R. 16 W. 114°00'

R. 15 W.

113°451

R. 13 W.

R. 14 W.

R. 12 W.

113°30' R. 11 W.

R. 10 W.

EXPLANATION

WRi

QTb ● 4E(1976)

1600

— — 1700 — — WATER-LEVEL CONTOUR—Shows approximate altitude of the water level where data are available. Contour interval 100 feet. Datum is mean sea level

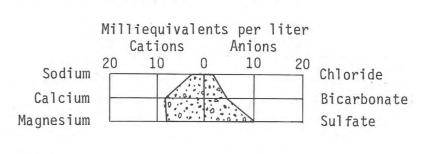
WELL—First entry, Qal, is principal aquifer (see composite stratigraphic column for explanation of letter symbol). 64M(1976) Second entry, 64M(1976), is depth to water in feet below land surface [R, depth to water reported; M, depth to water measured, E, depth to water estimated; (1976), year in which water level was determined]. Third entry, 1576, is altitude of the water level in feet above mean sea level. Fourth entry, 1950, is specific conductance in micromhos per centimeter at 25°C (specific conductance is an indication of the dissolved-solids concentration in water). Fifth entry, 0.7, is fluoride concentration in milligrams per liter

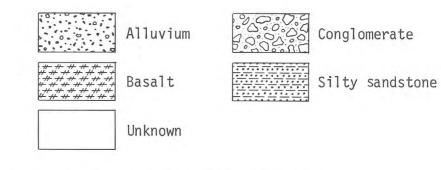
> SPRING—First entry, QTb, is aquifer from which the spring issues (see composite stratigraphic column for explanation of letter symbol). Second entry, 4E(1976), is discharge of spring in gallons per minute [E, discharge estimated; (1976), year in which discharge was estimated]. Third entry, 1600, is altitude of the land surface in feet above mean sea level. Fourth entry, 430, is specific conductance in micromhos per centimeter at 25°C (specific conductance is an indication of the dissolved-solids concentration in water). Fifth entry, 0.4, is fluoride concentration in milligrams per liter

CONTINUOUS-RECORD STREAMFLOW-GAGING STATION

EXPLORATION HOLE—Letter symbol, Mr, is oldest geologic unit penetrated (see composite stratigraphic column for explanation of letter symbol)

CHEMICAL-QUALITY PATTERN DIAGRAM—Shows major chemical constituents in milliequivalents per liter. The patterns are in a variety of shapes and sizes, which provides a means of comparing, correlating, and characterizing similar or dissimilar types of water. The pattern tends to maintain its characteristic shape as the sample becomes dilute or concentrated, and the pattern size varies in proportion to the variation in dissolved solids. The general lithology of the water-bearing unit is designated in the chemical-quality pattern diagram



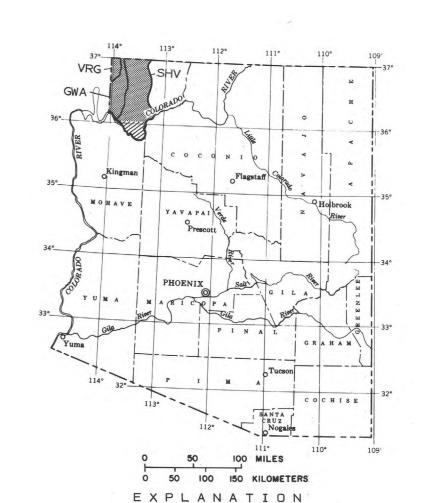


GENERALIZED DIRECTION OF GROUND-WATER FLOW

Composite stratigraphic column for the Virgin River, Grand Wash, and Shivwits areas

ARBITRARY BOUNDARY OF GROUND-WATER AREA

System	Group or formation	Letter symbol for geologic unit	
Quaternary	Alluvium	Qal	
Quaternary and Tertiary	Conglomerate Basalt	QTs QTb	
Tertiary and Tertiary(?)	Muddy Creek Formation Tertiary sedimentary rocks, undifferentiated	Tmc Ts	
3,17	Cottonwood Wash Formation of Moore (1972)	Tcw	
Cretaceous(?)	Jacobs Ranch Formation of Moore (1972)	Kjr	
Jurassic and Triassic(?)	Navajo Sandstone	JTan	
Triassic	Chinle Formation Moenkopi Formation	Tec Tem	
Permian	Kaibab Limestone Toroweap Formation Coconino Sandstone Hermit Shale Pakoon Limestone of McNair (1951)	Pk Pt Pc Ph	
Permian and Pennsylvanian	Supai Group Callville Limestone	PIPs PIPc	
Mississippian	Redwall Limestone	Mr	



ARBITRARY BOUNDARY OF GROUND-WATER AREA-VIRGIN RIVER AREA, VRG; GRAND WASH AREA, GWA; SHIVWITS AREA, SHV INDEX MAP SHOWING AREAS OF REPORT (SHADED). CROSSHATCHED PART OF

SHIVWITS AREA WAS NOT INCLUDED IN THE STUDY OWING TO LACK OF DATA

CONVERSION FACTORS

For use of those readers who may prefer to use metric units rather than inch-pound units, the conversion factors for the terms used in this

Multiply inch-pound unit	By	To obtain metric unit
foot (ft)	0.3048	meter (m)
square mile (mi ²)	2.590	
acre-foot (acre-ft)	0.001233	square kilometer (km²) cubic hectometer (hm³)
cubic foot per second		cubic meter per second
(ft^3/s)	0.02832	(m ³ /s)
gallon per minute		liter per second
(gal/min)	0.06309	(L/s)

SELECTED REFERENCES

report are listed below:

Bureau of Water Quality Control, 1978, Drinking water regulations for the State of Arizona: Arizona Department of Health Services duplicated report, 39 p.

Glancy, P. A., and Van Denburgh, A. S., 1969, Water-resources appraisal of the lower Virgin River Valley area, Nevada, Arizona, and Utah: Nevada Department of Conservation and Natural Resources, Water Resources-Reconnaissance Series Report 51, 87 p.

McNair, A. H., 1951, Paleozoic stratigraphy of part of northwestern Arizona: American Association of Petroleum Geologists Bulletin, v. 35, no. 3, p. 503-541.

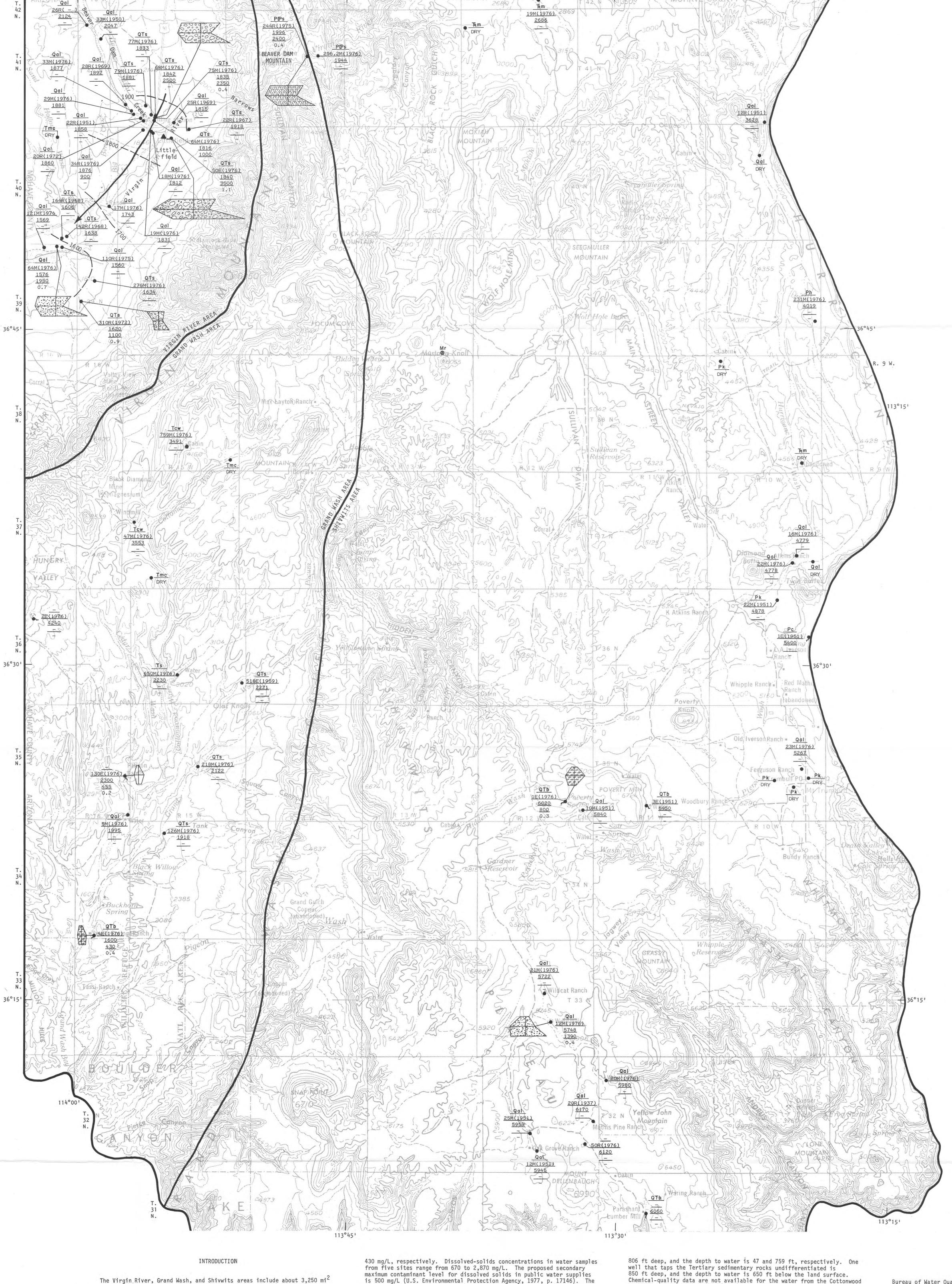
Moore, R. T., 1972, Geology of the Virgin and Beaverdam Mountains, Arizona: Arizona Bureau of Mines Bulletin 186, 63 p.

National Academy of Sciences and National Academy of Engineering, 1973 [1974], Water quality criteria, 1972: U.S. Environmental Protection Agency Report, EPA-R3-73-033, 594 p.

U.S. Environmental Protection Agency, 1976 [1978], Quality criteria for water: U.S. Environmental Protection Agency Publication, 256 p. 1977, National secondary drinking water regulations: Federal

Register, v. 42, no. 62, Thursday, March 31, 1977, p. 17143-17147. Wilson, E. D., and Moore, R. T., 1959, Geologic map of Mohave County, Arizona: Arizona Bureau of Mines map, 1:375,000.

5 MILES 10 KILOMETERS CONTOUR INTERVAL 200 FEET WITH SUPPLEMENTARY CONTOURS AT 100-FOOT INTERVALS DATUM IS MEAN SEA LEVEL



The Virgin River, Grand Wash, and Shivwits areas include about 3,250 mi² in northwestern Arizona. Ground water is obtained mainly from the alluvium, conglomerate, and basalt; however, several other formations yield small amounts of water in places. The composite stratigraphic column indicates the relative positions of the formations.

The hydrologic data on which the map is based are available, for the most part, in computer-printout form for consultation at the Arizona Water Commission, 222 North Central Avenue, Suite 800, Phoenix, and at U.S. Geological Survey offices in: Federal Building, 301 West Congress Street, Tucson; Valley Center, Suite 1880, Phoenix; and 2255 North Gemini Drive, Building 3, Flagstaff. Material from which copies can be made at private expense is available at the Tucson, Phoenix, and Flagstaff offices of the

VIRGIN RIVER AREA

U.S. Geological Survey.

In the Virgin River area the main area of ground-water development is along the Virgin River west of the Virgin and Beaver Dam Mountains, where the alluvium and conglomerate are hydraulically connected and act as a single aquifer where saturated. Most wells that penetrate the aquifer are less than 200 ft deep; the greatest known well depth is 490 ft. Water levels range from 17 to 310 ft below the land surface, and well yields reportedly range from a few gallons per minute to as much as 2,000 gal/min from a well in sec. 30, T. 41 N., R. 15 W. Most large-diameter properly constructed wells that tap the alluvium along the Virgin River yield several hundred gallons per minute of water. In 1976 about 5,000 acre-ft of ground water was withdrawn mainly for irrigation use along the Virgin River. The general direction of ground-water movement is from the northeast to the southwest.

Water in the alluvium and conglomerate may contain sulfate and chloride concentrations in excess of the recommended limit of 250 mg/L (milligrams per liter) for each constituent in drinking water (National Academy of Sciences and National Academy of Engineering, 1973, p. 61, 89); however, water that contains larger concentrations is being used where water of better quality is not available. The sulfate and chloride concentrations in water samples from eight sites range from 95 to 1,300 mg/L and 29 to

maximum contaminant level for fluoride in public water supplies differs according to the annual average maximum daily air temperature (Bureau of Water Quality Control, 1978, p. 6). The annual average maximum daily air temperature in the Virgin River area is about 82°F, and the maximum contaminant level for fluoride is 1.4 mg/L. The fluoride concentrations in the water from five sites range from 0.4 to 1.1 mg/L.

Springs along the Virgin River between Littlefield and the Narrows and along the lower reach of Beaver Dam Creek contribute about 70 ft³/s of water to the Virgin River (Glancy and Van Denburgh, 1969). Most of the springs are along the banks of the Virgin River and cannot be easily identified or individually measured. Data from the streamflow-gaging station on the Virgin River below its confluence with Beaver Dam Creek were used to estimate the amount of water discharged by the springs.

GRAND WASH AREA

In the Grand Wash area ground water is obtained from the alluvium, conglomerate, basalt, Cottonwood Wash Formation of Moore (1972), Tertiary sedimentary rocks undifferentiated, and the Supai Group. Ground-water development is minimal, and less than 10 acre-ft was withdrawn in 1976. Sufficient data are not available to contour the altitude of the water level in the area.

Only one well obtains its water from the alluvium. The well is 35 ft deep, and in 1976 the depth to water was 5 ft below the land surface. Three wells that tap the conglomerate are 165, 240, and 548 ft deep, and the depth to water is, respectively, 126, 218, and 518 ft bellow the land surface. Chemical-quality data are not available for water from the alluvium and conglomerate. A spring in sec. 35, T. 34 N., R. 16 W., issues from the basalt. The source of the spring in sec. 24, T. 35 N., R. 16 W., is unknown, but the similarity in the chemical quality of the water from the two springs indicates that it probably discharges from the basalt into the alluvium along an unnamed wash. The dissolvedsolids concentrations in the water from the two springs are 287 and 317 mg/L, and the fluoride concentrations are 0.2 and 0.4 mg/L. The two wells that tap the Cottonwood Wash Formation of Moore (1972) are 153 and

Wash Formation of Moore (1972) and the Tertiary sedimentary rocks undifferentiated. A well in sec. 14, T. 41 N., R. 14 W., penetrates the Supai Group. The well is 343 ft deep, the depth to water is reported to be 244 ft below the land surface, and the yield is reported to be 300 gal/min. The water is similar in chemical quality to water from wells penetrating the alluvium along the Virgin River. The dissolved-solids and sulfate concentrations are 1,740 and 710 mg/L, respectively; the fluoride concentration is 0.4 mg/L.

SHIVWITS AREA

In the Shivwits area ground water is obtained mainly from the alluvium along the large washes. In places water is obtained from the basalt, Moenkopi Formation, Kaibab Limestone, Coconino Sandstone, Hermit Shale, and Supai Group. Ground-water development is minimal, and less than 10 acre-ft was withdrawn in 1976. Only 16 producing wells are known to exist in the area, and the water is used for domestic and livestock supplies. Sufficient data are not available to contour the altitude of the water level in the area.

Wells in the Shivwits area are reported to be from 10.5 to 300 ft deep, and water levels range from 10 to 256 ft below the land surface. Several deeper holes have been drilled, but were reported to be dry. Well yields generally are less than 10 gal/min, although larger yields might be obtained in places. A well that penetrates the Kaibab Limestone in sec. 3, T. 36 N., R. 10 W., is reported to yield 45 gal/min with 8 ft of drawdown. Chemical analyses of the water are available from one well in sec. 27, T. 33 N., R. 12 W., and from one spring in sec. 26, T. 35 N., R. 12 W. The well obtains its water from the alluvium, and the spring issues from the basalt. The dissolved-solids concentration is 1,100 mg/L in water from the well and 537 mg/L in water from the spring. Water from the well contains a sulfate concentration of 510 mg/L, which is in excess of the recommended limit of 250 mg/L in drinking water (National Academy of Sciences and National Academy of Engineering, 1973, p. 89). The fluoride concentrations in the water from the well and spring are 0.4 and 0.3 mg/L, respectively.

LAS VEGAS 1:250,000, 1954