## EXPLANATION

Alluvium and Terrace Deposits and Their Recharge Areas (Quaternary in age). Unconsolidated deposits of sand, silt, clay, and gravel that occur along or adjacent to modern and ancient streams. Thickness generally ranges from 10 to 50 ft (locally as much as 100 ft). Wells generally yield 10 to 500 gpm of water (locally several thousand gpm), and most water is of good quality (less than 1,000 mg/L dissolved solids). Recharge areas are essentially the same as distribution of the alluvium and terrace deposits.

Bedrock Aquifers and Their Recharge Areas (Cambrian through Tertiary in age). Rock units and sediments that generally are favorable or moderately favorable for development of groundwater resources. Thickness of aquifers generally ranges from 100 ft to several thousand ft. Depths to fresh water range from a few feet to more than 1,000 ft, with most wells 100-400 ft deep. Wells drilled into these aquifers generally yield 25–300 gpm, although wells in some aquifers yield up to 600–2,500 gpm. Water in most aquifers is of good to fair quality (300–1,000 mg/L dissolved solids). Pattern on map also includes known and potential recharge areas for bedrock aquifers.

This map shows the distribution of the principal aquifers and their recharge areas in Oklahoma. It brings together, in one map, data that previously had been presented on two maps; the two earlier maps, one on bedrock aquifers and the other on alluvium and terrace deposits, were compiled by K. S. Johnson, 1983 (Maps Showing Principal Ground-Water Resources and Recharge Areas in Oklahoma: Oklahoma State Department of Health and the Oklahoma Geological Survey, 2 sheets, scale 1:500,000). The reader is referred to the two maps for more detail on the aquifers and their recharge areas, and for a comprehensive bibliography. **See OGS Maps GM-42 and GM-43.**

The term "aquifer" refers to those rocks and sediments that are saturated with good- to fair-quality water and are sufficiently permeable to yield significant volumes of water (generally more than 25 gpm) from wells. Bedrock aquifers in Oklahoma consist of sandstone, sand, limestone, dolomite, gypsum, or fractured novaculite and chert; the general distribution and lithology of these aquifers is given on the small bedrock-aquifer map to the lower right. Alluvium and terrace deposits consist mainly of unconsolidated sand, silt, clay, and gravel laid down by streams that flow generally to the east and southeast across the State. The term "alluvium" refers to sediments in stream channels or flood plains of modern-day streams, whereas the term "terrace deposits" refers to older flood-plain or alluvial deposits that have been left behind after a stream shifts position or cuts deeply into underlying rocks. Alluvium and terrace deposits are the youngest (most recent) of all geologic deposits, and therefore they overlie the bedrock aquifers where the two are mapped together.

Fresh water stored in Oklahoma's aquifers results from downward movement of surface waters that have entered each aquifer at its recharge area and have displaced saline waters that originally may have occupied that portion of the aquifer. The system is dynamic, inasmuch as these aquifers are still being recharged by continual downward percolation of surface waters to the zone of saturation. The rate of ground-water movement in the State's various aquifers has not been fully determined, but it probably ranges from about 5 to 100 ft per year in most aquifers, and locally may range from 100 to 1,000 ft (or more) per year under certain geologic and hydrologic conditions.

The term "recharge areas" refers to those portions of the land surface where surface water (precipitation, surface runoff, streams, and lakes) enters the subsurface and eventually migrates downward to the zone of saturation in an aquifer. The recharge areas include both known recharge areas (outcrops of the aquifer, and outcrops of overlying rocks hydraulically connected with the aquifer) and potential recharge areas (outcrops of confining strata that may overlie unknown extensions of an aquifer or contain natural or artificial hydraulic pathways to the aquifer, and a safety zone that extends 4 miles beyond the currently known limits of an aquifer). The reader is referred to the two maps done in 1983 by K. S. Johnson for separate delineation of the known recharge areas and the potential recharge areas.

Because the known and potential recharge areas are critical in protecting the State's aquifers, special care must be taken in the utilization of these lands. In particular, special attention must be exercised in the storage or disposal of waste materials that contain leachable or liquid contaminants that could degrade the quality of water within or flowing across the known and potential recharge areas.

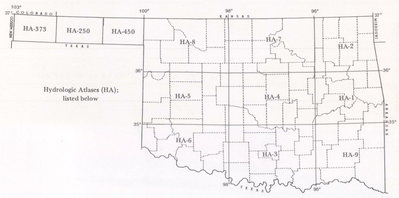
A special purpose of this map is to assist the Oklahoma State Department of Health (OSDH), Industry, and the public in identifying sites that may be suitable or unsuitable for the storage or disposal of industrial wastes. In the OSDH's Rules and Regulations for Industrial Waste Management (ODH Bulletin 0525, effective September 25, 1990) is an exclusionary criterion (section 631) which states:

> No construction permit shall hereafter be granted for an off-site controlled industrial waste treatment, storage or disposal facility proposed to be located over or through unconsolidated alluvial aquifer or terrace deposit aquifer, or over or through bedrock aquifers or their recharge areas. There shall be a presumption that the proposed location is unapprovable on this basis if the proposed location lies wholly or partially within an area designated as an actual or potential unconsolidated alluvial aquifer or terrace deposit aquifer or bedrock aquifer or recharge area, as shown on the maps described as "Sheet 1—Unconsolidated Alluvium and Terrace Deposits" and "Sheet 2—Bedrock Aquifers and Recharge Areas" of the "Maps Showing Principal Ground Water Resources and Recharge Areas in Oklahoma," compiled by Kenneth S. Johnson, Oklahoma Geological Survey (1983), or any successor map(s) compiled by the Oklahoma Geological Survey. Such presumption may be rebutted by site-specific hydrological and geological data and other information submitted by the applicant sufficient to demonstrate clearly and convincingly that the proposed location does not lie in a prohibited area. In making a determination whether a proposed location is within a prohibited area, the Department shall request and rely upon review and conclusions by the Oklahoma Geological Survey. [Similar procedures shall be used in determining whether a groundwater protection plan is required for an on-site facility pursuant to 63 O.S. Section 1-2014(B).] Existing facilities in these areas may continue to operate and may modify or expand their operations to the extent permitted by 63 O.S. Section 1-2014. The Department may require site-specific hydrological and geological information for proposed facility locations outside a designated principle groundwater resource or recharge area where there is reason to believe that the proposed location may be unsuitable due to localized groundwater conditions.

Thus, this current map is intended to assist the screening procedure and show on a single map the aquifers and recharge areas where such construction permits shall not be granted. Sites located outside of the aquifer and recharge areas, are not, however, automatically to be considered suitable for waste disposal; such site-specific suitability can be established only by detailed on-site investigations. Further aid in screening these areas is provided in the report by K. S. Johnson, K. V. Luza, and J. F. Roberts, 1980, Disposal of Industrial Wastes in Oklahoma: Oklahoma Geological Survey Circular 80, 82 p.

The two original ground-water-resources maps, done in 1983, and this map were compiled mainly from a series of hydrologic atlases prepared cooperatively by the Oklahoma Geological Survey and the U.S. Geological Survey (see Hydrologic Atlases listed below). The boundaries of the aquifers embrace the areas shown as being favorable or moderately favorable for development of ground-water resources (yields generally more than 25 gpm) on the hydrologic atlases. The hydrologic atlases, which are reconnaissance studies of the water resources of Oklahoma, should be referred to by the reader for more detailed information on the distribution and character of the aquifers and their recharge areas, and on the quality and quantity of water that is available from the aquifers.

Mapping in the three Panhandle counties is mainly from hydrologic atlases prepared cooperatively by the U.S. Geological Survey and the Oklahoma Water Resources Board (see Hydrologic Atlases listed below), and from work done by the Oklahoma Geological Survey and released as part of the Perryton and Dalhart Sheets of the Geologic Atlas of Texas.




Hydrologic Atlases (HA); listed below

### Hydrologic Atlases

HA-1. Marcher, M.V., 1969, Reconnaissance of the water resources of the Fort Smith Quadrangle, east-central Oklahoma: Oklahoma Geological Survey Hydrologic Atlas 1, 4 sheets, scale 1:250,000.

HA-2. Marcher, M.V., and Bingham, R.H., 1971, Reconnaissance of the water resources of the Tulsa Quadrangle, northeastern Oklahoma: Oklahoma Geological Survey Hydrologic Atlas 2, 4 sheets, scale 1:250,000.

HA-3. Hart, D.L., Jr., 1974, Reconnaissance of the water resources of the Ardmore and Sherman Quadrangles, southern Oklahoma: Oklahoma Geological Survey Hydrologic Atlas 3, 4 sheets, scale 1:250,000.

HA-4. Bingham, R.H., and Moore, R.L., 1975, Reconnaissance of the water resources of the Oklahoma City Quadrangle, central Oklahoma: Oklahoma Geological Survey Hydrologic Atlas 4, 4 sheets, scale 1:250,000.

HA-5. Carr, J.E., and Bergman, D.L., 1976, Reconnaissance of the water resources of the Clinton Quadrangle, west-central Oklahoma: Oklahoma Geological Survey Hydrologic Atlas 5, 4 sheets, scale 1:250,000.

HA-6. Havens, J.S., 1977, Reconnaissance of the water resources of the Lawton Quadrangle, southwestern Oklahoma: Oklahoma Geological Survey Hydrologic Atlas 6, 4 sheets, scale 1:250,000.

HA-7. Bingham, R.H., and Bergman, D.L., 1980, Reconnaissance of the water resources of the Enid Quadrangle, north-central Oklahoma: Oklahoma Geological Survey Hydrologic Atlas 7, 4 sheets, scale 1:250,000.

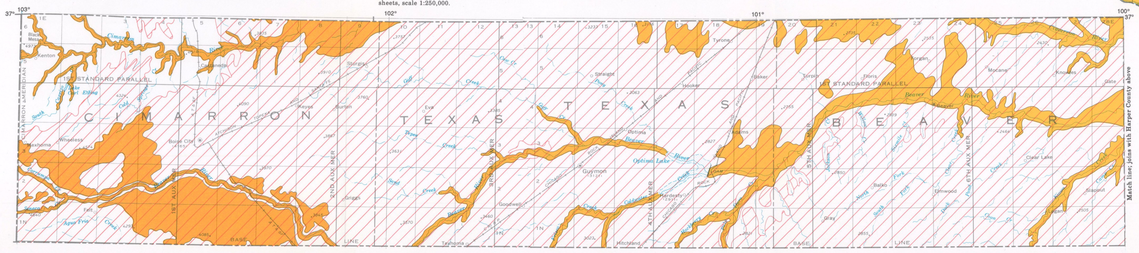
HA-8. Morton, R.B., 1980, Reconnaissance of the water resources of the Woodward Quadrangle, northwestern Oklahoma: Oklahoma Geological Survey Hydrologic Atlas 8, 4 sheets, scale 1:250,000.

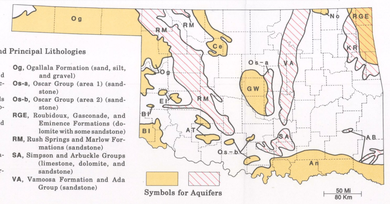
HA-9. Marcher, M.V., and Bergman, D.L., 1983, Reconnaissance of the water resources of the McAlester and Texarkana Quadrangles, southeastern Oklahoma: Oklahoma Geological Survey Hydrologic Atlas 9, 4 sheets, scale 1:250,000.

HA-250. Wood, P.R., and Hart, D.L., Jr., 1967, Availability of ground water in Texas County, Oklahoma: U.S. Geological Survey Hydrologic Investigations Atlas HA-250, 3 sheets, scale 1:125,000.

HA-373. Sapik, D.B., and Goemaat, R.L., 1973, Reconnaissance of the ground-water resources of Cimarron County, Oklahoma: U.S. Geological Survey Hydrologic Investigations Atlas HA-373, 3 sheets, scale 1:125,000.

HA-450. Morton, R.B., and Goemaat, R.L., 1973, Reconnaissance of the water resources of Beaver County, Oklahoma: U.S. Geological Survey Hydrologic Investigations Atlas HA-450, 3 sheets, scale 1:125,000.




**Generalized Map Showing Bedrock Aquifers in Oklahoma (from Oklahoma Geological Survey Map GM-43)**

Bedrock Aquifers and Principal Lithologies

**An**, Antlers Sandstone
**AB**, Arkansas Novaculite and Bigfork Chert (rock is fractured)
**AT**, Arbuckle and Timbered Hills Groups (limestone and dolomite, some sandstone)
**Bl**, Blaine Formation (gypsum and dolomite)
**Ce**, Cedar Hills Sandstone
**El**, Elk City Sandstone
**GW**, Garber and Wellington Formations (sandstone)
**KR**, Keokuk and Reeds Spring Formations (limestone)
**No**, Noxie Sandstone
**Og**, Ogallala Formation (sand, silt, and gravel)
**Os-a**, Oscar Group (area 1) (sandstone)
**Os-b**, Oscar Group (area 2) (sandstone)
**RGE**, Roubidoux, Gasconade, and Eminence Formations (dolomite with some sandstone)
**RM**, Rush Springs and Marlow Formations (sandstone)
**SA**, Simpson and Arbuckle Groups (limestone, dolomite, and sandstone)
**VA**, Vamoosa Formation and Ada Group (sandstone)

Symbols for Aquifers

# Figure B-23

# MAP OF AQUIFERS AND RECHARGE AREAS IN OKLAHOMA

Compiled by
Kenneth S. Johnson
Oklahoma Geological Survey
1991

Scale 1:500,000

10 0 10 20 30 40 Miles
10 0 10 20 30 40 50 60 Kilometers

Base map modified from U.S. Geological Survey, 1:500,000 Series, dated 1972

Cartography by David M. Deering,
additional work by James H. Anderson