PHYSICAL SETTING OF BARRON COUNTY, WISCONSIN

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Introduction

Barron County, 903 square miles (approximately 578,000 acres) in size, ranks as the 24th largest county of Wisconsin. Agriculture is the largest industry. With about 2,000 farms and an annual gross income of approximately $145 million in 1984, Barron County is the richest agriculturally of any Wisconsin county this far north. Dairying (the primary agricultural industry), turkey raising, and vegetable production for commercial processing support a strong agribusiness sector. Recreation is a growing economic asset of the county.

Almost all water used in 1985 for residential, municipal, industrial, and agricultural purposes came from groundwater sources. Concern over the quality of groundwater supplies prompted the Barron County government to initiate a study to define the current quality of groundwater and identify existing and potential pollution sources and potential problem areas. The Wisconsin Geological and Natural History Survey (WGNHS) and the Barron County Zoning Department began a joint study in July 1983; field work was completed in April 1986.

Information from this study is presented in several sheets, collectively called the Barron County Atlas. The atlas is designed to describe, in general terms, the physical environment of Barron County, emphasizing the availability, distribution, movement, and quality of groundwater and its potential to be polluted. In general, this information is not detailed enough to be applicable for site-specific situations. Local details have been generalized to fit the mapping scales (1:100,000 and 1:250,000). In places, data scarcity has required generalized interpretations. Detailed studies of individual areas may be necessary when specific information is needed.

Many organizations and people assisted the study by providing data and information. Among the contributors are the Wisconsin Department of Natural Resources (DNR), Northwest District in Spooner and Bureau of Water Supply in Madison; the U.S. Department of Agriculture Soil Conservation Service (SCS) and Agricultural Stabilization and Conservation Service offices in Barron; and the U.S. Geological Survey District Office in Madison. The author is especially indebted to Gene Hausner, SCS District Conservationist; to Don Drost, County Agricultural Agent; and to Dale Hanson, County Conservationist, for providing help in collecting local data. Many individuals and Jerome's Food, Inc., allowed access to their wells for collection of water samples for chemical analysis. Acknowledgment is given to all reviewers of the individual atlas sheets, who provided helpful suggestions. Special appreciation is due to the Barron County Board of Supervisors who, on the recommendation of the Land Conservation Committee and Planning and Zoning Committee, contributed a part of the cost of the study; and to Dale Thorsbakken, County Zoning Administrator, for enthusiastic support of the study and general guidance, and the generous help that he and his staff provided in collecting water samples and in gathering basic data.

Physiography

Barron County consists of a fairly level to gently sloping central plain rimmed on the south by dissected sandstone and dolomite hills, on the north by moraines, and on the east by a range of quartzite ridges. Parts of Barron County lie in three different physiographic provinces of Wisconsin (fig. 1). Most of the county lies in the Central Plain province (Martin, 1932), where a combination of smooth uplands, rolling till plains, and flat outwash plains predominate. The southwestern hills are part of the Western Upland province; the quartzite ridge in the eastern portion of the county, known as the Blue Hills, is part of the Northern Highland province. The prominent landscape features are the extensive ground moraine and the outwash plains, which cover approximately 55 and 25 percent, respectively, of the surface area of the county. The parts of northern Barron County covered by the youngest glacial deposits have a characteristic glacial landscape consisting of flat ice-walled-lake plains and high-relief hummocky topography (Johnson, 1984).

The land surface ranges from 995 feet above mean sea level (msl) at the point where the Red Cedar River leaves Barron County to 1,630 feet above msl in the Blue Hills in the southeastern part of the town of Doyle. Topography of the central area is characterized by flat outwash plains and flat to gently rolling till uplands with low hills of sandstone. There, relief is usually less than 100 feet. Terrain is more varied in the southwestern and south-central parts of the county, where the sandstone plateau is dissected by relatively steep-sloped valleys and in the northwest. In these areas, elevation changes are between 100 and 200 feet. Relief varies as much as 300 feet in parts of the Blue Hills.

U.S. Geological Survey topographic maps, showing relief features, woodlands, and water, are available for the entire county at a 1:24,000 scale (1 inch = 2,000 feet) (fig. 2).

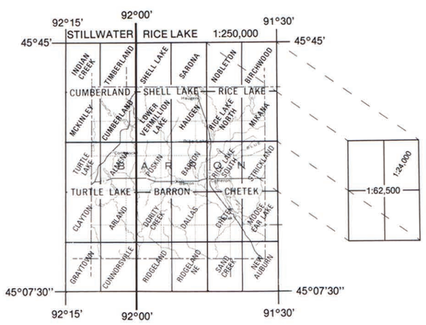

Figure 2. Topographic map coverage of Barron County.

Surface water

Barron County, rich in surface-water resources, ranks 17th in the state in total surface-water area. Approximately 18,550 acres (about 3% of the county) are covered by water, exclusive of numerous small pothole ponds (Wis. Legislative Reference Bureau, 1981). Lakes account for 94 percent of the total water area, and Barron County ranks 12th in the state in the density of lakes per square mile (0.43). These lakes provide the basis for a growing recreational industry. Named lakes and impoundments in the county number 111 (Sather and Threinen, 1964). Red Cedar Lake, a natural lake, is the largest single body of water (1,881.8 surface acres); Prairie Lake, in the Chetek Lake chain, is the largest impoundment (1,545 surface acres). The greatest maximum depth (106 feet) occurs in Beaver Dam Lake. A majority of the larger lakes (those with surface areas of 100 acres or more) are ice-block lakes, situated in the outwash plain or at the contact point between till plains and the recessional moraine.

Except for the parts along the western boundary, which fall into the St. Croix River basin, Barron County lies within the Chippewa River basin (fig. 3) and is drained by the Red Cedar River, a major tributary of the Chippewa River. The county area can be subdivided into five major watersheds: portions of the St. Croix River basin, Hay River, Yellow River, Red Cedar River, and Lake Chetek/Chetek River. The Yellow River watershed has been included as one of the top 20-percent priority watersheds for the Wisconsin Nonpoint Source Water Pollution Control Program. Three other watersheds have been designated as potential priority watersheds: Hay River, Upper Pine Creek, and Lake Chetek (fig. 3).

There are 55 named, permanent streams in the county; total stream length is 366 miles (Sather and Threinen, 1964). The Red Cedar River is the largest stream (505 acres of surface water, not counting its impoundments), and it has an average width of 110 feet. The gradients of the streams of Barron County are moderate to low. The steepest is Silver Creek in the town of Doyle in the Blue Hills, which drops an average of 58 feet per mile. The lowest is Sweeny Pond Creek in the town of Arland, which drops 2 feet per mile. Overall gradient of the Red Cedar River is fairly uniform, about 4.5 feet per mile from Red Cedar Lake to the river mouth (Young and Hindall, 1972).

The streams in Barron County are in a young stage of development. Glaciation destroyed the preglacial drainage network and the streams are beginning to develop a dendritic drainage pattern, which is especially well defined in the southern part of the county. Because of the relatively recent retreat of the continental glacier in northern Barron County (10,000 to 15,000 years ago), streams have accomplished little in draining this area, and numerous lakes and swamps are present there. The central plain also has poorly developed drainage because of the high permeability of outwash sand and gravel. Runoff in streams that cross the plain is mainly groundwater.

Climate

The location of Barron County near the center of the North American continent provides a typical temperate, subhumid, continental climate. It is characterized by the regular alternation of four climatic seasons with marked seasonal changes and by moderate amounts of rainfall.

The temperature varies widely from season to season and also from year to year. The average annual temperature is 42.3°F, but temperature extremes of 48°F below and 102°F above zero have been recorded. The hottest month is July, when the average is 70°F; the coldest is January, when the average temperature drops below 20°F (fig. 4). The growing season averages 125 days. The average date of the last freeze is May 15, and of the first freeze, September 25. Soil begins to freeze in the latter part of November and thaws in late April; frost depth reaches its average maximum of 26 inches in late February.

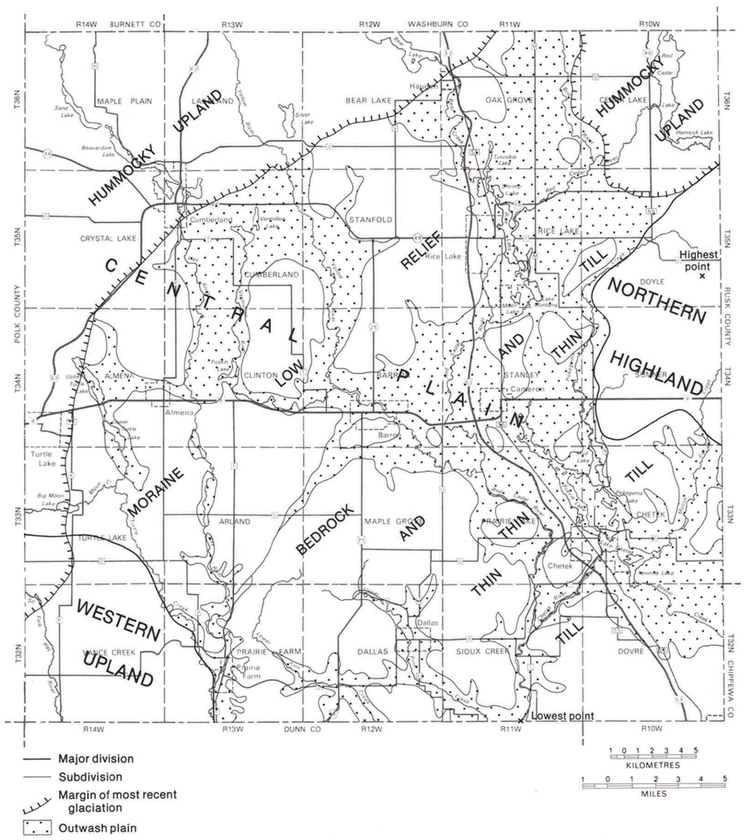

Figure 1. Major physiographic areas and landscape features of Barron County, Wisconsin (based on Martin, 1932 and Johnson, 1984).

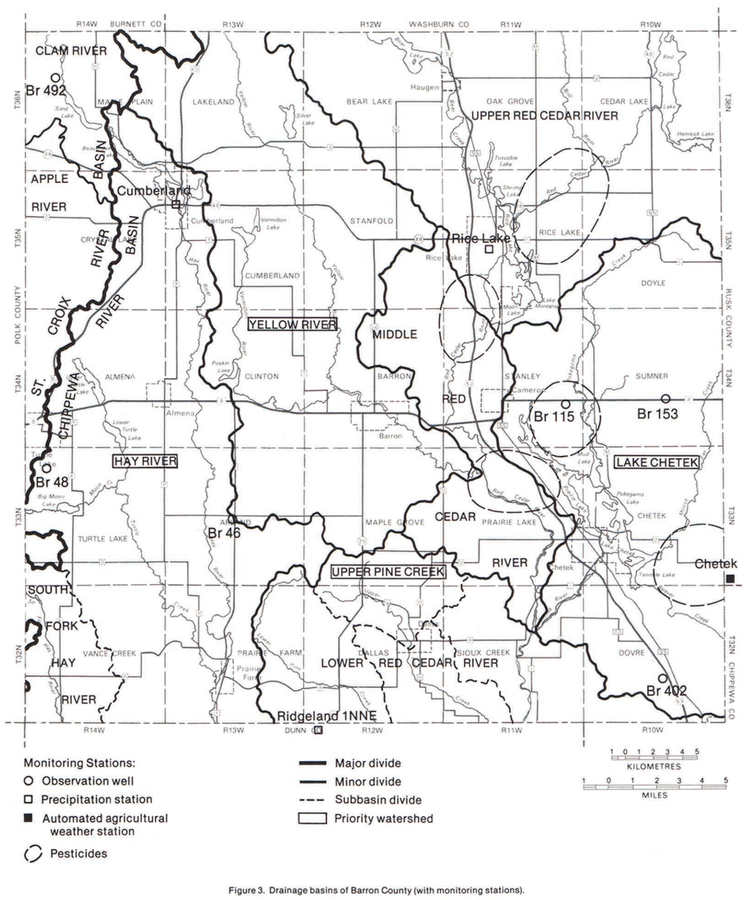

Figure 3. Drainage basins of Barron County (with monitoring stations).

Precipitation is ordinarily adequate for the crops and water supplies of the county. Normal annual precipitation is about 32 inches; the greatest amount (65% of the total) is concentrated between May and September (fig. 4). The wettest months are June and August (> 4 in.); the driest are January and February (< 1.00 in.). About 70 percent of the average precipitation is lost by evaporation and used by plants, and 30 percent runs off in streams (Young and Hindall, 1972).

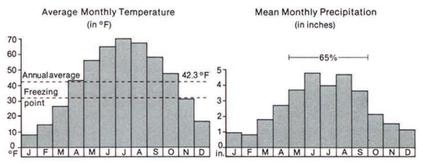

Figure 4. Average monthly temperature and mean monthly precipitation in Barron County (data from National Weather Bureau stations at Cumberland, Rice Lake, and Ridgeland).

Even though Barron County normally has adequate precipitation, drought periods are common and may cause problems in agriculture and water supply by depleting soil moisture, by lowering groundwater and lake levels, and by reducing streamflow. For example, during 10 of the last 35 years, precipitation at Cumberland did not reach 85 percent of the average for that period (fig. 5); the driest periods were observed in the late 1950s and in 1976. However, precipitation in Barron County has been above normal for five of the last six years and has caused flooding problems for owners of low lands and lakeshores.

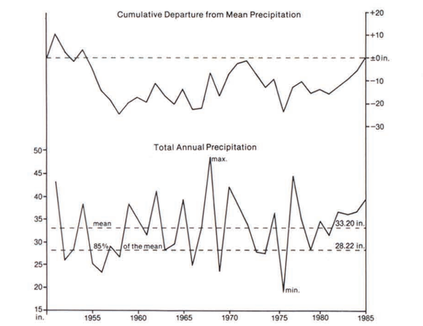

Figure 5. Precipitation at Cumberland, Wisconsin, 1951—85.

Water use

The entire population of Barron County (currently, about 41,000 people) relies on groundwater as a source of water. Public water systems supply 43 percent of the county population; the rest use individual wells. In 1985, domestic use in municipal areas was 44 gallons per day (gpd) per capita; in rural areas, 51 gpd per capita (Solley and others, in press). About 9.6 million gallons of water per day (mgd) were withdrawn from Barron County aquifers in 1985 to supply the county residents, agriculture, industry, commerce, and recreational facilities. Only 0.1 mgd was withdrawn from county streams to supplement groundwater withdrawals.

Withdrawal of water for agriculture (irrigation and stock watering) was the largest use, accounting for 43 percent of the total amount of water withdrawn (table 1), and was entirely self-supplied. Domestic use was the second largest use (20%), and the remainder (37%) was divided between industrial, other public (schools, governmental buildings, parks, and recreational facilities within city limits) and commercial uses. Most of water used was self-supplied: only 38 percent came from public supplies (fig. 6). Although the total use of groundwater increased only 5.6 percent in the last five years (table 1), there were significant changes in the distribution of water uses in the county. Since 1979 irrigational use has doubled, and self-supplied industrial use has dropped to about half. However, some of the changes probably have resulted from differences in accuracy of the estimates in the two reporting periods.

Table 1. Estimated use of groundwater in Barron County

	1979		1985		Change
Type of use	mgd	percent	mgd	percent	(%)
Commercial	0.93	10.2	0.76	7.9	- 18.3
Domestic	1.71	18.7	1.97	20.5	+ 15.3
Industrial	2.30	25.3	1.66	17.2	- 27.8
Irrigation	1.07	11.7	2.18	22.6	+103.7
Stock	1.84	20.1	1.93	20.1	+ 4.9
Other	1.27	14.0	1.13	11.7	- 11.0
Totals	9.12	100.0	9.63	100.0	+ 5.6

Source: Lawrence and Ellefson, 1982; Solley and others, in press.

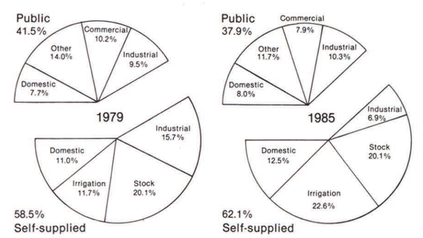

Figure 6. Groundwater use in Barron County (source: Lawrence and Ellefson, 1982; Solley and others, in press).

The main pumpage centers and principal groundwater users are shown in figure 7. Withdrawal use of water in the county is greatest in the eastern half, reflecting the location of the major population centers, recreational centers, and irrigated fields. The most concentrated areas of irrigation used for field crops are on the outwash plains along the Red Cedar River.

Mineral resources

Mining plays only a small role in the Barron County economy. Sand and gravel is the primary mineral produced; however, production has been declining since 1976 (table 2). A limited amount of crushed stone (sandstone, quartzite) is extracted for local use. In 1984 Barron County produced 218,000 short tons of construction sand and gravel from 10 pits, worth approximately $464,000 (Hill and others, 1986). In 1978 the U.S. Soil Conservation Service conducted an inventory of nonmetallic minerals in the River County Resource Conservation and Development Area (USDA, 1981), which also includes Barron County. The inventory, compiled from maps, aerial photographs, personal interviews, and limited field trips, identified 54 intermittently active and 68 inactive surface mines in Barron County (fig. 8). Materials mined included sand and gravel (28 sites), rock (5 sites), and borrow or fill material (85 sites); 4 sites were used for purposes other than mining.

Table 2. Construction sand and gravel sold or used by producers in Barron County

Year	Number of mines	Quantity (in thousand tons)	Value (in thousand dollars)
1976	12	1,763	1,048
1977	9	848	1,334
1979	-	716	1,076
1980	-	177	243
1982	9	129	251
1984	10	218	464

Source: U.S. Bureau of Mines Minerals Yearbooks.

Clay suitable for lining waste pits is available only in two parts of the county (Johnson, 1984). The most clay-rich sediment (till) is exposed in the southwestern part of the county. Another possible source is the silty lake sediment beneath the centers of ice-walled-lake plains, located primarily in the town of Crystal Lake.

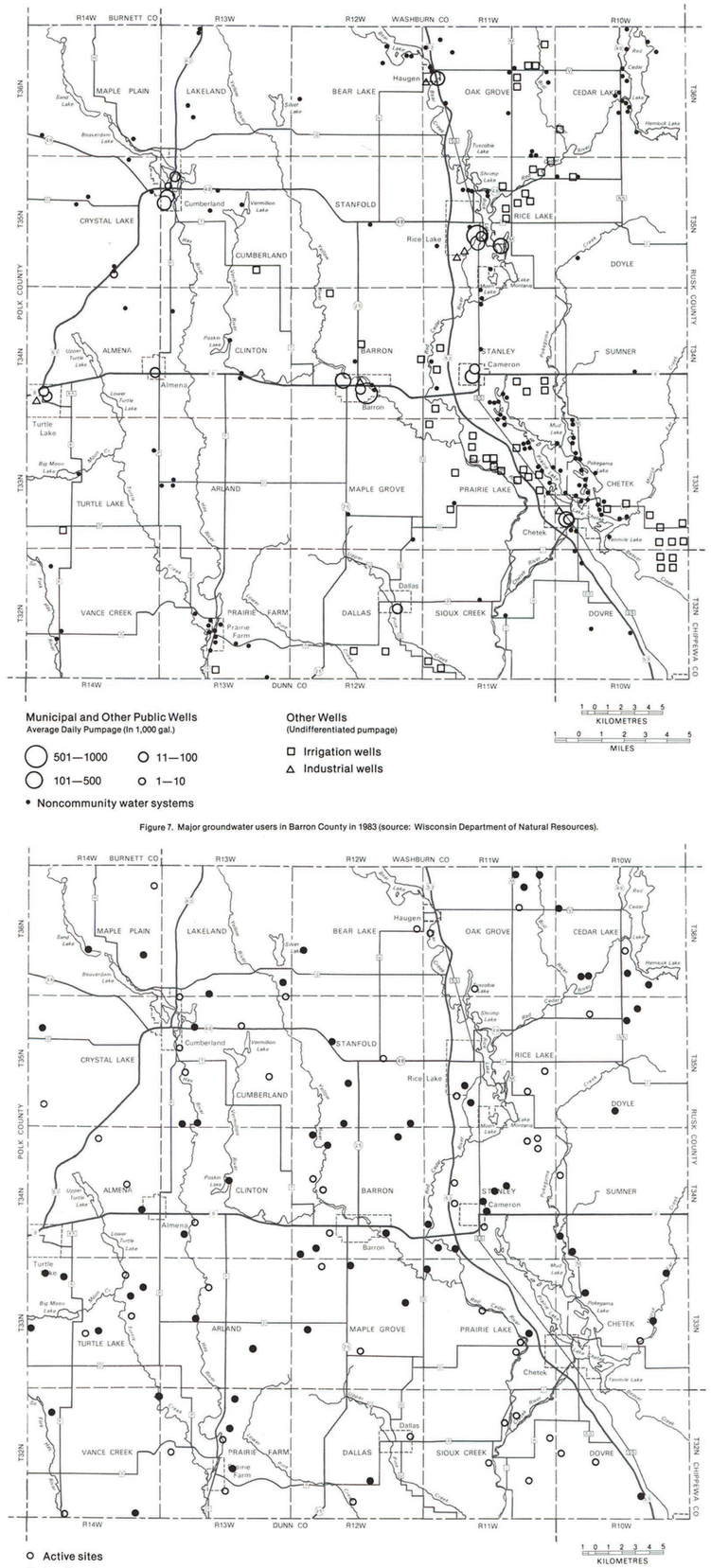

Figure 7. Major groundwater users in Barron County in 1983 (source: Wisconsin Department of Natural Resources).

Figure 8. Mineral extraction sites in Barron County (source: U.S. Department of Agriculture Soil Conservation Service, 1981).

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Map 87-2a

A part of the Barron County Atlas

Cartography by B.R. Haskins-Grahn

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