PREPARED BY THE UNITED STATES GEOLOGICAL SURVEY
IN COOPERATION WITH THE NORTH DAKOTA STATE WATER
COMMISSION AND HETTINGER AND STARK COUNTIES
WATER MANAGEMENT DISTRICTS

COUNTY GROUND-WATER STUDIES 16
PARTS I AND III PLATE 1

BASE PREPARED FROM NORTH DAKOTA STATE HIGHWAY DEPARTMENT COUNTY HIGHWAY MAPS

EXPLANATION

QUATERNARY

Pleistocene and Holocene

Qu — Silt and Clay
Includes till and possibly a few beds of sand and gravel

Qg — Sand and Gravel

TERTIARY

Miocene — **Tc** — Arikaree Formation
Consists of cross-bedded tuffaceous sandstone; conglomeratic at base. Beds are 8 to 65 feet (2.4 to 19.8 metres) thick

Oligocene — **Tw** — White River Formation
Consists of conglomerate, arkose, tuffaceous sandstone, siltstone, claystone, and fresh-water limestone. Rocks are 200 to 250 feet (60.9 to 76.2 metres) thick

Eocene — **Tg** — Golden Valley Formation
Includes an upper sandstone member and a lower member consisting of shale and white sandy claystone with orange staining. Maximum thickness about 200 feet (60.9 metres)

Paleocene — *Fort Union Group*

Ts — Sentinel Butte Formation
Silty sandstone, carbonaceous claystone, and lignite. About 450 feet (137.1 metres) thick

Tt — Tongue River Formation
Sandstone interbedded with siltstone, claystone, and lignite. A persistent sandstone at base. Typically lighter colored than overlying Sentinel Butte Formation. Rocks are 250 to 570 feet (76.2 to 173.7 metres) thick

2700 — Structure Contour
Shows altitude of top of Tongue River Formation. Dashed where inferred. Contour interval 100 feet (30.5 metres). Datum is mean sea level

X2440 — Outcrop
Number is altitude, in feet above mean sea level, at top of Tongue River Formation

•2450 — Control Point
Number is altitude, in feet above mean sea level, of top of Tongue River Formation

△ — Triangulation Station

Synclinal Axis

A — A′ — Trace of Section

Geology by Henry Trapp, Jr., R. L. Klausing, and James Stokoe 1966-70

Geology by K. Soward and G. Mowat

2 0 2 4 6 8 10 MILES

2 0 2 4 6 8 10 KILOMETRES

PLATE 1.—GEOLOGIC AND STRUCTURE MAP OF HETTINGER AND STARK COUNTIES, NORTH DAKOTA

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WATER MANAGEMENT DISTRICTS

COUNTY GROUND-WATER STUDIES 16
PARTS I AND III PLATE 2

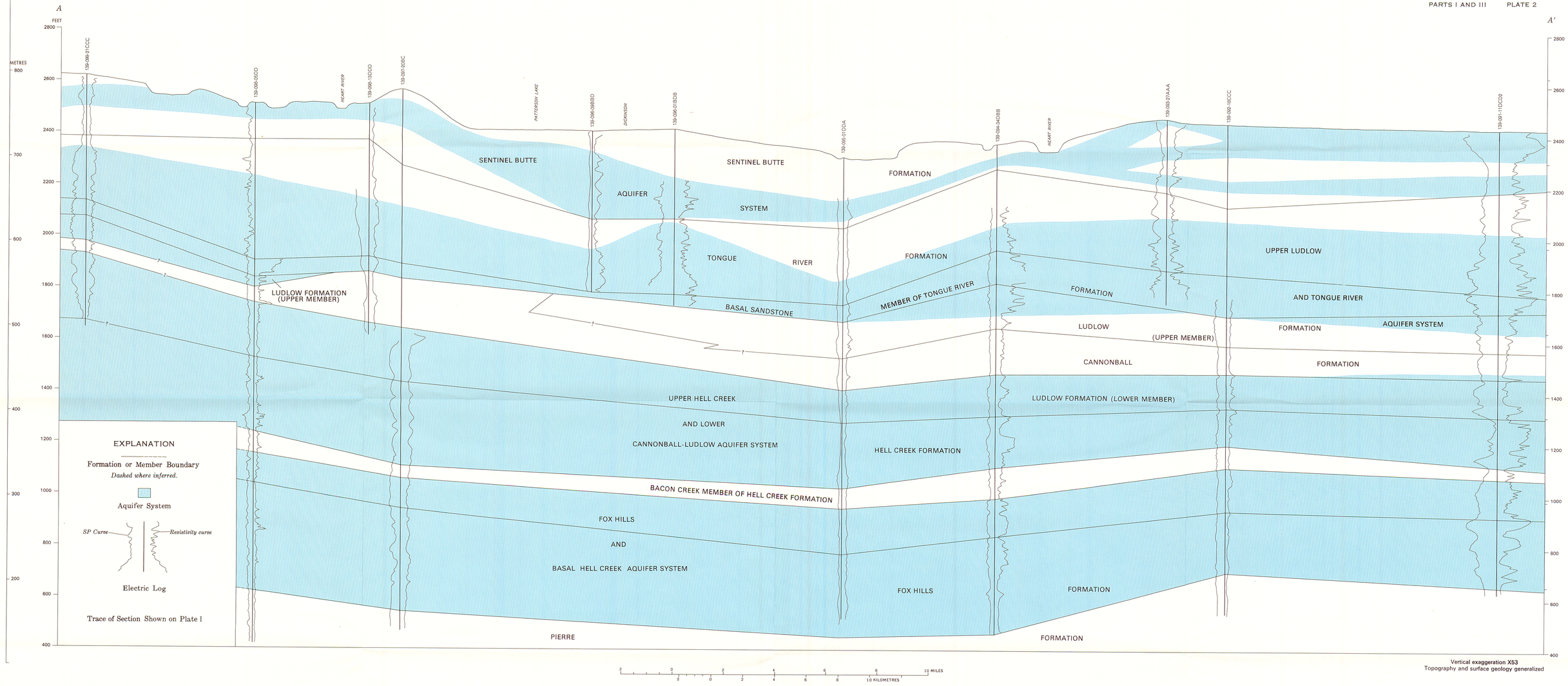

PLATE 2.—GEOHYDROLOGIC SECTION A-A', HETTINGER AND STARK COUNTIES, NORTH DAKOTA

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COUNTY GROUND-WATER STUDIES 16
PARTS I AND III PLATE 3

B B'

FEET METRES

Altitude above mean sea level

134-097-15CCC1
134-098-24CC (PROJECTED)
134-098-25BBB1
REGENT
134-094-09BDCC
CANNONBALL RIVER
133-094-02ABA
132-091-28DDD

SENTINEL BUTTE FORMATION
BASAL TONGUE OF THE RIVER SANDSTONE MEMBER OF THE CANNONBALL FORMATION
LUDLOW FORMATION (UPPER MEMBER)
UPPER LUDLOW AND TONGUE RIVER AQUIFER SYSTEM
TONGUE RIVER FORMATION
LUDLOW FORMATION (LOWER FORMATION)
UPPER HELL CREEK AND LOWER LUDLOW FORMATION (LOWER FORMATION)
BACON CREEK MEMBER OF HELL CREEK FORMATION
HELL CREEK FORMATION
FOX HILLS AND HELL CREEK AQUIFER SYSTEM
FOX HILLS FORMATION
PIERRE FORMATION

EXPLANATION

Formation or Member Boundary
Dashed where inferred.

Aquifer System

SP Curve — *Resistivity curve*

Electric Log

Trace of Section Shown on Plate 1

2 0 2 4 6 8 10 MILES
2 0 2 4 6 8 10 KILOMETRES

Vertical exaggeration X53
Topography and surface geology generalized

PLATE 3.—GEOHYDROLOGIC SECTION B-B', HETTINGER AND STARK COUNTIES, NORTH DAKOTA

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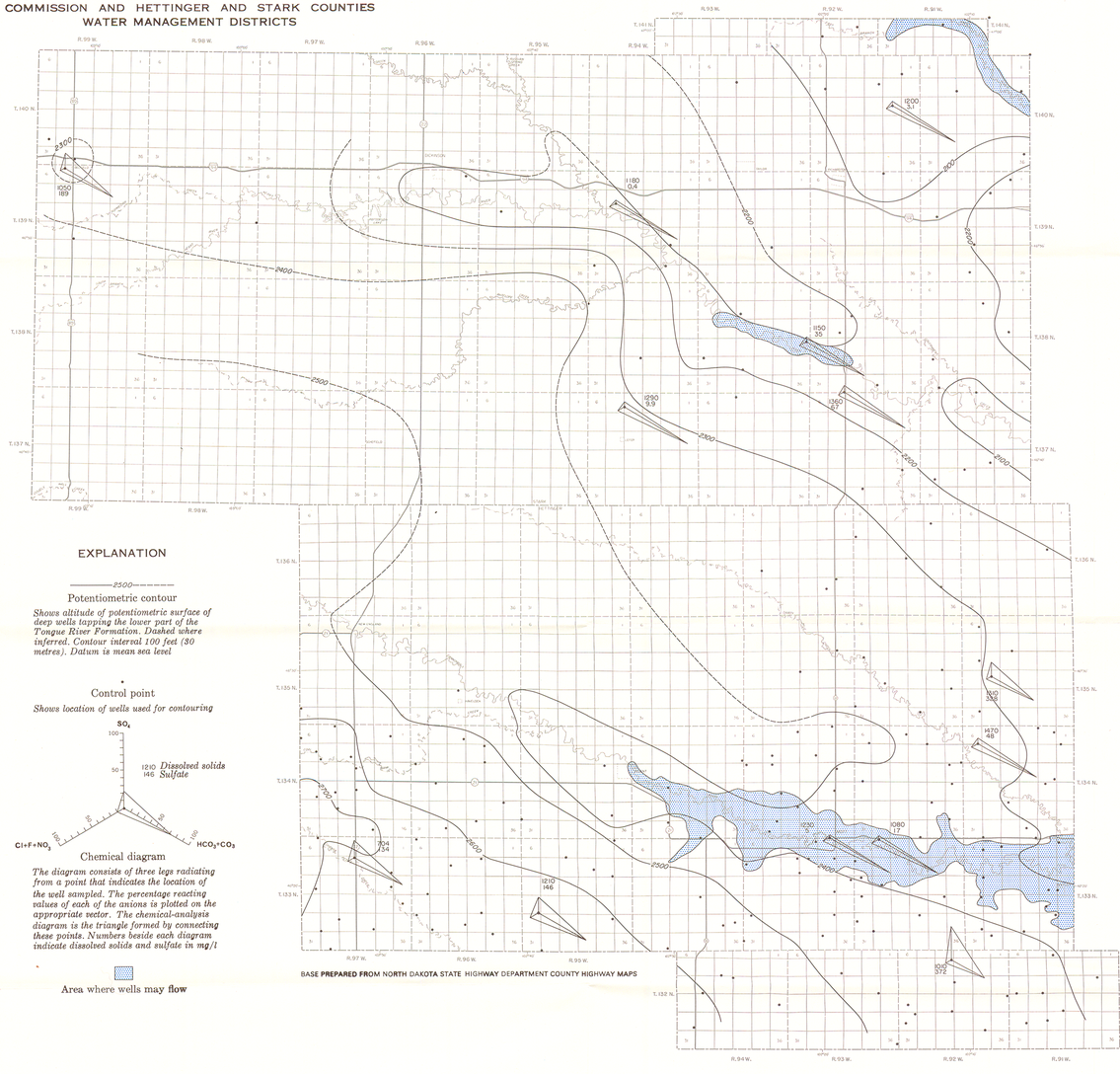
IN COOPERATION WITH THE NORTH DAKOTA STATE WATER
COMMISSION AND HETTINGER AND STARK COUNTIES
WATER MANAGEMENT DISTRICTS



BASE PREPARED FROM NORTH DAKOTA STATE HIGHWAY DEPARTMENT COUNTY HIGHWAY MAPS

EXPLANATION

2500 — Potentiometric contour

Shows altitude of potentiometric surface of deep wells tapping the lower part of the Tongue River Formation. Dashed where inferred. Contour interval 100 feet (30 metres). Datum is mean sea level

Control point

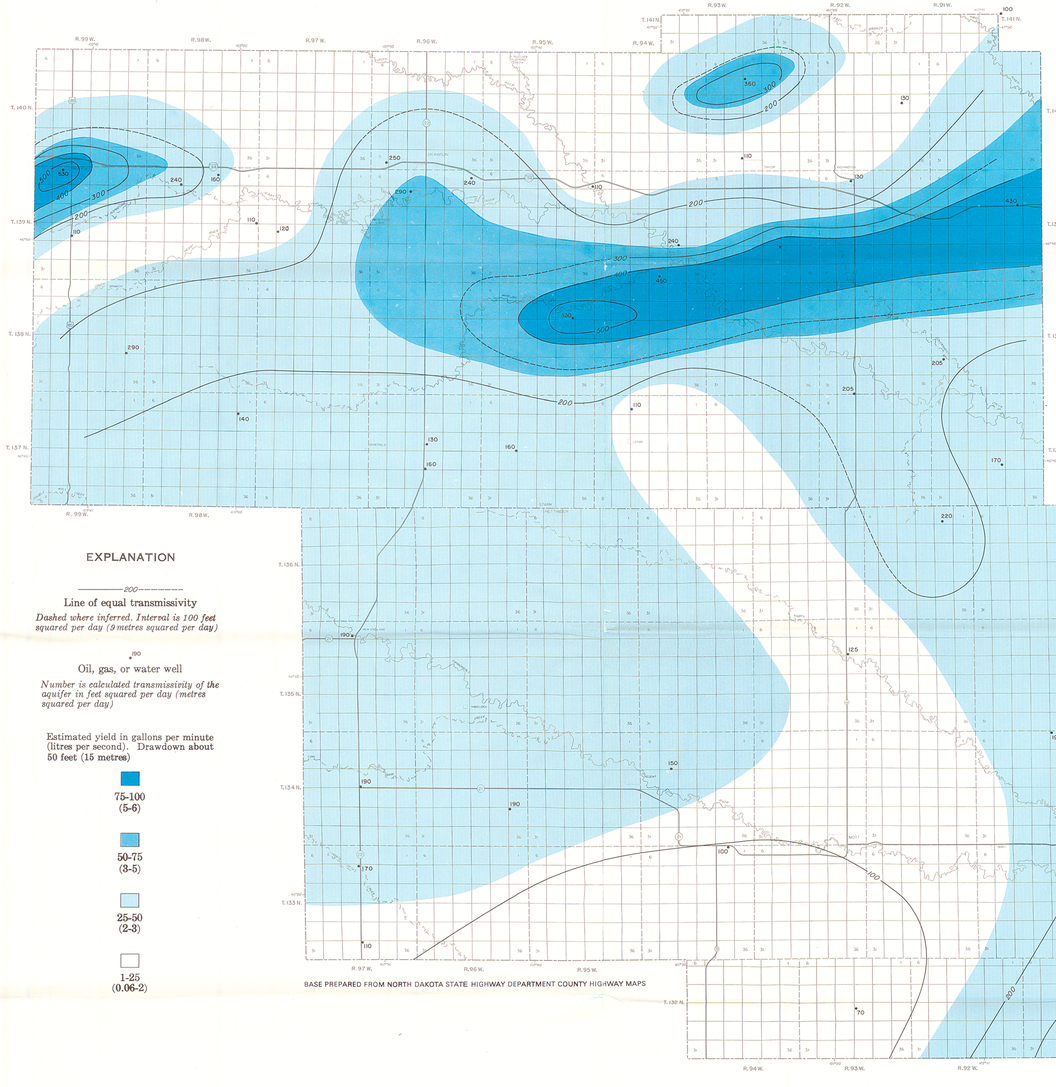
Shows location of wells used for contouring

Chemical diagram

The diagram consists of three legs radiating from a point that indicates the location of the well sampled. The percentage reacting values of each of the anions is plotted on the appropriate vector. The chemical-analysis diagram is the triangle formed by connecting these points. Numbers beside each diagram indicate dissolved solids and sulfate in mg/l

Area where wells may flow

A.–POTENTIOMETRIC SURFACE OF THE UPPER LUDLOW AND TONGUE RIVER AQUIFER AND ANION COMPOSITION OF WATER IN THE BASAL SANDSTONE MEMBER OF THE TONGUE RIVER FORMATION



BASE PREPARED FROM NORTH DAKOTA STATE HIGHWAY DEPARTMENT COUNTY HIGHWAY MAPS

EXPLANATION

200 — Line of equal transmissivity

Dashed where inferred. Interval is 100 feet squared per day (9 metres squared per day)

190 Oil, gas, or water well

Number is calculated transmissivity of the aquifer in feet squared per day (metres squared per day)

Estimated yield in gallons per minute (litres per second). Drawdown about 50 feet (15 metres)

- 75-100 (5-6)
- 50-75 (3-5)
- 25-50 (2-3)
- 1-25 (0.06-2)

2 0 2 4 6 8 10 MILES
2 0 2 4 6 8 10 KILOMETRES

B.–TRANSMISSIVITY AND YIELD OF BASAL SANDSTONE MEMBER OF THE TONGUE RIVER FORMATION

PLATE 4.–GEOHYDROLOGY OF THE UPPER LUDLOW AND TONGUE RIVER AQUIFER, HETTINGER AND STARK COUNTIES, NORTH DAKOTA