PREPARED COOPERATIVELY BY THE
UNITED STATES GEOLOGICAL SURVEY AND THE GEOLOGICAL SURVEY OF NIGERIA
UNDER THE AUSPICES OF THE
U.S. AGENCY FOR INTERNATIONAL DEVELOPMENT

WATER-SUPPLY PAPER 1767–1
PLATE 5

EXPLANATION

High-yield artesian aquifer (a)
Aquifer consists of 10–20 feet of silt to coarse sand. High initial yields may be obtained from boreholes, bud base should be restricted to conserve artesian heads. Artesian flows up to 200 gph (gallons per hour) can be maintained for at least 30 years if boreholes are spaced 5 miles apart. However, no average flow of 100 gph (that is, 300 gph if the borehole is used only during daylight hours) is adequate for cattle watering areas. Larger flows would be for towns supplying water to a population of 50,000 or more. Boreholes spaced 10 miles apart would be maintained from more widely spaced boreholes. For example, flows up to 200 gph could be maintained from boreholes spaced 10 miles apart.

Moderate-yield artesian (b) and subartesian aquifer (b)
Aquifer consists of 10–20 feet of fine to coarse sand. Although free flows up to 10,000 gph can be obtained initially from boreholes, flows must be restricted to maintain artesian heads for the future. With average flows of 20 gph, boreholes spaced 1 mile apart will continue to flow for more than 50 years. If operating costs are high, boreholes spaced 5 miles apart might be more economical. Boreholes spaced 10 miles apart would have to be spaced 20 miles apart. In the subartesian area near the limit of flowing boreholes, pumping should be restricted to the indicated amount and boreholes similarly spaced to maintain flow in the artesian area.

Low-yield artesian aquifer (c)
Aquifer consists of thin, fine to coarse sand which may be clayey or partly cemented. Because of the poor yield of the aquifer and low artesian heads, flows should be restricted. Average flows of 200 gph can be maintained for 30 years from boreholes spaced 1 mile apart. Initial yields from boreholes may exceed 300 gph, but all decline rapidly if boreholes are permitted to pump. No artesian aquifer should be permitted within this area.

Low-yield subartesian aquifer (d)
Aquifer consists of thin, fine to coarse sand which may be clayey or partly cemented. The yield of pumped boreholes is 100-200 gph, locally up to 400 gph. Pumping should not exceed 300 gph within 1 mile of flowing boreholes, but elsewhere no restrictions of yields is necessary.

Aquifer rising or yields insignificant (d)
Aquifer consists of clayey or cemented sand only. The yield of boreholes in the principal aquifer is too low to justify their cost. Shallow wells or boreholes in upper zone provide the best source of water.

Borehole penetrating middle zone

Borehole with reedbed

Approximate boundary of availability area

Note: Approximate inner limit of recharge is where the upper zone water table and middle zone geologic surface coincide. Approximate outer limit of recharge coincides with the approximate bedrock boundary.

MAP SHOWING AVAILABILITY OF ARTESIAN WATER IN MIDDLE ZONE, CHAD FORMATION
BORNU AND DIKW A EMIRATES, NORTHEASTERN NIGERIA

SCALE: 1:100,000

15°0' 30° 15°0' 30° 15°0' 30° 15°0' 30°

25 50 100 MILES

25 50 100 KILOMETERS

Base from Nigeria Government, 1963; D.O.G. (Geol.) 1136; Scale 1:500,000.