

WATER QUALITY OF BARRON COUNTY, WISCONSIN

Alexander Zaporozec

1987

Published by and available from Wisconsin Geological and Natural History Survey...

Introduction

The Wisconsin Geological and Natural History Survey (WGNHS) conducted a random sampling of private wells in Barron County from July 1983 to October 1985 to define the current quality of groundwater in the county and to identify potential problem areas.

Sixty complete chemical analyses were available for determining basic characteristics of groundwater quality in the county (Holt and Skinner, 1973); nine additional samples were collected by WGNHS and analyzed by the U.S. Geological Survey (USGS) laboratory.

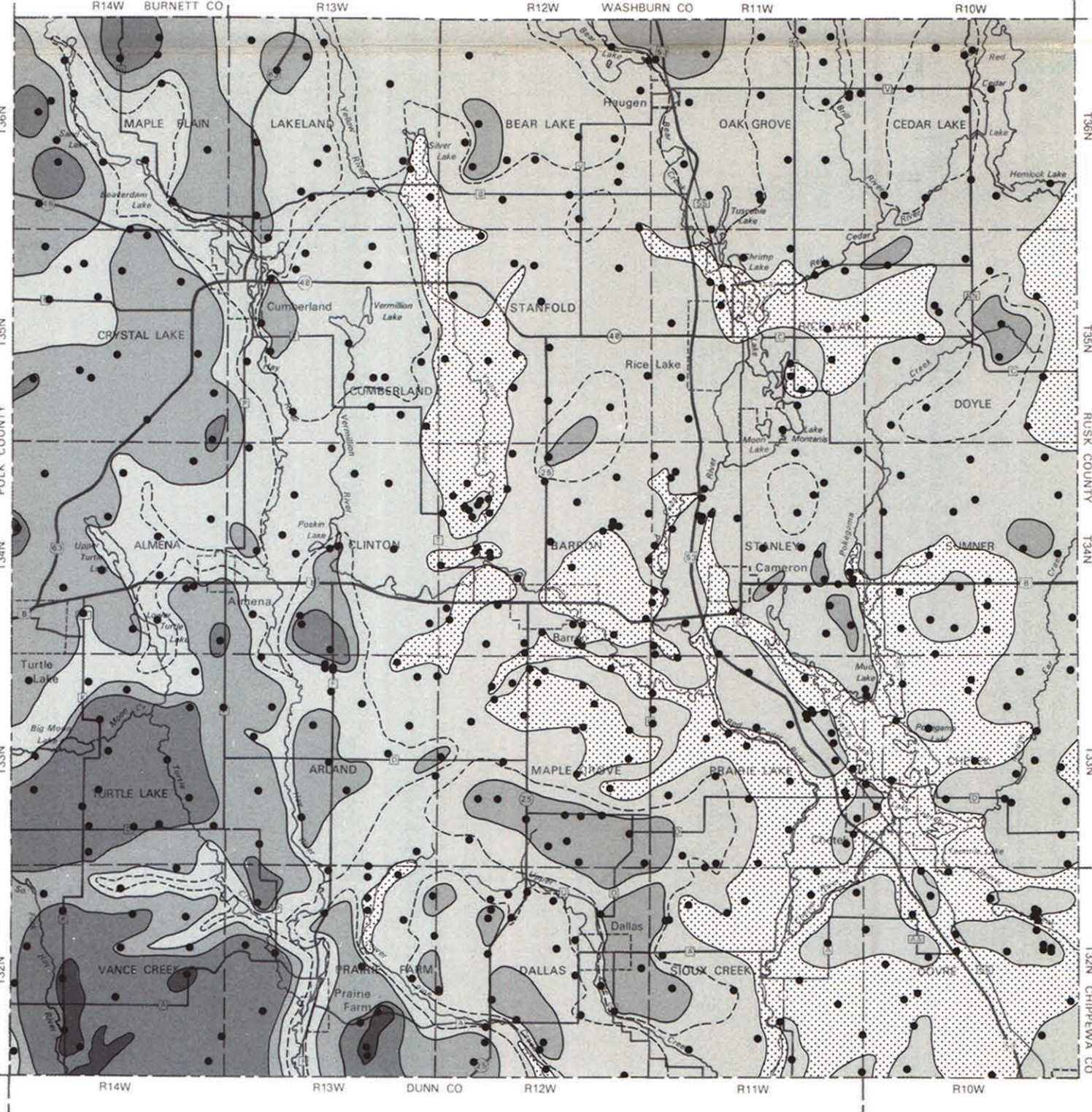


Figure 2. Generalized mineral concentration of groundwater in Barron County.

Cartography by K.M. Campbell Map 87-21 A part of the Barron County Atlas

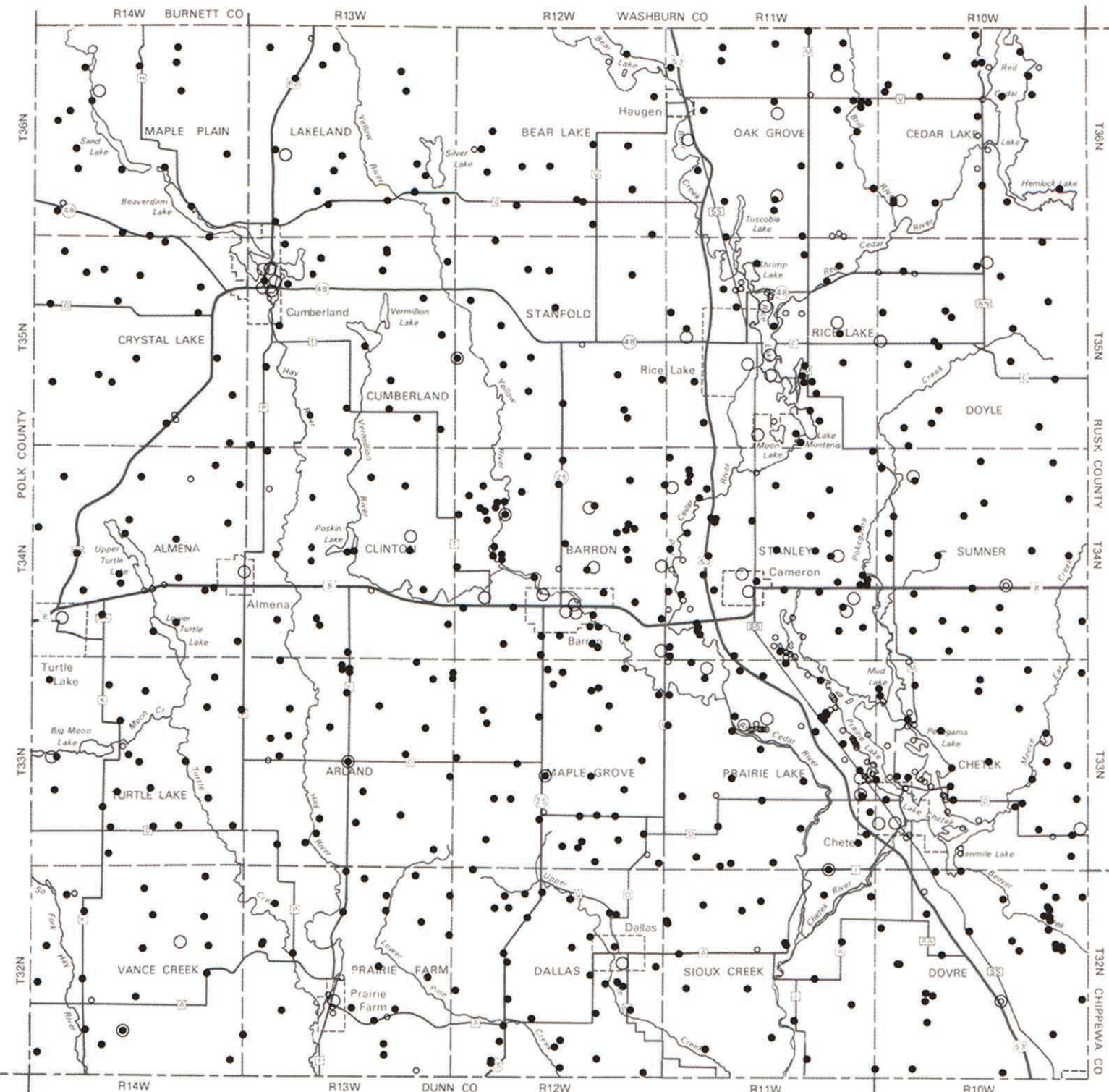


Figure 1. Well-water sampling locations in Barron County, 1983-85.

General water-quality problems

The quality of Barron County groundwater is much better than required by drinking-water standards (Wisconsin Administrative Code, 1982). Only a few of the properties and constituents of groundwater listed in table 1 have caused or have a potential to cause water-quality problems.

Minor water-use problems can be caused by hardness. Groundwater in Barron County is, on the average, moderately hard. The countywide median hardness for 198 samples was 84 mg/L as CaCO3 (table 1).

Table 1. Summary of chemical and physical characteristics of groundwater in Barron County (all in milligrams per liter, mg/L, unless indicated otherwise)

Table with 7 columns: Constituent or property, No. of samples, Maximum, Minimum, Median, Mean, No. over limit. Rows include Alkalinity, Bicarbonate, Calcium, Chloride, Fluoride, Hardness, Iron and Manganese, Magnesium, Nitrate-nitrogen, pH, Potassium, Sodium, Specific conductance, Sulfate, Total dissolved solids, Chloride, Hardness, Nitrate-nitrogen, and Total dissolved solids.

For limits, see Wisconsin Administrative Code, 1982. *Includes only results of the complete chemical analysis. Values from the analyses of samples collected during 1983-85 are below.

Table 2. Concentrations of minor and trace constituents in groundwater in Barron County (in micrograms per liter, µg/L)

Table with 6 columns: Constituent, No. of samples, Maximum, Minimum, Median, Maximum limit. Rows include Aluminum, Arsenic, Barium, Beryllium, Boron, Chromium, Cobalt, Copper, Lead, Molybdenum, Nickel, Scandium, Selenium, Silver, Tantalum, Zinc, and various anions.

From Wisconsin Administrative Code (1982). Source: Arendt and others (1978).

Nitrate

The concentration of nitrate in groundwater in Barron County generally was low during this study. Nitrate-nitrogen (NO3-N) concentrations ranged from 0 to 42 mg/L and averaged 3.0 mg/L (table 1). Concentrations in groundwater vary widely with respect to season, depth to water, location of wells, type of soil or sediment in the unsaturated zone, and available sources of nitrate.

An unusually large amount of nitrate in well water may indicate pollution from septic tanks, privies, manure pits, or barnyards. Even though nitrate is not a problem in itself, it may serve as an indicator that the water may contain harmful bacteria, which also may be carried into the aquifer from these sources of pollution.

High concentrations of nitrate can be a serious, though easily treated, blood disorder in infants called infantile methemoglobinemia (or cyanosis). Under certain conditions, nitrate can be reduced to nitrite (NO2) by denitrifying bacteria in the upper digestive tract of some infants.

Infants under 6 months of age are most susceptible to this disease, but not all infants are affected. Many infants have drunk water with nitrate concentration higher than 10 mg/L and have not developed the disease.

To determine the nitrate concentrations in Barron County, 722 analyses were collected from various sources. Table 3 shows that about 10 percent of the samples (76 samples) exceeded the established limit for drinking water (10 mg/L NO3-N) and that only 20 of the 76 samples contained more than 20 mg/L.

Nitrate in groundwater is derived from a variety of natural and human sources. The principal natural sources are soil nitrogen (product of decaying vegetation, growth of certain plants, and wild-animal waste) and atmospheric deposition.

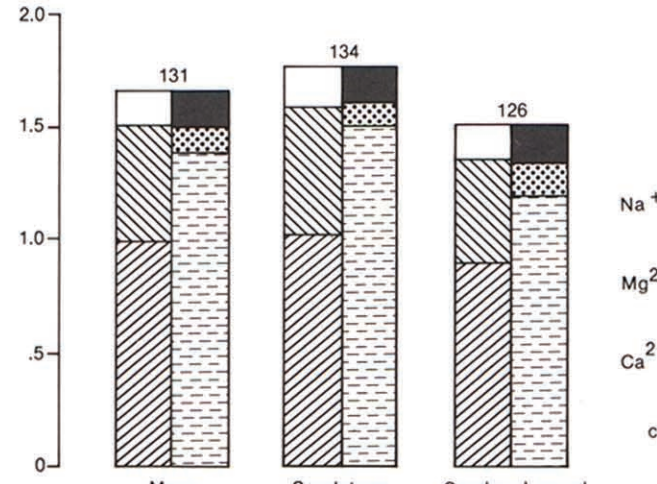


Figure 3. Mean composition of water in Barron County, by aquifer.

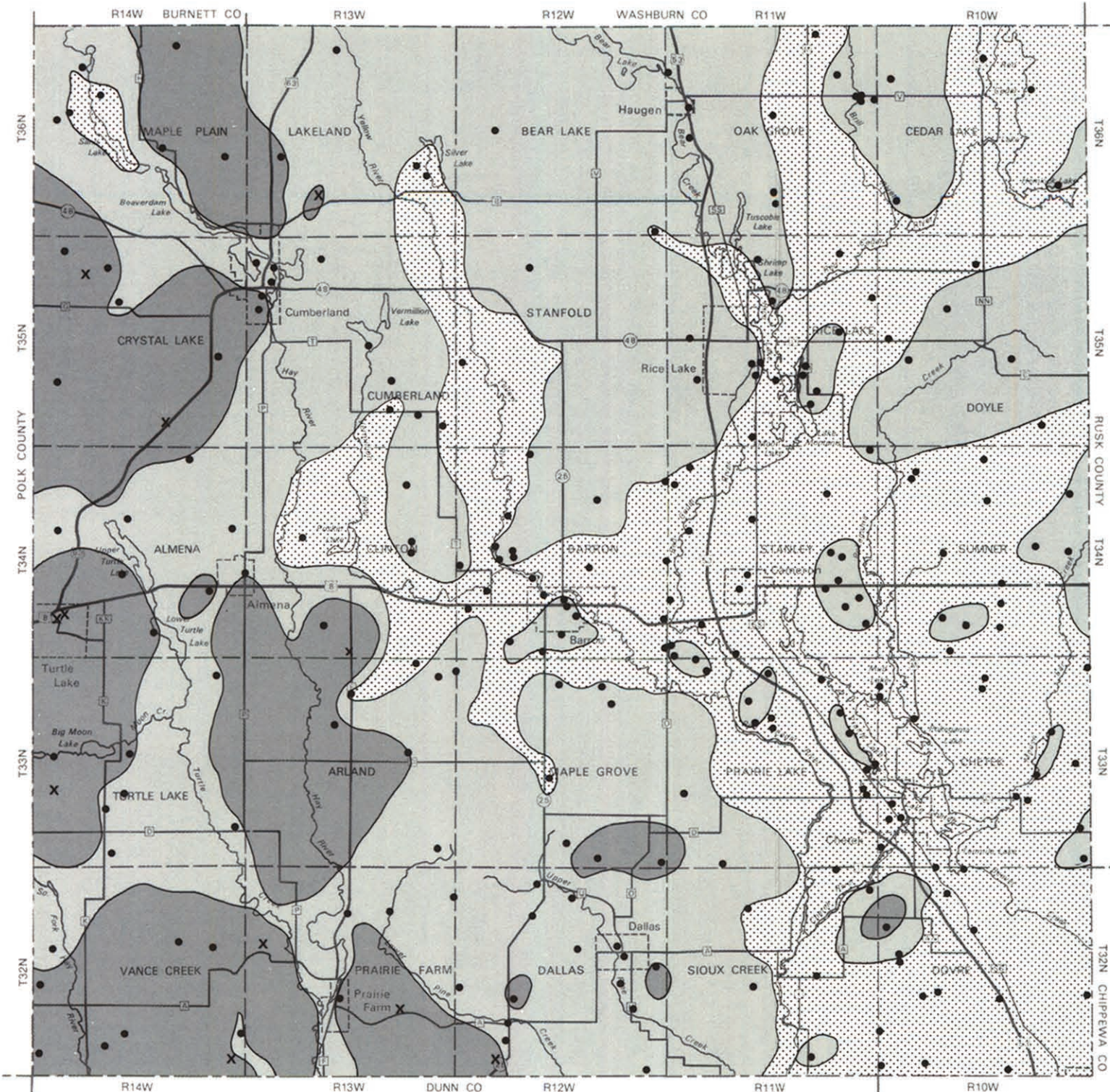


Figure 4. General distribution of hardness of groundwater in Barron County.

Table 3. Barron County nitrate survey, 1983-85

Large table showing nitrate survey data. Columns include Township, No. of samples, % of wells, Nitrate-nitrogen concentrations in mg/L (0-0.9, 1.0-2.99, 3.0-9.99, 10.0-19.9, 20.0 & more), Total no., % of wells, Highest value, Date, and Township average. Rows list various townships and a totals row.

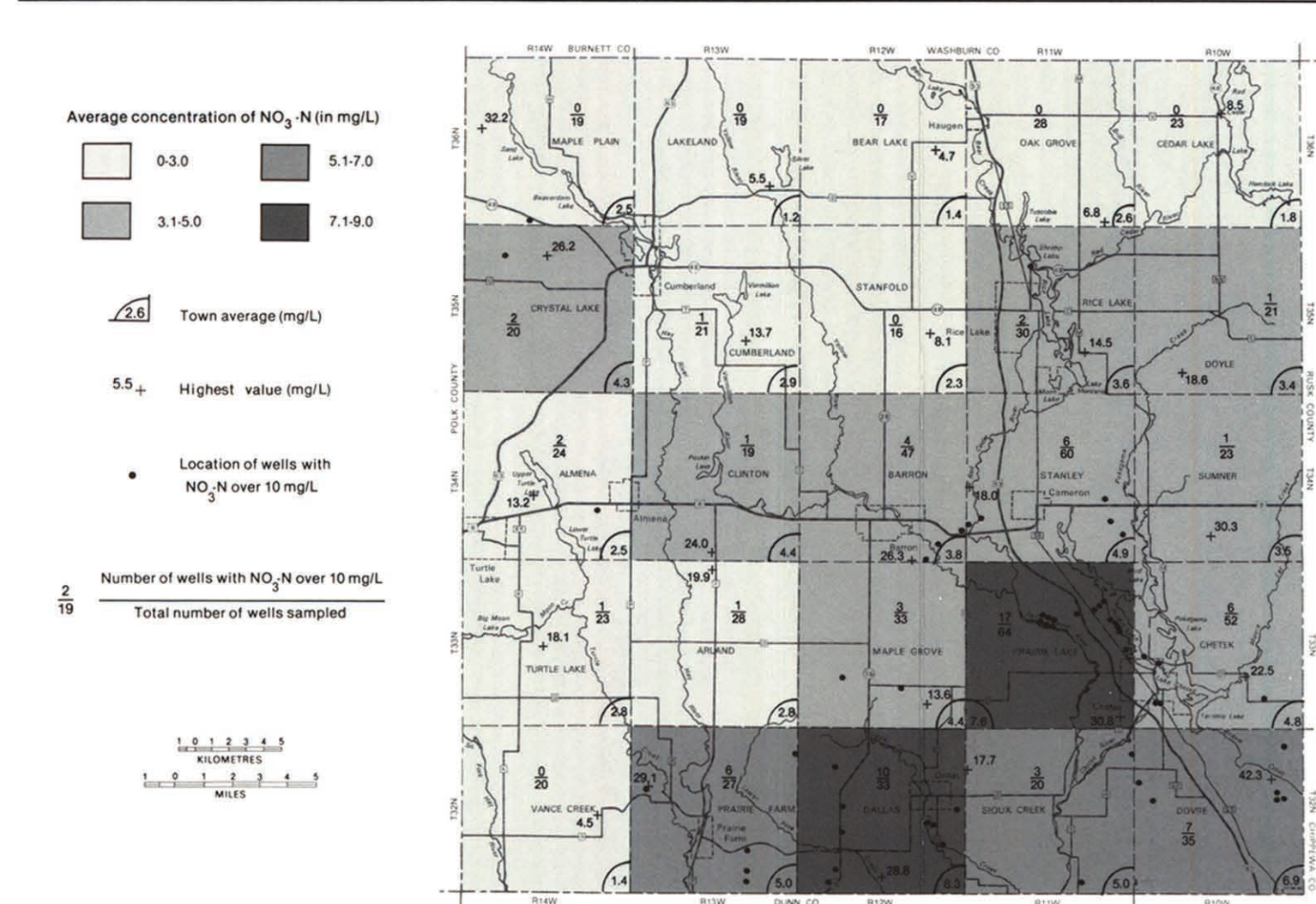


Figure 5. Nitrate distribution in Barron County, 1983-85, by town.

Twenty-two wells that exceeded 10 mg/L NO3-N during the first round of random sampling in 1983 were resampled in 1984 and showed essentially the same nitrate concentrations. The continuing presence of high amounts of nitrate indicated the presence of a pollution source.

Nitrate concentrations vary in space and time. Areal distribution of nitrate in Barron County was described previously. However, nitrate varies not only horizontally, but also vertically. In most instances, elevated nitrate concentrations can be found in water from relatively shallow wells (less than 50 ft deep).

Table 4. Well casing depth versus nitrate concentration in Barron County, 1983-85.

Table with 6 columns: Casing depth (ft), No. of wells, % of wells, Nitrate-Nitrogen Concentration (mg/L) in three ranges (0-0.9, 1.0-9.9, 10.0 & more), and % of wells in each range.

In an attempt to investigate long-term variations in nitrate concentrations over time, nitrate data were compiled for 232 samples taken by various agencies during 1964-82. These analyses are not directly comparable with the results of the 1983-85 sampling because the samples were not taken from the same wells and were not randomly distributed.

A comparison of two DNR studies from 1980 and 1986 shows that the nitrate concentration has not changed significantly during the last 5 years. Noncommunity public water supply systems in Barron County (i.e., systems serving at least 25 people per day at least 60 days per year) are being periodically sampled for nitrate by the DNR.

There are two basic options in dealing with the nitrate problem: 1) reduce the nitrate intake at the source and 2) develop an alternative source of water. The first option includes proper location, construction, and maintenance of water wells.

Three wells in the county were sampled frequently during our study to investigate short-term, seasonal variations of nitrate concentrations (fig. 6). Wells 49 and 4, both in Prairie Lake Township, were initially sampled quarterly during the summer of 1983.

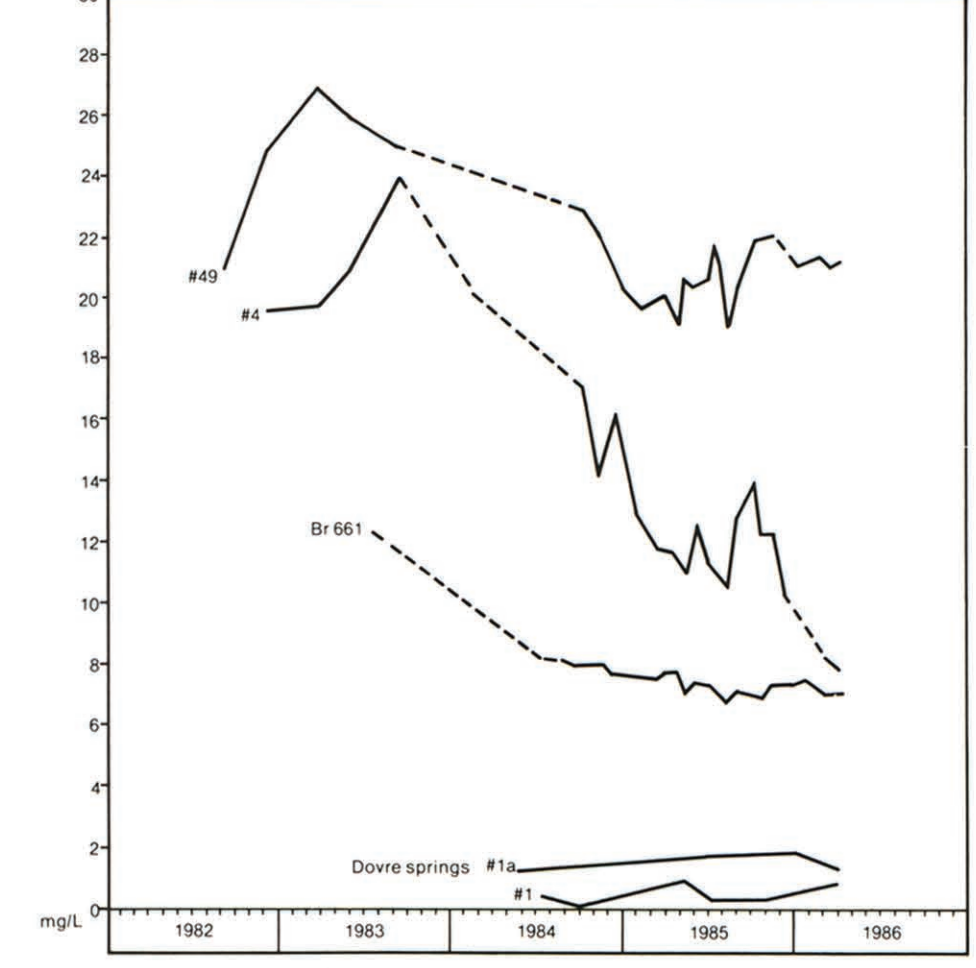


Figure 6. Seasonal variations in nitrate concentration in southern Barron County.

- REFERENCES
Arendt, J.W., and others, 1978. Hydrogeochemical and stream sediment reconnaissance basic data for Rice Lake UTM5 quadrangle. Wisconsin DNR NURE Program. U.S. Department of Energy Open File Report GJ/BX-95/78, Grand Junction, Colorado, 34 p.
Devaui, R.W., 1975a. Dissolved-solids concentrations of water in the sand-and-gravel aquifer. Wisconsin: Wisconsin Geological and Natural History Survey map, scale 1:1,000,000, 1 sheet.
Devaui, R.W., 1975b. Dissolved-solids concentrations of water in the sandstone aquifer. Wisconsin: Wisconsin Geological and Natural History Survey map, scale 1:1,000,000, 1 sheet.
Holt, C.L., Jr., and Skinner, E.L., 1973. Groundwater quality in Wisconsin through 1972. Wisconsin Geological and Natural History Survey information Circular 22, p. 26-29.
Madison, R.J., and Brunnett, J.O., 1985. Overview of the occurrence of nitrate in groundwater of the United States. In National Water Summary 1984. U.S. Geological Survey Water-Supply Paper 2275, p. 65.
Stroess, R.E., 1986. Noncommunity well nitrate resampling. Wisconsin Department of Natural Resources Administrative Rules, vol. 11, Rules of Department of Natural Resources, chapter NR 109.
Wisconsin Department of Natural Resources, 1980. Nitrate levels in small public water systems of Wisconsin. Wisconsin Department of Natural Resources. Bureau of Water Quality, 12 p.