U.S. DEPARTMENT OF THE INTERIOR
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NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION AND ENERGY

WATER-RESOURCES INVESTIGATIONS REPORT 93-4110
SHEET 4 OF 5

WATER QUALITY

The chemical quality of the ground water in the Kirkwood-Cohansey aquifer system and the surface water in the streams and rivers in the study area is presented on this sheet. Ground- and surface-water-quality data were compiled and analyzed in order to characterize ambient water quality throughout the study area.

The Kirkwood-Cohansey aquifer system is a major source of drinking water in the study area; therefore, the quality of the water in the aquifer and in the streams is of great importance. One ground-water sample was collected between July 1981 and July 1982 at each of 22 ground-water sites distributed throughout the study area. The ground-water samples were collected according to the methods described in Wood (1976) and Claassen (1982). One surface-water sample was collected at the Toms River near Toms River (01408500) streamflow-gaging station six times per year in 1988 and 1989. These surface-water samples were collected by using the equal-discharge-increment method described in Ward and Harr (1990). All water samples were analyzed at the USGS National Water-Quality Laboratory in Denver, Colorado; the results of these analyses are presented in tables 4-1 and 4-2 and are stored in the WATSTORE data base, which is maintained by the USGS. None of the 22 wells contained any of the constituents measured in concentrations that exceed the USEPA primary drinking-water regulations (U.S. Environmental Protection Agency, 1986a and 1988b); however, water from several wells exceeded the USEPA secondary maximum contaminant level (U.S. Environmental Protection Agency, 1986c) established in accordance with the Safe Drinking Water Act (PL 93-523). Water from 10 of the 22 wells exceeded the limit of 0.3 mg/L (milligrams per liter) for iron, water from 5 of the 22 wells exceeded the limit of 0.05 mg/L for manganese, and water from 21 of the 22 had a pH less than the acceptable range of 6.5 to 8.5.

Results of the water-quality analyses also were used to construct the Stiff diagrams in figure 4-1. These diagrams represent the relative concentrations of major ions dissolved in the water. Major cations are plotted to the left of the vertical axis, and major anions are plotted to the right. The Stiff diagram shown for the surface-water station at Toms River near Toms River (01408500) represents the composition of a sample collected in March 1988.

The Stiff diagrams in figure 4-1 indicate that the chemistry of the water from the Kirkwood-Cohansey aquifer system is not uniform throughout the study area. The quality of the water in an unconfined aquifer system such as the Kirkwood-Cohansey aquifer system typically varies more than that in a confined aquifer system. In many cases, the quality of water in shallow, unconfined systems is not uniform because the flow paths are short and the residence time of the water is insufficient to allow it to reach equilibrium with the surrounding aquifer matrix. The Cohansey Sand is composed mainly of quartz sand and gravel, which does not affect significantly the chemistry of the water moving through it, so that the chemical composition of the water does not change with time. Differences in the ground-water chemistry in the study area are probably the result of upward flow of ground water from deeper units with different mineralogic compositions or, even more likely, a result of the unimpeded downward movement of surface-generated constituents.

Despite the variations in their shapes, the Stiff diagrams indicate that sodium plus potassium and chloride are the major cations and anion, respectively, in a majority of the ground-water samples. In addition, the similar magnitudes of the sodium plus potassium component and the chloride component of samples from most wells most likely indicates a common source, such as sea salt. Sea salt can be introduced naturally into ground-water and surface-water systems in two ways: through atmospheric inputs of marine aerosols and by saltwater intrusion into the ground-water system. High concentrations of sodium and chloride could also be a result of the effects of human activities, such as runoff from roads that have been salted during the winter months, industrial waste, and leachate from fertilized land. Natural sources of potassium in the system include the decay of organic matter in forested areas that leaches into the ground water and, in deeper wells (those screened in and near the Kirkwood Formation), the dissolution of weathered feldspars and micas found in the Kirkwood Formation.

In addition to chloride, bicarbonate is a predominant anion that was present in several ground-water samples throughout the study area. The oxidation of organic matter and the dissolution of carbonaceous shell material contribute to high bicarbonate concentrations in the ground water. High concentrations of bicarbonate also are seen in water from deeper wells (those screened in and near the Kirkwood Formation) which contains considerably more cation-rich clay than the quartz-rich Cohansey Sand. Nitrate is a major constituent in the water from three wells in the study area. These wells are located in suburban areas; consequently, the nitrate concentrations could be attributed to leaky septic systems or to the application of lawn fertilizers.

Surface-water-quality data for the study area is limited; however, available information from the sample collected at the Toms River near Toms River streamflow-gaging station indicate that sodium plus potassium and, to a lesser extent, calcium, are the dominant cations and sulfate and chloride are the dominant anions (fig. 4-1). The surface water in the study area contains more sulfate than does the ground water. This indicates that the sulfate in the surface water probably originates from a source other than ground water, such as direct runoff, precipitation, or both.

Surface-water quality at Toms River near Toms River has been monitored by the USGS since 1963. Boxplots showing the concentrations of selected constituents in water samples collected at this station from January 1979 through December 1989 (fig. 4-2) are constructed by using the DWGRAPH boxplot program written for use with USGS WATSTORE data (Maddy and others, 1990). These diagrams display the statistical distribution of reported water-quality values. Table 4-3 is a statistical summary table of the data used in the boxplot.

The median monthly concentrations of fecal coliform bacteria at Toms River near Toms River for the 13-year period from November 1976 through November 1989 are shown in figure 4-3. Colony counts are affected by temperature and the availability of nutrients; high counts typically coincide with warm months. A similar seasonal trend is observed for fecal streptococci.

The time-series plot of dissolved nitrate plus nitrite and discharge at Toms River near Toms River from September 1979 through November 1989 (fig. 4-4) shows an inverse relation between the two variables. Peaks in the concentration of nitrate plus nitrite coincide with low discharges, and low nitrate plus nitrite concentrations coincide with high discharges, indicating that high discharge dilutes nitrate plus nitrite, thereby reducing the concentration.

EXPLANATION

STUDY AREA BOUNDARY

LOCATIONS OF WATER-QUALITY SITES--

29-673   Ground-water site and identifier

1408500   Surface-water site and identifier

STIFF DIAGRAM

Figure 4-1.--Locations of water-quality stations and Stiff diagrams showing ionic composition of water samples.

Base from U.S. Geological Survey, 1:24,000, quadrangles, Roosevelt, 1948;
Adelphia, 1948; Farmingdale, 1943; Cassville, 1948; Lakehurst, 1948;
Lakewood, 1947; Point Pleasant, 1953; Whiting, 1949; Keswick Grove, 1949;
Toms River, 1953; Seaside Park, 1953

Table 4-1.--Selected results of water-quality analyses of ground-water samples from 22 wells

Table 4-2.--Selected results of water-quality analyses of surface-water samples from Toms River near Toms River, N.J. (01408500)

Table 4-3.--Statistical summary of selected water-quality data, Toms River near Toms River, N.J. (01408500), January 1979 through November 1989
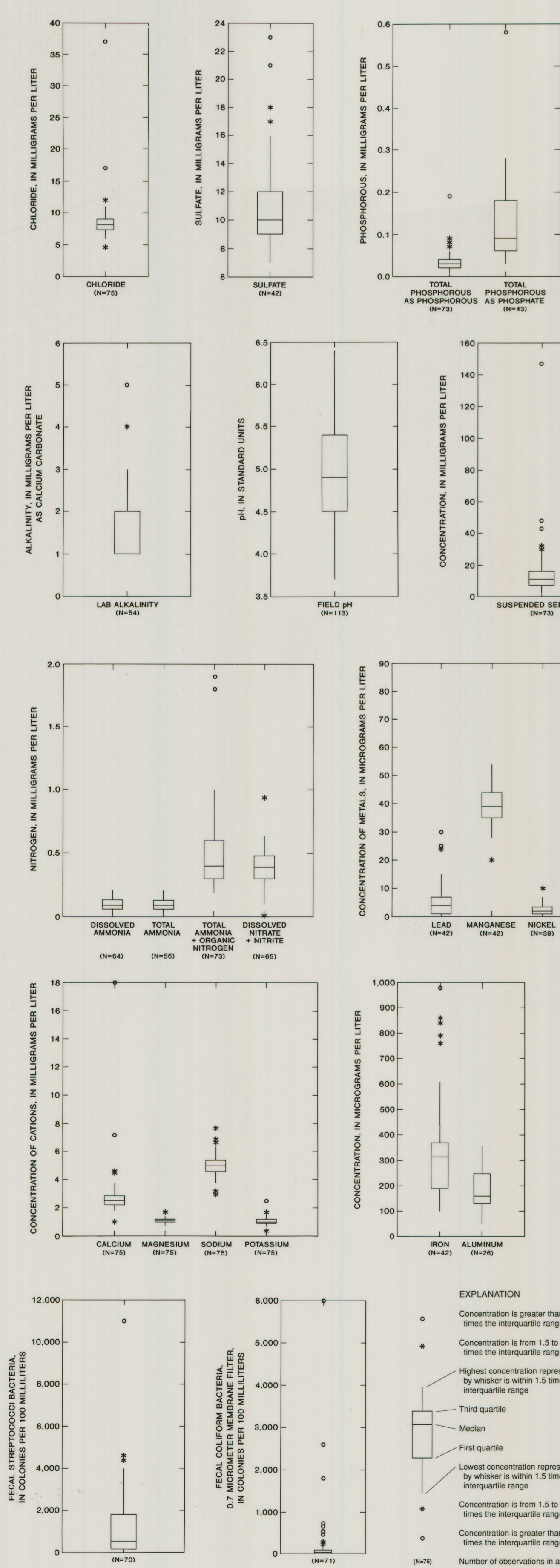
Figure 4-2.--Boxplots showing the range of concentrations of selected physical, chemical, and biological constituents and characteristics at Toms River near Toms River, N.J. (01408500), January 1979 through December 1989.
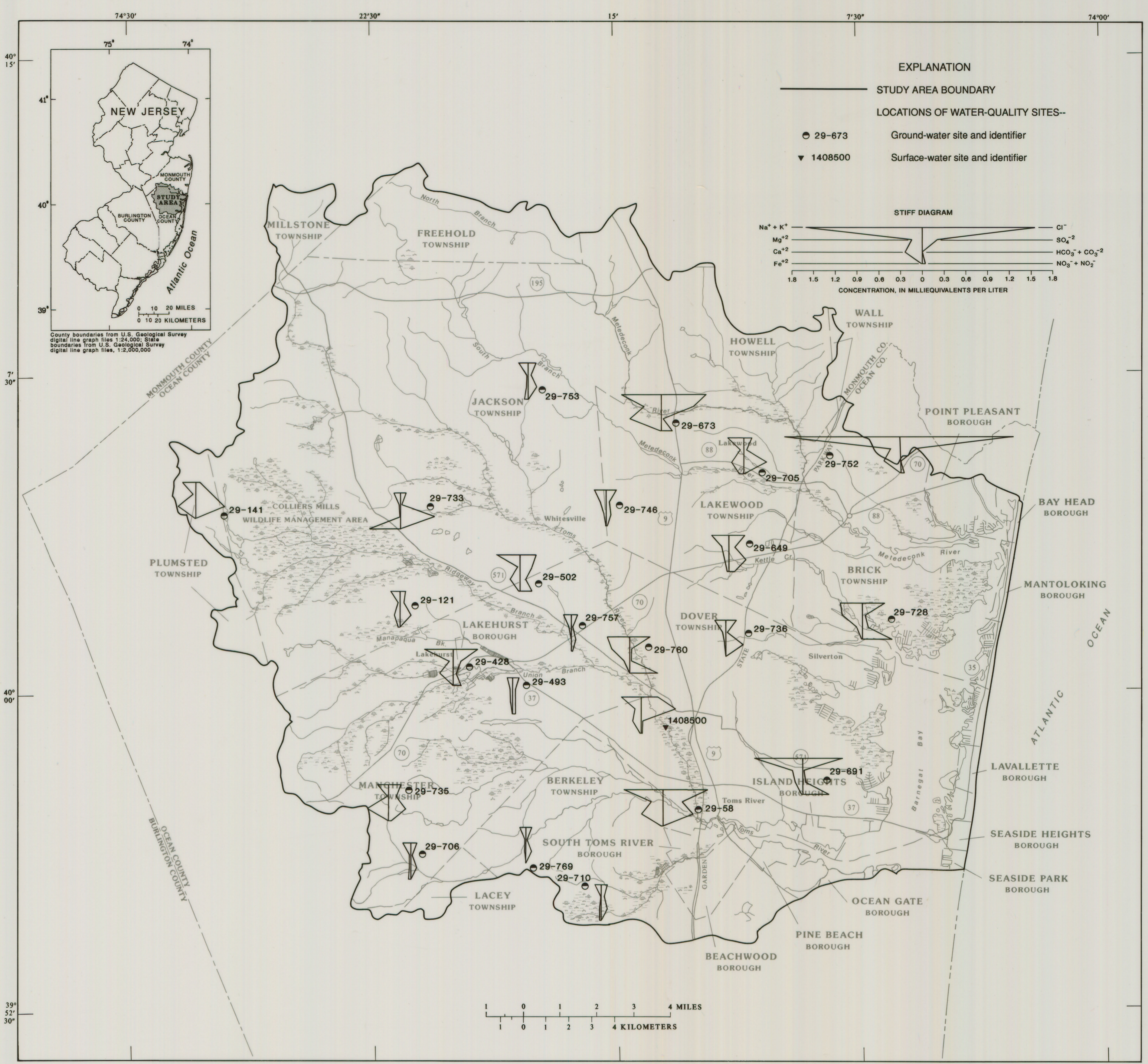
Figure 4-3.--Median monthly concentrations of fecal coliform bacteria at Toms River near Toms River, N.J. (01408500), November 1976 through November 1989.

Figure 4-4.--Concentrations of dissolved nitrate plus nitrite and total discharge at Toms River near Toms River, N.J. (01408500), September 1979 through November 1989.

HYDROLOGY OF THE UNCONFINED AQUIFER SYSTEM, TOMS RIVER, METEDECONK RIVER, AND KETTLE CREEK BASINS, NEW JERSEY, 1987-90

By

Martha K. Watt, Melissa L. Johnson, and Pierre J. Lacombe

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