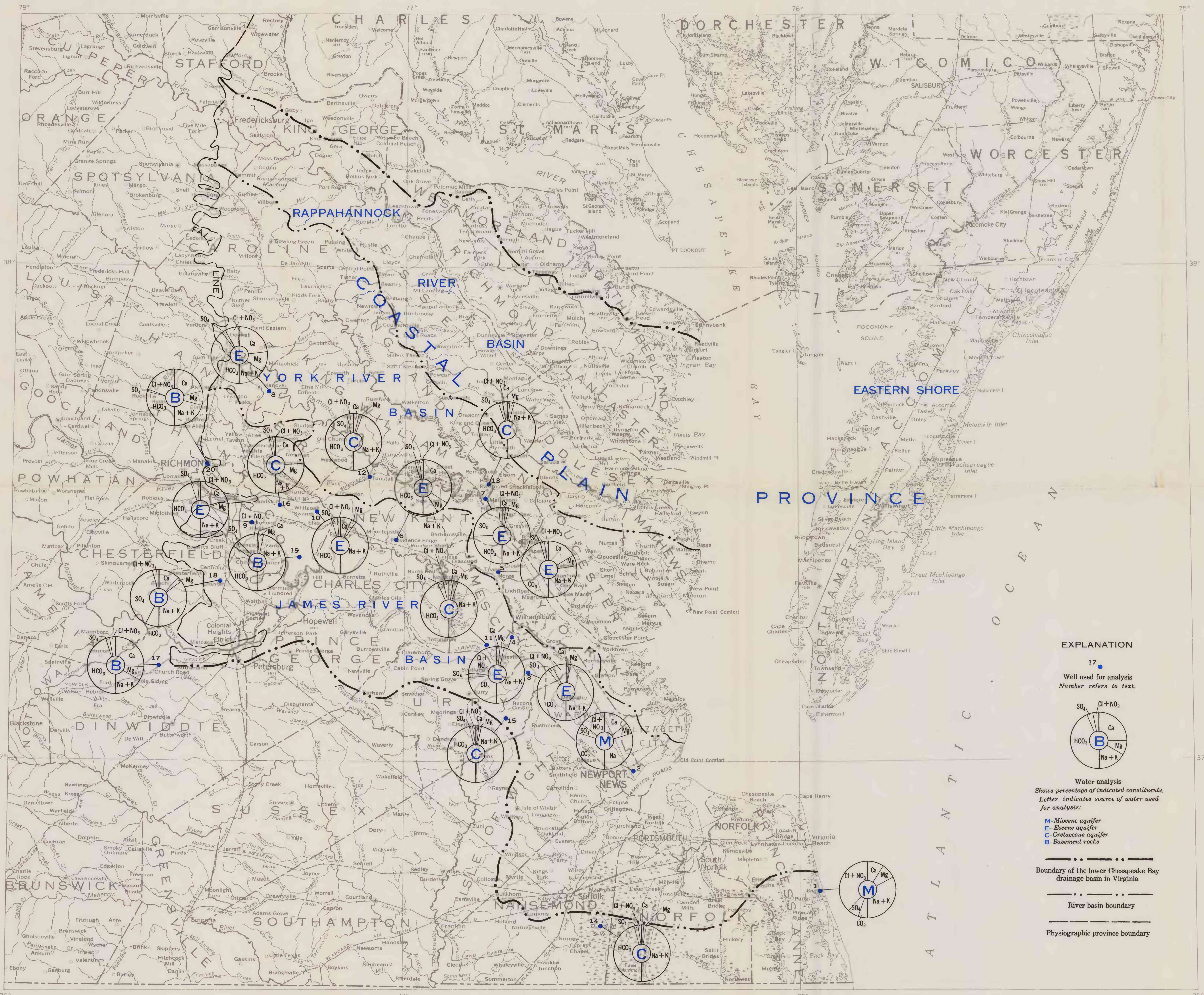
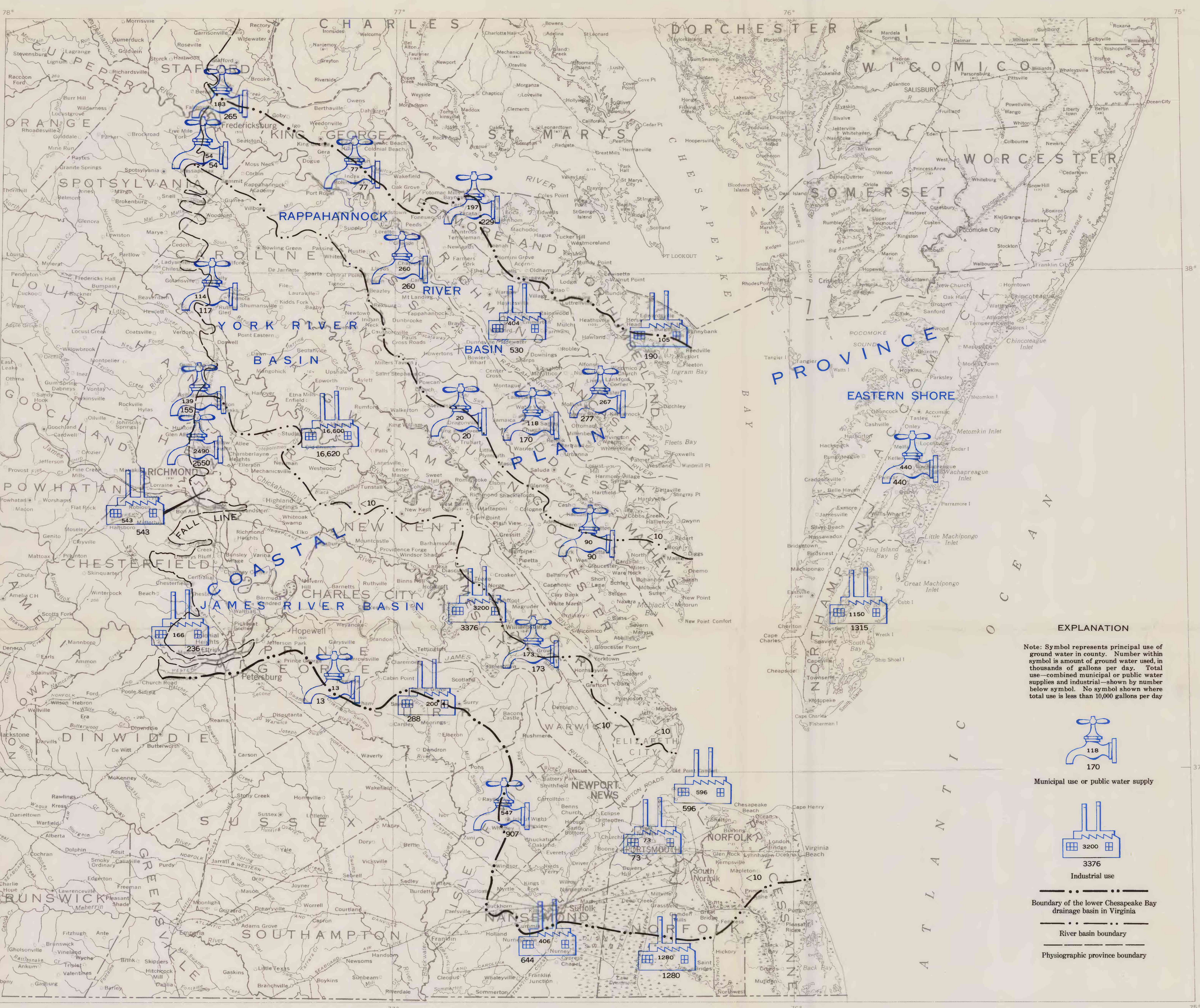


MAP SHOWING QUALITY OF GROUND WATER



MAP SHOWING GROUND-WATER USE

CHEMICAL QUALITY OF GROUND WATERS

The proportions, by chemical equivalents, of the dissolved ions in waters from selected wells which tap the major Coastal Plain aquifers of Virginia are shown by symbols on the map of the area.

The predominance of the chloride ion in wells numbered 1 and 4 is an indication of mixture with mineralized water farther down dip in the aquifer or encroachment of saline water from a nearby surface source.

Wells numbered 8, 9, and 10 all tapping the Aquia Formation show a typical change in the chemical characteristic of the formational waters down dip, changing from a calcium bicarbonate (water from well 8) to a sodium bicarbonate (water from well 10) type water. This change in the chemical characteristic of water is typical of many of the Coastal Plain aquifers. Generally, as the water changes from the calcium type to the sodium type water, the sulfate ion remains low, and in some cases, such as in the aquifers of Cretaceous age, the fluoride ion frequently increases as the water is traced down dip. The sodium bicarbonate waters appear to encourage higher fluoride concentrations.

The suitability of Coastal Plain ground waters for public water supplies is indicated in table 2. All the chemical analyses that could be identified as to aquifer origin have been used in this table. The total number of determinations for given chemical constituents varied between different analyses; many of the analyses reported are only partial analyses made for a specific purpose. The range in concentration for each constituent is given as well as the maximum acceptable concentration as specified for public water supplies in the United States Public Health Service drinking water standards.

It is noted in table1 that one or more analyses from each major aquifer indicate that the water analyzed exceeded the maximum acceptable concentration for a given constituent for public water supply use. This does not mean that the water is not amenable to treatment. In its natural state this particular chemical constituent is higher than that prescribed for drinking water by the United States Public Health Service. In many cases where the tabulation indicates that the maximum concentration of a given chemical constituent is above that prescribed by the Public Health Service only one or two of the analyses have exceeded this maximum standard; the remaining analyses are of acceptable quality

TABLE 2. —*Suitability of untreated ground water for public supply*

Number of determinations	Chemical characteristics	Range in concentrations (ppm) Min.	Avg.	Max.	Maximum acceptance concentrations U.S.P.H.S. standards (ppm)[10]
	Basement rocks				
11	Hardness	11	85	285	
8	Iron	.03	.8	[2] 5.1	0.3
11	Bicarbonate	18	145	309	
11	Sulfate	.2	66	[2] 468	250
11	Chloride	2.6	34	63	250
6	Nitrate	.1	1.14	5.4	45
8	Fluoride	.1	2.3	[2] 5.8	[9] 1.2
	Cretaceous aquifers (Patapsco and Patuxent)				
32	Hardness	4.1	55	225	
24	Iron	.02	.82	[6] 8.9	0.3
34	Bicarbonate	12	251	775	
34	Sulfate	1	12	44	250
34	Chloride	1	33	[2] 351	250
20	Nitrate	.05	.65	2.5	45
21	Fluoride	.0	2.4	[7] 6.6	[9] 1.2
	Upper Cretaceous to Paleocene				
24	Hardness	3	24.1	76	
15	Iron	.02	1.68	[4] 16	0.3
25	Bicarbonate	136	386	686	
25	Sulfate	1.6	47	[1] 265	250
25	Chloride	1	475	[8] 4,978	250
12	Nitrate	.1	4.4	82	45
18	Fluoride	.1	1.7	[8] 3.1	[9] 1.2
	Paleocene to Eocene				
9	Hardness	12	76	152	
8	Iron	.03	2.7	[4] 15	0.3
10	Bicarbonate	153	194	260	
10	Sulfate	6.7	19	75	250
10	Chloride	1	12	69	250
5	Nitrate	.3	.5	.7	45
9	Fluoride	.1	.6	[1] 1.9	[9] 1.2
	Eocene-Nanjemoy				
14	Hardness	10	51	100	
6	Iron	.06	.3	[2] .93	0.3
14	Bicarbonate	131	253	402	
14	Sulfate	5	25	247	250
14	Chloride	2	20	149	250
4	Nitrate	.2	.4	.6	45
11	Fluoride	.2	.8	[3] 2.0	[9] 1.2
	Eocene-Chickahominy				
9	Hardness	6	62	240	
4	Iron	.06	4.56	[1] 18	0.3
9	Bicarbonate	233	494	11.84	
9	Sulfate	1	56	[1] 300	250
9	Chloride	2	413	[1] 2,200	250
5	Nitrate	.39	.65	1.0	45
8	Fluoride	.9	1.6	[3] 4.6	[9] 1.2
	Miocene-Chesapeake Group				
19	Hardness	3	118	576	
11	Iron	.04	4.6	[7] 19	0.3
19	Bicarbonate	5	171	625	
19	Sulfate	1	18	105	250
19	Chloride	1	66	[1] 950	250
16	Nitrate	.1	3.5	38	45
13	Fluoride	3.2	.7	[2] 3.4	[9] 1.2

[1] One analysis exceeded acceptable concentrations.
[2] Two analyses exceeded acceptable concentrations.
[3] Three analyses exceeded acceptable concentrations.
[4] Four analyses exceeded acceptable concentrations.
[5] Five analyses exceeded acceptable concentrations.
[6] Six analyses exceeded acceptable concentrations
[7] Nine analyses exceeded acceptable concentrations.
[8] Twelve analyses exceeded acceptable concentrations.
[9] Annual mean daily maximum temperature at Williamsburg, Va. was 69.2°F for 64 years of record.
[10] Standards are for treated water–raw water can frequently be treated to comparable quality.

GROUND-WATER USE

The average daily ground-water pumpage by municipal, industrial, and domestic wells drilled in the Coastal Plain of the Eastern Shore and the James, York, and Rappahannock River basins of Virginia, is estimated to be about 31 mgd (million gallons per day). Water-use records, as compiled by State and Federal agencies, indicate that about half is pumped from wells in King William County where a paper company, The Chesapeake Corporation of Virginia, is located at the head of the York River. Eighty percent of the ground water used in this 6,600-square mile area is withdrawn by municipalities and industries located in King William, James City, Henrico, Northampton, and Norfolk Counties.

Shallow aquifers adjacent to Chesapeake Bay or along estuaries feeding the bay are subject to salt-water encroachment if they are over developed. Most of the water pumped in this area, with the exception of a few deep wells to the Lower Cretaceous aquifers in the southeastern part of the area, is potable water of from good to excellent quality.

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INTERIOR—GEOLOGICAL SURVEY, WASHINGTON, D.C.—1968—W67408

Base from U.S. Geological Survey 1:500,000, state bases: Virginia 1961; Maryland and Delaware, 1959

GROUND-WATER RESOURCES OF THE EASTERN SHORE OF VIRGINIA AND THE JAMES, YORK, AND RAPPAHANNOCK RIVER BASINS OF VIRGINIA EAST OF THE FALL LINE

By
George D. DeBuchananne

SCALE 1:500 000

10 0 10 20 30 40 50 MILES

10 0 10 20 30 40 50 KILOMETERS

1968