WATER RESOURCES OF THE BAD RIVER INDIAN RESERVATION, NORTHERN WISCONSIN

By W.G. Batten and R.A. Lidwin

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CONTENTS

PLATES

[Plates are in pocket]

Maps showing:

FIGURES

TABLES

CONVERSION FACTORS AND VERTICAL DATUM

Multiply	By	To obtain
foot (ft)	0.3048	meter
mile (mi)	1.609	kilometer
acre	.004047	square kilometer
square mile (mi^2)	2.590	square kilometer
inch per year	25.40	millimeter per year
foot per day (ft/d)	.3048	meter per day
foot per mile (ft/mi)	0.1894	meter per kilometer
gallon per minute (gal/min)	0.06309	liter per second
cubic foot per second (ft^3/s)	0.02832	cubic meter per second

Temperature, in degrees Fahrenheit (°F) can be converted to degree Celsius (°C) by use of the following equation:

$$°F = 1.8 \times °C + 32.$$

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.

Abbreviated water-quality units used in this report: Chemical concentrations and water temperature are given in metric units. Chemical concentration is given in milligrams per liter (mg/L) or micrograms per liter (µg/L). Milligrams per liter is a unit expressing the concentration of chemical constituents in solution as weight (milligrams) of solute per unit volume (liter) of water. One thousand micrograms per liter is equivalent to one milligram per liter. For concentrations less than 7,000 mg/L, the numerical value is the same as for concentrations in parts per million.

Specific conductance of water is expressed in microsiemens per centimeter at 25 degrees Celsius (µS/cm). This unit is equivalent to micromhos per centimeter at 25 degrees Celsius (µmho/cm), formerly used by the U.S. Geological Survey.

Water Resources of the Bad River Indian Reservation, Northern Wisconsin

By W.G. Batten *and* R.A. Lidwin

Abstract

Water-resources data were collected in the Bad River Indian Reservation of northern Wisconsin from 1983 through 1987. Some data are interpreted to describe ground-water flow, ground-water quality, streamflow, and surface-water quality. Data also are presented in tables and appendixes for baseline reference.

Precambrian sandstone and basalt underlie varying thicknesses of sandy till, outwash sand and gravel, and clay deposited in glacial meltwater lakes. The thickness of glacial deposits generally ranges from 100 to 300 ft but reaches a known thickness of almost 1,000 ft on the east-central edge of the Reservation. Sand and gravel deposits are generally buried beneath 50 to 150 ft of glacial lake clays and silts throughout most of the Reservation. These buried sand and gravel deposits lie directly on Precambrian sandstone of unknown thickness in the northern half of the Reservation. The sand and gravel deposits and the sandstone form a single aquifer system confined by the overlying clay deposits. In and near the village of Odanah, numerous wells finished in either the sand and gravel or in the sandstone flow above land surface.

Estimates of the horizontal hydraulic conductivity of the sand and gravel based on 30 specific-capacity tests range from about 2 to 700 ft per day with a median value of about 80 ft per day. Horizontal hydraulic conductivity estimates for the sandstone range from about 1 to 360 ft per day with a median of about 2 ft per day. These estimates are based on 42 specific-capacity tests of wells open only to the upper 20 to 60 ft of sandstone. The horizontal hydraulic conductivity of the sandstone appears to decrease with depth; highest estimates were determined for wells open only to the upper 20 ft of sandstone.

Ground water in the confined aquifer system is a calcium magnesium bicarbonate type with relatively low total dissolved solids concentrations. The median total dissolved solids concentration of water from 17 sand and gravel wells is about 150 milligrams per liter and the median for water from 21 sandstone wells is about 244 milligrams per liter. High concentrations of iron and manganese were found in water from 12 of 36 sampled wells. Total recoverable concentrations of iron exceeded 500 micrograms per liter in 5 wells and concentrations of manganese exceeded 50 micrograms per liter in 7 wells.

Streamflow has been continuously measured at a streamflow-gaging station in the Bad River near Odanah for much of the time since 1914. This station monitors drainage from a basin with an area of 597 square miles and the average daily discharge of the Bad River at this gaging station is 622 cubic feet per second. The peak instantaneous flow at the station was 27,700 cubic feet per second on April 24, 1960 and the minimum instantaneous flow was 34 cubic feet per second on November 8, 1976.

Analysis of water samples collected at 12 sites at 10 small streams during base-flow conditions indicate that the concentrations of common chemical constituents are similar to but lower than those found in ground water. The median concentration of total dissolved solids was about 110 milligrams per liter as compared to about 155 milligrams per liter in ground-water samples from wells finished in sand and gravel.

INTRODUCTION

Hydrologic and water-quality data were collected on the Bad River Indian Reservation from 1983 through 1987 by the U.S. Geological Survey (USGS), in cooperation with the Bad River Chippewa Indian Tribe of Wisconsin. These baseline hydrologic and water-quality data will be used by tribal planners and leaders to manage and protect the water resources of the Reservation.

Purpose and Scope

This report summarizes ground- and surface-water data collected during the study. Ground-water and streamflow data have been analyzed and interpreted; surface-water quality data are presented in tabular form with minimal interpretation and discussion. Data from seismic-refraction survey lines and drillers' well-construction reports were used to compile maps of the altitude of the bedrock surface, the thickness of glacial deposits, and the potentiometric surface of the confined ground-water-flow system. These data also were used to construct an idealized geologic section and a conceptual model of the ground-water-flow system. Selected well-construction data were analyzed to estimate the hydraulic properties of the sand and gravel and sandstone aquifers that make up the confined ground-water-flow system. Water samples from wells, streams, lakes, and sloughs were analyzed for major ions and trace metals. Streamflow data were analyzed to determine flow-duration, flood, and low-flow frequency characteristics of the Bad River near Odanah.

Identification of Data-Collection Sites

Each surface-water data-collection site and well mentioned in this report and shown on plate 1 has a unique identification number. The system for assigning these identification numbers is based on the geographic location of the surface-water sites and wells. There are two groups of surface-water data-collection sites: streamflow-gaging stations and sites used for collecting surface-water (and bottom material) quality samples. Each streamflow-gaging station has a "downstream order number" that consists of seven or eight digits, with the number increasing in the "downstream" direction within a given stream basin. Each surface-water quality sampling site has a unique fifteen-digit identification number that combines the (approximate) latitude and longitude of the site plus a two-digit sequence number which further distinguishes each site.

Wells and springs also are identified by a unique 15-digit number that is a combination of the site's latitude and longitude and a two-digit sequence number. The sequence number distinguishes sites located less than about 100 ft from each other with the same latitude and longitude. Each well is also identified by a local number in addition to the identification number. The local number consists of an abbreviation for the county name; the township, range and section; and a four-digit sequence number assigned to the well. For example, well AS-46/03W/20-0221 is located in Ashland County (AS), township 46 north, range 3 west, section 20; its sequence number is 0221. The local number is used in the appendixes in this report. Only the last two or three digits of the four-digit sequence number are used to identify wells and springs on plate 1.

Description of Study Area

The Bad River Indian Reservation encompasses about 195 mi^2 in northeastern Ashland County in north-central Wisconsin (fig. 1). The Reservation also includes a 9-mi^2 area in northwestern Iron County and a small, 196-acre parcel of land on the northeastern tip of Madeline Island (fig. 1) in Lake Superior. The parcel on Madeline Island is not included in the present study.

Lowlands in the northern two-thirds of the Reservation contain many wetlands. This part of the Reservation slopes at a rate of about 10 to 15 ft/mi to Lake Superior, which has a mean elevation of 602 ft above sea level. A 20-mi^2 area of marshes and sloughs borders Lake Superior at the mouths of the Bad and Kakagon Rivers (pl. 1). Uplands in the southeastern part of the Reservation rise over 500 ft above the lowlands to more than 1,250 ft above sea level.

Approximately 85 percent of the Reservation is covered by second-growth forest of aspen and white birch. Northern hardwoods and white pine cover the few upland areas. Swamp and marsh vegetation cover the wetlands along Lake Superior (U.S. Department of Housing and Urban Development, 1976). Virtually no agricultural crops are grown on the poorly drained clay soils that cover most of the land.

GEOLOGIC SETTING[1]

Precambrian basalt and sandstone bedrock underlies the entire Reservation. A sequence of dark-colored volcanic basalt lava flows, sometimes referred to as "traprock," underlies the topographic high in the extreme southeastern corner of the Reservation (fig. 2). The Oronto Group, a sequence of sandstone with some shale and conglomerate (Mudrey and others, 1982), underlies most of the Reservation (fig. 2). The youngest of the bedrock units is called the Bayfield Group. This unit consists of nearly flat-lying sandstone and is found in the northwestern part of the Reservation (fig. 2). The contact between the Bayfield and Oronto Groups is somewhat uncertain. The basalt lava flows are about 1 to 1.5 billion years old and the youngest

[1]The stratigraphic nomenclature used in this report is that of the Wisconsin Geological and Natural History Survey and does not necessarily follow usage of the U.S. Geological Survey.

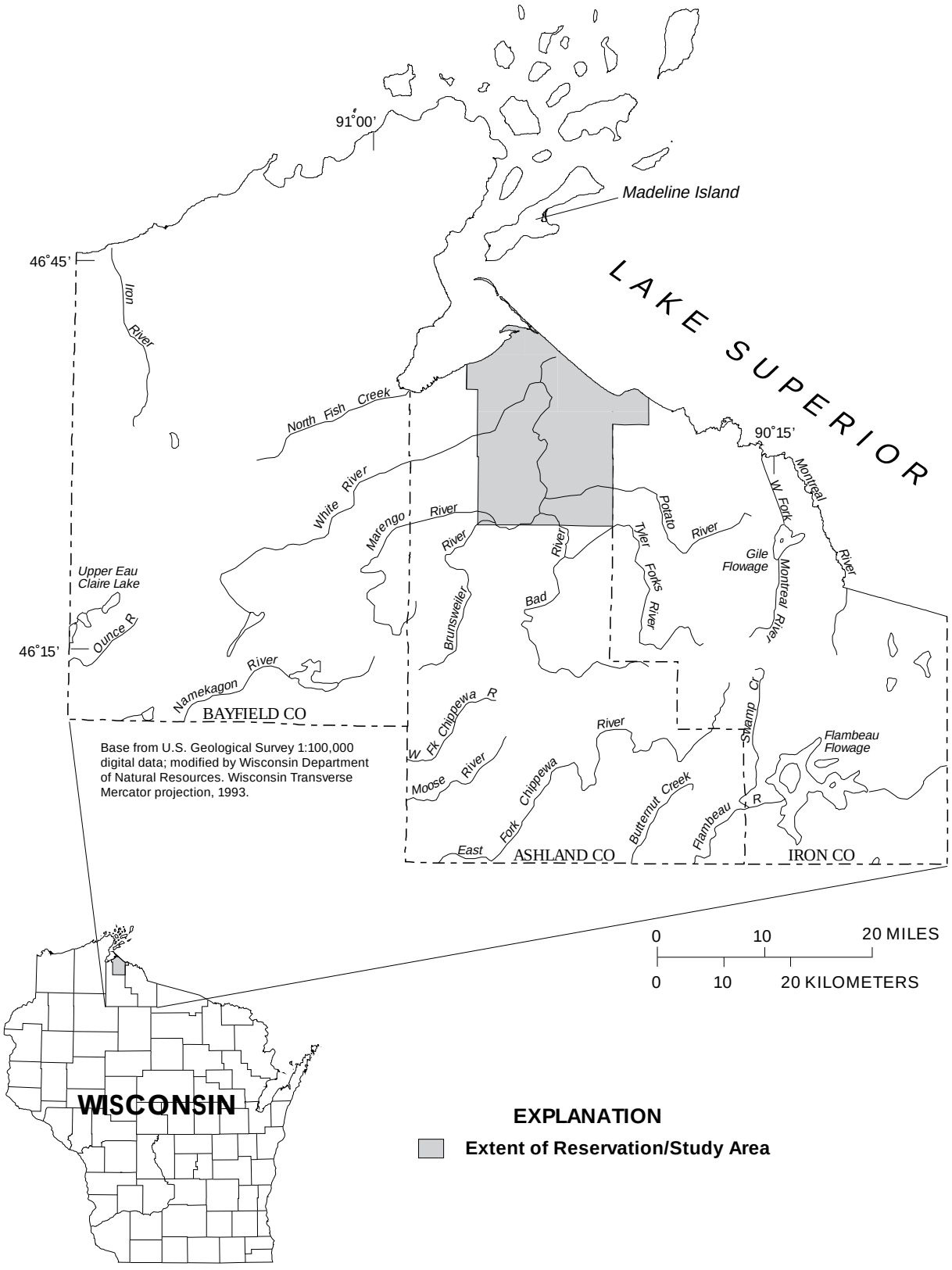

Figure 1. Location of the Bad River Indian Reservation in northern Wisconsin.

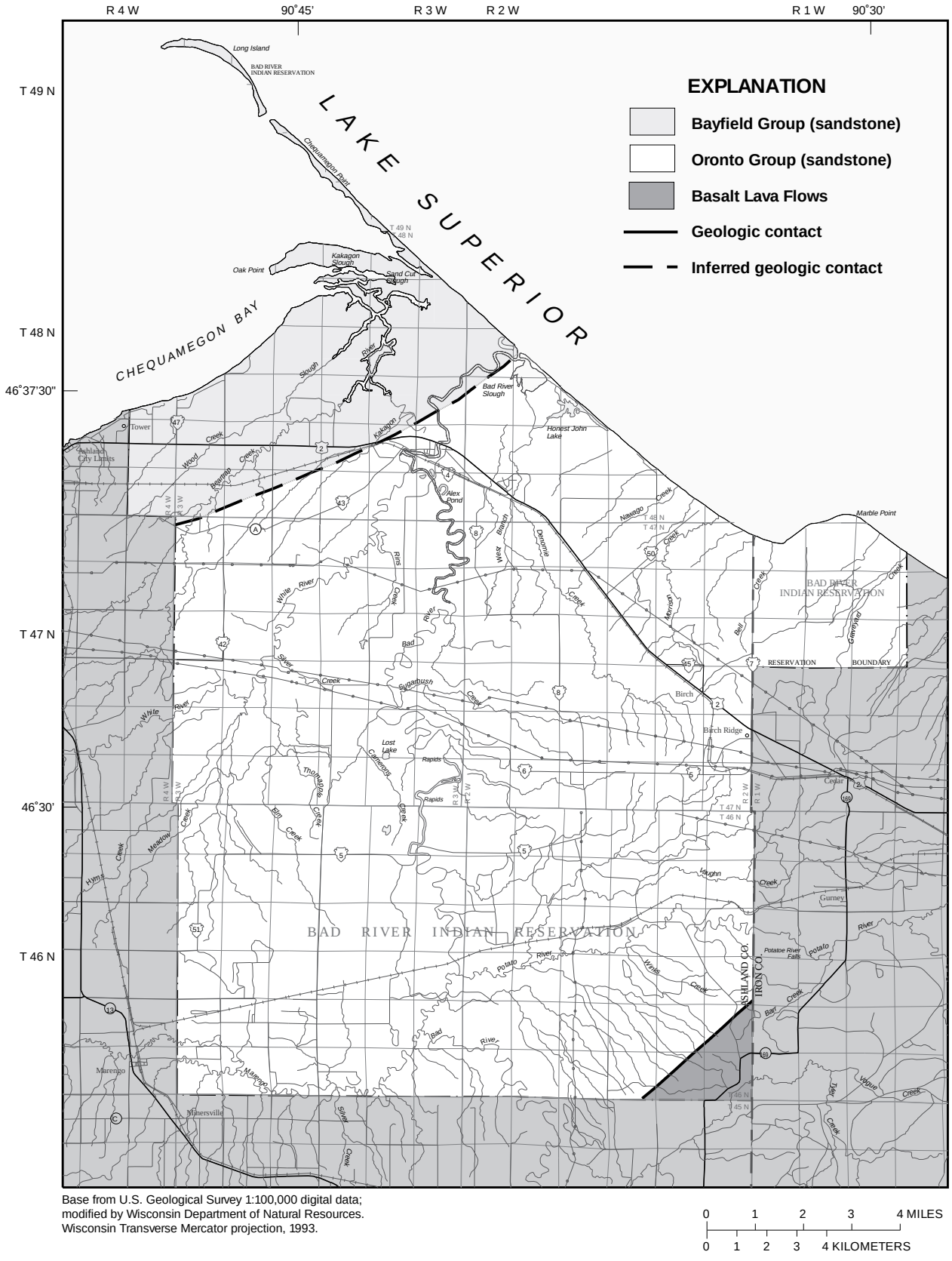

Figure 2. Bedrock geology of the Bad River Indian Reservation.

rocks in the Bayfield Group are just under 1 billion years old (Mudrey and others, 1982).

Drillers' geologic logs, outcrop locations, and seismic-refraction data were analyzed to determine the altitude of the bedrock surface in feet above sea level. Plate 2 is a contour map of the bedrock surface from a plot of these data. The shape and location of contour lines are inferred in large areas of the Reservation interior where few data are available. The bedrock surface ranges from a known altitude of about 1,150 ft above sea level in the extreme southeastern corner of the Reservation (pl. 2) to about 20 ft below sea level determined from a seismic-refraction survey line just east of the Reservation boundary in section 31 of T47N, R1W, about 1 mi southeast of the settlement at Birch Ridge (pl. 2). Two community-supply wells at Birch Ridge also penetrate more than 950 ft of glacial material that overlies sandstone bedrock. This bedrock low extends from the Birch Ridge area to the southwest as a bedrock valley, or more likely as a structural trough formed by folding of the bedrock layers (M.G. Mudrey, Wisconsin Geological and Natural History Survey, oral commun., 1989). Another broad but shallower bedrock trough appears to underlie the central part of the Reservation and trends from the southwest to the northeast with bedrock altitudes ranging from 300 to 400 ft above sea level (pl. 2).

Wisconsin stage glacial deposits directly overlie Precambrian bedrock throughout most of the Reservation. The glacial deposits in the Lake Superior region of northern Wisconsin that includes the Bad River Indian Reservation have been described by Clayton (1984). Clayton (1984) identifies glacial deposits within the Reservation as part of the Miller Creek Formation (fig. 3) deposited approximately 9,500 to 11,500 years ago, or as part of the Copper Falls Formation, deposited earlier than 11,500 years ago. Deposits of the Miller Creek Formation overlie the Copper Falls Formation throughout most of the Reservation (fig. 3).

The Miller Creek Formation consists of two types of deposits: (1) clayey till that was reworked by glacial-meltwater lake-wave action, and (2) offshore clay and silt deposited by turbidity currents flowing into glacial lakes (Clayton, 1984). The offshore clay and silt which covers most of the lowland along Lake Superior is locally referred to as the "red clay." This material underlies Quaternary alluvial sand and gravel deposited along major streams and underlies recent organic deposits in wetland areas.

The Copper Falls Formation consists of sandy till and sandy outwash deposited by glacial meltwater. These deposits underlie the Miller Creek Formation throughout most of the Reservation (fig. 3). The Miller Creek Formation is absent in the extreme southeastern corner of the Reservation where the Copper Falls Formation extends from land surface to volcanic bedrock (fig. 3). Glacial deposits older than the Copper Falls Formation may be present where the thickness of glacial deposits exceeds 300 ft or more.

Glacial deposits overlie sandstone bedrock in the northern half of the Reservation (fig. 4). The thickness of glacial deposits differs greatly throughout the Reservation. Average thickness ranges from 200 to 400 ft but attain a maximum thickness of the glacial deposit is about 1,000 ft in the center of the bedrock trough along the east edge of the Reservation (fig. 4). Glacial deposits are less than 100 ft thick in the upland area in the southeastern and west-central part of the Reservation. Sandstone bedrock crops out along the Bad River in sections 35 and 36 of T47N, R3W (pl. 2). The thickness of glacial deposits is estimated in many areas of the Reservation where no data are available.

GROUND WATER

All water used by Reservation residents is supplied by wells that pump water from saturated sand and gravel deposits or Precambrian sandstone. The occurrence and availability of this ground water is determined by the hydraulic properties of these deposits.

Occurrence and Flow

Ground-water occurrence and flow can best be described by referring to the geohydrologic section shown in figure 3. The shaded zones represent the two ground-water-flow systems. The shallow system represents flow that takes place at shallow depths (probably less than 50 ft in most areas). Flow paths, indicated by small arrows, within this shallow system tend to be short. Flow begins as precipitation infiltrates the soil and moves downward through vertical cracks (fractures) in the generally clayey Miller Creek Formation. Flow is horizontal through thin sand or silty layers interlayered in the clay in this shallow system. Some water flows in the clay itself at the microscopic level. However, the velocity or flow rate of water in the clay is probably on the order of 1 in/yr or less. Ground water in this shallow system generally flows from topographic highs toward the nearest stream or wetland where the water seeps (discharges) into the surface-water body. The level below land surface in this shallow system where all openings between individual sand grains or clay particles are completely saturated is called the water table (fig. 3); the shallow system can be referred to as a water-table system.

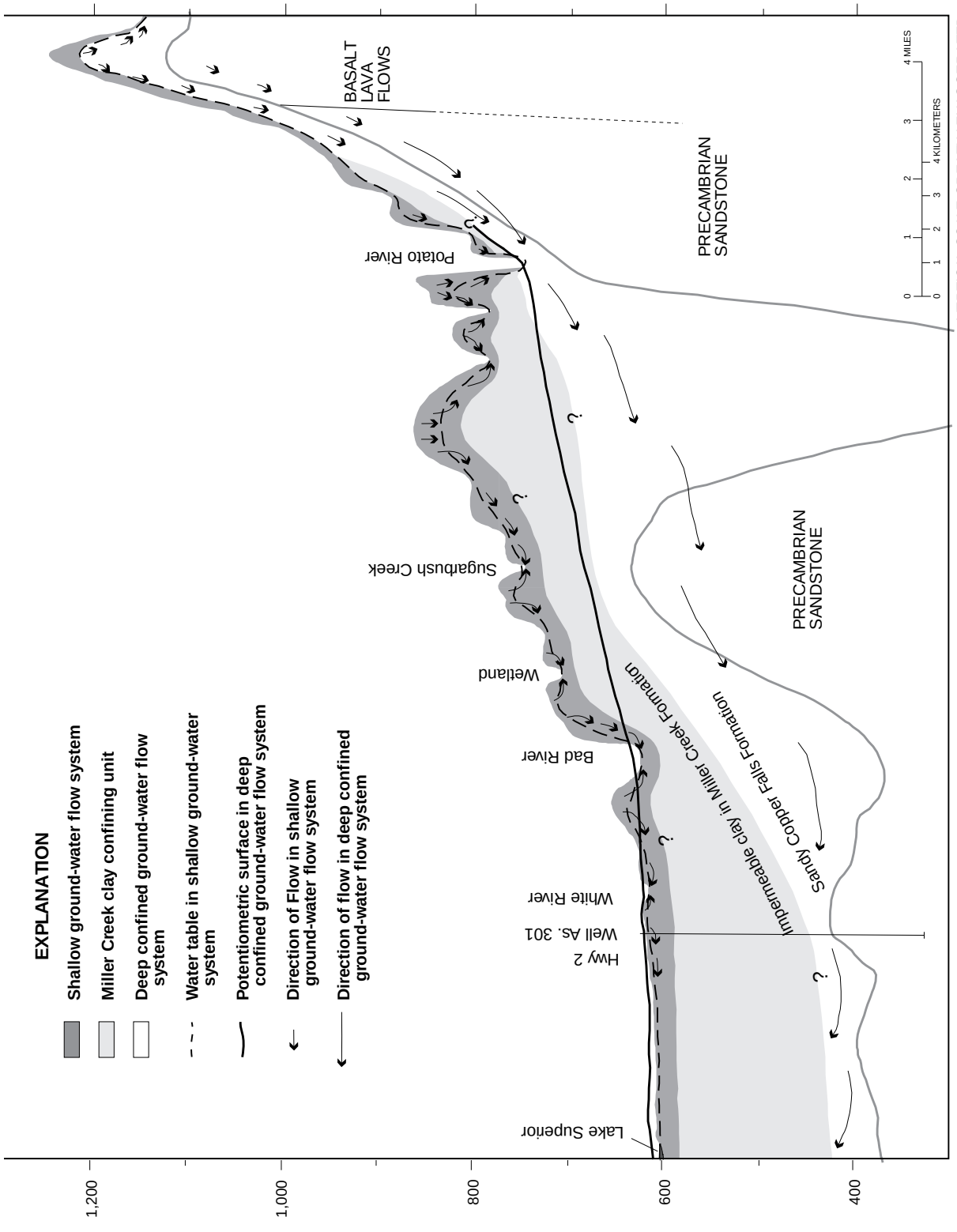

Figure 3. Idealized geologic section and conceptualized ground-water-flow systems in the Bad River Indian Reservation.

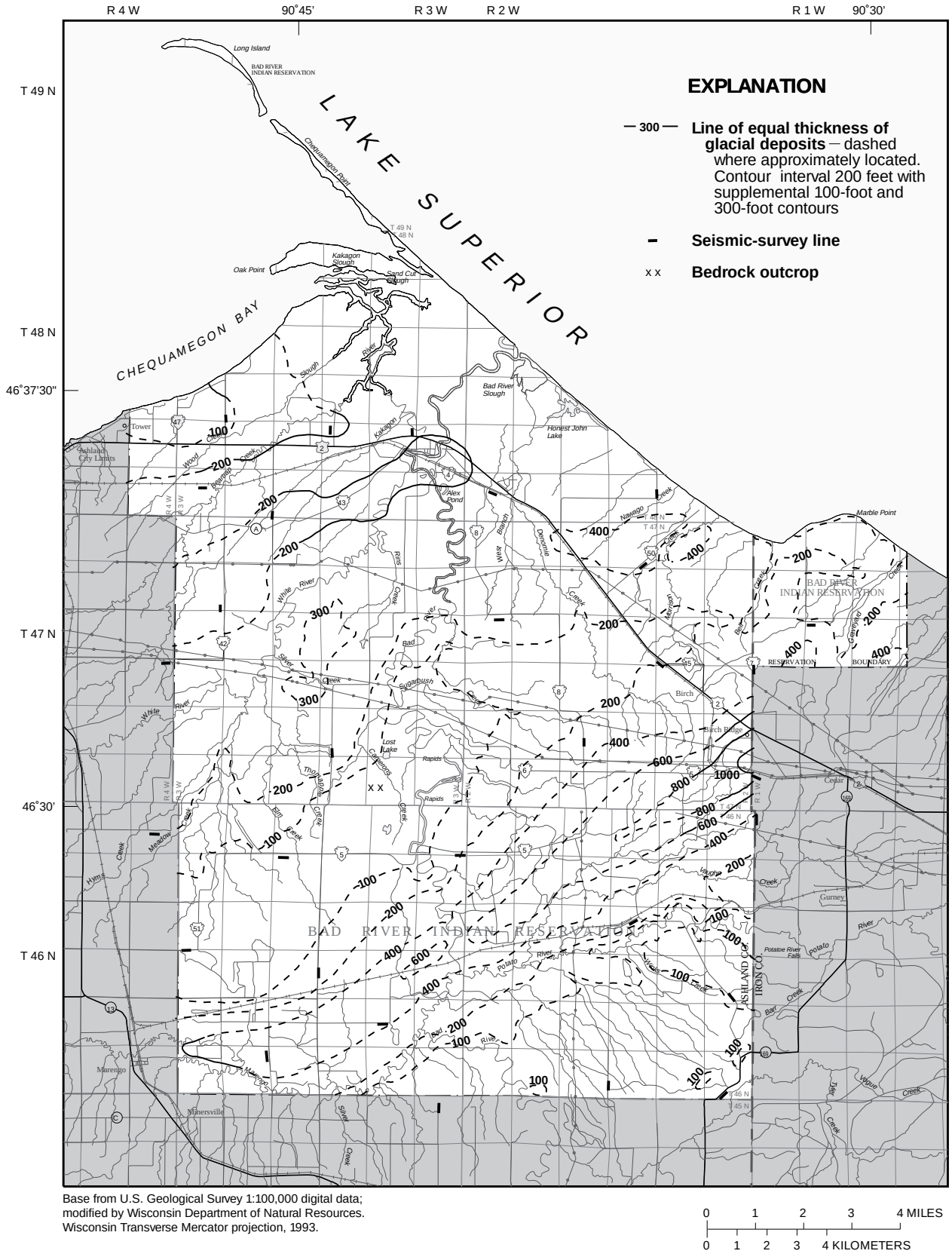

Figure 4. Thickness of glacial deposits within the Bad River Indian Reservation, northern Wisconsin.

The shallow system is separated from the deep system by a layer of massive clay in the Miller Creek Formation that probably ranges from about 50 to 150 ft in thickness (fig. 3). The clay at this depth does not contain channels created by plant roots or by the chemical or physical breakdown of clay material by infiltrating precipitation. Therefore, this clay is not able to conduct water unlike the near-surface clay deposits that comprise the shallow (water-table) system. As a result, the channel-free clay acts as a layer that retards the vertical flow of water and confines the deep ground-water-flow system.

The deep ground-water-flow system is referred to as a confined or artesian aquifer system. In this deep system (fig. 3), ground water flows through both the permeable Precambrian sandstone and sand deposits of the Copper Falls Formation. The deep system is a large regional flow system, as indicated by the long arrows in figure 3. Water in this system comes from precipitation and snowmelt infiltrating the sandy Copper Falls Formations (fig. 3) in the upland area in the southeastern part of the Reservation and in uplands south of the Reservation (not shown). Ground water generally flows northward within these deposits toward Lake Superior (fig. 3) and becomes confined where the thickness of the overlying clay layer of the Miller Creek Formation is great enough to retard vertical movement. In upland areas, the deep system is not confined by overlying clay, and flow of the ground water is similar to that in the shallow system, where the ground water flows along short paths from topographically high areas toward nearby headwaters of streams. However, some of the ground water in these upland areas does not discharge to streams; instead, it flows along extended flow paths under the confining clay layer, as shown by the long arrows in figure 3.

As water moves northward under the clay, the hydraulic head or pressure on water in the deep flow system can cause the water level in a well open only to this flow system to rise above the top of the system. The imaginary surface representing the water levels in these wells is commonly called the potentiometric surface of the ground-water-flow system. The altitude of the potentiometric surface is shown in figure 5.

The relation between the water-table and the potentiometric surface is important for understanding the overall flow system. This relation depends on the hydraulic gradient. The hydraulic gradient is simply the difference or change in the hydraulic (pressure) head over the distance from one point in the ground-water system to another point in the system. Where the water table is above the potentiometric surface, some water flows downward from the shallow system through any confining clay and into the deep system, because ground water flows from areas of high hydraulic (pressure) head toward areas of low hydraulic head.

In the lowland area near Lake Superior, the hydraulic gradient is reversed. The hydraulic head in the confined (deep) system is greater than in the shallow water table system. This is evidenced by water levels in a number of domestic wells open to sandstone or sand and gravel in the deep system near the village of Odanah. Water levels in these wells are above the land surface, which causes the well to flow.

Availability

In 1988, information was available for 90 wells within the Reservation boundaries. Eight of these wells were community-supply wells serving a total of 205 homes in New Odanah, Odanah, and the community on Birch Ridge. The remaining 82 domestic-supply wells served individual homes throughout the Reservation. Drillers' construction information is available for 72 of the 90 wells. Forty-two of the 72 wells are finished with the borehole open to and receiving water from Precambrian sandstone. The remaining 30 wells typically are finished with 2-, 3-, or 4-ft-long screens open to sand and gravel deposits of the Copper Falls Formation just above the sandstone bedrock. General construction information for each well is listed in appendix 1. Well locations are shown on plate 1.

Wells finished either in the sand and gravel deposits, or in sandstone, appear capable of producing yields for domestic purposes in those few areas of the Reservation where well data are available. Drillers report well yields of about 5 to 20 gal/min for domestic supply, and about 25 to 90 gal/min for community-supply wells. Yields larger than those reported are possible depending on lithology and location.

Aquifer Characteristics of Sand and Gravel Deposits

Sand and gravel deposits, which are probably part of the Copper Falls Formation (fig. 3), generally are found between the depths of about 175 and 225 ft below land surface in the populated areas of Odanah and New Odanah, and at varying depths in the upland area around the community of Birch Ridge (pl. 1). Specific-capacity data from drillers' construction reports exist for 30 wells that obtain water from sand and gravel deposits in these areas. The specific capacity of a well is the rate of water pumped, in gallons per minute, divided by the total drawdown that occurs from

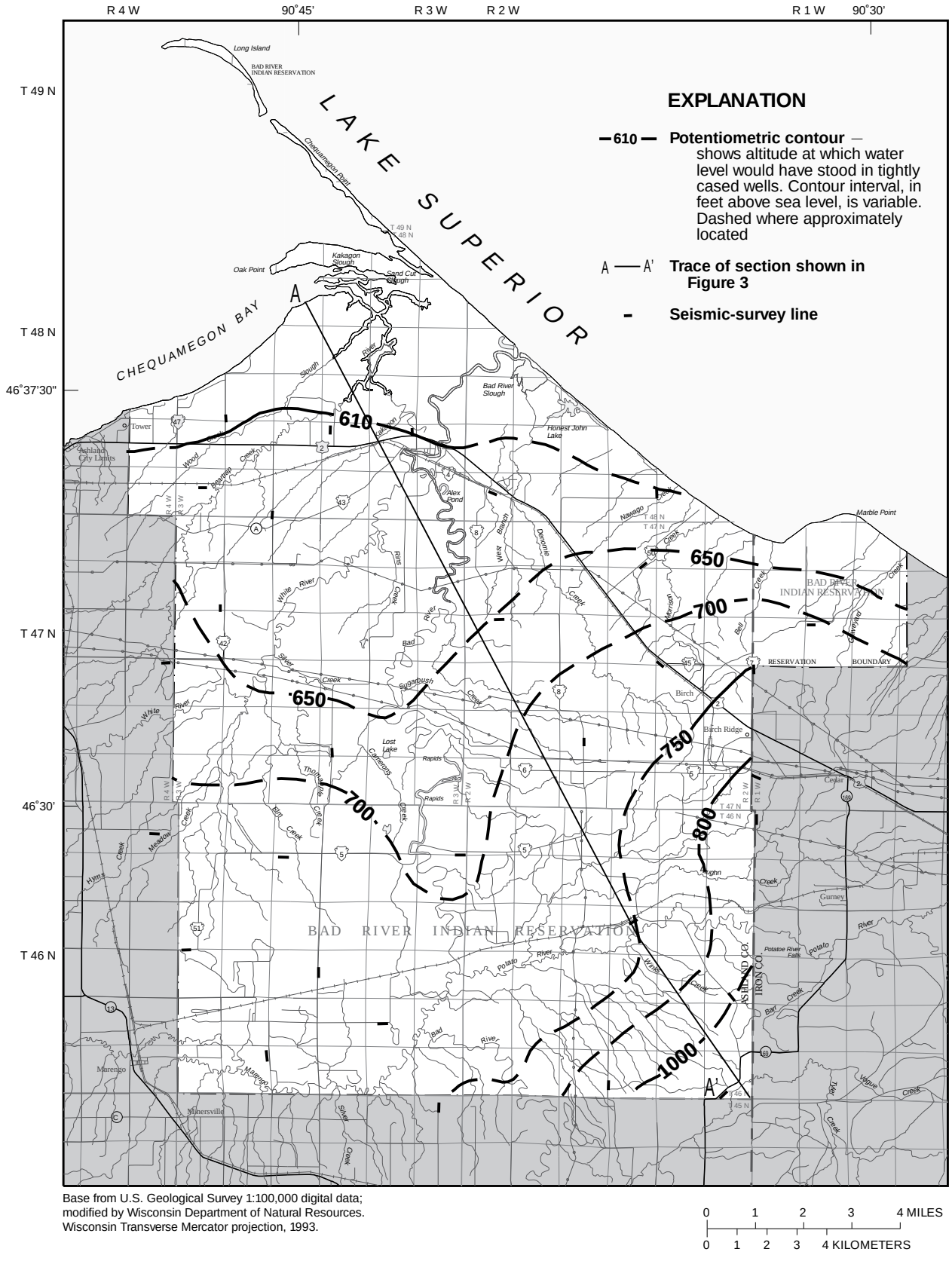

Figure 5. Potentiometric surface in the deep confined ground-water system on the Bad River Indian Reservation, northern Wisconsin.

pumping. Drawdown is the decline, in feet, of the water level in the well caused by the pumping.

Drillers' specific-capacity data were analyzed using a procedure developed by Bradbury and Rothschild (1985) to estimate the horizontal hydraulic conductivity of the sand and gravel deposits in the Copper Falls Formation. Horizontal hydraulic conductivity indicates the ability of an aquifer (in this case, the sand and gravel deposits) to transmit water. It is defined as the volume of water that will move in a unit of time under a unit hydraulic gradient at unit kinematic viscosity through a unit area at right angles to the direction of ground-water flow. Generally, horizontal hydraulic conductivity is directly proportional to well yield.

The horizontal hydraulic conductivity of the sand and gravel deposits estimated from drillers' specific-capacity tests ranges from about 2 to 700 ft/d. The median value is about 80 ft/d, which is indicative of a clean, somewhat compacted sand. These values are within the wide range of hydraulic-conductivity values given by Freeze and Cherry (1979, p. 29) for silty sand and clean sand.

Aquifer Characteristics of Precambrian Sandstone

Data from drillers' construction reports are available for 42 wells cased through the glacial deposits and open to the underlying sandstone. Most of these wells also are located in and around the populated area of Odanah (pl. 1). These wells range from 87 to 985 ft in depth and typically are open to the uppermost 10 to 50 ft of sandstone.

Specific-capacity data were analyzed to estimate the horizontal hydraulic conductivity of the sandstone. Hydraulic-conductivity values range from less than 1 to about 360 ft/d. The median value for the 42 wells is about 2 ft/d. According to Freeze and Cherry (1979, p. 29), this median value is at the upper end of the range of hydraulic conductivity for sandstone. Two factors may account for the apparent large values of horizontal hydraulic conductivity. First, most of these wells are only open to the upper 10 to 50 ft of sandstone. Second, the upper sandstone generally is fractured or broken up by weathering. Water can move at a faster rate through these openings than it can through unfractured rock. The 10 largest horizontal hydraulic-conductivity values were determined for wells open to an average of just 18 ft in the upper part of the sandstone. The 10 smallest values were determined for wells that are open to an average of about 60 ft of sandstone. This indicates that the horizontal hydraulic conductivity in the sandstone tends to decrease with depth.

Quality

Ground-water samples from 38 wells and 3 springs were collected in accordance with U.S. Geological Survey standard methods (U.S. Department of the Interior, 1977). The samples were analyzed at the USGS's National Water-Quality Laboratory in Arvada, Colo. Results of all chemical analyses are given in appendixes 2 and 3.

A total of 21 water samples were collected from 17 wells finished in sand and gravel deposits, and single samples were collected from each of 21 wells finished in Precambrian sandstone wells. Most of these samples (36 of 42) were collected from 1983 through 1987 to characterize recent ground-water quality on the Bad River Indian Reservation.

Concentrations of dissolved constituents most commonly found in Wisconsin ground water are summarized in table 1 for wells on the Bad River Indian Reservation. The principal dissolved constituents are calcium, magnesium, and bicarbonate. Median values of most constituents shown in table 1 are similar for water from both sand and gravel deposits and Precambrian sandstone. Exceptions are the somewhat larger median concentrations of sodium, sulfate, and chloride and somewhat smaller concentrations of manganese in water from wells finished in Precambrian sandstone (table 1). In general, the similarity in composition of water from both units is reasonable because sand and gravel wells derive water from deposits that lie directly on the Precambrian sandstone. Together, these two units make up the deep ground-water-flow system previously discussed and shown in figure 3. Median concentrations of constituents shown in table 1 are similar to those reported by Kammerer (1984) for a large area of northern Wisconsin that includes the Reservation. Median values reported by Kammerer for selected constituents are shown in parentheses in table 1. Median concentrations of sulfate, chloride, and dissolved solids in wells finished in sand and gravel in the larger area are 7.2, 2.5, and 150 mg/L, respectively (Kammerer, 1984, p. 38–39). Median concentrations of the same three constituents in Reservation sand and gravel wells are 6.6, 2.7, and 155 mg/L, respectively (table 1). Median concentrations of sulfate, chloride, and dissolved solids in water from wells finished in Precambrian sandstone in the larger area are 22, 16, and 244 mg/L, respectively. These median values are almost identical to those of Reservation well water, with the exception of dissolved-solids concentrations in water from Precambrian sandstone wells. The median concentration of dissolved solids in Precambrian sandstone wells on the Reservation is only 157 mg/L.

Table 1. Summary of dissolved chemical constituents in ground-water samples

[All units are milligrams per liter unless otherwise indicated. Numbers in parentheses represent concentrations or values from summary of water-quality data by Kammerer (1984). µS/cm, microsiemens per centimeter at 25˚C; $CaCO_3$, calcium carbonate; ˚C, degrees Celsius; mg/L, milligrams per liter]

	No. of samples	Minimum concentration or value	Maximum concentration or value	Median concentration or value
Wells open to sand and gravel deposits				
Specific conductance (µS/cm)	16	95	510	250
pH (standard units)	17	7.5	10.0	8.3
Hardness (as $CaCO_3$)	13	49	200	99
Calcium	11	14	44	24
Magnesium	10	3.5	23	8.8
Sodium	6	1.9	120	9.2
Potassium	6	0.6	6.5	1.3
Alkalinity (as $CaCO_3$)	17	52	220	96
Sulfate	16	.7	21	6.6 (7.2)
Chloride	17	.7	100	2.7 (2.5)
Dissolved solids (at 180˚C)	17	74	294	155 (150)
Iron (mg/L)	12	<10	2,300	30 (100)
Manganese (mg/L)	12	1	98	46 (30)
Wells open to Precambrian sandstone				
Specific conductance (µS/cm)	21	200	560	275
pH (standard units)	21	7.5	9.4	8.1
Hardness (as $CaCO_3$)	13	6	140	90
Calcium	13	2.1	38	23
Magnesium	13	.3	12	6.5
Sodium	3	21	29	26
Potassium	3	4.1	5.8	4.7
Alkalinity (as $CaCO_3$)	21	63	170	84
Sulfate	21	4.4	29	19 (22)
Chloride	21	.6	100	17 (16)
Dissolved solids (at 180˚C)	21	117	307	157 (244)
Iron (mg/L)	12	<10	1,100	80 (100)
Manganese (mg/L)	12	<1	41	3 (40)

Water samples were analyzed for many constituents that have maximum permissible and recommended concentrations specified in Wisconsin's drinking-water standards for public-water supplies (Wisconsin Department of Natural Resources, 1978). Wisconsin's drinking-water standards are summarized in table 2. Analyses of ground-water samples collected during this study indicate no health-related problems from inorganic constituents. This is best shown by comparing analysis results in appendixes 2 and 3 to the drinking-water standards in table 2. The trace metal lead exceeded the primary health standard of 50 µg/L (table 2) in water from two wells. Water from these wells, AS-38 and AS-288 in appendix 3, had lead concentrations of 64 and 98 µg/L, respectively. Well AS-38 is an old unused well; AS-288 is an active domestic-supply well. Water from well AS-38 also had a zinc concentration of 11,000 µg/L, which exceeds the aesthetic standard of 5,000 µg/L. The source of these metals may be dissolution of these metals in the plumbing pipes. Metals may dissolve in well water in contact with pipes for long periods of time while the well is unused.

The predominant ground-water-quality problem on the Reservation is large concentrations of iron and manganese. Concentrations of these metals that exceed

Table 2. Summary of Wisconsin's drinking-water standards
[From Wisconsin Department of Natural Resources, 1978. --, standard not applicable]

	[Maximum recommended total or dissolved concentration. All concentrations in milligrams per liter (micrograms per liter in parentheses) unless otherwise indicated]			
Constituent	**Primary (health) standard**		**Secondary (aesthetic) standard**	
Arsenic	0.05	(50)	--	--
Barium	1	(1,000)	--	--
Cadmium	.01	(10)	--	--
Chromium	.05	(50)	--	--
Fluoride	2.2	--	--	--
Lead	.05	(50)	--	--
Mercury	.002	(2)	--	--
Nitrate (as N)	10	--	--	--
Selenium	.01	(10)	--	--
Silver	.05	(50)	--	--
Chloride	--	--	250	--
Color	--	--	15 units[1]	--
Foaming agents (MBAS)	--	--	0.5	--
Hydrogen sulfide	--	--	not detectable	
Iron	--	--	.3	(300)
Manganese	--	--	.05	(50)
Odor	--	--	3	threshold number
Sulfate	--	--	250	--
Total residue	--	--	500	--
Zinc	--	--	5	(5,000)

[1]Platinum cobalt scale.

the Wisconsin secondary (aesthetic) drinking-water standards may cause objectionable taste and staining of laundry and plumbing fixtures. Dissolved and total-recoverable (dissolved plus particulate) concentrations were determined in water from 36 wells on the Reservation (appendix 3). Water samples from 5 wells had total-recoverable iron concentrations that exceeded 500 µg/L, and 8 water samples from 7 wells exceeded the secondary drinking-water standard of 50 µg/L for total-recoverable manganese. Kammerer (1984) found that one-fourth to one-half of all water samples collected from wells in northern Wisconsin, including the Reservation, had iron and manganese concentrations that exceeded Wisconsin's drinking-water standards.

SURFACE WATER

The Reservation is named after the Bad River, which flows northward through the middle of the Reservation. About three-quarters of the Reservation lies within the Bad River basin. The largest tributary to the Bad River is the White River, which empties into the Bad River on the west edge of the village of Odanah (pl. 1). Smaller streams, such as Morrison and Denomie Creeks in the northeast, and Beartrap Creek and the Kakagon River in the northwest, drain directly into Lake Superior (pl. 1).

Streamflow

Streamflow has been measured continuously at one of two gaging stations on the Bad River for much of the period from 1914 to the present. The principal station, the Bad River near Odanah (station number 04027000), is located about 8 mi south of the village of Odanah (pl. 1). This station has a drainage basin of 597

Table 3. Daily flow-duration characteristics for the Bad River near Odanah (station number 04027000)
[Based on 1914–91 period of record]

Discharge, in cubic feet per second, which is equaled or exceeded for indicated percentage of time											
Percentage of time	95	90	80	70	60	50	40	30	20	10	5
Discharge	99	117	149	184	226	279	362	491	762	1,505	2,380

mi^2; about 55 mi^2 of this area lies within the Reservation. Streamflow was measured at this station from 1914 through 1922 and from 1948 through the present. This station was discontinued, and streamflow was measured as the Bad River at Odanah (station number 04027595) from 1978 through 1988 to include more of the total Bad River basin. The drainage area at this station is 990 mi^2, which includes about 140 mi^2 of Reservation land. Operation of this station (Bad River at Odanah) was discontinued after 1987 because backwater effects from nearby Lake Superior caused the streamflow record to be unsatisfactory. Operation of the gaging station was returned to the original location (Bad River near Odanah) in 1987.

The average daily discharge for the Bad River near Odanah (location number 04027000) for the period of record ending September, 1988 is 622 ft^3/s. The maximum instantaneous discharge ever recorded was 27,700 ft^3/s on April 24, 1960. The peak flow of this same flood downstream at the Bad River at Odanah (station number 04027595) was estimated to be 45,600 ft^3/s as determined indirectly from high-water marks. The minimum instantaneous discharge for the Bad River near Odanah was 34 ft^3/s on November 8, 1976, during fall freezeup.

Flow-duration characteristics indicate the percentage of time that a specified streamflow discharge is equaled or exceeded during the period of record. For example, table 3 shows that streamflow in the Bad River near Odanah equals or exceeds 762 ft^3/s 20 percent of the time. However, this does not mean that flow will exceed 762 ft^3/s for 20 percent of each year or even within a specific 10-year period.

Knowledge of flow characteristics, particularly low flow, is useful when making decisions regarding multiple use of a stream resource. For example, knowledge of low flow in a stream is necessary when the maintenance of fish habitat is weighed against hydropower production or against dilution of wastes. Flood and low-flow frequency characteristics were estimated from mean-daily discharge values for the period of record at Bad River near Odanah (site 04027000). The recurrence intervals were determined using a log-Pearson Type III distribution. Computed discharges with their associated recurrence intervals are shown in table 4. Table 4 shows, for example, that the average time between floods with a peak flow of 11,000 ft^3/s is 5 years. The low-flow frequency values in table 4 show that the average time interval between a period of at least 7 consecutive days having a maximum discharge of 104 ft^3/s is 2 years. For comparison, table 3 shows that flow equals or exceeds 104 ft^3/s almost 95 percent of the time.

Quality

Water samples were collected from 12 sites on 10 streams during July and August 1983–87. These samples were collected during base-flow conditions when streamflow is derived largely from ground-water discharge. The samples were analyzed for common inorganic constituents, nutrients, trace metals, and organic-carbon concentrations. Analysis results are shown in appendix 4.

Concentrations of common chemical constituents in surface water are somewhat lower than concentrations in ground water. For example, the median total-dissolved solids concentration in 19 stream-water samples is 110 mg/L and in ground-water samples from Reservation wells is about 155 mg/L.

The backwater sloughs and lakes near the mouths of the Kakagon and Bad Rivers provide habitat for extensive stands of wild rice. Wild rice depends on large nutrient concentrations in bottom material for growth. Samples of bottom material were collected at eight sites on the Kakagon slough (pl. 1) during July and August 1986 and 1987 and analyzed for concentrations of nitrogen and phosphorus. Results of these analyses are presented in appendix 5. Water samples also were collected from open water in two backwater lakes—Honest John Lake and the Bad River Slough—and from Lake Superior (pl. 1) during July 1986. These samples were analyzed for common chemical constituents. Results of these three analyses (appendix 5) suggest the dissolved-solids concentration in water from these lakes is approximately half that of ground water. This indicates that precipitation, which has a low concentration of dissolved solids, is the source of much of the water in these lakes.

Water-quality samples have been collected at the Bad River near Odanah gaging station (station number

Table 4. Flood and low-flow frequency characteristics for the Bad River near Odanah (station number 04027000)
[Based on 1914–91 period of record]

	Flood frequency					
	Peak discharge, in cubic feet per second, for indicated recurrence interval, in years:					
	2	5	10	25	50	100
Discharge	7,730	11,000	13,400	16,600	19,100	21,900

	Low-flow frequency			
	Discharge, in cubic feet per second, for indicated recurrence interval, in years:			
Consecutive-day period	2 years	5 years	10 years	20 years
7	104	79	68	59
14	112	84	71	62
30	124	94	80	70
60	146	110	95	83
90	165	123	106	94

04027000) since October 1964. In October 1974, this station became part of the U.S. Geological Survey's National Stream Quality Accounting Network (NASQAN). This nationwide program established monthly sampling at gaging stations on major rivers to provide consistent and continuous monitoring of stream-water quality. Water samples at the Bad River gaging station and other NASQAN stations are analyzed for common chemical constituents, nutrients, and selected trace-metal concentrations. NASQAN water-quality data are available for the Bad River near Odanah gaging station for the periods October 1974 to January 1978, and from October 1987 to October 1993. The NASQAN sampling site was moved downstream to the Bad River at Odanah (station number 04027595, pl. 1) from February 1978 through September 1987, to represent a larger part of the drainage basin.

All water-quality data for these two NASQAN stations are accessible from the National Water Information System (NWIS) data base at the U.S. Geological Survey District office in Madison, Wis. These data also are available in annual Water Resources Data reports published by the District office in Madison, Wis.

SUMMARY

The Bad River Indian Reservation is located along the Lake Superior shore in northwestern Wisconsin. The area is underlain by unconsolidated glacial deposits that overlie basalt lava flows and Precambrian sandstone. Glacial deposits exceed 1,000 ft in thickness in a small area along the eastern edge of the Reservation. Bedrock is exposed at several locations along streambeds.

All community and domestic water supplies on the Reservation are obtained from wells finished in buried glacial sand and gravel deposits or in Precambrian sandstone. Wells typically are about 150 to 250 ft deep. However, two community-supply wells along the eastern edge of the Reservation are more than 950 ft deep. The sand and gravel deposits and Precambrian sandstone that provide water to wells are buried beneath nearly impermeable glacial-lake clay deposits throughout most of the Reservation. The buried sand and gravel deposits and the upper 50 ft of Precambrian sandstone together form a confined ground-water-flow system underlying the Reservation. Several wells in and around the village of Odanah that are finished in these deposits flow above land surface as is common with wells open to aquifers in a confined ground-water system.

Drillers' specific-capacity data were used to estimate the horizontal hydraulic conductivity of the aquifer. The horizontal hydraulic conductivity of the sand and gravel deposits ranges from about 2 to 700 ft/d, with a median value of about 80 ft/d. Estimated horizontal hydraulic conductivity of the Precambrian sandstone ranges from less than 1 to about 360 ft/d, with a median of about 2 ft/d. Yields of 5 to 10 gal/min for domestic supply appear to be available from sand and gravel and sandstone throughout the Reservation. Small community-supply yields of 25 to 90 gal/min appear to be available from wells finished in Precambrian sandstone.

Concentrations of dissolved chemical constituents in water from the sand and gravel are almost identical to those in water from the Precambrian sandstone. Concentrations of individual constituents, in turn, are similar to those found in these two rock types throughout northern Wisconsin. The principal dissolved constituents are calcium, magnesium, and bicarbonate; minor concentrations of sodium, sulfate, chloride, and fluoride are common. Dissolved-solids concentrations typically range from about 150 to 250 mg/L. Concentrations of dissolved iron and manganese exceed Wisconsin aesthetic drinking-water standards of 300 and 50 µg/L, respectively, in about 10 to 20 percent of all ground-water samples. The largest nitrate concentration was about 0.30 mg/L; most nitrate concentrations (34 of 38 samples) were less than 0.10 mg/L (the Wisconsin primary drinking-water standard for nitrate is 10 mg/L).

Flow-duration, flood, and low-flow frequency characteristics of the Bad River were estimated using streamflow data collected at the gaging station near Odanah. Surface-water quality in small streams and in the Bad River is similar to ground-water quality. Calcium, magnesium, and bicarbonate are the principal dissolved constituents. However, concentrations of dissolved solids in stream water range from about 50 to 150 mg/L, somewhat less than those in ground water. NASQAN water-quality data are available for the Bad River and provide continuous baseline water-quality data since 1974.

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APPENDIXES 1-5

Appendix 1. Water-level and construction data for wells within the Bad River Indian Reservation
[Data from drillers' construction reports; --, no data available; well locations shown on plate 1]

Local identifier	Date of water-level measurement	Land-surface altitude (feet above sea level)	Water level (feet below land surface)	Depth of well	Screen or opening length (feet)	Aquifer type[1]
AS-46/03W/20-0221	05-20-1947	790	40	130	10	Precambrian
AS-46/03W/23-0227	10-21-1958	790	36	--	--	--
AS-46/03W/29-0222	11-15-1966	780	10	254	3	Precambrian
AS-46/03W/33-0223	07-07-1943	740	[2]-20	414	3	Sand and gravel
AS-47/02W/05-0231	03-20-1941	690	45	110	3	Sand and gravel
AS-47/02W/10-0290	11-22-1983	750	80	190	3	Sand and gravel
AS-47/02W/23-0089	07-13-1940	855	118	142	4	Sand and gravel
AS-47/02W/23-0232	06-28-1980	859	118	185	4	Sand and gravel
AS-47/02W/23-0293	11-01-1973	855	112	176	3	Sand and gravel
AS-47/02W/24-0233	06-25-1980	890	148	197	4	Sand and gravel
AS-47/02W/25-0171	08-31-1979	1,080	321	349	4	Sand and gravel
[3]AS-47/02W/25-0294	06-01-1985	1,085	376	971	23	Precambrian, sand and gravel
[3]AS-47/02W/25-0295	06-01-1985	1,090	372	985	34	Precambrian, sand and gravel
AS-47/03W/02-0038	07-21-1941	668	60	187	2	Sand and gravel
AS-47/03W/02-0309	11-30-1973	668	57	256	20	Precambrian
AS-47/03W/05-0093	09-27-1939	682	65	266	42	Precambrian
AS-48/02W/29-0025	08-20-1956	622	-3	--	--	--
AS-48/02W/30-0088	08-14-1941	609	-2	191	12	Precambrian
AS-48/02W/31-0278	08-22-1984	632	5	200	--	Sand and gravel
[3]AS-48/02W/31-0296	08-28-1973	625	15	252	9	Precambrian
AS-48/02W/32-0026	08-20-1958	645	1	--	--	--
[3]AS-48/02W/32-0069	12-29-1966	628	7	178	6	Sand and gravel
[3]AS-48/02W/32-0094	12-01-1966	628	4	174	6	Sand and gravel
[3]AS-48/02W/32-0297	12-16-1966	628	4	350	100	Precambrian
AS-48/02W/35-0090	04-11-1941	671	38	122	4	Sand and gravel
AS-48/02W/35-0276	12-21-1964	667	37	135	3	Sand and gravel
AS-48/02W/35-0277	08-12-1964	662	64	130	3	Sand and gravel
AS-48/03W/19-0273	05-19-1982	625	18	225	72	Precambrian
AS-48/03W/19-0274	05-22-1968	620	20	110	14	Precambrian
AS-48/03W/19-0275	07-07-1967	620	42	120	28	Precambrian

Appendix 1. Water-level and construction data for wells within the Bad River Indian Reservation—Continued

Local identifier	Date of water-level measurement	Land-surface altitude (feet above sea level)	Water level (feet below land surface)	Depth of well	Screen or opening length (feet)	Aquifer type[1]
AS-48/03W/19-0291	12-15-1978	625	26	87	9	Precambrian
AS-48/03W/22-0270	12-01-1938	612	6	259	56	Precambrian
AS-48/03W/22-0271	10-06-1969	610	1	325	127	Precambrian
AS-48/03W/22-0272	11-01-1980	612	2	271	70	Precambrian
AS-48/03W/23-0037	08-04-1988	605	-5	272	29	Precambrian
AS-48/03W/23-0218	07-07-1976	605	Flows	235	4	Precambrian
AS-48/03W/23-0219	08-04-1988	606	-1	270	24	Precambrian
AS-48/03W/25-0265	06-07-1939	610	-4	275	92	Precambrian
AS-48/03W/25-0266	02-03-1939	615	-2	178	--	Sand and gravel
AS-48/03W/25-0267	04-29-1939	610	-4	125	0	Sand and gravel
AS-48/03W/25-0268	05-10-1982	620	6	250	56	Precambrian
AS-48/03W/25-0269	04-23-1982	610	4	241	48	Precambrian
AS-48/03W/25-0299	10-26-1973	615	4	150	3	Sand and gravel
AS-48/03W/26-0178	07-15-1970	610	3	137	3	Sand and gravel
AS-48/03W/26-0260	02-27-1939	610	5	207	--	Precambrian
AS-48/03W/26-0261	09-24-1973	605	-4	137	3	Sand and gravel
AS-48/03W/26-0262	04-01-1982	610	0	170	0	Sand and gravel
AS-48/03W/26-0263	03-08-1939	610	-3	127	2	Sand and gravel
AS-48/03W/26-0264	10-24-1973	610	Flows	137	3	Sand and gravel
[3]AS-48/03W/26-0300	07-01-1976	615	2	300	88	Precambrian
[3]AS-48/03W/26-0301	12-02-1982	615	3	300	87	Precambrian
AS-48/03W/26-0302	11-08-1973	610	0	136	3	Sand and gravel
AS-48/03W/26-0303	11-12-1973	608	0	142	6	Sand and gravel
AS-48/03W/26-0347	08-28-1990	625	16	175	--	Sand and gravel
AS-48/03W/27-0259	08-21-1974	622	--	220	0	Sand and gravel
AS-48/03W/28-0092	07-31-1940	630	15	190	10	Precambrian
AS-48/03W/28-0252	07-23-1960	630	15	265	0	Sand and gravel
AS-48/03W/28-0253	04-15-1939	620	24	201	16	Precambrian
AS-48/03W/28-0254	11-15-1938	621	8	220	18	Precambrian
AS-48/03W/28-0255	10-31-1980	620	7	270	75	Precambrian

Appendix 1. Water-level and construction data for wells within the Bad River Indian Reservation—Continued

Local identifier	Date of water-level measurement	Land-surface altitude (feet above sea level)	Water level (feet below land surface)	Depth of well	Screen or opening length (feet)	Aquifer type[1]
AS-48/03W/28-0256	04-26-1982	630	10	300	57	Precambrian
AS-48/03W/28-0257	04-16-1982	630	25	285	62	Precambrian
AS-48/03W/28-0258	06-29-1980	630	16	292	35	Precambrian
AS-48/03W/29-0220	06-24-1976	638	24	181	30	Precambrian
AS-48/03W/29-0251	04-05-1939	638	40	153	16	Precambrian
AS-48/03W/29-0304	05-30-1978	635	27	200	49	Precambrian
AS-48/03W/29-0305	10-27-1977	635	24	200	53	Precambrian
AS-48/03W/30-0068	10-17-1967	640	29	165	19	Precambrian
AS-48/03W/30-0250	04-19-1948	645	35	167	10	Precambrian
AS-48/03W/30-0313	11-02-1977	645	35	180	33	Precambrian
AS-48/03W/31-0091	09-13-1939	652	48	250	0	Sand and gravel
AS-48/03W/31-0087	08-23-1939	681	70	211	11	Precambrian
AS-48/03W/33-0246	04-27-1982	682	75	285	52	Precambrian
AS-48/03W/33-0247	05-24-1939	680	43	118	2	Sand and gravel
AS-48/03W/33-0248	06-27-1980	681	63	292	86	Precambrian
AS-48/03W/33-0279	05-31-1978	670	47	280	38	Precambrian
AS-48/03W/33-0306	07-12-1978	655	40	260	14	Precambrian
AS-48/03W/33-0307	10-04-1985	660	47	253	7	Precambrian
AS-48/03W/34-0242	06-20-1939	670	58	178	2	Sand and gravel
AS-48/03W/34-0243	05-16-1939	654	44	163	2	Sand and gravel
AS-48/03W/34-0244	08-23-1939	680	70	211	11	Precambrian
AS-48/03W/34-0245	04-28-1982	661	46	297	30	Precambrian
AS-48/03W/35-0241	12-12-1938	645	38	156	2	Sand and gravel
AS-48/03W/36-0007	08-22-1958	620	9	105	--	Sand and gravel
AS-48/03W/36-0280	12-14-1978	620	11	257	40	Precambrian
AS-48/03W/36-0288	11-06-1973	620	10	180	3	Sand and gravel
AS-48/03W/36-0308	10-28-1977	625	14	260	13	Precambrian
AS-48/04W/24-0086	12-29-1953	631	28	96	17	Precambrian
AS-48/04W/25-0289	03-01-1979	638	32	162	60	Precambrian
AS-48/04W/25-0312	10-10-1985	645	45	185	53	Precambrian

[1]Precambrian, Precambrian sandstone; sand and gravel, sand and gravel deposits.

[2]Minus sign indicates water level in feet above land surface.

[3]Community-supply well.

Appendix 2. Physical and chemical characteristics of water from wells and springs within the Bad River Indian Reservation

[˚C, degrees Celsius; µS/cm, microsiemens per centimeter at 25˚C; mg/L, milligrams per liter; --, no data available; <, less than. The five digit number ending some column headings is the parameter code used in the U.S. Geological Survey's Water Data Storage and Retrieval System; locations shown on plate 1]

Local identifier	Site number	Date	Time (24-hour)	Depth of well (feet) (72008)	Specific conductance (µS/cm) (00095)	pH (standard units) (00400)	Temperature, water (˚C) (00010)	Oxygen demand, chemical (high level) (mg/L) (00340)
AS-46/03W/20-0221	462642090455901	08-01-85	1120	129	260	8.8	9.0	--
AS-46/03W/29-0222	462616090460101	08-01-85	1230	254	260	9.4	9.0	--
AS-46/03W/33-0223	462529090441701	08-01-85	1415	414	175	8.6	10.0	--
AS-47/01W/19-0172	463205090330001	05-25-83	0900	spring	<50	6.0	7.0	<10
AS-47/01W/19-0173	463225090330001	05-25-83	1000	spring	<50	5.8	9.0	<10
AS-47/02W/10-0290	463349090364201	08-20-86	1640	190	280	7.9	10.0	--
AS-47/02W/23-0089	463209090342701	08-02-73	1000	142	128	8.0	8.0	--
		05-23-75	0950	142	140	8.0	7.0	--
		05-20-76	0945	142	95	8.4	10.5	--
AS-47/02W/23-0232	463220090343201	07-09-85	0945	185	195	8.4	10.0	--
AS-47/02W/24-0233	463152090335501	07-09-85	1450	197	140	8.5	9.0	--
AS-47/02W/25-0171	463135090330301	05-24-83	1600	349	140	8.4	11.0	<10
AS-47/02W/25-0174	463141090340001	05-25-83	1100	spring	60	7.2	10.5	10
AS-47/03W/02-0038	463442090420501	07-10-85	0930	187	148	10.1	9.0	--
AS-48/02W/30-0088	463619090402201	07-09-85	1300	191	365	8.2	8.5	--
AS-48/02W/21-0278	463547090393301	07-31-85	1000	200	345	8.3	10.0	--
AS-48/02W/32-0069	463602090391102	01-31-67	--	178	--	8.2	--	--
		10-01-70	--	178	412	7.9	9.0	--
AS-48/02W/32-0094	463602090391101	12-07-66	--	174	--	8.0	--	--
AS-48/03W/19-0291	463709090480201	08-19-86	1630	78	345	8.0	9.0	--
AS-48/03W/22-0272	463704090440001	07-09-85	1615	271	230	7.6	9.5	--
AS-48/03W/23-0037	463709090421201	08-01-85	1625	272	230	8.3	9.0	--
AS-48/03W/23-0218	463712090421301	07-10-85	1350	235	245	8.3	8.5	--
AS-48/03W/23-0219	463709090420901	07-10-85	1415	270	257	8.1	9.0	--
AS-48/03W/25-0267	463631090414801	07-30-85	1630	125	280	8.5	8.5	--

Appendix 2. Physical and chemical characteristics of water from wells and springs within the Bad River Indian Reservation—Continued

Local identifier	Site number	Date	Time (24-hour)	Depth of well (feet) (72008)	Specific conductance (µS/cm) (00095)	pH (standard units) (00400)	Temperature, water (°C) (00010)	Oxygen demand, chemical (high level) (mg/L) (00340)
AS-48/03W/25-0268	463609090411601	07-31-85	1245	250	380	8.2	10.0	--
AS-48/03W/25-0269	463606090411801	07-30-85	1820	241	380	8.2	8.5	--
AS-48/03W/26-0178	464157090363401	08-21-86	1515	137	250	8.2	11.0	--
AS-48/03W/26-0261	463634090421201	07-11-85	0920	137	250	8.6	10.5	--
AS-48/03W/26-0263	463622090424001	07-10-85	1130	127	295	8.5	8.5	--
AS-48/03W/26-0264	463626090422601	07-31-85	1415	137	280	8.5	9.0	--
AS-48/03W/27-0259	463635090434401	07-11-85	1230	220	260	8.2	9.5	--
AS-48/03W/28-0255	463658090443501	07-10-85	1530	270	218	7.5	11.0	--
AS-48/03W/28-0257	463636090450201	07-11-85	1345	285	230	7.7	8.5	--
AS-48/03W/28-0258	463632090450601	07-31-85	1545	292	200	8.0	8.0	--
AS-48/03W/29-0220	463635090463702	07-11-85	1500	181	270	8.1	8.5	--
AS-48/03W/30-0068	463634090470001	12-01-70	--	165	288	7.8	9.0	--
AS-48/03W/33-0246	463518090444101	07-30-85	1500	285	275	8.3	10.5	--
AS-48/03W/33-0248	463520090441901	07-30-85	1330	292	290	8.3	9.0	--
AS-48/03W/33-0279	463530090452701	08-01-85	0930	280	290	7.8	10.0	--
AS-48/03W/34-0245	463529090434601	07-11-85	1030	297	335	7.8	9.5	--
AS-48/03W/36-0280	463551090413002	07-31-85	1100	257	560	8.2	8.5	--
AS-48/03W/36-0288	463548090413001	08-19-86	1015	177	510	7.5	9.5	--
		03-18-87	0820	177	315	8.1	5.5	--
AS-48/04W/25-0289	463646090484001	08-19-86	1130	161	365	8.1	9.0	--

Appendix 2. Physical and chemical characteristics of water from wells and springs within the Bad River Indian Reservation—Continued

Local identifier	Date	Hardness, total (mg/L as $CaCO_3$) (00900)	Calcium, dissolved (mg/L as Ca) (00915)	Calcium, total recoverable (mg/L as Ca) (00916)	Magnesium, dissolved (mg/L as Mg) (00925)	Magnesium, total recoverable (mg/L as Mg) (00927)	Sodium, dissolved (mg/L as Na) (00930)	Potassium, dissolved (mg/L as K) (00935)	Alkalinity, field (mg/L as $CaCO_3$) (00410)
AS-46/03W/20-0221	08-01-85	28	7.3	--	2.4	--	--	--	64
AS-46/03W/29-0222	08-01-85	6	2.1	--	.3	--	--	--	85
AS-46/03W/33-0223	08-01-85	72	15	--	8.4	--	--	--	95
AS-47/01W/19-0172	05-25-83	9	2.6	--	.6	--	1.2	0.7	--
AS-47/01W/19-0173	05-25-83	7	1.9	--	.5	--	1.2	.3	--
AS-47/02W/10-0290	08-20-86	130	31	--	12	--	6.3	1.3	--
AS-47/02W/23-0089	08-02-73	63	18	--	4.3	--	2.4	.7	--
	05-23-75	49	14	--	3.5	--	2.5	.9	53
	05-20-76	--	--	--	--	--	--	--	--
AS-47/02W/23-0232	07-09-85	--	--	22	--	7.0	--	--	96
AS-47/02W/24-0233	07-09-85	--	--	15	--	4.6	--	--	63
AS-47/02W/25-0171	05-24-83	68	21	--	3.7	--	1.9	.6	--
AS-47/02W/25-0174	05-25-83	25	7.4	--	1.7	--	1.6	.6	--
AS-47/03W/02-0038	07-10-85	--	--	3.5	--	3.5	--	--	52
AS-48/02W/30-0088	07-09-85	--	--	24	--	18	--	--	170
AS-48/02W/21-0278	07-31-85	160	33	--	20	--	--	--	190
AS-48/02W/32-0069	01-31-67	190	--	--	--	--	--	--	--
	10-01-70	200	44	--	23	--	12	2.4	--
AS-48/02W/32-0094	12-07-66	180	27	--	--	--	--	--	--
AS-48/03W/19-0291	08-19-86	100	23	--	11	--	26	4.7	--
AS-48/03W/22-0272	07-09-85	--	--	15	--	5.5	--	--	65
AS-48/03W/23-0037	08-01-85	66	18	--	5.0	--	--	--	64
AS-48/03W/23-0218	07-10-85	--	--	15	--	4.3	--	--	71
AS-48/03W/23-0219	07-10-85	--	--	16	--	4.9	--	--	73

Appendix 2. Physical and chemical characteristics of water from wells and springs within the Bad River Indian Reservation—Continued

Local identifier	Date	Hardness, total (mg/L as $CaCO_3$) (00900)	Calcium, dissolved (mg/L as Ca) (00915)	Calcium, total recoverable (mg/L as Ca) (00916)	Magnesium, dissolved (mg/L as Mg) (00925)	Magnesium, total recoverable (mg/L as Mg) (00927)	Sodium, dissolved (mg/L as Na) (00930)	Potassium, dissolved (mg/L as K) (00935)	Alkalinity, field (mg/L as $CaCO_3$) (00410)
AS-48/03W/25-0267	07-30-85	96	24	--	8.8	--	--	--	130
AS-48/03W/25-0268	07-31-85	120	30	--	10	--	--	--	88
AS-48/03W/25-0269	07-30-85	110	30	--	9.4	--	--	--	94
AS-48/03W/26-0178	08-21-86	83	22	--	6.9	--	22	3.9	--
AS-48/03W/26-0261	07-11-85	--	--	--	--	--	--	--	86
AS-48/03W/26-0263	07-10-85	--	--	20	--	7.6	--	--	120
AS-48/03W/26-0264	07-31-85	99	25	--	8.9	--	--	--	120
AS-48/03W/27-0259	07-11-85	--	--	--	--	--	--	--	75
AS-48/03W/28-0255	07-10-85	--	--	14	--	4.9	--	--	63
AS-48/03W/28-0257	07-11-85	--	--	--	--	--	--	--	79
AS-48/03W/28-0258	07-31-85	67	18	--	5.3	--	--	--	72
AS-48/03W/29-0220	07-11-85	--	--	--	--	--	--	--	79
AS-48/03W/30-0068	12-01-70	90	24	--	7.2	--	21	5.8	--
AS-48/03W/33-0246	07-30-85	69	20	--	4.5	--	--	--	86
AS-48/03W/33-0248	07-30-85	76	22	--	5.0	--	--	--	91
AS-48/03W/33-0279	08-01-85	94	27	--	6.5	--	--	--	110
AS-48/03W/34-0245	07-11-85	--	--	--	--	--	--	--	120
AS-48/03W/36-0280	07-31-85	140	38	--	11	--	--	--	74
AS-48/03W/36-0288	08-19-86	140	36	--	11	--	37	6.5	--
	03-18-87	--	--	--	--	--	120	--	--
AS-48/04W/25-0289	08-19-86	120	27	--	12	--	29	4.1	--

Appendix 2. Physical and chemical characteristics of water from wells and springs within the Bad River Indian Reservation—Continued

Local identifier	Date	Alkalinity, lab (mg/L as $CaCO_3$) (90410)	Sulfate, dissolved (mg/L as SO_4) (00945)	Chloride, dissolved (mg/L as Cl) (00940)	Fluoride, dissolved (mg/L as F) (00950)	Silica, dissolved (mg/L as SiO_2) (00955)	Solids, residue at 180°C, dissolved (mg/L) (70300)	Nitrogen, nitrite, dissolved (mg/L as N) (00613)
AS-46/03W/20-0221	08-01-85	--	26	17	0.9	--	149	<0.01
AS-46/03W/29-0222	08-01-85	--	4.4	22	.5	--	157	<.01
AS-46/03W/33-0223	08-01-85	--	1.9	2.1	.1	--	108	<.01
AS-47/01W/19-0172	05-25-83	4	10	.6	<.1	9.2	40	.01
AS-47/01W/19-0173	05-25-83	4	6.8	.4	<.1	9.0	30	<.01
AS-47/02W/10-0290	08-20-86	140	5.2	2.2	.1	12	157	--
AS-47/02W/23-0089	08-02-73	66	2.6	1.0	.1	14	78	--
	05-23-75	--	2.6	.9	.1	7.9	74	<.01
	05-20-76	--	--	--	--	--	--	--
AS-47/02W/23-0232	07-09-85	--	5.6	.7	.1	--	125	<.01
AS-47/02W/24-0233	07-09-85	--	4.9	2.5	.1	--	81	<.01
AS-47/02W/25-0171	05-24-83	62	6.6	1.4	<.1	12	81	<.01
AS-47/02W/25-0174	05-25-83	20	10	.6	<.1	11	53	<.01
AS-47/03W/02-0038	07-10-85	--	.7	14	.3	--	83	<.01
AS-48/02W/30-0088	07-09-85	--	5.7	2.9	.2	--	213	<.01
AS-48/02W/21-0278	07-31-85	--	3.9	2.7	.3	--	199	<.01
AS-48/02W/32-0069	01-31-67	190	--	--	.2	--	--	--
	10-01-70	220	9.2	1.5	.8	20	225	--
AS-48/02W/32-0094	12-07-66	190	--	2.0	--	--	232	--
AS-48/03W/19-0291	08-19-86	130	20	17	.4	15	188	--
AS-48/03W/22-0272	07-09-85	--	21	.6	.4	--	136	<.01
AS-48/03W/23-0037	08-01-85	--	19	17	.3	--	139	<.01
AS-48/03W/23-0218	07-10-85	--	21	14	.3	--	149	<.01
AS-48/03W/23-0219	07-10-85	--	19	17	.3	--	148	<.01
AS-48/03W/25-0267	07-30-85	--	9.1	9.6	.3	--	170	<.01

Appendix 2. Physical and chemical characteristics of water from wells and springs within the Bad River Indian Reservation—Continued

Local identifier	Date	Alkalinity, lab (mg/L as $CaCO_3$) (90410)	Sulfate, dissolved (mg/L as SO_4) (00945)	Chloride, dissolved (mg/L as Cl) (00940)	Fluoride, dissolved (mg/L as F) (00950)	Silica, dissolved (mg/L as SiO_2) (00955)	Solids, residue at 180°C, dissolved (mg/L) (70300)	Nitrogen, nitrite, dissolved (mg/L as N) (00613)
AS-48/03W/25-0268	07-31-85	--	15	50	.3	--	209	<.01
AS-48/03W/25-0269	07-30-85	--	16	52	.3	--	214	<.01
AS-48/03W/26-0178	08-21-86	110	16	8.3	.3	16	153	--
AS-48/03W/26-0261	07-11-85	--	17	15	.2	--	169	<.01
AS-48/03W/26-0263	07-10-85	--	16	8.1	.4	--	175	<.01
AS-48/03W/26-0264	07-31-85	--	16	8.8	.5	--	176	<.01
AS-48/03W/27-0259	07-11-85	--	21	17	.3	--	140	<.01
AS-48/03W/28-0255	07-10-85	--	13	15	.3	--	119	<.01
AS-48/03W/28-0257	07-11-85	--	15	19	.3	--	118	<.01
AS-48/03W/28-0258	07-31-85	--	16	10	.4	--	117	<.01
AS-48/03W/29-0220	07-11-85	--	23	19	.4	--	143	<.01
AS-48/03W/30-0068	12-01-70	84	26	18	.4	16	164	--
AS-48/03W/33-0246	07-30-85	--	23	20	.4	--	167	<.01
AS-48/03W/33-0248	07-30-85	--	22	18	.3	--	170	<.01
AS-48/03W/33-0279	08-01-85	--	20	16	.4	--	166	<.01
AS-48/03W/34-0245	07-11-85	--	18	12	.5	--	143	<.01
AS-48/03W/36-0280	07-31-85	--	15	100	.3	--	307	<.01
AS-48/03W/36-0288	08-19-86	75	16	100	.2	9.5	294	--
	03-18-87	--	--	49	--	--	--	--
AS-48/04W/25-0289	08-19-86	130	29	18	.4	16	208	--

Appendix 2. Physical and chemical characteristics of water from wells and springs within the Bad River Indian Reservation—Continued

Local identifier	Date	Nitrogen, $NO_2 + NO_3$, total (mg/L as N) (00630)	Nitrogen, $NO_2 + NO_3$, dissolved (mg/L as N) (00631)	Nitrogen, NH_4, dissolved (mg/L as N) (00608)	Nitrogen, NH_4 + organic, total (mg/L as N) (00625)	Nitrogen, NH_4 + organic, dissolved (mg/L as N) (00623)	Phosphorus, total (mg/L as P) (00665)	Carbon, organic, dissolved (mg/L as C) (00681)
AS-46/03W/20-0221	08-01-85	--	<0.10	--	--	--	--	2.0
AS-46/03W/29-0222	08-01-85	--	<.10	--	--	--	--	.7
AS-46/03W/33-0223	08-01-85	--	<.10	--	--	--	--	.5
AS-47/01W/19-0172	05-25-83	--	<.10	0.03	--	0.30	--	8.5
AS-47/01W/19-0173	05-25-83	--	<.10	<.01	--	.20	--	5.5
AS-47/02W/10-0290	08-20-86	<0.10	--	--	0.30	--	0.01	--
AS-47/02W/23-0089	08-02-73	--	--	--	--	--	--	--
	05-23-75	--	.09	--	.11	--	.01	--
	05-20-76	--	--	--	--	--	--	--
AS-47/02W/23-0232	07-09-85	--	.29	--	--	--	--	1.9
AS-47/02W/24-0233	07-09-85	--	.21	--	--	--	--	1.3
AS-47/02W/25-0171	05-24-83	--	.19	.02	--	.20	--	1.5
AS-47/02W/25-0174	05-25-83	--	<.10	.03	--	.40	--	7.3
AS-47/03W/02-0038	07-10-85	--	<.10	--	--	--	--	3.5
AS-48/02W/30-0088	07-09-85	--	<.10	--	--	--	--	3.4
AS-48/02W/21-0278	07-31-85	--	<.10	--	--	--	--	1.3
AS-48/02W/32-0069	01-31-67	--	--	--	--	--	--	--
	10-01-70	--	--	--	--	--	--	--
AS-48/02W/32-0094	12-07-66	--	--	--	--	--	--	--
AS-48/03W/19-0291	08-19-86	<.10	--	--	<.20	--	.05	--
AS-48/03W/22-0272	07-09-85	--	<.10	--	--	--	--	.8
AS-48/03W/23-0037	08-01-85	--	<.10	--	--	--	--	.4
AS-48/03W/23-0218	07-10-85	--	<.10	--	--	--	--	1.4
AS-48/03W/23-0219	07-10-85	--	<.10	--	--	--	--	1.1
AS-48/03W/25-0267	07-30-85	--	<.10	--	--	--	--	1.1

Appendix 2. Physical and chemical characteristics of water from wells and springs within the Bad River Indian Reservation—Continued

Local identifier	Date	Nitrogen, $NO_2 + NO_3$, total (mg/L as N) (00630)	Nitrogen, $NO_2 + NO_3$, dissolved (mg/L as N) (00631)	Nitrogen, NH_4, dissolved (mg/L as N) (00608)	Nitrogen, NH_4 + organic, total (mg/L as N) (00625)	Nitrogen, NH_4 + organic, dissolved (mg/L as N) (00623)	Phosphorus, total (mg/L as P) (00665)	Carbon, organic, dissolved (mg/L as C) (00681)
AS-48/03W/25-0268	07-31-85	--	<.10	--	--	--	--	.4
AS-48/03W/25-0269	07-30-85	--	<.10	--	--	--	--	.2
AS-48/03W/26-0178	08-21-86	<.10	--	--	.20	--	.03	--
AS-48/03W/26-0261	07-11-85	--	<.10	--	--	--	--	1.2
AS-48/03W/26-0263	07-10-85	--	<.10	--	--	--	--	1.8
AS-48/03W/26-0264	07-31-85	--	<.10	--	--	--	--	.6
AS-48/03W/27-0259	07-11-85	--	<.10	--	--	--	--	1.4
AS-48/03W/28-0255	07-10-85	--	<.10	--	--	--	--	1.2
AS-48/03W/28-0257	07-11-85	--	<.10	--	--	--	--	.5
AS-48/03W/28-0258	07-31-85	--	<.10	--	--	--	--	.1
AS-48/03W/29-0220	07-11-85	--	<.10	--	--	--	--	.7
AS-48/03W/30-0068	12-01-70	--	--	--	--	--	--	--
AS-48/03W/33-0246	07-30-85	--	<.10	--	--	--	--	1.0
AS-48/03W/33-0248	07-30-85	--	<.10	--	--	--	--	1.1
AS-48/03W/33-0279	08-01-85	--	<.10	--	--	--	--	.7
AS-48/03W/34-0245	07-11-85	--	<.10	--	--	--	--	1.1
AS-48/03W/36-0280	07-31-85	--	<.10	--	--	--	--	.2
AS-48/03W/36-0288	08-19-86	<.10	--	--	<.20	--	.04	--
	03-18-87	--	--	--	--	--	--	--
AS-48/04W/25-0289	08-19-86	<.10	--	--	<.20	--	.09	--

Appendix 3. Trace-constituent analyses of water from wells and springs within the Bad River Indian Reservation

[µg/L, micrograms per liter; mg/L, milligrams per liter; --, no data available; <, less than; ND, not detected. The five-digit number ending some column headings is the parameter code used in the U.S. Geological Survey's Water Data Storage and Retrieval System; locations shown on plate 1]

Local identifier	Data-collection site number	Date	Time (24-hour)	Depth of well (feet) (72008)	Aluminum, total recoverable (µg/L as Al) (01105)	Arsenic, total (µg/L as As) (01002)	Arsenic, dissolved (µg/L as As) (01000)	Barium, total recoverable (µg/L as Ba) (01007)	Barium, dissolved (µg/L as Ba) (01005)
AS-46/03W/20-0221	462642090455901	08-01-85	1120	129	--	--	1	--	32
AS-46/03W/29-0222	462616090460101	08-01-85	1230	254	--	--	4	--	10
AS-46/03W/33-0223	462529090441701	08-01-85	1415	414	--	--	2	--	130
AS-47/01W/19-0172	463205090330001	05-25-83	0900	spring	--	--	<1	--	--
AS-47/01W/19-0173	463225090330001	05-25-83	1000	spring	--	--	<1	--	--
AS-47/02W/10-0290	463349090364201	08-20-86	1640	190	<10	2	--	--	--
AS-47/02W/23-0089	463209090342701	08-02-73	1000	142	--	--	--	--	--
		05-23-75	0950	142	--	--	--	--	--
		05-20-76	0945	142	--	--	<1	--	--
AS-47/02W/23-0232	463220090343201	07-09-85	0945	185	--	--	--	<100	--
AS-47/02W/24-0233	463152090335501	07-09-85	1450	197	--	--	--	<100	--
AS-47/02W/25-0171	463135090330301	05-24-83	1600	349	--	--	1	--	--
AS-47/02W/25-0174	463141090340001	05-25-83	1100	spring	--	--	<1	--	--
AS-47/03W/02-0038	463442090420501	07-10-85	0930	187	--	--	--	<100	--
AS-48/02W/30-0088	463619090402201	07-09-85	1300	191	--	--	--	200	--
AS-48/02W/21-0278	463547090393301	07-31-85	1000	200	--	--	2	--	240
AS-48/02W/32-0069	463602090391102	01-31-67	--	178	--	--	--	--	--
		10-01-70	--	178	--	--	--	--	--
AS-48/02W/32-0094	463602090391101	12-07-66	--	174	--	--	--	--	--
AS-48/03W/19-0291	463709090480201	08-19-86	1630	78	<10	<1	--	--	--
AS-48/03W/22-0272	463704090440001	07-09-85	1615	271	--	--	--	<100	--
AS-48/03W/23-0037	463709090421201	08-01-85	1625	272	--	--	2	--	39
AS-48/03W/23-0218	463712090421301	07-10-85	1350	235	--	--	--	<100	--
AS-48/03W/23-0219	463709090420901	07-10-85	1415	270	--	--	--	<100	--
AS-48/03W/25-0267	463631090414801	07-30-85	1630	125	--	--	1	--	98

Appendix 3. Trace-constituent analyses of water from wells and springs within the Bad River Indian Reservation—Continued

Local identifier	Data-collection site number	Date	Time (24-hour)	Depth of well (feet) (72008)	Aluminum, total recoverable (µg/L as Al) (01105)	Arsenic, total (µg/L as As) (01002)	Arsenic, dissolved (µg/L as As) (01000)	Barium, total recoverable (µg/L as Ba) (01007)	Barium, dissolved (µg/L as Ba) (01005)
AS-48/03W/25-0268	463609090411601	07-31-85	1245	250	--	--	1	--	86
AS-48/03W/25-0269	463606090411801	07-30-85	1820	241	--	--	<1	--	61
AS-48/03W/26-0178	464157090363401	08-21-86	1515	137	30	2	--	--	--
AS-48/03W/26-0261	463634090421201	07-11-85	0920	137	--	--	--	--	--
AS-48/03W/26-0263	463622090424001	07-10-85	1130	127	--	--	--	<100	--
AS-48/03W/26-0264	463626090422601	07-31-85	1415	137	--	--	1	--	68
AS-48/03W/27-0259	463635090434401	07-11-85	1230	220	--	--	2	--	--
AS-48/03W/28-0255	463658090443501	07-10-85	1530	270	--	--	--	<100	--
AS-48/03W/28-0257	463636090450201	07-11-85	1345	285	--	--	<1	--	--
AS-48/03W/28-0258	463632090450601	07-31-85	1545	292	--	--	1	--	91
AS-48/03W/29-0220	463635090463702	07-11-85	1500	181	--	--	2	--	--
AS-48/03W/30-0068	463634090470001	12-01-70	--	165	--	--	--	--	--
AS-48/03W/33-0246	463518090444101	07-30-85	1500	285	--	--	1	--	74
AS-48/03W/33-0248	463520090441901	07-30-85	1330	292	--	--	1	--	63
AS-48/03W/33-0279	463530090452701	08-01-85	0930	280	--	--	<1	--	95
AS-48/03W/34-0245	463529090434601	07-11-85	1030	297	--	--	--	--	--
AS-48/03W/36-0280	463551090413002	07-31-85	1100	257	--	--	<1	--	92
AS-48/03W/36-0288	463548090413001	08-19-86	1015	177	<10	<1	--	--	--
		03-18-87	0820	177	--	--	--	--	--
AS-48/04W/25-0289	463646090484001	08-19-86	1130	161	<10	2	--	--	--

Appendix 3. Trace-constituent analyses of water from wells and springs within the Bad River Indian Reservation—Continued

Local identifier	Date	Cadmium, total recoverable (µg/L as Cd) (01027)	Cadmium, dissolved (µg/L as Cd) (01025)	Chromium, total recoverable (µg/L as Cr) (01034)	Chromium, dissolved (µg/L as Cr) (01030)	Cobalt, total recoverable (µg/L as Co) (01037)	Cobalt, dissolved (µg/L as Co) (01035)	Copper, total recoverable (µg/L as Cu) (01042)	Copper, dissolved (µg/L as Cu) (01040)	Iron, total recoverable (µg/L as Fe) (01045)
AS-46/03W/20-0221	08-01-85	--	1.0	--	<10	--	--	--	1	--
AS-46/03W/29-0222	08-01-85	--	2.0	--	<10	--	--	--	1	--
AS-46/03W/33-0223	08-01-85	--	2.0	--	<10	--	--	--	1	--
AS-47/01W/19-0172	05-25-83	--	<1.0	--	20	--	--	--	20	--
AS-47/01W/19-0173	05-25-83	--	<1.0	--	10	--	--	--	9	--
AS-47/02W/10-0290	08-20-86	<1	--	2	--	<1	--	47	--	810
AS-47/02W/23-0089	08-02-73	--	--	--	--	--	--	--	--	--
	05-23-75	--	--	--	--	--	--	--	--	--
	05-20-76	--	<2.0	--	<20	--	ND	--	ND	--
AS-47/02W/23-0232	07-09-85	--	--	20	--	--	--	12	--	480
AS-47/02W/24-0233	07-09-85	--	--	<10	--	--	--	8	--	170
AS-47/02W/25-0171	05-24-83	--	<1.0	--	10	--	--	--	14	--
AS-47/02W/25-0174	05-25-83	--	<1.0	--	<10	--	--	--	13	--
AS-47/03W/02-0038	07-10-85	--	--	10	--	--	--	140	--	26,000
AS-48/02W/30-0088	07-09-85	--	--	10	--	--	--	8	--	370
AS-48/02W/21-0278	07-31-85	--	2.0	--	<10	--	--	--	2	--
AS-48/02W/32-0069	01-31-67	--	--	--	--	--	--	--	--	--
	10-01-70	--	--	--	--	--	--	--	--	--
AS-48/02W/32-0094	12-07-66	--	--	--	--	--	--	--	--	--
AS-48/03W/19-0291	08-19-86	<1	--	1	--	<1	--	10	--	100
AS-48/03W/22-0272	07-09-85	--	--	10	--	--	--	26	--	660
AS-48/03W/23-0037	08-01-85	--	2.0	--	<10	--	--	--	1	--
AS-48/03W/23-0218	07-10-85	--	--	<10	--	--	--	2	--	160
AS-48/03W/23-0219	07-10-85	--	--	10	--	--	--	10	--	170
AS-48/03W/25-0267	07-30-85	--	<1.0	--	<10	--	--	--	1	--

Appendix 3. Trace-constituent analyses of water from wells and springs within the Bad River Indian Reservation—Continued

Local identifier	Date	Cadmium, total recoverable (µg/L as Cd) (01027)	Cadmium, dissolved (µg/L as Cd) (01025)	Chromium, total recoverable (µg/L as Cr) (01034)	Chromium, dissolved (µg/L as Cr) (01030)	Cobalt, total recoverable (µg/L as Co) (01037)	Cobalt, dissolved (µg/L as Co) (01035)	Copper, total recoverable (µg/L as Cu) (01042)	Copper, dissolved (µg/L as Cu) (01040)	Iron, total recoverable (µg/L as Fe) (01045)
AS-48/03W/25-0268	07-31-85	--	1.0	--	<10	--	--	--	1	--
AS-48/03W/25-0269	07-30-85	--	<1.0	--	<10	--	--	--	1	--
AS-48/03W/26-0178	08-21-86	<1	--	2	--	<1	--	7	--	<10
AS-48/03W/26-0261	07-11-85	--	--	--	--	--	--	--	--	--
AS-48/03W/26-0263	07-10-85	--	--	10	--	--	--	7	--	250
AS-48/03W/26-0264	07-31-85	--	<1.0	--	<10	--	--	--	<1	--
AS-48/03W/27-0259	07-11-85	--	--	--	--	--	--	--	--	--
AS-48/03W/28-0255	07-10-85	--	--	10	--	--	--	32	--	650
AS-48/03W/28-0257	07-11-85	--	--	--	--	--	--	--	--	--
AS-48/03W/28-0258	07-31-85	--	<1.0	--	<10	--	--	--	1	--
AS-48/03W/29-0220	07-11-85	--	--	--	--	--	--	--	--	--
AS-48/03W/30-0068	12-01-70	--	--	--	--	--	--	--	--	--
AS-48/03W/33-0246	07-30-85	--	1.0	--	<10	--	--	--	3	--
AS-48/03W/33-0248	07-30-85	--	<1.0	--	<10	--	--	--	1	--
AS-48/03W/33-0279	08-01-85	--	2.0	--	10	--	--	--	1	--
AS-48/03W/34-0245	07-11-85	--	--	--	--	--	--	--	--	--
AS-48/03W/36-0280	07-31-85	--	2.0	--	<10	--	--	--	1	--
AS-48/03W/36-0288	08-19-86	<1	--	6	--	1	--	11	--	950
	03-18-87	--	--	--	--	--	--	--	--	--
AS-48/04W/25-0289	08-19-86	<1	--	5	--	<1	--	11	--	130

Appendix 3. Trace-constituent analyses of water from wells and springs within the Bad River Indian Reservation—Continued

Local identifier	Date	Iron, suspended recoverable (µg/L as Fe) (01044)	Iron, dissolved (µg/L as Fe) (01046)	Iron (µg/L as Fe) (71885)	Lead, total recoverable (µg/L as Pb) (01051)	Lead, dissolved (µg/L as Pb) (01049)	Manganese, total recoverable (µg/L as Mn) (01055)	Manganese, suspended recoverable (µg/L as Mn) (01054)	Manganese, dissolved (µg/L as Mn) (01056)	Manganese, elemental, total (µg/L as Mn) (71883)
AS-46/03W/20-0221	08-01-85	--	13	--	--	10	--	--	3	--
AS-46/03W/29-0222	08-01-85	--	8	--	--	19	--	--	1	--
AS-46/03W/33-0223	08-01-85	--	14	--	--	21	--	--	15	--
AS-47/01W/19-0172	05-25-83	--	150	--	--	2	--	--	14	--
AS-47/01W/19-0173	05-25-83	--	21	--	--	1	--	--	7	--
AS-47/02W/10-0290	08-20-86	780	32	--	<5	--	20	9	11	--
AS-47/02W/23-0089	08-02-73	--	330	--	--	--	--	--	<10	--
	05-23-75	--	20	--	--	--	--	--	40	--
	05-20-76	--	--	--	--	4	--	--	--	--
AS-47/02W/23-0232	07-09-85	--	--	--	25	--	40	--	--	--
AS-47/02W/24-0233	07-09-85	--	--	--	17	--	20	--	--	--
AS-47/02W/25-0171	05-24-83	--	10	--	--	2	--	--	1	--
AS-47/02W/25-0174	05-25-83	--	250	--	--	4	--	--	24	--
AS-47/03W/02-0038	07-10-85	--	--	--	64	--	160	--	--	--
AS-48/02W/30-0088	07-09-85	--	--	--	15	--	90	--	--	--
AS-48/02W/21-0278	07-31-85	--	17	--	--	14	--	--	46	--
AS-48/02W/32-0069	01-31-67	--	--	60	--	--	--	--	--	60
	10-01-70	--	--	160	--	--	--	--	--	70
AS-48/02W/32-0094	12-07-66	--	--	2,300	--	--	--	--	--	80
AS-48/03W/19-0291	08-19-86	60	44	--	<5	--	40	0	41	--
AS-48/03W/22-0272	07-09-85	--	--	--	5	--	30	--	--	--
AS-48/03W/23-0037	08-01-85	--	6	--	--	10	--	--	1	--
AS-48/03W/23-0218	07-10-85	--	--	--	6	--	20	--	--	--
AS-48/03W/23-0219	07-10-85	--	--	--	8	--	30	--	--	--
AS-48/03W/25-0267	07-30-85	--	47	--	--	10	--	--	98	--

Appendix 3. Trace-constituent analyses of water from wells and springs within the Bad River Indian Reservation—Continued

Local identifier	Date	Iron, suspended recoverable (µg/L as Fe) (01044)	Iron, dissolved (µg/L as Fe) (01046)	Iron (µg/L as Fe) (71885)	Lead, total recoverable (µg/L as Pb) (01051)	Lead, dissolved (µg/L as Pb) (01049)	Manganese, total recoverable (µg/L as Mn) (01055)	Manganese, suspended recoverable (µg/L as Mn) (01054)	Manganese, dissolved (µg/L as Mn) (01056)	Manganese, elemental, total (µg/L as Mn) (71883)
AS-48/03W/25-0268	07-31-85	--	58	--	--	12	--	--	3	--
AS-48/03W/25-0269	07-30-85	--	80	--	--	<1	--	--	4	--
AS-48/03W/26-0178	08-21-86	--	8	--	7	--	60	7	53	--
AS-48/03W/26-0261	07-11-85	--	--	--	--	--	--	--	--	--
AS-48/03W/26-0263	07-10-85	--	--	--	19	--	100	--	--	--
AS-48/03W/26-0264	07-31-85	--	5	--	--	<1	--	--	85	--
AS-48/03W/27-0259	07-11-85	--	--	--	--	--	--	--	--	--
AS-48/03W/28-0255	07-10-85	--	--	--	15	--	40	--	--	--
AS-48/03W/28-0257	07-11-85	--	--	--	--	--	--	--	--	--
AS-48/03W/28-0258	07-31-85	--	180	--	--	17	--	--	3	--
AS-48/03W/29-0220	07-11-85	--	--	--	--	--	--	--	--	--
AS-48/03W/30-0068	12-01-70	--	--	80	--	--	--	--	--	0
AS-48/03W/33-0246	07-30-85	--	100	--	--	13	--	--	5	--
AS-48/03W/33-0248	07-30-85	--	67	--	--	3	--	--	1	--
AS-48/03W/33-0279	08-01-85	--	1,100	--	--	10	--	--	39	--
AS-48/03W/34-0245	07-11-85	--	--	--	--	--	--	--	--	--
AS-48/03W/36-0280	07-31-85	--	170	--	--	16	--	--	8	--
AS-48/03W/36-0288	08-19-86	740	210	--	98	--	10	0	12	--
	03-18-87	--	--	--	<5	--	--	--	--	--
AS-48/04W/25-0289	08-19-86	0	130	--	7	--	40	1	39	--

Appendix 3. Trace-constituent analyses of water from wells and springs within the Bad River Indian Reservation—Continued

Local identifier	Date	Mercury, total recoverable (µg/L as Hg) (71900)	Mercury, dissolved (µg/L as Hg) (71890)	Nickel, dissolved (µg/L as Ni) (01065)	Selenium, total (µg/L as Se) (01147)	Selenium, dissolved (µg/L as Se) (01145)	Silver, dissolved (µg/L as Ag) (01075)	Zinc, total recoverable (µg/L as Zn) (01092)	Zinc, dissolved (µg/L as Zn) (01090)	Cyanide, dissolved (µg/L as Cn) (00723)
AS-46/03W/20-0221	08-01-85	--	0.1	--	--	<1	--	--	7	<0.01
AS-46/03W/29-0222	08-01-85	--	<.1	--	--	<1	--	--	7	<.01
AS-46/03W/33-0223	08-01-85	--	<.1	--	--	<1	--	--	8	<.01
AS-47/01W/19-0172	05-25-83	--	.1	<1	--	1	--	--	32	--
AS-47/01W/19-0173	05-25-83	--	.1	<1	--	1	--	--	14	--
AS-47/02W/10-0290	08-20-86	<0.1	--	--	<1	--	--	130	--	--
AS-47/02W/23-0089	08-02-73	--	--	--	--	--	--	--	--	--
	05-23-75	--	--	--	--	--	--	--	--	--
	05-20-76	--	<.5	ND	--	<1	ND	--	130	--
AS-47/02W/23-0232	07-09-85	--	<.1	--	--	--	--	280	--	<.01
AS-47/02W/24-0233	07-09-85	--	<.1	--	--	--	--	160	--	<.01
AS-47/02W/25-0171	05-24-83	--	.1	<1	--	1	--	--	94	--
AS-47/02W/25-0174	05-25-83	--	.1	1	--		--	--	6	--
AS-47/03W/02-0038	07-10-85	--	<.1	--	--	--	--	11,000	--	<.01
AS-48/02W/30-0088	07-09-85	--	<.1	--	--	--	--	170	--	<.01
AS-48/02W/21-0278	07-31-85	--	.1	--	--	<1	--	--	21	<.01
AS-48/02W/32-0069	01-31-67	--	--	--	--	--	--	--	--	--
	10-01-70	--	--	--	--	--	--	--	--	--
AS-48/02W/32-0094	12-07-66	--	--	--	--	--	--	--	--	--
AS-48/03W/19-0291	08-19-86	<.1	--	--	<1	--	--	40	--	--
AS-48/03W/22-0272	07-09-85	--	.1	--	--	--	--	120	--	<.01
AS-48/03W/23-0037	08-01-85	--	<.1	--	--	<1	--	--	17	<.01
AS-48/03W/23-0218	07-10-85	--	<.1	--	--	--	--	30	--	<.01
AS-48/03W/23-0219	07-10-85	--	<.1	--	--	--	--	40	--	<.01
AS-48/03W/25-0267	07-30-85	--	.1	--	--	<1	--	--	17	<.01

Appendix 3. Trace-constituent analyses of water from wells and springs within the Bad River Indian Reservation—Continued

Local identifier	Date	Mercury, total recoverable (µg/L as Hg) (71900)	Mercury, dissolved (µg/L as Hg) (71890)	Nickel, dissolved (µg/L as Ni) (01065)	Selenium, total (µg/L as Se) (01147)	Selenium, dissolved (µg/L as Se) (01145)	Silver, dissolved (µg/L as Ag) (01075)	Zinc, total recoverable (µg/L as Zn) (01092)	Zinc, dissolved (µg/L as Zn) (01090)	Cyanide, dissolved (µg/L as Cn) (00723)
AS-48/03W/25-0268	07-31-85	--	<.1	--	--	<1	--	--	16	<.01
AS-48/03W/25-0269	07-30-85	--	.3	--	--	<1	--	--	56	<.01
AS-48/03W/26-0178	08-21-86	<.1	--	--	<1	--	--	30	--	--
AS-48/03W/26-0261	07-11-85	--	<.1	--	--	--	--	--	--	<.01
AS-48/03W/26-0263	07-10-85	--	<.1	--	--	--	--	70	--	<.01
AS-48/03W/26-0264	07-31-85	--	<.1	--	--	<1	--	--	22	<.01
AS-48/03W/27-0259	07-11-85	--	<.1	--	--	--	--	--	--	<.01
AS-48/03W/28-0255	07-10-85	--	<.1	--	--	--	--	530	--	<.01
AS-48/03W/28-0257	07-11-85	--	.1	--	--	--	--	--	--	<.01
AS-48/03W/28-0258	07-31-85	--	<.1	--	--	<1	--	--	99	<.01
AS-48/03W/29-0220	07-11-85	--	<.1	--	--	--	--	--	--	<.01
AS-48/03W/30-0068	12-01-70	--	--	--	--	--	--	--	--	--
AS-48/03W/33-0246	07-30-85	--	.1	--	--	<1	--	--	66	<.01
AS-48/03W/33-0248	07-30-85	--	.2	--	--	<1	--	--	52	<.01
AS-48/03W/33-0279	08-01-85	--	<.1	--	--	<1	--	--	54	<.01
AS-48/03W/34-0245	07-11-85	--	<.1	--	--	--	--	--	--	<.01
AS-48/03W/36-0280	07-31-85	--	.5	--	--	<1	--	--	39	<.01
AS-48/03W/36-0288	08-19-86	<0.1	--	--	<1	--	--	300	--	--
	03-18-87	--	--	--	--	--	--	--	--	--
AS-48/04W/25-0289	08-19-86	.1	--	--	<1	--	--	30	--	--

Appendix 4. Physical and chemical characteristics of water from streams within the Bad River Indian Reservation

[ft^3/s, cubic feet per second; µS/cm, microsiemens per centimeter at 25˚C; ˚C, degrees Celsius; mg/L, milligrams per liter; µg/L, micrograms per liter; --, no data available; <, less than. The five-digit number ending some column headings is the parameter code used in the U.S. Geological Survey's Water Storage and Retrieval System; locations shown on plate 1]

Local identifier	Data-collection site number	Date	Time (24-hour)	Discharge, instantaneous, ft^3/s (00061)	Specific conductance (µS/cm) (00095)	pH (standard units) (00400)	Oxygen demand, chemical (high level) (mg/L) (00340)	Hardness, total (mg/L as $CaCO_3$) (00900)
Beartrap Creek near Ashland	04026385	07-16-85	0800	--	160	7.5	--	70
		07-29-86	1540	--	120	7.2	--	63
Marengo River at Marengo	04026600	01-18-71	1530	46	180	7.6	--	86
		04-20-71	1445	386	67	7.0	--	29
		08-14-85	1000	137	113	7.8	--	55
		08-14-85	1259	137	113	7.8	--	--
Marengo River near Mellen	04026740	07-18-85	1420	--	163	7.5	--	70
		07-31-86	1440	--	100	7.5	--	53
Silver Creek near High Bridge	04026761	07-17-85	1500	--	220	7.8	--	80
Potato River near Gurney	04026910	07-10-85	1700	--	140	7.2	--	--
		07-16-85	1700	--	140	7.2	--	59
		07-29-86	1000	--	63	6.9	--	35
Vaughn Creek near Gurney	04026950	07-17-85	0815	--	222	8.1	--	100
		07-29-86	1215	--	160	7.3	--	76
Silver Creek at mouth	04027550	08-27-87	1000	--	190	7.4	21	93
Denomie Creek at Town Road	040276505	07-16-85	1140	--	190	7.7	--	78
		08-14-85	1300	3.2	110	7.3	--	46
Morrison Creek near Birch	04027662	07-16-85	1430	--	250	8.5	--	120
		07-30-86	1135	--	245	7.6	--	--
Bell Creek near Birch	04027675	07-30-86	1040	--	315	7.9	--	130
Graveyard Creek near Birch	04027688	05-25-83	1530	--	<50	6.9	<10	15
Graveyard Creek near Saxon	04027690	07-30-86	0950	--	175	6.9	--	86

Appendix 4. Physical and chemical characteristics of water from streams within the Bad River Indian Reservation—Continued

Local identifier	Date	Hardness, noncarbonate, total (mg/L as $CaCO_3$) (95902)	Calcium, dissolved (mg/L as Ca) (00915)	Magnesium, dissolved (mg/L as Mg) (00925)	Sodium, dissolved (mg/L as Na) (00930)	Potassium, dissolved (mg/L as K) (00935)	Bicarbonate, water, field (mg/L as HCO_3) (00440)	Alkalinity, field (mg/L as $CaCO_3$) (00410)	Alkalinity, lab (mg/L as $CaCO_3$) (90410)
Beartrap Creek near Ashland	07-16-85	--	17	6.8	4.2	2.1	--	--	72
	07-29-86	5	16	5.7	2.5	2.2	--	--	58
Marengo River at Marengo	01-18-71	--	22	7.5	3.6	1.2	100	82	--
	04-20-71	--	8.8	1.8	2.2	.8	28	23	--
	08-14-85	--	14	4.9	2.0	.9	--	--	51
	08-14-85	--	--	--	--	--	--	--	--
Marengo River near Mellen	07-18-85	--	18	6.1	2.8	.9	--	--	70
	07-31-86	5	14	4.5	1.9	1.0	--	--	49
Silver Creek near High	07-17-85	--	20	7.2	4.8	1.9	--	--	83
Potato River near Gurney	07-10-85	--	--	--	--	--	--	--	--
	07-16-85	--	17	4.1	3.3	.7	--	--	55
	07-29-86	6	10	2.5	1.9	.7	--	--	29
Vaughn Creek near Gurney	07-17-85	--	30	6.1	3.9	1.0	--	--	98
	07-29-86	3	22	5.0	3.3	1.3	--	--	73
Silver Creek at mouth	08-27-87	--	24	8.1	3.7	--	--	--	--
Denomie Creek at Town Road	07-16-85	--	22	5.5	7.9	1.1	--	--	72
	08-14-85	--	13	3.3	3.9	1.5	--	--	40
Morrison Creek near Birch	07-16-85	--	37	7.8	7.1	<.1	--	--	120
	07-30-86	--	--	--	--	--	--	--	--
Bell Creek near Birch	07-30-86	0	37	10	4.6	1.6	--	--	140
Graveyard Creek near Birch	05-25-83	--	4.4	1.0	1.2	1.2	--	--	12
Graveyard Creek near Saxon	07-30-86	0	25	5.8	2.1	1.1	--	--	86

Appendix 4. Physical and chemical characteristics of water from streams within the Bad River Indian Reservation—Continued

Local identifier	Date	Sulfate, dissolved (mg/L as SO_4) (00945)	Chloride, dissolved (mg/L as Cl) (00940)	Fluoride, dissolved (mg/L as F) (00950)	Silica, dissolved (mg/L as SiO_2) (00955)	Solids, residue at 180°C, dissolved (mg/L) (70300)	Nitrogen, nitrate, total (mg/L as N) (00620)	Nitrogen, nitrate, dissolved (mg/L as NO_3) (71851)	Nitrogen, nitrite, total (mg/L as N) (00615)
Beartrap Creek near Ashland	07-16-85	0.7	3.7	--	5.2	121	0.28	--	0.02
	07-29-86	12	2.9	--	6.5	121	.09	--	.01
Marengo River at Marengo	01-18-71	7.5	2.2	<0.1	17	113	--	4.1	--
	04-20-71	10	1.0	.2	8.6	59	--	1.5	--
	08-14-85	5.1	1.2	--	9.8	86	--	--	--
	08-14-85	--	--	--	--	--	--	--	<.01
Marengo River near Mellen	07-18-85	7.5	2.2	--	10	105	--	--	<.01
	07-31-86	12	1.4	--	9.1	69	--	--	<.01
Silver Creek near High Bridge	07-17-85	<.2	4.6	--	5.4	137	--	--	<.01
Potato River near Gurney	07-10-85	--	--	--	--	--	--	--	--
	07-16-85	8.4	4.2	--	8.2	103	--	--	--
	07-29-86	11	2.5	--	8.4	80	--	--	<.01
Vaughn Creek near Gurney	07-17-85	5.9	5.0	--	11	141	--	--	<.01
	07-29-86	8.9	3.8	--	11	126	--	--	<.01
Silver Creek at mouth	08-27-87	6.4	--	--	--	110	--	--	--
Denomie Creek at Town Road	07-16-85	8.0	14	--	15	135	--	--	<.01
	08-14-85	5.1	5.5	--	7.1	85	--	--	<.01
Morrison Creek near Birch	07-16-85	6.9	8.3	--	16	159	--	--	<.01
	07-30-86	--	--	--	--	--	--	--	<.01
Bell Creek near Birch	07-30-86	7.2	2.6	--	13	155	--	--	<.01
Graveyard Creek near Birch	05-25-83	9.8	.5	<.1	9.5	39	--	--	--
Graveyard Creek near Saxon	07-30-86	8.7	1.3	--	12	101	--	--	<.01

Appendix 4. Physical and chemical characteristics of water from streams within the Bad River Indian Reservation—Continued

Local identifier	Date	Nitrogen, $NO_2 + NO_3$, total (mg/L as N) (00630)	Nitrogen, NH_4, total (mg/L as N) (00610)	Nitrogen, organic, total (mg/L as N) (00605)	Nitrogen, NH_4 + organic, total (mg/L as N) (00625)	Nitrogen, total (mg/L as N) (00600)	Nitrogen, total (mg/L as NO_3) (71887)	Arsenic, dissolved (µg/L as As) (01000)	Cadmium, dissolved (µg/L as Cd) (01025)
Beartrap Creek near Ashland	07-16-85	0.30	0.21	1.3	1.5	1.8	8.0	--	--
	07-29-86	.10	.03	1.4	1.4	1.5	6.6	--	--
Marengo River at Marengo	01-18-71	--	--	--	--	--	--	--	--
	04-20-71	--	--	--	--	--	--	--	--
	08-14-85	--	--	--	--	--	--	--	--
	08-14-85	<.10	.02	.48	.50	--	--	--	--
Marengo River near Mellen	07-18-85	.20	.02	.78	.80	1.0	4.4	--	--
	07-31-86	.10	.02	.78	.80	.90	4.0	--	--
Silver Creek near High Bridge	07-17-85	.60	<.01	--	.70	1.3	5.8	--	--
Potato River near Gurney	07-10-85	--	--	--	--	--	--	--	--
	07-16-85	--	--	--	--	--	--	--	--
	07-29-86	<.10	.02	.88	.90	--	--	--	--
Vaughn Creek near Gurney	07-17-85	.40	.04	.56	.60	1.0	4.4	--	--
	07-29-86	.30	.02	.48	.50	.80	3.5	--	--
Silver Creek at mouth	08-27-87	--	--	--	--	--	--	--	--
Denomie Creek at Town Road	07-16-85	.20	.19	.91	1.1	1.3	5.8	--	--
	08-14-85	<.10	.07	.43	.50	--	--	--	--
Morrison Creek near Birch	07-16-85	<.10	.34	.36	.70	--	--	--	--
	07-30-86	<.10	.02	.88	.90	--	--	--	--
Bell Creek near Birch	07-30-86	.10	.05	.45	.50	.60	2.7	--	--
Graveyard Creek near Birch	05-25-83	--	--	--	--	--	--	<1	<1
Graveyard Creek near Saxon	07-30-86	<.10	.04	.56	.60	--	--	--	--

Appendix 4. Physical and chemical characteristics of water from streams within the Bad River Indian Reservation—Continued

Local identifier	Date	Chromium, dissolved (µg/L as Cr) (01030)	Copper, dissolved (µg/L as Cu) (01040)	Iron, total recoverable (µg/L as Fe) (01045)	Iron, suspended recoverable (µg/L as Fe) (01044)	Iron, dissolved (µg/L as Fe) (01046)	Iron (µg/L as Fe) (71885)	Lead, dissolved (µg/L as Pb) (01049)	Manganese, dissolved (µg/L as Mn) (01056)
Beartrap Creek near Ashland	07-16-85	--	--	2,700	700	2,000	--	--	89
	07-29-86	--	--	2,200	900	1,300	--	--	34
Marengo River at Marengo	01-18-71	--	--	--	--	--	420	--	--
	04-20-71	--	--	--	--	--	480	--	--
	08-14-85	--	--	1,800	1,500	310	--	--	9
	08-14-85	--	--	--	--	--	--	--	--
Marengo River near Mellen	07-18-85	--	--	600	230	370	--	--	14
	07-31-86	--	--	1,400	960	440	--	--	10
Silver Creek near High Bridge	07-17-85	--	--	2,400	700	1,700	--	--	110
Potato River near Gurney	07-10-85	--	--	--	--	--	--	--	--
	07-16-85	--	--	410	100	310	--	--	14
	07-29-86	--	--	850	370	480	--	--	8
Vaughn Creek near Gurney	07-17-85	--	--	410	200	210	--	--	7
	07-29-86	--	--	850	340	510	--	--	8
Silver Creek at mouth	08-27-87	--	--	--	--	--	--	--	--
Denomie Creek at Town Road	07-16-85	--	--	220	70	150	--	--	3
	08-14-85	--	--	1,900	1,200	730	--	--	34
Morrison Creek near Birch	07-16-85	--	--	240	60	180	--	--	37
	07-30-86	--	--	--	--	--	--	--	--
Bell Creek near Birch	07-30-86	--	--	300	220	85	--	--	35
Graveyard Creek near Birch	05-25-83	10	14	--	--	79	--	1	5
Graveyard Creek near Saxon	07-30-86	--	--	1,500	1,000	500	--	--	45

Appendix 4. Physical and chemical characteristics of water from streams within the Bad River Indian Reservation—Continued

Local identifier	Date	Manganese, elemental, total (µg/L as Mn) (71883)	Mercury, total recoverable (µg/L as Hg) (71900)	Mercury, dissolved (µg/L as Hg) (71890)	Nickel, dissolved (µg/L as Ni) (01065)	Selenium, dissolved (µg/L as Se) (01145)	Zinc, dissolved (µg/L as Zn) (01090)	Carbon, organic, dissolved (mg/L as C) (00681)	Carbon, organic, suspended, total (mg/L as C) (00689)
Beartrap Creek near Ashland	07-16-85	--	<0.1	--	--	--	--	21	0.4
	07-29-86	--	.1	--	--	--	--	33	.3
Marengo River at Marengo	01-18-71	9	--	--	--	--	--	--	--
	04-20-71	96	--	--	--	--	--	--	--
	08-14-85	--	.2	--	--	--	--	11	.7
	08-14-85	--	--	--	--	--	--	--	--
Marengo River near Mellen	07-18-85	--	<.1	--	--	--	--	9.1	.3
	07-31-86	--	.1	--	--	--	--	14	.5
Silver Creek near High Bridge	07-17-85	--	<.1	--	--	--	--	7.6	.3
Potato River near Gurney	07-10-85	--	--	--	--	--	--	--	--
	07-16-85	--	<.1	--	--	--	--	13	.3
	07-29-86	--	.1	--	--	--	--	22	.3
Vaughn Creek near Gurney	07-17-85	--	<.1	--	--	--	--	6.2	.3
	07-29-86	--	.1	--	--	--	--	10	--
Silver Creek at mouth	08-27-87	--	--	--	--	--	--	--	--
Denomie Creek at Town Road	07-16-85	--	<.1	--	--	--	--	17	--
	08-14-85	--	.2	--	--	--	--	14	.8
Morrison Creek near Birch	07-16-85	--	<.1	--	--	--	--	2.5	.1
	07-30-86	--	.1	--	--	--	--	10	.3
Bell Creek near Birch	07-30-86	--	.1	--	--	--	--	4.8	.2
Graveyard Creek near Birch	05-25-83	--	--	.1	<1	1	6	6.3	--
Graveyard Creek near Saxon	07-30-86	--	.2	--	--	--	--	7.2	.5

Appendix 5. Physical and chemical characteristics of water and bottom material in lakes and sloughs within the Bad River Indian Reservation

[µS/cm, microsiemens per centimeter at 25˚C; ˚C, degrees Celsius; mg/L, milligrams per liter; µg/L, micrograms per liter; mg/kg, milligrams per kilogram; µg/g, micrograms per gram; --, no data available. The five-digit number ending some column headings is the parameter code used in the U.S. Geological Survey's Water Storage and Retrieval System; locations shown on plate 1]

Local identifier	Data-collection site number	Date	Time (24-hour)	Specific conductance (µS/cm) (00095)	pH (standard units) (00400)	Temperature, water (˚C) (00010)	Hardness, total (mg/L as $CaCO_3$) (00900)	Hardness, noncarbonate total (mg/L as $CaCO_3$) (95902)	Calcium, dissolved (mg/L as Ca) (00915)
Lake Superior near Bad River	463655090365501	07-30-86	1140	90	8.1	21.0	44	1	13
Honest John Lake near Odanah	463700090370001	07-30-86	1120	83	7.3	24.0	45	1	12
Bad River Slough near Odanah	463800090383001	07-30-86	1300	100	7.6	24.0	54	3	15
Kakagon Slough site No. 1	463900090430001	07-22-86	0800	--	--	--	--	--	--
Kakagon Slough site No. 5	463900090430005	07-22-86	0900	--	--	--	--	--	--
		08-26-87	1014	--	--	18.5	--	--	--
Kakagon Slough site No. 7	463900090430007	07-22-86	1000	--	--	--	--	--	--
		08-26-87	1035	--	--	18.5	--	--	--
Kakagon Slough site No. 9	463900090430009	07-22-86	1100	--	--	--	--	--	--
		08-26-87	1215	78	7.0	19.0	--	--	--
Kakagon Slough site No. 11	463900090430011	07-22-86	1200	--	--	--	--	--	--
		08-26-87	1145	--	--	19.0	--	--	--
Kakagon Slough site No. 12	463900090430012	07-22-86	1300	--	--	--	--	--	--
		08-26-87	1120	--	--	19.0	--	--	--
Kakagon Slough site No. 16	463900090430016	07-22-86	1400	--	--	--	--	--	--
		08-26-87	1355	82	6.9	19.5	--	--	--
Kakagon Slough site No. 20	463900090430020	07-22-86	1500	--	--	--	--	--	--

Appendix 5. Physical and chemical characteristics of water and bottom material in lakes and sloughs within the Bad River Indian Reservation—Continued

Local identifier	Date	Magnesium, dissolved (mg/L as Mg) (00925)	Sodium, dissolved (mg/L as Na) (00930)	Potassium, dissolved (mg/L as K) (00935)	Alkalinity, lab (mg/L as $CaCO_3$) (90410)	Sulfate, dissolved (mg/L as SO_4) (00945)	Chloride, dissolved (mg/L as Cl) (00940)	Fluoride, dissolved (mg/L as F) (00950)	Silica, dissolved (mg/L as SiO_2) (00955)	Solids, residue at 180°C, dissolved (mg/L) (70300)
Lake Superior near Bad River	07-30-86	2.7	1.3	0.7	43	4.3	1.5	<0.1	2.1	54
Honest John Lake near Odanah	07-30-86	3.6	2.3	1.0	44	11	2.3	<.1	2.9	74
Bad River Slough near Odanah	07-30-86	4.1	2.1	1.2	51	12	2.0	<.1	8.2	90
Kakagon Slough site No. 1	07-22-86	--	--	--	--	--	--	--	--	--
Kakagon Slough site No. 5	07-22-86	--	--	--	--	--	--	--	--	--
	08-26-87	--	--	--	--	--	--	--	--	--
Kakagon Slough site No. 7	07-22-86	--	--	--	--	--	--	--	--	--
	08-26-87	--	--	--	--	--	--	--	--	--
Kakagon Slough site No. 9	07-22-86	--	--	--	--	--	--	--	--	--
	08-26-87	--	--	--	--	--	--	--	--	--
Kakagon Slough site No. 11	07-22-86	--	--	--	--	--	--	--	--	--
	08-26-87	--	--	--	--	--	--	--	--	--
Kakagon Slough site No. 12	07-22-86	--	--	--	--	--	--	--	--	--
	08-26-87	--	--	--	--	--	--	--	--	--
Kakagon Slough site No. 16	07-22-86	--	--	--	--	--	--	--	--	--
	08-26-87	--	--	--	--	--	--	--	--	--
Kakagon Slough site No. 20	07-22-86	--	--	--	--	--	--	--	--	--

Appendix 5. Physical and chemical characteristics of water and bottom material in lakes and sloughs within the Bad River Indian Reservation—Continued

Local identifier	Date	Nitrogen, $NO_2 + NO_3$, dissolved (mg/L as N) (00631)	Nitrogen, $NO_2 + NO_3$, total in bottom material (mg/kg as N) (00633)	Nitrogen, total in bottom material (mg/kg as N) (00611)	Nitrogen, NH_4 + organic, total in bottom material (mg/kg as N) (00626)	Nitrogen, NH_4 ortho, dissolved (mg/L as P) (00671)	Phosphorus, total in bottom material (mg/kg as P) (00668)	Phosphorus iron, dissolved (µg/L as Fe) (01046)	Lead, recoverable from bottom material (µg/g as Pb) (01052)
Lake Superior near Bad River	07-30-86	0.26	--	--	--	<0.01	--	65	--
Honest John Lake near Odanah	07-30-86	<.1	--	--	--	<.01	--	690	--
Bad River Slough near Odanah	07-30-86	<.1	--	--	--	.01	--	460	--
Kakagon Slough site No. 1	07-22-86	--	3.0	62	5,900	--	670	--	--
Kakagon Slough site No. 5	07-22-86	--	10	61	13,000	--	800	--	--
	08-26-87	--	<2.0	21	11,000	--	340	--	20
Kakagon Slough site No. 7	07-22-86	--	3.0	28	4,500	--	370	--	--
	08-26-87	--	<2.0	28	7,800	--	320	--	10
Kakagon Slough site No. 9	07-22-86	--	2.0	71	5,000	--	660	--	--
	08-26-87	--	<2.0	40	4,800	--	410	--	20
Kakagon Slough site No. 11	07-22-86	--	5.0	86	6,400	--	210	--	--
	08-26-87	--	<2.0	38	9,800	--	310	--	30
Kakagon Slough site No. 12	07-22-86	--	2.0	56	3,500	--	580	--	--
	08-26-87	--	<2.0	37	4,600	--	430	--	20
Kakagon Slough site No. 16	07-22-86	--	3.0	38	2,900	--	710	--	--
	08-26-87	--	<2.0	48	1,400	--	440	--	10
Kakagon Slough site No. 20	07-22-86	--	<2.0	25	830	--	420	--	--