon River near Caseville, MI.	4/22/2004	--	--	--	--	--	--	--	--
04159010	Pigeon River near Caseville, MI.	8/25/2004	--	--	--	--	--	--	--	--
041590107	Pigeon River at Caseville, MI.	4/22/2004	--	--	--	--	--	--	--	--
041590107	Pigeon River at Caseville, MI.	8/26/2004	--	--	--	--	--	--	--	--
041590114	Pinnebog River at Moore Road near Elkton, MI.	4/22/2004	--	--	--	--	--	--	--	--
041590114	Pinnebog River at Moore Road near Elkton, MI.	8/25/2004	--	--	--	--	--	0.003	0.007	--
041590117	Pinnebog River at Richardson Road near Elkton, MI.	4/23/2004	0.072	0.055	0.018	--	--	--	--	0.010
041590117	Pinnebog River at Richardson Road near Elkton, MI.	8/25/2004	--	--	--	--	--	--	--	--
04159045	Pinnebog River at Limerick Road near Pinnebog, MI.	4/22/2004	.028	.013	--	--	--	--	--	--
04159045	Pinnebog River at Limerick Road near Pinnebog, MI.	8/26/2004	--	--	--	--	--	--	.007	.061
04159064	Pinnebog River near Port Crescent, MI.	4/22/2004	.026	.100	--	--	--	--	--	--
04159064	Pinnebog River near Port Crescent, MI.	8/26/2004	--	--	--	--	--	--	--	.012
434900083071801	Huron County USGS Well H-14	8/26/2004	--	--	--	--	--	--	--	--
435326083105701	Huron County USGS Well H-20	8/27/2004	--	--	--	--	--	--	--	--

Table 14. Available water-quality criteria and standards for detected compounds in Huron County, Michigan

[Table only includes detected compounds with available criteria or standard. USEPA, U.S. Environmental Protection Agency; CMC/CCC, criterion maximum concentration/criterion continuous concentration; mg/L, milligrams per liter; µg/L, micrograms per liter; NH_3, Ammonia (unionized); N, nitrogen; --, not available]

Compound	Unit	USEPA Drinking-Water Maximum Contaminant Level	USEPA Aquatic Life Criteria			Michigan Rule 57 Water-Quality Values		Michigan Part 4 Water Quality Standards
			Draft Nutrient Criteria[1]		Draft[2] CMC/CCC	Human NonCancer Value	Final Chronic Value (Aquatic Life)	
			Eco-region VI	Eco-region VII				
Total Nitrogen	mg/L	--	2.18	0.54	--	--	--	--
Total Phosphorous	µg/L	--	76.25	33.00	--	--	--	--
Dissolved Oxygen (cold water)	mg/L	--	--	--	--	--	--	5
Dissolved Oxygen (warm water)	mg/L	--	--	--	--	--	--	7
Ammonia, unionized (cold water)	µg-NH_3/L	--		--	--	--	29	--
Ammonia, unionized (warm water)	µg-NH_3/L	--	--	--	--	--	53	--
Nitrate	mg-N/L	10	--	--	--	--	--	--
E. coli (Full Body Contact)	Cells per 100 mL	--	--	--	--	--	--	300
E. coli (Partial Body Contact)	Cells per 100 mL	--	--	--	--	--	--	1000
2,4-D[3]	µg/L	70	--	--	--	240	220	--
1,4-Dichlorobenzene	µg/L	7.5	--	--	--	1100	16	--
2-methylnaphthalene	µg/L	--	--	--	--	600	--	--
4-Nonylphenol	µg/L	--	--	--	27.9/5.9	130	--	--
Atrazine	µg/L	3	--	--	1511/ --	880	7.3	--
Diazinon	µg/L	--	--	--	0.10/0.10	12	0.004	--
Fluoranthene	µg/L	--	--	--	--	18	1.6	--
Isophorone	µg/L	--	--	--	--	4100	1300	--
Naphthalene	µg/L	--	--	--	--	540	13	--
Phenol	µg/L	--	--	--	--	1100	450	--
Simazine	µg/L	4	--	--	--	--	--	--

[1]U.S. Environmental Protection Agency (2000b), U.S. Environmental Protection Agency (2000c)

[2]U.S. Environmental Protection Agency (accessed, 2005)

[3]Michigan Department of Environmental Quality (2004)

Table 15. Comparison of data from 1980 through 2004 for Huron County, Michigan

[Temp., temperature; Phosphate, reactive phosphorus (orthophosphate); Ammonia, ammonia as nitrogen; TSS, total suspended solids; °C , degrees Celsius; µS/cm, microsiemens per centimeter; mg/L, milligrams per liter; N, nitrogen; m^3/s, cubic meters per second; nm, not measured; E, estimate; -- not detected]

Station number	Station name	Date	Discharge	Temp	Dissolved oxygen	Specific conductance	pH
			m^3/s	°C	mg/L	µS/cm	units
04159010	Pigeon River near Caseville, MI.	4/8/1980	4.36	9.0	10.4	850	7.7
04159010	Pigeon River near Caseville, MI.	8/19/1980	0.04	22.0	10.1	790	8.2
04159010	Pigeon River near Caseville, MI.	5/24/1983	4.19	15.0	11.4	764	8.1
04159010	Pigeon River near Caseville, MI.	8/30/1983	.12	22.0	7	682	7.8
04159010	Pigeon River near Caseville, MI.	10/18/1988	.74	10.5	7.7	937	8.2
04159010	Pigeon River near Caseville, MI.	3/25/1992	4.22	3.0	13.3	731	8.2
04159010	Pigeon River near Caseville, MI.	8/25/1992	.16	23.0	10.5	698	8.3
04159010	Pigeon River near Caseville, MI.	4/22/2004	nm	14.4	9.7	858	8.2
04159010	Pigeon River near Caseville, MI.	5/17/2004	3.62	15.5	7.4	792	8.3
04159010	Pigeon River near Caseville, MI.	8/25/2004	.03	21.0	7.3	731	8.0
04159010	Pigeon River near Caseville, MI.	11/3/2004	nm	8.6	5.8	726	7.1

Station number	Date	Ammonia	Phosphate	Fecal coliform	Entero-cocci	TSS	2, 4-D	2,4,5-T	Alachlor
		mg/L as N	mg/L as PO_4^{3-}	CFU/100 ml	CFU/100 ml	mg/L	ug/L	ug/L	ug/L
04159010	4/8/1980	0.07	0.09	160	148	16	nm	nm	nm
04159010	8/19/1980	.05	.12	500	290	4	nm	nm	nm
04159010	5/24/1983	nm	.32	500	nm	44	nm	nm	nm
04159010	8/30/1983	nm	.12	2200	4600	2	nm	nm	nm
04159010	10/18/1988	.03	.08	3600	E14000	30	0.21	--	--
04159010	3/25/1992	.06	.03	290	E25000	16	nm	nm	nm
04159010	8/25/1992	.01	.04	E370	E286	23	nm	nm	nm
04159010	4/22/2004	.01	.02	33	15	30	nm	nm	nm
04159010	5/17/2004	.01	.09	83	35	39	.0344	nm	--
04159010	8/25/2004	.01	.1	900	200	34	--	nm	--
04159010	11/3/2004	.01	.99	13	42	17	nm	nm	nm

Table 15. Comparison of data from 1980 through 2004 for Huron County, Michigan —Continued

[Temp., temperature; Phosphate, reactive phosphorus (orthophosphate); Ammonia, ammonia as nitrogen; TSS, total suspended solids; °C , degrees Celsius; µS/cm, microsiemens per centimeter; mg/L, milligrams per liter; N, nitrogen; m^3/s, cubic meters per second; nm, not measured; E, estimate; -- not detected]

Station number	Date	Ametryn	Atrazine	Cyanazine	Dichlorprop	Metolachlor
		ug/L	ug/L	ug/L	ug/L	ug/L
04159010	4/8/1980	nm	nm	nm	nm	nm
04159010	8/19/1980	nm	nm	nm	nm	nm
04159010	5/24/1983	nm	nm	nm	nm	nm
04159010	8/30/1983	nm	nm	nm	nm	nm
04159010	10/18/1988	--	0.3	--	--	--
04159010	3/25/1992	nm	nm	nm	nm	nm
04159010	8/25/1992	nm	nm	nm	nm	nm
04159010	4/22/2004	nm	nm	nm	nm	nm
04159010	5/17/2004	--	0.017-0.05	--	E0.0870	--
04159010	8/25/2004	--	0.166-0.25	--	E0.0850	0.05
04159010	11/3/2004	nm	nm	nm	nm	nm

Station number	Date	Metribuzin	Prometon	Pometryn	Propazine	Simazine
		ug/L	ug/L	ug/L	ug/L	ug/L
04159010	4/8/1980	nm	nm	nm	nm	nm
04159010	8/19/1980	nm	nm	nm	nm	nm
04159010	5/24/1983	nm	nm	nm	nm	nm
04159010	8/30/1983	nm	nm	nm	nm	nm
04159010	10/18/1988	--	--	--	--	--
04159010	3/25/1992	nm	nm	nm	nm	nm
04159010	8/25/1992	nm	nm	nm	nm	nm
04159010	4/22/2004	nm	nm	nm	nm	nm
04159010	5/17/2004	--	--	--	--	--
04159010	8/25/2004	--	--	--	--	0.06
04159010	11/3/2004	nm	nm	nm	nm	nm

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