DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH THE
WYOMING STATE ENGINEER

HYDROLOGIC INVESTIGATIONS
ATLAS HA-539 (SHEET 2 OF 3)

HYDROGEOLOGIC MAP AND WELL AND SPRING DATA

EXPLANATION FOR HYDROGEOLOGIC MAP

CORRELATION OF MAP UNITS IN HYDROGEOLOGIC DIVISIONS

DESCRIPTION OF MAP UNITS

(See table on sheet 1 for more detail)

HYDROGEOLOGIC DIVISION 8:
Qal, alluvium, includes flood-plain deposits and alluvial fans
Qt, terrace deposits
Qd, rock debris
Qg, glacial deposits

HYDROGEOLOGIC DIVISION 7:
Tsl, Salt Lake Formation
Tcd, Camp Davis Formation
Tbp, Browns Park Formation
Tbi, Bishop Conglomerate

HYDROGEOLOGIC DIVISION 6:
Tf, Fowkes Formation
Tb, Bridger Formation
Tgr, Green River Formation
Tw, Wasatch Formation
Th, Hoback Formation
TKe, Evanston Formation
Tfw, Fowkes, Green River, and Wasatch Formations
TKfe, Fowkes, Green River, Wasatch and Evanston Formations

HYDROGEOLOGIC DIVISION 5:
Kav, Adaville Formation
Kh, Hilliard Shale
Kbb, Blind Bull Formation
Kf, Frontier Formation
Khb, Hilliard Shale, Blind Bull Formation and Frontier Formation
Ksj, Sage Junction Formation
Ka, Aspen Formation
Kq, Quealy Formation
Kc, Cokeville Formation
Kbr, Bear River Formation
Ktf, Thomas Fork Formation
Ks, Smiths Formation

HYDROGEOLOGIC DIVISION 4:
Kg, Gannett Group
Jsp, Stump Sandstone and Preuss Redbeds
KJgp, Gannett Group, Stump Sandstone, and Preuss Redbeds
Jtc, Twin Creek Limestone
Jst, Stump Sandstone, Preuss Redbeds, and Twin Creek Limestone
JTsn, Nugget Sandstone

HYDROGEOLOGIC DIVISION 3:
Tsat, Ankareh Formation and Thaynes Limestone
Tsaw, Ankareh Formation, Thaynes Limestone and Woodside Formation
Trd, Dinwoody Formation
Pp, Phosphoria and Park City Formations

HYDROGEOLOGIC DIVISION 2:
PMwa, Wells and Amsden Formations
PMta, Tensleep Sandstone and Amsden Formation
Mm, Madison Limestone
MDd, Darby Formation
Ob, Bighorn Dolomite
Cgf, Gallatin Limestone, Gros Ventre Formation, and Flathead Quartzite

HYDROGEOLOGIC DIVISION 1:
QTi, igneous intrusive and extrusive rocks
pCr, metamorphic and igneous rocks

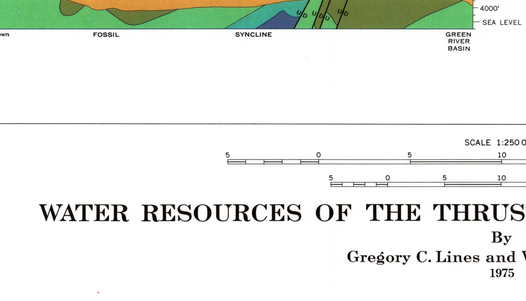
GEOLOGIC SYMBOLS

Contact
Approximately located

High-angle fault
Approximately located, dotted where concealed. Relative movement shown by arrows; U, upthrown side; D, downthrown side; A, away from observer; T, towards observer

Thrust fault
Approximately located, dotted where concealed. Sawteeth on upper plate. Arrows in structure sections on upper plate

SOURCES OF DATA USED IN COMPILING HYDROGEOLOGIC MAP AND STRUCTURE SECTIONS



Generalized block diagram of part of the Salt River Range and Star Valley with arrows showing the inferred movement of ground water. Note the interbasin movement of ground water, the draining of rocks that overlie Paleozoic limestones or that have been butted against the limestones along thrust fault, and the concentration of flow through solution openings in the vicinity of spring.

EXPLANATION FOR WELL-AND SPRING-DATA MAP

WELL AND SPRING SYMBOLS

Well — Flowing well — Spring

Color denotes geologic source of water by hydrogeologic division
(See explanation for hydrogeologic map for color code)
33bc1 Section number segment of well or spring number.
(See explanation of numbering system.)
W20 Depth to water below or head above (+) land surface, in feet; R, reported.
D150 Depth of well below land surface, in feet.
F50 Flow of spring or well, in gallons per minute; may not indicate the average flow.
Y300 Yield of pumped well, in gallons per minute; generally not the maximum amount available from the well; R, reported.
C55 Specific capacity of well, in gallons per minute per foot of drawdown.
SC Specific conductance of water, in micromhos per centimetre at 25° C.
Kf Geologic source of water. (See explanation for hydrogeologic map and other symbols below.) Queried where questionable.

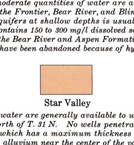
Other symbols used for geologic source of water not used on hydrogeologic map

Js, Stump Sandstone
Jp, Preuss Redbeds
Ka, Ankareh Formation
Tet, Thaynes Limestone
PPw, Wells Formation
PPt, Tensleep Sandstone
PPMs, Amsden Formation

WELL AND SPRING NUMBERING SYSTEM

The numbering of wells and springs is based on the U.S. Land Grant System. The first segment of the number is the township (north); the second segment of the number is the range (west); the third segment of the number is the section, which is followed by a first letter that designates the quarter section, a second letter, if shown, that designates the quarter-quarter section, etc., (a-NE¼, b-NW¼, c-SW¼, d-SE¼). Well 17-120-6ac2, for example, is in the SW¼ of the NE¼ of section 6, Township 17 North, Range 120 West. The number 2 indicates a second well or spring in the same quarter-quarter section. The first and second segments of the number are not shown on the map when the area has been surveyed and the township-range grid is shown. Well 17-120-6ac2, for example is in a surveyed area and is simply designated 6ac2 on the map

CHEMICAL-QUALITY SYMBOLS



RANGE OF DISSOLVED SOLIDS IN MILLIGRAMS PER LITER

The chemical type of water is shown by segments of a colored circle; the size of the circle denotes the range in total dissolved solids. Segment divisions are diagrammatic with the major cation relation shown in the top half of the circle and the major anion relation shown in the bottom half. The following procedure is used in determining the water type:

1. The sum of major cations—calcium, magnesium, and sodium (or sodium plus potassium)—in milliequivalents per liter is taken to be 100 percent and the percentage of each cation is calculated from that base. Similarly, the major anions—bicarbonate (or bicarbonate plus carbonate), sulfate, and chloride—are calculated from a base of 100 percent
2. Where one cation constitutes 50 percent or more of the total cations and one anion constitutes 50 percent or more of the total anions, that cation and that anion designate the water type. For example, if calcium is 60 percent of the total cations and bicarbonate is 75 percent of the total anions, the water is classified as a calcium bicarbonate type
3. If no ions constitute as much as 50 percent of the total cations, or anions, the ion with the highest percentage is given two-thirds of the semicircle and is named first, and the ion with the second highest percentage is given one-third of the semicircle and follows as a subsidiary term—for example, sodium chloride bicarbonate type or calcium magnesium sulfate bicarbonate type

GEOGRAPHIC SUBAREAS AND THE MOST FAVORABLE AQUIFERS FOR DEVELOPMENT

Snake River valley

Alluvium in the Snake River valley and along Flat Creek in Tps. 40 and 41 N. is capable of yielding large quantities of water to wells. The depth to water in alluvium is rarely greater than 50 feet and commonly less than 25 feet below land surface in this area. The maximum thickness of alluvium is unknown, but it is at least 200 feet thick at Jackson. The thickness of alluvium is less along the Snake River in Tps. 37, 38, and 39 N.; the river has cut its channel in bedrock along much of this reach. Water in alluvium is a calcium bicarbonate type and contains 150 to 300 mg/l dissolved solids

Salt River, Snake River, and Wyoming Ranges

Large quantities of water are available from limestone and dolomite aquifers in the Madison Limestone, Darby Formation, and Bighorn Dolomite in the vicinity of large springs where there is solution permeability and a concentration of flow. There also are large volumes of poorly permeable rock and drained rock, however, and the availability of water from these limestone and dolomite aquifers therefore is quite variable. Water from the Madison, Darby, and Bighorn at shallow depths is usually a calcium bicarbonate type and contains 100 to 250 mg/l dissolved solids. Water from springs that issue from these limestones along major faults along the Snake and Hoback Rivers commonly is a calcium sulfate or calcium sodium sulfate type and contains 1,000 to 1,500 mg/l dissolved solids. Water from these springs may be indicative of the quality of water in these aquifers at great depths

Sandstone aquifers in the Wells Formation and Tensleep Sandstone are sufficiently permeable that they should be capable of yielding moderate quantities of water to wells. However, topographic highs underlain by these rocks may be drained to depths of several hundred feet, especially if underlying limestones have extensive solution development. Water in the Wells and Tensleep at shallow depths is usually a calcium bicarbonate type and contains 200 to 500 mg/l dissolved solids

Along the Greys River, south of "The Elbow", the Nugget Sandstone and lower part of the Twin Creek Limestone should be capable of yielding moderate quantities of water to wells. Wells that tap the Nugget and the Twin Creek in this area may flow if they are located in topographic lows. Small to moderate quantities of water are available from sandstone aquifers in the Frontier, Bear River, and Blind Bull Formations. Water in these aquifers at shallow depths is usually a calcium bicarbonate type and contains 150 to 300 mg/l dissolved solids. Some domestic wells that tap the Bear River and Aspen Formations along the Snake River in T. 39 N. have been abandoned because of hydrogen sulfide gas

Star Valley

Large quantities of water are generally available to wells from alluvium in Star Valley north of T. 31 N. No wells penetrate the entire thickness of alluvium, which has a maximum thickness of at least 224 feet. The water level in alluvium near the center of the valley is less than 25 feet below land surface, but it is greater than 100 feet along the east side of the valley between Grover and Smoot. Zones of perched water in alluvium are topped by many domestic wells along the east side of the valley. A flowing well (34-119-19cc1) in alluvium is located northeast of Thayne. Water in alluvium is usually a calcium bicarbonate type and contains 200 to 300 mg/l total dissolved solids. Between Auburn and "The Narrows" along the west side of the valley, however, water in alluvium may be a sodium chloride or sodium calcium chloride type and may contain greater than 500 mg/l dissolved solids. Water from springs issuing from the Preuss Redbeds along Stump Creek in Idaho and water from hot springs (33-119-23ac1 and 33-119-26ad1) are a sodium chloride type and recharge the alluvium

Gannett Hills, Sublette Range, and Tunp Range

Small quantities of water are available to wells from aquifers in the Twin Creek Limestone, Gannett Group, Preuss Redbeds, and Stump Sandstone. The Wells Formation and the Nugget Sandstones are capable of yielding moderate quantities of water. The Thaynes Limestone and Phosphoria Formation yield moderate quantities of water to wells in the southern part of the Tunp Range; in T. 22 N., R. 118 W., wells that tap these formations at depths of 200 to 600 feet flow. Water at shallow depths in the Wells, Thaynes, Nugget, Twin Creek, Gannett, and Stump is usually a calcium bicarbonate type and contains 250 to 500 mg/l dissolved solids. Water in the Preuss, however, is commonly a sodium chloride or sodium chloride bicarbonate type and contains 500 to 1,000 mg/l dissolved solids. Water in the Phosphoria in the southern part of the Tunp Range is a calcium sulfate or calcium magnesium sulfate type and contains 1,000 to 3,000 mg/l dissolved solids

Fossil Syncline

Conglomerate and conglomeratic sandstone aquifers in the Wasatch and Evanston Formations and the Gannet Group are capable of yielding moderate to large quantities of water to wells. Finer grained sandstones in the Wasatch, Green River, and Fowkes Formations will yield small quantities of water. Drilling depths in the area to tap a sufficient thickness of sandstone, are usually less than 200 feet for domestic wells and as much as 700 feet for municipal wells. Zones of perched water occur in these formations near land surface, however, in topographic lows at depths greater than about 100 feet, water is confined and some wells flow. In the southern and central parts of the Fossil Syncline, water at shallow depths in these sandstone and conglomerate aquifers is usually a calcium bicarbonate type and rarely contains more than 500 mg/l dissolved solids; however, water in these aquifers in the northern part of the Fossil Syncline usually contains 500 to 2,000 mg/l dissolved solids and larger concentrations of sodium, chloride, and sulfate

Hilliard Flat, Cumberland Flat, and Mammoth Hollow

These areas are structural synclines in which the topographic lows or flats are usually underlain by a large thickness of Hilliard Shale, and the surrounding hills are underlain by older Cretaceous and Jurassic rocks. (See structure section D–D'.) Oyster Ridge, a prominent topographic feature that extends along the eastern edge of most of this area, is formed by resistant sandstone beds in the Frontier Formation that dip to the west under the Hilliard Shale. Very small quantities of water are available from the Hilliard Shale. Most domestic wells in Hilliard Flats tap the thin mantle of terrace deposits that overlies the shale. Small to moderate quantities of water may be available from sandstone in the Frontier, but drilling depths to tap the Frontier increase rapidly away from its outcrop areas. In Hilliard and Cumberland Flats, drilling depths to reach the Frontier could be as much as 7,000 feet where a large thickness of Hilliard Shale is present. Small quantities of water should be available from the Lazeart Sandstone Member at the base of the Adaville Formation along the western margin of Cumberland Flats; however, in much of this area, the Adaville has been eroded away and outcrops of the Lazeart are small. Other aquifers that will yield small quantities of water are thin sandstone beds in the Aspen and Bear River Formations, sandstone in the Stump Sandstone, and conglomerate and sandstone in the Gannett Group. The Nugget Sandstone should yield moderate quantities of water east of Mammoth Hollow; however, the Nugget may be beyond present (1973) economic drilling depths a short distance from its outcrop

Although the quality of ground water varies considerably in these areas, water in Cretaceous aquifers is generally of better chemical quality in Mammoth Hollow than in Cumberland and Hilliard Flats. Water in Cretaceous aquifers at shallow depths in Mammoth Hollow is usually a calcium bicarbonate or sodium bicarbonate type and contains 250 to 500 mg/l dissolved solids. In Cumberland Flats, water in the Frontier usually contains 750 to 1,500 mg/l dissolved solids, and water in the Aspen Formation and Hilliard Shale usually contains more than 2,000 mg/l dissolved solids

Bear River valley

Alluvium in the Bear River valley north of Evanston is capable of yielding large quantities of water to wells. The maximum thickness of alluvium has not been penetrated by wells in this area but is at least 110 feet thick near Border. (See well 26-120-1cdd.) A well that penetrates a sufficient saturated thickness of alluvium could be expected to produce 2,000 gpm or more. The water level in alluvium is usually less than 25 feet below land surface, but it may be 100 feet or more below land surface in alluvial fans along the margins of the northern Bear River valley. Alluvium in the Bear River valley south of Evanston and along Yellow Creek is probably capable of yielding moderate quantities of water to wells where there is sufficient saturated thickness of gravel and sand (25 to 50 feet). Well 15-120-31bb1 penetrates about 50 feet of sand and gravel along Yellow Creek and is pumped at a rate of 320 gpm. Several domestic wells tap terrace deposits south of Evanston, but the saturated thickness of sand and gravel is small. During relatively dry years, some of these wells reportedly have failed. Water in alluvium in the Bear River valley contains 300 to 600 mg/l dissolved solids and is usually a calcium bicarbonate or calcium magnesium bicarbonate type

Western Green River structural basin

Individual sandstone aquifers in the La Barge Member of the Wasatch Formation are capable of yielding small quantities of water to wells; however, wells may yield moderate quantities of water where more than one sandstone aquifer is tapped. Conglomerates in the conglomerate member of the Wasatch yield small quantities of water to wells, and, in areas where the conglomerate is well sorted, moderate quantities of water may be available. The Green River Formation and the upper tongue and New York Tongue of the Wasatch contain comparatively small thicknesses of sandstone and are capable of yielding only small quantities of water to wells. Rocks in the Bridger Formation are relatively impermeable in most areas and will yield very small quantities. However, north of the Uinta Mountains along the southern boundary of the area, the Bridger is conglomeratic and may be capable of yielding larger quantities of water. Conglomerates in the Browns Park Formation and Bishop Conglomerate are usually well drained and will yield only small quantities of water to wells

In the more humid southern part of the area just north of the Uinta Mountains, Tertiary aquifers are generally conglomeratic, and ground water is of excellent chemical quality. In this area, water in the Wasatch and Bridger Formations is usually a calcium bicarbonate type and contains 200 to 350 mg/l dissolved solids. To the north, the Tertiary rocks are finer grained and precipitation is less. The Wasatch and Bridger Formations intertongue with lake beds of the Green River Formation, and water in these formations commonly contains 500 to 1,000 mg/l dissolved solids

Geology compiled by G. C. Lines, 1972–73

HYDROGEOLOGIC MAP AND STRUCTURE SECTIONS

Hydrologic data compiled by G. C. Lines, 1972–73

WELL- AND SPRING-DATA MAP

Base from U.S. Geological Survey
Driggs (1962), Ogden (1960), and Preston (1958)

SCALE 1:250 000
5 0 5 10 15 20 25 MILES
5 0 5 10 15 20 25 KILOMETRES

Interior–Geological Survey, Reston, Va.–1975

WATER RESOURCES OF THE THRUST BELT OF WESTERN WYOMING

By
Gregory C. Lines and William R. Glass

1975