RELATION OF GROUND-WATER QUALITY TO LAND USE IN THE PHILADELPHIA, PENNSYLVANIA--CAMDEN, NEW JERSEY AREA

By Roy S. Blickwedel and Charles R. Wood

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CONVERSION FACTORS AND ABBREVIATIONS

For the convenience of readers who may prefer to use metric (International System) units, the inch-pound units used in this report may be converted as follows:

Multiply inch-pound unit	By	To obtain metric unit
	Length	
inch (in.)	2.54	centimeter (cm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
foot per second (ft/s)	0.3048	meter per second (m/s)
foot per day (ft/d)	0.3048	meter per day (m/d)
	Area	
square mile (mi^2)	2.590	square kilometer (km^2)
	Volume	
gallon (gal)	0.003785	cubic meter (m^3)
	Flow	
gallon per minute (gal/min)	0.06309	liter per second (L/s)

Sea level: 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."

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ABSTRACT

The distributions of common dissolved constituents, trace metals, and volatile organic compounds in ground water near Philadelphia, Pennsylvania, and Camden, New Jersey, are influenced by local geology and land use. Many common dissolved constituents are more concentrated in ground water beneath urban and industrial areas than in water beneath suburban and undeveloped and agricultural areas. Industrial and urban land uses commonly are situated in the outcrop of the aquifer where vulnerability of ground water to contamination is increased by the lack of overlying confining strata. Ground water beneath undeveloped and agricultural lands is least affected by trace metal or volatile organic contamination, but differences in water quality as related to other land-use categories are less clear and vary according to the chemical constituent considered.

Only about 20 percent of all water samples contained detectable concentrations of trace metals or volatile organic compounds; as a result, determinations of relations between water quality and land use are difficult. Variations in detection limits further complicated data interpretation. The proportion of water samples in which concentrations of constituents were below detection compared to water samples in which concentrations were present in detectable amounts is the most useful statistic in determining relations based on trace-metal or volatile organic-compound data. Iron and manganese concentrations are elevated in water throughout the Coastal Plain aquifer in Pennsylvania, but the elevated concentrations cannot be adequately explained on the basis of land use alone.

Manuscript approved for publication November 17, 1988.

INTRODUCTION

Background

This study was conducted as part of a U.S. Geological Survey program to appraise the chemical quality of the nation's ground-water resources, especially the occurrence of trace metals and volatile organic compounds. The chemistry of common dissolved constituents in ground water has been extensively studied for many years. However, only in the last decade has the environmental importance of trace metals and volatile organic compounds been fully realized. Especially lacking are regional studies that characterize the occurrence and distribution of trace metals as they relate to land use, climate, and hydrogeologic setting. The Coastal Plain in the vicinity of Philadelphia, Pennsylvania, and Camden, New Jersey, contains land use that is representative of the land use found over much of the Atlantic Coastal Plain and is well suited for an appraisal of ground-water quality in this physiographic setting.

Purpose and Scope

This report presents the results of a study to summarize the hydrogeologic setting of the region and the common dissolved constituents in ground water, describe the distribution of trace metals and volatile organic compounds in ground water using graphical and statistical methods, and relate the effects of land use to ground-water quality. The information presented also is intended to provide baseline data against which future changes in ground-water quality can be evaluated.

For inorganic constituents, comparisons between ground-water quality and land use are limited to wells tapping Coastal Plain sediments in the outcrop band of the Potomac-Raritan-Magothy aquifer system. For volatile organic compounds, water samples from a few wells tapping crystalline rocks northwest of the Fall Line are included (fig. 1). No samples were collected for this investigation. All ground-water chemistry data used in this report were retrieved from the U.S. Geological Survey National Water Data Storage and Retrieval System (WATSTORE). Summary statistics are presented to characterize the occurrence of trace metals and volatile organic compounds sufficiently represented in the data base.

Previous Investigations

Hydrogeologic descriptions of the project area are contained in several regional water-resource appraisal reports (Hall, 1934; Thompson, 1932; Barksdale and others, 1958; Greenman and others, 1961; and Vowinkel and Foster, 1981) and countywide water-resource investigations (Greenman, 1955; Paulachok, in press; Rush, 1968; Hardt and Hilton, 1969; and Farlekas and others, 1976). Water-quality problems associated with elevated iron concentrations were realized as early as the work of Thompson (1932). Barksdale and others (1958) presented the first comprehensive discussion of ground-water quality in the Potomac-Raritan-Magothy aquifer system in the lower Delaware River valley. Many changes in ground-water chemistry were attributed to changes in the regional ground-water-flow pattern. Heavy ground-water use in

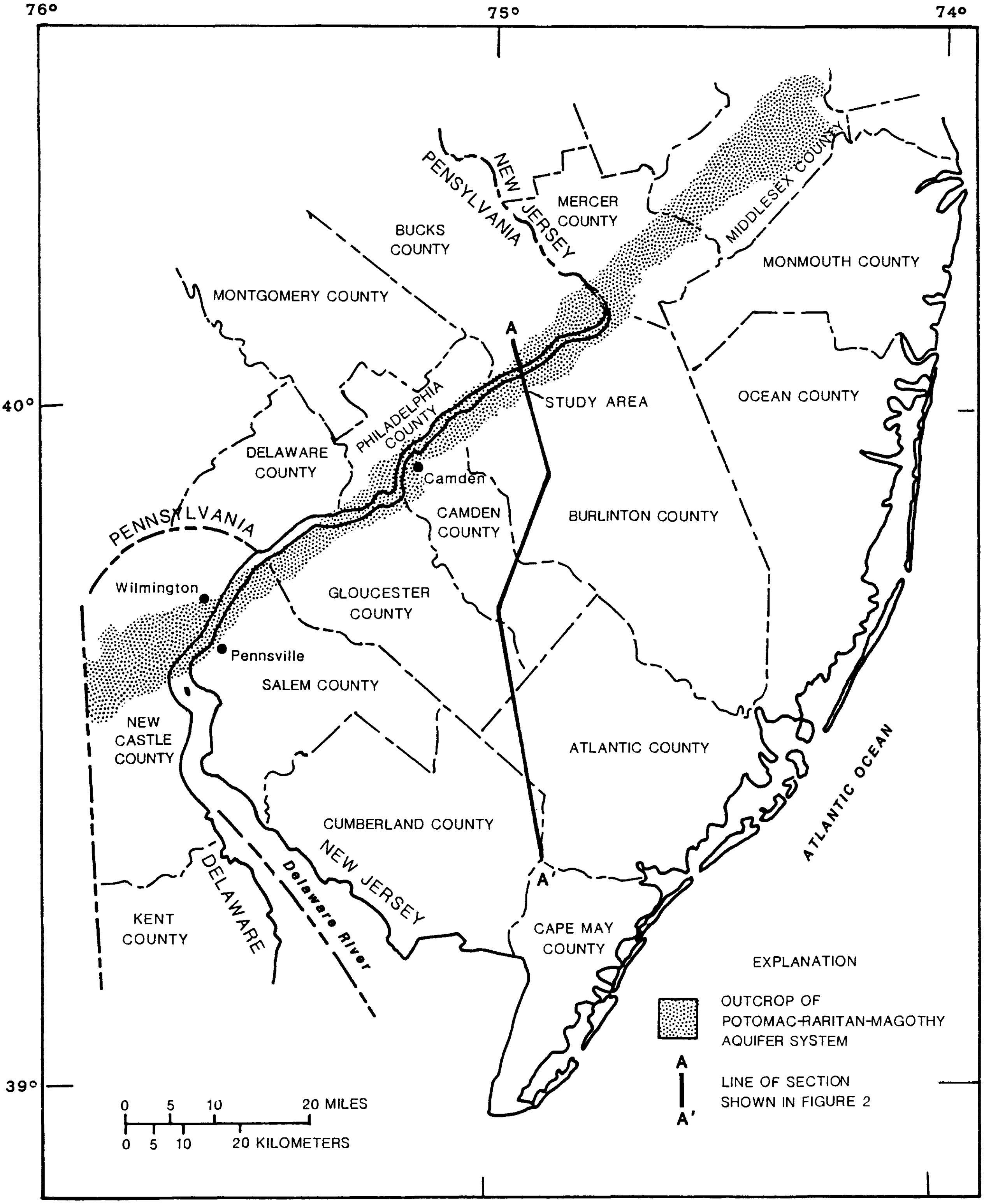


Figure 1.--Location of the study area.
(From Fusillo and Voronin, 1981, plate 2.)

the Philadelphia-Camden area induced the recharge of more mineralized river water that produced well-documented increases in the concentration of many common dissolved ions. More serious water-quality degradation was attributed to waste-disposal practices because river water quality was superior to that in the aquifer in many areas.

Graham and Kammerer (1952) evaluated the ground-water resources at the U.S. Naval Base in Philadelphia and concluded that water quality, especially high iron concentrations, limited further development of ground water at the base. Induced recharge from the river was found to be less mineralized than water from the Potomac-Raritan-Magothy aquifer system. Poor quality recharge from leaky sewers, land disposal of wastes or waste-water injection, and vertical leakage from the contaminated surficial aquifer were thought to be responsible for the observed chemical trends.

Extensive analytical data for common dissolved constituents in ground water were compiled by Greenman and others (1961) for the Pennsylvania Coastal Plain. Dramatic variability in water chemistry with respect to time, location, and type of constituent was documented. Multiple sources of recharge, mixed in differing proportions, was cited to explain the chemical variability.

More recently, research concentrated on explaining the aqueous geochemistry of the Potomac-Raritan-Magothy aquifer system. Back (1966) studied the hydrologic and lithologic controls on the chemistry of ground water in the northern part of the Atlantic Coastal Plain. Back and Barnes (1965) and Langmuir (1969) interpreted the behavior of iron in Coastal Plain ground waters. Much of the recent water-quality data collected in the Philadelphia-Camden area has included analyses for volatile organic compounds, trace metals, and nutrients (Fusillo and Voronin, 1981; Paulachok and others, 1984). Fusillo and others (1985) compared the distribution of volatile organic compounds to land use in the New Jersey Coastal Plain.

HYDROGEOLOGIC SETTING

The hydrogeologic character of an area greatly affects the types and quantities of chemical constituents that occur naturally or are introduced into ground water. The mineralogy, structure, and hydraulic properties of the subsurface must be well understood before the influence of man's activities on water quality can be evaluated. A summary of the regional hydrogeology is presented below.

Cretaceous and Younger Deposits

Relatively flat-lying unconsolidated deposits of sand, gravel, and clay unconformably overlie a basement complex. These sediments were deposited as a wedge-shaped mass over the inclined bedrock surface and thicken southeastward from the Fall Line in the direction of their dip as shown on the generalized geologic section in figure 2. Nearly all of these sediments lie within the Atlantic Coastal Plain physiographic province. The oldest of these deposits in the project area is the Potomac Group of Cretaceous age, which is present only locally and only in New Jersey. It is overlain by the Raritan Formation of Late Cretaceous age, which was deposited principally by fluvial action in

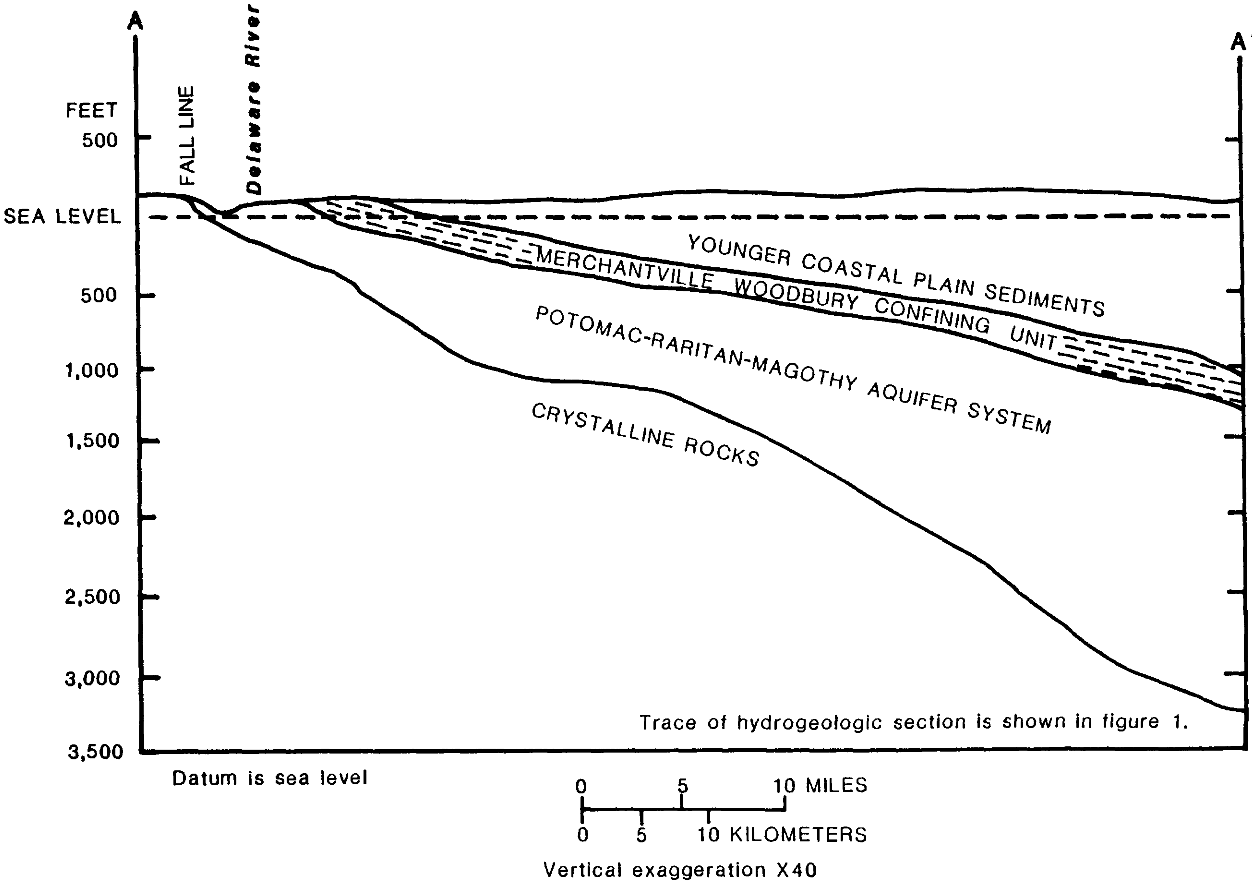


Figure 2.--Generalized hydrogeologic section showing the Potomac-Raritan-Magothy aquifer system extending from the vicinity of Philadelphia, Pennsylvania, southeastward into New Jersey. (Modified from Luzier, 1980, figure 4.)

channels cut into the crystalline basement. A transition to deltaic/marginal marine-type sedimentation in the downdip direction is indicated by the presence of marine fossils. The Raritan Formation crops out in a band about 5 miles wide. The Delaware River (fig. 1) flows roughly through the middle of this band. The base of the formation dips an average of 60 feet per mile, and the top of the formation dips about 40 feet per mile. The Magothy Formation of Late Cretaceous age overlies the Raritan Formation and shares a similar origin and lithology. The Potomac Group and Raritan and Magothy Formations are considered a single hydrologic unit (Potomac-Raritan-Magothy aquifer system) from a regional perspective.

In New Jersey, three depositional cycles were identified in the Potomac Group and Raritan and Magothy Formations and are characterized by "fining upwards" alluvial sequences. Each cycle is divided into a predominantly coarse unit and an upper pelitic unit. The earliest of these cycles is referred to as the lower sand unit and lower clay unit, the following cycle as the middle sand unit and middle clay unit, and the last cycle as the upper sand unit and upper clay unit. In Pennsylvania, some of the sand and clay units may be missing (fig. 3). The deposits are unconformable between cycles; therefore, their occurrence and superposition depend on the extent of erosion

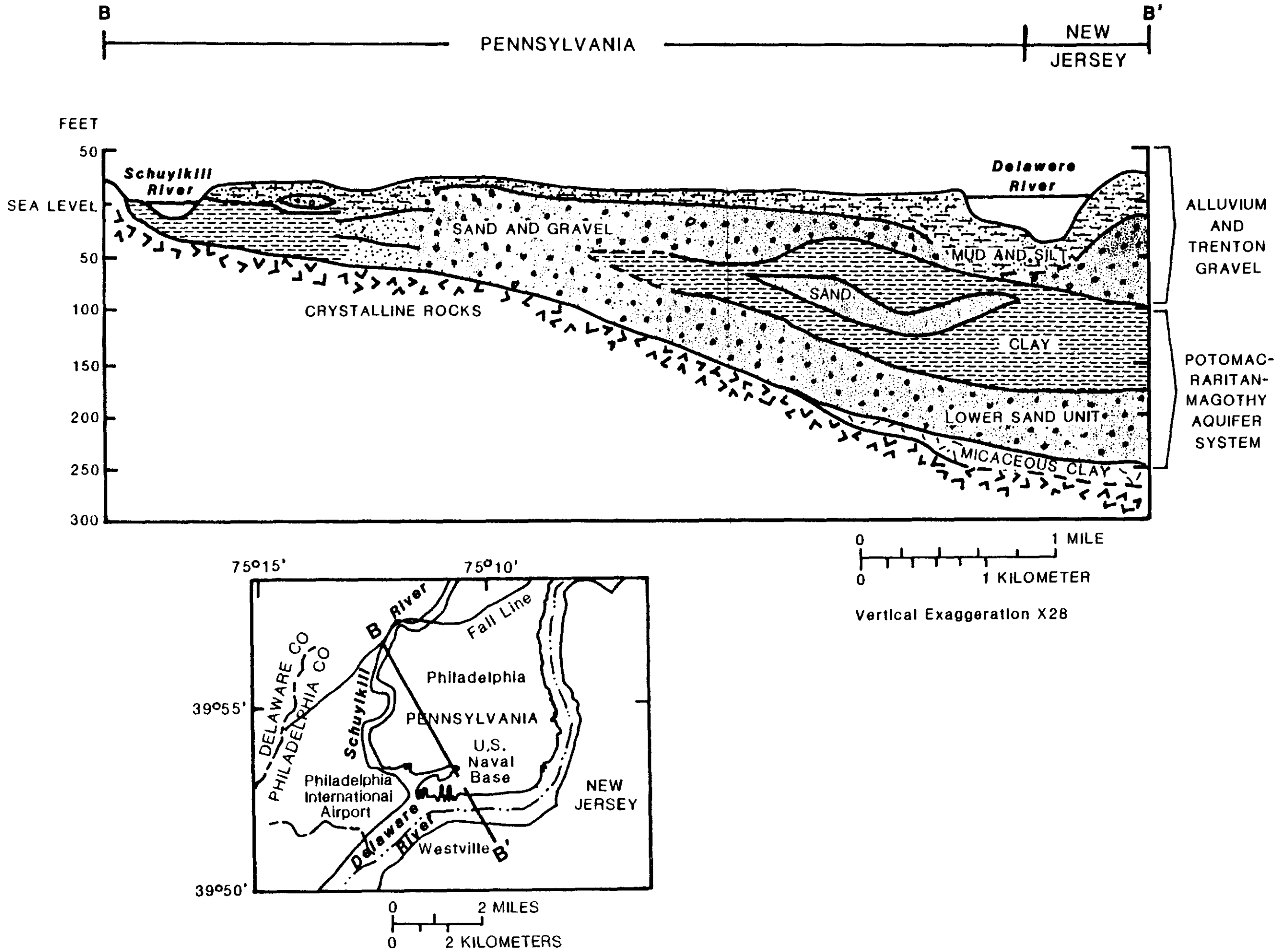


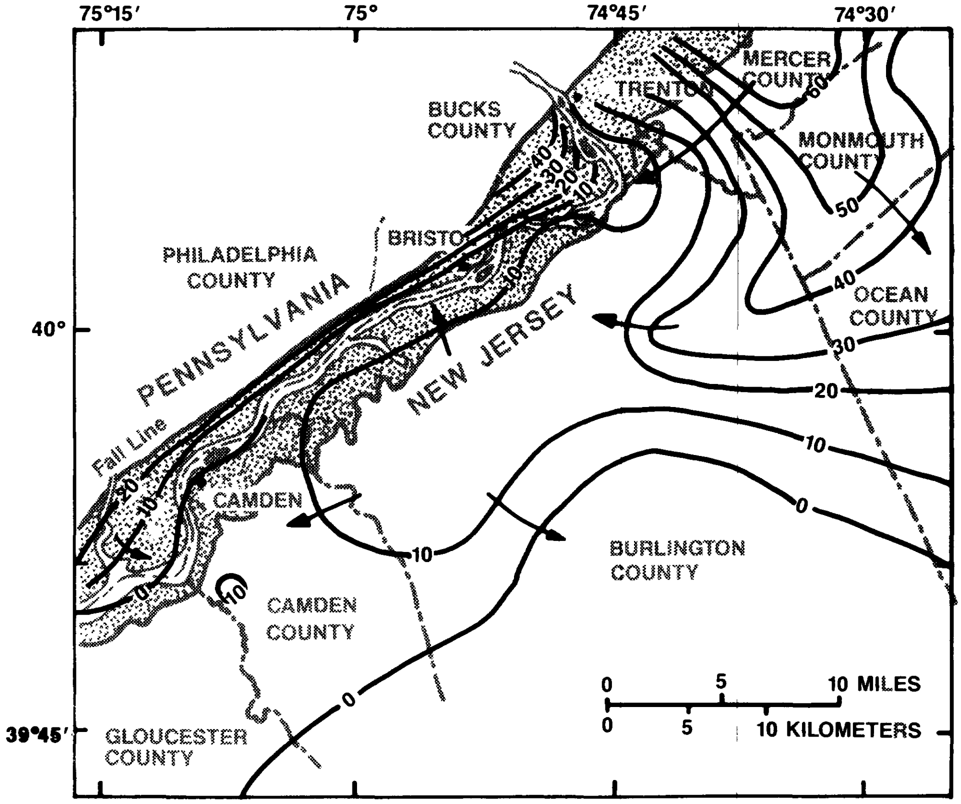
Figure 3.—Generalized geologic section, Philadelphia, Pennsylvania, to Westville, New Jersey. (Section from Graham and Kammerer, 1952, figure 8.)

and the channel morphologies that developed between depositional cycles. Although three sand and three clay units are also recognized in Pennsylvania, they are not equivalent to those recognized in New Jersey. The lower sand of Pennsylvania is equivalent to at least part of the lower sand of New Jersey. The middle sand of Pennsylvania is equivalent to either the upper part of the lower sand of New Jersey or part of the middle sand of New Jersey. Greenman and others (1961) present maps showing the extent, surface contours, and thicknesses of the units in Pennsylvania. Similar information is reported for New Jersey by Hardt and Hilton (1969), Rush (1968), and Farlekas and others (1976). The lateral and vertical extent of the Magothy Formation is limited in Philadelphia, where it may not exist at all. Thus, the upper sand of New Jersey probably is absent in Pennsylvania.

Similarities in the depositional environment between the Potomac Group and Raritan and Magothy Formations have produced similar hydraulic properties. Furthermore, the discontinuous deposition of clay sequences in the alluvial environment produced interconnections between the water-bearing units in each formation. Less permeable confining units are found above and below the Raritan and Magothy Formations in the Merchantville Formation-Woodbury Clay sequence and the crystalline basement, respectively.

From a local perspective, the Potomac-Raritan-Magothy aquifer system is more complex as its updip termination is approached. In the outcrop area in Pennsylvania, two distinct aquifers are recognized: a confined aquifer and a water-table aquifer. The confined aquifer comprises the lower and middle sand units of the Raritan Formation. Hydraulic heads measured in the sand units are similar indicating that substantial interconnection exists between them. Water-table conditions generally are found in the upper sand unit of the Raritan Formation and in the overlying surficial deposits. The surficial deposits include scattered sand and gravel deposits of the Miocene Bridgeton Formation, the Trenton gravel (informal usage)--a sand and gravel outwash of Pleistocene age, and alluvium of Holocene age.

Significant modification to the flow regime of the Potomac-Raritan-Magothy aquifer system was documented during periods of rapid urban growth. Extensive ground-water development adjacent to the Delaware River in Philadelphia and Camden caused significant changes in the direction of ground-water flow and sources of recharge to the Potomac-Raritan-Magothy aquifer system. A comparison of the predevelopment potentiometic surface (fig. 4) postulated by Langmuir (1969b) to a recent potentiometric surface map (fig. 5) that combines efforts by Walker (1983) and Paulachok (U.S. Geological Survey, written comm., 1985) illustrates the reversals in hydraulic gradient over most of the area. Under the predevelopment flow pattern, the Delaware River was the ultimate discharge zone for the confined aquifer. Recharge originated to the northeast in the topographically high outcrop area near Trenton, New Jersey and to some extent from leakage from overlying strata. However, present flow conditions in the area are such that confined ground water is recharged from the Delaware and Schuylkill Rivers and moves toward pumping centers in New Jersey southeast of the confluence of the rivers. Increased head differentials between the confined and unconfined aquifers has increased the downward flow component in the water-table aquifer. Therefore, leakage from the unconfined aquifer now contributes a larger proportion of recharge to the confined aquifer than occurred previously.



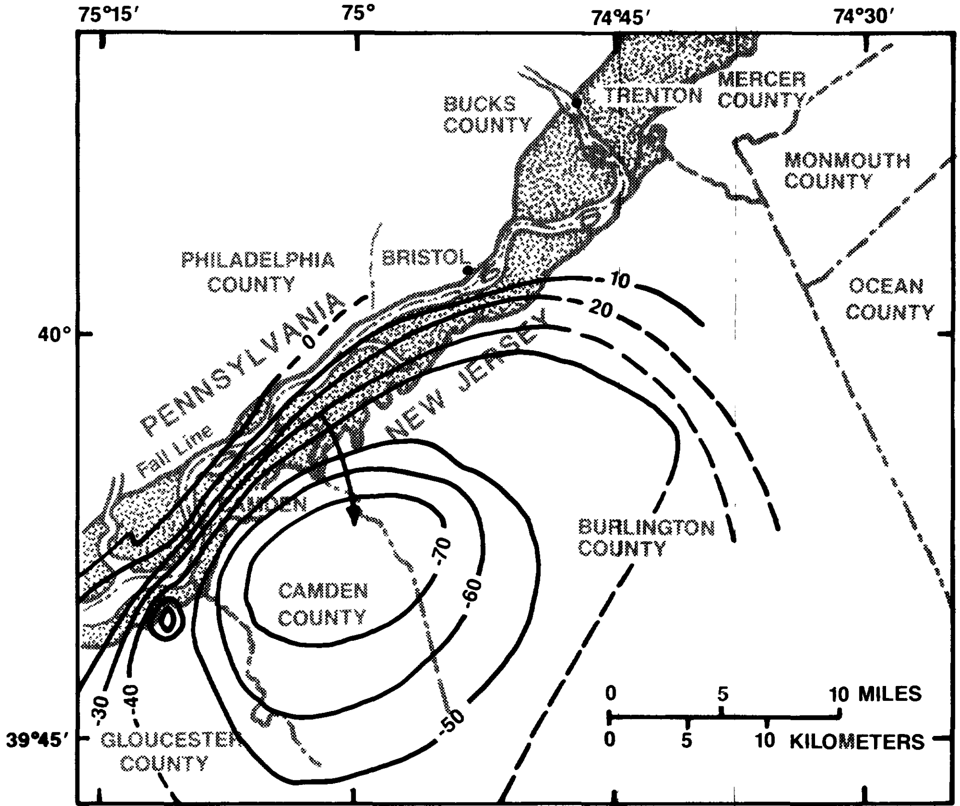
EXPLANATION

OUTCROP OF THE POTOMAC-RARITAN-MAGOTHY AQUIFER SYSTEM.

40 POTENTIOMETRIC CONTOUR--Shows altitude at which water level would have stood in tightly cased wells. Contour interval 10 feet. Datum is sea level

ARROW--Shows direction of ground-water movement

Figure 4.--The theoretical flow pattern in the Potomac-Raritan-Magothy aquifer system before pumping began. (After Langmuir, 1969b, figure 3.)



EXPLANATION

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ARROW--Shows direction of ground-water movement

Figure 5.--Potentiometic-surface map of the lower sand unit of the Potomac-Raritan-Magothy acuifer system, 1978. (After Walker, 1983, plate 1 and Paulachok, U.S. Geological Survey, written comm., 1985.

Crystalline Rocks

The oldest rock units are gneisses and schist of early Paleozoic age. These rocks compose the crystalline basement on which younger sedimentary sequences of the Coastal Plain were deposited. Crystalline rock outcrops northwest of the Fall Line in the Piedmont physiographic province and dips to the southeast as shown on the generalized geologic section in figure 2.

Ground water in the crystalline basement rocks beneath the Coastal Plain in Pennsylvania was never extensively developed because larger and more readily available supplies can be obtained from the unconsolidated sediments. Where the crystalline rock crops out, ground water is under water-table conditions; however, down dip from the Fall Line, the crystalline rock commonly is overlain by a residual clay layer that confines it from the overlying sediments. Where the residual clay layer is absent, the hydraulic head in the crystalline rock is the same as that for the unconsolidated material (sand and gravel) above it. Therefore, the units are locally interconnected, but the crystalline rock serves mainly to limit the downward movement of water from the more transmissive Coastal Plain sediments. Based on data from 118 wells in southeastern Pennsylvania, the specific capacity of wells that tap crystalline rock range from 0.01 to 75 (gal/min)/ft (gallon per minute per foot) of drawdown [median, 0.6 (gal/min)/ft; average, 2.4 (gal/min)/ft]. The specific capacity for 24 wells tapping the Potomac-Raritan-Magothy aquifer system range from 2 to 37 (gal/min)/ft and average 18 (gal/min)/ft (Greenman and others, 1961).

LAND USE

The cultural character of the area is representative of that found in the Washington, D.C. - New York City corridor. Large, long-established urban centers are typical of the region. Suburban and high-technology industry is rapidly spreading outward from the metropolitan areas. The area surrounding Philadelphia is representative of this growth pattern; it is a region where the effects of land use on the extensively used Coastal Plain aquifers can be evaluated. The land is used for a variety of purposes, and land uses include undisturbed woodland, agricultural, urban, suburban residential, and heavy industrial with a large petrochemical sector.

Land-use information for this report was obtained from the Delaware Valley Regional Planning Commission's (DVRPC) 1970 land-use map series. The land-use classification system is based on aerial photographic interpretation of 88 land-use categories that were combined to form 13 categories for mapping (table 1). The 13 DVRPC land-use categories were further grouped into four major land-use types for this study because some land uses are consistently closely associated, and insufficient water-quality data are available in many of the other land-use categories to consider them independently. The four categories are industrial, suburban, urban, and undeveloped and agricultural. These categories are related to the 13 DVRPC categories in table 1.

Land uses have developed in response to the geography, geology, and cultural development of the region. In general, industrial and urban land use is concentrated adjacent to the Delaware and Schuylkill Rivers in the outcrop band of the Potomac-Raritan-Magothy aquifer system. Suburban residential land

Table 1.--Land-use-mapping categories

Category used in this report	Category and definition used by the Delaware Valley Regional Planning Commission	
1. Undeveloped and agricultural	Agricultural:	Acreage devoted to crops, pastures, orchards and tree farms.
	Forests and undeveloped land:	Acreage in woodlands, natural lands, vacant and abandoned lands, marshes, and swamps
	Water areas:	Acreage in rivers, streams, lakes, and ponds.
2. Suburban	Residential:	Single family detached--acreage devoted to single family detached houses.
	Recreational and cultural:	Acreage devoted to parks, playgrounds, theaters, stadiums, museums, golf courses, and related facilities.
3. Urban	Communitv services:	Acreage devoted to health, educational, government, and religious facilities (including cemeteries).
	Residential:	Multiple units--acreage devoted to two family and row houses, apartments, group-quarters, and mobile homes.
4. Industrial	Manufacturing:	Acreage devoted to fabrication or assembly of raw materials or component parts into products for use by other manufactures or by consumers.
	Transportation:	Acreage devoted to rail, air, marine, and highway transportation, including automobile parking.
	Communications and utilities:	Acreage devoted to communications and utilities facilities, including sewage and waste disposal.
	Commercial:	Acreage devoted to retail and wholesale trade; personal, business, and professional services; contract construction; and hotels and motels. Includes storage facilities and tank farms.
	Mining:	Acreage devoted to mining and other extractive industries.
	Military:	Acreage devoted to military bases and facilities.

use is common in the areas surrounding the cities of Philadelphia and Camden, and is the most rapidly growing land use. Undeveloped and agricultural land is most abundant downdip from the Potomac-Raritan-Magothy outcrop area. Differences in land use commonly are paralleled by differences in the hydrogeologic regimen in this region.

Each well used in this study was assigned to one of the four land-use categories described above. The location of each well was plotted on the DVRPC land-use map, and the dominant land use (more than 50 percent of the area) within a radius of 1,000 ft (feet) of the well was assigned. Data from wells in areas of mixed land use where no use was dominant were not used.

GROUND-WATER QUALITY

Description of Data

The ground-water chemistry data used in this study were presented in earlier reports. Greenman and others (1961) contains an extensive listing of common dissolved constituents in the Coastal Plain in Pennsylvania. Trace metal and volatile organic compound analyses, in addition to common constituents, were presented by Paulachok and others (1984) for Philadelphia and by Fusillo and Voronin (1981) and Fusillo and others (1984) for the Potomac-Raritan-Magothy aquifer system in the vicinity of Camden, New Jersey.

Analyses of common constituents in water from the Coastal Plain aquifers are available for samples collected from the early 1940's to the present, but the record is discontinuous. In Pennsylvania, analyses are abundant for samples collected from 1943-57 and after 1979. In New Jersey, analyses are abundant for samples collected from 1953-56 and after 1980. Data on trace metals and volatile organic compounds in amounts adequate for evaluation are available only for the period following 1979. Detection limits for the trace constituents are variable, and a large proportion of analyses indicate that the concentrations of these constituents were below detection limits. Well-construction and hydraulic data and common-dissolved-constituent data for sampled wells are given in the reports cited above and by Blickwedel and Linn (1987) and Balmer and Davis (in press).

Variation

Temporal

Ground water in the Coastal Plain near Philadelphia is most commonly classified as a calcium bicarbonate type. Sulfate and chloride are important secondary anions, and locally are the principal anions (Greenman and others, 1961). Figures 6-14 depict the frequency of occurrence of pH and specific conductance values and concentrations of bicarbonate, calcium, magnesium, chloride, sulfate, iron, and manganese in ground water from the Coastal Plain aquifers. Based primarily on the availability of data, the data are plotted for 1943-78 and for 1979-84. Data for New Jersey and Pennsylvania have been plotted separately so that temporal and areal differences can be detected. Nearly all of the New Jersey data used in figures 6-14 are from Fusillo and others (1984) and are for wells in Burlington, Camden, and Gloucester Counties. All wells are either in the outcrop area of the Potomac-Raritan-Magothy aquifer system or in the Potomac-Raritan-Magothy no more than 15 miles downdip from the outcrop. The data for Pennsylvania are from Balmer and Davis (in press), Blickwedel and Linn (1987), Koester and Miller (1982) and Paulachok and others (1984). Only data for wells and three sumps that drain ground water from subway tunnels and the playing field at Veterans Stadium in the Potomac-Raritan-Magothy aquifer system and the overlying Trenton gravel were used. For 1943-78, the earliest available analysis for each constituent was used; for 1979-84 the most recent available analysis for each constituent was used. Sulfate and pH changed very little from the earlier to the later period. Chloride and magnesium concentrations and specific conductance of water underwent small increases in Pennsylvania and New Jersey. Concentrations of calcium, iron, manganese, and bicarbonate in ground water increased, slightly if at all, in New Jersey, but large increases occurred in Pennsylvania. Manganese concentrations in ground water in Pennsylvania increased by more than an order of magnitude. The 1943-78 data do not necessarily reflect predevelopment water quality, because much of the dramatic change in ground-water chemistry that occurred subsequent to the development of the ground-water resource may have occurred before the earliest analysis (Barksdale and others, 1958; Greenman and others, 1961).

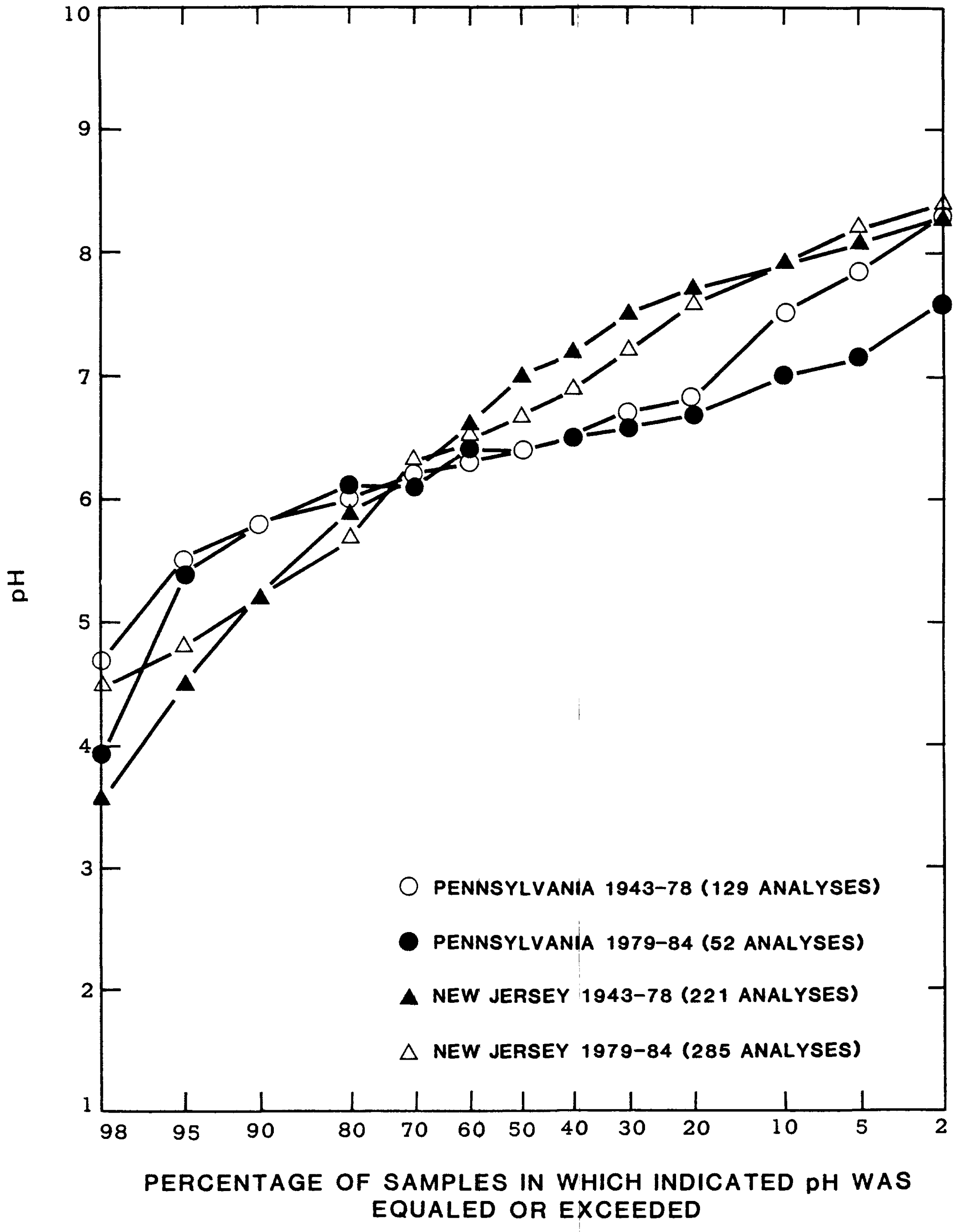

Figure 6.--Frequency distribution for pH in the Coastal Plain aquifers.

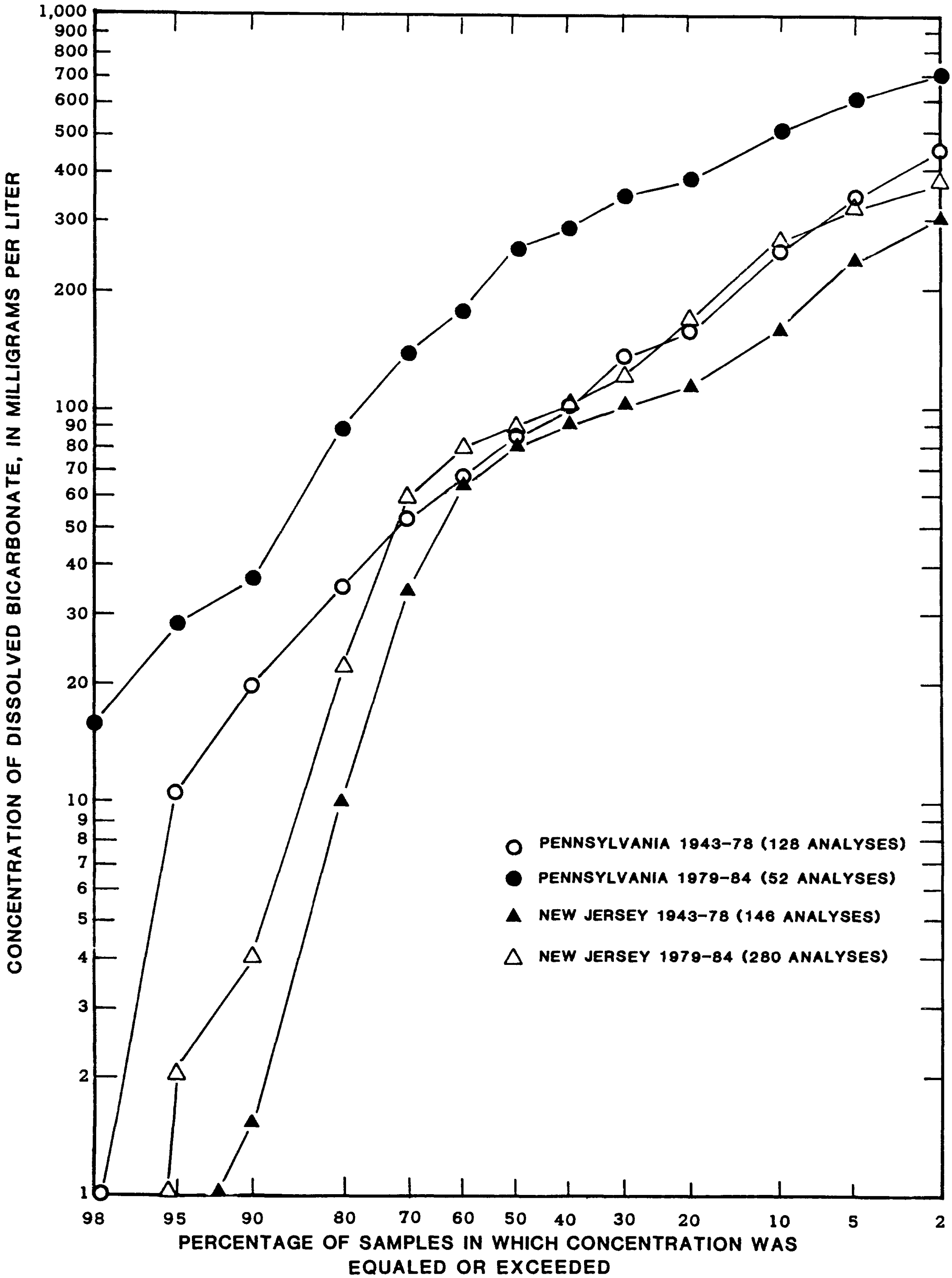

Figure 7.--Frequency distribution for bicarbonate in Coastal Plain aquifers.

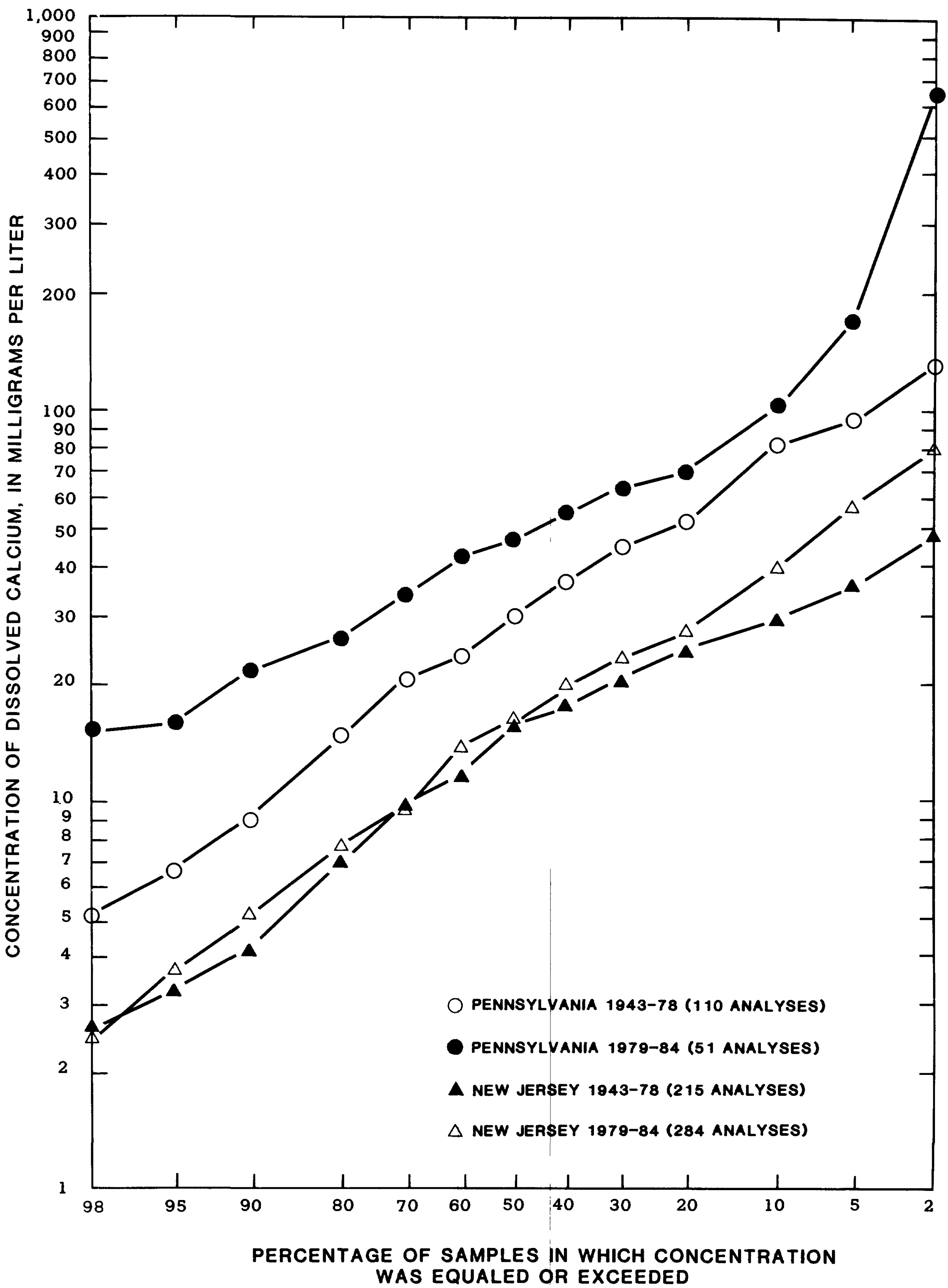

Figure 8.--Frequency distribution for calcium in the Coastal Plain aquifers.

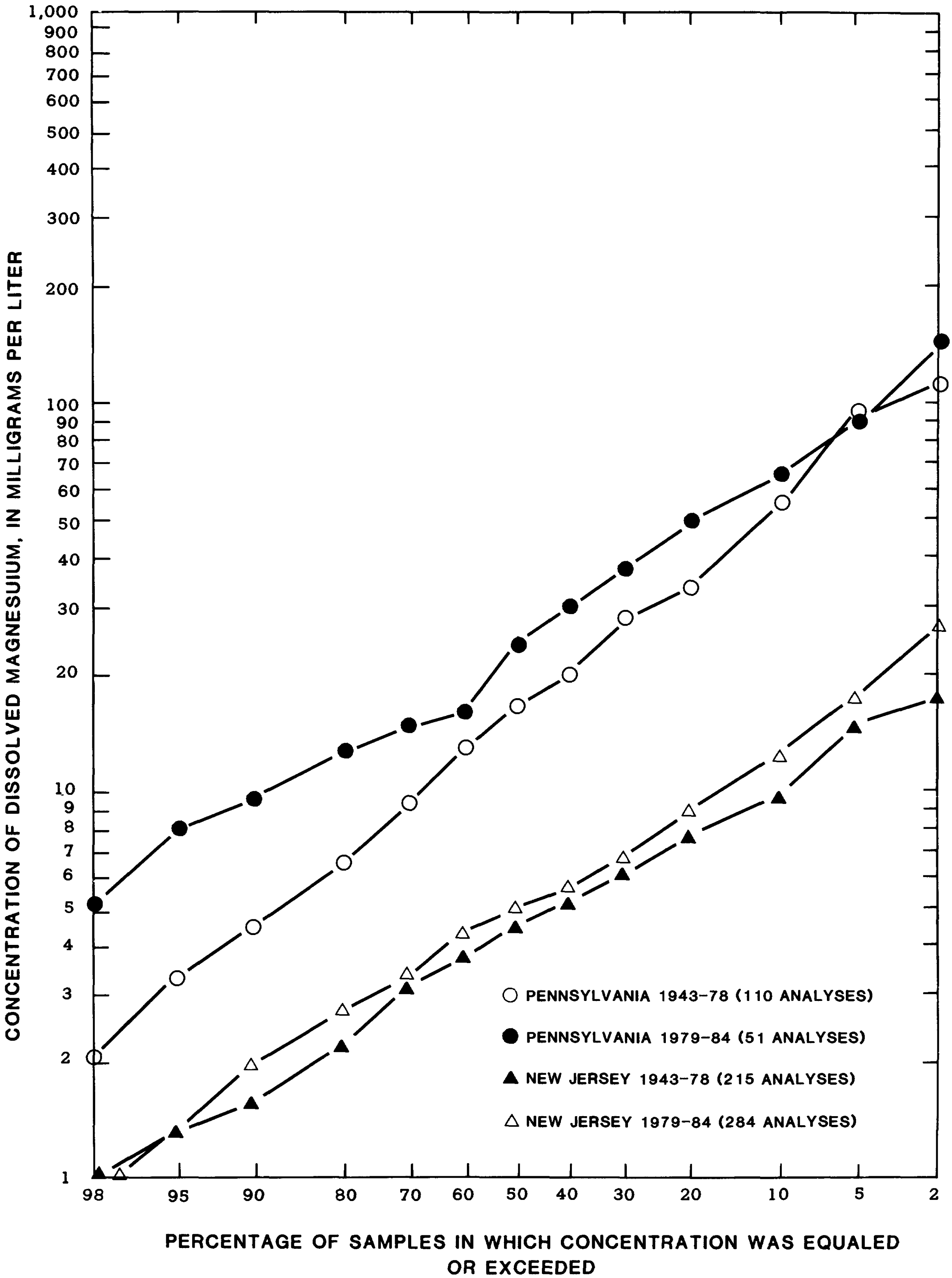

Figure 9.--Frequency distribution for magnesium in the Coastal Plain aquifers.

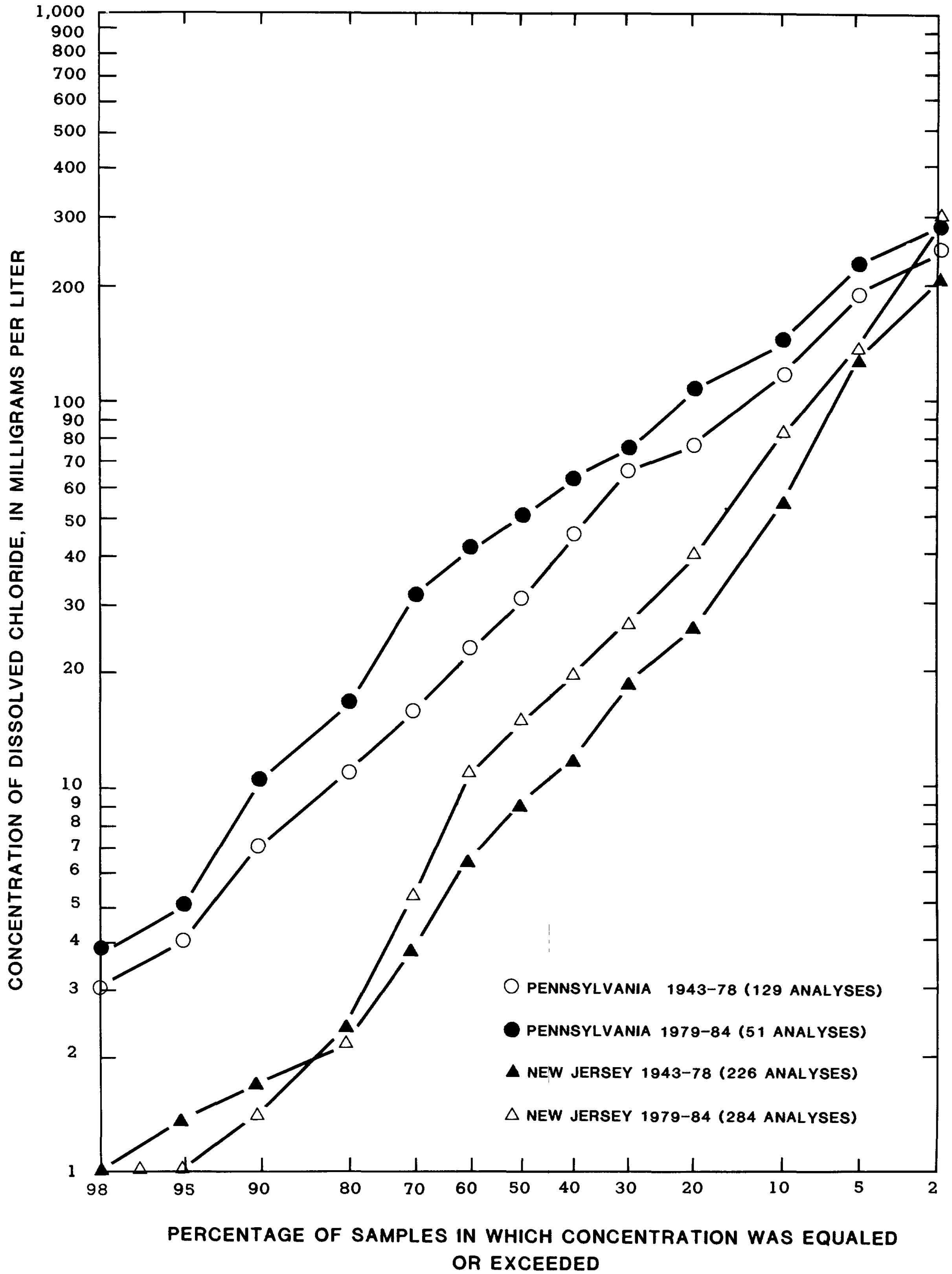

Figure 10.--Frequency distribution for chloride in the Coastal Plain aquifers.

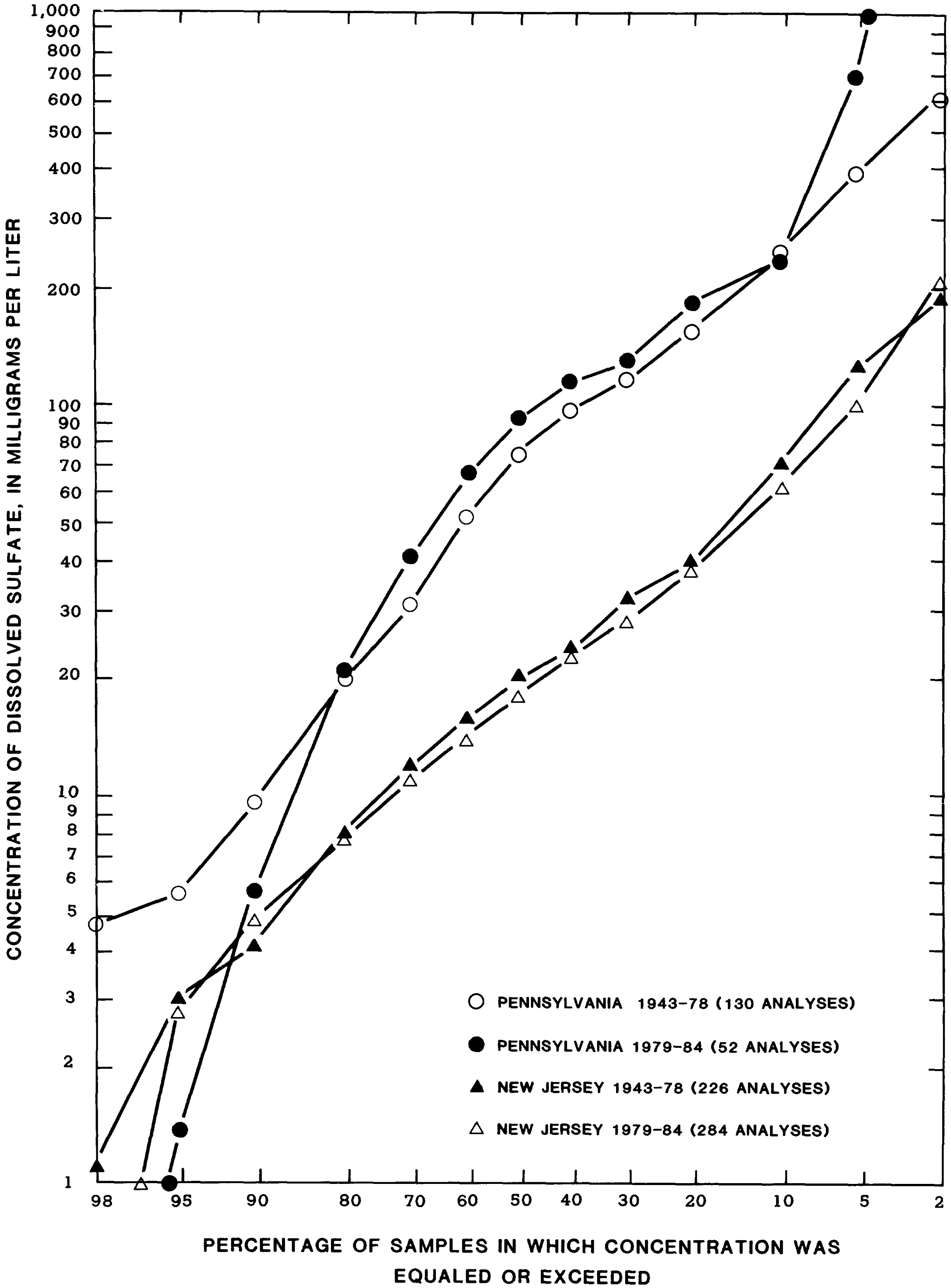

Figure 11.--Frequency distribution for sulfate in the Coastal Plain aquifers.

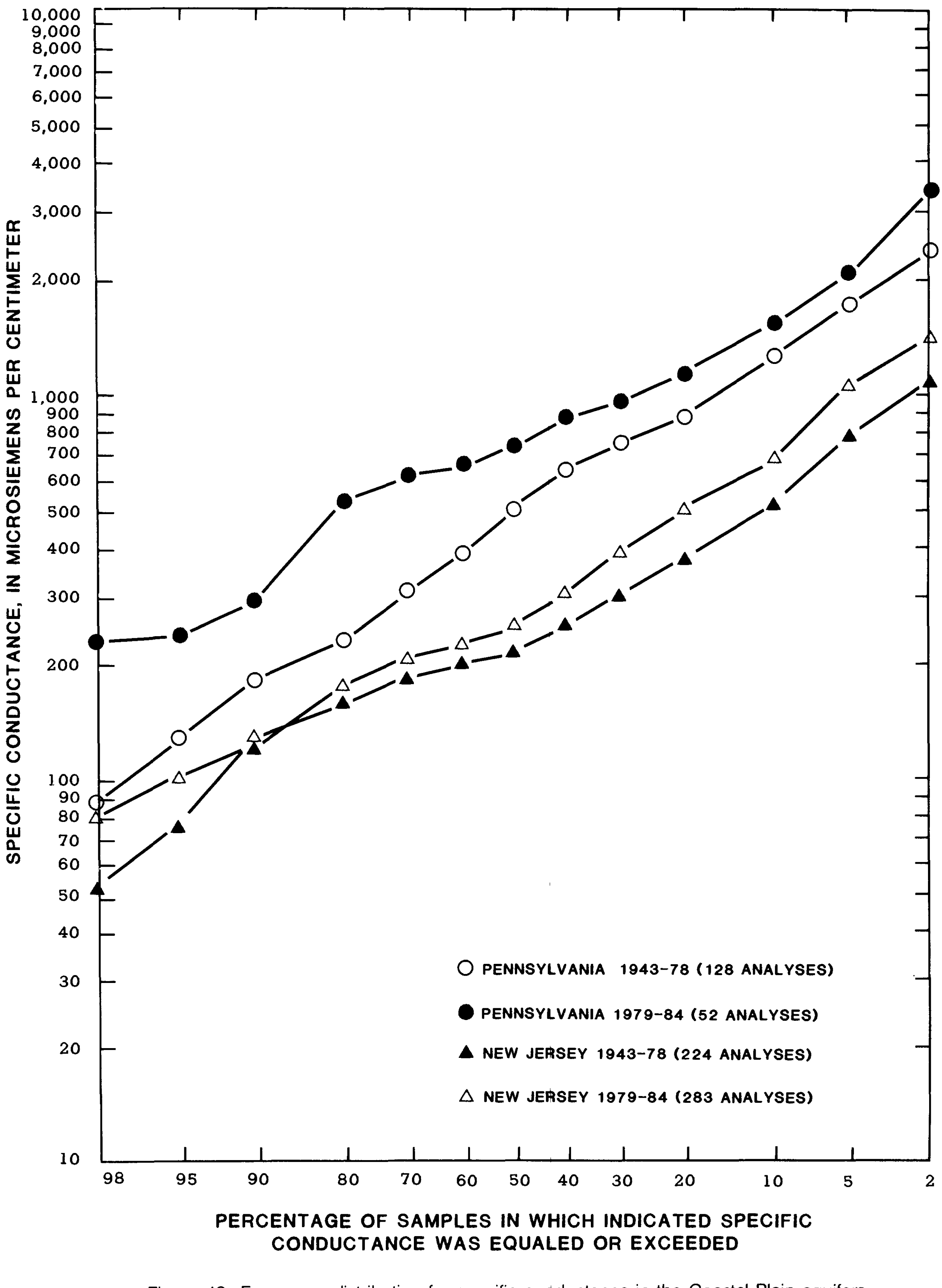

Figure 12.--Frequency distribution for specific conductance in the Coastal Plain aquifers.

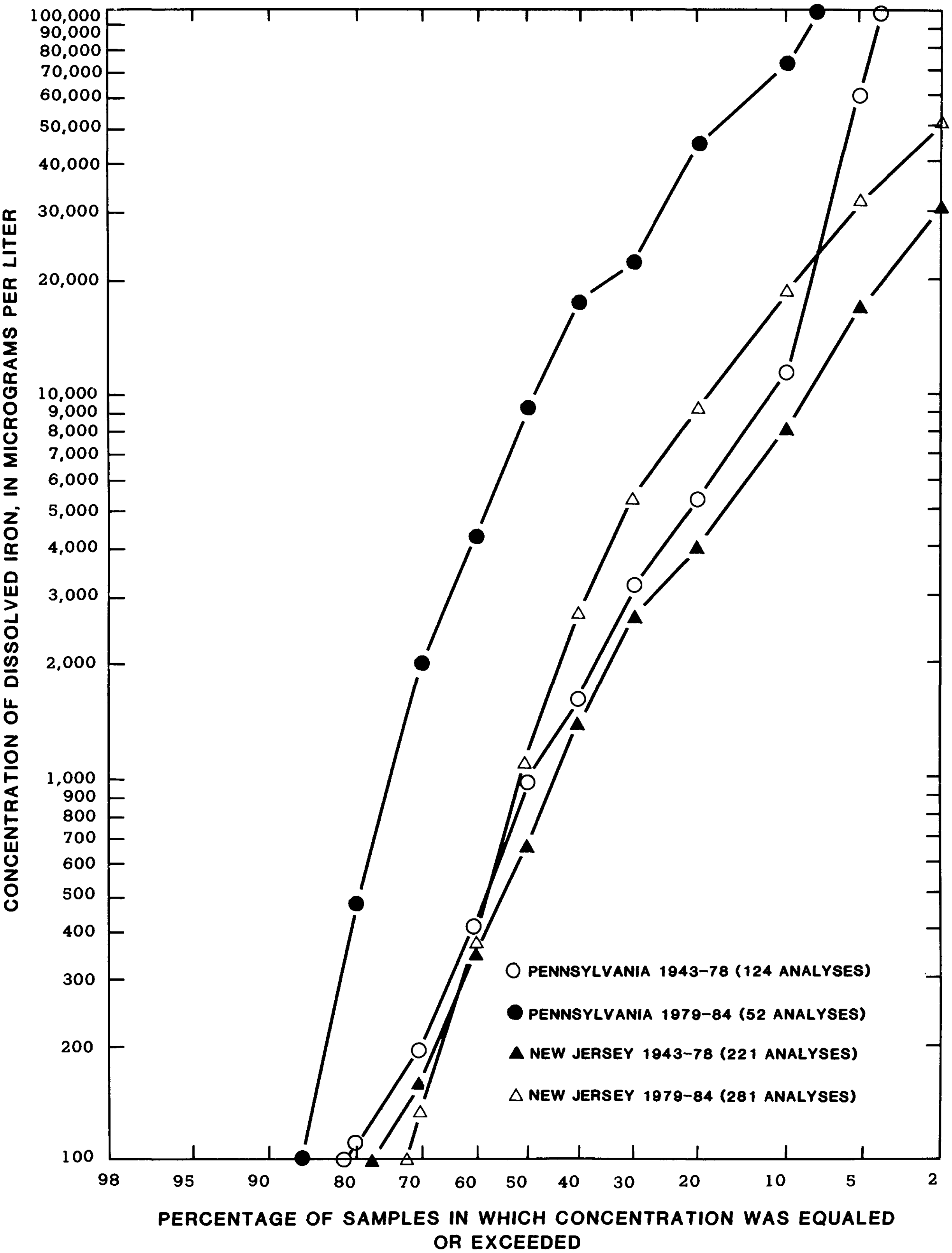

Figure 13.--Frequency distribution for iron in the Coastal Plain aquifers.

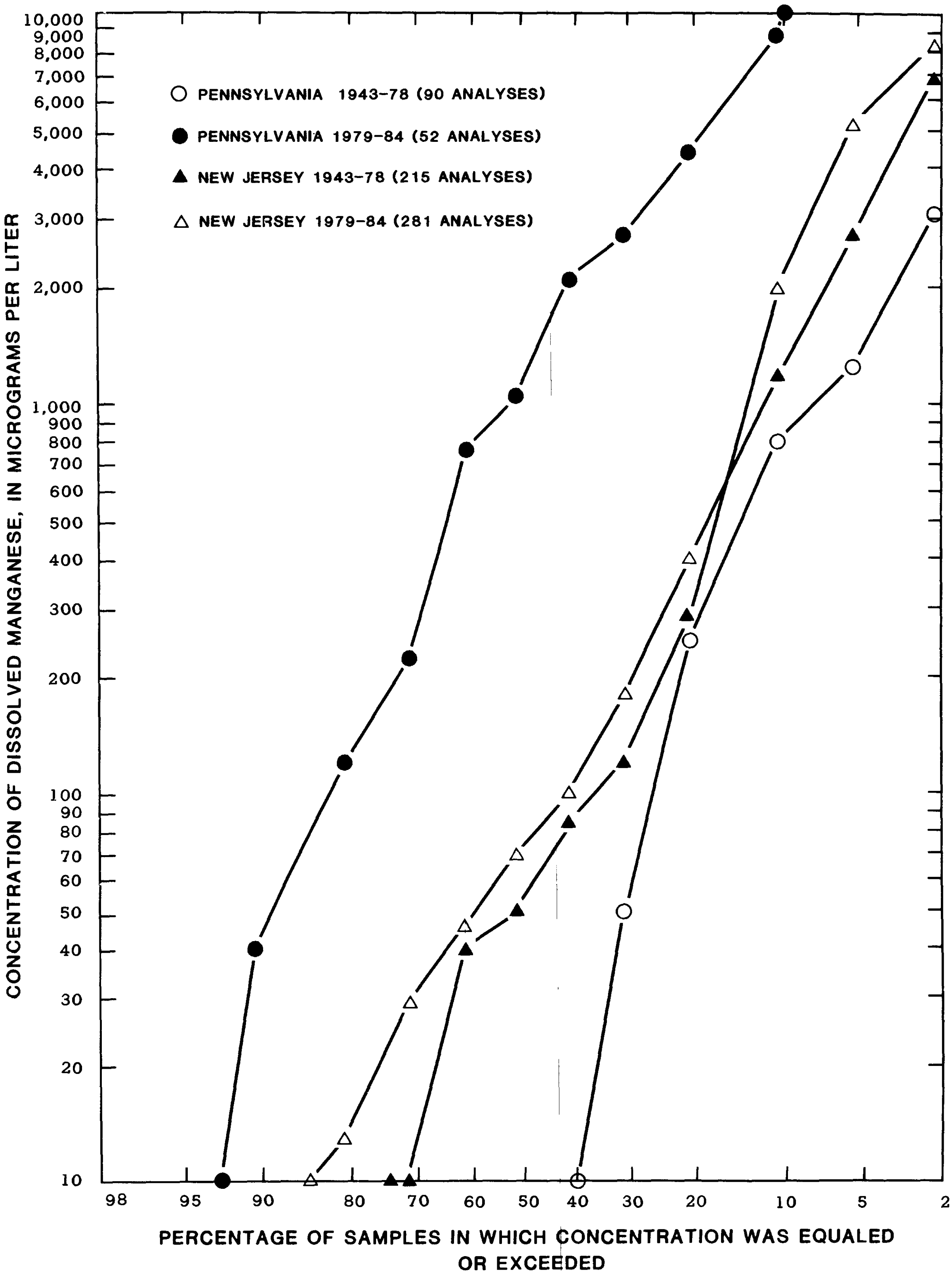

Figure 14.--Frequency distribution for manganese in the Coastal Plain aquifers.

Areal

Mean and median concentrations of common dissolved ions are shown in table 2. Only the most recent analysis was used for each constituent. All centrations are much higher in the Pennsylvania Coastal Plain aquifers than further downdip in the New Jersey Coastal Plain aquifers. This is a general indication that more highly mineralized water is found in the more industrialized outcrop areas of the aquifer (Greenman and others, 1961; Langmuir, 1969). The aquifer is most vulnerable to contamination in the outcrop area because it is unprotected by overlying confining units and is more highly developed both in terms of industry and ground-water use. Thus, more industrial waste is present and downward migration of waste occurs readily.

Table 2.--Means and medians for selected dissolved constituents in Coastal Plain aquifers compared between Pennsylvania and New Jersey

[Concentrations in milligrams per liter]

	Mean		Median	
Constituent	PA	NJ	PA	NJ
Calcium	52	18	44	16
Magnesium	27	6.0	21	4.0
Bicarbonate	179	81	140	72
Sulfate	138	36	86	15
Chloride	70	27	44	7.8
Ammonium and Organic Nitrogen (as N)	7.1	2.0	3.4	0.5
Organic Carbon	9.4	2.6	4.0	1.3

Statistics summarizing the presence of trace metals in Coastal Plain aquifers are presented in tables 3 and 4. Only analyses from 1979-84 were used. Where more than one analysis was available for a site, the median value for each constituent was used in the data analysis. In general, differences in metal concentrations between Pennsylvania and New Jersey were more difficult to discern than were differences in common ions. Concentrations of more than 70 percent of all trace metal analyses are below detection limits, except those for iron, manganese, and zinc, which have significantly higher median concentrations in the Coastal Plain in Pennsylvania; a higher percentage of samples in this area contain concentrations of barium, iron, lead, and manganese that exceed maximum contaminant levels set by the U.S. Environmental Protection Agency (Federal Register, 1980) as compared to samples from the Coastal Plain in New Jersey.

Table 3.--Selected statistics for trace metals in Coastal Plain ground water in Pennsylvania

[All concentrations are given in micrograms per liter; a dash indicates no data; <, less than; ND, not determined]

Constituent	Number of analyses	Detection limit[1]	Percent analyses below highest detection limit	Median concentration	Minimum concentration	Maximum concentration	Drinking-water regulation or recommended limit[2]	Percentage of analyses having constituent concentrations above drinking-water regulation or recommended limit
Arsenic	35	1-50	100	< 4	<1.0	<50	50	0
Barium	42	10-200	71	<180	30	2,100	1,000	5
Beryllium	17	1-2	88	<1.0	<1.0	3	-	-
Cadmium	48	.1-20	100	<10	<.1	<20	10	ND
Chromium	41	10-20	93	<20	<10	40	50	0
Hexavalent Chromium	6	1	83	<1.0	<1.0	2	50	0
Copper	48	1-20	81	<12	<1.0	480	1,000	0
Iron	48	10	0	12,000	20	220,000	300	85
Lead	38	1-10	76	<10	<1	81	50	5
Manganese	48	1	0	1,250	3	31,000	50	88
Mercury	39	.1-2	85	<.1	<.1	55	2.0	15
Nickel	40	1-50	98	<20	<1.0	60	13.4	ND
Selenium	22	1	95	<1	<1.0	24	10	5
Zinc	48	4	21	32	<4	4,600	5,000	0

[1] The minimum and maximum values are given where more than one detection limit was used.
[2] Federal Register, Nov. 28, 1980.

Table 4.--Selected statistics for trace metals in Coastal Plain ground water in New Jersey

[All are given in micrograms per liter; a dash indicates no data; ND, not determined; <, less than]

Constituent	Number of analyses	Detection limit[1]	Percent analyses below highest detection limit	Median concentration	Minimum concentration	Maximum concentration	Drinking-water regulation or recommended limit[2]	Percentage of analyses having constituent concentrations above drinking-water regulation or recommended limit
Arsenic	125	1	88	<1	<1	11	50	0
Barium	207	1	100	80	2	410	1,000	0
Beryllium	207	1	82	<1.0	<1	5	-	-
Cadmium	208	1-2	61	<2	<1	22	10	1
Chromium	126	1-10	90	<10	<1	50	50	0
Hexavalent Chromium	124	1	99	<1	<1	3.0	50	0
Copper	208	1-10	83	<10.0	<1	<10.0	1,000	0
Iron	278	3	3	960	<3	460,000	300	63
Lead	195	1-10	74	<10	7.0	100	50	1
Manganese	278	1	4	68	<1	15,000	50	56
Mercury	1	0.1	ND	ND	ND	ND	2.0	ND
Nickel	0	-	-	-	-	-	13.4	-
Selenium	0	-	-	-	-	-	10	-
Zinc	208	4	21	<10	3.0	1,000	5,000	0

[1] The minimum and maximum values are given where more than one detection limit was used.
[2] Federal Register, Nov. 28, 1980.

Statistical

Meaningful interpretations of metal concentrations in the Pennsylvania data are made difficult by variations in the detection limits and the large proportion of values below detection limits. Without more information about the distribution of concentrations below the detection limit, the most useful statistical tool becomes the categorization of analyses by detection limit.

The volatile organic compounds analyzed and those actually found in Coastal Plain aquifers are summarized in table 5. Summary statistics are presented in tables 6 and 7. Analyses of volatile organic compounds for Pennsylvania could not simply be categorized by detection limit, because the detection limits in some samples exceed reported concentrations in other samples. Direct comparison to the New Jersey data is possible by comparing the percentage of concentrations that exceeded 1.0 μg/L (microgram per liter).

Aquifer contamination by volatile organic compounds is substantially greater in Pennsylvania in terms of the percentage of analyses that exceed 1.0 μg/L and the number of compounds present. The concentrations of volatile organic compounds, like those for the common dissolved ions and trace metals, increase upgradient in the Potomac-Raritan-Magothy aquifer system. Similarly, Fusillo and others (1985) explained the differences in the distribution of volatile organic compounds in New Jersey by showing that concentrations were affected by proximity to urban development and the degree of confinement in the Potomac-Raritan-Magothy aquifer system.

Table 5.--Volatile organic compounds analyzed but not detected in Coastal Plain ground water

[Detection limit is generally 1.0 micrograms per liter
Number in parentheses represents number of analyses]

Pennsylvania	
Dichlorodifluoromethane (16)	1,1,2,2-Tetrachloroethane (16)
1,1-Dichloroethylene (26)	Toluene (26)
1,3-Dichloropropene (14)	1,1,2-Trichloroethane (26)
Ethylbenzene (16)	Trichlorofluoromethane (16)
Methylbromide (14)	Vinyl Chloride (14)
New Jersey	
Bromoform (114)	1,3-Dichloropropene (113)
Carbon tetrachloride (340)	Methylbromide (113)
Dichlorobromomethane (340)	1,1,2-Trichloroethane (113)
Dichlorodifluoromethane (113)	Trichlorofluoromethane (113)
1,2-Dichloropropane (113)	Vinyl Chloride (113)

Table 6.--Volatile organic compounds in Coastal Plain ground water in Pennsylvania

[µg/L, micrograms per liter]

Constituent	Number of analyses	Detection limits[1]	Percentage of analyses: Below detection limit of 0.1 µg/L	Below detection limit of 1.0 µg/L	Above detection limit of 0.1 µg/L and below 1.0 µg/L	Above 1.0 µg/L
Benzene	20	1.0	0	90	0	10
Bromoform	29	0.1,1.0	48	48	3	0
Carbon tetrachloride	35	0.1,1.0	43	54	0	3
Chlorobenzene	27	0.1,1.0	44	33	7	15
1,2-Transdichloroethylene	19	1.0	0	95	0	5
bis 2 Chloroethyl ether	13	0.1,1.0	92	0	0	8
Chloroform	35	0.1,1.0	0	83	0	17
Dichlorobromomethane	35	0.1,1.0	40	49	11	0
1,2-Dichloroethane	35	0.1,1.0	14	46	23	17
1,2-Dichloropropane	30	0.1,1.0	43	33	17	7
Methylene chloride	32	0.1,1.0	22	66	6	6
Tetrachloroethylene	35	0.1,1.0	20	43	9	29
1,1,1-Trichloroethane	20	0.1,1.0	9	63	9	19
Trichloroethylene	35	0.1,1.0	17	37	6	40

[1] Laboratories analyzing samples used two different detection limits.

Table 7.--Percentage of analyses where concentrations of volatile organic compounds exceed the detection limit in ground water in the Coastal Plain of New Jersey

[Detection limit is 1.0 micrograms per liter for all analyses]

Constituent	Number of analyses	Percentage of analyses above detection limit
Benzene	340	9
Chlorobenzene	113	4
1,2,-Transdichloroethylene	340	4
Chloroform	340	2
1,2-Dichloroethane	340	4
1,1-Dichloroethylene	113	1
Ethylbenzene	113	2
Methylene chloride	340	2
Tetrachloroethylene	340	7
Toluene	340	5
1,1,1-Trichloroethane	340	1
Trichloroethylene	340	13

RELATION OF GROUND-WATER QUALITY TO LAND USE

The combined influences of land use and hydrogeology on the distribution of organic compounds in ground water were summarized for the Philadelphia-Camden area by Fusillo and others, (1985). However, the extent to which metals, common constituents, and individual volatile organic compounds can be related to land use was not evaluated in that study. Ground-water analyses limited to the outcrop band of the Potomac-Raritan-Magothy aquifer system after 1978 were selected for comparison to land use to minimize the geologic and temporal influences on ground-water chemistry. Well locations are shown on plate 1, aquifer and county codes are given in table 10, and water-chemistry data are given in tables 11 and 12 (tables 10, 11, and 12 at back of report).

All wells completed in Coastal Plain sediments that could be assigned to a single land-use category were used in the data analysis. Although it would be better to analyze statistically for each individual aquifer, too few data exist to permit this approach, and data for both shallow and deep wells are grouped together. Because contamination appears to be pervasive and affect all units within the outcrop band of the Potomac-Raritan-Magothy aquifer system, grouping all units appears to be an acceptable approach.

For concentrations below the detection limit, the highest detection limit was used to compute the median and mean concentration. Therefore, if the concentration of any constituent in a data set was less than the detection limit, the mean calculated for the data set is too high and will be preceded by a "less than" (<) sign. Also, if one half of the concentrations were below the highest detection limit, the median concentration given in the data tables will be preceded by a < sign.

Where more than one chemical analysis was available for the same well, the most complete one was used in the land-use data analysis. If two or more equally complete analyses were available, the earliest was used.

Although the concentrations of common constitutents in ground water are primarily related to aquifer lithology, they also appear to be distributed on the basis of land use (figs. 15-20). Cumulative frequency distributions for concentrations of dissolved sodium, calcium, magnesium, sulfate, bicarbonate, and chloride are similar among urban and industrial settings and among suburban and undeveloped and agricultural settings. In general, concentrations are higher in ground water beneath industrial and urban land uses compared to undeveloped areas and agricultural and suburban land uses. The induced recharge of river water and the leakage of wastewater commonly found in the industrial and urban areas adjacent to the Delaware River are largely responsible (Barksdale and others, 1958; Graham and Kammerer, 1952). Ground water beneath industrial land contains higher concentrations of ammonium plus organic nitrogen and dissolved organic carbon than water beneath other land-use areas (figs. 21 and 22), partly because waste treatment and storage facilities are assigned to the industrial land-use category.

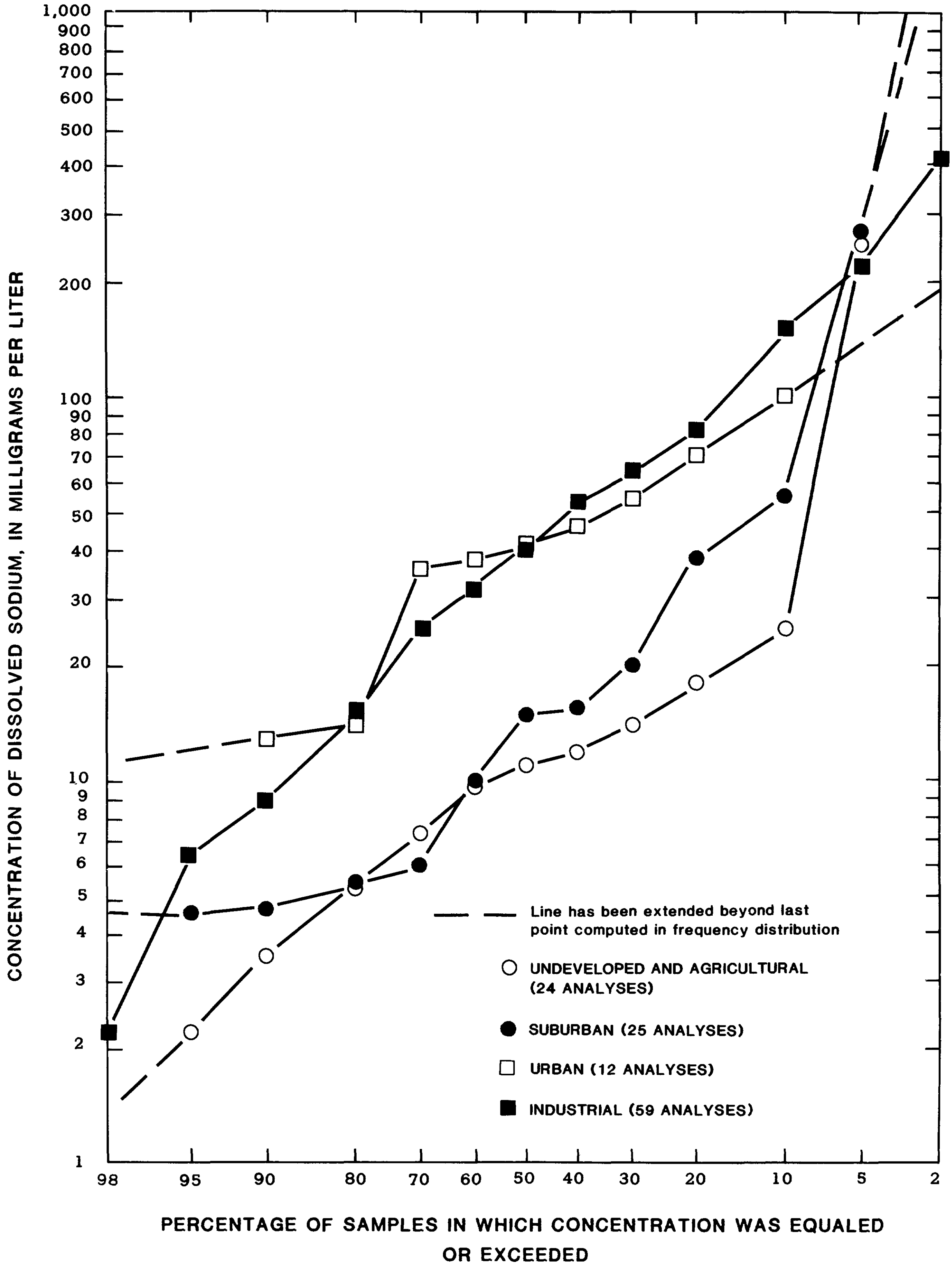

Figure 15.--Concentration-frequency diagram for sodium, by land use.

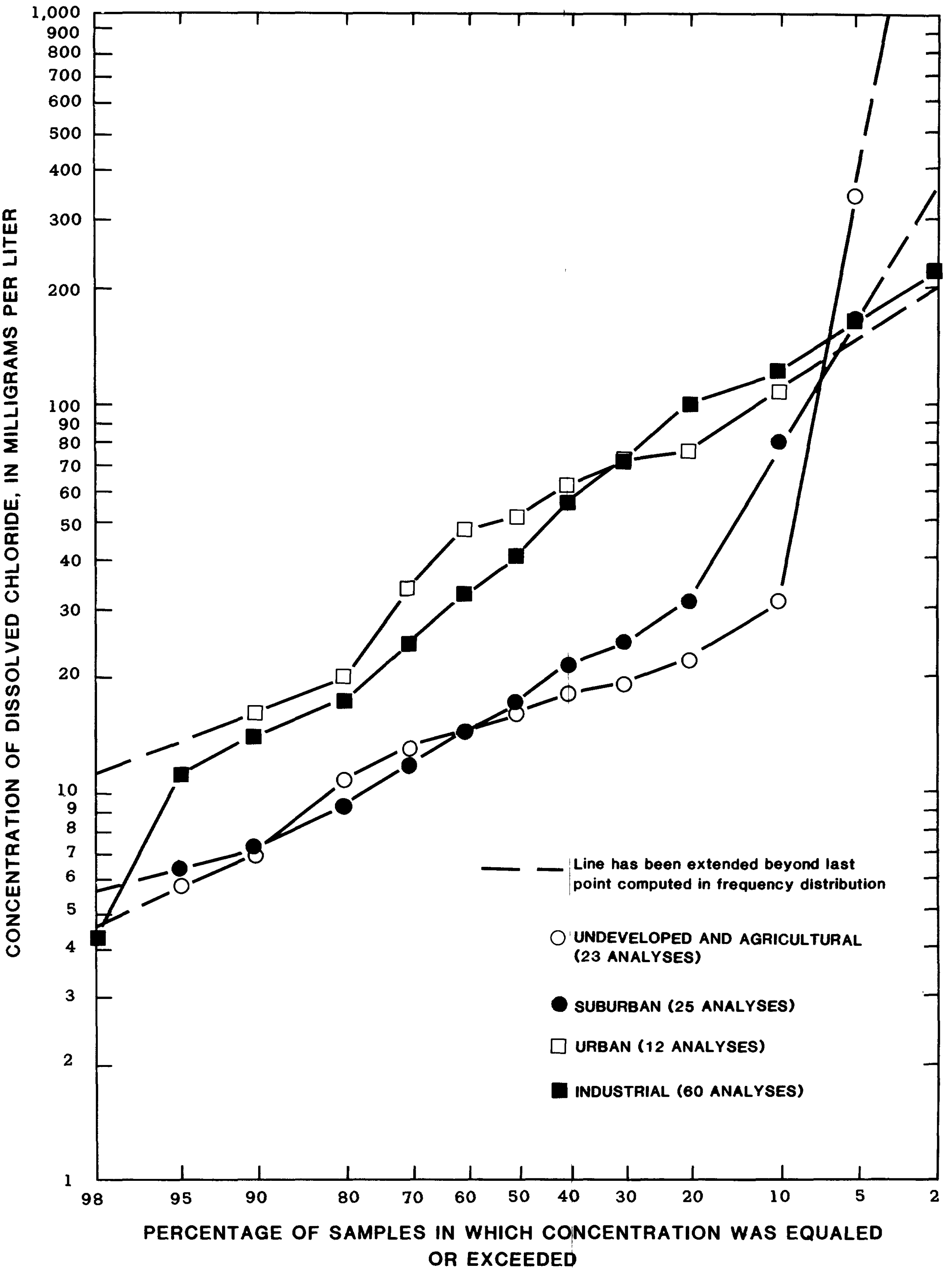

Figure 16.--Concentration-frequency diagram for chloride, by land use.

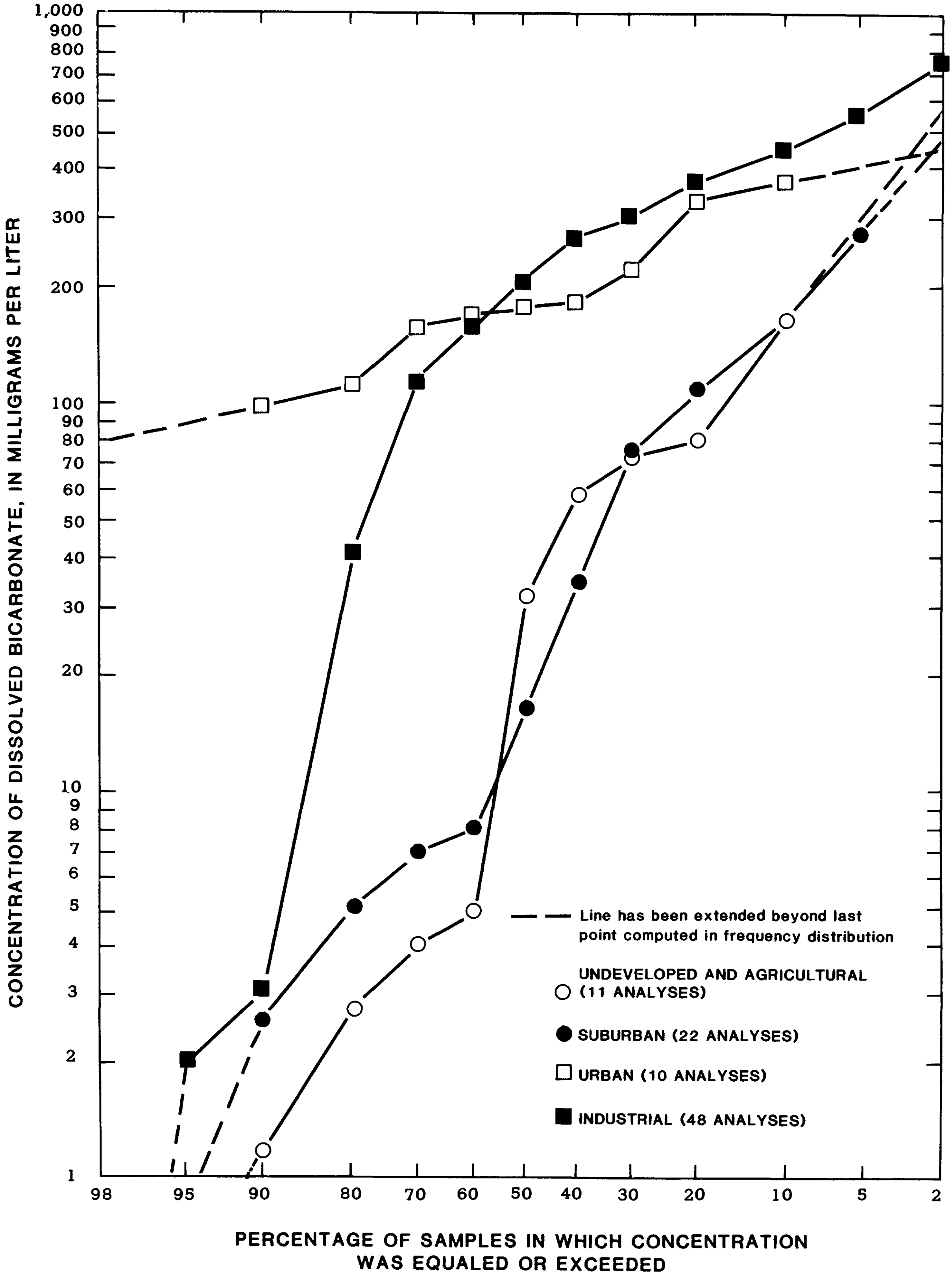

Figure 17.--Concentration-frequency diagram for bicarbonate, by land use.

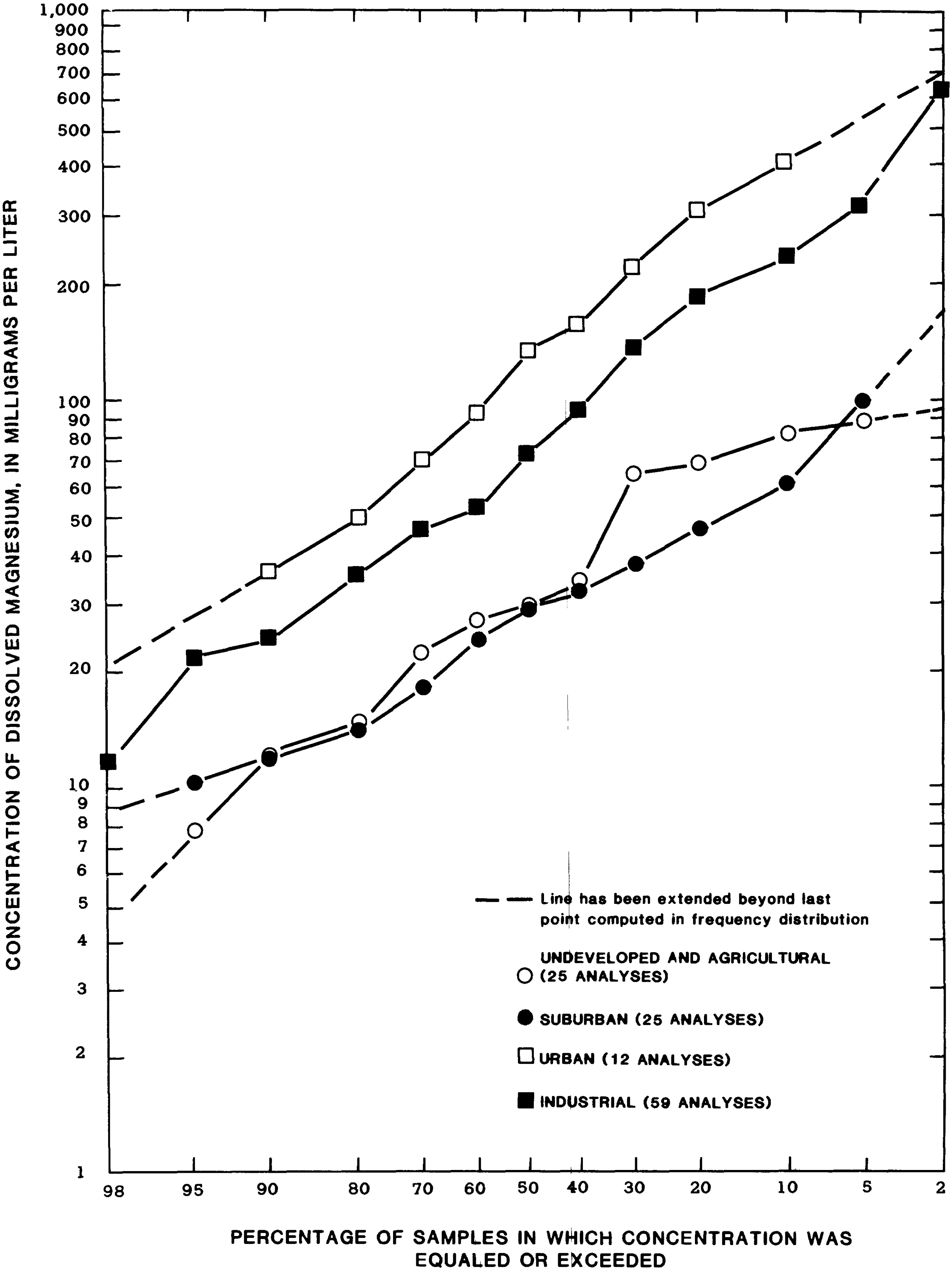

Figure 18.--Concentration-frequency diagram for magnesium, by land use.

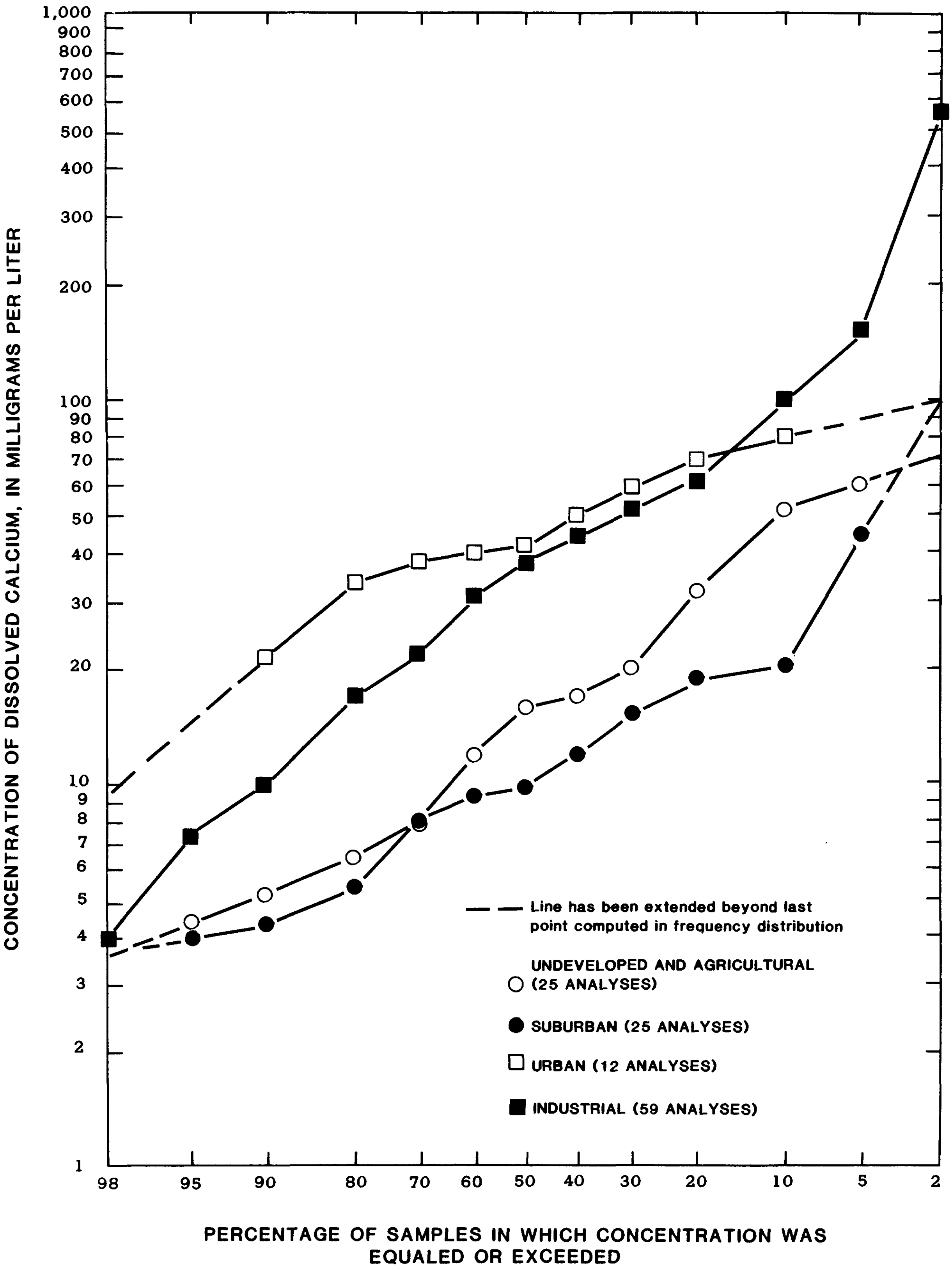

Figure 19.--Concentration-frequency diagram for calcium, by land use.

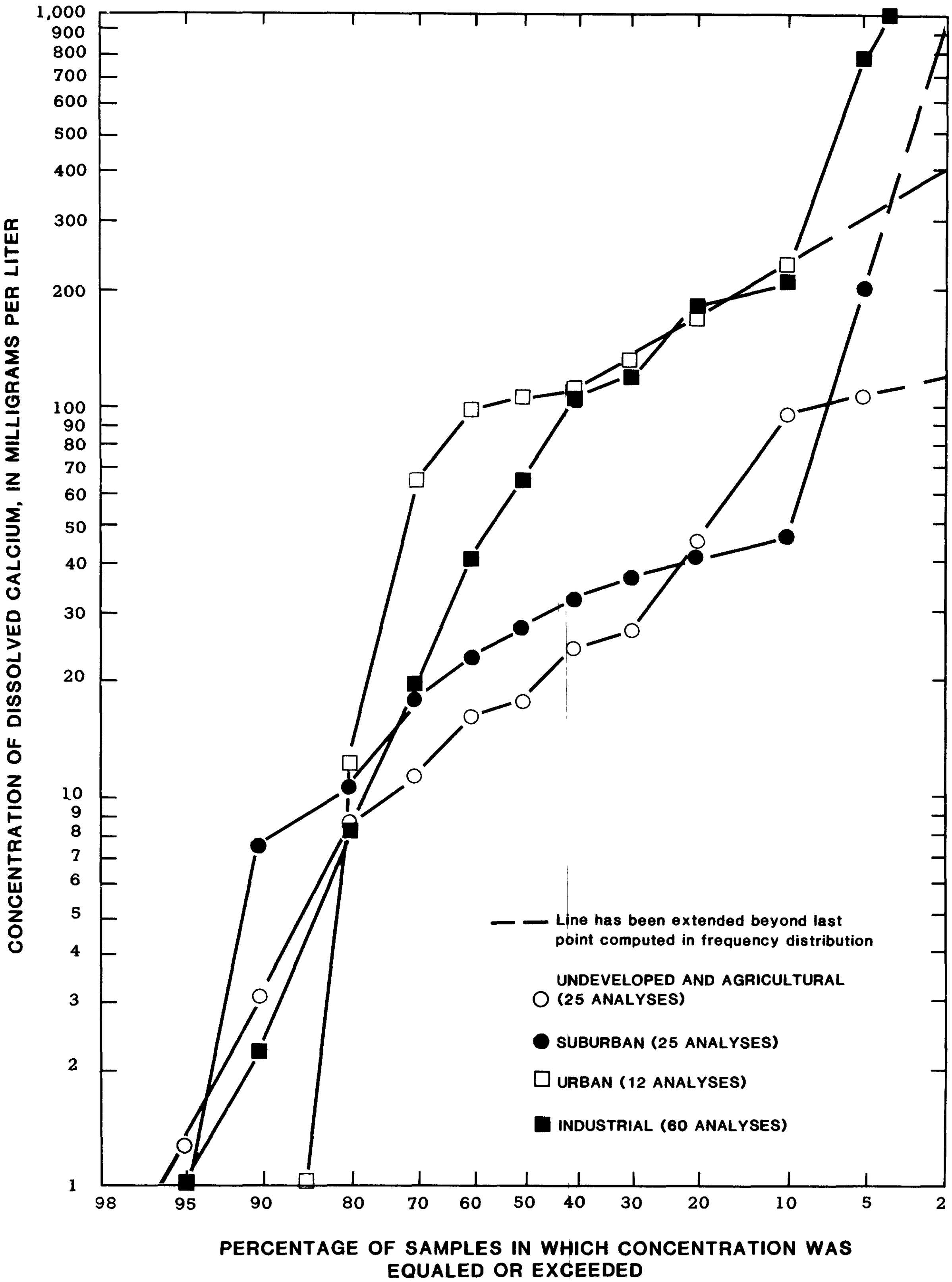

Figure 20.--Concentration-frequency diagram for calcium, by land use.

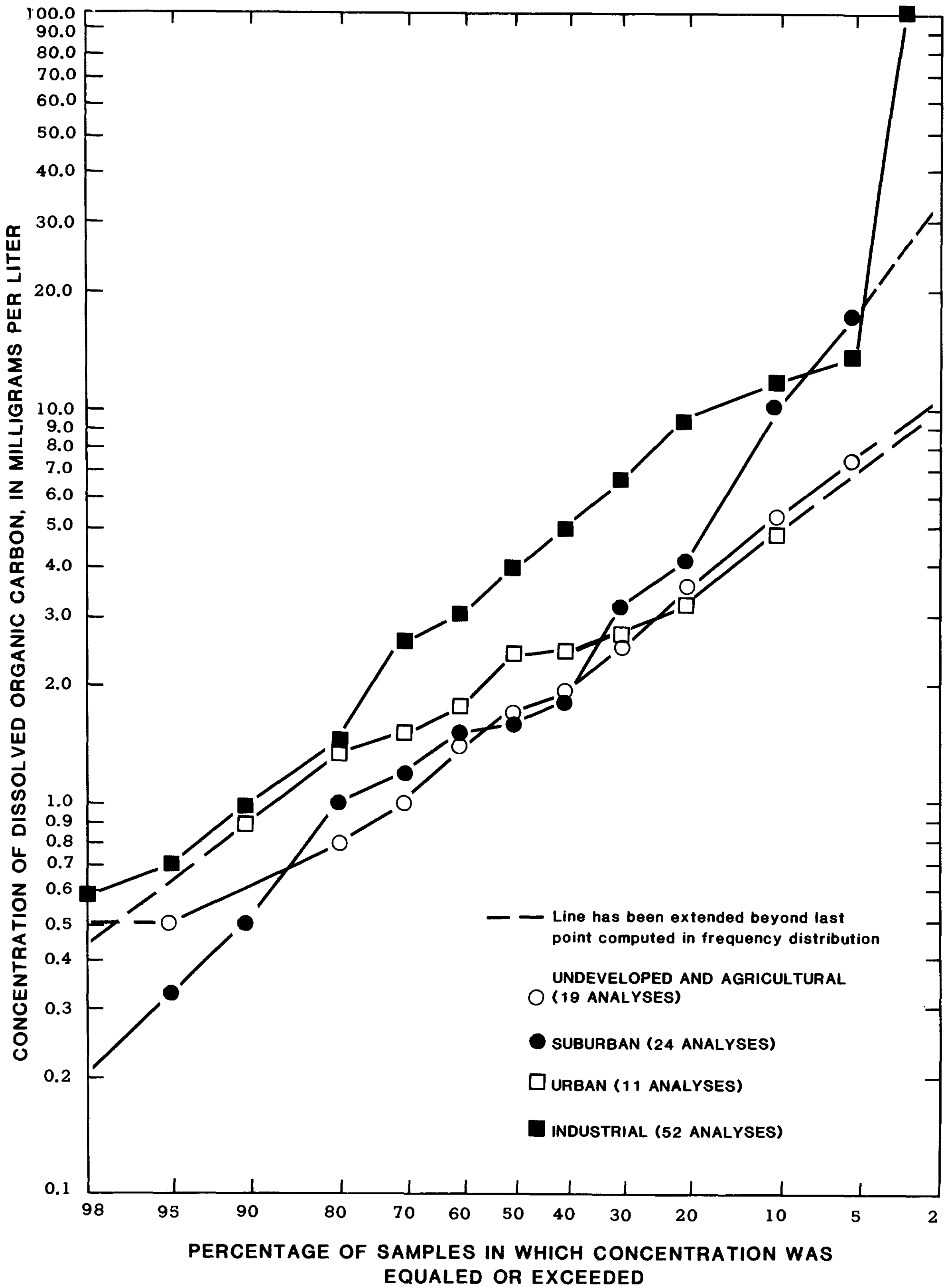

Figure 21.--Concentration-frequency diagram for dissolved organic carbon, by land use.

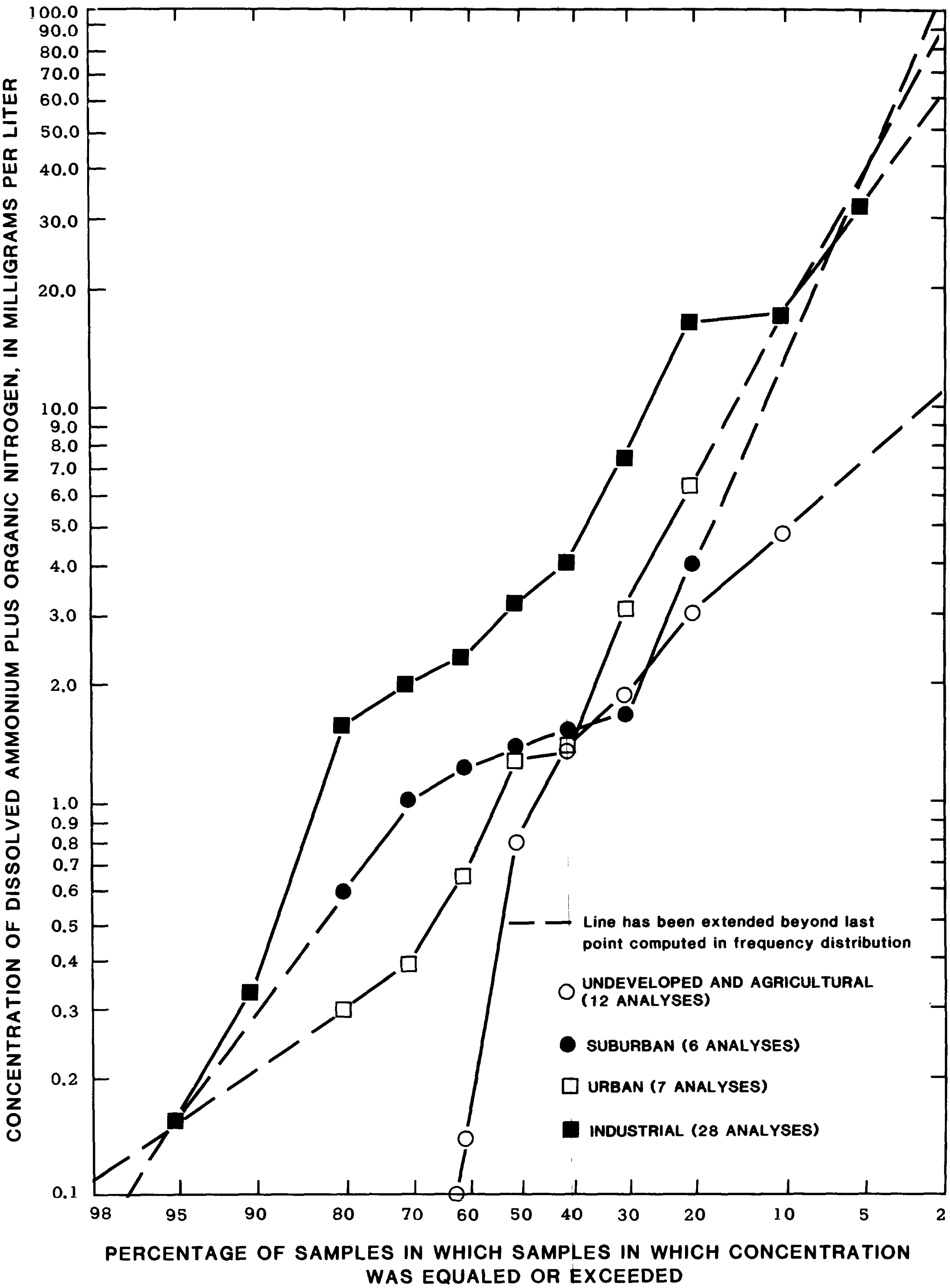

Figure 22.--Concentration-frequency diagram for ammonium plus organic nitrogen, by land use.

Relations among concentrations of dissolved iron and manganese and land use are different than for the other common dissolved ions (figs. 23 and 24). Although use of ground-water from the Potomac-Raritan-Magothy aquifer system in Pennsylvania and, to a lesser extent, in New Jersey, has become increasingly limited because of elevated concentrations of dissolved iron and manganese, this pervasive increase in iron and manganese cannot easily be understood by considering only changes in the regional flow system or land use. Ground water beneath undeveloped and agricultural and industrial lands, which share few common cultural attributes, is more likely to contain higher concentrations of iron than ground water in urban or suburban environments. Statistically significant differences in the concentration of manganese between land-use types are not apparent.

Concentrations of dissolved trace metals are least affected by land use, probably because they do occur naturally, unlike the volatile organic compounds, which are derived from human activities. Also, relations between trace metal concentrations and land use are difficult to interpret because these constituents usually are present in concentrations below detection limits. Less than 20 percent of the trace-metal concentrations in ground water in the Philadelphia-Camden area could be quantified; arsenic, cadmium, and selenium never exceeded detection limits. Furthermore, trace metals can be affected by chemical processes that regulate their concentrations in solution. Absorption, oxidation-reduction, and the formation of metal oxyhydroxides or sulfides at very low metal activities can mask the influence of land use on trace metal concentrations.

Differences in the proportion of trace metals in ground water whose concentrations were above detection limits differ among the industrial, urban, and suburban land-use categories according to the constituent. The close spatial association of urban and industrial land uses in the Philadelphia-Camden area can mask differences in the types and concentrations of trace metals in water between these land-use categories. Furthermore, land use in the region has long been established, thereby providing enough time for contaminants to spread through the ground-water system, especially in view of the extensive changes in regional flow directions that have occurred since 1940. The lack of significant or uniform differences in the proportion of trace constituents whose concentrations are above detection limit supports the perception that trace metals are best studied as point-source phenomena. Ground water in areas of undeveloped and agricultural land is least affected by trace-metal contamination. Concentrations of only three trace metals were above detection limits in undeveloped and agricultural areas. Chromium concentrations exceeded detection limits in 11 percent of the samples, lead in 19 percent of the samples, and copper in 6 percent of the samples. Summary statistics, by land use, are presented in table 8.

Fusillo and others (1985) showed that the concentrations of volatile organic compounds vary in response to land use and geologic environment in the Philadelphia-Camden area, if the sum of all the volatile-organic-compound concentrations is used as the indicator. Therefore, there would appear to be a general correlation between land use and total volatile-organic-compound concentration; but, when taken individually, the percentage of volatile organic compounds in concentrations above detection limits do not relate well to land use. In some cases, the number of analyses in a given land-use category is

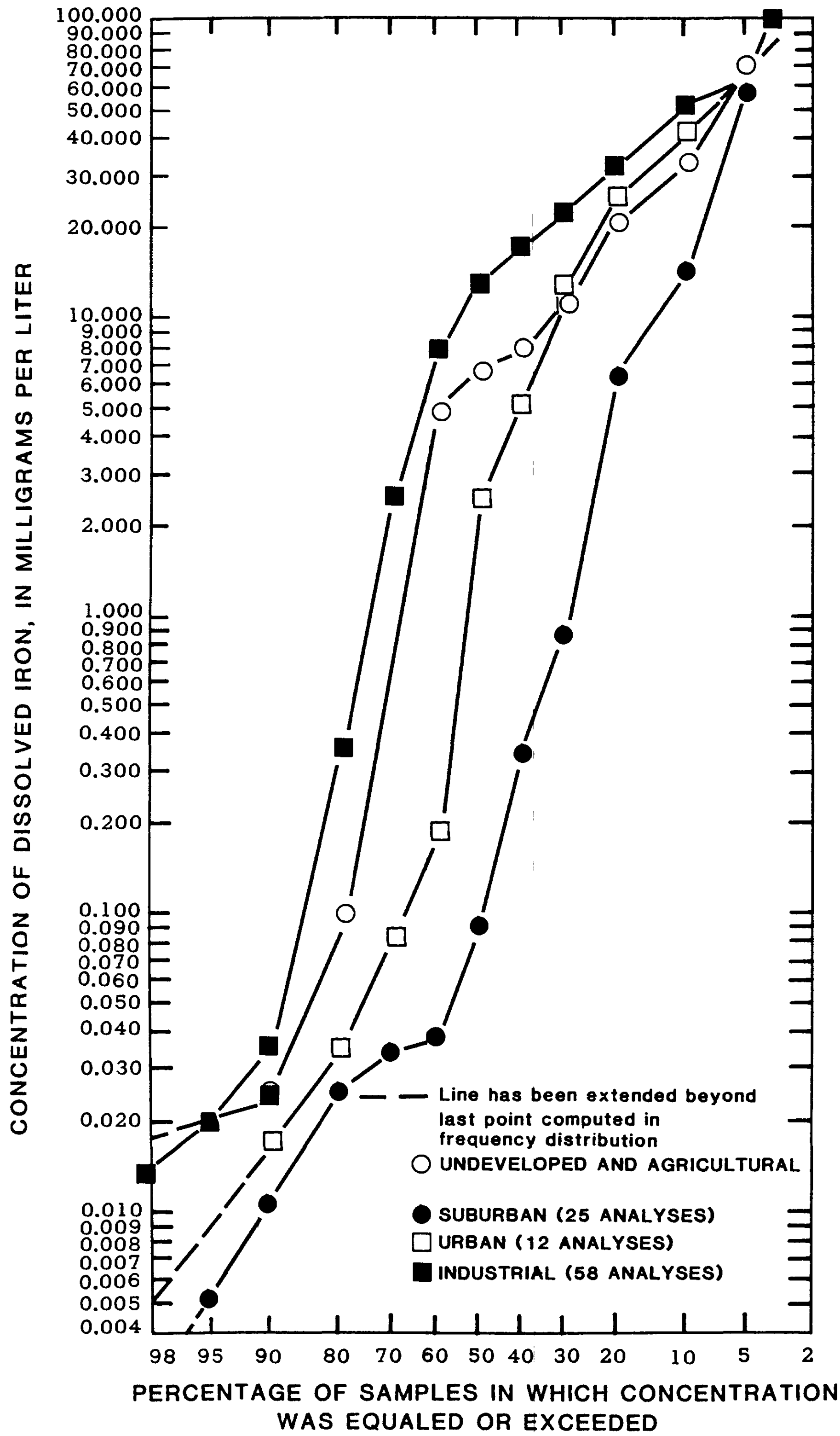

Figure 23.--Concentration-frequency diagram for iron, by land use.

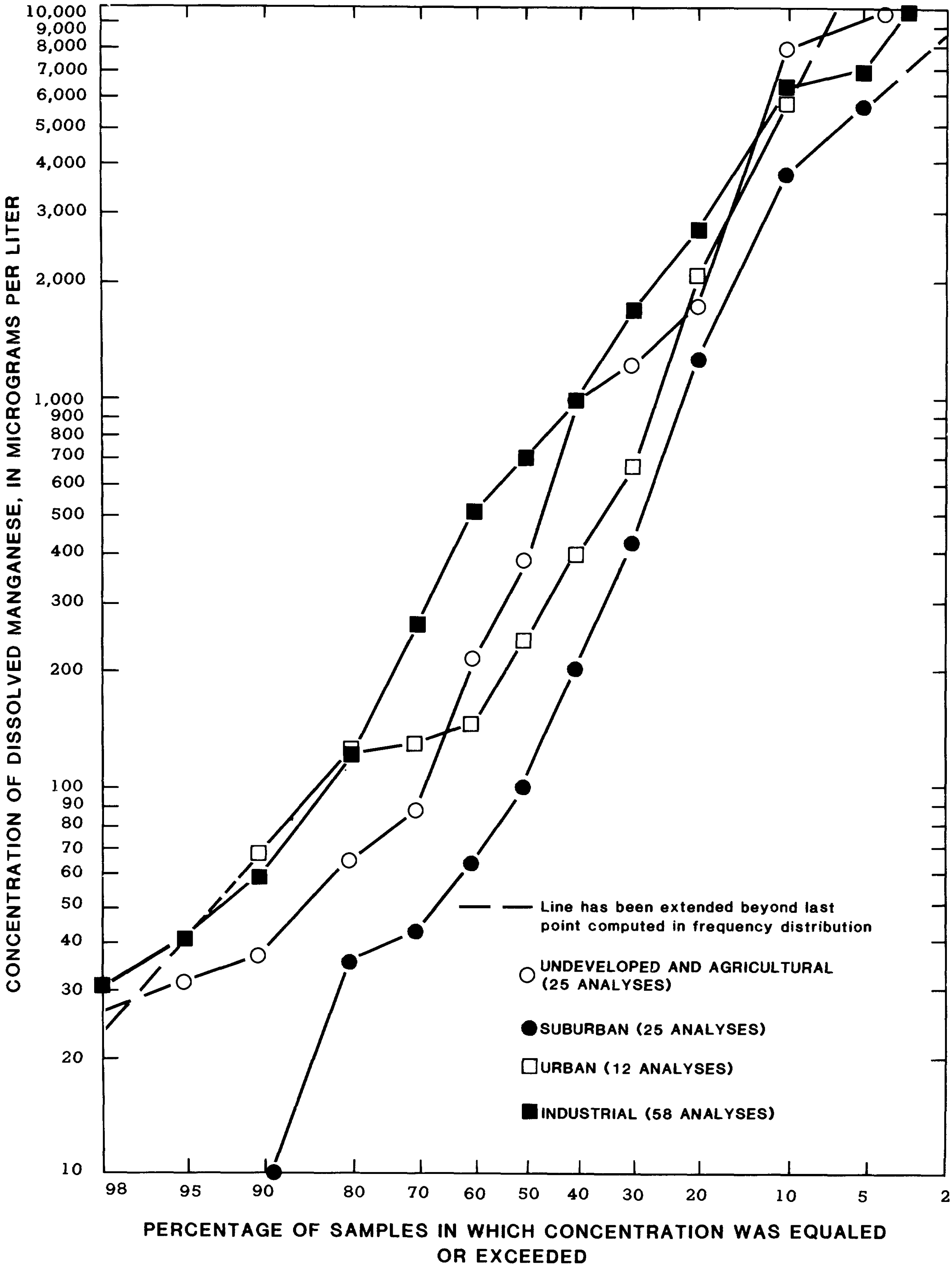

Figure 24.--Concentration-frequency diagram for manganese, by land use.

Table 8.--Summary of trace-metal concentrations by land use

[µg/L, micrograms per liter; <, less than; --, too few data to compute mean and median]

Land use category	Number of analyses	Percentage of analyses having concentrations above highest detection limit	Mean concentration (µg/L)	Median concentration (µg/L)
	Barium	[Highest detection limit is 200 µg/L]		
1. Undeveloped and agricultural	13	0	<72	<60
2. Suburban	22	0	<80	<80
3. Urban	9	11	<130	<100
4. Industrial	48	33	<248	<145
	Beryllium	[Highest detection limit is 2.0µg/L]		
1. Undeveloped and agricultural	13	0	<1.1	<1
2. Suburban	20	10	<1.2	<1
3. Urban	5	20	<1.6	<1
4. Industrial	28	7	<1.3	<1
	Chromium	[Highest detection limit is 20 µg/L]		
1. Undeveloped and agricultural	9	0	<7.1	<10
2. Suburban	5	20	<16	<10
3. Urban	5	0	<16	<20
4. Industrial	27	11	<7.4	<20
	Hexavalent chromium	[Highest detection limit is 1.0 µg/L]		
1. Undeveloped and agricultural	6	0	<1.0	<1.0
2. Suburban	4	25	<1.5	<1.0
3. Urban	1	0	--	--
4. Industrial	5	0	<1.0	<1.0
	Copper	[Highest detection limit is 20 µg/L]		
1. Undeveloped and agricultural	16	6	<13	<10
2. Suburban	18	28	<64	<10
3. Urban	9	11	<17	<10
4. Industrial	48	17	<26	<10

Table 8.--Summary of trace-metal concentrations by land use--Continued

[μg/L, micrograms per liter; <, less than; --, too few data to compute mean and median]

Land use category	Number of analyses	Percentage of analyses having concentrations above highest detection limit	Mean concentration (μg/L)	Median concentration (μg/L)
	Lead		[Highest detection limit is 10 μg/L]	
1. Undeveloped and agricultural	16	19	<9.9	<10
2. Suburban	18	22	<13	<10
3. Urban	7	29	<11	<10
4. Industrial	41	22	<11	<10
	Mercury		[Highest detection limit is 0.5 μg/L]	
1. Undeveloped and agricultural	3	0	<0.1	<0.1
2. Suburban	2	50	--	--
3. Urban	4	0	<0.3	<0.3
4. Industrial	22	32	<3.5	<0.1
	Nickel		[Highest detection limit is 50 μg/L]	
1. Undeveloped and agricultural	3	0	<10	<5.0
2. Suburban	1	0	--	--
3. Urban	4	0	<42	<50
4. Industrial	22	5	<34	<20.0
	Zinc		[Highest detection limit is 4 μg/L]	
1. Undeveloped and agricultural	16	100	46	32
2. Suburban	22	100	79	30
3. Urban	9	89	<38	40
4. Industrial	48	79	<69	32

insufficient to be considered a representative sampling. More importantly, ground water containing detectable concentrations of volatile organic compounds usually contains more than one compound, making the sum of volatile-organic-compound concentrations a better indicator of contamination than the concentration of a single constituent. The percentage of analyses having concentrations above detection for the most commonly encountered compounds, trichloroethylene and tetrachloroethylene (table 9), compare well to what would be expected for specific land uses. For these compounds, the highest percentage of analyses that have concentrations of trichloroethylene and tetrachloroethylene above the detection limit, 44 and 50 percent, respectively, are for urban areas; 32 and 22 percent respectively, are for industrial areas; 14 and 18 percent respectively, are for suburban areas; and 5 percent for both compunds are for undeveloped and agricultural areas.

Table 9.--Summary of volatile-organic-compound concentrations by land use

[μg/L, micrograms per liter; <, less than]

Land use category	Number of analyses	Percentage of analyses having concentrations above highest detection limit	Mean concentration (μg/L)	Median concentration (μg/L)
	Benzene		[Highest detection limit is 1.0 μg/L]	
1. Undeveloped and agricultural	20	0	<1.0	<1.0
2. Suburban	23	4	<32	<1.0
3. Urban	7	14	<1.6	<1.0
4. Industrial	33	18	<21	<1.0
	Bromoform		[Highest detection limit is 1.0 μg/L]	
1. Undeveloped and agricultural	7	0	<1.0	<1.0
2. Suburban	6	0	<.8	<1.0
3. Urban	4	0	<.6	<.6
4. Industrial	18	0	<.5	<1.0
	Carbon tetrachloride		[Highest detection limit is 1.0 μg/L]	
1. Undeveloped and agricultural	20	0	<1.0	<1.0
2. Suburban	25	0	<1.0	<1.0
3. Urban	9	0	<.8	<1.0
4. Industrial	45	0	<.8	<1.0

Table 9.--Summary of volatile-organic-compound concentrations by land use--Continued

[μg/L, micrograms per liter; <, less than]

Land use category	Number of analyses	Percentage of analyses having concentrations above highest detection limit	Mean concentration (μg/L)	Median concentration (μg/L)
	Chlorobenzene [Highest detection limit is 1.0 μg/L]			
1. Undeveloped and agricultural	7	14	<1.1	<1.0
2. Suburban	6	17	<1.4	<1.0
3. Urban	4	0	<.6	<.6
4. Industrial	18	22	<19	<.6
	Chloroform [Highest detection limit is 1.0 μg/L]			
1. Undeveloped and agricultural	20	0	<1.0	<1.0
2. Suburban	25	0	<.9	<1.0
3. Urban	9	44	<3.0	<1.0
4. Industrial	45	16	<2.9	<1.0
	1,2-dichloroethane [Highest detection limit is 1.0 μg/L]			
1. Undeveloped and agricultural	20	0	<1.0	<1.0
2. Suburban	25	4	<2.9	<1.0
3. Urban	9	11	<1.1	<1.0
4. Industrial	45	9	<1.2	<1.0
	1,2-dichloropropane [Highest detection limit is 1.0 μg/L]			
1. Undeveloped and agricultural	7	0	<1.0	<1.0
2. Suburban	6	0	<.7	<1.0
3. Urban	4	0	<.6	<.6
4. Industrial	18	6	<.9	<.2
	Methylene chloride [Highest detection limit is 1.0 μg/L]			
1. Undeveloped and agricultural	20	5	<1.3	<1.0
2. Suburban	24	0	<1.0	<1.0
3. Urban	8	0	<.9	<1.0
4. Industrial	41	2	<1.3	<1.0

Table 9.--Summary of volatile-organic-compound concentrations by land use--Continued

[μg/L, micrograms per liter; <, less than]

Land use category	Number of analyses	Percentage of analyses having concentrations above highest detection limit	Mean concentration (μg/L)	Median concentration (μg/L)
Tetrachloroethylene [Highest detection limit is 1.0 μg/L]				
1. Undeveloped and agricultural	20	5	<1.1	<1.0
2. Suburban	25	12	<3.8	<1.0
3. Urban	9	56	<15	8.0
4. Industrial	45	16	<2.6	<1.0
Toluene [Highest detection limit is 1.0 μg/L]				
1. Undeveloped and agricultural	20	5	<1.1	<1.0
2. Suburban	23	0	<1.0	<1.0
3. Urban	7	0	<1.0	<1.0
4. Industrial	33	9	<1.4	<1.0
1,2-Transdichloroethylene [Highest detection limit is 1.0 μg/L]				
1. Undeveloped and agricultural	20	5	<1.6	<1.0
2. Suburban	23	4	<1.6	<1.0
3. Urban	7	14	<11	<1.0
4. Industrial	33	6	<2.8	<1.0
1,1,1-Trichloroethane [Highest detection limit is 1.0 μg/L]				
1. Undeveloped and agricultural	3	0	<1.0	<1.0
2. Suburban	1	100	--	--
3. Urban	1	100	--	--
4. Industrial	14	14	<41	<1.0
Trichloroethylene [Highest detection limit is 1.0 μg/L]				
1. Undeveloped and agricultural	20	5	<8.5	<1.0
2. Suburban	25	12	<3.9	<1.0
3. Urban	9	56	<19	6.4
4. Industrial	45	27	<7.4	<1.0

Table 9.--Summary of volatile-organic-compound concentrations by land use--Continued

[μg/L, micrograms per liter; <, less than]

Land use category	Number of analyses	Percentage of analyses having concentrations above highest detection limit	Mean concentration[1] (μg/L)	Median concentration (μg/L)
		Total volatile organic compounds		
1. Undeveloped and agricultural	20	20	6.5	BDT[2]
2. Suburban	26	31	37	BDT
3. Urban	16	69	33	10
4. Industrial	51	43	53	BDT

[1] All less than values assumed to be zero for total volatile organic compounds.
[2] BDT--No compounds were detected in more than half the samples.

SUMMARY AND CONCLUSIONS

A combination of land use and geologic environment have contributed to the observed concentrations of many major ions in aquifers underlying the Coastal Plain near Philadelphia, Pennsylvania, and Camden, New Jersey. In general, distributions of trace metals and volatile organic compounds are not clearly related to land use except that the sum of volatile-organic-compound concentrations and the concentrations of trichloroethylene and tetrachloroethylene indicate that some wells in urban and industrial areas are more likely to be contaminated by these compounds than wells in suburban areas. Also, ground water in undeveloped and agricultural lands is least affected by metallic or organic contamination. The large proportion of ground-water samples containing volatile-organic-compound concentrations below detection limits, together with variations in the detection limits, may be the primary limit on the degree to which concentrations of these elements or compounds can be distinguished among differing land uses. In addition, trace-metal concentrations may be difficult to relate to human activity because the metals are naturally occurring and their concentrations can be regulated by normal geochemical processes. Iron and manganese concentrations can be interpreted only with a clear understanding of the processes responsible for their release from solid phases.

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Table 10.--Description of codes used in water-chemistry tables

Eonothem, Erathem, or series	Geologic unit	Aquifer code
	Geologic unit descriptions	
Holocene	Trenton gravel and dredge spoil	111FILL
Pleistocene	Trenton gravel (informal usage)	112TRNN
Upper Cretaceous	Potomac-Raritan-Magothy aquifer system in Potomac Group, Raritan, and Magothy Formations	211MRPA
	Potomac-Raritan-Magothy aquifer system, upper sand unit	211MRPAU
	Potomac-Raritan-Magothy aquifer system, middle sand unit	211MRPAM
	Potomac-Raritan-Magothy aquifer system, lower sand unit	211MRPAL
Lower Paleozoic and upper Proterozoic	Wissahickon Formation, oligoclase mica schist	300WSCKO

Land use

(see table 1)

County codes

005	Burlington County, New Jersey
007	Camden County, New Jersey
015	Gloucester County, New Jersey
Bk	Bucks County, Pennsylvania
De	Delaware County, Pennsylvania
Ph	Philadelphia County, Pennsylvania

Table 11.--Chemical analyses of trace metals in ground water used for land-use comparisons

[Dashes indicate no data; <, less than; μg/L, micrograms per liter; land use codes are defined in table 1; aquifer codes are defined in table 10]

Local identifier	Land use code	Station number	Aquifer code	Date of sample	Arsenic dis-solved (μg/L as As)	Barium, dis-solved (μg/L as Ba)	Beryl-lium, dis-solved (μg/L as Be)	Cadmium dis-solved (μg/L as Cd)	Chro-mium, dis-solved (μg/L as Cr)	Chro-mium, hexa-valent, dis. (μg/L as Cr)	Copper, dis-solved (μg/L as Cu)	Lead, dis-solved (μg/L as Pb)	Mercury dis-solved (μg/L as Hg)	Nickel, dis-solved (μg/L as Ni)	Zinc, dis-solved (μg/L as Zn)
5- 39	2	400404074552001	211MRPAM	06-30-80	--	110	<1.0	<1	--	--	<10	<10	--	--	46
			211MRPAM	12-17-82	1	--	--	--	10	<1	--	--	--	--	--
5- 87	4	400407074524601	211MRPAM	07-25-80	--	230	1.0	3	--	--	<10	12	--	--	79
5- 89	4	400409074524701	211MRPAM	06-20-80	--	70	<1.0	5	--	--	<10	--	--	--	23
			211MRPAM	08-12-82	1	--	--	--	10	<1	--	--	--	--	--
5-123	2	395904075000901	211MRPAL	08-06-80	--	50	<1.0	2	--	--	25	<10	--	--	56
			211MRPAL	12-02-82	1	--	--	--	10	1	--	--	--	--	--
5-126	4	395929074592202	211MRPAM	08-06-80	--	110	<1.0	2	--	--	17	<10	--	--	12
			211MRPAM	12-17-82	1	--	--	--	10	<1	--	--	--	--	--
5-127	4	395938074581001	211MRPAM	06-30-80	--	80	<1.0	2	--	--	40	<10	--	--	34
			211MRPAM	12-02-82	1	--	--	--	10	<1	--	--	--	--	--
5-130	2	400002075004401	211MRPAM	06-30-80	--	90	<1.0	2	--	--	250	--	--	--	33
			211MRPAM	12-02-82	1	--	--	--	10	1	--	--	--	--	--
5-139	2	400204074554101	211MRPAM	08-29-80	--	110	<1.0	4	--	--	15	<10	--	--	30
5-140	1	400241074554601	211MRPAM	08-29-80	--	50	<1.0	4	--	--	<10	13	--	--	18
5-392	2	400158074571001	211MRPAM	06-17-80	--	110	1.0	3	--	--	35	--	--	--	24
5-667	1	400250074532101	211MRPAM	06-18-80	--	100	2.0	1	--	--	20	<10	--	--	40
			211MRPAM	12-17-82	1	--	--	--	10	<1	--	--	--	--	--
5-761	4	400417074532201	211MRPAM	07-30-82	1	--	--	--	10	<1	--	--	--	--	--
5-777	1	400213074551301	211MRPA	08-29-80	--	60	<1.0	2	--	--	56	<10	--	--	18
5-780	4	400100074591301	211MRPA	12-02-80	--	120	1.0	<1	--	--	<10	<10	--	--	8
5-781	4	400100074592701	211MRPA	12-02-80	--	40	3.0	1	--	--	14	<10	--	--	62
7- 30	3	395447075071101	211MRPAU	11-03-80	--	30	<1.0	10	--	--	<10	19	--	--	8
7- 39	4	395457075064001	211MRPAM	07-30-80	--	20	<1.0	1	--	--	<10	<10	--	--	19
			211MRPAM	11-05-82	2	--	--	--	10	<1	--	--	--	--	--
7- 58	4	395539075063001	211MRPAM	09-21-82	1	--	--	--	880	130	--	--	--	--	--
7- 61	3	395541075062201	211MRPAM	07-30-80	--	40	<1.0	1	--	--	<10	<10	--	--	12
			211MRPAM	07-06-82	1	--	--	--	20	<1	--	--	--	--	--
7- 68	3	395552075053501	211MRPAL	07-30-80	--	90	<1.0	<1	--	--	15	<10	--	--	14
			211MRPAL	07-06-82	1	--	--	--	10	<1	--	--	--	--	--
7- 70	3	395557075062901	211MRPAM	11-15-82	1	--	--	--	10	<1	--	--	--	--	--
7- 78	4	395615075063301	211MRPAL	07-31-80	--	40	3.0	2	--	--	15	<10	--	--	22
			211MRPAL	07-06-82	1	--	--	--	10	<1	--	--	--	--	--
7- 94	4	395706075055301	211MRPAL	07-31-80	--	200	3.0	4	--	--	<10	<10	--	--	<4
7-110	3	395725075052101	211MRPAL	08-21-80	--	190	4.0	10	--	--	<10	22	--	--	<4

Table 11.--Chemical analyses of trace metals in ground water used for land-use comparisons--Continued

[Dashes indicate no data; <, less than; μg/L, micrograms per liter; land use codes are defined in table 1; aquifer codes are defined in table 10]

Local identifier	Land use code	Station number	Aquifer code	Date of sample	Arsenic dis-solved (μg/L as As)	Barium, dis-solved (μg/L as Ba)	Beryl-lium, dis-solved (μg/L as Be)	Cadmium dis-solved (μg/L as Cd)	Chro-mium, dis-solved (μg/L as Cr)	Chro-mium, hexa-valent, dis. (μg/L as Cr)	Copper, dis-solved (μg/L as Cu)	Lead, dis-solved (μg/L as Pb)	Mercury dis-solved (μg/L as Hg)	Nickel, dis-solved (μg/L as Ni)	Zinc, dis-solved (μg/L as Zn)
7-193	3	395258075064101	211MRPAU	07-07-80	--	220	<1.0	<1	--	--	<10	10	--	--	55
7-194	4	395308075074401	211MRPAL	07-03-80	--	100	<1.0	2	--	--	<10	<10	--	--	<4
			211MRPAL	09-16-82	1	--	--	--	10	<1	--	--	--	--	--
7-195	4	395308075074901	211MRPAL	07-03-80	--	140	<1.0	3	--	--	<10	<10	--	--	<4
7-197	4	395313075080401	211MRPAL	09-16-82	1	--	--	--	10	1	--	--	--	--	--
7-210	2	395343075065201	211MRPAL	07-07-80	--	80	<1.0	<1	--	--	<10	<10	--	--	11
7-221	4	395355075073801	211MRPAL	07-23-80	--	150	<1.0	4	--	--	<10	14	--	--	8
7-335	2	395720075022501	211MRPAL	07-10-80	--	70	<1.0	2	--	--	15	<10	--	--	28
			211MRPAL	12-21-82	<1	--	--	--	10	<1	--	--	--	--	--
7-339	4	395743075044801	211MRPAM	09-05-80	--	70	<1.0	22	--	--	<10	<10	--	--	<4
7-341	2	395752075041102	211MRPAM	07-10-80	--	70	<1.0	<1	--	--	<10	<10	--	--	11
7-350	1	395802075011801	211MRPAL	07-10-80	--	40	<1.0	<1	--	--	17	<10	--	--	19
			211MRPAL	10-27-82	1	--	--	--	10	<1	--	--	--	--	--
7-354	4	395811075054901	211MRPAL	11-19-80	--	270	<1.0	8	--	--	<10	<10	--	--	500
7-363	2	395842075031201	211MRPAL	09-15-82	1	--	--	--	40	3	--	--	--	--	--
7-366	2	395845075031201	211MRPAL	07-13-82	1	--	--	--	<10	<1	--	--	--	--	--
7-367	2	395845075031701	211MRPAL	07-21-80	--	60	3.0	<1	--	--	20	<10	--	--	53
			211MRPAL	07-27-81	--	--	--	--	--	<1	--	--	--	--	--
7-368	2	395848075034701	211MRPAL	07-22-80	--	80	1.0	2	--	--	<10	<10	--	--	13
			211MRPAL	09-15-82	1	--	--	--	<10	<1	--	--	--	--	--
7-369	1	395851075035501	211MRPAL	09-15-82	2	--	--	--	<10	<1	--	--	--	--	--
7-370	1	395853075034801	211MRPAL	09-15-82	1	--	--	--	10	<1	--	--	--	--	--
7-386	4	395934075022901	211MRPAL	07-12-82	2	--	--	--	<10	<1	--	--	--	--	--
7-527	3	395556075053701	211MRPAL	10-29-82	<1	--	--	--	10	<1	--	--	--	--	--
7-528	2	395835075030201	211MRPAL	07-13-82	1	--	--	--	10	<1	--	--	--	--	--
7-535	1	395857075034401	211MRPAL	07-28-80	--	30	<1.0	2	--	--	<10	<10	--	--	8
7-559	4	395833075020701	211MRPAU	07-01-80	--	70	1.0	1	--	--	33	<10	--	--	77
7-560	2	395652075030702	211MRPAM	07-10-80	--	80	<1.0	<1	--	--	<10	<10	--	--	6
			211MRPAM	10-27-82	1	--	--	--	20	<1	--	--	--	--	--
7-511	4	395912075024801	211MRPA	10-29-80	--	70	1.0	8	--	--	55	47	--	--	140
7-573	2	395355075073802	211MRPAU	07-23-80	--	20	<1.0	3	--	--	<10	14	--	--	12
7-575	2	395806075004601	211MRPAU	08-25-80	--	60	3.0	<1	--	--	300	22	--	--	1000
7-586	1	395914075032402	211MRPAL	07-27-81	3	30	1.0	1	1	<1	10	10	--	--	5
			211MRPAL	07-13-82	4	--	--	--	<10	<1	--	--	--	--	--
7-587	1	395905075033302	211MRPAL	07-27-81	3	30	1.0	1	<1	<1	10	14	--	--	10

Table 11.--Chemical analyses of trace metals in ground water used for land-use comparisons--Continued

[Dashes indicate no data; <, less than; μg/L, micrograms per liter; land use codes are defined in table 1; aquifer codes are defined in table 10]

Local identifier	Land use code	Station number	Aquifer code	Date of sample	Arsenic dis-solved (μg/L as As)	Barium, dis-solved (μg/L as Ba)	Beryl-lium, dis-solved (μg/L as Be)	Cadmium dis-solved (μg/L as Cd)	Chro-mium, dis-solved (μg/L as Cr)	Chro-mium, hexa-valent, dis. (μg/L as Cr)	Copper, dis-solved (μg/L as Cu)	Lead, dis-solved (μg/L as Pb)	Mercury dis-solved (μg/L as Hg)	Nickel, dis-solved (μg/L as Ni)	Zinc, dis-solved (μg/L as Zn)
15- 72	2	394936075174701	211MRPAM	09-12-80	--	80	<1.0	2	--	--	10	<10	--	--	52
			211MRPAM	08-24-82	<1	--	--	--	<10	<1	--	--	--	--	--
15- 76	2	394940075170901	211MRPAM	09-15-80	--	70	<1.0	7	--	--	<10	<10	--	--	13
			211MRPAM	11-18-82	3	--	--	--	10	<1	--	--	--	--	--
15- 79	2	394944075173401	211MRPAM	09-12-80	--	90	<1.0	1	--	--	10	<10	--	--	29
			211MRPAM	08-24-82	<1	--	--	--	<10	<1	--	--	--	--	--
15- 81	2	394945075171701	211MRPAM	09-12-80	--	80	<1.0	1	--	--	10	46	--	--	20
			211MRPAM	08-24-82	<1	--	--	--	<10	<1	--	--	--	--	--
15- 94	4	394958075151201	211MRPAM	09-17-80	--	40	2.0	<1	--	--	<10	<10	--	--	89
15- 98	4	395005075152301	211MRPAM	09-17-80	--	50	3.0	<1	--	--	<10	<10	--	--	170
			211MRPAM	08-11-82	3	--	--	--	20	<1	--	--	--	--	--
15-109	4	395027075150301	211MRPAL	08-11-82	1	--	--	--	10	<1	--	--	--	--	--
15-118	4	395036075150101	211MRPAL	09-17-80	--	40	<1.0	2	--	--	<10	<10	--	--	<4
			211MRPAL	08-11-82	1	--	--	--	10	<1	--	--	--	--	--
15-137	1	394535075205401	211MRPAM	09-26-80	--	90	<1.0	2	--	--	<10	<10	--	--	15
15-139	1	394606075213301	211MRPAL	09-26-80	--	200	<1.0	2	--	--	<10	<10	--	--	11
15-166	1	394755075210802	211MRPAM	09-16-80	--	80	<1.0	3	--	--	<10	<10	--	--	34
			211MRPAM	12-22-82	<1	--	--	--	10	<1	--	--	--	--	--
15-207	2	395156075105301	211MRPAL	09-09-80	--	40	<1.0	5	--	--	<10	14	--	--	8
15-320	4	395216075091501	211MRPAL	09-09-80	--	70	<1.0	5	--	--	<10	16	--	--	<4
15-321	4	395221075085601	211MRPAL	09-09-80	--	90	<1.0	5	--	--	<10	18	--	--	4
			211MRPAL	08-09-82	1	--	--	--	<10	<1	--	--	--	--	--
15-324	1	395236075082101	211MRPAL	11-19-82	1	--	--	--	20	<1	--	--	--	--	--
15-345	1	394642075182301	211MRPAU	10-27-80	--	60	<1.0	6	--	--	<10	17	--	--	120
15-347	2	394932075172202	211MRPAM	12-10-80	--	80	<1.0	<1	--	--	<10	<10	--	--	62
			211MRPAM	09-22-82	1	--	--	--	10	<1	--	--	--	--	--
15-348	2	394920075154101	211MRPAU	09-18-80	--	40	<1.0	<1	--	--	17	<10	--	--	87
			211MRPAU	12-22-82	<1	--	--	--	10	<1	--	--	--	--	--
15-395	1	394807075172701	211MRPAU	09-24-80	--	60	1.0	2	--	--	<10	<10	--	--	39
15-399	1	394900075191301	211MRPAM	09-15-80	--	90	<1.0	3	--	--	<10	<10	--	--	43
15-417	1	394820075183301	211MRPAU	09-25-80	--	50	1.0	<1	--	--	16	<10	--	--	230
15-439	4	395048075140101	211MRPA	10-08-80	--	90	<1.0	6	--	--	10	10	--	--	36
			211MRPA	07-23-82	1	--	--	--	20	<1	--	--	--	--	--

Table 11.--Chemical analyses of trace metals in ground water used for land-use comparisons--Continued

[Dashes indicate no data; <, less than; µg/L, micrograms per liter; land use codes are defined in table 1; aquifer codes are defined in table 10]

Local identifier	Land use code	Station number	Aquifer code	Date of sample	Arsenic dis-solved (µg/L as As)	Barium, dis-solved (µg/L as Ba)	Beryl-lium, dis-solved (µg/L as Be)	Cadmium dis-solved (µg/L as Cd)	Chro-mium, dis-solved (µg/L as Cr)	Chro-mium, hexa-valent, dis. (µg/L as Cr)	Copper, dis-solved (µg/L as Cu)	Lead, dis-solved (µg/L as Pb)	Mercury dis-solved (µg/L as Hg)	Nickel, dis-solved (µg/L as Ni)	Zinc, dis-solved (µg/L as Zn)
BK-1153	1	400433074544301	111FILL	02-27-84	--	--	--	9	10	--	<1	4	<.1	3	31
BK-1154	1	400440074544601	112TRNN	10-13-83	--	--	--	2	<1	--	10	9	<.1	22	85
BK-1155	1	400434074544401	112TRNN	10-14-83	--	--	--	<1	<1	--	4	2	<.1	5	34
BK-1156	1	400430074550001	112TRNN	10-17-83	--	--	--	2	<1	--	2	5	<.1	47	93
PH- 6	4	395348075105901	211MRPAL	08-13-79	18	300	--	<20	<20	--	<20	<10	1.5	10	70
			211MRPAL	11-23-82	1	--	--	--	10	1	--	--	--	--	--
PH- 12	4	395342075102101	211MRPAM	08-14-79	12	400	--	<20	<20	--	20	<10	<.1	20	60
PH- 14	4	395336075101301	112TRNN	08-15-79	<2	650	--	<20	<20	--	<20	<10	<.1	<10	30
PH- 15	4	395326075101501	211MRPAU	06-04-80	<50	300	--	<10	<10	--	50	0	.0	<20	130
PH- 19	4	395314075101001	211MRPAL	08-15-79	9	500	--	<20	<20	--	20	--	<.1	50	110
PH- 20	4	395316075104901	211MRPAL	11-18-80	--	60	<1.0	6	--	--	<10	<10	--	--	<4
			211MRPAL	11-24-82	1	--	--	--	20	2	--	--	--	--	--
PH- 44	4	395410075120703	211MRPAL	08-16-79	<2	300	--	<20	<20	--	20	<10	<.1	<10	40
PH- 64	2	395403075104901	112TRNN	08-23-79	11	<100	--	<20	--	--	70	--	<.1	--	40
PH- 83	4	395533075120901	211MRPAL	08-20-79	<2	600	--	<20	<20	--	<20	<10	<.1	<10	20
PH- 100	3	~~395617075102301~~	~~112TRNN~~	~~08-21-79~~	<2	200	--	<20	<20	--	<20	--	<.1	<50	100
PH- 124	3	395534075110601	211MRPAL	08-28-79	1	<100	--	<0	<20	--	<2	0	<.5	<50	40
PH- 205	4	395711075082701	211MRPAL	08-22-79	<2	<100	--	<20	<20	--	260	--	1.0	<50	200
			211MRPAL	11-06-80	--	50	<1.0	<1	--	--	480	<10	--	--	410
PH- 242	4	395523075083901	211MRPAL	06-06-80	<50	<200	--	<10	<10	--	90	0	.5	<20	260
PH- 287	4	395836075071201	112TRNN	09-04-79	11	400	--	<20	<20	--	<20	--	55	<50	350
PH- 288	4	395838075070901	112TRNN	06-19-80	<50	<200	--	<10	<10	--	<10	11	.0	<20	20
PH- 307	4	395926075040401	112TRNN	08-30-79	7	400	--	<20	<20	--	<20	--	<.1	<50	100
PH- 407	4	395431075075701	211MRPAL	11-05-80	--	150	<1.0	4	--	--	<10	25	--	--	13
PH- 408	4	395433075080001	211MRPAL	08-16-79	<2	300	--	<20	20	--	<20	<10	<.1	<10	30
PH- 415	4	395430075081001	211MRPAU	11-05-80	--	160	<1.0	7	--	--	<10	19	--	--	<4
PH- 417	4	395429075080301	211MRPAL	11-05-80	--	100	<1.0	6	--	--	<10	25	--	--	<4
PH- 430	3	395539075084001	211MRPAL	08-21-79	<2	<100	--	<20	<20	--	<20	--	<.1	<50	50
PH- 454	4	395518075084601	112TRNN	08-20-79	<2	300	--	<20	<20	--	<20	--	2.0	<50	50
PH- 466	3	395534075084001	211MRPAL	06-05-80	<50	<200	--	<10	<10	--	60	5	.5	<20	60
PH- 750	4	395445075083101	211MRPAL	09-17-80	<50	<200	--	<10	<10	--	10	10	.0	<20	40
PH- 752	4	395443075083201	211MRPAU	08-21-80	<50	290	--	<10	30	--	10	0	9.5	<20	50
PH- 763	4	400018075040401	112TRNN	09-05-79	10	<100	--	<20	<20	--	<20	--	<.1	<50	20
PH- 770	4	400022075034301	112TRNN	09-05-79	4	2100	--	<20	20	--	30	--	5.0	<200	30

Table 11.--Chemical analyses of trace metals in ground water used for land-use comparisons--Continued

[Dashes indicate no data; <, less than; µg/L, micrograms per liter; land use codes are defined in table 1; aquifer codes are defined in table 10]

Local identifier	Land use code	Station number	Aquifer code	Date of sample	Arsenic dis-solved (µg/L as As)	Barium, dis-solved (µg/L as Ba)	Beryl-lium, dis-solved (µg/L as Be)	Cadmium dis-solved (µg/L as Cd)	Chro-mium, dis-solved (µg/L as Cr)	Chro-mium, hexa-valent, dis. (µg/L as Cr)	Copper, dis-solved (µg/L as Cu)	Lead, dis-solved (µg/L as Pb)	Mercury dis-solved (µg/L as Hg)	Nickel, dis-solved (µg/L as Ni)	Zinc, dis-solved (µg/L as Zn)
PH- 780	4	395529075084601	211MRPAL	06-06-80	1	70	<1.0	4	<10	--	<10	<10	.0	6	86
PH- 790	4	395318075131501	112TRNN	06-18-80	<50	1300	--	<10	<10	--	<10	3	.0	.20	10
PH- 794	2	400008075035001	211MRPAL	10-20-80	<50	<200	--	<10	<10	--	350	6	3.5	20	90
PH- 796	4	395816075073301	112TRNN	10-10-80	50	<200	--	<10	40	--	20	5	5.5	20	70
TASKER	3	395550075100701	112TRNN	10-02-79	10	--	--	<20	<20	--	<20	--	.0	50	40
MORRIS															
STS															
SUMP															

Table 12.--Chemical analyses of volatile organic compounds in ground water used for land-use comparisons

[Dashes indicate no data; <, less than; µg/L, micrograms per liter; land use codes are defined in table 1; aquifer codes are defined in table 10]

Local identifier	Land use code	Station number	Aquifer code	Date of sample	Benzene total (µg/L)	Bis 2-Chloro-ethyl ether total (µg/L)	Brom-oform total (µg/L)	Carbon-tetra-chlo-ride total (µg/L)	Chloro-benzene total (µg/L)	Chloro-form total (µg/L)	Di-chloro-bromo-methane total (µg/L)	Di-chloro-di-fluoro-methane total (µg/L)	1,2-Di-chloro-ethane total (µg/L)	1,1-Di-chloro-ethyl-ene total (µg/L)	1,2-Di-chloro-propane total (µg/L)
5- 39	2	400404074552001	211MRPAM	06-30-80	<1.0	--	--	<1.0	--	<1	<1.0	--	<1.0	--	--
5- 87	4	400407074524601	211MRPAM	07-25-80	<1.0	--	--	<1.0	--	<1	<1.0	--	<1.0	--	--
5- 89	4	400409074524701	211MRPAM	06-20-80	<1.0	--	--	<1.0	--	<1	<1.0	--	<1.0	--	--
5-123	2	395904075000901	211MRPAL	08-06-80	<1.0	--	--	<1.0	--	<1	<1.0	--	<1.0	--	--
5-126	4	395929074592202	211MRPAM	08-06-80	<1.0	--	--	<1.0	--	<1	<1.0	--	<1.0	--	--
5-127	4	395938074581001	211MRPAM	06-30-80	<1.0	--	--	<1.0	--	<1	<1.0	--	<1.0	--	--
5-130	2	400002075004401	211MRPAM	06-30-80	<1.0	--	--	<1.0	--	<1	<1.0	--	<1.0	--	--
5-139	2	400204074554101	211MRPAM	08-29-80	<1.0	--	--	<1.0	--	<1	<1.0	--	<1.0	--	--
5-140	1	400241074554601	211MRPAM	08-29-80	<1.0	--	--	<1.0	--	<1	<1.0	--	<1.0	--	--
5-392	2	400158074571001	211MRPAM	06-17-80	<1.0	--	--	<1.0	--	<1	<1.0	--	<1.0	--	--
5-667	1	400250074532101	211MRPAM	06-18-80	<1.0	--	--	<1.0	--	<1	<1.0	--	<1.0	--	--
5-761	4	400417074532201	211MRPAM	07-30-82	<1.0	<1.0	<1.0	<1.0	<1.0	<1	<1.0	<1.0	<1.0	<1.0	<1.0
5-777	1	400213074551301	211MRPA	08-29-80	<1.0	--	--	<1.0	--	<1	<1.0	--	<1.0	--	--
5-780	4	400100074591301	211MRPA	12-02-80	<1.0	--	--	<1.0	--	<1	<1.0	--	<1.0	--	--
5-781	4	400100074592701	211MRPA	12-02-80	<1.0	--	--	<1.0	--	<1	<1.0	--	<1.0	--	--
7- 30	3	395447075071101	211MRPAU	11-03-80	<1.0	--	--	<1.0	--	<1	<1.0	--	<1.0	--	--
7- 39	4	395457075064001	211MRPAM	07-30-80	<1.0	--	--	<1.0	--	<1	<1.0	--	<1.0	--	--
7- 58	4	395539075063001	211MRPAM	09-21-82	<1.0	--	<1.0	<1.0	<1.0	<1	<1.0	<1.0	<1.0	<1.0	<1.0
7- 61	3	395541075062201	211MRPAM	07-30-80	<1.0	--	--	<1.0	--	<1	<1.0	--	<1.0	--	--
7- 68	3	395552075053501	211MRPAL	07-30-80	<1.0	--	--	<1.0	--	5	<1.0	--	<1.0	--	--
7- 70	3	395557075062901	211MRPAM	11-15-82	5.0	--	<1.0	<1.0	<1.0	<1	<1.0	<1.0	<1.0	<1.0	<1.0
7- 78	4	395615075063301	211MRPAL	07-31-80	<1.0	--	--	<1.0	--	<1	<1.0	--	<1.0	--	--
7- 94	4	395706075055301	211MRPAL	07-31-80	<1.0	--	--	<1.0	--	<1	<1.0	--	<1.0	--	--
7-110	3	395725075052101	211MRPAL	08-21-80	<1.0	--	--	<1.0	--	<1	<1.0	--	<1.0	--	--
7-193	3	395258075064101	211MRPAU	07-07-80	<1.0	--	--	<1.0	--	<1	<1.0	--	<1.0	--	--
7-194	4	395308075074401	211MRPAL	07-03-80	<1.0	--	--	<1.0	--	<1	<1.0	--	<1.0	--	--
7-195	4	395308075074901	211MRPAL	07-03-80	<1.0	--	--	<1.0	--	<1	<1.0	--	<1.0	--	--
7-210	2	395343075065201	211MRPAL	07-07-80	<1.0	--	--	<1.0	--	<1	<1.0	--	<1.0	--	--
7-221	4	395355075073801	211MRPAL	07-23-80	<1.0	--	--	<1.0	--	<1	<1.0	--	<1.0	--	--
7-335	2	395720075022501	211MRPAL	07-11-80	<1.0	--	--	<1.0	--	<1	<1.0	--	<1.0	--	--
7-339	4	395743075044801	211MRPAM	09-05-80	<1.0	--	--	<1.0	--	<1	<1.0	--	<1.0	--	--
7-341	2	395752075041102	211MRPAM	07-10-80	<1.0	--	--	<1.0	--	<1	<1.0	--	<1.0	--	--
7-350	1	395802075011801	211MRPAL	10-27-82	<1.0	--	<1.0	<1.0	<1.0	<1	<1.0	<1.0	<1.0	<1.0	<1.0
7-354	4	395811075054901	211MRPAL	11-19-80	<1.0	--	--	<1.0	--	<1	<1.0	--	<1.0	--	--
7-363	2	395842075031201	211MRPAL	09-15-82	<1.0	--	<1.0	<1.0	<1.0	<1	<1.0	<1.0	<1.0	1.0	<1.0

Table 12.--Chemical analyses of volatile organic compounds in ground water used for land-use comparisons--Continued

[Dashes indicate no data; <, less than; µg/L, micrograms per liter; land use codes are defined in table 1; aquifer codes are defined in table 10]

Local identifier	Date of sample	1,3-Dichloropropene total (µg/L)	2,4-Dinitrotoluene total (µg/L)	Ethylbenzene total (µg/L)	Methylbromide total (µg/L)	Methylene chloride total (µg/L)	1,1,2,2 Tetrachloroethane total (µg/L)	Tetrachloroethylene total (µg/L)	Toluene total (µg/L)	1,2-Transdichloroethylene total (µg/L)	1,1,1-Trichloroethane total (µg/L)	1,1,2-Trichloroethane total (µg/L)	Trichloroethylene total (µg/L)	Trichlorofluoromethane total (µg/L)	Vinyl chloride total (µg/L)
5- 39	06-30-80	--	--	--	--	<1.0	--	<1.0	<1.0	<1.0	<1.0	--	<1.0	--	--
5- 87	07-25-80	--	--	--	--	<1.0	--	<1.0	<1.0	<1.0	<1.0	--	<1.0	--	--
5- 89	06-20-80	--	--	--	--	<1.0	--	<1.0	3.0	<1.0	<1.0	--	8.0	--	--
5-123	08-06-80	--	--	--	--	<1.0	--	<1.0	<1.0	<1.0	<1.0	--	<1.0	--	--
5-126	08-06-80	--	--	--	--	<1.0	--	<1.0	<1.0	<1.0	<1.0	--	<1.0	--	--
5-127	06-30-80	--	--	--	--	<1.0	--	<1.0	<1.0	<1.0	<1.0	--	<1.0	--	--
5-130	06-30-80	--	--	--	--	<1.0	--	<1.0	<1.0	<1.0	<1.0	--	<1.0	--	--
5-139	08-29-80	--	--	--	--	<1.0	--	<1.0	<1.0	<1.0	<1.0	--	<1.0	--	--
5-140	08-29-80	--	--	--	--	<1.0	--	<1.0	<1.0	<1.0	<1.0	--	<1.0	--	--
5-392	06-17-80	--	--	--	--	<1.0	--	<1.0	<1.0	<1.0	<1.0	--	<1.0	--	--
5-667	06-18-80	--	--	--	--	1.0	--	<1.0	2.7	<1.0	<1.0	--	<1.0	--	--
5-761	07-30-82	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
5-777	08-29-80	--	--	--	--	<1.0	--	<1.0	<1.0	<1.0	<1.0	--	<1.0	--	--
5-780	12-02-80	--	--	--	--	<1.0	--	<1.0	<1.0	<1.0	<1.0	--	<1.0	--	--
5-781	12-02-80	--	--	--	--	<1.0	--	<1.0	<1.0	<1.0	<1.0	--	5.0	--	--
7- 30	11-03-80	--	--	--	--	<1.0	--	<1.0	<1.0	<1.0	<1.0	--	<1.0	--	--
7- 39	07-30-80	--	--	--	--	<1.0	--	<1.0	<1.0	<1.0	<1.0	--	<1.0	--	--
7- 58	09-21-82	<1.0	--	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
7- 61	07-30-80	--	--	--	--	<1.0	--	73	<1.0	68	<1.0	--	84.0	--	--
7- 68	07-30-80	--	--	--	--	<1.0	--	<1.0	<1.0	<1.0	<1.0	--	38.0	--	--
7- 70	11-15-82	<1.0	--	<1.0	<1.0	<1.0	<1.0	8.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
7- 78	07-31-80	--	--	--	--	<1.0	--	<1.0	<1.0	10	<1.0	--	90.0	--	--
7- 94	07-31-80	--	--	--	--	<1.0	--	<1.0	<1.0	<1.0	<1.0	--	<1.0	--	--
7-110	08-21-80	--	--	--	--	<1.0	--	<1.0	<1.0	<1.0	<1.0	--	<1.0	--	--
7-193	07-07-80	--	--	--	--	<1.0	--	<1.0	<1.0	<1.0	<1.0	--	<1.0	--	--
7-194	07-03-80	--	--	--	--	<1.0	--	<1.0	<1.0	<1.0	<1.0	--	<1.0	--	--
7-195	07-03-80	--	--	--	--	<1.0	--	<1.0	<1.0	<1.0	<1.0	--	<1.0	--	--
7-210	07-07-80	--	--	--	--	<1.0	--	<1.0	<1.0	<1.0	<1.0	--	<1.0	--	--
7-221	07-23-80	--	--	--	--	<1.0	--	<1.0	<1.0	<1.0	<1.0	--	<1.0	--	--
7-335	07-11-80	--	--	--	--	<1.0	--	<1.0	<1.0	<1.0	<1.0	--	<1.0	--	--
7-339	09-05-80	--	--	--	--	<1.0	--	<1.0	<1.0	<1.0	<1.0	--	<1.0	--	--
7-341	07-10-80	--	--	--	--	<1.0	--	<1.0	<1.0	<1.0	<1.0	--	<1.0	--	--
7-350	10-27-82	<1.0	--	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	12	<1.0	<1.0	150	<1.0	<1.0
7-354	11-19-80	--	--	--	--	<1.0	--	<1.0	<1.0	<1.0	<1.0	--	<1.0	--	--
7-363	09-15-82	<1.0	--	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0

Table 12.--Chemical analyses of volatile organic compounds in ground water used for land-use comparisons--Continued

[Dashes indicate no data; <, less than; μg/L, micrograms per liter; land use codes are defined in table 1; aquifer codes are defined in table 10]

Local identifier	Land use code	Station number	Aquifer code	Date of sample	Benzene total (μg/L)	Bis 2-Chloro-ethyl ether total (μg/L)	Brom-oform total (μg/L)	Carbon-tetra-chlo-ride total (μg/L)	Chloro-benzene total (μg/L)	Chloro-form total (μg/L)	Di-chloro-bromo-methane total (μg/L)	Di-chloro-di-fluoro-methane total (μg/L)	1,2-Di-chloro-ethane total (μg/L)	1,1-Di-chloro-ethyl-ene total (μg/L)	1,2-Di-chloro-propane total (μg/L)
7-366	2	395845075031201	211MRPAL	07-13-82	<1.0	<1.0	<1.0	<1.0	<1.0	<1	<1.0	<1.0	<1.0	<1.0	<1.0
7-367	2	395845075031701	211MRPAL	07-21-80	<1.0	--	--	<1.0	--	<1	<1.0	--	<1.0	--	--
7-368	2	395848075034701	211MRPAL	07-22-80	<1.0	--	--	<1.0	--	<1	<1.0	--	<1.0	--	--
7-369	1	395851075035501	211MRPAL	09-15-82	<1.0	--	<1.0	<1.0	2.0	<1	<1.0	<1.0	<1.0	<1.0	<1.0
7-370	1	395853075034801	211MRPAL	09-15-82	<1.0	--	<1.0	<1.0	<1.0	<1	<1.0	<1.0	<1.0	1.0	<1.0
7-386	4	395934075022901	211MRPAL	07-12-82	<1.0	<1.0	<1.0	<1.0	10	<1	<1.0	<1.0	<1.0	<1.0	<1.0
7-527	3	395556075053701	211MRPAL	10-29-82	<1.0	--	<1.0	<1.0	<1.0	10	<1.0	<1.0	<1.0	<1.0	<1.0
7-528	2	395835075030201	211MRPAL	07-13-82	<1.0	<1.0	<1.0	<1.0	<1.0	<1	<1.0	<1.0	<1.0	<1.0	<1.0
7-535	1	395857075034401	211MRPAL	07-28-80	<1.0	--	--	<1.0	--	<1	<1.0	--	<1.0	--	--
7-559	4	395833075020701	211MRPAU	07-01-80	<1.0	--	--	<1.0	--	<1	<1.0	--	<1.0	--	--
7-560	2	395652075030702	211MRPAM	07-10-80	<1.0	--	--	<1.0	--	<1	<1.0	--	<1.0	--	--
7-571	4	395912075024801	211MRPA	10-29-80	<1.0	--	--	<1.0	--	<1	<1.0	--	<1.0	--	--
7-573	2	395355075073802	211MRPAU	07-23-80	<1.0	--	--	<1.0	--	<1	<1.0	--	<1.0	--	--
7-575	2	395806075004601	211MRPAU	08-25-80	<1.0	--	--	<1.0	--	<1	<1.0	--	<1.0	--	--
7-586	1	395914075032402	211MRPAL	07-27-81	<1.0	--	--	<1.0	--	<1	<1.0	--	<1.0	--	--
7-587	1	395905075033302	211MRPAL	07-27-81	<1.0	--	--	<1.0	--	<1	<1.0	--	<1.0	--	--
15- 72	2	394936075174701	211MRPAM	09-12-80	<1.0	--	--	<1.0	--	<1	<1.0	--	<1.0	--	--
15- 76	2	394940075170901	211MRPAM	09-15-80	724	--	--	<1.0	--	<1	<1.0	--	<1.0	--	--
15- 79	2	394944075173401	211MRPAM	09-12-80	<1.0	--	--	<1.0	--	<1	<1.0	--	<1.0	--	--
15- 81	2	394945075171701	211MRPAM	09-12-80	<1.0	--	--	<1.0	--	<1	<1.0	--	<1.0	--	--
15- 94	4	394958075151201	211MRPAM	09-17-80	103	--	--	<1.0	--	<1	<1.0	--	<1.0	--	--
15- 98	4	395005075152301	211MRPAM	09-17-80	219	--	--	<1.0	--	<1	<1.0	--	<1.0	--	--
15-109	4	395027075150301	211MRPAL	08-11-82	160	--	<1.0	<1.0	<1.0	<1	<1.0	<1.0	<1.0	<1.0	<1.0
15-118	4	395036075150101	211MRPAL	09-17-80	<1.0	--	--	<1.0	--	<1	<1.0	--	<1.0	--	--
15-137	1	394535075205401	211MRPAM	09-26-80	<1.0	--	--	<1.0	--	<1	<1.0	--	<1.0	--	--
15-139	1	394606075213301	211MRPAL	09-26-80	<1.0	--	--	<1.0	--	<1	<1.0	--	<1.0	--	--
15-166	1	394755075210802	211MRPAM	09-16-80	<1.0	--	--	<1.0	--	<1	<1.0	--	<1.0	--	--
15-207	2	395156075105301	211MRPAL	09-09-80	<1.0	--	--	<1.0	--	<1	<1.0	--	<1.0	--	--
15-220	4	395053075141901	211MRPAL	10-13-81	50	--	<1.0	<1.0	<1.0	<1	<1.0	<1.0	<1.0	<1.0	<1.0
15-320	4	395216075091501	211MRPAL	09-09-80	<1.0	--	--	<1.0	--	<1	<1.0	--	<1.0	--	--
15-321	4	395221075085601	211MRPAL	09-09-80	<1.0	--	--	<1.0	--	<1	<1.0	--	<1.0	--	--
15-324	1	395236075082101	211MRPAL	11-19-82	<1.0	--	<1.0	<1.0	<1.0	<1	<1.0	<1.0	<1.0	<1.0	<1.0
15-345	1	394642075182301	211MRPAU	10-27-80	<1.0	--	--	<1.0	--	<1	<1.0	--	<1.0	--	--
15-347	2	394932075172202	211MRPAM	12-10-80	<1.0	--	--	<1.0	--	<1	<1.0	--	<1.0	--	--
15-348	2	394920075154101	211MRPAU	09-18-80	<1.0	--	--	<1.0	--	<1	<1.0	--	<1.0	--	--
15-395	1	394807075172701	211MRPAU	09-24-80	<1.0	--	--	<1.0	--	<1	<1.0	--	<1.0	--	--
15-399	1	394900075191301	211MRPAM	09-15-80	<1.0	--	--	<1.0	--	<1	<1.0	--	<1.0	--	--
15-417	1	394820075183301	211MRPAU	09-25-80	<1.0	--	--	<1.0	--	<1	<1.0	--	<1.0	--	--
15-439	4	395048075140101	211MRPA	10-08-80	131	--	--	<1.0	--	70	<1.0	--	<1.0	--	--

Table 12.--Chemical analyses of volatile organic compounds in ground water used for land-use comparisons--Continued

[Dashes indicate no data; <, less than; µg/L, micrograma per liter; land use codes are defined in table 1; aquifer codes are defined in table 10]

Local identifier	Date of sample	1,3-Di-chloro-propene total (µg/L)	2,4-Di-nitro-toluene total (µg/L)	Ethyl-benzene total (µg/L)	Methyl-bromide total (µg/L)	Methyl-ene chlo-ride total (µg/L)	1,1,2,2 Tetra-chloro-ethane total (µg/L)	Tetra-chloro-ethyl-ene total (µg/L)	Toluene total (µg/L)	1,2-Transdi-chloro-ethyl-ene total (µg/L)	1,1,1-Tri-chloro-ethane total (µg/L)	1,1,2-Tri-chloro-ethane total (µg/L)	Tri-chloro-ethyl-ene total (µg/L)	Tri-chloro-flouro-methane total (µg/L)	Vinyl chlo-ride total (µg/L)
7-366	07-13-82	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
7-367	07-21-80	--	--	--	--	<1.0	--	<1.0	<1.0	<1.0	<1.0	--	14.0	--	--
7-368	07-22-80	--	--	--	--	<1.0	--	<1.0	<1.0	<1.0	<1.0	--	<1.0	--	--
7-369	09-15-82	<1.0	--	<1.0	<1.0	<1.0	<1.0	3.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
7-370	09-15-82	<1.0	--	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
7-386	07-12-82	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
7-527	10-29-82	<1.0	--	<1.0	<1.0	<1.0	<1.0	14	<1.0	<1.0	<1.0	<1.0	20.0	<1.0	<1.0
7-528	07-13-82	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	15	<1.0	<1.0	64.0	<1.0	<1.0
7-535	07-28-80	--	--	--	--	<1.0	--	<1.0	<1.0	<1.0	<1.0	--	<1.0	--	--
7-559	07-01-80	--	--	--	--	<1.0	--	<1.0	<1.0	<1.0	<1.0	--	<1.0	--	--
7-560	07-10-80	--	--	--	--	<1.0	--	<1.0	<1.0	<1.0	<1.0	--	<1.0	--	--
7-571	10-29-80	--	--	--	--	<1.0	--	<1.0	<1.0	<1.0	<1.0	--	<1.0	--	--
7-573	07-23-80	--	--	--	--	<1.0	--	<1.0	<1.0	<1.0	<1.0	--	<1.0	--	--
7-575	08-25-80	--	--	--	--	<1.0	--	<1.0	<1.0	<1.0	<1.0	--	<1.0	--	--
7-586	07-27-81	--	--	--	--	<1.0	--	<1.0	<1.0	<1.0	<1.0	--	<1.0	--	--
7-587	07-27-81	--	--	--	--	<1.0	--	<1.0	<1.0	<1.0	<1.0	--	<1.0	--	--
15- 72	09-12-80	--	--	--	--	<1.0	--	<1.0	<1.0	<1.0	<1.0	--	<1.0	--	--
15- 76	09-15-80	--	--	--	--	<1.0	--	<1.0	<1.0	<1.0	<1.0	--	<1.0	--	--
15- 79	09-12-80	--	--	--	--	<1.0	--	44	<1.0	<1.0	<1.0	--	<1.0	--	--
15- 81	09-12-80	--	--	--	--	<1.0	--	27	<1.0	<1.0	<1.0	--	<1.0	--	--
15- 94	09-17-80	--	--	--	--	<1.0	--	<1.0	<1.0	<1.0	<1.0	--	<1.0	--	--
15- 98	09-17-80	--	--	--	--	<1.0	--	<1.0	<1.0	<1.0	<1.0	--	<1.0	--	--
15-109	08-11-82	<1.0	--	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
15-118	09-17-80	--	--	--	--	<1.0	--	<1.0	<1.0	<1.0	<1.0	--	<1.0	--	--
15-137	09-26-80	--	--	--	--	<1.0	--	<1.0	<1.0	<1.0	<1.0	--	<1.0	--	--
15-139	09-26-80	--	--	--	--	<1.0	--	<1.0	<1.0	<1.0	<1.0	--	<1.0	--	--
15-166	09-16-80	--	--	--	--	<1.0	--	<1.0	<1.0	<1.0	<1.0	--	<1.0	--	--
15-207	09-09-80	--	--	--	--	<1.0	--	<1.0	<1.0	<1.0	<1.0	--	<1.0	--	--
15-220	10-13-81	<1.0	--	<1.0	<1.0	<1.0	<1.0	10	3.0	50	10	<1.0	20.0	<1.0	<1.0
15-320	09-09-80	--	--	--	--	<1.0	--	<1.0	<1.0	<1.0	<1.0	--	<1.0	--	--
15-321	09-09-80	--	--	--	--	<1.0	--	<1.0	<1.0	<1.0	<1.0	--	<1.0	--	--
15-324	11-19-82	<1.0	--	<1.0	<1.0	6.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
15-345	10-27-80	--	--	--	--	<1.0	--	<1.0	<1.0	<1.0	<1.0	--	<1.0	--	--
15-347	12-10-80	--	--	--	--	<1.0	--	<1.0	<1.0	<1.0	<1.0	--	<1.0	--	--
15-348	09-18-80	--	--	--	--	<1.0	--	<1.0	<1.0	<1.0	<1.0	--	<1.0	--	--
15-348	09-18-80	--	--	--	--	<1.0	--	<1.0	<1.0	<1.0	<1.0	--	<1.0	--	--
15-395	09-24-80	--	--	--	--	<1.0	--	<1.0	<1.0	<1.0	<1.0	--	<1.0	--	--
15-399	09-15-80	--	--	--	--	<1.0	--	<1.0	<1.0	<1.0	<1.0	--	<1.0	--	--
15-417	09-25-80	--	--	--	--	<1.0	--	<1.0	<1.0	<1.0	<1.0	--	<1.0	--	--
15-439	10-08-80	--	--	--	--	22	--	15	10	<1.0	<1.0	--	23.0	--	--

Table 12.--Chemical analyses of volatile organic compounds in ground water used for land-use comparisons--Continued

[Dashes indicate no data; <, less than; μg/L, micrograms per liter; land use codes are defined in table 1; aquifer codes are defined in table 10]

Local identifier	Land use code	Station number	Aquifer code	Date of sample	Benzene total (μg/L)	Bis 2-Chloro-ethyl ether total (μg/L)	Brom-oform total (μg/L)	Carbon-tetra-chlo-ride total (μg/L)	Chloro-benzene total (μg/L)	Chloro-form total (μg/L)	Di-chloro-bromo-methane total (μg/L)	Di-chloro-di-fluoro-methane total (μg/L)	1,2-Di-chloro-ethane total (μg/L)	1,1-Di-chloro-ethyl-ene total (μg/L)	1,2-Di-chloro-propane total (μg/L)
BK-1142	3	400713074584601	300WSCKO	11-18-80	--	<.10	<.10	<.10	<.10	0	<.10	--	<.10	--	.10
BK-1154	1	400440074544601	112TRNN	10-13-83	<1.0	--	<1.0	<1.0	<1.0	<1	<1.0	<1.0	<1.0	<1.0	<1.0
BK-1155	1	400434074544401	112TRNN	10-14-83	<1.0	--	<1.0	<1.0	<1.0	<1	<1.0	<1.0	<1.0	<1.0	<1.0
BK-1156	1	400430074550001	112TRNN	10-17-83	<1.0	--	<1.0	<1.0	<1.0	<1	<1.0	<1.0	<1.0	<1.0	<1.0
DE- 501	3	395545075144401	300WSCKO	07-28-83	<1.0	--	<1.0	<1.0	<1.0	<1	<1.0	<1.0	<1.0	<1.0	<1.0
DE- 882	2	395255075195101	300WSCKO	12-15-83	<3.0	--	<3.0	<3.0	<3.0	<3	<3.0	<3.0	<3.0	<3.0	<3.0
PH- 6	4	395348075105901	211MRPAL	11-23-82	<1.0	--	<1.0	<1.0	<1.0	<1	<1.0	<1.0	<1.0	<1.0	<1.0
PH- 12	4	395342075102101	211MRPAM	08-14-79	--	--	<.10	<.10	.10	0	<.10	--	.30	--	<.10
PH- 14	4	395336075101301	112TRNN	08-15-79	--	--	<.10	.40	.10	2	.60	--	.50	--	.10
PH- 15	4	395326075101501	211MRPAU	06-04-80	--	<.10	<.10	<.10	3.5	0	<.10	--	.30	--	.10
PH- 19	4	395314075101001	211MRPAL	08-15-79	--	--	.30	<.10	<.10	6	.10	--	5.3	--	<.10
PH- 20	4	395316075104901	211MRPAL	11-18-80	<1.0	--	--	<1.0	--	<1	<1.0	--	<1.0	<1.0	--
PH- 44	4	395410075120703	211MRPAL	08-16-79	--	--	.10	<.10	<.10	1	.10	--	.10	--	<.10
PH- 64	4	395403075104901	112TRNN	08-23-79	--	--	<.10	<.10	<.10	0	<.10	--	<.10	--	<.10
PH- 205	4	395711075082701	211MRPAL	11-06-80	<1.0	--	--	<1.0	--	<1	<1.0	--	<1.0	<1.0	--
PH- 242	4	395523075083901	211MRPAL	06-06-80	--	<.10	<.10	<.10	<.10	0	<.10	--	4.3	--	.10
PH- 283	3	395813075083501	300WSCKO	06-09-80	--	<.10	<.10	<.10	<.10	0	<.10	--	.10	--	<.10
PH- 288	4	395838075070901	112TRNN	06-19-80	--	<.10	<.10	<.10	1.1	15	<.10	--	4.6	--	8.2
PH- 344	4	400029075044901	300WSCKO	07-01-80	--	<.10	<.10	<.10	2.4	11	2.7	--	11	--	1.1
PH- 407	4	395431075075701	211MRPAL	11-05-80	<1.0	--	--	<1.0	--	<1	<1.0	--	<1.0	<1.0	--
PH- 415	4	395430075081001	211MRPAU	11-05-80	<1.0	--	--	<1.0	--	<1	<1.0	--	<1.0	<1.0	--
PH- 417	4	395429075080301	211MRPAL	11-05-80	7.0	--	--	<1.0	--	<1	<1.0	--	<1.0	<1.0	--
PH- 466	3	395534075084001	211MRPAL	06-05-80	--	<.10	<.10	<.10	<.10	1	<.10	--	2.7	--	.10
PH- 486	3	395801075101601	300WSCKO	06-05-80	--	<.10	<.10	<.10	<.10	11	.20	--	.70	--	<.10
PH- 592	3	400009075095501	300WSCKO	07-10-80	--	<.10	<.10	<.10	<.10	4	.40	--	44	--	.20
PH- 612	4	395736075092201	300WSCKO	06-12-80	--	<.10	<.10	<.10	<.10	0	<.10	--	.70	--	.10
PH- 724	2	400403074595801	300WSCKO	07-01-80	--	<.10	<.10	<.10	<.10	2	.20	--	<.10	--	<.10
PH- 748	4	395739075083701	300WSCKO	06-09-80	--	<.10	<.10	<.10	<.10	0	<.10	--	<.10	--	<.10
PH- 750	4	395445075083101	211MRPAL	09-17-80	--	<.10	<.10	<.10	<.10	0	.10	--	1.0	--	<.10
PH- 752	4	395443075083201	211MRPAU	08-21-80	--	<.10	<.10	<.10	<.10	0	<.10	--	<.10	--	<.10
PH- 771	4	400524074593501	300WSCKO	07-01-80	--	<.10	<.10	<.10	.20	2	.20	--	.20	--	<.10
PH- 780	4	395529075084601	211MRPAL	06-06-80	--	<.10	<.10	<.10	.10	1	<.10	--	3.4	--	.10
PH- 783	4	400019075101001	300WSCKO	07-03-80	--	<.10	<.10	<.10	2.7	<0	<.10	--	8.7	--	<.10
PH- 790	4	395318075131501	112TRNN	06-18-80	--	<.10	<.10	<.10	320	1	.10	--	.20	--	.20
PH- 793	3	395720075113801	300WSCKO	08-19-80	--	<.10	<.10	<.10	<.10	0	<.10	--	.50	--	<.10

Table 12.--Chemical analyses of volatile organic compounds in ground water used for land-use comparisons--Continued

[Dashes indicate no data; <, less than; µg/L, micrograms per liter; land use codes are defined in table 1; aquifer codes are defined in table 10]

Local identifier	Date of sample	1,3-Di-chloro-propene total (µg/L)	2,4-Di-nitro toluene total (µg/L)	Ethyl-benzene total (µg/L)	Methyl-bromide total (µg/L)	Methyl-ene chlo-ride total (µg/L)	1,1,2,2 Tetra-chloro-ethane total (µg/L)	Tetra-chloro-ethyl-ene total (µg/L)	Toluene total (µg/L)	1,2-Transdi-chloro-ethyl-ene total (µg/L)	1,1,1-Tri-chloro-ethane total (µg/L)	1,1,2-Tri-chloro-ethane total (µg/L)	Tri-chloro-ethyl-ene total (µg/L)	Tri-chloro-flouro-methane total (µg/L)	Vinyl chlo-ride total (µg/L)
BK-1142	11-18-80	--	--	--	--	<.10	--	1.5	--	--	.20	--	.1	--	--
BK-1154	10-13-83	<1.0	--	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
BK-1155	10-14-83	<1.0	--	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
BK-1156	10-17-83	<1.0	--	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
DE- 501	07-28-83	<1.0	--	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
DE- 882	12-15-83	--	--	<3.0	--	<3.0	<3.0	<3.0	3.3	<3.0	<3.0	<3.0	<3.0	<3.0	--
PH- 6	11-23-82	<1.0	--	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
PH- 12	08-14-79	--	--	--	--	--	--	<.10	--	--	--	--	<.1	--	--
PH- 14	08-15-79	--	--	--	--	--	--	.20	--	--	--	--	30.0	--	--
PH- 15	06-04-80	--	--	--	--	<.10	--	<.10	--	--	1.0	--	<.1	--	--
PH- 19	08-15-79	--	--	--	--	--	--	.10	--	--	--	--	.8	--	--
PH- 20	11-18-80	--	--	--	--	<1.0	--	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	--	--
PH- 44	08-16-79	--	--	--	--	--	--	<.10	--	--	--	--	.1	--	--
PH- 64	08-23-79	--	--	--	--	--	--	<.10	--	--	--	--	<.1	--	--
PH- 205	11-06-80	--	--	--	--	<1.0	--	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	--	--
PH- 242	06-06-80	--	--	--	--	.10	--	7.1	--	--	.10	--	5.3	--	--
PH- 283	06-09-80	--	--	--	--	<.10	--	1.2	--	--	.40	--	.4	--	--
PH- 288	06-19-80	--	--	--	--	.10	--	11	--	--	570	--	3.6	--	--
PH- 344	07-01-80	--	--	--	--	.10	--	230	--	--	17	--	32.0	--	--
PH- 407	11-05-80	--	--	--	--	<1.0	--	6.0	<1.0	<1.0	<1.0	<1.0	47.0	--	--
PH- 415	11-05-80	--	--	--	--	<1.0	--	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	--	--
PH- 417	11-05-80	--	--	--	--	<1.0	--	<1.0	<1.0	<1.0	<1.0	<1.0	5.0	--	--
PH- 466	06-05-80	--	--	--	--	.10	--	21	--	--	1.7	--	22.0	--	--
PH- 486	06-05-80	--	--	--	--	.50	--	.70	--	--	.90	--	2.9	--	--
PH- 592	07-10-80	--	--	--	--	.70	--	3.4	--	--	5.0	--	52.0	--	--
PH- 612	06-12-80	--	--	--	--	<.10	--	5.3	--	--	.80	--	9.4	--	--
PH- 724	07-01-80	--	--	--	--	2.7	--	1.1	--	--	5.4	--	<.1	--	--
PH- 748	06-09-80	--	--	--	--	<.10	--	<.10	--	--	.20	--	<.1	--	--
PH- 750	09-17-80	--	--	--	--	<.10	--	15	--	--	.10	--	38.0	--	--
PH- 752	08-21-80	--	--	--	--	<.10	--	<.10	--	--	<.10	--	<.1	--	--
PH- 771	07-01-80	--	--	--	--	.10	--	15	--	--	12	--	80.0	--	--
PH- 780	06-06-80	--	--	--	--	.30	--	20	--	--	.70	--	31.0	--	--
PH- 783	07-03-80	--	--	--	--	.10	--	30	--	--	.90	--	95.0	--	--
PH- 790	06-18-80	--	--	--	--	.20	--	.10	--	--	1.1	--	.3	--	--
PH- 793	08-19-80	--	--	--	--	<.10	--	<.10	--	--	.40	--	<.1	--	--

Table 12.--Chemical analyses of volatile organic compounds in ground water used for land-use comparisons--Continued

[Dashes indicate no data; <, less than; μg/L, micrograms per liter; land use codes are defined in table 1; aquifer codes are defined in table 10]

Local identifier	Land use code	Station number	Aquifer code	Date of sample	Benzene total (μg/L)	Bis 2-Chloro-ethyl ether total (μg/L)	Brom-oform total (μg/L)	Carbon-tetra-chlo-ride total (μg/L)	Chloro-benzene total (μg/L)	Chloro-form total (μg/L)	Di-chloro-bromo-methane total (μg/L)	Di-chloro-di-fluoro-methane total (μg/L)	1,2-Di-chloro-ethane total (μg/L)	1,1-Di-chloro-ethyl-ene total (μg/L)	1,2-Di-chloro-propane total (μg/L)
PH- 794	2	400008075035001	211MRPAL	10-20-80	--	2.1	<1.0	<1.0	4.3	0	<1.0	--	50	--	.20
PH- 796	4	395816075073301	112TRNN	10-10-80	--	<.10	<1.0	<1.0	.20	0	.10	--	.80	--	.40
PH- 799	3	395904075083401	300WSCKO	10-17-80	--	<.10	<1.0	<1.0	.20	3	.40	--	.80	--	1.9
TASKER-MORRIS STS SUMP	3	395550075100701	112TRNN	10-02-79	--	--	<.10	<.10	<.10	5	<.10	--	<.10	--	<.10

Local identifier	Date of sample	1,3-Di-chloro-propene total (μg/L)	2,4-Di-nitro toluene total (μg/L)	Ethyl-benzene total (μg/L)	Methyl-bromide total (μg/L)	Methyl-ene chlo-ride total (μg/L)	1,1,2,2 Tetra-chloro-ethane total (μg/L)	Tetra-chloro-ethyl-ene total (μg/L)	Toluene total (μg/L)	1,2-Transdi-chloro-ethyl-ene total (μg/L)	1,1,1-Tri-chloro-ethane total (μg/L)	1,1,2-Tri-chloro-ethane total (μg/L)	Tri-chloro-ethyl-ene total (μg/L)	Tri-chloro-flouro-methane total (μg/L)	Vinyl chlo-ride total (μg/L)
PH- 794	10-20-80	--	--	--	--	.10	--	1.9	--	--	1.1	--	2.3	--	--
PH- 796	10-10-80	--	--	--	--	<1.0	--	<1.0	--	--	.40	--	.1	--	--
PH- 799	10-17-80	--	--	--	--	.10	--	.20	--	--	.30	--	.1	--	--
TASKER-MORRIS STS SUMPS	10-02-79	--	--	--	--	--	--	11	--	--	--	--	6.4	--	--