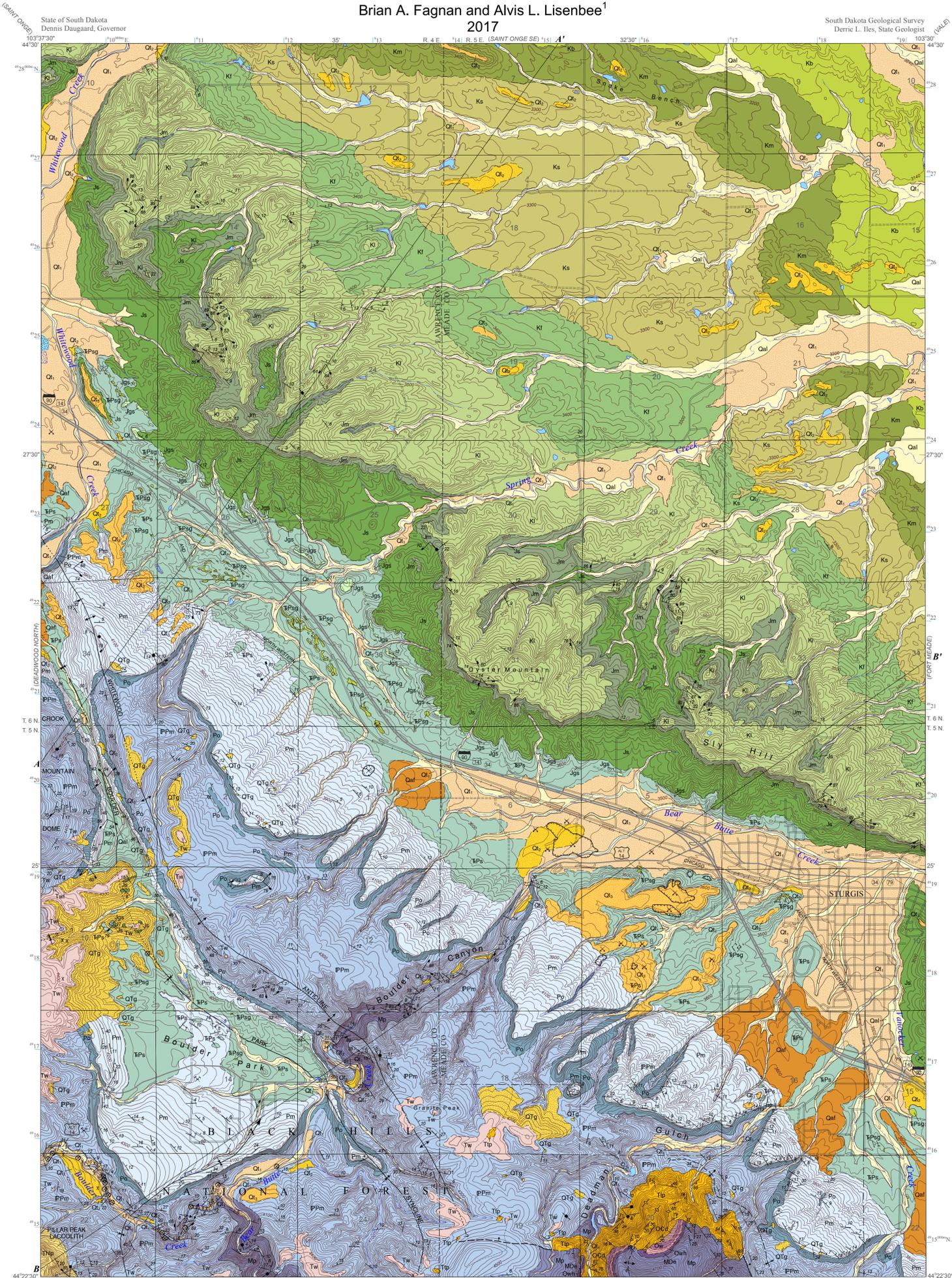


GEOLOGIC MAP OF THE STURGIS QUADRANGLE, SOUTH DAKOTA

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2017

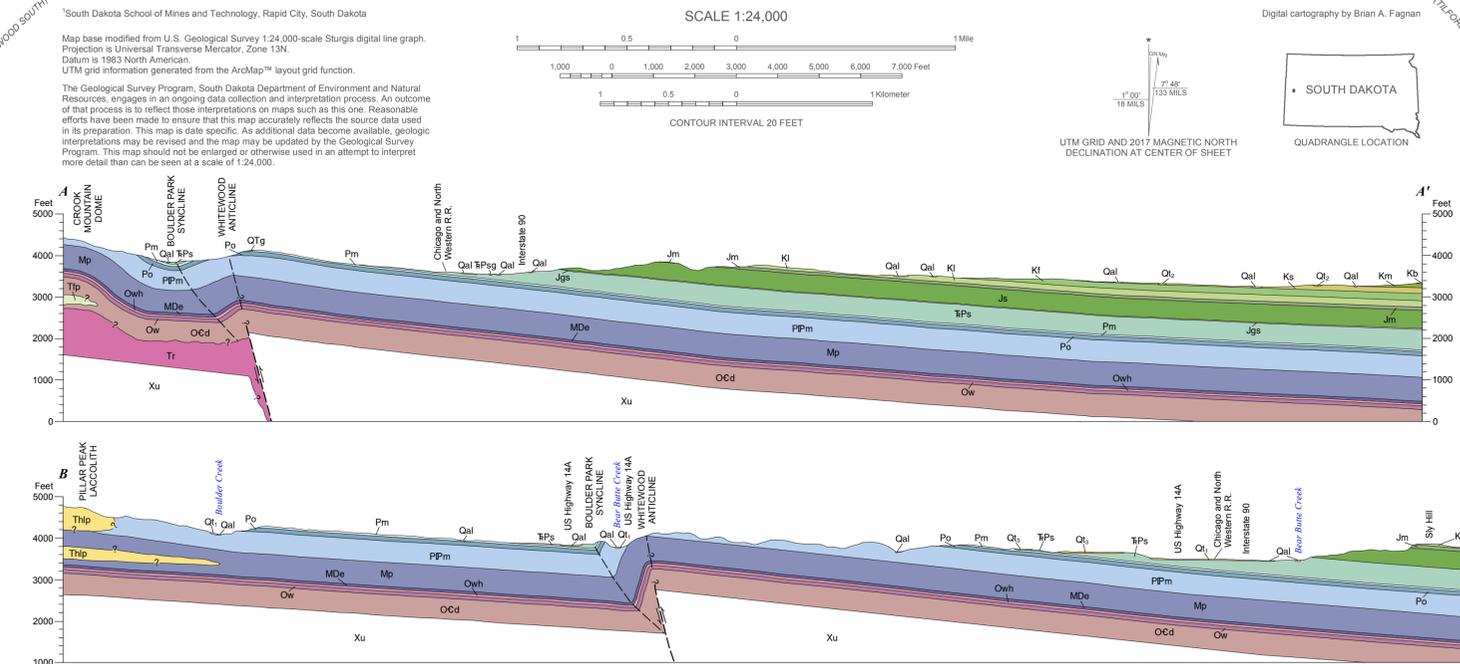
South Dakota Geological Survey
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SOUTH DAKOTA DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES
DIVISION OF FINANCIAL AND TECHNICAL ASSISTANCE
GEOLOGICAL SURVEY PROGRAM
7.5 MINUTE SERIES GEOLOGIC QUADRANGLE MAP 27



EXPLANATION

- Quaternary**
 - Qal** Alluvium - Unconsolidated to loosely consolidated, clay- to boulder-sized clasts deposited in drainages and as overbank material during floods. May include undifferentiated terrace deposits occurring 1-5 ft (0.3-1.5 m) above stream level.
 - Qt1** Terrace deposit 1 - Unconsolidated to loosely consolidated, clay- to boulder-sized clasts. Gravel is sub-rounded to rounded. Deposited up to 20 ft (6.1 m) above alluvium.
 - Qt2** Terrace deposit 2 - Unconsolidated to loosely consolidated, clay- to boulder-sized clasts. Gravel is sub-rounded to rounded. Deposited 20-60 ft (6.1-18.3 m) above alluvium.
 - Qt3** Terrace deposit 3 - Unconsolidated to loosely consolidated, clay- to boulder-sized clasts. Gravel is sub-rounded to rounded. Deposits are equivalent to the Rapid terrace of Plumley (1948) and are found between 3,600 to 3,900 feet in elevation. Deposits found in sections 7, 8, 9, and 17, T. 5 N., R. 5 E. and sections 27, 34, and 35, T. 6 N., R. 4 E. are probably dissected Quaternary alluvial fans (Qaf) that have the eroded appearance of terraces. Deposited 60-160 ft (18.3-48.8 m) above alluvium.
 - Qaf** Alluvial fan - Poorly sorted, unconsolidated, clay- to boulder-sized clasts deposited at the mouths of northeast-facing valleys eroded through the Minnekahta Limestone. Deposits usually begin at 3,700 feet elevation and spread down slope approximately 100 feet in elevation. Gravel deposits in sections 9, 15, 16, 17, 21, and 22, T. 5 N., R. 5 E. are equivalent to the Sturgis terrace of Plumley (1948), but probably are dissected alluvial fans that show the eroded appearance of terrace deposit Qt₂. Estimated maximum thickness 30 ft (9.1 m).
 - QTg** Gravel deposit - Unconsolidated to loosely consolidated, clay- to boulder-sized clasts comprised of Precambrian lithologies and minor Paleozoic chert and sandstone reworked from the White River Group. Gravel is sub-rounded to rounded and spreads down slope up to 200 feet below the base of the White River Group. Estimated maximum thickness 30 ft (9.1 m).
- Oligocene - Eocene**
 - Tw** White River Group - Tw - Variable amounts of unconsolidated to moderately consolidated pebbles to boulder-sized gravel with tan, brown, and light gray bentonitic siltstone and claystone. Gravel is sub-rounded to rounded and is comprised of Precambrian lithologies with very minor amounts of Paleozoic chert and sandstone. Deposits are equivalent to the Mountain Meadow terrace of Plumley (1948). Tw1 - White to light gray, vuggy, finely-crystalline, lacustrine limestone. Locally occurs near the top of the White River Group. Estimated maximum thickness of White River Group greater than 200 ft (61 m).
- Tertiary**
 - Tr** Rhyolite - Shown only in cross section. Based on cross section B-B' from the "Geologic map of the Deadwood North quadrangle" (Lisenbee and others, 2014).
 - Tp** Trachyte porphyry - Light brown to light gray, weathers light tan. Porphyritic with aphanitic groundmass. Phenocrysts are 15% euhedral to subhedral plagioclase from 0.02-0.12 in (0.5-3 mm) and 2-4% euhedral to subhedral hornblende from 0.01-0.08 in (0.2-2 mm). Contains accessory magnetite. Staining of groundmass reveals minor quartz and the remainder as potassium feldspar (Matthews, 1979).
 - Fp** Feldspar porphyry - Shown only in cross section. Based on cross section B-B' from the "Geologic map of the Deadwood North quadrangle" (Lisenbee and others, 2014).
 - Hlp** Hornblende latite porphyry - Light gray to dark greenish-gray. Aphanitic groundmass of orthoclase with less than 3% quartz, 40% euhedral oligoclase phenocrysts, 1-10% aligned hornblende, and 10% sanidine phenocrysts. Locally, has calcite- and quartz-filled amygdaloids to 0.16 in (4 mm) across. Contains trace pyroxene, magnetite, ilmenite, pyrite, and calcite. Local propylitic alteration (Beck, 1976). Has a K-Ar date of 60.5 ± 3 m.y. (Mukherjee, 1968).
- CRETACEOUS**
 - Uc** Belle Fourche Shale - Dark brownish-black shale with bentonite beds. Basal contact locally has thin, strongly bioturbated calcareous beds composed of echinoid spines, pelecypods, and minor graptolites. The basal 50 ft (15 m) contains iron-manganese concretions up to 10 ft (3 m) in diameter that weather to angular pebble-sized fragments. Exposed thickness approximately 100 ft (30.5 m).
 - Km** Mowry Shale - Light gray siliceous shale that weathers to platy chert. Contains numerous bentonite layers. Upper portion contains dense, siltstone concretions, some having cone-in-cone structures. The approximately 3 ft (0.9 m) thick Spur Bentonite Bed marks the top of the formation. Approximate maximum thickness 150 ft (45.7 m).
 - Ks** Skull Creek Shale - Medium-gray shale, with abundant thin beds and lenses of fine-grained quartz arenite, and dark brown to maroon weathering, fine-grained concretions. Generally grass covered. Prone to landslides in areas of steep slopes. Approximate maximum thickness 180 ft (54.9 m).
 - Kl** Fall River Formation - Variegated, interbedded, very fine- to fine-grained quartz arenite and mudstone. The arenite is orange-tan to light-brown, commonly massive, ripple marked, and transitional to the overlying Skull Creek shale over several feet. May contain pyrite and abundant mica flakes. Estimated thickness 120-180 ft (36-54.9 m).
 - Disconformity**
 - Kl** Lakota Formation - Orange-tan, light-maroon and white, fine-grained, quartz arenite and brown to light-gray mudstone. The basal portion is planar-bedded sandstone locally containing Skolithes burrows. The middle portion contains lensoid channel sandstones up to 100 ft (30.5 m) thick enclosed in brown mudstone. The upper portion is light-gray, maroon, red, and brown mudstone of the Fuson Member. Silted wood is common in the wood deposits, and ostracods are abundant in some mudstone layers. The fish *Leptodus lacustris* was observed in talus. Approximate thickness 200 ft (60 m).
 - Disconformity**
 - Jm** Morrison Formation - Variegated gray, green, to maroon bentonitic claystone, siltstone, and sandstone with minor limestone. Forms grass-covered slopes below sandstone ledges of the Lakota Formation. Approximate thickness 70 ft (21.3 m).
 - Disconformity**
 - Js** Sundance Formation - Tan to light gray-green sandstone, siltstone and shale with belemnites in the Redwater Shale and Stockade Beaver Shale members. Middle part of formation includes rose-colored, massive, fine-grained sandstone and siltstone of the Lak member, and white to tan, fine-grained, rippled quartz arenite of the Huelt Sandstone member. Approximate thickness 430 ft (131.1 m).
 - Jgs** Gypsum Spring Formation - Massive white to light gray gypsum conformable with the lower contact of the Sundance Formation. Locally absent due to dissolution, but more resistant to erosion than surrounding Spearfish Formation. Pinches out near the southeast portion of the quadrangle. Estimated thickness 0-30 ft (0-9.1 m).
 - Disconformity**
- JURASSIC**
 - Jp** Spearfish Formation - Red to rose colored mudstone, siltstone, and fine-grained sandstone. TPs - Beds of gypsum up to 20 ft (6.1 m) thick occur at base and near top of formation, with veins of gypsum throughout. Estimated thickness of formation 425-525 ft (129.5-160 m).
 - Disconformity**
 - Pm** Minnekahta Limestone - Pale-lavender, beige, and light-gray laminated limestone (micrite). Contains abundant stylolites, kink bands, and box folds. Stromatolites common at base. Has minor karstic features, and a petrolierous odor when broken. Thickness 40-60 ft (12.2-18.3 m).
 - Disconformity**
 - Po** Opeche Shale - Red to maroon mudstone, shale, and siltstone. Lavender zone at top approximately 5 ft (1.5 m) thick due to ground-water leaching. Poorly exposed on slopes below Minnekahta Limestone. Estimated thickness 90-130 ft (27.4-39.6 m).
 - Disconformity**
 - PPm** Minnelusa Formation - Beige to pale-orange, white and gray. Lower portion is medium- to thick-bedded sandstone, dolomite, limestone, and shale. Upper portion commonly thick- to massive-bedded sandstone. Strongly deformed by solution of interbedded evaporite. Excellent exposures in canyon walls but few outcrops in uplands. Approximate thickness 520 ft (158.5 m).
 - Disconformity**
 - Mp** Pahasa Limestone - Beige to light-gray dolomite and limestone with thin lenses of brown to light-gray chert. Medium to massive bedded. Forms prominent cliffs that weather to dark-gray, vuggy, with caves and solution breccia, dominantly in the upper one-third of the formation. Upper contact is an irregular paleokarstic surface with a terra rossa horizon. Approximate thickness 575 ft (175.3 m).
 - MDe** Englewood Limestone - Pink, gray, to purple-gray, argillaceous limestone, dolomite, and shale. Laminated to medium-bedded, finely to medium crystalline, bioturbated, locally containing conical columnals, brachiopods, and bryozoa. Approximate thickness 60 ft (18.3 m).
 - Disconformity**
 - Ow** Whitewood Limestone - Variegated, yellowish-brown, brownish-orange to gray, bioturbated, dolomitic limestone and dolomite. Thin-bedded to massive. Fossils include colonial and solitary corals, the gastropod *Maclurea*, and orthocone nautilus. Estimated thickness 30-60 ft (9.1-18.3 m).
 - Ow** Winnipeg Formation - Includes the Sobex Shale Member of greenish-gray, fissile shale, and the Roughlock Siltstone Member of tan to yellowish-gray, calcareous siltstone. Poorly exposed. Estimated thickness 50-100 ft (15.2-30.5 m).
 - Disconformity**
 - Ocd** Deadwood Formation - Uppermost part is composed of Skolithos-bearing, heavily iron-stained, quartz arenite overlying greenish- to reddish-brown, laminated to thick-bedded, argillaceous sandstone, siltstone, and intraformational conglomerate. Local basal conglomerate. Only upper 60 ft (18.3 m) exposed. Total thickness greater than 500 ft (152.4 m) shown in cross section.
- PRECAMBRIAN**
 - Xu** Undifferentiated Precambrian rocks - Shown only in cross section.



- CONTACTS**
 - Long dashed where approximately located; short dashed where inferred; queried where uncertain
 - Long dashed where approximately located; dotted where concealed; queried where uncertain
- FAULTS**
 - Long dashed where approximately located; dotted where concealed; queried where uncertain
 - Long dashed where approximately located; short dashed where inferred; queried where uncertain
- FOLDS**
 - Anticline, asymmetrical: Showing generalized trace of the axial plane and direction of plunge. Shorter arrow indicates steeper beds. Long dashed where approximately located; dotted where concealed; queried where uncertain.
 - Syncline, asymmetrical: Showing generalized trace of the axial plane and direction of plunge. Shorter arrow indicates steeper beds. Long dashed where approximately located; dotted where concealed; queried where uncertain.
 - Monocline, synclinal bend: Shorter arrow indicates steeper beds. Long dashed where approximately located; short dashed where inferred; dotted where concealed; queried where uncertain.
- MINOR FOLDS**
 - Small anticline: Showing bearing and plunge
 - Small syncline: Showing bearing and plunge
- STRIKE AND DIP OF BEDDING**
 - Inclined
- STRIKE AND DIP OF FRACTURES**
 - Inclined
 - Vertical
 - Multiple
- POINT OF OBSERVATION AT JOIN OF STRIKE LINES**
- STRIKE AND DIP OF IGNEOUS FLOW FOLIATION**
 - Inclined
 - Vertical
- OTHER FEATURES**
 - Quarry or gravel pit boundary
 - Quarry
 - Abandoned quarry
 - Gravel pit
 - Abandoned gravel pit
 - Mine adit or cave entrance
 - Trench
 - Prospect pit
 - Group of prospect pits
 - Gas well

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Map based modified from U.S. Geological Survey 1:24,000-scale Sturgis digital line graph. Projection is Universal Transverse Mercator, Zone 13N. Datum is 1983 North American. UTM grid information generated from the ArcMap™ layout grid function.

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Scale 1:24,000
1 Mile
0 1,000 2,000 3,000 4,000 5,000 6,000 7,000 Feet
1 Kilometer
0 0.5 1 1.5 2 Kilometers

CONTOUR INTERVAL 20 FEET
UTM GRID AND 2017 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET
QUADRANGLE LOCATION
SOUTH DAKOTA

Scale 1:24,000
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