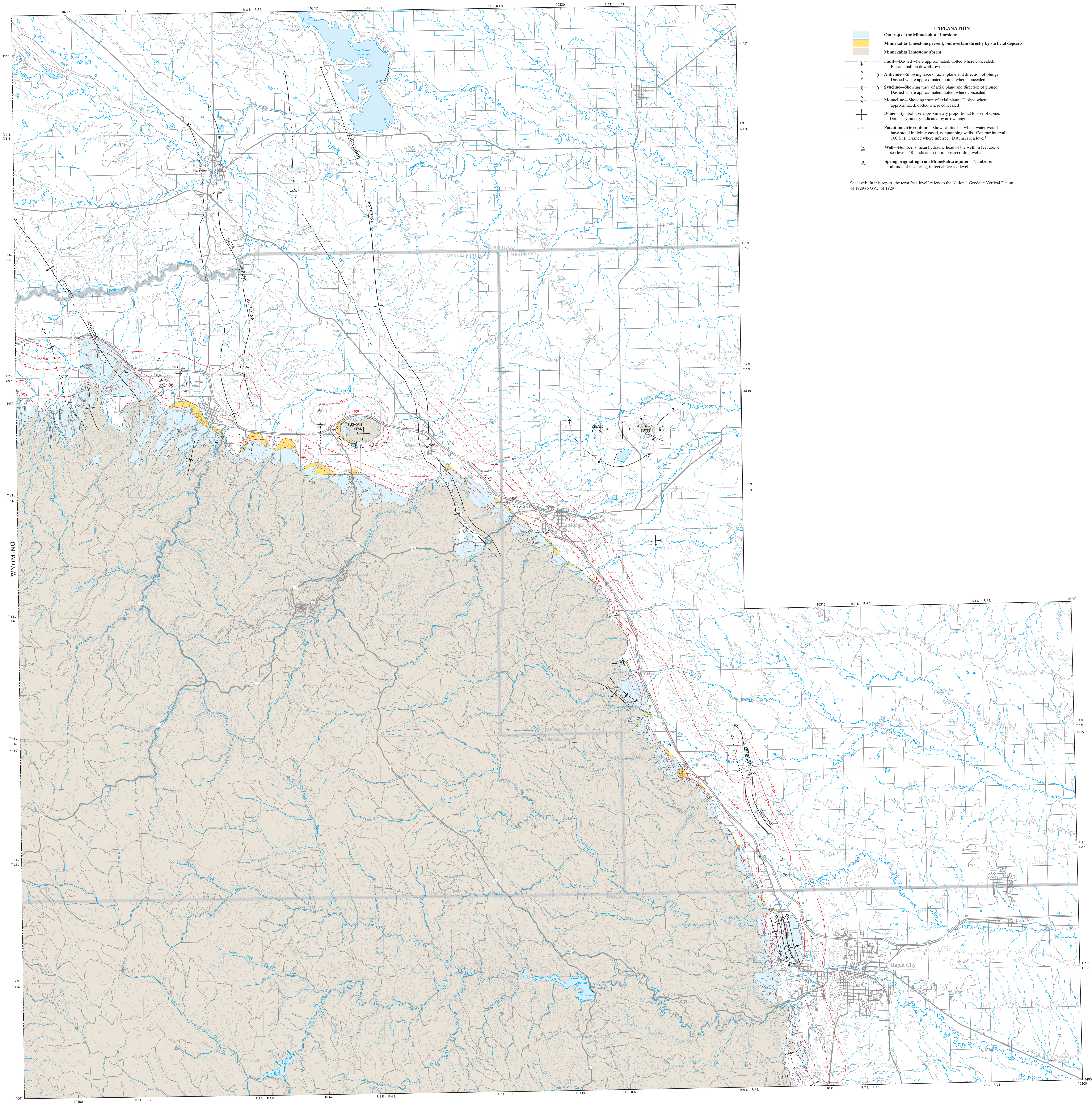
U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH THE
SOUTH DAKOTA DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES
AND THE WEST DAKOTA WATER DEVELOPMENT DISTRICT

HYDROLOGIC INVESTIGATIONS ATLAS HA-745-B
Northern part of area —SHEET 1 OF 2
Strobel, M.L., Galloway, J.M., Hamade, G.R., and Jarrell, G.J., 2000,
Potentiometric Surface of the Minnekahta Aquifer in the Black Hills Area, South Dakota



Planimetric base from U.S. Geological Survey digital data, 1:100,000: Devils Tower and Sundance, 1979; Belle Fourche, 1983; Rapid City, 1977
Topographic base modified from U.S. Geological Survey digital data, 1:24,000, from maps dated 1950-84
Universal Transverse Mercator projection
Zone 13
North American Horizontal Datum 1927

EXPLANATION

Outcrop of the Minnekahta Limestone

Minnekahta Limestone present, but overlain directly by surficial deposits

Minnekahta Limestone absent

Fault—Dashed where approximated, dotted where concealed. Bar and ball on downthrown side

Anticline—Showing trace of axial plane and direction of plunge. Dashed where approximated, dotted where concealed

Syncline—Showing trace of axial plane and direction of plunge. Dashed where approximated, dotted where concealed

Monocline—Showing trace of axial plane. Dashed where approximated, dotted where concealed

Dome—Symbol size approximately proportional to size of dome. Dome asymmetry indicated by arrow length

3500 **Potentiometric contour**—Shows altitude at which water would have stood in tightly cased, nonpumping wells. Contour interval 100 feet. Dashed where inferred. Datum is sea level[1]

R 3571 **Well**—Number is mean hydraulic head of the well, in feet above sea level. "R" indicates continuous recording wells

3720 **Spring originating from Minnekahta aquifer**—Number is altitude of the spring, in feet above sea level

[1]Sea level: In this report, the term "sea level" refers to the National Geodetic Vertical Datum of 1929 (NGVD of 1929)

INTRODUCTION

This map is a product of the Black Hills Hydrology Study, which was initiated in 1990 to assess the quantity, quality, and distribution of surface water and ground water in the Black Hills area of South Dakota (Driscoll, 1992). This long-term study is a cooperative effort between the U.S. Geological Survey (USGS), the South Dakota Department of Environment and Natural Resources, and the West Dakota Water Development District, which represents various local and county cooperators. This map is part of a series of 1:100,000-scale maps for the study. The maps include a hydrogeologic map, structure-contour maps (altitudes of the tops of formations) for five formations that contain major aquifers in the study area, and potentiometric maps for these five major aquifers (the Inyan Kara, Minnekahta, Minnelusa, Madison, and Deadwood aquifers).

The study area consists of the topographically defined Black Hills and adjacent areas located in western South Dakota. The Black Hills area is an elongated, dome-shaped feature, about 125 miles long and 60 miles wide, which was uplifted during the Laramide orogeny (Feldman and Heimlich, 1980). The oldest geologic units in the study area are Precambrian metamorphic and igneous rocks, which are exposed in the central core of the Black Hills. Surrounding the Precambrian core is a layered series of sedimentary rocks including limestones, sandstones, and shales that are exposed in roughly concentric rings around the uplifted flanks of the Black Hills. The bedrock sedimentary units typically dip away from the uplifted Black Hills at angles that approach or exceed 10 degrees near the outcrops, and decrease with distance from the uplift. Many of the sedimentary units contain aquifers, both within and beyond the study area. Recharge to these aquifers occurs from infiltration of precipitation upon the outcrops and, in some cases, from infiltration of streamflow (Hortness and Driscoll, 1998). Artesian conditions generally exist within these aquifers where an upper confining layer is present. Flowing wells and springs that originate from the confined aquifers are common around the periphery of the Black Hills.

The purpose of this map is to show the potentiometric surface of the Minnekahta aquifer within the study area. The map provides a tool for evaluating ground-water flow directions and hydraulic gradients in the Minnekahta aquifer.

AQUIFER DESCRIPTION

The Minnekahta aquifer is comprised within the Minnekahta Limestone. The Permian-age Minnekahta Limestone is a fine-grained, purple to gray laminated limestone that ranges in thickness from 25 to 65 feet in the study area (Strobel and others, 1999). The outcrop of the Minnekahta Limestone shown on the map is from Strobel and others (1999). The Minnekahta Limestone is overlain by the Spearfish Formation and underlain by the Opeche Shale. The Minnekahta aquifer is separated from overlying major aquifers by the Spearfish and Sundance Formations and from the underlying Minnelusa aquifer in the study area by the Opeche Shale.

POTENTIOMETRIC SURFACE

The potentiometric surface was mapped by contouring altitudes of water levels in wells completed in the Minnekahta aquifer and altitudes of springs originating from the Minnekahta aquifer. The water-level and spring altitudes shown on the map are from the ground-water database of the USGS National Water Information System and are presented in Galloway (2000). The majority of wells in the study area have a single water-level measurement that usually was obtained at the time of well completion. Some wells, especially continuous-recording wells, have numerous water-level measurements available, in which case a mean value from all measurements was calculated and used for contouring purposes. Ranges in measured water levels for continuous-recording wells generally are less than the 100-foot contour interval used; thus, in most areas the configuration of the potentiometric surface during the period of water-level data collection (approximately 1950-98) probably does not deviate substantially from that which is shown. Deviations between the mapped and actual potentiometric surfaces may be larger for areas with dashed (inferred) contours than for solid contours. The Minnekahta Limestone is about 25 to 65 feet thick in the study area, and wells generally are open to the entire interval.

Most of the springs used in contouring are on or near the outcrop area. The actual hydraulic head in the vicinity of the springs probably is higher than the spring altitudes. In outcrop areas, stream altitudes also were considered in contouring the potentiometric surface.

In general, ground-water flow in the aquifer is radially outward from the Black Hills. Structural features in the Minnekahta Formation (Carter and Redden, 1999), such as folds and faults, may have local influence on ground-water flow directions. Therefore, structural trends also were considered in the contouring of the

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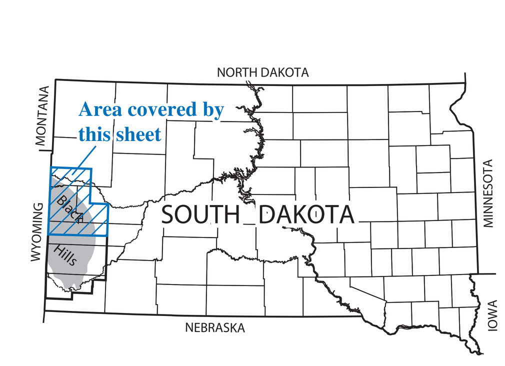

SCALE 1:100,000
2 1 0 2 4 6 8 10 MILES
2 1 0 2 4 6 8 10 KILOMETERS
LAND SURFACE CONTOUR INTERVAL 200 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

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By
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2000

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