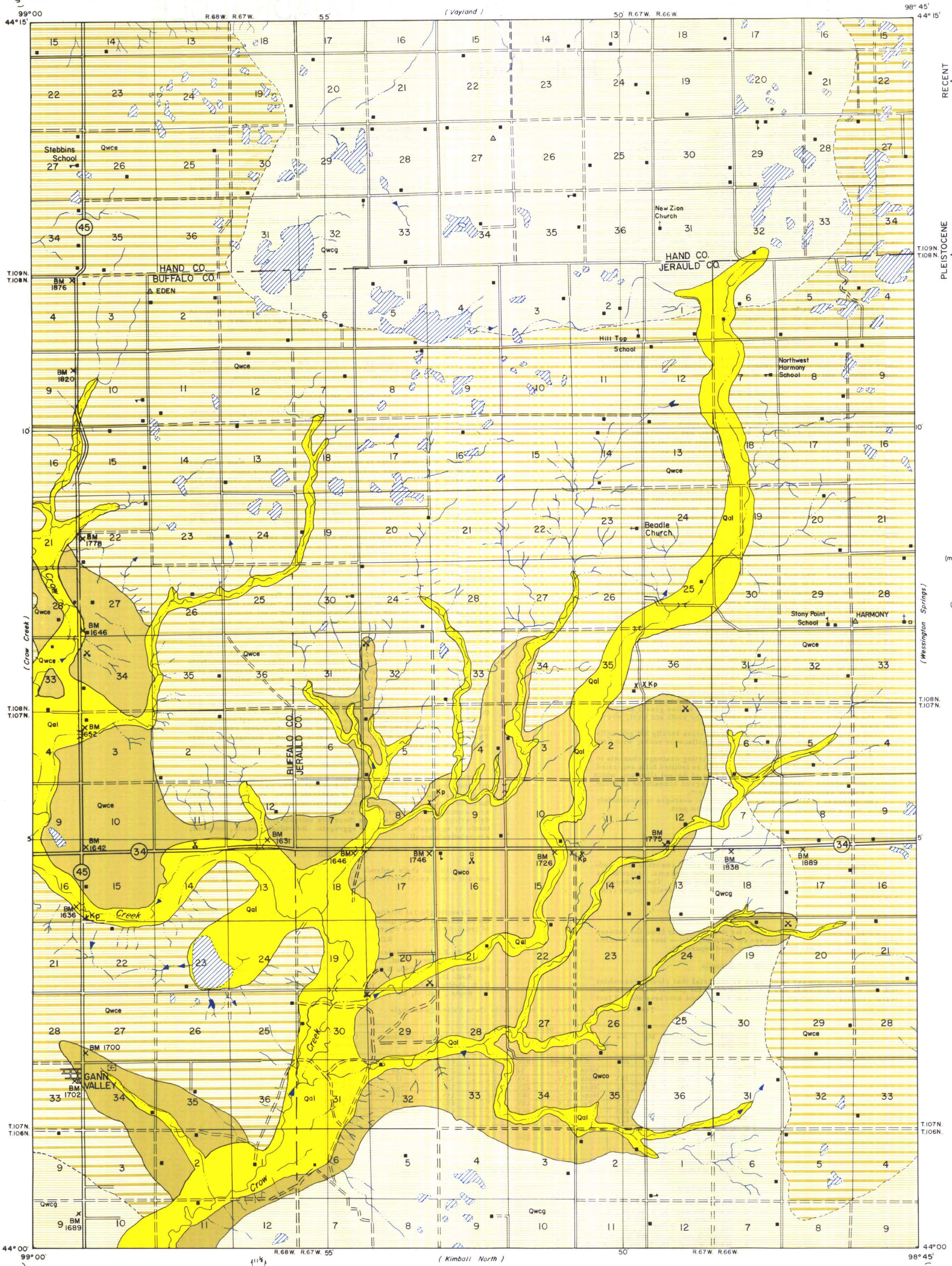
SOUTH DAKOTA GEOLOGICAL SURVEY
ALLEN F. AGNEW, STATE GEOLOGIST

STATE OF SOUTH DAKOTA
RALPH HERSETH, GOVERNOR

GEOLOGY of the GANN VALLEY QUADRANGLE SOUTH DAKOTA



EXPLANATION

QUATERNARY

RECENT

Qal Alluvium
(Semi-stratified deposits of brownish-gray to black fine sand, silt, and clay; in stream flood plains, 0–5 feet thick.)

PLEISTOCENE — WISCONSIN

Qwco Cary Outwash
(Stratified to semi-stratified deposits of brownish-red sand and gravel; poorly sorted; 0–80 feet thick.)

Qwce Cary End Moraine
(Ridge-like accumulations of till characterized by rugged topography, undrained depressions, and boulder-strewn surfaces.)

Qwcg Cary Ground Moraine
(Relatively flat-lying accumulations of till characterized by swell and swale topography, few undrained depressions, and fewer boulders than on end moraine.)

x Kp
Pierre shale

Geologic Contact
(dashed where approximately located)

Gravel Pit

x BM 1800
Bench Mark
(monument showing exact altitude above sea level)

△ EDEN
Triangulation Station
(monument marking exact geographic location)

House, school, and church

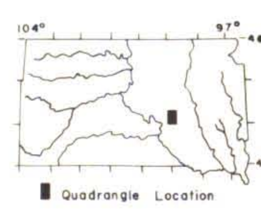
Cemetery

Geology by J. H. Hoff, 1960
Assisted by E. Mickel
Vertical and horizontal control surveyed from triangulation and level lines of Federal surveys
Drafted by H. D. Wong, 1960

TRUE NORTH — MAGNETIC NORTH 11½°
APPROXIMATE MEAN DECLINATION 1959

Scale 1:62 500
1 ½ 0 1 2 3 4 Miles

Vermillion, South Dakota
1960



GANN VALLEY QUADRANGLE

GEOLOGY OF THE GANN VALLEY QUADRANGLE

By

Jerald H. Hoff

INTRODUCTION

The Gann Valley Quadrangle includes about 216 square miles in Jerauld, Buffalo, and Hand Counties, in east-central South Dakota. The eastern edge of the quadrangle is approximately 12 miles west of the town of Wessington Springs (pop. 1453 in 1950). The area lies within the Wessington Hills, which marks the eastern border of the Missouri Plateau subdivision of the Great Plains physiographic province (fig. 1). The Wessington Hills is a bedrock high area that extends from Wessington Springs for a distance of approximately 20 miles westward.

There are no permanent lakes or streams within the quadrangle, but the area is drained toward the south and west by the intermittent Crow Creek and its numerous tributaries. Crow Creek empties into the Missouri River at a point 20 miles west of the quadrangle.

Gann Valley (pop. 100 in 1950) is the county seat of Buffalo County and is the only incorporated area within the quadrangle. State Route 34 crosses the central part of the quadrangle from east to west, and State Route 45 from north to south along the western border. Most county roads are unimproved and trails provide the only access to much of the quadrangle. The climate is characterized by a wide range of temperature, and an average annual precipitation of approximately 18 inches. Stock grazing is the principal industry, and some small grain is grown.

The surface geology was mapped on air photos during the summer of 1959 under the supervision of Fred V. Steece. Additional information was provided by hand-auger borings, supplemented by the State Geological Survey's jeep-mounted auger drill.

SURFICIAL DEPOSITS

The Gann Valley Quadrangle is covered by unconsolidated material which can be divided into four groups: glacial deposits, stream deposits, wind deposits, and a combination of the latter two.

Glacial Deposits

The glacial materials within the quadrangle were deposited by the Cary ice, the third ice advance of the Wisconsin age, which represents the last of the four major subdivisions of the Pleistocene epoch. The ice sheet deposited drift consisting of clay, silt, sand, gravel, and boulders which were removed from bedrock or were reworked from older surficial deposits. The drift lies on Pierre shale. Data from water wells in the quadrangle indicate that the Cary drift averages approximately 200 feet thick in the northern part of the quadrangle, and thins to an average of 60 feet in the southwestern part.

The drift is divisible into two groups, till and outwash deposits. Till is the most abundant, and consists of unsorted and unstratified materials that range in size from clay to boulders. The constituents of the till were derived through abrasion of the underlying land surface, incorporated into the ice, and deposited when the ice melted. Outwash deposits consist of silt, sand, and gravel reworked from the drift by glacial meltwater streams, and later deposited in stratified and relatively well-sorted beds.

The till exposed at the surface is probably Cary in age (Flint, 1955). End moraine is the material formed in ridge-like accumulations around the edges of the glacier, whereas ground moraine is the material deposited under the ice sheet. Both the end moraine and ground moraine in the area are only partially drained. The end moraine has distinct boulder-covered crests and has up to 200 feet of local relief. The ground moraine has a maximum local relief of approximately 40 feet, and presents a smoothly rolling surface. The surface of the north-central part of the quadrangle is characterized by gently rolling ground moraine which merges with the end moraine to the south and west. There is no distinctive break between the ground moraine and the end moraine on the basis of topography. Recognizable end moraine crests in the northern part of the quadrangle trend southeasterly. The end moraine becomes less distinctive to the southwest, where it merges with the outwash plain in the central and western parts of the quadrangle. The outwash plain is so dissected that except for its more mature expression, it is difficult to distinguish from the end moraine on the basis of topography.

Outwash deposits cover an area of 51½ square miles (33,000 acres) in the southern half of the quadrangle. The outwash material was derived from the Cary end moraine immediately to the north and east. The material ranges in size from medium sand to cobbles and is generally poorly sorted, although locally well-sorted medium sands or fine gravel are present. The deposits are generally better sorted to the south and west, where they were laid farther from the ice front.

The composition of the sand and gravel varies locally but generally ranges from 35 to 55 per cent carbonate and argillaceous rocks, with 5-15 percent iron- and manganese-bearing rocks.

The outwash area has been incised by existing drainage channels to such an extent that the sand and gravel are present as isolated hills seperated by drainageways that contain 6 inches to 5 feet of Recent alluvium, which rests upon bedrock. Outwash gravel is preserved beneath the alluvium only in widely separated patches of small extent.

The thickness of the outwash sand and gravel averages approximately 20 feet, with a maximum of 80 feet in the northern part.

Stream Deposits

Recent alluvium consists of silt and a little sand, reworked from bedrock and older surficial deposits by present-day streams. Alluvium is found along most of the streams, even the minor ones. The thickness of the alluvium does not exceed 6 feet at any place, and generally ranges from 1 to 2½ feet.

Wind Deposits

Loess is wind-deposited silt and clay derived mainly from the outwash plain. In this area loess deposits are sporadic and thin -- less than 6 inches in thickness. Loess was therefore not mapped separately.

Wind-Stream Deposits

Most of the outwash is covered by material that closely resembles till, but which apparently was not deposited by the glacial ice. This material reaches a maximum thickness of 6 feet, and averages about 2 feet thick. It is unstratified and consists of clay to silt-size particles with sparsely scattered pebbles and cobbles ½-4 inches in diameter. This material probably represents deposition by both wind and water.

SUBSURFACE ROCKS

There are no natural exposures of bedrock in the quadrangle; however, several road cuts and dug-outs expose Pierre shale. The electric log of the Gann Valley School well (sec. 33, T. 107 N., R. 68 W., Buffalo County) shows the following sequence:

Depth, feet	Formation and General Lithology
0- 25	Glacial till
25- 500	Pierre shale
500- 624	Niobrara calcareous shale
624- 720	Carlile shale
720- 786	Greenhorn calcareous shale
786-1070	Graneros shale
1070-1132	"Dakota" sandstone

The well was drilled from a surface elevation of 1755 feet, and was bottomed at 1132 feet. The basement rock which lies about 400 feet lower, is probably the Sioux quartzite (A. F. Agnew, personal communication).

STRUCTURE

The Gann Valley Quadrangle is in part of the Stable Interior of the United States, and is characterized by essentially flat Cretaceous sedimentary rocks which lie unconformably upon Precambrian basement rock.

ECONOMIC GEOLOGY

The most valuable geologic products in this area are ground water, and sand and gravel. Clay and boulders are present in large quantities, but have not been used to date.

Ground Water

Nearly all ground water is derived from precipitation. Rain or melting snow either percolates directly downward to the water table or drains off as surface water. Surface water will either evaporate, escape to the ocean, or if the surface water is above the water table in the surrounding ground it will percolate downward from the ground surface to the water table and then laterally down the hydraulic gradient. If the water is moving down the hydraulic gradient it is said to be in transient storage. Therefore recharge, or the addition of water to an aquifer, is accomplished in three ways:

1. Direct downward percolation derived from rain or snow melt.
2. Downward percolation from surface bodies of water.
3. Water in transient storage.

The amount of ground water which can be stored in an aquifer is dependent upon the percentage of void space in the aquifer and the volume of the aquifer.

The outwash sand and gravel deposits in the Gann Valley quadrangle contain ground water adequate to supply domestic farm needs at present, and the water is generally of good quality (Table 1). However the dissected outwash does not provide a continuous aquifer but many small, separate aquifers, none of which has a very large storage capacity. The low annual precipitation (18 inches) does not adequately recharge the aquifers, and much of the precipitation is drained off as surface water. Water is lost from the aquifer through wells serving the farms in the area, by plant transpiration, and by percolation into the underlying Pierre shale, where it becomes transient water. For these reasons the quantity of water available from the outwash sand and gravel varies from season to season and year to year; after a drought of several years duration, shallow wells cannot be depended upon for a continuous supply of water.

Water may also be obtained from sand and gravel lenses in the end moraine; however, this source of supply is even less dependable because of the smaller volume of the aquifer and therefore the lesser storage capacity.

Water may be obtained in large quantities from the basal sands of the till at its contact with the Pierre shale, and also in the Pierre shale itself. This water is generally of poor quality (Table 1). Many springs and several flowing wells within the quadrangle derive their water from this source.

Sand and Gravel

The outwash area covers 51½ square miles and contains approximately 815,000,000 cubic yards of sand and gravel. The gravel is suitable for road material if the large amounts of carbonate rocks, argillaceous rocks, limonitic rocks, and iron-manganese concretions are first removed. There are numerous local deposits of gravel which have a low percentage of these deleterious constituents and are therefore suitable for road material, bituminous aggregate, or concrete aggregate. Individual deposits, however, are relatively small.

Clay and Silt

The till and shale bedrock of this area contain large amounts of clay and silt which could possibly be used in the manufacture of brick and tile.

Rock

Granitic glacial boulders virtually blanket the end moraine crests in the northern part of the quadrangle. The boulders could be used as a source of crushed rock or for rip-rap material.

REFERENCES CITED

Flint, R. F., 1955, Pleistocene Geology of Eastern South Dakota: U. S. Geol. Survey, Prof. Paper 262, 173 p.

Rothrock, E. P., 1943, A Geology of South Dakota: S. Dak. Geol. Survey, Bull. 13, 88 p.

U. S. Public Health Service, 1946, Drinking Water Standards: Public Health Repts., vol. 61, no. 11, p. 371-389.

Table 1. --Water Analyses of Wells in the Gann Valley Quadrangle

	ppm									
Sample Number	Ca	Mg	Na	Mn	Fe	SO_4	Cl	Alkalinity	Hardness	Total Solids
**1	445	125	200	3.9	None	1876	32	595	1625	2952
*2	95	24	2	None	Tr.	52	11	209	334	436
*3	66	11	153	None	Tr.	193	22	310	11	662
*4	147	47	46	None	Tr.	279	22	314	562	856
**5	56	12	313	None	Tr.	362	142	335	189	1110
**6	87	19	552	Tr.	1.5	489	437	400	295	1864
**7	153	16	400	.08	None	864	95	397	449	1852
**8	565	1.9	622	1.9	None	2515	77	360	1617	4340
U.S. Public Health Standards (1946)		125		0.3		250		250		500

*Water obtained from outwash sand and gravel.
** Water obtained from the Pierre shale or from basal sands at the till-shale contact.

Sample Locations

1. SW¼SW¼ sec. 1, T. 108 N., R. 67 W.
2. NW¼NW¼ sec. 3, T. 107 N., R. 68 W.
3. SE¼NW¼ sec. 1, T. 107 N., R. 67 W.
4. NE¼ sec. 16, T. 107 N., R. 68 W.
5. NE¼SE¼ sec. 6, T. 108 N., R. 67 W.
6. NW¼NW¼ sec. 12, T. 106 N., R. 67 W.
7. NW¼NE¼ sec. 33, T. 107 N., R. 68 W.
8. SW¼SW¼ sec. 34, T. 108 N., R. 68 W.

Samples analyzed by State Chemical Laboratory, Vermillion, S. Dak., 1959

Samples 2, 3, and 4 are suitable for irrigation.
Samples 1, 5, 6, 7 and 8 are not suitable for irrigation.
(Written communication with Martin Fogel, S. Dak. State College, Brookings, 1959).