

EXPLANATION DESCRIPTION OF MAP UNITS

Qal

Alluvium

Q1

Landslide block

Qc

Colluvium and talus_

Terrace deposits

K1

Lakota Formation

LOCAL UNCONFORMITY

Morrison Formation

Jms, sandstone at base

Ju

Unkpapa Sandstone

Js

Sundance Formation

UNCONFORMITY

RPs

Spearfish Formation

Pm

Minnekahta Limestone

Po

Opeche Formation

Minnelusa Formation

Contact

short dashed where inferred;

side; D, downthrown side

Fault or abrupt downfold

Dashed where approximately located;

Anticline

X R-7

Sample location

Selected References

resources of the northern portion of the Black Hills and adjoining regions:

U.S. Geological Survey Prof. Paper 65,

of the northern and western flanks of

the Black Hills uplift, Wyo., Mont., and South Dakota: U.S. Geological Sur-

vey Prof. Paper 404, 134 p.

Strike and dip of beds

queried where existence uncertain;

dotted where concealed. U, upthrown

dotted where concealed

Dashed where approximately located;

Qal ALLUVIUM -- Interlensed clay, silt, sand, and gravel. Along Rapid Creek the alluvium includes the present flood plain and a low terrace that is 10 to about 25 feet above river level. Generally the top 3-8 feet is brown sandy loam that is underlain by interlayered sandy clay and gravel lenses. The publics and cobbles are composed mainly of the more resistant crystalline rocks (quartz, quartzite, granite, and schist) from the cantral Black Hills. Drill records indicate that the alluvium along Rapid Creek is as much as 65 feet thick, Alluvium of the tributary valleys generally is silty clay containing gravel lenses of subrounded to angular pebbles and cobbles derived from local sedimentary rocks (limestone, sandstone, and siltstone).

Q1 LANDSLIDE BLOCK--Coherent mass of rock displaced down slope. The landslide block north of U.S. 14 near the east boundary of the quadrangle is composed of Unkpapa Sandstone capped by a small thickness of the overlying Morrison Formation. This landslide probably is late Pleistocene or Recent in age and resulted from steep topography that was localized along the postulated "Fault or abrupt downfold." Landslides of the block type are a definite possibility on slopes of easily eroded shale that are capped by resistant sandstone or limestone. Small landslides in colluvium and slumping in shale are likely along oversteepened natural slopes or artificial cuts.

Qc COLLUVIUM AND TALUS (1-25 ft) -- Heterogeneous mixture of large sandstone or limestone blocks, cobbles, sand, and clay derived from the upslope formations. Land slump and soil creep in the colluvium is an ever present possibility; such activity will be increased with increased water content.

Qt TERRACE DEPOSITS (thin veneer-20 ft) -- Interlensed silty clay, sand, and gravel. The gravel is composed mainly of rounded pabbles and cobbles of the more resistant crystalline rocks (quartz, quartzite, granite, and schist) from the central Black Hills, but locally contains as much as 35 percent subangular fragments of sedimentary rocks (limestone, sandstone, and chert).

K1 LAKOTA FORMATION (200+ ft) -- Sandstone and, locally, claystone. The sandstone is hard, gray to light brown, fine to coarse grained, and contains some lanses of conglowerate; crossbedding is common in some beds of sandstone but other beds are massive; beds are 0.5 to 8 feet thick. The claystone is cream, gray, or brownred; it apparently may occur in any part of the Lakota as thin beds or as lenses as much as 30 feet in thickness. The sandstones of the Lakota form ledges along the steep western scarp of the hogback.

Jm MORRISON FORMATION -- Shale, silty shale, thin-bedded calcareous sandstone, and limestone; gray, buff, green, and locally purple or various shades of red; generally soft or friable in natural outcrops, but moderately hard at depths greater than 10 feet in excavations. On the west side of the hogback north of Rapid Creek along the east boundary of the quadrangle the normal Morrison interval of about 135 feet is occupied by a fine-grained white sandstone and only 5-35 feet of the characteristic Morrison silt or shale is found between this sandstone and the overlying Lakota. This sandstone previously has been mapped as an unusually thick section of Unkpapa Sandstone, but it is mapped as Morrison sandstone (Jms) in this report because features of its lithology and spatial relations indi-

cate that the sandstone is part of the Morrison. Ju UNKPAPA SANDSTONE (40± ft) -- Fine-grained white sandstone stained yellow to light brown in outcrop -- a feature that distinguishes the Unkpapa from the overlying sandstone in the Morrison.

Js SUNDANCE FORMATION (350± ft) -- Shale, siltstone, sandstone, and thin-bedded limestone; gray to drab-green, glauconitic. Ripple marks are common bedding surfaces of the siltstones and sandstones. North of Rapid Creek a 2- to 5-foot limestone bed occurs in the upper 10 feet of the Sundance; south of Rapid Creek this limestone was not found, but a fine- to medium-grained white sandstone with a light-red matrix was mapped in the upper 10-30 feet of the Sundance. The contact with the underlying Spearfish Formation is unconformable. The Sundance erodes to moderately gentle slopes, but apparently stands well in steep cuts.

RPs SPEARFISH FORMATION (>450 ft) -- Shale, siltstone, sandstone; medium- to dark-red. Thick pods or lenses of gypsum occur locally near the top; gypsum beds, 20 to 30 feet thick, are interbedded in the middle and lower parts. Although the rocks are moderately easy to excavate and apparently have caused relatively few construction problems in the city area, sinking and slumping caused by leaching of the gypsum has been noted outside the city area.

Pm MINNEKAHTA LIMESTONE (38-40 ft) -- Limestone, medium- to thick-bedded (3 ft) in upper part, thin-bedded to laminated in middle and lower parts; crystalline to very finely crystalline. The weathered outcrop is generally gray but in the quarries the upper beds have a light-brown cast and the lower beds are light red.

Po OPECHE FORMATION (90-125 ft) -- Shale, silty shale, and finegrained sandstone. The upper 1-6 feet is shaly calcareous sandstone with a distinctive purple cast. Dr. J. P. Gries (oral communication, 1965) has suggested the possibility that this is a relict soil horizon. The remainder of the formation is dark-red thin-bedded silty shale and shale. The formation generally crops out in a steep slope.

PPm MINNELUSA FORMATION (400 ft; Darton, 1909, p. 25) -- Interbedded sandstone, limestone, and dolomite. The upper part is mainly brown to red fine- to coarse-grained sandstone that is generally crossbedded and occurs in beds 1-4 feet thick. Lower in the section gray, brown, or red limestone and dolomite in units 2-15 feet thick are interbedded with the sandstone. Collapse structures are prominent in canyon walls and are attributed to leaching of anhydrite or gypsum that is reported in many subsurface well records but rarely seen in outcrop (Dr. J. P. Gries, oral communication, 1965).

TEST DATA [Analyses by George S. Erickson, U.S. Geol. Survey]

	Formation Symbol	Location			Atterberg Limits					
Field Sample Number							A 43		Potential volume 1/	P.V.C. Rating
		Section	T. N.	R.E.	Liquid	Plastic	Plasticity Index	PH	change (psf)	
R-2 2-b	Js Js	SE \ 34 SE \ 34	2 2	7	36 (<u>2</u> /)	28	8	7.63 7.92	2100	2.5 Marginal.
2-1	(3/)	NEŁ 4	1	7	21	17	4	7.62		
4/2-m	RPs	SE 1 33	2	7	36	25	11	7.43	son too star into one see ago ego	
There of	RPs	SE 1 33	2	7	(2/)	460 100	400 100	7.80	250	0.1 Noncritical.
R-7	Qal	SEŁ 8	1	7	(2/)	600 etc	009-000	7.93		
5/1-q 5/1-su 5/1-em	Ju	SW\ 26	1	7	(2/)	dis- 100	900 HDD	7.98	des sele sele sele sele sele seje	
5/1-su	Jm	NW 2 26	2	7	21	15	6	4. 20	NOT AND AND AND AND AND AND	
er chris	Jin	NW \$ 26	2	7	27	22	5	7.73	550	0.5 Noncritical.
2-k	Qal	NW 3	1	7	23	18	5	7.92	NO TOP TOX 100 NO TOP 100 100	
2-kr	Qal	SWŁ 3	1	7	29	24	5	7.73	stire viter state state and state atta	
6-f	Po	NE% 8	1	7	29	20	9	7.82	100 con 400 con 100 con 400 con	

1/ Lambe, T. W., 1960, The character and identification of expansive soils: Federal Housing Administration Tech. Studies Rept., F.H.A. -701, 46 p.

2/ Sandy. 3/ Soil.

4/ Sample from dapth of 3 ft at same location as sample 2-m.

5/ Highway cut 400 ft and 800 ft east of this quadrangle. South Dakota (Rapid City guad.)

M(200) R290

no. 65- 29