R. 30 E.

R. 31 E.

109°151

R. 29 E.

R. 28 E.

R. 27 E.

## INTRODUCTION

The northern part of the Chinle area includes about 3,000 mi<sup>2</sup> in northeastern Arizona and is entirely in the Navajo Indian Reservation. The main source of water is from the several aquifers that are made up of one or more formations. The aquifers are stacked one on the other and generally are not hydraulically connected; the composite stratigraphic column indicates the relative position of the formations. The main water-bearing units are the C, N, and D aquifers and the alluvium. The geologic structure and topographic relief preclude a uniform depth to water in the area; therefore, recommended drilling depths should be determined on an individual site basis. Ground-water development has been slight and has been mainly for public, domestic, and livestock supplies. In 1975 about 1,000 acre-ft of ground water was withdrawn from the aquifers, and the water levels measured in 1976 probably are similar to those in 1951-76—the period for which data were used to compile these maps.

The hydrologic data on which these maps are 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 U.S. Geological Survey.

## C AQUIFER

The C aquifer underlies the entire northern part of the Chinle area and consists of the Shinarump Member of the Chinle Formation, the De Chelly Sandstone, and the uppermost beds of the Supai Formation. The aquifer, which is composed of a series of conglomerate, sandstone, and siltstone beds, crops out in the southeastern part of the area. The depth to the top of the aquifer generally increases from south to north; near Red Mesa, it is about 1,500 ft below land surface. The aquifer is about 1,500 ft thick in the Black Mountain area and thins to less than 500 ft in Canyon de Chelly, where erosion has removed the units that overlie the Supai Formation.

Ground water is under confined conditions along the west and east edges and probably in the northern part of the area; no water wells penetrate the aquifer in the northern part of the area. In the Many Farms and Round Rock areas wells flow at the land surface. The aquifer is partly saturated and ground water is under unconfined or water-table conditions in the southeastern part of the area, where the aquifer receives its recharge and the overlying Chinle Formation has been removed by erosion. Ground water moves to the west and northwest from the recharge area.

The C aquifer yields small to moderate quantities of water to wells. Well yields range from less than 10 to more than 125 gal/min and depend on the saturated thickness of the aquifer. The water is of suitable chemical quality for most uses. In general, the water contains less than 500 mg/L (milligrams per liter) of dissolved solids and has a calcium bicarbonate composition. The fluoride concentration ranges from 0.2 to 5.9 mg/L; however, fluoride concentrations generally are equal to or less than the recommended average optimum concentration in drinking water (U.S. Public Health Service, 1962). The recommended average optimum fluoride concentration for a water supply differs according to the annual average maximum daily air temperatures. In the northern part of the Chinle area the annual average maximum daily air temperature is about 68°F, and the optimum concentration of fluoride in drinking water is 0.9 mg/L. The presence of concentrations greater than 1.8 mg/L is grounds for rejection of the water for public supply.

## N AQUIFER

The N aquifer underlies the north half and the west edge of the area and consists of the Navajo Sandstone, the Kayenta Formation, and the Lukachukai Member of the Wingate Sandstone. The aquifer is composed of fine-grained sandstone and siltstone and is about 700 ft thick near Red Mesa, 500 ft thick near Red Rock, 1,100 ft thick near Rock Point, and 800 ft thick near Lohali Point.

In most of the area the aquifer is only partly saturated, and ground water occurs under unconfined conditions. Near Lohali Point, the aquifer is completely saturated, and ground water occurs under confined conditions. The N aquifer yields small quantities of water to wells. Well yields range from less than 5 to as much as 50 gal/min and depend on the saturated thickness of the sandstone bed penetrated by the well. In general, the water contains less than 500 mg/L of dissolved solids and has a sodium or calcium bicarbonate composition. The fluoride concentration ranges from 0.0 to 2.2 mg/L but generally is equal to or less than the recommended average optimum concentration in drinking water.

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EXPLANATION 09T-516 203M 9Y-12 5197 192 ENCON! 4924 70M altitude at which water level would have 9K-210 5095 stood in tightly cased well. Dashed 27M 630 where approximately located. Contour 9Y-10 4813 5178 150M 5110 interval 200 feet. Datum is mean sea 218 620 9B-17 279M 5141 800 679 0.4 → 5000 → POTENTIOMETRIC CONTOUR, N AQUIFER—Shows 4830 altitude at which water level would have 9T-514 0 stood in tightly cased well. Contour interval 200 feet. Datum is mean sea 4922 30R 4720 Teec Nos' Pas • 11Y-109 WELL THAT PENETRATES THE C AQUIFER—First entry, 11Y-109, is well number or name. 166M 5599 Second entry, 166M, is depth to water in feet below land surface (R, depth to water reported; M, depth to water measured; F, flowing well). Third entry, 5599, is altitude of the water level in 9K-218 feet above mean sea level. Fourth entry, o 216M 9T-224 894, is specific conductance in micromhos 5084 172M 5139 per centimeter at 25°C (specific conduct-<u>9T-545</u> ance is an indication of the dissolved-1100R solids concentration in water). Fifth 5660 entry, 0.7, is fluoride concentration in milligrams per liter 210R o 9K-218 WELL THAT PENETRATES THE N AQUIFER—First 5140 38R 5162 216M entry, 9K-218, is well number. Second 5084 entry, 216M, is depth to water in feet below land surface (R, depth to water reported; M, depth to water measured). Third entry, 5084, is altitude of the water level in feet above mean sea level. Fourth entry, 219, is specific conductance in micromhos per centimeter at 25°C (specific conductance is an indication of the dissolved-solids concentration in water). Fifth entry, 0.2, is fluoride concentration in milligrams per liter 9Y-81 9 165M 5508 CHEMICAL-QUALITY PATTERN DIAGRAM—Shows 193 major chemical constituents in milliequivalents per liter. The pattern is 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 Rock Point shape as the sample becomes dilute or concentrated, and the pattern size varies in proportion to the variation in dissolved solids Milliequivalents per liter Cations Anions 10 20 Chloride Bicarbonate 9Y-97 46M 5039 1010 APPROXIMATE AREAL EXTENT OF THE N AQUIFER APPROXIMATE BOUNDARY BETWEEN CONFINED AND UNCONFINED CONDITIONS IN THE C AQUIFER APPROXIMATE BOUNDARY BETWEEN CONFINED AND UNCONFINED CONDITIONS IN THE UNCONFINED N AQUIFER—Queried where uncertain 11K-246 5602 <u>115M</u> 389 5440 GENERALIZED DIRECTION OF GROUND-WATER FLOW 9K-215 700R 15M ARBITRARY BOUNDARY OF GROUND-WATER AREA 5740 5470 648 540 229M 5571 <u>25M</u> 5248 6175 11K-255 132M 899 5628 9Y-95 120M 5513 369 Round Rock <u>\_F</u> <u>5174</u>● 11K-243 112M 5973 11Y-58 10R-174 <u>F</u> 5445 ● 97R 5595 257M 5518 526 2.2 945 564 166M 5599 240M <u>F</u> 5290 741 5760 886 0.6 Composite stratigraphic column for the 10K-235 11K-256 <u>438M</u> 100M 5587 282M 6082 System Formation or member 5978 Quaternary Alluvium 339 Tertiary Chuska Sandstone 11T-235 339M Wepo Formation Toreva Formation Mancos Shale 10T-253 B <u>5865</u> Cretaceous 68M 956 Dakota Sandstone UPPER GREASEWOOD T.F 5360 Morrison Formation Cow Springs Sandstone Bluff Sandstone Summerville Formation Entrada\_Sandstone 732 320R 6300 MANY FARMS PM 6 Jurassic 0 10R-111 Carmel Formation Navajo Sandstone Kayenta Formation 170M 5587 - Sheet 1 Many Farms 5030 0.6 Wingate Sandstone Lukachukai Member Rock Point Member 10K-213 10T-539 204M 5641 Chinle Formation Owl Rock Member 426M Sonsela Sandstone Bed Monitor Butte Member NCC-5 380M 6760 327 944 0.6 Shinarump Member 10T-258 301M De Chelly Sandstone Supai Formation Upper member 416M 6524 11Y-69 512M 6246 10K-248 334M 5511 11K-237 286M 752 0.5 322R 6778 6134 NCC-6 108M 7077 320 916 11K-259 480M 6180 10T-514 A 230R 414M 10K-200 97M 5432 1150 7050 5435 861 830R 6015 NAVAJO BASE LINE 392M 5823 472 R. 6 W. 210R 6870 1020 874R 6066 450 0.5 0.9 NTUA-1 33M 5477 446 0.4 10T-272 0 M 5555 392 Point 📈 Canyon de Chelly Black Mountain 10T-523 280M 5340 COTTONWOOD PM 2 346 950M 5100 500 10T-524 750R 5158 520

BASE FROM U.S. GEOLOGICAL SURVEY

SHIPROCK 1:250,000, 1969

INDEX MAP SHOWING AREA

OF REPORT (SHADED)

5 0 5 MILES

5 0 5 10 KILOMETERS

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

10K-234 750R 5155

725

10T-556 1090R

GROUND-WATER CONDITIONS IN THE C AND N AQUIFERS

MAPS SHOWING GROUND-WATER CONDITIONS IN THE NORTHERN PART OF THE CHINLE AREA, APACHE COUNTY, ARIZONA—1976

114M 7386 458 0.2

298M 6432