An Estimate of Chemical Loads From Ground Water to the Grand Calumet River and Indiana Harbor Canal, Northwestern Indiana

Water-Resources Investigations Report 01-4020

Prepared in cooperation with the
U.S. Army Corps of Engineers

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Multiply	By	To obtain
	Length	
foot (ft)	0.3048	meter
mile (mi)	1.609	kilometer
	Area	
square mile (mi^2)	2.590	square kilometer
	Flow rate	
cubic foot per second (ft^3/s)	0.02832	cubic meter per second
	Hydraulic conductivity	
foot per day (ft/d)	0.3048	meter per day

Vertical datum: In this report, "sea level" refers to the National Geodetic Vertical Datum of 1929 (NGVD of 1929)—a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called Sea Level Datum of 1929.

Chemical concentration is given in milligrams per liter (mg/L) and micrograms per liter (µg/L). Milligrams per liter is a unit expressing the concentration of chemical constituents in solution as weight (milligrams) of solute per unit volume (liter) of water. One thousand micrograms per liter is equivalent to one milligram per liter.

Load is given in kilograms per day (kg/d).

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Abstract

Chemical loads from ground water to the Grand Calumet River and the Indiana Harbor Canal in northwestern Indiana were estimated to aid in determining the total maximum daily load. Data from two previous studies, completed in 1987 and 1993, were used to compute loads. The first study included a ground-water-flow model. Results from this model were used to determine ground-water fluxes to eight distinct reaches of the Grand Calumet River and the Indiana Harbor Canal at assumed horizontal hydraulic conductivities of 50 and 100 feet per day. In addition, water-quality data collected during the first study and a second study that further described the quality of water from wells screened in the Calumet aquifer, were used with the ground-water fluxes to compute estimates of chemical loads for selected constituents contributing to the Grand Calumet River and Indiana Harbor Canal. Constituents included trace elements, polychlorinated biphenyls, pesticides, polynuclear aromatic hydrocarbons, and selected general chemistry properties.

Total dissolved solids, sulfate, chloride, and dissolved ammonia as nitrogen had the largest estimated loads to the Grand Calumet River and the Indiana Harbor Canal for any river reach. The estimated loads for total dissolved solids ranged from 239 to 12,800 kilograms per day. Dissolved iron had the largest estimated load for the trace elements and exceeded 1 kilogram per day for all river reaches for which data were available. The majority of ground-water concentrations for polychlorinated biphenyls, pesticides, and polynuclear aromatic hydrocarbons were reported as less than the method reporting limit, resulting in small computed loads to the river and canal.

Introduction

The Grand Calumet River and Indiana Harbor Canal in northwestern Indiana have been identified as an area of concern having one or more specific impairments to beneficial uses of Great Lakes waters (International Joint Commission, 1978). Section 303(d) of the Clean Water Act (Indiana Department of Environmental Management 303(d) list, 2000) requires each State to complete the following tasks: (1) Identify water bodies that do not meet State requirements for water-quality standards for their designated uses; (2) develop a Total Maximum Daily Load (TMDL), or the amount of a specific pollutant that can be absorbed without causing in-stream water-quality violations; and (3) implement strategies to meet the TMDL requirements in order to meet the water-quality standards. The U.S. Army Corps of Engineers (USACE) is determining the TMDL for the Grand Calumet River and the Indiana Harbor Canal. Determination of TMDL's requires knowledge of inflow and outflow components of the river system. Of these components, the relation of ground water to surface water is often the most difficult to determine. A previous study in northwestern Indiana by the U.S Geological Survey (USGS) included development of a surface-water-flow model that simulated flow to the Grand Calumet River and the Indiana Harbor Canal. The model was used with water-quality data to estimate chemical loads from ground water to the entire river system (Fenelon and Watson, 1993). For determination of the TMDL, the USACE needed estimates of chemical loads for individual reaches of the river. On the basis of the previous study, the USACE and USGS entered into an agreement to estimate chemical loads from ground water to the Grand Calumet River and the Indiana Harbor Canal for eight river reaches.

Purpose and Scope

This report describes the methods used to compute the estimated chemical loads from ground-water to the Grand Calumet River and the Indiana Harbor Canal. Loads are presented for eight river reaches. The report also describes known limitations of the methods and data and discusses the potential effects on the results of the computation of the loads.

Description of Study Area

The Grand Calumet River watershed is in north-western Indiana and northeastern Illinois. The river consists of three parts. The east branch, which is about 10 mi long, flows westward from its headwaters near the Grand Calumet Lagoons to its confluence with the Indiana Harbor Canal (fig. 1). The west branch, which is about 6 mi long, flows both eastward to the Indiana Harbor Canal and westward to Illinois from a divide near the Hammond-East Chicago border. The Indiana Harbor Canal, which flows northward approximately 3 mi from its confluence with the Grand Calumet River, discharges into Lake Michigan (Crawford and Wang-sness, 1987). For this study, the Lake George Arm of the Indiana Harbor Canal also was included. The Lake George arm begins approximately 2 mi west of the Indiana Harbor Canal and has its confluence with the Indiana Harbor Canal approximately 1.5 mi north of the confluence of the Grand Calumet River and the Indiana Harbor Canal.

Usage of Lake Michigan for the transport of raw materials and finished goods, as well as a source for process water and a location for waste disposal, brought about an industrialization and urbanization of the study area in the late 1800's and early 1900's (Crawford and Wangsness, 1987). The area grew into one of the most industrialized regions in the United States. Major industries in the study area include steel production; refining and storing of petrochemicals; railcar, truck, and automobile assembly plants; scrap processing; and chemical manufacturing (Kay and others, 1996). Major population centers in the study area are East Chicago, Gary, Hammond, and Whiting (fig. 1).

Geohydrology

The study area is in the Calumet Lacustrine Plain, a subdivision of the Northern Moraine and Lake Region as defined by the Indiana Department of Conservation (Malott, 1922, p. 113) and by the Indiana Geological Survey (Schneider, 1966, p. 50). The Calumet Lacustrine Plain is characterized by a flat to undulating surface that slopes gently toward Lake Michigan. The Calumet aquifer, designated by Hartke and others (1975), is an unconfined, or water-table aquifer and is continuous through most of the study area. The Calumet aquifer consists primarily of sand, including dune, beach and lacustrine sediments that may contain thin, discontinuous layers of muck, peat, and organic material. The sand ranges in thickness from 0 ft to more than 100 ft and is thickest in the eastern part of the study area (Duwelius and others, 1996).

The Calumet aquifer is recharged by direct infil-tration of precipitation. The average depth to water is probably less than 10 ft. The saturated thickness of the aquifer is approximately 40 ft (Watson and others, 1989). Discharge from the Calumet aquifer is primarily to surface water, including rivers, ditches, wetlands, and lakes (Duwelius and others, 1996). A substantial amount of water in the Calumet aquifer may discharge to sewers in some urban areas (Fenelon and Watson, 1993). The horizontal hydraulic conductivity of the Calumet aquifer previously was estimated to range from 10 to 130 ft/d (Rosenshein and Hunn, 1968). Other estimates of the horizontal hydraulic conduc-tivity for the Calumet aquifer, in the central part of the study area, ranged from 47 to 63 ft/d (Geosciences Research Associates, Inc., 1987).

Streamflow in the Grand Calumet River and Indiana Harbor Canal is controlled mainly by intake and discharge of industrial process water and by discharge from municipal wastewater-treatment plants (Crawford and Wangsness, 1987). Streamflow also is affected by backwater from Lake Michigan, especially in the Indiana Harbor Canal. The drainage area for the river system is indeterminate; however, it is relatively small (less than 50 mi^2) and the sandy texture of the soils results in small contributions to streamflow from surface runoff. The contribution to streamflow from discharge of ground water was determined to be less than 10 percent of the total streamflow (Crawford and Wangsness, 1987, p. 1).

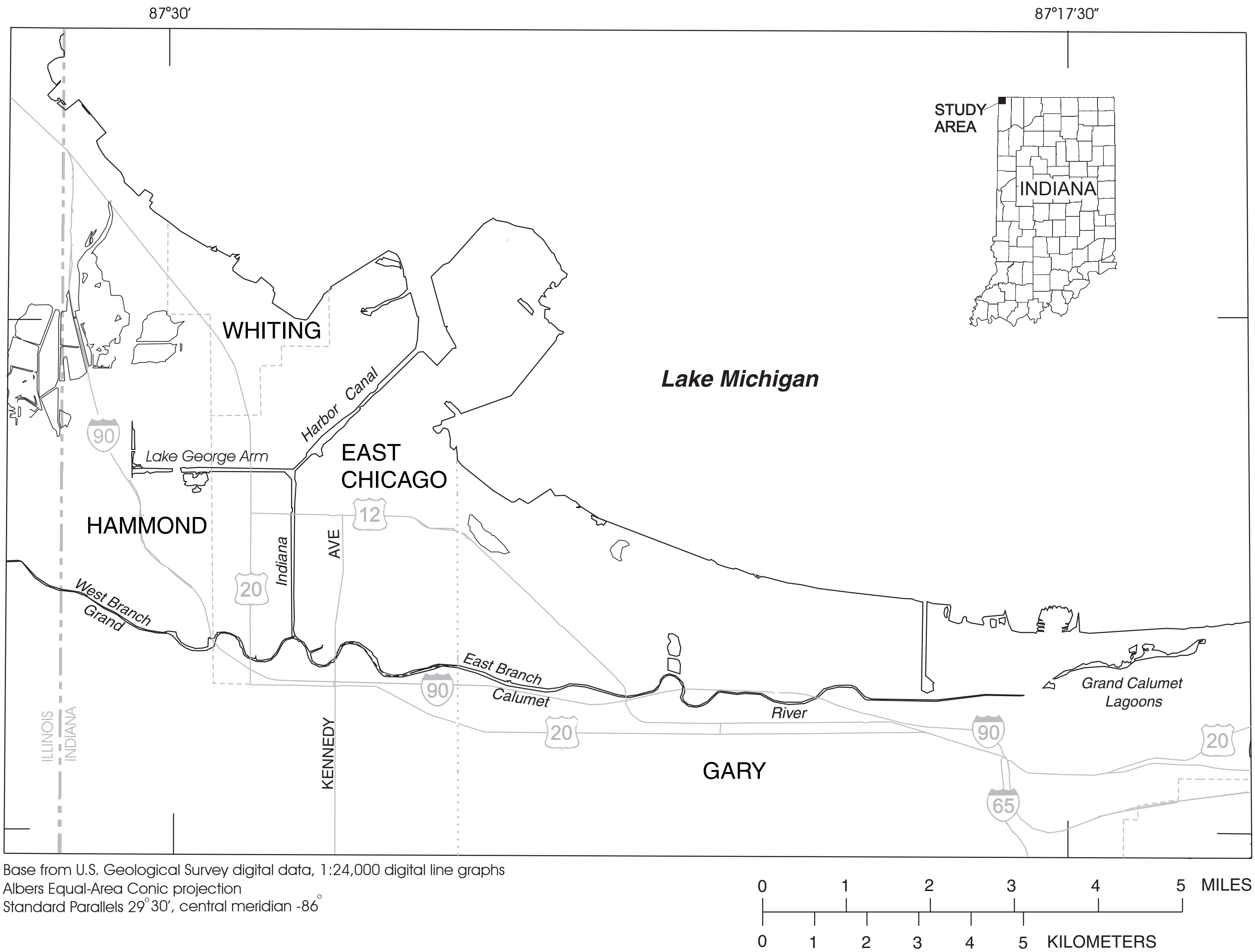


Figure 1. Location of study area, northwestern Indiana.

Three streamflow gaging stations are located within the river system. The Indiana Harbor Canal at East Chicago (station number 04092750) has a mean annual discharge of 647 ft^3/s for the period of record 1994-99 (Stewart and others, 2000, p. 186). The record at this station was rated poor (greater than plus or minus 15 percent of the true value) because the discharge is affected by backwater from Lake Michigan. The mean annual discharge in the east branch of the Grand Calumet River at the Grand Calumet River at Industrial Highway at Gary (station number 04092677) was 484 ft^3/s for water years 1995-99 (Stewart and other, 2000, p. 185). The record at this station was rated good (within plus or minus 10 percent of the true value). The mean annual discharge in the west branch of the Grand Calumet River at the Grand Calumet River at Hohman Avenue at Hammond (station number 05536357) was 44.9 ft^3/s for water years 1991-99 (Stewart and others, 2000, p. 234). The record at this station was rated poor.

Study Methods

This section describes the methods used to estimate chemical loads from ground water to eight reaches of the Grand Calumet River, Indiana Harbor Canal, and the Lake George Arm of the Indiana Harbor Canal. This section also describes the ground-water-flow model used to estimate the ground-water flux to surface water for each of the defined reaches, the selection of ground-water wells and water-quality data, and the constituents of interest.

Selection of River Reaches

Eight reaches were selected by the USACE for determination of chemical loads from ground water. Three reaches were on the east branch of the Grand Calumet River, and two reaches were on the west branch of the Grand Calumet River (fig. 2). Two reaches were selected on the Indiana Harbor Canal. The Lake George Arm of the Indiana Harbor Canal also was defined as a reach. The river reaches were selected to coincide with river reaches in the surface-water models used by the USACE for the TMDL determinations. The locations of wells sampled for water quality in previous studies by the USGS also were a factor in selecting some of the river reaches.

Selection of Wells

Wells used for this study (fig. 3) were installed either during 1985 or 1987 as part of a study to describe the geohydrology and water quality of the Calumet aquifer (Fenelon and Watson, 1993), or as part of a study conducted in 1993 to describe the ground-water quality in the Calumet region (Duwelius and others, 1996). The direction of ground-water flow in relation to the wells and the river was determined from a comprehensive map of water levels measured in 525 wells and at 34 surface-water sites during a synoptic water-level survey of northwestern Indiana and northeastern Illinois conducted during June 23-25, 1992 (Kay and others, 1996). Figure 3 shows the water-table altitude and location of the observation wells used in the current study. Directions of ground-water flow and (or) proximity of the well to the river were used to assign each well to one of the eight reaches.

All of the wells selected were within 0.5 mi of the Grand Calumet River or Indiana Harbor Canal. Table 1 lists well characteristics and the river reach to which each well was assigned. Because changes in ground-water quality can occur with distance along the flow path, wells 0.5 mi or closer to the river were believed to better represent the quality of ground water entering the river than samples from wells greater than 0.5 mi away from the river. The wells ranged in depth from 4 to 37 ft and were constructed with stainless-steel screens and either stainless steel or polyvinyl chloride casings. At three locations (B7-B8, D67-D68, and D30-D31), two wells were installed within several feet of each other and were screened at different depths in the Calumet aquifer.

Selection of Water-Quality Constituents

The constituents of interest for this study were selected by the USACE and were limited by analyses completed for the previous studies. Constituents that were measured in samples from each well are listed in table 2. Constituents not listed as dissolved are total or unfiltered measurements. Constituent concentrations measured in samples collected from these wells were published previously (Fenelon and Watson, 1993; Duwelius and others, 1996). The constituents selected by the USACE include trace elements, polychlorinated biphenyls (PCBs), pesticides, polynuclear aromatic hydrocarbons, major ions, and general water-chemistry properties. Not all constituents of interest to the USACE were measured during the two previous studies. Only constituents that were measured in the previously published studies are discussed in this report.

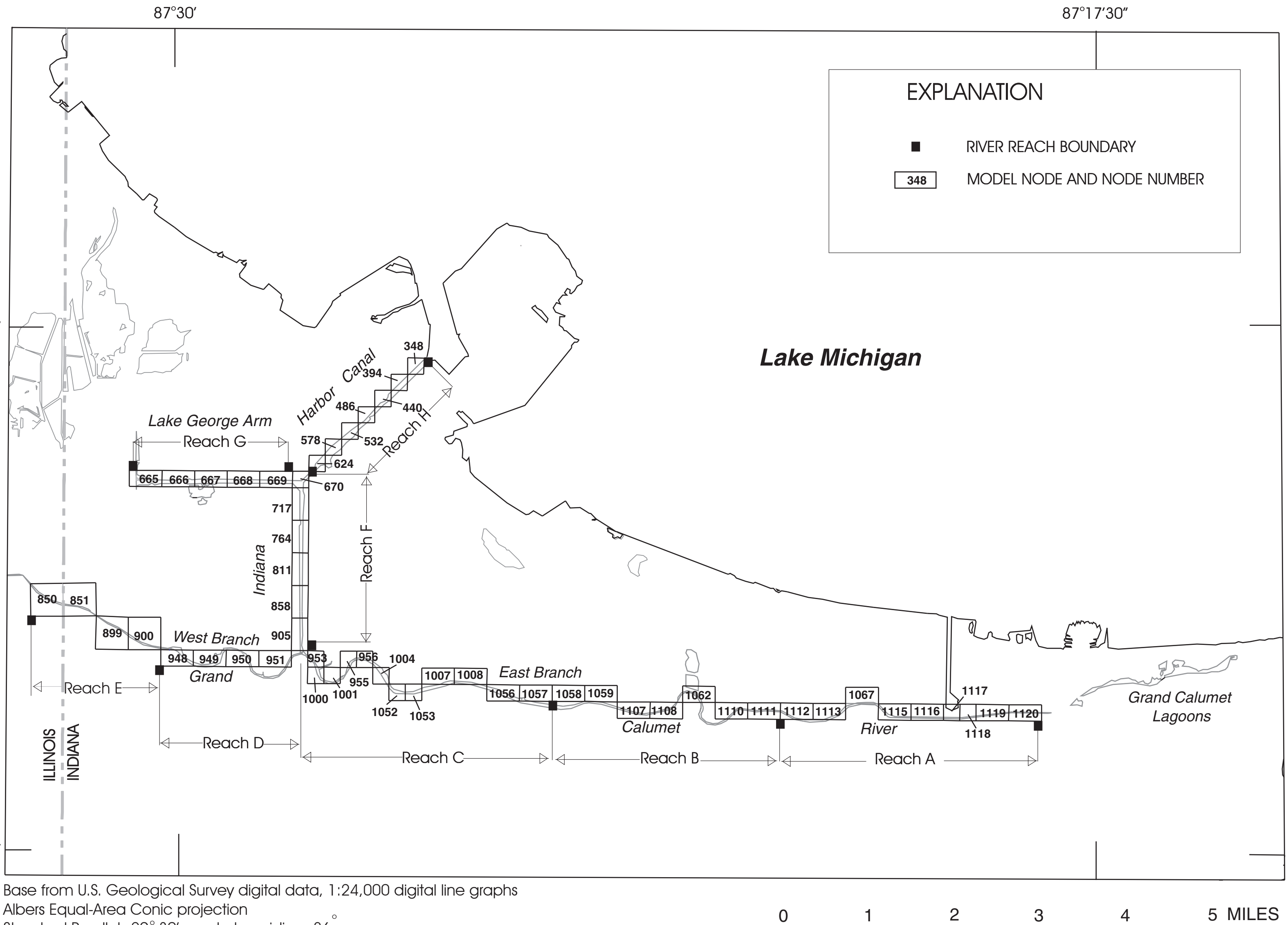
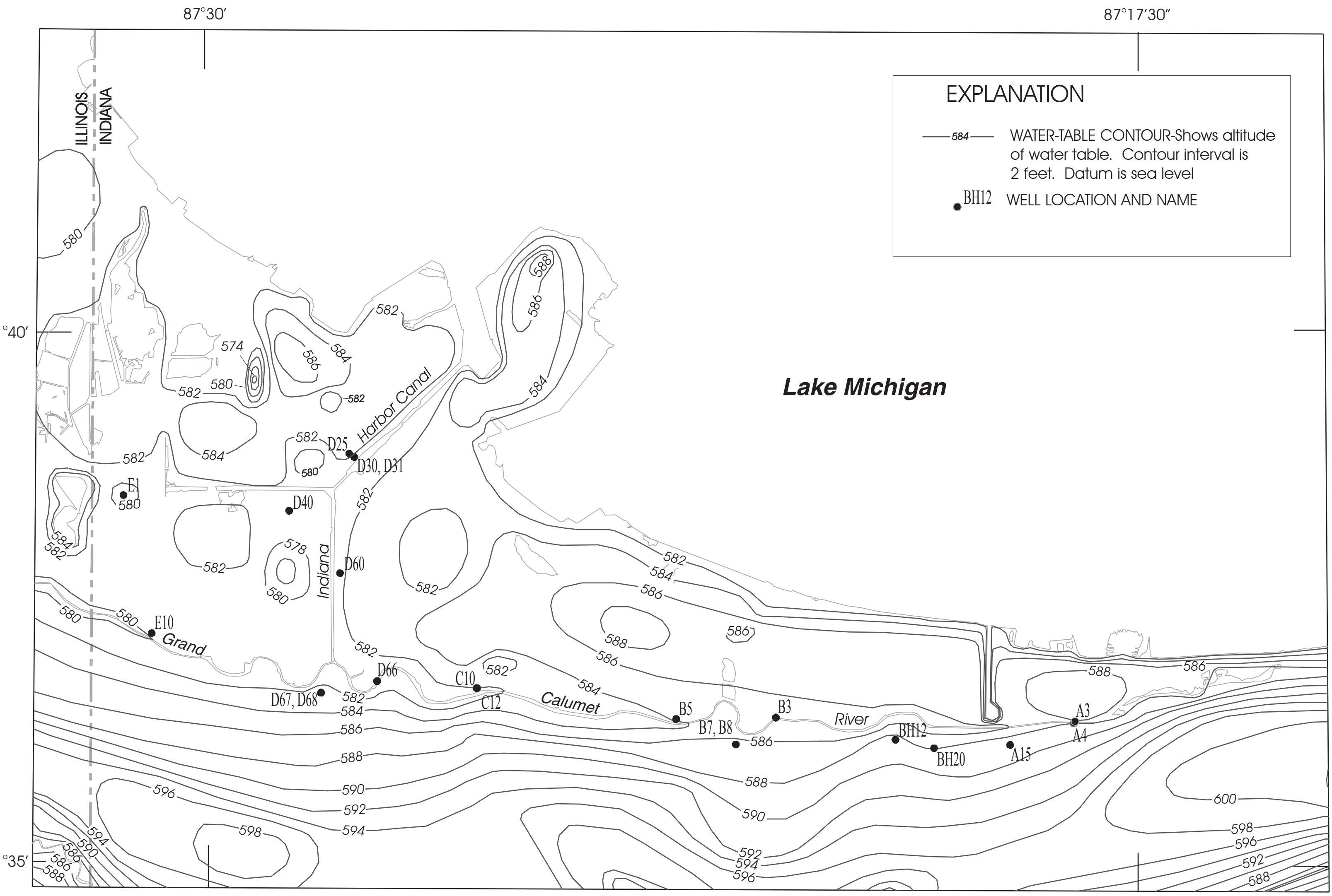


Figure 2. Location of river reaches and ground-water model nodes used for the estimate of chemical loads from ground water to the Grand Calumet River and Indiana Harbor Canal, northwestern Indiana.



Base from U.S. Geological Survey digital data, 1:24,000 digital line graphs
Albers Equal-Area Conic projection
Standard Parallels 29°30′, central meridian -86°

Water-level altitude data from Open-File Report 94-516
Kay, R.T. and others, 1994

0 1 2 3 4 5 MILES

0 1 2 3 4 5 KILOMETERS

Figure 3. Water-table altitude (June 23-25, 1992) and locations of observation wells used for estimate of chemical loads from ground water to the Grand Calumet River and Indiana Harbor Canal, northwestern Indiana.

Table 1. Selected characteristics of observation wells and river reach assigned to the well used for the estimate of chemical loads from ground water to the Grand Calumet River and Indiana Harbor Canal, northwestern Indiana

[USGS, U.S. Geological Survey; ˚, degrees; ´, minutes; ´´, seconds; SS, stainless steel; PVC, polyvinyl chloride]

Well name[1]	Assigned river reach	Latitude	Longitude	USGS site identification number	Land surface altitude (feet above sea level)	Screened interval (feet below land surface)	Casing/screen material
A3	A	41˚ 36´ 31´´	87˚ 18´ 20´´	413631087182000	590	3-6	SS/SS
A4	A	41˚ 36´ 30´´	87˚ 18´ 21´´	413630087182100	603	18-23	SS/SS
A15	A	41˚ 36´ 17´´	87˚ 19´ 12´´	413617087191201	591	2-5	SS/SS
BH20	A	41˚ 36´ 15´´	87˚ 20´ 13´´	413615087201301	600	14-24	PVC/SS
BH12	A	41˚ 36´ 20´´	87˚ 20´ 44´´	413620087204401	601	10-20	PVC/SS
B3	B	41˚ 36´ 33´´	87˚ 22´ 20´´	413633087222000	594	18-23	SS/SS
B7	B	41˚ 36´ 17´´	87˚ 22´ 52´´	413617087225202	596	8-11	SS/SS
B8	B	41˚ 36´ 17´´	87˚ 22´ 52´´	413617087225201	596	32-37	SS/SS
B5	B	41˚ 36´ 32´´	87˚ 23´ 40´´	413632087234001	589	7-10	SS/SS
C10	C	41˚ 36´ 49´´	87˚ 26´ 21´´	413652087274901	584	1-4	SS/SS
C12	C	41˚ 36´ 50´´	87˚ 26´ 20´´	413650087262000	584	13-18	SS/SS
D66	C	41˚ 36´ 54´´	87˚ 27´ 40´´	413654087274000	587	17-22	SS/SS
D67	D	41˚ 36´ 47´´	87˚ 28´ 25´´	413647087282502	589	4-7	SS/SS
D68	D	41˚ 36´ 47´´	87˚ 28´ 25´´	413647087282501	589	18-23	SS/SS
E10	E	41˚ 37´ 22´´	87˚ 30´ 41´´	413722087304101	586	6-9	SS/SS
D60	F	41˚ 37´ 58´´	87˚ 28´ 10´´	413758087281001	587	5-8	SS/SS
D40	G	41˚ 38´ 35´´	87˚ 28´ 51´´	413835087245101	584	4-7	SS/SS
E1	G	41˚ 38´ 44´´	87˚ 31´ 04´´	413844087310401	582	5-8	SS/SS
D25	H	41˚ 39´ 09´´	87˚ 28´ 03´´	413804087291102	588	5-8	SS/SS
D30	H	41˚ 39´ 07´´	87˚ 27´ 58´´	413758087290702	586	6-9	SS/SS
D31	H	41˚ 39´ 07´´	87˚ 27´ 58´´	413907087275901	586	12-17	SS/SS

[1]Well names are those used in Fenelon and Watson (1993) and Duwelius and Kay (1996) and are not associated with the assigned river reach.

Table 2. Constituents of interest and wells from which samples were analyzed for each constituent used to estimate chemical loads to the Grand Calumet River and Indiana Harbor Canal, northwestern Indiana

Constituent	Well name, by river reach							
	A	B	C	D	E	F	G	H
Trace elements								
Mercury	A3, A4, BH20, BH12	B3, B7, B8, B5	C12, D66	D67, D68	E10	D60	D40, E1	D25, D30, D31
Aluminum (dissolved)	A3, A4, BH20, BH12	B3, B7, B8, B5	C10, C12, D66	D67, D68	E10	D60	D40, E1	D25, D30, D31
Iron (dissolved)	A3, A4, BH20, BH12	B3, B7, B8, B5	C10, C12, D66	D67, D68	E10	No well	D40, E1	D25, D30, D31
Lead (dissolved)	A3, A4, BH20, BH12	B3, B7, B8, B5	C10, C12, D66	D67, D68	E10	D60	D40, E1	D25, D30, D31
Manganese (dissolved)	A3, A4, BH20, BH12	B3, B7, B8, B5	C10, C12, D66	D67, D68	E10	No well	D40, E1	D25, D30, D31
Nickel (dissolved)	A3, A4, BH20, BH12	B3, B7, B8, B5	C12	D67, D68	E10	No well	D40, E1	D25
Arsenic (dissolved)	A3, A4, BH20, BH12	B3, B7, B8, B5	C10, C12, D66	D67, D68	E10	D60	D40, E1	D25, D30, D31
Barium (dissolved)	A3, A4, BH20, BH12	B3, B7, B8, B5	C10, C12, D66	D67, D68	E10	No well	D40, E1	D25, D30, D31
Cadmium (dissolved)	A3, A4, BH20, BH12	B3, B7, B8, B5	C10, C12, D66	D67, D68	E10	D60	D40, E1	D25, D30, D31
Chromium (dissolved)	A3, A4, BH20, BH12	B3, B7, B8, B5	C10, C12, D66	D67, D68	E10	D60	D40, E1	D25, D30, D31
Copper (dissolved)	A3, A4, BH20, BH12	B3, B7, B8, B5	C10, C12, D66	D67, D68	E10	D60	D40, E1	D25, D30, D31
Zinc (dissolved)	A3, A4, BH20, BH12	B3, B7, B8, B5	C10, C12, D66	D67, D68	E10	D60	D40, E1	D25, D30, D31
Selenium (dissolved)	A3, A4, BH20, BH12	B3, B7, B8, B5	C12	D67, D68	E10	No well	D40, E1	D25
Polychlorinated biphenyls								
Aroclor 1260	A3, A4, BH20, BH12	B3, B7, B8, B5	C12	D67, D68	E10	No well	D40, E1	D25
Aroclor 1254	A3, A4, BH20, BH12	B3, B7, B8, B5	C12	D67, D68	E10	No well	D40, E1	D25
Aroclor 1232	A3, A4, BH20, BH12	B3, B7, B8, B5	C12	D67, D68	E10	No well	D40, E1	D25
Aroclor 1248	A3, A4, BH20, BH12	B3, B7, B8, B5	C12	D67, D68	E10	No well	D40, E1	D25
Aroclor 1016	A3, A4, BH20, BH12	B3, B7, B8, B5	C12	D67, D68	E10	No well	D40, E1	D25
Aroclor 1242	A3, A4, BH20, BH12	B3, B7, B8, B5	C12	D67, D68	E10	No well	D40, E1	D25
Pesticides								
Heptachlor epoxide	A3, A4, BH20, BH12	B3, B7, B8, B5	C12	D67, D68	E10	No well	D40, E1	D25
Endosulfan sulfate	A3, A4, BH20, BH12	B3, B7, B8, B5	C12	D67, D68	E10	No well	D40, E1	D25
Aldrin	A3, A4, BH20, BH12	B3, B7, B8, B5	C12	D67, D68	E10	No well	D40, E1	D25
alpha-BHC	A3, A4, BH20, BH12	B3, B7, B8, B5	C12	D67, D68	E10	No well	D40, E1	D25
beta-BHC	A3, A4, BH20, BH12	B3, B7, B8, B5	C12	D67, D68	E10	No well	D40, E1	D25
delta-BHC	A3, A4, BH20, BH12	B3, B7, B8, B5	C12	D67, D68	E10	No well	D40, E1	D25
Endosulfan II	A3, A4, BH20, BH12	B3, B7, B8, B5	C12	D67, D68	E10	No well	D40, E1	D25
4,4'-DDT	A3, A4, BH20, BH12	B3, B7, B8, B5	C12	D67, D68	E10	No well	D40, E1	D25

Table 2. Constituents of interest and wells from which samples were analyzed for each constituent used to estimate chemical loads to the Grand Calumet River and Indiana Harbor Canal, northwestern Indiana—Continued

Constituent	Well name, by river reach							
	A	B	C	D	E	F	G	H
Pesticides—Continued								
Endrin ketone	A3, A4, BH20, BH12	B3, B7, B8, B5	C12	D67, D68	E10	No well	D40, E1	D25
Chlordane (technical)	A3, A4, BH20, BH12	B3, B7, B8, B5	C12	D67, D68	E10	No well	D40, E1	D25
gamma-BHC (Lindane)	A3, A4, BH20, BH12	B3, B7, B8, B5	C12	D67, D68	E10	No well	D40, E1	D25
Dieldrin	A3, A4, BH20, BH12	B3, B7, B8, B5	C12	D67, D68	E10	No well	D40, E1	D25
Endrin	A3, A4, BH20, BH12	B3, B7, B8, B5	C12	D67, D68	E10	No well	D40, E1	D25
Methoxychlor	A3, A4, BH20, BH12	B3, B7, B8, B5	C12	D67, D68	E10	No well	D40, E1	D25
4,4'-DDD	A3, A4, BH20, BH12	B3, B7, B8, B5	C12	D67, D68	E10	No well	D40, E1	D25
4,4'-DDE	A3, A4, BH20, BH12	B3, B7, B8, B5	C12	D67, D68	E10	No well	D40, E1	D25
Endrin aldehyde	A3, A4, BH20, BH12	B3, B7, B8, B5	C12	D67, D68	E10	No well	D40, E1	D25
Heptachlor	A3, A4, BH20, BH12	B3, B7, B8, B5	C12	D67, D68	E10	No well	D40, E1	D25
Toxaphene	A3, A4, BH20, BH12	B3, B7, B8, B5	C12	D67, D68	E10	No well	D40, E1	D25
Endosulfan I	A3, A4, BH20, BH12	B3, B7, B8, B5	C12	D67, D68	E10	No well	D40, E1	D25
Polynuclear aromatic hydrocarbons								
Anthracene	A3, A4, BH20, BH12	B3, B7, B8, B5	C10, C12, D66	D67, D68	E10	D60	D40, E1	D25, D30, D31
Pyrene	A3, A4, BH20, BH12	B3, B7, B8, B5	C10, C12, D66	D67, D68	E10	D60	D40, E1	D25, D30, D31
Benzo(ghi)perylene	A3, A4, BH20, BH12	B3, B7, B8, B5	C10, C12, D66	D67, D68	E10	D60	D40, E1	D25, D30, D31
Indeno(1,2,3-cd)pyrene	A3, A4, BH20, BH12	B3, B7, B8, B5	C10, C12, D66	D67, D68	E10	D60	D40, E1	D25, D30, D31
Benzo(b)fluoranthene	A3, A4, BH20, BH12	B3, B7, B8, B5	C10, C12, D66	D67, D68	E10	D60	D40, E1	D25, D30, D31
Fluoranthene	A3, A4, BH20, BH12	B3, B7, B8, B5	C10, C12, D66	D67, D68	E10	D60	D40, E1	D25, D30, D31
Benzo(k)fluoranthene	A3, A4, BH20, BH12	B3, B7, B8, B5	C10, C12, D66	D67, D68	E10	D60	D40, E1	D25, D30, D31
Acenaphthylene	A3, A4, BH20, BH12	B3, B7, B8, B5	C10, C12, D66	D67, D68	E10	D60	D40, E1	D25, D30, D31
Chrysene	A3, A4, BH20, BH12	B3, B7, B8, B5	C10, C12, D66	D67, D68	E10	D60	D40, E1	D25, D30, D31
Benzo(a)pyrene	A3, A4, BH20, BH12	B3, B7, B8, B5	C10, C12, D66	D67, D68	E10	D60	D40, E1	D25, D30, D31
Benzo(a)anthracene	A3, A4, BH20, BH12	B3, B7, B8, B5	C10, C12, D66	D67, D68	E10	D60	D40, E1	D25, D30, D31
Acenaphthene	A3, A4, BH20, BH12	B3, B7, B8, B5	C10, C12, D66	D67, D68	E10	D60	D40, E1	D25, D30, D31
Phenanthrene	A3, A4, BH20, BH12	B3, B7, B8, B5	C10, C12, D66	D67, D68	E10	D60	D40, E1	D25, D30, D31
Fluorene	A3, A4, BH20, BH12	B3, B7, B8, B5	C10, C12, D66	D67, D68	E10	D60	D40, E1	D25, D30, D31
Naphthalene	A3, A4, BH20, BH12	B3, B7, B8, B5	C10, C12, D66	D67, D68	E10	D60	D40, E1	D25, D30, D31

Table 2. Constituents of interest and wells from which samples were analyzed for each constituent used to estimate chemical loads to the Grand Calumet River and Indiana Harbor Canal, northwestern Indiana—Continued

Constituent	Well name, by river reach							
	A	B	C	D	E	F	G	H
General chemistry								
Hardness as $CaCO_3$	No well	No well	No well	No well	No well	No well	D40	No well
Total dissolved solids	A3, A4, BH20, BH12	B3, B7, B8, B5	C10, C12, D66	D67, D68	E10	D60	D40, E1	D25, D30, D31
Total suspended solids	A3, A4, BH20, BH12	B3, B7, B8, B5	C12	D67, D68	E10	No well	D40, E1	D25
Nitrate-Nitrite as N	A3, A4	B3, B7, B8	C10	D67, D68	E10	No well	D40	D30, D31
Chloride	A3, A4, BH20, BH12	B3, B7, B8, B5	C10, C12, D66	D67, D68	E10	D60	D40, E1	D25, D30, D31
Sulfate	A3, A4, BH20, BH12	B3, B7, B8, B5	C10, C12, D66	D67, D68	E10	D60	D40, E1	D25, D30, D31
Fluoride	A3, A4	B3, B7, B8	C10, C12, D66	D67, D68	E10	D60	D40	D30, D31
Total organic carbon	A3, A4, BH20, BH12	B3, B7, B8, B5	C12	D67, D68	E10	No well	D40, E1	D25
Total phenols	A3, A4, BH20, BH12	B3, B7, B8, B5	C10, C12, D66	D67, D68	E10	D60	D40, E1	D25, D30, D31
Ammonia as N	A3, A4, BH20, BH12	B3, B7, B8, B5	C12	D67, D68	E10	No well	D40, E1	No well
Orthophosphate (dissolved)	A3	B3, B7, B8	No well	No well	E10	No well	No well	
Ammonia as N (dissolved)	A3, A4	B3, B7, B8	C10	D67, D68	E10	No well	D40	D30, D31
Dissolved oxygen	A3, A4, A15, BH20, BH12	B3, B7, B8, B5	C10, C12, D66	D67, D68	E10	D60	D40, E1	D25, D30, D31
Cyanide (dissolved)	A3, A4, BH20, BH12	B3, B7, B8, B5	C10, C12	D67, D68	E10	D60	D40, E1	D25, D30, D31

Simulation of Ground-Water Flow

The ground-water-flow model used in this study is described by Fenelon and Watson (1993). No modifications were made to the model for this study. The model is a three-dimensional, finite-difference, ground-water-flow model (McDonald and Harbaugh, 1988) and was used by Fenelon and Watson (1993) to evaluate (1) recharge to the Calumet aquifer, (2) movement of water through the Calumet aquifer as a homogeneous aquifer, (3) flow of water between the bedrock and the Calumet aquifer, (4) flow of water between the Calumet aquifer and surface waters, and (5) discharge of ground water to sewers and ditches. The model simulated flow in one layer and was used to evaluate only steady-state conditions.

Two model simulations were used by Fenelon and Watson (1993) to estimate a water budget for the Calumet aquifer. The first simulation assumed a horizontal hydraulic conductivity of 50 ft/d. The second simulation assumed a horizontal hydraulic conductivity of 100 ft/d. These two simulations were selected to bracket the probable rates of ground-water discharge to the river and canal (Fenelon and Watson, 1993). For both simulations, a vertical hydraulic conductivity of 1 ft/d was used for the riverbed. Simulated thickness of the river bed ranged from 3 to 9 ft.

The flow of water between the aquifer and surface waters—specifically the Grand Calumet River, the Indiana Harbor Canal, and the Lake George Arm of the Indiana Harbor Canal—were of interest for this study. The Grand Calumet River, the Indiana Harbor Canal, and the Lake George Arm of the Indiana Harbor Canal were simulated by river nodes. Model node sizes along the Grand Calumet River and the Indiana Harbor Canal were either 1,000 by 1,000 ft, 1,000 by 2,000 ft, or 2,000 by 2,000 ft. In each node, the river is assigned a width and length, a water level, and a vertical hydraulic conductivity and thickness of the riverbed. The model calculates flow, or flux, to the river by use of Darcy’s law and the gradient between the water-level in the river and the adjacent ground-water level simulated by the model. The ground-water flux for each reach was computed as the sum of the fluxes for each of the model nodes within the river reach. Figure 2 shows the model nodes, the number assigned by the model to each node, and the river reach to which each node was assigned.

Computation of Chemical Loads

Chemical loads were computed by multiplying the concentration of each constituent by the ground-water flux simulated by the ground-water-flow model. For wells having samples in which selected constituents were measured more than once, chemical loads were computed on the basis of only the most recently measured constituent concentrations. When two wells at the same location were screened at different depths within the Calumet aquifer—wells B7 and B8, D67 and D68, and D30 and D31—constituent concentrations from the wells were averaged for that location. An average constituent concentration was then computed for all the well locations that contributed to each of the eight reaches.

The average concentration was multiplied by the two ground-water fluxes simulated for each river reach by the ground-water-flow model (table 3) to obtain a high and low (minimum and maximum) estimate of the chemical load. A range for each chemical load was computed for a specific flux if any of the wells contributing to a river reach had a measured constituent concentration less than the method reporting limit. In these cases, a minimum chemical load was computed by substituting zero for the constituent concentration and a maximum chemical load was computed by substituting the method reporting limit for the concentration. If all of the measured constituent concentrations were greater than the method reporting limit, a single value for the constituent load for that river reach was computed for each of the two horizontal hydraulic conductivities. Chemical loads are reported in kilograms per day.

Chemical Loads to the Grand Calumet River and the Indiana Harbor Canal

The river reaches and the minimum and maximum simulated ground-water fluxes are listed in table 3. Ground-water fluxes ranged from 0.28 to 1.95 ft^3/s for individual reaches when the horizontal hydraulic conductivity of the Calumet aquifer was simulated as 50 ft/d, and from 0.58 to 3.63 ft^3/s when the horizontal hydraulic conductivity of the Calumet aquifer was simulated as 100 ft/d.

Table 3. Simulated ground-water fluxes for the eight reaches on the Grand Calumet River and the Indiana Harbor Canal, northwestern Indiana

[ft^3/s, cubic foot per second; ft/d, foot per day; EBGCR, East Branch of the Grand Calumet River; WBGCR, West Branch of the Grand Calumet River; IHC, Indiana Harbor Canal; LGAIHC, Lake George Arm of the Indiana Harbor Canal

		Ground-water flux (ft^3/s)	
River reach	Location	Horizontal hydraulic conductivity of the Calumet aquifer simulated as 50 ft/d	Horizontal hydraulic conductivity of the Calumet aquifer simulated as 100 ft/d
A	EBGCR	1.68	3.10
B	EBGCR	1.95	3.63
C	EBGCR	1.68	3.23
D	WBGCR	.39	.68
E	WBGCR	.28	.58
F	IHC	.45	.91
G	LGAIHC	.55	1.20
H	IHC	.50	.98

Tables 4 and 5 (at the back of this report) list the average constituent concentrations and the estimated chemical loads computed from the two horizontal hydraulic conductivities for each of the eight reaches. The largest loads of specific trace elements were for dissolved iron, which had estimated loads ranging from 47.4 to 90.9 kg/d in river reach C. Iron exceeded 1 kg/d in all of the other reaches, with the exception of reach F, which had no data. Dissolved aluminum, barium, and manganese were the only other trace elements that had loads greater than 1 kg/d.

Most of the PCBs, pesticides, and the polynuclear aromatic hydrocarbons measured in samples from wells used for this study were reported at concentrations less than the method reporting limit, resulting in small computed loads to the river, less than 0.1 kg/d. For these constituents, the estimated maximum loads are dependent on the method reporting limit and may be overestimated based on the concentrations in the limited data sets. PCB loads for each river reach were less than 0.01 kg/d, with the exception of reach F, which had no data. The largest load of pesticides was that for toxaphene. Toxaphene loads of 0.038, 0.044, and 0.040 kg/d were computed for a horizontal hydraulic conductivity of 100 ft/d for reaches A, B, and C, respectively. The loads for the polynuclear aromatic hydrocarbons ranged from 0 to less than 0.1 kg/d; however, these estimates are based on the method reporting limit. All the concentrations of the polynuclear aromatic hydrocarbons were reported at less than the method reporting limit.

Total dissolved solids had the largest estimated loads computed for any of the constituents. Total dissolved solids loads ranged from a minimum of 239 kg/d for reach D to a maximum of 12,800 kg/d for reach C. Chloride, sulfate, and dissolved ammonia were the only other constituents which had maximum estimated loads that exceeded 1,000 kg/d for an individual river reach. Total suspended solids was the only other constituent that had maximum estimated loads that exceeded 100 kg/d for an individual river reach.

The ammonia concentrations reported for well A3 appear to be inconsistent. Fenelon and Watson (1993) reported a value of 640 mg/L for dissolved ammonia. Duwelius and others (1996) reported a value of 90.3 mg/L for total ammonia. Lacking other data for this well, the use of these reported concentrations results in a larger load of dissolved ammonia to the river compared to total ammonia. The discrepancy may indicate that concentrations of ammonia in ground water near well A3 are highly variable, or may be the result of an error in sampling, analysis, or reporting.

Limitations of the Study

The estimates of chemical loads are subject to several limitations, including those inherent in the ground-water-flow model and those related to the availability, location, and consistency of ground-water-quality data. Ground-water-flow models are, at best, simplifications of a real system. The model that provided the flux of ground water to the river for this study was described by Fenelon and Watson (1993, p. 34) as not calibrated because of too many unknown parameters. No changes were made to the model for this study. To improve the ground-water-flow model, additional information would be needed about the rates and distribution of recharge, the distribution of hydraulic conductivity in the aquifer and streambed, and locations and flow rates of pumping wells and leaking sewers. The limitations of the model are described in more detail by Fenelon and Watson (1993, p. 37). To account for some of the uncertainty in the volume of ground water discharged to the stream, two values of horizontal hydraulic conductivity were assumed in the simulation to provide a range for the estimates of loads.

The ground-water-quality data also are limited, not only in the number and location of sampled wells, but also in consistency of constituents analyzed among collected samples. No new wells were installed and no new water-quality data were collected for this study. The wells installed for previous investigations were not situated to provide ground-water-quality data everywhere adjacent to the river, and none of the wells used for this study were installed in known contaminated areas, or drilled into known contaminated ground-water plumes. The number of wells available for each of the selected river reaches ranged from one to six. Data were not available from both sides of the river for several of the reaches. The assumption that water quality determined for samples from the wells is representative of the ground-water quality adjacent to the river becomes more valid as the number of wells sampled increases.

In addition, the wells used for this study were limited by distance from the river. Because the loads were estimated by multiplying the average constituent concentration by the flux of ground water, the method assumes no change in water quality between the well and the river. Chemical constituents in ground water are subject to several natural processes such as adsorption, volatilization, chemical mixing, and biodegradation, which can change the concentrations as the water moves along the flow path. The effect on the estimates of loads depends on the constituent. For example, organic compounds such as pesticides are more likely to degrade, resulting in a change in concentration, than is chloride, which is considered stable. Wells were selected for this study on the basis of their proximity to the river to provide the shortest potential flow path to the river.

Water quality also may change as the water moves through the sediments in the streambed. Generally, the concentration of dissolved oxygen is much less in ground water than in surface water. Constituents dissolved in the ground water and prone to oxidation, such as iron and other metals, may form oxides and precipitate as the water moves from the ground water to the river. This effectively lowers the constituent concentration in the river below that of the ground water. In these cases, the method used for this study may overestimate the constituent load.

For constituents such as pesticides and PCB's that were reported as less than the method reporting limit, the true concentrations in ground water are not known. The constituent may not be present, or may be present at any concentration below the reporting limit. Two estimates of loads are provided, one assuming the constituent is not present (zero concentration) and one based on the reporting limit. This provides a range of possible loads and increases the likelihood that the actual load is somewhere within that range.

Summary

Data from two previous studies were used to compute estimates of chemical loads from ground water to the Grand Calumet River and the Indiana Harbor Canal. The first study included a ground-water-flow model that was used to determine the ground-water flux to the Grand Calumet River and the Indiana Harbor Canal; however, the model could not be calibrated because of uncertainties in several model parameters. Loads were therefore computed using fluxes resulting from two modeled horizontal hydraulic conductivities of 50 and 100 ft/d in an attempt to bracket the probably range of fluxes. Water-quality data from 21 wells sampled in 1987-88 and (or) in 1993 were used in conjunction with the ground-water fluxes to compute the loads.

The largest computed loads to the Grand Calumet River and the Indiana Harbor Canal for any river reach were from total dissolved solids, sulfate, chloride, and dissolved ammonia as nitrogen. The estimated loads for total dissolved solids ranged from 239 kg/d to 12,800 kg/d. Dissolved iron had the largest estimated loads for the trace elements. Iron exceeded 1 kg/d in all of the river reaches that data were available. The majority of the concentrations measured in the 21 wells for PCBs, pesticides, and polynuclear aromatic hydrocarbons were measured less than the method reporting limit, resulting in small loads to the river. Maximum loads estimated for the PCBs, pesticides, and polynuclear aromatic hydrocarbons were less than 0.1 kg/d.

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DATA TABLES

Table 4. Estimated chemical loads from ground water to the Grand Calumet River and Indiana Harbor Canal, northwestern Indiana, computed using a horizontal hydraulic conductivity of 50 feet per day

[Minimum average concentration and minimum chemical load were computed from concentrations measured less than the method reporting limit set equal to zero; maximum average concentration and maximum chemical load were computed from concentrations measured less than the method reporting limit set equal to the reporting limit; ft^3/s, cubic foot per second; kg/d, kilogram per day; µg/L, microgram per liter; mg/L, milligram per liter; --, no load estimated; ND, no data]

Constituent (in concentration units)	River reach	Ground water flux (ft^3/s)	Number of analyses used to compute averages	Minimum average concentration	Minimum chemical loading (kg/d)	Maximum average concentration	Maximum chemical loading (kg/d)
Trace elements							
Mercury, in µg/L	A	1.68	4	0.073	0.0003	0.120	0.0005
	B	1.95	4	.073	.0003	.140	.0007
	C	1.68	3	.210	.0009	.250	.0010
	D	.39	2	0	0	.100	.0001
	E	.28	1	.150	.0001	.150	.0001
	F	.45	1	.200	.0002	.200	.0002
	G	.55	2	0	0	.100	.0001
	H	.50	3	.100	.0001	.150	.0002
Aluminum (dissolved), in µg/L	A	1.68	4	19.6	.080	30.0	.123
	B	1.95	4	17.6	.084	28.0	.134
	C	1.68	3	367	1.51	377	1.55
	D	.39	2	12.3	.012	22.7	.022
	E	.28	1	0	0	23.5	.016
	F	.45	1	0	0	10.0	.011
	G	.55	2	0	0	22.2	.030
	H	.50	3	33.4	.041	33.3	.040
Iron (dissolved), in µg/L	A	1.68	4	875	3.59	878	3.60
	B	1.95	4	6,150	29.4	6,150	29.4
	C	1.68	3	11,500	47.4	11,500	47.4
	D	.39	2	1,270	1.22	1,270	1.22
	E	.28	1	3,480	2.40	3,480	2.40
	F	.45	0	ND	--	ND	--
	G	.55	2	8,660	11.7	8,660	11.7
	H	.50	3	15,000	18.2	15,000	18.2
Lead (dissolved), in µg/L	A	1.68	4	1.03	.0042	1.30	.0053
	B	1.95	4	2.30	.011	2.30	.011
	C	1.68	3	67.1	.277	68.7	.283
	D	.39	2	.75	.0007	1.45	.0014
	E	.28	1	0	0	1.1	.0008
	F	.45	1	6.00	.0066	6.00	.0066
	G	.55	2	1.10	.0015	1.65	.0022
	H	.50	3	0	0	3.05	.0037

Table 4. Estimated chemical loads from ground water to the Grand Calumet River and Indiana Harbor Canal, northwestern Indiana, computed using a horizontal hydraulic conductivity of 50 feet per day—Continued

[Minimum average concentration and minimum chemical load were computed from concentrations measured less than the method reporting limit set equal to zero; maximum average concentration and maximum chemical load were computed from concentrations measured less than the method reporting limit set equal to the reporting limit; ft^3/s, cubic foot per second; kg/d, kilogram per day; µg/L, microgram per liter; mg/L, milligram per liter; --, no load estimated; ND, no data]

Constituent (in concentration units)	River reach	Ground water flux (ft^3/s)	Number of analyses used to compute averages	Minimum average concentration	Minimum chemical loading (kg/d)	Maximum average concentration	Maximum chemical loading (kg/d)
Trace elements—Continued							
Manganese (dissolved), in µg/L	A	1.68	4	635	2.61	635	2.61
	B	1.95	4	336	1.61	336	1.61
	C	1.68	3	717	2.96	717	2.96
	D	.39	2	61.9	.060	61.9	.060
	E	.28	1	631	.434	631	.434
	F	.45	0	ND	--	ND	--
	G	.55	2	688	.93	688	.93
	H	.50	3	1,130	1.37	1,130	1.37
Nickel (dissolved), in µg/L	A	1.68	4	0	0	5.40	.022
	B	1.95	4	1.08	.0052	5.00	.024
	C	1.68	1	0	0	4.70	.019
	D	.39	2	3.40	.0033	5.75	.0055
	E	.28	1	0	0	6.10	.0042
	F	.45	0	ND	--	ND	--
	G	.55	2	0	0	5.40	.007
	H	.50	1	0	0	6.10	.007
Arsenic (dissolved), in µg/L	A	1.68	4	4.28	.018	5.12	.021
	B	1.95	4	2.03	.010	4.28	.020
	C	1.68	3	18.3	.075	19.2	.079
	D	.39	2	1.80	.0017	3.15	.0030
	E	.28	1	0	0	1.70	.0012
	F	.45	1	3.00	.0033	3.00	.0033
	G	.55	2	4.45	.006	5.80	.0078
	H	.50	3	15.3	.019	15.3	.019
Barium (dissolved), in µg/L	A	1.68	4	34.9	.143	34.9	.143
	B	1.95	4	301	1.44	301	1.44
	C	1.68	3	227	.936	260	1.07
	D	.39	2	53.7	.052	53.7	.052
	E	.28	1	47.1	.032	47.1	.032
	F	.45	0	ND	--	ND	--
	G	.55	2	50.2	.068	50.2	.068
	H	.50	3	15.8	.019	65.8	.080

Table 4. Estimated chemical loads from ground water to the Grand Calumet River and Indiana Harbor Canal, northwestern Indiana, computed using a horizontal hydraulic conductivity of 50 feet per day—Continued

[Minimum average concentration and minimum chemical load were computed from concentrations measured less than the method reporting limit set equal to zero; maximum average concentration and maximum chemical load were computed from concentrations measured less than the method reporting limit set equal to the reporting limit; ft^3/s, cubic foot per second; kg/d, kilogram per day; µg/L, microgram per liter; mg/L, milligram per liter; --, no load estimated; ND, no data]

Constituent (in concentration units)	River reach	Ground water flux (ft^3/s)	Number of analyses used to compute averages	Minimum average concentration	Minimum chemical loading (kg/d)	Maximum average concentration	Maximum chemical loading (kg/d)
Trace elements—Continued							
Cadmium (dissolved), in µg/L	A	1.68	4	0	0	1.60	0.0066
	B	1.95	4	0	0	1.50	.0072
	C	1.68	3	0	0	4.17	.017
	D	.39	2	0	0	1.50	.0014
	E	.28	1	0	0	1.70	.0012
	F	.45	1	0	0	1	.0011
	G	.55	2	0	0	1.6	.0022
	H	.50	3	0	0	1.35	.0016
Chromium (dissolved), in µg/L	A	1.68	4	0	0	5.45	.022
	B	1.95	4	0	0	5.10	.024
	C	1.68	3	13.3	.055	18.4	.076
	D	.39	2	3.95	.0038	6.50	.0063
	E	.28	1	0	0	5.80	.0040
	F	.45	1	20.0	.022	20.0	.022
	G	.55	2	0	0	5.45	.007
	H	.50	3	5.00	.006	7.90	.010
Copper (dissolved), in µg/L	A	1.68	4	17.6	.072	19.7	.081
	B	1.95	4	0	0	4.00	.019
	C	1.68	3	23.7	.098	25.0	.103
	D	.39	2	0	0	4.00	.0039
	E	.28	1	0	0	4.20	.0029
	F	.45	1	0	0	1.00	.0011
	G	.55	2	0	0	4.10	.0055
	H	.50	3	0	0	2.60	.0032
Zinc (dissolved), in µg/L	A	1.68	4	1.58	.0065	4.20	.017
	B	1.95	4	0	0	3.70	.018
	C	1.68	3	46.3	.191	47.6	.196
	D	.39	2	3.75	.0036	5.60	.0054
	E	.28	1	0	0	3.40	.0023
	F	.45	1	7.00	.008	7.00	.0077
	G	.55	2	0	0	3.55	.0048
	H	.50	3	5.00	.0061	6.70	.0081

Table 4. Estimated chemical loads from ground water to the Grand Calumet River and Indiana Harbor Canal, northwestern Indiana, computed using a horizontal hydraulic conductivity of 50 feet per day—Continued

[Minimum average concentration and minimum chemical load were computed from concentrations measured less than the method reporting limit set equal to zero; maximum average concentration and maximum chemical load were computed from concentrations measured less than the method reporting limit set equal to the reporting limit; ft^3/s, cubic foot per second; kg/d, kilogram per day; µg/L, microgram per liter; mg/L, milligram per liter; --, no load estimated; ND, no data]

Constituent (in concentration units)	River reach	Ground water flux (ft^3/s)	Number of analyses used to compute averages	Minimum average concentration	Minimum chemical loading (kg/d)	Maximum average concentration	Maximum chemical loading (kg/d)
Trace elements—Continued							
Selenium (dissolved), in µg/L	A	1.68	4	1.38	0.0057	2.53	0.010
	B	1.95	4	.800	.0038	3.88	.019
	C	1.68	1	0	0	2.30	.009
	D	.39	2	0	0	3.70	.0036
	E	.28	1	0	0	2.30	.0016
	F	.45	0	ND	--	ND	--
	G	.55	2	0	0	2.90	.0039
	H	.50	1	0	0	2.30	.0028
Polychlorinated biphenyls							
Aroclor 1260, in µg/L	A	1.68	4	0	0	1.00	.0041
	B	1.95	4	0	0	1.00	.0048
	C	1.68	1	0	0	1.00	.0041
	D	.39	2	0	0	1.00	.0010
	E	.28	1	0	0	1.00	.0007
	F	.45	0	ND	--	ND	--
	G	.55	2	0	0	1.00	.0013
	H	.50	1	0	0	1.00	.0012
Aroclor 1254, in µg/L	A	1.68	4	0	0	1.00	.0041
	B	1.95	4	0	0	1.00	.0048
	C	1.68	1	0	0	1.00	.0041
	D	.39	2	0	0	1.00	.0010
	E	.28	1	0	0	1.00	.0007
	F	.45	0	ND	--	ND	--
	G	.55	2	0	0	1.00	.0013
	H	.50	1	0	0	1.00	.0012
Aroclor 1232, in µg/L	A	1.68	4	0	0	1.00	.0041
	B	1.95	4	0	0	1.00	.0048
	C	1.68	1	0	0	1.00	.0041
	D	.39	2	0	0	1.00	.0010
	E	.28	1	0	0	1.00	.0007
	F	.45	0	ND	--	ND	--
	G	.55	2	0	0	1.00	.0013
	H	.50	1	0	0	1.00	.0012

Table 4. Estimated chemical loads from ground water to the Grand Calumet River and Indiana Harbor Canal, northwestern Indiana, computed using a horizontal hydraulic conductivity of 50 feet per day—Continued

[Minimum average concentration and minimum chemical load were computed from concentrations measured less than the method reporting limit set equal to zero; maximum average concentration and maximum chemical load were computed from concentrations measured less than the method reporting limit set equal to the reporting limit; ft^3/s, cubic foot per second; kg/d, kilogram per day; µg/L, microgram per liter; mg/L, milligram per liter; --, no load estimated; ND, no data]

Constituent (in concentration units)	River reach	Ground water flux (ft^3/s)	Number of analyses used to compute averages	Minimum average concentration	Minimum chemical loading (kg/d)	Maximum average concentration	Maximum chemical loading (kg/d)
Polychlorinated biphenyls—Continued							
Aroclor 1248, in µg/L	A	1.68	4	0	0	1.00	0.0041
	B	1.95	4	0	0	1.00	.0048
	C	1.68	1	0	0	1.00	.0041
	D	.39	2	0	0	1.00	.0010
	E	.28	1	0	0	1.00	.0007
	F	.45	0	ND	--	ND	--
	G	.55	2	0	0	1.00	.0013
	H	.50	1	0	0	1.00	.0012
Aroclor 1016, in µg/L	A	1.68	4	0	0	1.00	.0041
	B	1.95	4	0	0	1.00	.0048
	C	1.68	1	0	0	1.00	.0041
	D	.39	2	0	0	1.00	.0010
	E	.28	1	0	0	1.00	.0007
	F	.45	0	ND	--	ND	--
	G	.55	2	0	0	1.00	.0013
	H	.50	1	0	0	1.00	.0012
Aroclor 1242, in µg/L	A	1.68	4	.250	.0010	1.00	.0041
	B	1.95	4	0	0	1.00	.0048
	C	1.68	1	0	0	1.00	.0041
	D	.39	2	0	0	1.00	.0010
	E	.28	1	0	0	1.00	.0007
	F	.45	0	ND	--	ND	--
	G	.55	2	0	0	1.00	.0013
	H	.50	1	0	0	1.00	.0012
Pesticides							
Heptachlor epoxide, in µg/L	A	1.68	4	0	0	.050	.0002
	B	1.95	4	0	0	.050	.0002
	C	1.68	1	0	0	.050	.0002
	D	.39	2	0	0	.050	.00005
	E	.28	1	0	0	.050	.00003
	F	.45	0	ND	--	ND	--
	G	.55	2	0	0	.050	.0001
	H	.50	1	0	0	.050	.0001

Table 4. Estimated chemical loads from ground water to the Grand Calumet River and Indiana Harbor Canal, northwestern Indiana, computed using a horizontal hydraulic conductivity of 50 feet per day—Continued

[Minimum average concentration and minimum chemical load were computed from concentrations measured less than the method reporting limit set equal to zero; maximum average concentration and maximum chemical load were computed from concentrations measured less than the method reporting limit set equal to the reporting limit; ft^3/s, cubic foot per second; kg/d, kilogram per day; µg/L, microgram per liter; mg/L, milligram per liter; --, no load estimated; ND, no data]

Constituent (in concentration units)	River reach	Ground water flux (ft^3/s)	Number of analyses used to compute averages	Minimum average concentration	Minimum chemical loading (kg/d)	Maximum average concentration	Maximum chemical loading (kg/d)
			Pesticides—Continued				
Endosulfan sulfate, in µg/L	A	1.68	4	0	0	0.100	0.0004
	B	1.95	4	0	0	.100	.0005
	C	1.68	1	0	0	.100	.0004
	D	.39	2	0	0	.100	.0001
	E	.28	1	0	0	.100	.0001
	F	.45	0	ND	--	ND	--
	G	.55	2	0	0	.100	.0001
	H	.50	1	0	0	.100	.0001
Aldrin, in µg/L	A	1.68	4	0	0	.050	.0002
	B	1.95	4	0	0	.050	.0002
	C	1.68	1	0	0	.050	.0002
	D	.39	2	0	0	.050	.00005
	E	.28	1	0	0	.050	.00003
	F	.45	0	ND	--	ND	--
	G	.55	2	0	0	.050	.0001
	H	.50	1	0	0	.050	.0001
alpha-BHC, in µg/L	A	1.68	4	0	0	.050	.0002
	B	1.95	4	0	0	.050	.0002
	C	1.68	1	0	0	.050	.0002
	D	.39	2	0	0	.050	.00005
	E	.28	1	0	0	.050	.00003
	F	.45	0	ND	--	ND	--
	G	.55	2	0	0	.050	.0001
	H	.50	1	0	0	.050	.0001
beta-BHC, in µg/L	A	1.68	4	0	0	.050	.0002
	B	1.95	4	0	0	.050	.0002
	C	1.68	1	0	0	.050	.0002
	D	.39	2	0	0	.050	.00005
	E	.28	1	0	0	.050	.00003
	F	.45	0	ND	--	ND	--
	G	.55	2	0	0	.050	.0001
	H	.50	1	0	0	.050	.0001

Table 4. Estimated chemical loads from ground water to the Grand Calumet River and Indiana Harbor Canal, northwestern Indiana, computed using a horizontal hydraulic conductivity of 50 feet per day—Continued

[Minimum average concentration and minimum chemical load were computed from concentrations measured less than the method reporting limit set equal to zero; maximum average concentration and maximum chemical load were computed from concentrations measured less than the method reporting limit set equal to the reporting limit; ft^3/s, cubic foot per second; kg/d, kilogram per day; µg/L, microgram per liter; mg/L, milligram per liter; --, no load estimated; ND, no data]

Constituent (in concentration units)	River reach	Ground water flux (ft^3/s)	Number of analyses used to compute averages	Minimum average concentration	Minimum chemical loading (kg/d)	Maximum average concentration	Maximum chemical loading (kg/d)
Pesticides—Continued							
delta-BHC, in µg/L	A	1.68	4	0	0	0.050	0.0002
	B	1.95	4	0	0	.050	.0002
	C	1.68	1	0	0	.050	.0002
	D	.39	2	0	0	.050	.00005
	E	.28	1	0	0	.050	.00003
	F	.45	0	ND	--	ND	--
	G	.55	2	0	0	.050	.0001
	H	.50	1	0	0	.050	.0001
Endosulfan II, in µg/L	A	1.68	4	0	0	.100	.0004
	B	1.95	4	0	0	.100	.0005
	C	1.68	1	0	0	.100	.0004
	D	.39	2	0	0	.100	.0001
	E	.28	1	0	0	.100	.0001
	F	.45	0	ND	--	ND	--
	G	.55	2	0	0	.100	.0001
	H	.50	1	0	0	.100	.0001
4,4'-DDT, in µg/L	A	1.68	4	0	0	.100	.0004
	B	1.95	4	0	0	.100	.0005
	C	1.68	1	0	0	.100	.0004
	D	.39	2	0	0	.100	.0001
	E	.28	1	0	0	.100	.0001
	F	.45	0	ND	--	ND	--
	G	.55	2	0	0	.100	.0001
	H	.50	1	0	0	.100	.0001
Endrin ketone, in µg/L	A	1.68	4	0	0	.100	.0004
	B	1.95	4	0	0	.100	.0005
	C	1.68	1	0	0	.100	.0004
	D	.39	2	0	0	.100	.0001
	E	.28	1	0	0	.100	.0001
	F	.45	0	ND	--	ND	--
	G	.55	2	0	0	.100	.0001
	H	.50	1	0	0	.100	.0001

Table 4. Estimated chemical loads from ground water to the Grand Calumet River and Indiana Harbor Canal, northwestern Indiana, computed using a horizontal hydraulic conductivity of 50 feet per day—Continued

[Minimum average concentration and minimum chemical load were computed from concentrations measured less than the method reporting limit set equal to zero; maximum average concentration and maximum chemical load were computed from concentrations measured less than the method reporting limit set equal to the reporting limit; ft^3/s, cubic foot per second; kg/d, kilogram per day; µg/L, microgram per liter; mg/L, milligram per liter; --, no load estimated; ND, no data]

Constituent (in concentration units)	River reach	Ground water flux (ft^3/s)	Number of analyses used to compute averages	Minimum average concentration	Minimum chemical loading (kg/d)	Maximum average concentration	Maximum chemical loading (kg/d)
Pesticides—Continued							
Chlordane (technical), in µg/L	A	1.68	4	0	0	0.040	0.0002
	B	1.95	4	0	0	.050	.0002
	C	1.68	1	0	0	.050	.0002
	D	.39	2	0	0	.050	.00005
	E	.28	1	0	0	.050	.00003
	F	.45	0	ND	--	ND	--
	G	.55	2	0	0	.050	.0001
	H	.50	1	0	0	.050	.0001
gamma-BHC (Lindane), in µg/L	A	1.68	4	0	0	.050	.0002
	B	1.95	4	0	0	.050	.0002
	C	1.68	1	0	0	.050	.0002
	D	.39	2	0	0	.050	.00005
	E	.28	1	0	0	.050	.00003
	F	.45	0	ND	--	ND	--
	G	.55	2	0	0	.050	.0001
	H	.50	1	0	0	.050	.0001
Dieldrin, in µg/L	A	1.68	4	0	0	.100	.0004
	B	1.95	4	0	0	.100	.0005
	C	1.68	1	0	0	.100	.0004
	D	.39	2	0	0	.100	.0001
	E	.28	1	0	0	.100	.0001
	F	.45	0	ND	--	ND	--
	G	.55	2	0	0	.100	.0001
	H	.50	1	0	0	.100	.0001
Endrin, in µg/L	A	1.68	4	0	0	.100	.0004
	B	1.95	4	0	0	.100	.0005
	C	1.68	1	0	0	.100	.0004
	D	.39	2	0	0	.100	.0001
	E	.28	1	0	0	.100	.0001
	F	.45	0	ND	--	ND	--
	G	.55	2	0	0	.100	.0001
	H	.50	1	0	0	.100	.0001

Table 4. Estimated chemical loads from ground water to the Grand Calumet River and Indiana Harbor Canal, northwestern Indiana, computed using a horizontal hydraulic conductivity of 50 feet per day—Continued

[Minimum average concentration and minimum chemical load were computed from concentrations measured less than the method reporting limit set equal to zero; maximum average concentration and maximum chemical load were computed from concentrations measured less than the method reporting limit set equal to the reporting limit; ft^3/s, cubic foot per second; kg/d, kilogram per day; µg/L, microgram per liter; mg/L, milligram per liter; --, no load estimated; ND, no data]

Constituent (in concentration units)	River reach	Ground water flux (ft^3/s)	Number of analyses used to compute averages	Minimum average concentration	Minimum chemical loading (kg/d)	Maximum average concentration	Maximum chemical loading (kg/d)
Pesticides—Continued							
Methoxychlor, in µg/L	A	1.68	4	0	0	0.500	0.0021
	B	1.95	4	.010	.00005	.340	.0016
	C	1.68	1	0	0	.500	.0021
	D	.39	2	0	0	.500	.0005
	E	.28	1	0	0	.500	.0003
	F	.45	0	ND	--	ND	--
	G	.55	2	0	0	.500	.001
	H	.50	1	0	0	.500	.001
4,4'-DDD, in µg/L	A	1.68	4	0	0	.100	.0004
	B	1.95	4	0	0	.100	.0005
	C	1.68	1	0	0	.100	.0004
	D	.39	2	0	0	.100	.0001
	E	.28	1	0	0	.100	.0001
	F	.45	0	ND	--	ND	--
	G	.55	2	0	0	.100	.0001
	H	.50	1	0	0	.100	.0001
4,4'-DDE, in µg/L	A	1.68	4	0	0	.100	.0004
	B	1.95	4	0	0	.100	.0005
	C	1.68	1	0	0	.100	.0004
	D	.39	2	0	0	.100	.0001
	E	.28	1	0	0	.100	.0001
	F	.45	0	ND	--	ND	--
	G	.55	2	0	0	.100	.0001
	H	.50	1	0	0	.100	.0001
Endrin aldehyde, in µg/L	A	1.68	4	0	0	.100	.0004
	B	1.95	4	.010	.00005	.060	.0003
	C	1.68	1	0	0	.100	.0004
	D	.39	2	.010	.00001	.060	.0001
	E	.28	1	0	0	.100	.0001
	F	.45	0	ND	--	ND	--
	G	.55	2	0	0	.100	.0001
	H	.50	1	0	0	.100	.0001

Table 4. Estimated chemical loads from ground water to the Grand Calumet River and Indiana Harbor Canal, northwestern Indiana, computed using a horizontal hydraulic conductivity of 50 feet per day—Continued

[Minimum average concentration and minimum chemical load were computed from concentrations measured less than the method reporting limit set equal to zero; maximum average concentration and maximum chemical load were computed from concentrations measured less than the method reporting limit set equal to the reporting limit; ft^3/s, cubic foot per second; kg/d, kilogram per day; µg/L, microgram per liter; mg/L, milligram per liter; --, no load estimated; ND, no data]

Constituent (in concentration units)	River reach	Ground water flux (ft^3/s)	Number of analyses used to compute averages	Minimum average concentration	Minimum chemical loading (kg/d)	Maximum average concentration	Maximum chemical loading (kg/d)
			Pesticides—Continued				
Heptachlor, in µg/L	A	1.68	4	0	0	0.050	0.0002
	B	1.95	4	0	0	.050	.0002
	C	1.68	1	0	0	.050	.0002
	D	.39	2	0	0	.050	.00005
	E	.28	1	0	0	.050	.00003
	F	.45	0	ND	--	ND	--
	G	.55	2	0	0	.050	.0001
	H	.50	1	0	0	.050	.0001
Toxaphene, in µg/L	A	1.68	4	0	0	5.00	.021
	B	1.95	4	0	0	5.00	.024
	C	1.68	1	0	0	5.00	.021
	D	.39	2	0	0	5.00	.0048
	E	.28	1	0	0	5.00	.0034
	F	.45	0	ND	--	ND	--
	G	.55	2	0	0	5.00	.007
	H	.50	1	0	0	5.00	.006
Endosulfan I, in µg/L	A	1.68	4	0	0	.050	.0002
	B	1.95	4	0	0	.050	.0002
	C	1.68	1	0	0	.050	.0002
	D	.39	2	0	0	.050	.00005
	E	.28	1	0	0	.050	.00003
	F	.45	0	ND	--	ND	--
	G	.55	2	0	0	.050	.0001
	H	.50	1	0	0	.050	.0001
			Polynuclear aromatic hydrocarbons				
Anthracene, in µg/L	A	1.68	4	0	0	10.0	.041
	B	1.95	4	0	0	10.0	.048
	C	1.68	3	0	0	6.67	.028
	D	.39	2	0	0	10.0	.010
	E	.28	1	0	0	10.0	.007
	F	.45	1	0	0	5.00	.006
	G	.55	2	0	0	10.0	.013
	H	.50	3	0	0	7.50	.009

Table 4. Estimated chemical loads from ground water to the Grand Calumet River and Indiana Harbor Canal, northwestern Indiana, computed using a horizontal hydraulic conductivity of 50 feet per day—Continued

[Minimum average concentration and minimum chemical load were computed from concentrations measured less than the method reporting limit set equal to zero; maximum average concentration and maximum chemical load were computed from concentrations measured less than the method reporting limit set equal to the reporting limit; ft^3/s, cubic foot per second; kg/d, kilogram per day; µg/L, microgram per liter; mg/L, milligram per liter; --, no load estimated; ND, no data]

Constituent (in concentration units)	River reach	Ground water flux (ft^3/s)	Number of analyses used to compute averages	Minimum average concentration	Minimum chemical loading (kg/d)	Maximum average concentration	Maximum chemical loading (kg/d)
Polynuclear aromatic hydrocarbons—Continued							
Pyrene, in µg/L	A	1.68	4	0	0	10.0	0.041
	B	1.95	4	0	0	10.0	.048
	C	1.68	3	0	0	6.67	.028
	D	.39	2	0	0	10.0	.010
	E	.28	1	0	0	10.0	.007
	F	.45	1	0	0	5.00	.006
	G	.55	2	0	0	10.0	.013
	H	.50	3	0	0	7.50	.009
Benzo(ghi)perylene, in µg/L	A	1.68	4	0	0	10.0	.041
	B	1.95	4	0	0	10.0	.048
	C	1.68	3	0	0	10.0	.041
	D	.39	2	0	0	10.0	.010
	E	.28	1	0	0	10.0	.007
	F	.45	1	0	0	10.0	.011
	G	.55	2	0	0	10.0	.013
	H	.50	3	0	0	10.0	.012
Indeno(1,2,3-cd)pyrene, in µg/L	A	1.68	4	0	0	10.0	.041
	B	1.95	4	0	0	10.0	.048
	C	1.68	3	0	0	10.0	.041
	D	.39	2	0	0	10.0	.010
	E	.28	1	0	0	10.0	.007
	F	.45	1	0	0	10.0	.011
	G	.55	2	0	0	10.0	.013
	H	.50	3	0	0	10.0	.012
Benzo(b)fluoranthene, in µg/L	A	1.68	4	0	0	10.0	.041
	B	1.95	4	0	0	10.0	.048
	C	1.68	3	0	0	10.0	.041
	D	.39	2	0	0	10.0	.010
	E	.28	1	0	0	10.0	.007
	F	.45	1	0	0	10.0	.011
	G	.55	2	0	0	10.0	.013
	H	.50	3	0	0	10.0	.012

Table 4. Estimated chemical loads from ground water to the Grand Calumet River and Indiana Harbor Canal, northwestern Indiana, computed using a horizontal hydraulic conductivity of 50 feet per day—Continued

[Minimum average concentration and minimum chemical load were computed from concentrations measured less than the method reporting limit set equal to zero; maximum average concentration and maximum chemical load were computed from concentrations measured less than the method reporting limit set equal to the reporting limit; ft^3/s, cubic foot per second; kg/d, kilogram per day; µg/L, microgram per liter; mg/L, milligram per liter; --, no load estimated; ND, no data]

Constituent (in concentration units)	River reach	Ground water flux (ft^3/s)	Number of analyses used to compute averages	Minimum average concentration	Minimum chemical loading (kg/d)	Maximum average concentration	Maximum chemical loading (kg/d)
Polynuclear aromatic hydrocarbons—Continued							
Fluoranthene, in µg/L	A	1.68	4	0	0	10.0	0.041
	B	1.95	4	0	0	10.0	.048
	C	1.68	3	0	0	6.67	.028
	D	.39	2	0	0	10.0	.010
	E	.28	1	0	0	10.0	.007
	F	.45	1	0	0	5.00	.006
	G	.55	2	0	0	10.0	.013
	H	.50	3	0	0	7.50	.009
Benzo(k)fluoranthene, in µg/L	A	1.68	4	0	0	10.0	.041
	B	1.95	4	0	0	10.0	.048
	C	1.68	3	0	0	10.0	.041
	D	.39	2	0	0	10.0	.010
	E	.28	1	0	0	10.0	.007
	F	.45	1	0	0	10.0	.011
	G	.55	2	0	0	10.0	.013
	H	.50	3	0	0	10.0	.012
Acenaphthylene, in µg/L	A	1.68	4	0	0	10.0	.041
	B	1.95	4	0	0	10.0	.048
	C	1.68	3	0	0	6.67	.028
	D	.39	2	0	0	10.0	.010
	E	.28	1	0	0	10.0	.007
	F	.45	1	0	0	5.00	.006
	G	.55	2	0	0	10.0	.013
	H	.50	3	0	0	7.50	.009
Chrysene, in µg/L	A	1.68	4	0	0	10.0	.041
	B	1.95	4	0	0	10.0	.048
	C	1.68	3	0	0	10.0	.041
	D	.39	2	0	0	10.0	.010
	E	.28	1	0	0	10.0	.007
	F	.45	1	0	0	10.0	.011
	G	.55	2	0	0	10.0	.013
	H	.50	3	0	0	10.0	.012

Table 4. Estimated chemical loads from ground water to the Grand Calumet River and Indiana Harbor Canal, northwestern Indiana, computed using a horizontal hydraulic conductivity of 50 feet per day—Continued

[Minimum average concentration and minimum chemical load were computed from concentrations measured less than the method reporting limit set equal to zero; maximum average concentration and maximum chemical load were computed from concentrations measured less than the method reporting limit set equal to the reporting limit; ft^3/s, cubic foot per second; kg/d, kilogram per day; µg/L, microgram per liter; mg/L, milligram per liter; --, no load estimated; ND, no data]

Constituent (in concentration units)	River reach	Ground water flux (ft^3/s)	Number of analyses used to compute averages	Minimum average concentration	Minimum chemical loading (kg/d)	Maximum average concentration	Maximum chemical loading (kg/d)
Polynuclear aromatic hydrocarbons—Continued							
Benzo(a)pyrene, in µg/L	A	1.68	4	0	0	10.0	0.041
	B	1.95	4	0	0	10.0	.048
	C	1.68	3	0	0	10.0	.041
	D	.39	2	0	0	10.0	.010
	E	.28	1	0	0	10.0	.007
	F	.45	1	0	0	10.0	.011
	G	.55	2	0	0	10.0	.013
	H	.50	3	0	0	10.0	.012
Benzo(a)anthracene, in µg/L	A	1.68	4	0	0	10.0	.041
	B	1.95	4	0	0	10.0	.048
	C	1.68	3	0	0	6.67	.028
	D	.39	2	0	0	10.0	.010
	E	.28	1	0	0	10.0	.007
	F	.45	1	0	0	5.00	.006
	G	.55	2	0	0	10.0	.013
	H	.50	3	0	0	10.0	.012
Acenaphthene, in µg/L	A	1.68	4	0	0	10.0	.041
	B	1.95	4	0	0	10.0	.048
	C	1.68	3	0	0	6.67	.028
	D	.39	2	0	0	10.0	.010
	E	.28	1	0	0	10.0	.0069
	F	.45	1	0	0	5.00	.0055
	G	.55	2	0	0	10.0	.013
	H	.50	3	0	0	7.50	.0091
Phenanthrene, in µg/L	A	1.68	4	0	0	10.0	.041
	B	1.95	4	0	0	10.0	.048
	C	1.68	3	0	0	6.67	.028
	D	.39	2	0	0	10.0	.010
	E	.28	1	0	0	10.0	.0069
	F	.45	1	0	0	5.00	.0055
	G	.55	2	0	0	10.0	.013
	H	.50	3	0	0	7.50	.0091

Table 4. Estimated chemical loads from ground water to the Grand Calumet River and Indiana Harbor Canal, northwestern Indiana, computed using a horizontal hydraulic conductivity of 50 feet per day—Continued

[Minimum average concentration and minimum chemical load were computed from concentrations measured less than the method reporting limit set equal to zero; maximum average concentration and maximum chemical load were computed from concentrations measured less than the method reporting limit set equal to the reporting limit; ft^3/s, cubic foot per second; kg/d, kilogram per day; µg/L, microgram per liter; mg/L, milligram per liter; --, no load estimated; ND, no data]

Constituent (in concentration units)	River reach	Ground water flux (ft^3/s)	Number of analyses used to compute averages	Minimum average concentration	Minimum chemical loading (kg/d)	Maximum average concentration	Maximum chemical loading (kg/d)
Polynuclear aromatic hydrocarbons—Continued							
Fluorene, in µg/L	A	1.68	4	0	0	10.0	0.041
	B	1.95	4	0	0	10.0	.048
	C	1.68	3	0	0	6.67	.028
	D	.39	2	0	0	10.0	.010
	E	.28	1	0	0	10.0	.0069
	F	.45	1	0	0	5.00	.0055
	G	.55	2	0	0	10.0	.013
	H	.50	3	0	0	7.50	.0091
Naphthalene, in µg/L	A	1.68	4	0	0	10.0	.041
	B	1.95	4	0	0	10.0	.048
	C	1.68	3	0	0	6.67	.028
	D	.39	2	0	0	10.0	.010
	E	.28	1	0	0	10.0	.007
	F	.45	1	0	0	5.00	.006
	G	.55	2	0	0	10.0	.013
	H	.50	3	0	0	7.50	.009
General chemistry							
Hardness, as $CaCO_3$, in mg/L	A	1.68	0	ND	--	ND	--
	B	1.95	0	ND	--	ND	--
	C	1.68	0	ND	--	ND	--
	D	.39	0	ND	--	ND	--
	E	.28	0	ND	--	ND	--
	F	.45	0	ND	--	ND	--
	G	.55	1	.24	.32	.24	.32
	H	.50	0	ND	--	ND	--
Total dissolved solids, in mg/L	A	1.68	4	621	2550	621	2,550
	B	1.95	4	1,370	6,550	1,370	6,550
	C	1.68	3	1,620	6,670	1,617	6,670
	D	.39	2	248	239	248	239
	E	.28	1	523	360	523	360
	F	.45	1	436	482	436	482
	G	.55	2	370	499	370	498
	H	.50	3	1,970	2,390	1,970	2,390

Table 4. Estimated chemical loads from ground water to the Grand Calumet River and Indiana Harbor Canal, northwestern Indiana, computed using a horizontal hydraulic conductivity of 50 feet per day—Continued

[Minimum average concentration and minimum chemical load were computed from concentrations measured less than the method reporting limit set equal to zero; maximum average concentration and maximum chemical load were computed from concentrations measured less than the method reporting limit set equal to the reporting limit; ft^3/s, cubic foot per second; kg/d, kilogram per day; µg/L, microgram per liter; mg/L, milligram per liter; --, no load estimated; ND, no data]

Constituent (in concentration units)	River reach	Ground water flux (ft^3/s)	Number of analyses used to compute averages	Minimum average concentration	Minimum chemical loading (kg/d)	Maximum average concentration	Maximum chemical loading (kg/d)
General chemistry—Continued							
Total suspended solids, in mg/L	A	1.68	4	8.62	35.4	10.1	41.5
	B	1.95	4	16.92	80.9	17.4	83.3
	C	1.68	1	28.0	115	28.0	115
	D	.39	2	3.50	3.37	5.00	4.82
	E	.28	1	18.5	12.7	18.5	12.7
	F	.45	0	ND	--	ND	--
	G	.55	2	22.9	30.8	24.4	32.8
	H	.50	1	214	260	214	260
Nitrate-nitrite, in mg/L	A	1.68	2	1.30	5.33	1.30	5.33
	B	1.95	3	.300	1.43	.310	1.48
	C	1.68	1	.320	1.32	.320	1.32
	D	.39	2	2.00	1.93	2.00	1.93
	E	.28	1	0	0	.010	.0069
	F	.45	0	ND	--	ND	--
	G	.55	1	0	0	.010	.013
	H	.50	2	0	0	.010	.012
Chloride, in mg/L	A	1.68	4	63.1	259	63.1	259
	B	1.95	4	435	2,080	435	2,080
	C	1.68	3	86.2	356	86.2	356
	D	.39	2	7.10	6.84	7.10	6.84
	E	.28	1	6.80	4.68	6.80	4.68
	F	.45	1	15.0	16.6	15.0	16.6
	G	.55	2	23.0	31.0	23.0	31.0
	H	.50	3	291	353	291	353
Sulfate, in mg/L	A	1.68	4	194	797	194	797
	B	1.95	4	48.7	233	48.7	233
	C	1.68	3	504	2,080	504	2,080
	D	.39	2	44.5	42.9	47.0	45.3
	E	.28	1	28.0	19.3	28.0	19.3
	F	.45	1	35.0	38.7	35.0	38.7
	G	.55	2	203	273	203	273
	H	.50	3	930	1,130	1,860	2,260

Table 4. Estimated chemical loads from ground water to the Grand Calumet River and Indiana Harbor Canal, northwestern Indiana, computed using a horizontal hydraulic conductivity of 50 feet per day—Continued

[Minimum average concentration and minimum chemical load were computed from concentrations measured less than the method reporting limit set equal to zero; maximum average concentration and maximum chemical load were computed from concentrations measured less than the method reporting limit set equal to the reporting limit; ft^3/s, cubic foot per second; kg/d, kilogram per day; µg/L, microgram per liter; mg/L, milligram per liter; --, no load estimated; ND, no data]

Constituent (in concentration units)	River reach	Ground water flux (ft^3/s)	Number of analyses used to compute averages	Minimum average concentration	Minimum chemical loading (kg/d)	Maximum average concentration	Maximum chemical loading (kg/d)
General chemistry—Continued							
Fluoride, in mg/L	A	1.68	2	5.35	22.0	5.35	22.0
	B	1.95	3	.500	2.39	.500	2.39
	C	1.68	3	2.20	9.07	2.20	9.07
	D	.39	2	.850	.819	.850	.819
	E	.28	1	.800	.551	.800	.551
	F	.45	1	2.30	2.54	2.30	2.54
	G	.55	1	1.00	1.35	1.00	1.35
	H	.50	2	1.60	1.94	1.60	1.94
Total organic carbon, in mg/L	A	1.68	4	7.07	29.0	7.07	29.0
	B	1.95	4	7.00	33.5	7.00	33.5
	C	1.68	1	8.70	35.9	8.70	35.9
	D	.39	2	3.65	3.52	3.65	3.52
	E	.28	1	9.10	6.26	9.10	6.26
	F	.45	0	ND	--	ND	--
	G	.55	2	15.2	20.5	15.2	20.5
	H	.50	1	24.4	58.6	24.4	29.6
Total phenols, in mg/L	A	1.68	4	0	0	.010	.041
	B	1.95	4	0	0	.010	.048
	C	1.68	3	.0054	.022	.0090	.037
	D	.39	2	0	0	.010	.0096
	E	.28	1	0	0	.010	.0069
	F	.45	1	.0030	.0033	.0030	.0033
	G	.55	2	0	0	.010	.013
	H	.50	3	.0015	.0018	.0065	.0079
Ammonia as N, in mg/L	A	1.68	4	22.7	92.9	22.7	93.1
	B	1.95	4	1.73	8.27	1.73	8.27
	C	1.68	1	2.20	9.07	2.20	9.07
	D	.39	2	.150	.145	.150	.145
	E	.28	1	1.94	1.34	1.94	1.34
	F	.45	0	ND	--	ND	--
	G	.55	2	.320	.431	.370	.499
	H	.50	0	ND	--	ND	--

Table 4. Estimated chemical loads from ground water to the Grand Calumet River and Indiana Harbor Canal, northwestern Indiana, computed using a horizontal hydraulic conductivity of 50 feet per day—Continued

[Minimum average concentration and minimum chemical load were computed from concentrations measured less than the method reporting limit set equal to zero; maximum average concentration and maximum chemical load were computed from concentrations measured less than the method reporting limit set equal to the reporting limit; ft^3/s, cubic foot per second; kg/d, kilogram per day; µg/L, microgram per liter; mg/L, milligram per liter; --, no load estimated; ND, no data]

Constituent (in concentration units)	River reach	Ground water flux (ft^3/s)	Number of analyses used to compute averages	Minimum average concentration	Minimum chemical loading (kg/d)	Maximum average concentration	Maximum chemical loading (kg/d)
General chemistry—Continued							
Orthophosphate (dissolved), in mg/L	A	1.68	1	0.460	1.89	0.460	1.89
	B	1.95	3	.250	1.20	.250	1.20
	C	1.68	0	ND	--	ND	--
	D	.39	0	ND	--	ND	--
	E	.28	1	.060	.041	.060	.041
	F	.45	0	ND	--	ND	--
	G	.55	0	ND	--	ND	--
	H	.50	0	ND	--	ND	--
Ammonia as N (dissolved), in mg/L	A	1.68	3	320	1,310	320	1,310
	B	1.95	2	3.01	14.4	3.01	14.4
	C	1.68	1	.160	.660	.160	.660
	D	.39	2	.010	.0096	.010	.0096
	E	.28	1	1.70	1.17	1.70	1.17
	F	.45	0	ND	--	ND	--
	G	.55	1	.870	1.17	.870	1.17
	H	.50	2	.820	.996	.820	.996
Dissolved oxygen, in mg/L	A	1.68	5	2.22	9.11	2.22	9.11
	B	1.95	4	1.67	7.99	1.67	7.99
	C	1.68	3	.230	.948	.230	.948
	D	.39	2	.950	.916	.950	.916
	E	.28	1	1.00	.688	1.00	.688
	F	.45	1	.800	.884	.800	.884
	G	.55	2	.300	.404	.300	.404
	H	.50	3	.450	.547	.450	.547
Cyanide (dissolved) in µg/L	A	1.68	4	7.85	.032	15.4	.063
	B	1.95	4	11.0	.053	17.8	.085
	C	1.68	2	0	0	5.01	.021
	D	.39	2	0	0	10.0	.0096
	E	.28	1	0	0	10.0	.0069
	F	.45	1	0	0	.01	.00001
	G	.55	2	0	0	10.0	.013
	H	.50	3	7.11	.0086	7.11	.0086

Table 5. Estimated chemical loads from ground water to the Grand Calumet River and Indiana Harbor Canal, northwestern Indiana, computed using a horizontal hydraulic conductivity of 100 feet per day

[Minimum average concentration and minimum chemical load were computed from concentrations measured less than the method reporting limit set equal to zero; maximum average concentration and maximum chemical load were computed from concentrations measured less than the method reporting limit set equal to the reporting limit; ft^3/s, cubic foot per second; kg/d, kilogram per day; µg/L, microgram per liter; mg/L, milligram per liter; --, no load estimated; ND, no data]

Constituent (in concentration units)	River reach	Ground water flux (ft^3/s)	Number of analyses used to compute averages	Minimum average concentration	Minimum chemical loading (kg/d)	Maximum average concentration	Maximum chemical loading (kg/d)
Trace elements							
Mercury, in µg/L	A	3.10	4	0.073	0.0006	0.120	0.0009
	B	3.63	4	.073	.0006	.140	.0012
	C	3.23	3	.210	.0017	.250	.0020
	D	.68	2	0	0	.100	.0002
	E	.58	1	.150	.0002	.150	.0002
	F	.91	1	.200	.0004	.200	.0004
	G	1.20	2	0	0	.100	.0003
	H	.98	3	.100	.0002	.150	.0004
Aluminum (dissolved), in µg/L	A	3.10	4	19.6	.149	30.0	.228
	B	3.63	4	17.6	.157	28.0	.249
	C	3.23	3	367	2.90	377	2.98
	D	.68	2	12.3	.021	22.7	.038
	E	.58	1	0	0	23.5	.033
	F	.91	1	0	0	10.0	.022
	G	1.20	2	0	0	22.2	.065
	H	.98	3	33.4	.080	33.3	.080
Iron (dissolved), in µg/L	A	3.10	4	875	6.64	878	6.67
	B	3.63	4	6,150	54.7	6,150	54.7
	C	3.23	3	11,500	90.9	11,500	90.9
	D	.68	2	1,270	2.12	1,270	2.12
	E	.58	1	3,480	4.95	3,480	4.95
	F	.91	0	ND	--	ND	--
	G	1.20	2	8,660	25.5	8,660	25.5
	H	.98	3	15,000	36.0	15,000	36.0
Lead (dissolved), in µg/L	A	3.10	4	1.03	.0078	1.30	.0099
	B	3.63	4	2.30	.020	2.30	.020
	C	3.23	3	67.1	.530	68.7	.543
	D	.68	2	.75	.0013	1.45	.0024
	E	.58	1	0	0	1.1	.0016
	F	.91	1	6.00	.013	6.00	.013
	G	1.20	2	1.10	.0032	1.65	.0049
	H	.98	3	0	0	3.05	.0073

Table 5. Estimated chemical loads from ground water to the Grand Calumet River and Indiana Harbor Canal, northwestern Indiana, computed using a horizontal hydraulic conductivity of 100 feet per day—Continued

[Minimum average concentration and minimum chemical load were computed from concentrations measured less than the method reporting limit set equal to zero; maximum average concentration and maximum chemical load were computed from concentrations measured less than the method reporting limit set equal to the reporting limit; ft^3/s, cubic foot per second; kg/d, kilogram per day; µg/L, microgram per liter; mg/L, milligram per liter; --, no load estimated; ND, no data]

Constituent (in concentration units)	River reach	Ground water flux (ft^3/s)	Number of analyses used to compute averages	Minimum average concentration	Minimum chemical loading (kg/d)	Maximum average concentration	Maximum chemical loading (kg/d)
Trace elements—Continued							
Manganese (dissolved), in µg/L	A	3.10	4	635	4.82	635	4.82
	B	3.63	4	336	2.99	336	2.99
	C	3.23	3	717	5.67	717	5.67
	D	.68	2	61.9	.103	61.9	.103
	E	.58	1	631	.896	631	.896
	F	.91	0	ND	--	ND	--
	G	1.20	2	688	2.03	688	2.03
	H	.98	3	1,130	2.71	1,130	2.71
Nickel (dissolved), in µg/L	A	3.10	4	0	0	5.40	.041
	B	3.63	4	1.08	.0096	5.00	.044
	C	3.23	1	0	0	4.70	.037
	D	.68	2	3.40	.0057	5.75	.0096
	E	.58	1	0	0	6.10	.0087
	F	.91	0	ND	--	ND	--
	G	1.20	2	0	0	5.40	.016
	H	.98	1	0	0	6.10	.015
Arsenic (dissolved), in µg/L	A	3.10	4	4.28	.032	5.12	.039
	B	3.63	4	2.03	.018	4.28	.038
	C	3.23	3	18.3	.145	19.2	.152
	D	.68	2	1.80	.003	3.15	.0053
	E	.58	1	0	0	1.70	.0024
	F	.91	1	3.00	.0067	3.00	.0067
	G	1.20	2	4.45	.013	5.80	.017
	H	.98	3	15.3	.037	15.3	.037
Barium (dissolved), in µg/L	A	3.10	4	34.9	.265	34.9	.265
	B	3.63	4	301	2.68	301	2.68
	C	3.23	3	227	1.79	260	2.05
	D	.68	2	53.7	.090	53.7	.090
	E	.58	1	47.1	.067	47.1	.067
	F	.91	0	ND	--	ND	--
	G	1.20	2	50.2	.148	50.2	.148
	H	.98	3	15.8	.038	65.8	.158

Table 5. Estimated chemical loads from ground water to the Grand Calumet River and Indiana Harbor Canal, northwestern Indiana, computed using a horizontal hydraulic conductivity of 100 feet per day—Continued

[Minimum average concentration and minimum chemical load were computed from concentrations measured less than the method reporting limit set equal to zero; maximum average concentration and maximum chemical load were computed from concentrations measured less than the method reporting limit set equal to the reporting limit; ft^3/s, cubic foot per second; kg/d, kilogram per day; µg/L, microgram per liter; mg/L, milligram per liter; --, no load estimated; ND, no data]

Constituent (in concentration units)	River reach	Ground water flux (ft^3/s)	Number of analyses used to compute averages	Minimum average concentration	Minimum chemical loading (kg/d)	Maximum average concentration	Maximum chemical loading (kg/d)
Trace elements—Continued							
Cadmium (dissolved), in µg/L	A	3.10	4	0	0	1.60	0.012
	B	3.63	4	0	0	1.50	.013
	C	3.23	3	0	0	4.17	.033
	D	.68	2	0	0	1.50	.0025
	E	.58	1	0	0	1.70	.0024
	F	.91	1	0	0	1	.0022
	G	1.20	2	0	0	1.6	.0047
	H	.98	3	0	0	1.35	.0032
Chromium (dissolved), in µg/L	A	3.10	4	0	0	5.45	.041
	B	3.63	4	0	0	5.10	.045
	C	3.23	3	13.3	.105	18.4	.145
	D	.68	2	3.95	.0066	6.50	.011
	E	.58	1	0	0	5.80	.0083
	F	.91	1	20.0	.045	20.0	.045
	G	1.20	2	0	0	5.45	.016
	H	.98	3	5.00	.012	7.90	.019
Copper (dissolved), in µg/L	A	3.10	4	17.6	.133	19.7	.149
	B	3.63	4	0	0	4.00	.036
	C	3.23	3	23.7	.187	25.0	.198
	D	.68	2	0	0	4.00	.0067
	E	.58	1	0	0	4.20	.0060
	F	.91	1	0	0	1.00	.0022
	G	1.20	2	0	0	4.10	.012
	H	.98	3	0	0	2.60	.0062
Zinc (dissolved), in µg/L	A	3.10	4	1.58	.012	4.20	.032
	B	3.63	4	0	0	3.70	.033
	C	3.23	3	46.3	.366	47.6	.376
	D	.68	2	3.75	.0063	5.60	.0094
	E	.58	1	0	0	3.40	.0048
	F	.91	1	7.00	.016	7.00	.016
	G	1.20	2	0	0	3.55	.010
	H	.98	3	5.00	.012	6.70	.016

Table 5. Estimated chemical loads from ground water to the Grand Calumet River and Indiana Harbor Canal, northwestern Indiana, computed using a horizontal hydraulic conductivity of 100 feet per day—Continued

[Minimum average concentration and minimum chemical load were computed from concentrations measured less than the method reporting limit set equal to zero; maximum average concentration and maximum chemical load were computed from concentrations measured less than the method reporting limit set equal to the reporting limit; ft^3/s, cubic foot per second; kg/d, kilogram per day; µg/L, microgram per liter; mg/L, milligram per liter; --, no load estimated; ND, no data]

Constituent (in concentration units)	River reach	Ground water flux (ft^3/s)	Number of analyses used to compute averages	Minimum average concentration	Minimum chemical loading (kg/d)	Maximum average concentration	Maximum chemical loading (kg/d)
Trace elements—Continued							
Selenium (dissolved), in µg/L	A	3.10	4	1.38	0.010	2.53	0.019
	B	3.63	4	.800	.0071	3.88	.035
	C	3.23	1	0	0	2.30	.018
	D	.68	2	0	0	3.70	.0062
	E	.58	1	0	0	2.30	.0033
	F	.91	0	ND	--	ND	--
	G	1.20	2	0	0	2.90	.0085
	H	.98	1	0	0	2.30	.0055
Polychlorinated biphenyls							
Aroclor 1260, in µg/L	A	3.10	4	0	0	1.00	.0076
	B	3.63	4	0	0	1.00	.0089
	C	3.23	1	0	0	1.00	.0079
	D	.68	2	0	0	1.00	.0017
	E	.58	1	0	0	1.00	.0014
	F	.91	0	ND	--	ND	--
	G	1.20	2	0	0	1.00	.0029
	H	.98	1	0	0	1.00	.0024
Aroclor 1254, in µg/L	A	3.10	4	0	0	1.00	.0076
	B	3.63	4	0	0	1.00	.0089
	C	3.23	1	0	0	1.00	.0079
	D	.68	2	0	0	1.00	.0017
	E	.58	1	0	0	1.00	.0014
	F	.91	0	ND	--	ND	--
	G	1.20	2	0	0	1.00	.0029
	H	.98	1	0	0	1.00	.0024
Aroclor 1232, in µg/L	A	3.10	4	0	0	1.00	.0076
	B	3.63	4	0	0	1.00	.0089
	C	3.23	1	0	0	1.00	.0079
	D	.68	2	0	0	1.00	.0017
	E	.58	1	0	0	1.00	.0014
	F	.91	0	ND	--	ND	--
	G	1.20	2	0	0	1.00	.0029
	H	.98	1	0	0	1.00	.0024

Table 5. Estimated chemical loads from ground water to the Grand Calumet River and Indiana Harbor Canal, northwestern Indiana, computed using a horizontal hydraulic conductivity of 100 feet per day—Continued

[Minimum average concentration and minimum chemical load were computed from concentrations measured less than the method reporting limit set equal to zero; maximum average concentration and maximum chemical load were computed from concentrations measured less than the method reporting limit set equal to the reporting limit; ft^3/s, cubic foot per second; kg/d, kilogram per day; µg/L, microgram per liter; mg/L, milligram per liter; --, no load estimated; ND, no data]

Constituent (in concentration units)	River reach	Ground water flux (ft^3/s)	Number of analyses used to compute averages	Minimum average concentration	Minimum chemical loading (kg/d)	Maximum average concentration	Maximum chemical loading (kg/d)
Polychlorinated biphenyls—Continued							
Aroclor 1248, in µg/L	A	3.10	4	0	0	1.00	0.0076
	B	3.63	4	0	0	1.00	.0089
	C	3.23	1	0	0	1.00	.0079
	D	.68	2	0	0	1.00	.0017
	E	.58	1	0	0	1.00	.0014
	F	.91	0	ND	--	ND	--
	G	1.20	2	0	0	1.00	.0029
	H	.98	1	0	0	1.00	.0024
Aroclor 1016, in µg/L	A	3.10	4	0	0	1.00	.0076
	B	3.63	4	0	0	1.00	.0089
	C	3.23	1	0	0	1.00	.0079
	D	.68	2	0	0	1.00	.0017
	E	.58	1	0	0	1.00	.0014
	F	.91	0	ND	--	ND	--
	G	1.20	2	0	0	1.00	.0029
	H	.98	1	0	0	1.00	.0024
Aroclor 1242, in µg/L	A	3.10	4	.250	.0019	1.00	.0076
	B	3.63	4	0	0	1.00	.0089
	C	3.23	1	0	0	1.00	.0079
	D	.68	2	0	0	1.00	.0017
	E	.58	1	0	0	1.00	.0014
	F	.91	0	ND	--	ND	--
	G	1.20	2	0	0	1.00	.0029
	H	.98	1	0	0	1.00	.0024
Pesticides							
Heptachlor epoxide, in µg/L	A	3.10	4	0	0	.050	.0004
	B	3.63	4	0	0	.050	.0004
	C	3.23	1	0	0	.050	.0004
	D	.68	2	0	0	.050	.00008
	E	.58	1	0	0	.050	.00007
	F	.91	0	ND	--	ND	--
	G	1.20	2	0	0	.050	.0001
	H	.98	1	0	0	.050	.0001

Table 5. Estimated chemical loads from ground water to the Grand Calumet River and Indiana Harbor Canal, northwestern Indiana, computed using a horizontal hydraulic conductivity of 100 feet per day—Continued

[Minimum average concentration and minimum chemical load were computed from concentrations measured less than the method reporting limit set equal to zero; maximum average concentration and maximum chemical load were computed from concentrations measured less than the method reporting limit set equal to the reporting limit; ft^3/s, cubic foot per second; kg/d, kilogram per day; µg/L, microgram per liter; mg/L, milligram per liter; --, no load estimated; ND, no data]

Constituent (in concentration units)	River reach	Ground water flux (ft^3/s)	Number of analyses used to compute averages	Minimum average concentration	Minimum chemical loading (kg/d)	Maximum average concentration	Maximum chemical loading (kg/d)
Pesticides—Continued							
Endosulfan sulfate, in µg/L	A	3.10	4	0	0	0.100	0.0008
	B	3.63	4	0	0	.100	.0009
	C	3.23	1	0	0	.100	.0008
	D	.68	2	0	0	.100	.0002
	E	.58	1	0	0	.100	.0001
	F	.91	0	ND	--	ND	--
	G	1.20	2	0	0	.100	.0003
	H	.98	1	0	0	.100	.0002
Aldrin, in µg/L	A	3.10	4	0	0	.050	.0004
	B	3.63	4	0	0	.050	.0004
	C	3.23	1	0	0	.050	.0004
	D	.68	2	0	0	.050	.00008
	E	.58	1	0	0	.050	.00007
	F	.91	0	ND	--	ND	--
	G	1.20	2	0	0	.050	.0001
	H	.98	1	0	0	.050	.0001
alpha-BHC, in µg/L	A	3.10	4	0	0	.050	.0004
	B	3.63	4	0	0	.050	.0004
	C	3.23	1	0	0	.050	.0004
	D	.68	2	0	0	.050	.00008
	E	.58	1	0	0	.050	.00007
	F	.91	0	ND	--	ND	--
	G	1.20	2	0	0	.050	.0001
	H	.98	1	0	0	.050	.0001
beta-BHC, in µg/L	A	3.10	4	0	0	.050	.0004
	B	3.63	4	0	0	.050	.0004
	C	3.23	1	0	0	.050	.0004
	D	.68	2	0	0	.050	.00008
	E	.58	1	0	0	.050	.00007
	F	.91	0	ND	--	ND	--
	G	1.20	2	0	0	.050	.0001
	H	.98	1	0	0	.050	.0001

Table 5. Estimated chemical loads from ground water to the Grand Calumet River and Indiana Harbor Canal, northwestern Indiana, computed using a horizontal hydraulic conductivity of 100 feet per day—Continued

[Minimum average concentration and minimum chemical load were computed from concentrations measured less than the method reporting limit set equal to zero; maximum average concentration and maximum chemical load were computed from concentrations measured less than the method reporting limit set equal to the reporting limit; ft^3/s, cubic foot per second; kg/d, kilogram per day; µg/L, microgram per liter; mg/L, milligram per liter; --, no load estimated; ND, no data]

Constituent (in concentration units)	River reach	Ground water flux (ft^3/s)	Number of analyses used to compute averages	Minimum average concentration	Minimum chemical loading (kg/d)	Maximum average concentration	Maximum chemical loading (kg/d)
			Pesticides—Continued				
delta-BHC, in µg/L	A	3.10	4	0	0	0.050	0.0004
	B	3.63	4	0	0	.050	.0004
	C	3.23	1	0	0	.050	.0004
	D	.68	2	0	0	.050	.00008
	E	.58	1	0	0	.050	.00007
	F	.91	0	ND	--	ND	--
	G	1.20	2	0	0	.050	.0001
	H	.98	1	0	0	.050	.0001
Endosulfan II, in µg/L	A	3.10	4	0	0	.100	.0008
	B	3.63	4	0	0	.100	.0009
	C	3.23	1	0	0	.100	.0008
	D	.68	2	0	0	.100	.0002
	E	.58	1	0	0	.100	.0001
	F	.91	0	ND	--	ND	--
	G	1.20	2	0	0	.100	.0003
	H	.98	1	0	0	.100	.0002
4,4'-DDT, in µg/L	A	3.10	4	0	0	.100	.0008
	B	3.63	4	0	0	.100	.0009
	C	3.23	1	0	0	.100	.0008
	D	.68	2	0	0	.100	.0002
	E	.58	1	0	0	.100	.0001
	F	.91	0	ND	--	ND	--
	G	1.20	2	0	0	.100	.0003
	H	.98	1	0	0	.100	.0002
Endrin ketone, in µg/L	A	3.10	4	0	0	.100	.0008
	B	3.63	4	0	0	.100	.0009
	C	3.23	1	0	0	.100	.0008
	D	.68	2	0	0	.100	.0002
	E	.58	1	0	0	.100	.0001
	F	.91	0	ND	--	ND	--
	G	1.20	2	0	0	.100	.0003
	H	.98	1	0	0	.100	.0002

Table 5. Estimated chemical loads from ground water to the Grand Calumet River and Indiana Harbor Canal, northwestern Indiana, computed using a horizontal hydraulic conductivity of 100 feet per day—Continued

[Minimum average concentration and minimum chemical load were computed from concentrations measured less than the method reporting limit set equal to zero; maximum average concentration and maximum chemical load were computed from concentrations measured less than the method reporting limit set equal to the reporting limit; ft^3/s, cubic foot per second; kg/d, kilogram per day; µg/L, microgram per liter; mg/L, milligram per liter; --, no load estimated; ND, no data]

Constituent (in concentration units)	River reach	Ground water flux (ft^3/s)	Number of analyses used to compute averages	Minimum average concentration	Minimum chemical loading (kg/d)	Maximum average concentration	Maximum chemical loading (kg/d)
			Pesticides—Continued				
Chlordane (technical), in µg/L	A	3.10	4	0	0	0.040	0.0003
	B	3.63	4	0	0	.050	.0004
	C	3.23	1	0	0	.050	.0004
	D	.68	2	0	0	.050	.00008
	E	.58	1	0	0	.050	.00007
	F	.91	0	ND	--	ND	--
	G	1.20	2	0	0	.050	.0001
	H	.98	1	0	0	.050	.0001
gamma-BHC (Lindane), in µg/L	A	3.10	4	0	0	.050	.0004
	B	3.63	4	0	0	.050	.0004
	C	3.23	1	0	0	.050	.0004
	D	.68	2	0	0	.050	.00008
	E	.58	1	0	0	.050	.00007
	F	.91	0	ND	--	ND	--
	G	1.20	2	0	0	.050	.0001
	H	.98	1	0	0	.050	.0001
Dieldrin, in µg/L	A	3.10	4	0	0	.100	.0008
	B	3.63	4	0	0	.100	.0009
	C	3.23	1	0	0	.100	.0008
	D	.68	2	0	0	.100	.0002
	E	.58	1	0	0	.100	.0001
	F	.91	0	ND	--	ND	--
	G	1.20	2	0	0	.100	.0003
	H	.98	1	0	0	.100	.0002
Endrin, in µg/L	A	3.10	4	0	0	.100	.0008
	B	3.63	4	0	0	.100	.0009
	C	3.23	1	0	0	.100	.0008
	D	.68	2	0	0	.100	.0002
	E	.58	1	0	0	.100	.0001
	F	.91	0	ND	--	ND	--
	G	1.20	2	0	0	.100	.0003
	H	.98	1	0	0	.100	.0002

Table 5. Estimated chemical loads from ground water to the Grand Calumet River and Indiana Harbor Canal, northwestern Indiana, computed using a horizontal hydraulic conductivity of 100 feet per day—Continued

[Minimum average concentration and minimum chemical load were computed from concentrations measured less than the method reporting limit set equal to zero; maximum average concentration and maximum chemical load were computed from concentrations measured less than the method reporting limit set equal to the reporting limit; ft^3/s, cubic foot per second; kg/d, kilogram per day; µg/L, microgram per liter; mg/L, milligram per liter; --, no load estimated; ND, no data]

Constituent (in concentration units)	River reach	Ground water flux (ft^3/s)	Number of analyses used to compute averages	Minimum average concentration	Minimum chemical loading (kg/d)	Maximum average concentration	Maximum chemical loading (kg/d)
Pesticides—Continued							
Methoxychlor, in µg/L	A	3.10	4	0	0	0.500	0.0038
	B	3.63	4	.010	.00009	.340	.0030
	C	3.23	1	0	0	.500	.0040
	D	.68	2	0	0	.500	.0008
	E	.58	1	0	0	.500	.0007
	F	.91	0	ND	--	ND	--
	G	1.20	2	0	0	.500	.001
	H	.98	1	0	0	.500	.001
4,4'-DDD, in µg/L	A	3.10	4	0	0	.100	.0008
	B	3.63	4	0	0	.100	.0009
	C	3.23	1	0	0	.100	.0008
	D	.68	2	0	0	.100	.0002
	E	.58	1	0	0	.100	.0001
	F	.91	0	ND	--	ND	--
	G	1.20	2	0	0	.100	.0003
	H	.98	1	0	0	.100	.0002
4,4'-DDE, in µg/L	A	3.10	4	0	0	.100	.0008
	B	3.63	4	0	0	.100	.0009
	C	3.23	1	0	0	.100	.0008
	D	.68	2	0	0	.100	.0002
	E	.58	1	0	0	.100	.0001
	F	.91	0	ND	--	ND	--
	G	1.20	2	0	0	.100	.0003
	H	.98	1	0	0	.100	.0002
Endrin aldehyde, in µg/L	A	3.10	4	0	0	.100	.0008
	B	3.63	4	.010	.00009	.060	.0005
	C	3.23	1	0	0	.100	.0008
	D	.68	2	.010	.00002	.060	.0001
	E	.58	1	0	0	.100	.0001
	F	.91	0	ND	--	ND	--
	G	1.20	2	0	0	.100	.0003
	H	.98	1	0	0	.100	.0002

Table 5. Estimated chemical loads from ground water to the Grand Calumet River and Indiana Harbor Canal, northwestern Indiana, computed using a horizontal hydraulic conductivity of 100 feet per day—Continued

Constituent (in concentration units)	River reach	Ground water flux (ft^3/s)	Number of analyses used to compute averages	Minimum average concentration	Minimum chemical loading (kg/d)	Maximum average concentration	Maximum chemical loading (kg/d)
Pesticides—Continued							
Heptachlor, in µg/L	A	3.10	4	0	0	0.050	0.0004
	B	3.63	4	0	0	.050	.0004
	C	3.23	1	0	0	.050	.0004
	D	.68	2	0	0	.050	.00008
	E	.58	1	0	0	.050	.00007
	F	.91	0	ND	--	ND	--
	G	1.20	2	0	0	.050	.0001
	H	.98	1	0	0	.050	.0001
Toxaphene, in µg/L	A	3.10	4	0	0	5.00	.038
	B	3.63	4	0	0	5.00	.044
	C	3.23	1	0	0	5.00	.040
	D	.68	2	0	0	5.00	.0084
	E	.58	1	0	0	5.00	.0071
	F	.91	0	ND	--	ND	--
	G	1.20	2	0	0	5.00	.015
	H	.98	1	0	0	5.00	.012
Endosulfan I, in µg/L	A	3.10	4	0	0	.050	.0004
	B	3.63	4	0	0	.050	.0004
	C	3.23	1	0	0	.050	.0004
	D	.68	2	0	0	.050	.00008
	E	.58	1	0	0	.050	.00007
	F	.91	0	ND	--	ND	--
	G	1.20	2	0	0	.050	.0001
	H	.98	1	0	0	.050	.0001
Polynuclear aromatic hydrocarbons							
Anthracene, in µg/L	A	3.10	4	0	0	10.0	.076
	B	3.63	4	0	0	10.0	.089
	C	3.23	3	0	0	6.67	.053
	D	.68	2	0	0	10.0	.017
	E	.58	1	0	0	10.0	.014
	F	.91	1	0	0	5.00	.011
	G	1.20	2	0	0	10.0	.029
	H	.98	3	0	0	7.50	.018

Table 5. Estimated chemical loads from ground water to the Grand Calumet River and Indiana Harbor Canal, northwestern Indiana, computed using a horizontal hydraulic conductivity of 100 feet per day—Continued

[Minimum average concentration and minimum chemical load were computed from concentrations measured less than the method reporting limit set equal to zero; maximum average concentration and maximum chemical load were computed from concentrations measured less than the method reporting limit set equal to the reporting limit; ft^3/s, cubic foot per second; kg/d, kilogram per day; µg/L, microgram per liter; mg/L, milligram per liter; --, no load estimated; ND, no data]

Constituent (in concentration units)	River reach	Ground water flux (ft^3/s)	Number of analyses used to compute averages	Minimum average concentration	Minimum chemical loading (kg/d)	Maximum average concentration	Maximum chemical loading (kg/d)
Polynuclear aromatic hydrocarbons—Continued							
Pyrene, in µg/L	A	3.10	4	0	0	10.0	0.076
	B	3.63	4	0	0	10.0	.089
	C	3.23	3	0	0	6.67	.053
	D	.68	2	0	0	10.0	.017
	E	.58	1	0	0	10.0	.014
	F	.91	1	0	0	5.00	.011
	G	1.20	2	0	0	10.0	.029
	H	.98	3	0	0	7.50	.018
Benzo(ghi)perylene, in µg/L	A	3.10	4	0	0	10.0	.076
	B	3.63	4	0	0	10.0	.089
	C	3.23	3	0	0	10.0	.079
	D	.68	2	0	0	10.0	.017
	E	.58	1	0	0	10.0	.014
	F	.91	1	0	0	10.0	.022
	G	1.20	2	0	0	10.0	.029
	H	.98	3	0	0	10.0	.024
Indeno(1,2,3-cd)pyrene, in µg/L	A	3.10	4	0	0	10.0	.076
	B	3.63	4	0	0	10.0	.089
	C	3.23	3	0	0	10.0	.079
	D	.68	2	0	0	10.0	.017
	E	.58	1	0	0	10.0	.014
	F	.91	1	0	0	10.0	.022
	G	1.20	2	0	0	10.0	.029
	H	.98	3	0	0	10.0	.024
Benzo(b)fluoranthene, in µg/L	A	3.10	4	0	0	10.0	.076
	B	3.63	4	0	0	10.0	.089
	C	3.23	3	0	0	10.0	.079
	D	.68	2	0	0	10.0	.017
	E	.58	1	0	0	10.0	.014
	F	.91	1	0	0	10.0	.022
	G	1.20	2	0	0	10.0	.029
	H	.98	3	0	0	10.0	.024

Table 5. Estimated chemical loads from ground water to the Grand Calumet River and Indiana Harbor Canal, northwestern Indiana, computed using a horizontal hydraulic conductivity of 100 feet per day—Continued

[Minimum average concentration and minimum chemical load were computed from concentrations measured less than the method reporting limit set equal to zero; maximum average concentration and maximum chemical load were computed from concentrations measured less than the method reporting limit set equal to the reporting limit; ft^3/s, cubic foot per second; kg/d, kilogram per day; µg/L, microgram per liter; mg/L, milligram per liter; --, no load estimated; ND, no data]

Constituent (in concentration units)	River reach	Ground water flux (ft^3/s)	Number of analyses used to compute averages	Minimum average concentration	Minimum chemical loading (kg/d)	Maximum average concentration	Maximum chemical loading (kg/d)
Polynuclear aromatic hydrocarbons—Continued							
Fluoranthene, in µg/L	A	3.10	4	0	0	10.0	0.076
	B	3.63	4	0	0	10.0	.089
	C	3.23	3	0	0	6.67	.053
	D	.68	2	0	0	10.0	.017
	E	.58	1	0	0	10.0	.014
	F	.91	1	0	0	5.00	.011
	G	1.20	2	0	0	10.0	.029
	H	.98	3	0	0	7.50	.018
Benzo(k)fluoranthene, in µg/L	A	3.10	4	0	0	10.0	.076
	B	3.63	4	0	0	10.0	.089
	C	3.23	3	0	0	10.0	.079
	D	.68	2	0	0	10.0	.017
	E	.58	1	0	0	10.0	.014
	F	.91	1	0	0	10.0	.022
	G	1.20	2	0	0	10.0	.029
	H	.98	3	0	0	10.0	.024
Acenaphthylene, in µg/L	A	3.10	4	0	0	10.0	.076
	B	3.63	4	0	0	10.0	.089
	C	3.23	3	0	0	6.67	.053
	D	.68	2	0	0	10.0	.017
	E	.58	1	0	0	10.0	.014
	F	.91	1	0	0	5.00	.011
	G	1.20	2	0	0	10.0	.029
	H	.98	3	0	0	7.50	.018
Chrysene, in µg/L	A	3.10	4	0	0	10.0	.076
	B	3.63	4	0	0	10.0	.089
	C	3.23	3	0	0	10.0	.079
	D	.68	2	0	0	10.0	.017
	E	.58	1	0	0	10.0	.014
	F	.91	1	0	0	10.0	.022
	G	1.20	2	0	0	10.0	.029
	H	.98	3	0	0	10.0	.024

Table 5. Estimated chemical loads from ground water to the Grand Calumet River and Indiana Harbor Canal, northwestern Indiana, computed using a horizontal hydraulic conductivity of 100 feet per day—Continued

[Minimum average concentration and minimum chemical load were computed from concentrations measured less than the method reporting limit set equal to zero; maximum average concentration and maximum chemical load were computed from concentrations measured less than the method reporting limit set equal to the reporting limit; ft^3/s, cubic foot per second; kg/d, kilogram per day; µg/L, microgram per liter; mg/L, milligram per liter; --, no load estimated; ND, no data]

Constituent (in concentration units)	River reach	Ground water flux (ft^3/s)	Number of analyses used to compute averages	Minimum average concentration	Minimum chemical loading (kg/d)	Maximum average concentration	Maximum chemical loading (kg/d)
Polynuclear aromatic hydrocarbons—Continued							
Benzo(a)pyrene, in µg/L	A	3.10	4	0	0	10.0	0.076
	B	3.63	4	0	0	10.0	.089
	C	3.23	3	0	0	10.0	.079
	D	.68	2	0	0	10.0	.017
	E	.58	1	0	0	10.0	.014
	F	.91	1	0	0	10.0	.022
	G	1.20	2	0	0	10.0	.029
	H	.98	3	0	0	10.0	.024
Benzo(a)anthracene, in µg/L	A	3.10	4	0	0	10.0	.076
	B	3.63	4	0	0	10.0	.089
	C	3.23	3	0	0	6.67	.053
	D	.68	2	0	0	10.0	.017
	E	.58	1	0	0	10.0	.014
	F	.91	1	0	0	5.00	.011
	G	1.20	2	0	0	10.0	.029
	H	.98	3	0	0	10.0	.024
Acenaphthene, in µg/L	A	3.10	4	0	0	10.0	.076
	B	3.63	4	0	0	10.0	.089
	C	3.23	3	0	0	6.67	.053
	D	.68	2	0	0	10.0	.017
	E	.58	1	0	0	10.0	.014
	F	.91	1	0	0	5.00	.011
	G	1.20	2	0	0	10.0	.029
	H	.98	3	0	0	7.50	.018
Phenanthrene, in µg/L	A	3.10	4	0	0	10.0	.076
	B	3.63	4	0	0	10.0	.089
	C	3.23	3	0	0	6.67	.053
	D	.68	2	0	0	10.0	.017
	E	.58	1	0	0	10.0	.014
	F	.91	1	0	0	5.00	.011
	G	1.20	2	0	0	10.0	.029
	H	.98	3	0	0	7.50	.018

Table 5. Estimated chemical loads from ground water to the Grand Calumet River and Indiana Harbor Canal, northwestern Indiana, computed using a horizontal hydraulic conductivity of 100 feet per day—Continued

[Minimum average concentration and minimum chemical load were computed from concentrations measured less than the method reporting limit set equal to zero; maximum average concentration and maximum chemical load were computed from concentrations measured less than the method reporting limit set equal to the reporting limit; ft^3/s, cubic foot per second; kg/d, kilogram per day; µg/L, microgram per liter; mg/L, milligram per liter; --, no load estimated; ND, no data]

Constituent (in concentration units)	River reach	Ground water flux (ft^3/s)	Number of analyses used to compute averages	Minimum average concentration	Minimum chemical loading (kg/d)	Maximum average concentration	Maximum chemical loading (kg/d)
Polynuclear aromatic hydrocarbons—Continued							
Fluorene, in µg/L	A	3.10	4	0	0	10.0	0.076
	B	3.63	4	0	0	10.0	.089
	C	3.23	3	0	0	6.67	.053
	D	.68	2	0	0	10.0	.017
	E	.58	1	0	0	10.0	.014
	F	.91	1	0	0	5.00	.011
	G	1.20	2	0	0	10.0	.029
	H	.98	3	0	0	7.50	.018
Naphthalene, in µg/L	A	3.10	4	0	0	10.0	.076
	B	3.63	4	0	0	10.0	.089
	C	3.23	3	0	0	6.67	.053
	D	.68	2	0	0	10.0	.017
	E	.58	1	0	0	10.0	.014
	F	.91	1	0	0	5.00	.011
	G	1.20	2	0	0	10.0	.029
	H	.98	3	0	0	7.50	.018
General chemistry							
Hardness, as CaCO3, in mg/L	A	3.10	0	ND	--	ND	--
	B	3.63	0	ND	--	ND	--
	C	3.23	0	ND	--	ND	--
	D	.68	0	ND	--	ND	--
	E	.58	0	ND	--	ND	--
	F	.91	0	ND	--	ND	--
	G	1.20	1	.240	.706	.240	.706
	H	.98	0	ND	--	ND	--
Total dissolved solids, in mg/L	A	3.10	4	621	4,720	621	4,720
	B	3.63	4	1,370	12,200	1,370	12,200
	C	3.23	3	1,620	12,800	1,617	12,800
	D	.68	2	248	415	248	415
	E	.58	1	523	745	523	745
	F	.91	1	436	974	436	974
	G	1.20	2	370	1090	370	1,090
	H	.98	3	1,970	4,730	1,970	4,730

Table 5. Estimated chemical loads from ground water to the Grand Calumet River and Indiana Harbor Canal, northwestern Indiana, computed using a horizontal hydraulic conductivity of 100 feet per day—Continued

[Minimum average concentration and minimum chemical load were computed from concentrations measured less than the method reporting limit set equal to zero; maximum average concentration and maximum chemical load were computed from concentrations measured less than the method reporting limit set equal to the reporting limit; ft^3/s, cubic foot per second; kg/d, kilogram per day; µg/L, microgram per liter; mg/L, milligram per liter; --, no load estimated; ND, no data]

Constituent (in concentration units)	River reach	Ground water flux (ft^3/s)	Number of analyses used to compute averages	Minimum average concentration	Minimum chemical loading (kg/d)	Maximum average concentration	Maximum chemical loading (kg/d)
General chemistry—Continued							
Total suspended solids, in mg/L	A	3.10	4	8.62	65.4	10.1	76.8
	B	3.63	4	16.92	151	17.4	155
	C	3.23	1	28.0	221	28.0	221
	D	.68	2	3.50	5.85	5.00	8.36
	E	.58	1	18.5	26.3	18.5	26.3
	F	.91	0	ND	--	ND	--
	G	1.20	2	22.9	67.3	24.4	71.7
	H	.98	1	214	514	214	514
Nitrate-nitrite, in mg/L	A	3.10	2	1.30	9.87	1.30	9.87
	B	3.63	3	.300	2.67	.310	2.76
	C	3.23	1	.320	2.53	.320	2.53
	D	.68	2	2.00	3.34	2.00	3.34
	E	.58	1	0	0	.010	.014
	F	.91	0	ND	--	ND	--
	G	1.20	1	0	0	.010	.029
	H	.98	2	0	0	.010	.024
Chloride, in mg/L	A	3.10	4	63.1	479	63.1	479
	B	3.63	4	435	3,870	435	3,870
	C	3.23	3	86.2	681	86.2	681
	D	.68	2	7.10	11.9	7.10	11.9
	E	.58	1	6.80	9.68	6.80	9.68
	F	.91	1	15.0	33.5	15.0	33.5
	G	1.20	2	23.0	67.7	23.0	67.7
	H	.98	3	291	699	291	699
Sulfate, in mg/L	A	3.10	4	194	1,470	194	1,470
	B	3.63	4	48.7	433	48.7	433
	C	3.23	3	504	3,980	504	3,980
	D	.68	2	44.5	74.4	47.0	78.6
	E	.58	1	28.0	39.9	28.0	39.9
	F	.91	1	35.0	78.2	35.0	78.2
	G	1.20	2	203	597	203	597
	H	.98	3	930	2,230	1,860	4,460

Table 5. Estimated chemical loads from ground water to the Grand Calumet River and Indiana Harbor Canal, northwestern Indiana, computed using a horizontal hydraulic conductivity of 100 feet per day—Continued

[Minimum average concentration and minimum chemical load were computed from concentrations measured less than the method reporting limit set equal to zero; maximum average concentration and maximum chemical load were computed from concentrations measured less than the method reporting limit set equal to the reporting limit; ft^3/s, cubic foot per second; kg/d, kilogram per day; µg/L, microgram per liter; mg/L, milligram per liter; --, no load estimated; ND, no data]

Constituent (in concentration units)	River reach	Ground water flux (ft^3/s)	Number of analyses used to compute averages	Minimum average concentration	Minimum chemical loading (kg/d)	Maximum average concentration	Maximum chemical loading (kg/d)
General chemistry—Continued							
Fluoride, in mg/L	A	3.10	2	5.35	40.6	5.35	40.6
	B	3.63	3	.500	4.45	.500	4.45
	C	3.23	3	2.20	17.4	2.20	17.4
	D	.68	2	.850	1.42	.850	1.42
	E	.58	1	.800	1.14	.800	1.14
	F	.91	1	2.30	5.14	2.30	5.14
	G	1.20	1	1.00	2.94	1.00	2.94
	H	.98	2	1.60	3.84	1.60	3.84
Total organic carbon, in mg/L	A	3.10	4	7.07	53.7	7.07	53.7
	B	3.63	4	7.00	62.3	7.00	62.3
	C	3.23	1	8.70	68.7	8.70	68.7
	D	.68	2	3.65	6.10	3.65	6.10
	E	.58	1	9.10	13.0	9.10	13.0
	F	.91	0	ND	--	ND	--
	G	1.20	2	15.2	44.7	15.2	44.7
	H	.98	1	24.4	58.6	24.4	58.6
Total phenols, in mg/L	A	3.10	4	0	0	.010	.076
	B	3.63	4	0	0	.010	.089
	C	3.23	3	.0054	.042	.0090	.071
	D	.68	2	0	0	.010	.017
	E	.58	1	0	0	.010	.014
	F	.91	1	.0030	.0067	.0030	.0067
	G	1.20	2	0	0	.010	.029
	H	.98	3	.0015	.0036	.0065	.016
Ammonia as N, in mg/L	A	3.10	4	22.7	172	22.7	172
	B	3.63	4	1.73	15.4	1.73	15.4
	C	3.23	1	2.20	17.4	2.20	17.4
	D	.68	2	.150	.251	.150	.251
	E	.58	1	1.94	2.76	1.94	2.76
	F	.91	0	ND	--	ND	--
	G	1.20	2	.320	.942	.370	1.09
	H	.98	0	ND	--	ND	--

Table 5. Estimated chemical loads from ground water to the Grand Calumet River and Indiana Harbor Canal, northwestern Indiana, computed using a horizontal hydraulic conductivity of 100 feet per day—Continued

[Minimum average concentration and minimum chemical load were computed from concentrations measured less than the method reporting limit set equal to zero; maximum average concentration and maximum chemical load were computed from concentrations measured less than the method reporting limit set equal to the reporting limit; ft^3/s, cubic foot per second; kg/d, kilogram per day; µg/L, microgram per liter; mg/L, milligram per liter; --, no load estimated; ND, no data]

Constituent (in concentration units)	River reach	Ground water flux (ft^3/s)	Number of analyses used to compute averages	Minimum average concentration	Minimum chemical loading (kg/d)	Maximum average concentration	Maximum chemical loading (kg/d)
General chemistry—Continued							
Orthophosphate (dissolved), in mg/L	A	3.10	1	0.460	3.49	0.460	3.49
	B	3.63	3	.250	2.22	.250	2.22
	C	3.23	0	ND	--	ND	--
	D	.68	0	ND	--	ND	--
	E	.58	1	.060	.085	.060	.085
	F	.91	0	ND	--	ND	--
	G	1.20	0	ND	--	ND	--
	H	.98	0	ND	--	ND	--
Ammonia as N (dissolved), in mg/L	A	3.10	3	320	2,430	320	2,430
	B	3.63	2	3.01	26.8	3.01	26.8
	C	3.23	1	.160	1.26	.160	1.26
	D	.68	2	.010	.017	.010	.017
	E	.58	1	1.70	2.42	1.70	2.42
	F	.91	0	ND	--	ND	--
	G	1.20	1	.870	2.56	.870	2.56
	H	.98	2	.820	1.97	.820	1.97
Dissolved oxygen, in mg/L	A	3.10	5	2.22	16.9	2.22	16.9
	B	3.63	4	1.67	14.9	1.67	14.9
	C	3.23	3	.230	1.82	.230	1.82
	D	.68	2	.950	1.59	.950	1.59
	E	.58	1	1.00	1.42	1.00	1.42
	F	.91	1	.800	1.79	.800	1.79
	G	1.20	2	.300	.883	.300	.883
	H	.98	3	.450	1.08	.450	1.08
Cyanide (dissolved), in µg/L	A	3.10	4	7.85	.060	15.4	.117
	B	3.63	4	11.0	.098	17.8	.158
	C	3.23	2	0	0	5.01	.040
	D	.68	2	0	0	10.0	.017
	E	.58	1	0	0	10.0	.014
	F	.91	1	0	0	.0100	.00002
	G	1.20	2	0	0	10.0	.029
	H	.98	3	7.11	.017	7.11	.017