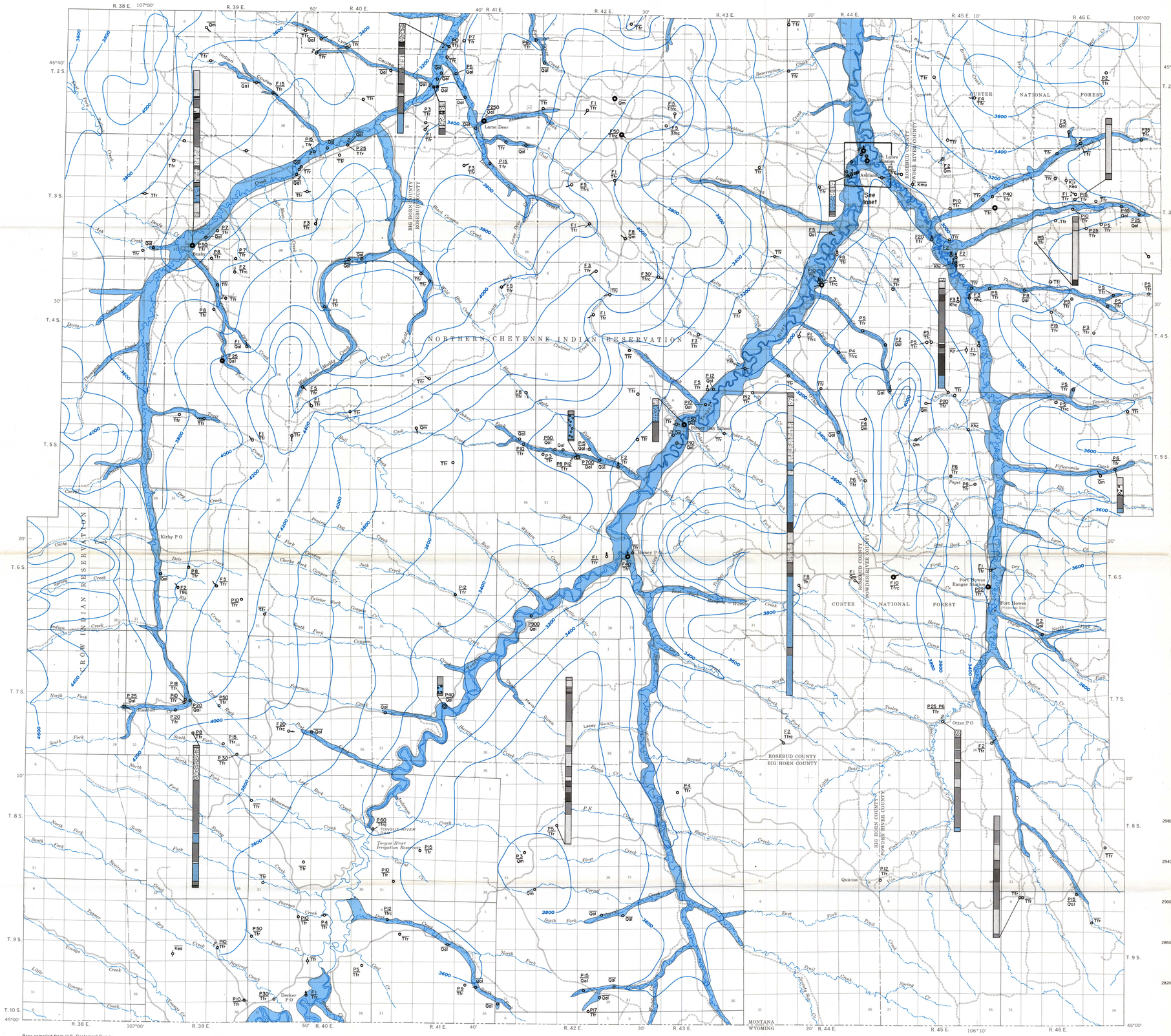
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

PREPARED AS PART OF THE PROGRAM OF THE
DEPARTMENT OF THE INTERIOR FOR THE
DEVELOPMENT OF THE MISSOURI RIVER BASIN

HYDROLOGIC INVESTIGATIONS
ATLAS HA-468 (SHEET 1 OF 2)

GROUND-WATER RESOURCES



Base compiled from U.S. Geological Survey 1:24,000; U.S. Forest Service, Custer National Forest (Ashland Division, 1966); and Montana State Highway Commission, Big Horn and Rosebud Counties, 1962

SCALE 1:125 000

2 0 2 4 6 8 10 MILES

2 0 2 4 6 8 10 KILOMETERS

DATUM IS MEAN SEA LEVEL

GEOHYDROLOGIC MAP

EXPLANATION

- Domestic or stock well — *Number indicates numbers of wells at site*
- Irrigation well
- Unused well
- Spring
- Flowing well
- U.S. Geological Survey test hole
- Oil-test hole
- Public supply well

P15 Ttr — Geologic formation yielding water to spring or well

Upper number indicates yield of well or spring, in gallons per minute; P, indicates pumped; F, flow. Not shown where yield is unknown or less than 1 gallon per minute.

Lower letters indicate geologic formation yielding water to spring or well:

Qal, *alluvium*
Qm, *mantle or surficial deposits*
Ttr, *Tongue River Member of Fort Union Formation*
Ttrc, *clinker from burned Tongue River Member*
Khc, *Hell Creek Formation*
Kjr, *Judith River Formation*
Kea, *Eagle Sandstone*
Kmu, *Muddy Sandstone Member of Thermopolis Shale*

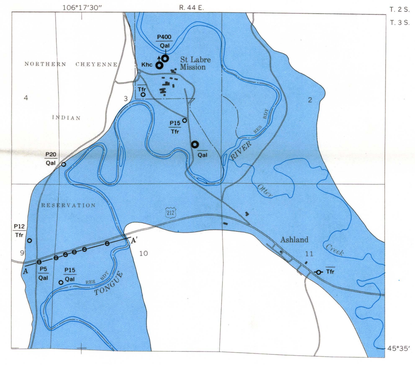
3400 — Generalized potentiometric contour

Shows altitude of potentiometric surface. Contour interval 200 feet. Datum is mean sea level

Area where wells can yield more than 10 gallons per minute from alluvium

FEET: 0, 50, 100, 150, 200, 250

Soil; Clinker; Gravel; Sandy gravel; Sand or sandstone; Clay or silt; Shale; Shaly sandstone or sandy clay; Coal; Water reported on drillers' log



Base from U.S. Geological Survey Ashland, 1966

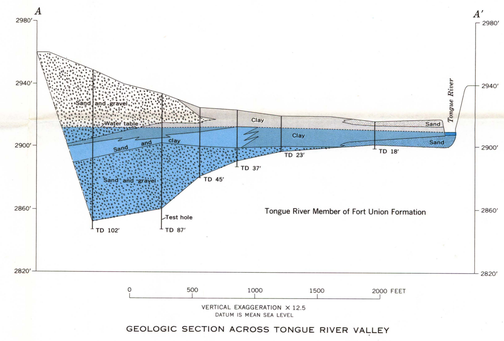
SCALE 1:24 000

0 ½ 1 MILE

0 .5 1 KILOMETER

See geohydrologic map for explanation

MAP OF ASHLAND AREA SHOWING LOCATION OF GEOLOGIC SECTION



GEOLOGIC SECTION ACROSS TONGUE RIVER VALLEY

PURPOSE OF INVESTIGATION

This investigation was made to evaluate the water resources of the Northern Cheyenne Indian Reservation and adjacent area in terms of sources, amounts available, and quality. Specific questions considered were (1) how are the water resources being used, (2) which rock formations yield water to wells and springs, (3) how much water is available from individual wells and springs and what is its quality, (4) what is the flow of the major streams, and what is the chemical quality of the surface water.

WATER USE

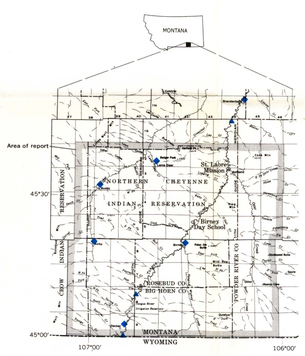
Present water use is small as only about 2,500 people live on the reservation, and approximately 1,000 more live on ranches in the rest of the area. Busby, Lame Deer, Birney, Birney Day School, and St. Labre Mission use wells and community water systems. Private wells and springs supply domestic water to the rest of the area. Stock water is obtained from wells, springs, streams, and ponds.

Extensive coal deposits in the area are being considered for industrial development. Abundant water is essential for conversion of coal to electricity, fluid fuel, or chemicals. Development of the coal deposits would significantly increase the use of water in the area.

GROUND-WATER RESOURCES

PHYSIOGRAPHY

The Northern Cheyenne Indian Reservation and adjacent area (see index map) includes about 2,500 square miles of the unglaciated Missouri Plateau part of the Great Plains province in southeastern Montana (Fenneman, 1931, p. 63–65). The topography is rough, with long narrow ridges, extensive hillsides, and generally narrow flood plains.



EXPLANATION

◆ Precipitation station

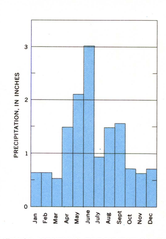
▲ Streamflow station

0 10 20 30 MILES

INDEX MAP OF REPORT AREA SHOWING LOCATION OF PRECIPITATION AND STREAMFLOW STATIONS

PRECIPITATION

Precipitation provides soil moisture and recharge to ground water, and contributes to streamflow. Wells and springs depend on recharge from rainfall or snowmelt that temporarily exceeds soil moisture requirements. The average annual precipitation from 1960 through 1968 as measured at six stations in and near the study area was 14.47 inches (see precipitation graph).



AVERAGE MONTHLY PRECIPITATION, 1960–68, BASED ON RECORDS FROM SIX STATIONS

GEOLOGY

Exposed rocks include soil and weathered clinker, alluvial deposits of sand and gravel, the Wasatch Formation, and the Tongue River Member of the Fort Union Formation (see summary table of geologic formations and their water-bearing properties). The soil and weathered clinker, referred to as "mantle," cover most of the ridges and the gently sloping hillsides. Because of their position, mantle deposits normally do not contain water in quantities sufficient to satisfy stock or domestic needs.

Alluvial deposits of sand and gravel underlie the flood plains. In places, this alluvium is sufficiently permeable to yield relatively large volumes of water to wells (see geohydrologic map).

Test holes drilled in secs. 9 and 10, T. 3 S., R. 44 E.,(see map of Ashland area) show the maximum thickness of the alluvium beneath the Tongue River flood plain to be 97 feet and the maximum saturated thickness about 60 feet. The alluvium in this area, as shown on the geologic section, is predominantly sand- and gravel-sized clinker fragments derived from the Tongue River Member of the Fort Union Formation.

The Wasatch Formation overlies the Tongue River Member of the Fort Union Formation on the ridges and uplands along the southern border of the project area. Of the Wasatch in the project area, Baker (1929, p. 25) noted: "There is ***no great lithologic difference between the Tongue River and Wasatch rocks *** "

The Tongue River Member of the Fort Union Formation contains beds of sandstone, shale, shaly sandstone, and coal. In describing the member, Bass (1932, p. 37) commented: "In detail the beds in the Tongue River member are not continuous over wide areas, but groups of beds maintain certain distinguishing characters throughout distances of 50 miles and more." The lithology of the Tongue River Member is indicated by the graphic logs of water wells shown on the geohydrologic map.

Fractured "clinker" beds at the surface of the Wasatch Formation and Tongue River Member permit rapid infiltration of precipitation, which recharges underlying strata or emerges at springs or seeps. Bass (1932, p. 27) commented: "As thick coal beds ***are uncovered by erosion they burn along their outcrops and for considerable distances back from the crop lines, and the great heat produced ***bakes the [overlying] beds to a very resistant slag ***called clinker. The resulting clinker beds ***commonly are 20 to 40 feet thick."

The Hell Creek Formation, which does not crop out in the area, yields usable water to wells. Water from the Hell Creek is under sufficient artesian pressure to flow from wells in the valleys of Otter Creek and Tongue River. Other water-bearing formations that lie below the Hell Creek and that have been tested, contain water that is too saline to be used for most purposes. The Fox Hills Sandstone, which is an important aquifer in other places in southeastern Montana, is absent in the study area.

OCCURRENCE OF GROUND WATER

Wells and springs yield water for domestic or stock supplies from the alluvium in stream valleys; from clinker beds, sandstone and coal beds in the Tongue River Member of the Fort Union Formation; and from sandstone beds in the Hell Creek Formation (see table and geohydrologic map). Wells that would yield more than 50 gpm (gallons per minute) would be limited to the alluvium along the perennial streams. A well in the SW¼NW¼ of sec. 21, T. 5 S., R. 42 E., reportedly yields 700 gpm from gravel along Cook Creek. Extensive saturated clinker beds would yield as much as 50 gpm to wells. Many wells and springs that yield 1 gpm or less from alluvium in the coulees have been developed for stock water.

Shale beds in the Tongue River Member of the Fort Union Formation restrict the downward percolation of water. Most springs in the area issue from hillsides at the contact between a water-bearing bed of sandstone or coal and an underlying shale bed. Springs are also found at or near the base of clinker beds.

The potentiometric surface contours (see geohydrologic map) show the altitude of ground water in the alluvium and in the Tongue River Member of the Fort Union Formation. The contours are based on altitude of water in wells and the altitude at which springs and seeps emerge along hillsides and in valley bottoms. Where springs emerge at the top of a shale bed, the rocks directly beneath the shale may not be water bearing, and the water above the shale may be limited to a thin zone.

Summary of geologic formations and their water-bearing properties

System	Series	Stratigraphic unit and symbol		Thickness, in feet	Character and distribution	Water supply
Quaternary	Holocene and Pleistocene	Alluvium (Qal) and mantle or surficial deposits (Qm)		0–80	Alluvium is detritus along streams derived from adjacent upland area. Includes beds of clay, sand, gravel, and mixtures of these. Most gravel is clinker fragments. Mantle includes soil and weathered clinker. The soil ranges from clay to sand.	Alluvium in valleys of Tongue River and other perennial streams includes gravel beds that yield adequate water for domestic and stock supplies. Wells along the larger perennial streams may yield as much as 700 gpm (gallons per minute). Alluvium in valleys of most intermittent streams contains adequate water suitable for domestic or stock supplies. Surficial deposits on the upland areas probably yield insufficient water for domestic or stock supplies.
Tertiary	Lower Eocene	Wasatch Formation (Twa)		Less than 500	Beds of coal, shale, and sandstone. Limited to southern part of area, on uplands.	Water-bearing characteristics similar to those of underlying Tongue River Member of Fort Union Formation.
	Paleocene	Fort Union Formation	Tongue River Member (Ttr) and clinker (Ttrc)	Less than 1,680	Beds of coal, shale, sandstone, and shaly sandstone. Few beds are persistent over several square miles. Contains clinker, which is altered soil or rock that has been heated when underlying coal beds burned. The material above the burned coal bed may be baked or fused, depending on the type of rock material and the intensity of heat generated.	Water is obtained from sandstone and coal beds. Wells and springs may yield as much as 50 gpm from clinker beds that are fractured and quite permeable. Seeps are common at base of clinker.
			Lebo Shale Member (Ttl)	100–300	Dark shale. Contains some lignite beds but no coal.	Not a source of water in this area.
			Tullock Member (Ttt)	100–250	Sandstone, coal, and shale beds.	Not identified as a source of water in this area.
Cretaceous[1]	Upper Cretaceous	Hell Creek Formation (Khc)		600–650	Beds of sandstone and sandy shale.	Reliable source of water for artesian wells in valleys of Otter Creek and Tongue River. Flowing wells yield less than 10 gpm.

[1]Water from formations that lie beneath the Hell Creek—Judith River Formation (Kjr), Eagle Sandstone (Kea), and Muddy Sandstone Member of Thermopolis Shale (Kmu)—is too saline for domestic or stock use.

WATER RESOURCES OF THE NORTHERN CHEYENNE INDIAN RESERVATION AND ADJACENT AREA, SOUTHEASTERN MONTANA

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For sale by U. S. Geological Survey, price $1.00 per set