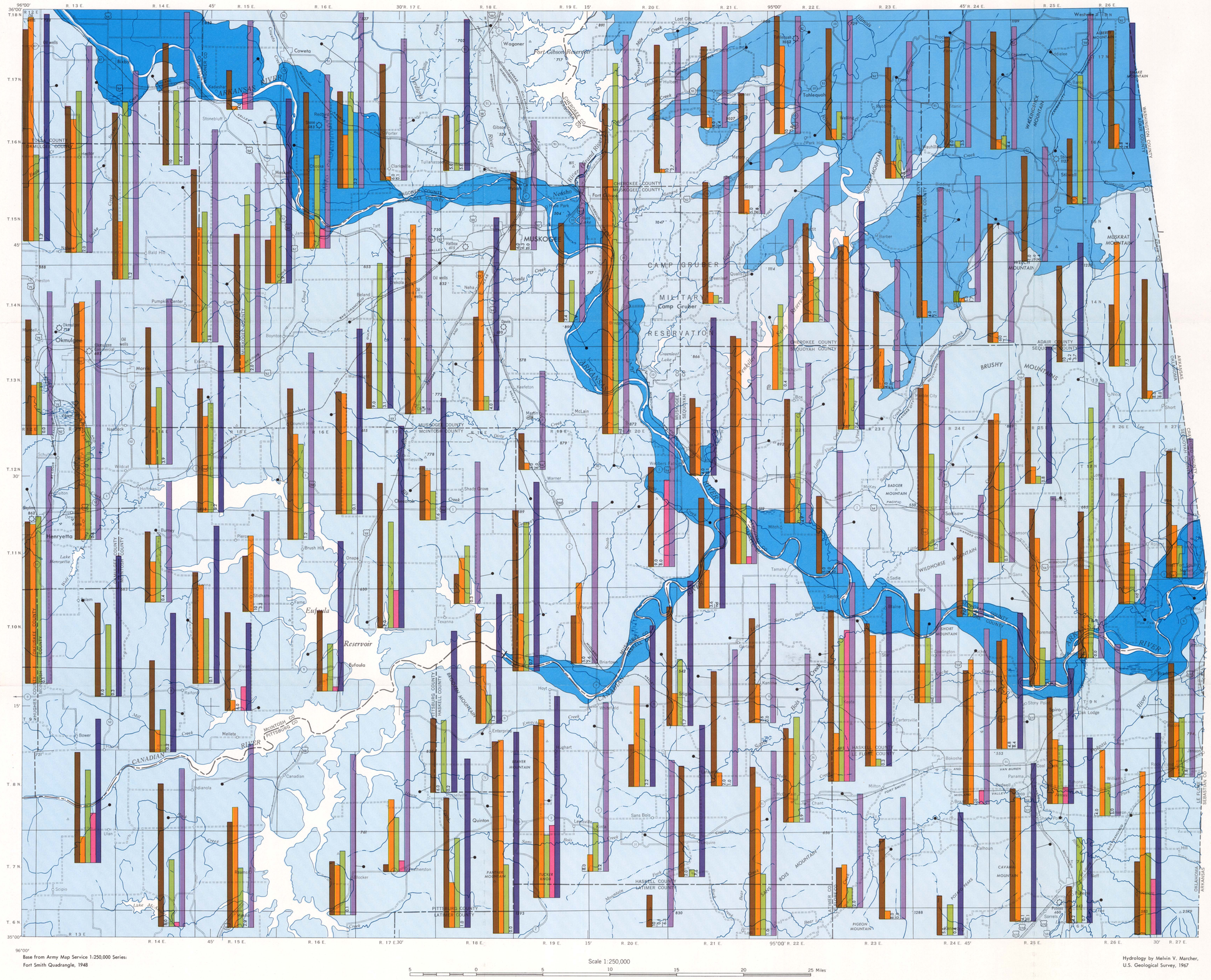


EXPLANATION

Chemical quality of water generally good to excellent

This area includes alluvium along the Arkansas and Canadian Rivers and some terrace deposits in Tulsa, Wagoner, and Muskogee Counties. Hardness is the most troublesome chemical characteristic; 90 percent of the water samples tested were hard or very hard. The total dissolved solids was low to moderate; less than 5 percent of the samples exceeded 500 ppm. Except at a few places, sulfate, chloride, and nitrate concentrations were low. Because of the low to moderate sodium and dissolved-solids contents, most of the water from these deposits is suitable for irrigation.

Summary of Available Chemical Data

	CONCENTRATION (PPM)			NUMBER OF ANALYSES
	MAXIMUM	MEDIAN	MINIMUM	
Hardness	640	255	26	44
Sulfate	198	32	0.0	44
Chloride	62	15	0.8	44
Nitrate	65	0.7	0.0	38
Total dissolved solids	702	335	86	44

Chemical quality of water generally fair to good

This area is underlain by the Keokuk and Reeds Spring Formations and older rocks. Hardness is the most troublesome chemical characteristic; 70 percent of the water samples tested were hard or very hard. Thirty-eight percent of the samples had a total dissolved solids content greater than 500 ppm. The sulfate, chloride, and nitrate contents are generally low, except locally.

Summary of Available Chemical Data

	CONCENTRATION (PPM)			NUMBER OF ANALYSES
	MAXIMUM	MEDIAN	MINIMUM	
Hardness	1,172	162	20	47
Sulfate	840	14	0.0	47
Chloride	840	16	0.2	47
Nitrate	62	2.2	0.0	47
Total dissolved solids	2,300	320	50	47

Chemical quality of water generally poor to fair

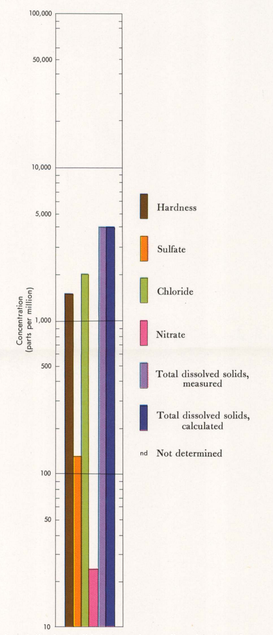
This area is underlain by shale, siltstone, and sandstone and some terrace deposits. Of the water samples tested, 57 percent contained more than 250 ppm sulfate, 10 percent contained more than 250 ppm chloride, and 53 percent contained more than 500 ppm total dissolved solids. Four samples contained more than 45 ppm nitrate; two of these were taken from wells that are apparently polluted. Water from sandstone is least highly mineralized, whereas that from shale, particularly shale that contains coal beds, is most highly mineralized.

Summary of Available Chemical Data

	CONCENTRATION (PPM)			NUMBER OF ANALYSES
	MAXIMUM	MEDIAN	MINIMUM	
Hardness	3,020	144	4.0	83
Sulfate	3,150	36	4.2	84
Chloride	715	44	2.0	84
Nitrate	82	1.6	0.0	82
Total dissolved solids	5,160	581	63	84

● Well from which water sample was taken

⚲ Spring from which water sample was taken



Concentration of selected dissolved solids in water from wells and springs. Concentrations of 10 ppm or less are shown by numbers in the appropriate column of the graph.

CHEMICAL QUALITY OF GROUND WATER

To provide data on chemical quality of ground water in the Fort Smith quadrangle, 96 water samples from wells and springs were collected and analyzed in the laboratory. Laboratory analysis included determination of hardness, sodium, sulfate, chloride, nitrate, and total dissolved solids. Analyses of water from alluvium along the Arkansas River were taken from an open-file report prepared by the U. S. Geological Survey for the U. S. Army Corps of Engineers; the remaining analyses, in Adair, Cherokee, McIntosh, and Pittsburg Counties, were provided by the U. S. Public Health Service.

All ground water contains minerals dissolved primarily from soil and rocks. High concentrations of dissolved minerals may restrict use of water for most purposes. The U. S. Public Health Service Drinking Water Standards state that the following chemical substances should not be present in a water supply in excess of listed concentrations, if, in the judgement of the reporting agency and certifying authority, other suitable supplies are or can be made available.

CONSTITUENT	MAXIMUM CONCENTRATION RECOMMENDED (PARTS PER MILLION)
Sulfate	250
Chloride	250
Nitrate	45
Total dissolved solids	500

Chloride is derived from some minerals, ancient sea brines trapped in the rocks, human and animal wastes, and industrial wastes. Chloride in small amounts has little effect on the usability of water for most purposes, but in concentrations of several hundred parts per million it gives water a salty taste. Small to moderate amounts of chloride have been reported to increase the corrosiveness of water.

Nitrate is derived from human waste, animal waste, and the soil; fertilizer may be a possible source of nitrate. Concentrations greater than about 45 ppm (parts per million) may cause methemoglobinemia ("blue baby") in infants, and therefore water with high nitrate concentration should not be used for baby feeding.

Total dissolved solids consists principally of dissolved mineral constituents but includes organic material that may be present after a measured quantity of water has been evaporated. Large amounts of dissolved solids limit the use of water for many beneficial purposes.

Hard water is objectionable because of its scale-forming properties and because it necessitates the use of large amounts of soap. Water having a hardness of less than 60 ppm is considered soft; 61 to 120 ppm, moderately hard; 121 to 180 ppm, hard; and more than 180 ppm, very hard. Of the samples analyzed in the laboratory and several hundred tested in the field, practically all were classed as hard or very hard. Water from alluvium, terrace deposits, and weathered chert is generally not so hard as water from shale, siltstone, and sandstone.

High mineralization of some ground waters may be due to contamination by oil-well brines, particularly in Okmulgee, Tulsa, and western Muskogee Counties, which include a number of large oil fields. Such contamination might be caused by seepage from waste pits, defective well casing, and water-flooding operations. Without detailed chemical analyses, contamination caused by oil-well brines is difficult to distinguish from that occurring naturally. Further investigation is needed to determine the effect, if any, oil production may have had on ground-water quality in the Fort Smith quadrangle.

In the areas of coal fields in parts of Okmulgee, Haskell, and Le Flore Counties, much of the mineralization of ground water is due to its having been in contact with buried coal beds. Water from abandoned coal pits may also be a source of ground-water contamination. However, the effect of mineralized water from coal pits on ground water probably is small because the rocks adjacent to the coal pits generally have a very low permeability, and, as most of the pits are in valleys, the flow of ground water is toward the pits. Only where coal pits are on slopes is there likely to be any significant seepage from the pits into the ground-water reservoir, and even here the effect is probably local. Water in some coal pits has recreational value and has been used for stock watering, irrigation, and municipal supplies.

Several springs in the Fort Smith quadrangle discharge highly mineralized water. Two of these, one in sec. 19, T. 12 N., R. 20 E., and the other in sec. 13, T. 13 N., R. 25 E., were analyzed for comparison with other natural waters of the area. Both of these springs discharge from fault zones that provide a conduit for upward movement of highly mineralized water.

In summary, the chemical quality of ground water is good in the alluvium along major streams of the area, fair to good in those parts of the area underlain by the Keokuk and Reeds Spring Formations and older rocks, and fair to poor in those parts of the area underlain by shale and siltstone. Contamination of ground water by oil-field brines and water from coal pits is probably limited.

RECONNAISSANCE OF THE WATER RESOURCES OF THE FORT SMITH QUADRANGLE, EAST-CENTRAL OKLAHOMA

MELVIN V. MARCHER

1969

Cartographers: Marion E. Clark, J. Langford and Roy D. Davis, Oklahoma Geological Survey