AREAL GEOLOGY
OF THE
MC LAUGHLIN QUADRANGLE

STATE OF SOUTH DAKOTA
JOE FOSS, GOVERNOR

STATE GEOLOGICAL SURVEY
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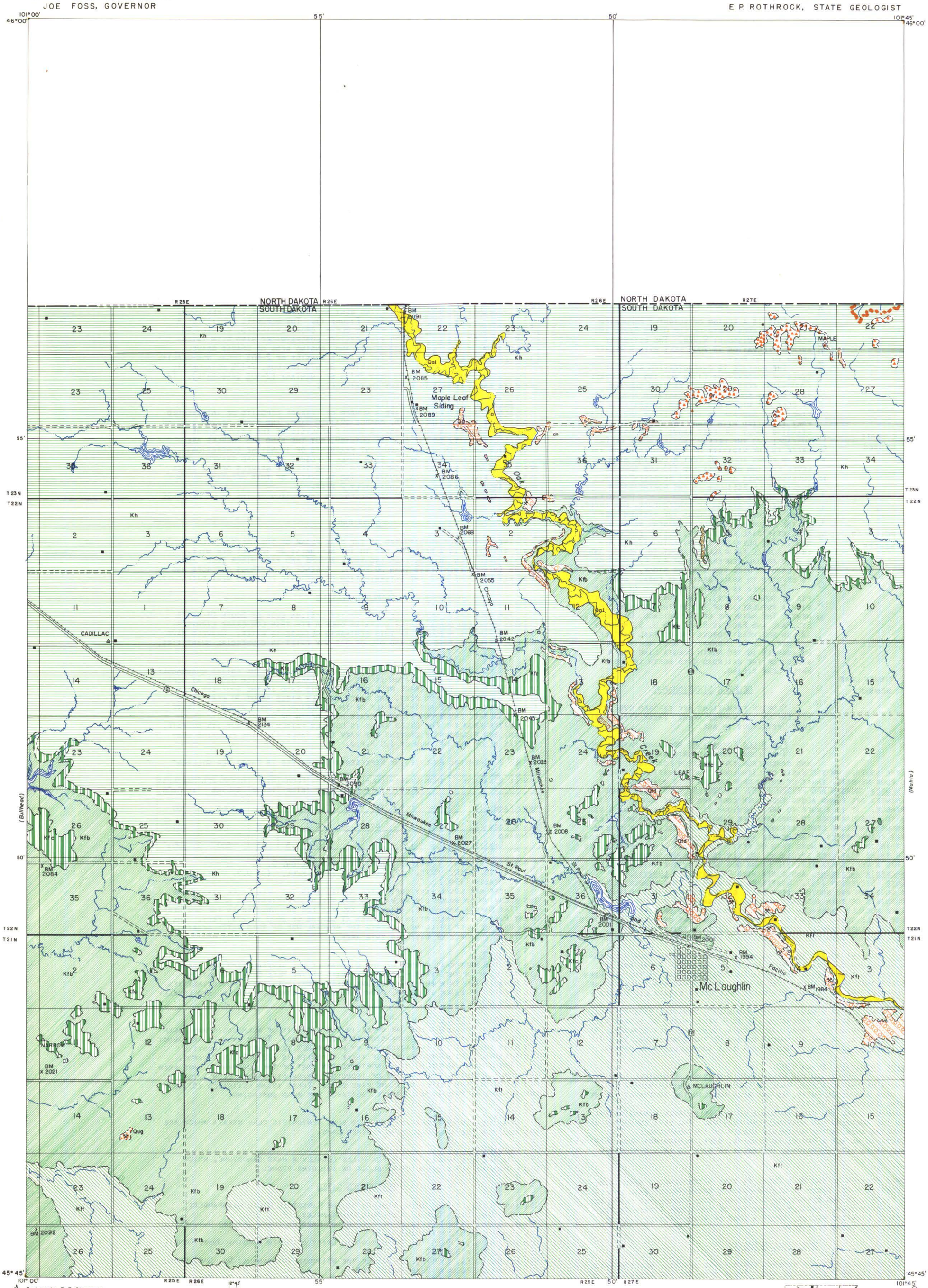


EXPLANATION

PLEISTOCENE — QUATERNARY

Qal — Alluvium
(Floodplain deposits of clay, sand and gravel in the major stream valleys.)

Qtd — Terrace Deposits
(River terrace deposits of interbedded silty sand and coarse gravel characterized by abundant ironstone fragments.)

Qug — Upland Gravel
(Fluvial deposits of interbedded silty sand and sandy gravel characterized by abundant ironstone fragments.)

Qo — Glacial Outwash
(Cross-bedded buff, coarse to fine grained, subgreywacke sand with interbeds and lenses of coarse gravel.)

Qt — Till Residuum
(Concentration of glacial cobbles and boulders > 6 cm in size, mostly of crystalline rocks. A matrix of loess.)

UPPER CRETACEOUS — FOX HILLS FORMATION — CRETACEOUS

Khi / Kh — Hell Creek Formation
(Buff to light grey, medium- to fine-grained, subgreywacke sand; grey to tan clay, silty clay and bentonitic clay and brown peat-clay. Abundant orange limonitic and black ferromanganese concretions. Rare dinosaur bone fragments. Khi-Isabel Firesteel facies: brown peat clay and clay with local thin black fissile lignite, 0"-10".)

Kfc — Colgate Member
(Grey to buff, medium-grained cross-bedded subgreywacke sand and siliceous sandstone. It forms a cap for many buttes. Locally a 0-5 ft. oyster bed is present basally.)

Kfb — Bullhead Member
(Alternating beds of light grey to buff fine subgreywacke sand and dark grey fissile clays.)

Kff — Timber Lake Member
(Cross-bedded, buff to light grey medium- to fine-grained locally silty, subgreywacke sand. Numerous nodular cementations of ferruginous sandstone. Occasional clay pebbles and horizons of orange limonitic concretions. Occasional fossil zones dominated by Tancredia americana.)

Contact
(dashed where approximately located)

Gravel Pit

x BM 2134
Bench Mark
(monument showing exact altitude above sea level)

△ NARROW
Triangulation Station
(monument marking exact geographic location)

x 10"
Measured coal thickness

Geology by R. E. Stevenson
Assisted by R. L. Hale
Surveyed in 1956. Drafted by M. Hale

Base Map by South Dakota State Geological Survey.

APPROXIMATE MEAN DECLINATION 1956
True North
Magnetic North

Scale = 1/62500
½ 0 1 2 3 4 MILES

Vermillion South Dakota
1957

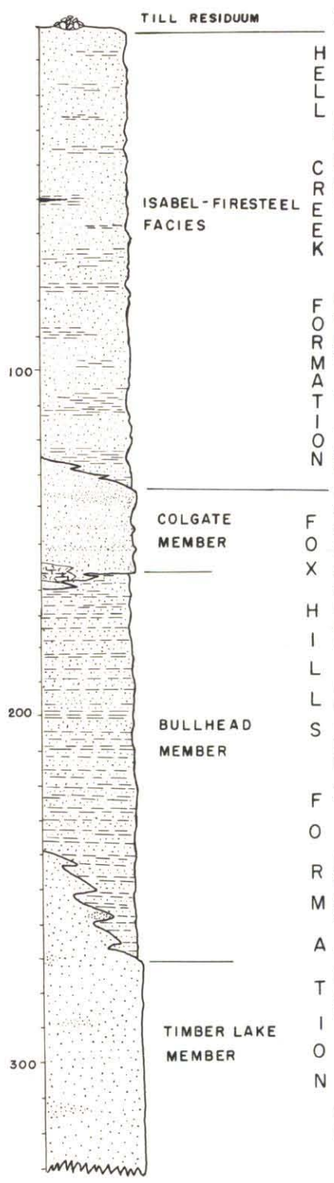
Quadrangle Location

GEOLOGY OF THE MC LAUGHLIN QUADRANGLE

By

Robert E. Stevenson

GENERALIZED COLUMNAR SECTION



INTRODUCTION

The mapping of this quadrangle was done in 1956 as a part of the State Geological Survey's general mapping program. The writer acknowledges with gratitude the assistance in the field of R. L. Hale.

LOCATION

The McLaughlin quadrangle lies along the North Dakota line in northeast Corson County. The area is approximately 100 miles north-northwest of Pierre and 170 miles northwest of Rapid City. It lies in the open Standing Rock Indian Reservation.

GEOGRAPHY

This is a region of slightly populated prairie uplands north of the Grand River and west of the Missouri River. The estimated average elevation is 2000 feet with a relief of 90 to 160 feet.

The surface is characterized by three types of topography: (1) a rolling high level (2000-2150 feet altitude) erosion surface that slopes southward and eastward about 20 - 27 feet per mile from the old interstream divide; this surface in its southern and eastern part is dotted with sandstone capped buttes standing about 100 feet above the erosion surface; (2) the deeply incised gorge of Oak creek in the vicinity of McLaughlin where the stream flows about 80 feet below the high level erosion surface; and (3) low boulder covered ridges and hillocks representing a glacial till residuum in the northeastern corner of the quadrangle.

The only stream of consequence, Oak creek, flows southeasterly across the eastern half of the quadrangle. All permanent water bodies are artificial reservoirs, mostly small stock dams. The climate is semi-arid with an average annual rainfall of about 18 inches, and a mean annual temperature of 43° F. Most of the land is used for grazing stock, but some is devoted to small grain and forage crops.

The area is lightly populated (1 family per 2½ square miles). The town of McLaughlin with a population of 713 is the only settlement. The mainline of the Chicago, Milwaukee, St. Paul and Pacific R. R. and U. S. Highway 12 run southeast across the central part of the map. S. D. Highway 63 goes north from McLaughlin to the North Dakota line and a branch of the railroad goes north through Maple Leaf siding.

BEDROCK STRATIGRAPHY

Bedrock formations are exposed over 95 percent of the mapped area. These strata are late Cretaceous in age.

Fox Hills Formation Meek and Hayden 1861. This formation was originally described and named from exposures on Fox Ridge, about 70 miles to the south. On the basis of lithology, the formation has been divided into four members, three of which crop out in this quadrangle.

Timber Lake Member Morgan and Petsch 1945. Exposures of the buff sands of this lowest member are found along the south edge and in the southeast ninth of the quadrangle. It is a buff to grey, medium- to fine-grained, massive, cross-laminated, subquartzose to subgraywacke sand with orange-brown calcareous ferruginous sandstone cementations, orange limonitic claystone concretions and grey clay-pebbles. The member increases rapidly in thickness from about 40 feet in the west to more than 87 feet in the east. Marine mollusks are common, both as scattered specimens and lenticular subcoquinas. The Timber Lake has a very characteristic fauna dominated by the thick-shelled pelecypod Tancredia americana, and containing Callista and Lunatia.

Bullhead Member Stevenson 1957. Scattered outcrops of this member are found in the southern and southeastern parts of the mapped area. Lithologically it consists of thin alternating beds of light grey to buff, medium- to fine-grained locally cross-laminated subgraywacke sand or silty sand and dark grey subfissile clay. Locally there may be horizons of orange limonitic concretions. The member ranges from 75 to 110 feet in thickness. It is sparsely fossiliferous with the upper portion characterized by scattered Ostrea glabra.

Colgate Member Calvert 1912. Sparse outcrops of this member form a narrow band zigzagging across the central part of the quadrangle. There are a number of buttes and small mesas capped by Colgate sandstone in the southern and southeastern part of the area. The member, with a maximum thickness of 38 feet, is locally absent in the east where Hell Creek strata lie directly upon the Bullhead beds.

The Colgate member is a gray "pepper and salt", massive, fine-grained, subgraywacke sand and several interbeds (1½ to 4 feet thick) of slabby siliceous sandstone ("caprock"). There may be local clay and silt streaks. At the base of the member, in the southwest corner of the quadrangle, is a 1-5 feet thick oyster (Ostrea glabra) bed with a silt and calcarenite matrix.

Hell Creek Formation Brown 1907.

Grassed over outcrops and the absence of the Isabel-Firesteel lignitic facies over most of the area have made it impossible to discriminate in mapping the lower and upper units, as has been done to the southwest and west (Curtiss, 1954, Stevenson, 1957a).

In the mapped area, the few exposures of the Hell Creek formation are restricted to the northern and northwestern portion. The best exposures are in a small badland area in the northeast corner of the quadrangle. The upper Hell Creek is mainly a series of lensing, buff, medium-grained, subgraywacke sand and silts with occasional interbeds of buff to grey bentonitic clay.

The lower portion of the Hell Creek is very heterogeneous with interbedded and lensing buff, fine- to medium-grained subgraywacke sand and silty sand; brown silty clay and bentonitic siltstone; grey bentonitic clay; and brown to black peat-clay. Locally at the top of the lower strata is the Isabel-Firesteel lignitic facies, about a foot of black fissile lignite, clayey lignite, and brown peat-clay.

SURFICIAL DEPOSITS

Lying unconformably on the bedrock surface are glacial, glaciofluvial and fluvial deposits of Pleistocene age. These deposits are restricted to areas adjacent to the major streams and in the northeastern corner of the mapped area. Scattered over the entire quadrangle surface are boulders representing a lag gravel derived from a former Tertiary sediment cover and glacial till.

Iowan or Older Glacial Deposits

These glacial deposits were assumed to belong to the Iowan substage of the Wisconsin by Flint (1955) but Leonard (1916) considered the North Dakota extension of these deposits to be Pre-Wisconsin, possibly Kansan. They show differences in lithology and topographic expression with the Iowan of eastern South Dakota and therefore as Leonard believed, could be Pre-Wisconsin. Their areal extent is shown in figure 1.

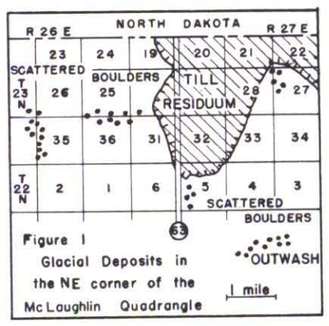


Figure 1
Glacial Deposits in the NE corner of the McLaughlin Quadrangle

Till Residuum. These are low ridges and hillocks veneered by 2-3 feet of abundant boulders and cobbles (minimum diameter of 2½ inches). The accumulations are very patchy. These boulder piles are mixtures of a pre-glacial lag gravel of gray angular siliceous clay ("orthoquartzite") boulders, and igneous (87%), metamorphic (10%), and a non-carbonate sedimentary (3%) glacial boulders. The matrix is loessial.

Outwash. These are patchy upland deposits lying west and south of the till residuum, (see Figure 1). The deposits consist of a fairly clean, cross-laminated, coarse- to fine-grained subgraywacke sand with interbedded and lensing beds of coarse gravel. The gravels consist of 2-40% local non-glacial material, 50-67% igneous, 7-13% metamorphic and 3-17% sedimentary (2-10% carbonate). The deposits range from 0 to 6 feet in thickness.

Alluvial and Gravel Deposits

Along Oak creek, there are a number of terrace deposits of interbedded and lensing fine-grained sand, coarse-grained sand, and sandy gravel ranging from 2 to 5+ feet in thickness. A cobble analysis of the gravel shows a partial similarity to the glacial outwash, but the sand and pebbles are dominantly local in origin (abundant fragments of ironstone concretions).

In Sec. 13, T21N., R25E., is a small exposure of upland gravel. The deposit is very similar in composition to the terrace gravels of Oak creek and Grand river (Stevenson, 1957b). The thickness of this deposit, which covers about 20 acres is approximately 2 feet.

An alluvium rich in clay is present in the bottom of the major drainage units.

STRUCTURE

The quadrangle is situated on the east flank of the Dakota (Williston) Basin resulting in a regional dip to the northwest of 12 feet per mile. Superimposed upon this surface are small slumps and rare minor folds and faults (displacement less than 30 feet). Absence of numerous outcrops and good key horizons make the determination of tectonic features very difficult.

ECONOMIC GEOLOGY

The McLaughlin quadrangle lies on the eastern edge of South Dakota's lignite area and consequently contains only a few thin low-grade lignites. The main mineral resource in this semi-arid climate is water. Gravels have been quarried in this area and oil or gas may exist in commercial quantities.

WATER

The Fox Hills formation yields artesian water over the entire quadrangle. The best water-bearing stratum is the Timber Lake sand which occurs at depths up to 300 feet. The average well depth to this sand in the southern half of the quadrangle is 95 feet, and water usually rises about 30 feet above the aquifer. In the northern half of the quadrangle, most wells penetrate to the Colgate sandstone at an average well depth of 95 feet.

Water from the Fox Hills sands is usually fairly soft, but its sulfate, sodium, and bicarbonate content may vary (see Table 1). The fluoride content is below the optimum of 1.0 p.p.m.

TABLE 1 Chemical Analyses of Representative Waters in Parts Per Million*

Sample Location	Iron	Magnesium	Sulfate	Sodium	Chloride	Fluoride	Nitrate	Dissolved Solids	Hardness as $CaCO_3$
Aman Farm (1)	---	3	227	550	9	---	1.0	1561	60
Banek Farm (2)	1.3	27	47	59	4	---	0.6	332	201
Standard Limits(3)	0.3	125	250		250	1.5	45	500	120+

* Analyses by State Chemical Laboratory, Vermillion, S. D.
(1) Sec. 18, T21N., R27E. (2) Sec. 3, T.22N., R26E. (3) U.S. Bureau of Public Health (1946)

There are local very soft water horizons in the Hell Creek strata and the alluvium in major stream valleys may yield sufficient for domestic use.

The Dakota sandstone, principal aquifer for groundwater in the northern Great Plains, is present in this area at depths of 2600 to 2900 feet. The high cost of deep drilling prevents the general use of this water-bearing strata as a source of water in this area.

LIGNITE

In the northeast corner of the quadrangle are several exposures of a lignite seam in the Isabel-Firesteel facies of the Hell Creek formation. The seam is too thin and bony to have present day commercial potentialities. The lignite is black in color, brownish-black in streak, fissile, and locally sandy or clayey.

SAND AND GRAVEL

Terrace gravels along Oak creek in the vicinity of McLaughlin have been used extensively for road surfacing in recent years. These gravels are about 70% sand and silt and characterized by having 20% fragments of limonitic concretions. Estimated reserve of these deposits is 428,000 cubic yards.

The outwash gravels in the northwestern part of the quadrangle have been used only slightly. The amount of ironstone fragments ranges from 2 to 30% and there is very little silt and fine sand. There is an estimated 153,000 cubic yards of this outwash gravel suitable for road surfacing.

CLAY

The Hell Creek formation includes some bentonitic clay strata which are suitable for use as a sealer in earthen dams.

SANDSTONE

The Colgate member of the Fox Hills locally a hard sandstone, which could provide small supplies of block or building stone.

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