



Base map from U.S. Geological Survey 1:250,000 series Clinton quadrangle, 1964

Scale 1:250,000  
CONTOUR INTERVAL 100 FEET  
WITH SUPPLEMENTARY CONTOURS AT 50-FOOT INTERVALS  
DATUM: MEAN SEA LEVEL

Figure 6. Map showing chemical quality of ground water.

#### CHEMICAL CHARACTERISTICS OF GROUND WATER

Water samples from 85 wells and 1 spring were analyzed by the U.S. Geological Survey during this study to provide data on the chemical characteristics of ground water in the Clinton quadrangle (fig. 6). Determination was made of the hardness, chloride, bicarbonate, sulfate, nitrate, and dissolved solids, and the amount of sodium and potassium was calculated. Water-quality data from various published reports and from the files of the U.S. Geological Survey were also used in the preparation of this information.

All ground water contains minerals.

High concentrations of dissolved minerals may restrict water usage in many purposes.

According to the Oklahoma State Department of Health (1962, p. 7), water used for public supplies must conform to the chemical-quality requirements listed in Section 5.2 of the U.S. Public Health Service Drinking Water Standards (1962, p. 7-8). An exception may be made if it can be demonstrated that no other source is available, and the concentration is less than 1 mg/l (milligrams per liter) recommended by the Standards for selected chemical substances as follows: sulfate ( $\text{SO}_4$ ), 250; chloride ( $\text{Cl}$ ), 250; nitrate ( $\text{NO}_3$ ), 45; and dissolved solids, 500.

Surface-ground water is derived from various minerals, notably gypsum. When in combination with calcium, sulfate may cause hard scale in boilers, water heaters, and pipes.

Chloride is derived from halite, from ancient sea beds trapped in sandstone, and from the waters near contact-mineral concentrations that exceed the recommended limits of the U.S. Public Health Service. Water from terrace deposits is very hard, but sulfate and chloride concentrations are low.

The Ogallala Formation, Elk City Sandstone, and Dovey Shale contain water that has a hardness of less than 500 mg/l of dissolved solids. Sulfate and chloride concentrations are low, but the water is very hard. Chemical fertilizers also may be a source of nitrate. Only a few milligrams of nitrate per liter are present

in natural, unpolluted waters, and this quantity has no effect on the value of water for ordinary usage.

Dissolved minerals and organic material present after a measured quantity of water has evaporated. Large amounts of dissolved solids limit the use of water for many purposes.

Hardness in general reduces the cleaning action of soap and has scale-forming properties. The U.S. Geological Survey classifies water having a hardness of less than 60 mg/l as soft; 61 to 120 mg/l moderately hard; 121 to 180 mg/l hard; and more than 180 mg/l, very hard.

#### CHEMICAL QUALITY OF WATER WITHIN GEOLOGIC UNITS

Water from alluvium generally is very hard and locally contains high concentrations of sulfate. Sulfate concentrations are generally above the recommended limit, and in some areas chloride concentrations are high. The chemical quality of water from alluvium can differ greatly with short lateral distances. Such differences are due partly to variations in quality of recharge from bedrock bordering or underlying the alluvium or to pumping that increases inflow of water into the alluvium from nearby streams.

Water from terrace deposits is of better quality than that from alluvium, and the quality of the water may contain mineral concentrations that exceed the recommended limits of the U.S. Public Health Service. Water from terrace deposits is very hard, but sulfate and chloride concentrations are low.

The Ogallala Formation, Elk City Sandstone, and Dovey Shale contain water that has a hardness of less than 500 mg/l of dissolved solids. Sulfate and chloride concentrations are low, but the water is very hard. Chemical fertilizers also may be a source of nitrate. The water is a calcium magnesium bicarbonate type.

Locally, water from the Elk City Sandstone has high nitrate concentrations.

Water from the Rush Springs Sandstone and the Marlow Formation yield water that generally contains less than 500 mg/l of dissolved solids in central Caddo, eastern Custer, and western Blaine Counties. In this area, sulfate and chloride concentrations are low, and the water is a calcium magnesium sulfate type. Hardness is a function of the character of the water and ranges from a calcium magnesium sulfate type; water quality deteriorates and water samples usually contain more than 1,000 mg/l dissolved solids. Sulfate and chloride concentrations generally exceed the recommended limit, and in some areas chloride concentrations are high. The chemical quality of water from alluvium can differ greatly with short lateral distances. Such differences are due partly to variations in quality of recharge from bedrock bordering or underlying the alluvium or to pumping that increases inflow of water into the alluvium from nearby streams.

The Cloud Chief Formation and the El Reno Group yield water that generally contains more than 1,000 mg/l of dissolved solids. The water is very hard, and sulfate and dissolved-solids concentrations are generally excessive. Locally, excessive chloride concentrations also occur in water from the overlying Cloud Chief Formation. In general, water from the Rush Springs is of poorer quality than that from the Rush Springs.

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The following tables summarize results of laboratory analyses of ground water in the Clinton quadrangle.

#### Summary of 25 chemical analyses of water from alluvium

	MAXIMUM	UPPER QUARTILE	MEDIAN	LOWER QUARTILE	MINIMUM
Hardness as $\text{CaCO}_3$	3,250	1,000	530	367	250
Sulfate ( $\text{SO}_4$ )	55	36	24	13	4.4
Chloride ( $\text{Cl}$ )	90	55	36	12	3.2
Nitrate ( $\text{NO}_3$ )	130	48	28	17	1
Dissolved solids	2,730	556	419	346	251

(ROE at 18°C)

#### Summary of 28 chemical analyses of water from Ogallala Formation

	MAXIMUM	UPPER QUARTILE	MEDIAN	LOWER QUARTILE	MINIMUM
Hardness as $\text{CaCO}_3$	1,600	143	52	36	11
Sulfate ( $\text{SO}_4$ )	100	50	36	12	3.2
Chloride ( $\text{Cl}$ )	130	90	55	10	6
Nitrate ( $\text{NO}_3$ )	130	48	28	17	1
Dissolved solids	2,730	556	419	346	251

(ROE at 18°C)

#### Summary of 66 chemical analyses of water from Rush Springs Sandstone and Marlow Formation

	MAXIMUM	UPPER QUARTILE	MEDIAN	LOWER QUARTILE	MINIMUM
Hardness as $\text{CaCO}_3$	2,550	908	265	183	54
Sulfate ( $\text{SO}_4$ )	2,280	993	70	11	4.4
Chloride ( $\text{Cl}$ )	230	90	30	12	3.2
Nitrate ( $\text{NO}_3$ )	220	22	6.3	5.4	0
Dissolved solids	3,890	1,210	386	275	154

(ROE at 18°C)

#### Summary of 14 chemical analyses of water from Elk City Sandstone and Marlow Formation

	MAXIMUM	UPPER QUARTILE	MEDIAN	LOWER QUARTILE	MINIMUM
Hardness as $\text{CaCO}_3$	465	270	225	210	170
Sulfate ( $\text{SO}_4$ )	55	36	24	13	4.4
Chloride ( $\text{Cl}$ )	90	55	36	10	6
Nitrate ( $\text{NO}_3$ )	49	41	20	14	6
Dissolved solids	570	444	362	286	255

(ROE at 18°C)

#### Summary of 18 chemical analyses of water from Cloud Chief Formation

	MAXIMUM	UPPER QUARTILE	MEDIAN	LOWER QUARTILE	MINIMUM
Hardness as $\text{CaCO}_3$	500	33	292	240	193
Sulfate ( $\text{SO}_4$ )	62	27	20	15	7.5
Chloride ( $\text{Cl}$ )	170	17	12	9.1	5.4
Nitrate ( $\text{NO}_3$ )	94	40	22	11	2.2
Dissolved solids	670	448	370	328	258

(ROE at 18°C)

#### Summary of 15 chemical analyses of water from El Reno Group

	MAXIMUM	UPPER QUARTILE	MEDIAN	LOWER QUARTILE	MINIMUM
Hardness as $\text{CaCO}_3$	2,200	1,850	1,380	967	130
Sulfate ( $\text{SO}_4$ )	4,400	1,700	1,600	315	22
Chloride ( $\text{Cl}$ )	1,500	100	35	26	7
Nitrate ( $\text{NO}_3$ )	60	16	14	4.1	.1
Dissolved solids	7,070	3,980	2,770	1,300	250

(ROE at 18°C)

#### Summary of 25 chemical analyses of water from El Reno Group

	MAXIMUM	UPPER QUARTILE	MEDIAN	LOWER QUARTILE	MINIMUM
Hardness as $\text{CaCO}_3$	2,200	1,850	1,380	967	130
Sulfate ( $\text{SO}_4$ )	4,400	1,700	1,600	315	22
Chloride ( $\text{Cl}$ )	1,500	100	35	26	7
Nitrate ( $\text{NO}_3$ )	60	16	14	4.1	.1
Dissolved solids	7,070	3,980	2,770	1,300	250

(ROE at 18°C)

#### Summary of 66 chemical analyses of water from Rush Springs Sandstone and Marlow Formation

	MAXIMUM	UPPER QUARTILE	MEDIAN	LOWER QUARTILE	MINIMUM
Hardness as $\text{CaCO}_3$	2,550	908	265	183	54
Sulfate ( $\text{SO}_4$ )	2,280	993	70	11	4.4
Chloride ( $\text{Cl}$ )	230	90	30	12	3.2
Nitrate ( $\text{NO}_3$ )	220	22	6.3	5.4	