WATER USE

Ground water is the source of almost all freshwater for domestic use on Cape Cod. Approximately 15,000 private wells and 17 public-supply systems that pump water from more than 100 wells and one pond supply freshwater for domestic and commercial use (Ryan, 1979). The wells in each of the supply systems, their capacities, and the volume of water pumped for 1975–76 are listed in table 3. These systems supply 80 percent of the Cape's permanent population and 50 percent of the summer population (Cape Cod Planning and Economic Development Commission, 1978, p. 5-25).

The total volume pumped for public supply has increased each year (fig. 19). In 1962, 3.1 billion gallons were pumped for public supply. By 1976, the volume pumped increased to 6.2 billion gallons. Part of the increase is due to extention of water systems into areas previously served by private wells. Water use is greatest in the summer when the Cape's population triples. For example, the Dennis Water District pumped five times more water in July 1975 than in February 1975. Much of the water supplied by public systems is returned to the aquifer by domestic and municipal wastewater disposal.

Ground water also is used to irrigate cranberry bogs, golf courses, lawns, and food and fodder crops. Other large users of ground water are several military installations, fish hatcheries, and commercial and industrial establishments.

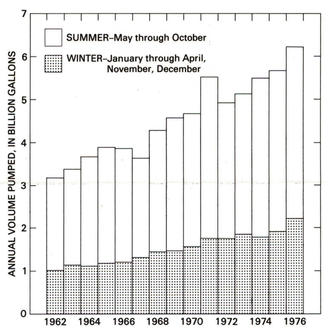

Figure 19.—Volume of water pumped by the 17 public water-supply districts, 1963–76, separated into summer and winter components.

Table 3.—*Well characteristics in late 1977 and summary of pumping during 1975–76 for public water-supply systems on Cape Cod. (Sources of data: Water-supply districts, departments, and companies. A dash indicates well not in use during 1975–76)*

Public water-supply systems	Well numbers[1] (Locations shown in figures 14, 18)	Total pumping capacity[2] (gal/min)	Volume pumped, 1975–76 (Mgal)				Volume pumped on peak day (Mgal)		Remarks
			1975		1976				
			Jan.-Apr., Nov.-Dec.	May-Oct.	Jan.-Apr., Nov.-Dec.	May-Oct.	1975	1976	
Barnstable Fire District	BF 228[a]	350	30.0	13.6	35.5	2.2	0.90	0.84	
	BF 370[a]	700	4.2	51.1	3.0	68.9			
Barnstable Water Company	BW 383[a], 387[a], 402[a], 403[a]	2,200	3.3	124.1	11.4	134.5	6.82	6.18	Use of BW 403 began in July 1975 Use of BW 402 began in June 1976
	BW 377[a], [385[a], 386[b]]	2,400	148.4	189.7	91.8	170.9			
	BW 229[c], 384[b], 376[b]	1,700	113.0	215.5	191.3	248.2			
Bourne Water District	BO [1[b], 2[b], 3[b], 136[a]]	1,000	23.9	53.1	44.9	36.3	2.03	2.02	Use of BO 233 began in May 1976
	BO 199[a], 233[a]	1,230	23.4	44.6	17.5	64.2			
	BO 137[a]	620	25.4	45.7	18.4	45.9			
Brewster Water Department	BR 37[a], 41[a]	2,050	35.0	81.7	40.7	87.6	1.00	.99	
Centerville-Osterville Fire District	CE 226[c], 227[c], 368[a]	800	—	61.8	—	50.4	4.81	4.30	Use of CE 371 and CE 372 began in April 1975
	CE 371[a], 372[a]	600	25.0	44.7	22.5	61.8			
	CE 259[a], 373[a]	775	37.9	59.3	61.2	78.2			
	CE[107[e(50)]],[158[d(43)]],249[a]	900	99.1	182.0	102.9	168.4			
Chatham Water Company	CH 1[a], 2[a], 153[a]	1,100	.4	52.6	.4	67.3	1.75	1.81	
	CH 211[f]	700	76.9	97.3	87.0	104.8			
Cotuit Fire District	CO 224[a]	300	1.0	10.9	1.4	8.5	.57	.53	Use of CO 59 ended in January 1976
	CO 251[a], 369[a]	1,025	20.3	28.3	23.1	34.0			
	CO [59[e(5)]]	—	1.2	1.9	.3	—			
Dennis Water District	D 1[d], 2[d], 3[d], 4[d], 5[d], 66[a]	1,100	18.9	67.7	2.8	102.5	5.36	6.01	Use of D 87 began in May 1976 Use of D 205 began in July 1977 D 244 planned to be operational in summer 1978 Use of D 57 and D 232 ended in fall 1975; capacity of wells not included in total
	D 67[a], 79[a], 112[a], 232[a]	1,650	68.0	134.5	135.1	130.1			
	D 56[a], 57[a], 58[a], 77[a]	2,400	71.2	218.5	45.6	211.0			
	D 85[a], 86[a], 87[a]								
	D 205[a]	600	—	—	—	—			
	D 244[a]	450	—	—	—	—			
Falmouth Water Department	F -Long Pond	10,900	337.3	614.5	354.5	651.2	7.25	6.73	Use of F 214 began in June 1977 Long Pond only public reservoir on Cape
	F 214[a]	700	—	—	—	—			
Harwich Water Department	HA [1[e(4)]], 49[a], 55[a]	3,130	90.1	186.7	95.7	189.1	3.54	3.20	
	HA 56[a], 160[a]								
	HA 161[a], 162[a], 163[a]	1,500	17.7	66.6	19.8	73.9			
Highwood Water Company	HW 32[d], 35[a]	850	13.6	34.1	14.6	30.9	.67	.50	
Orleans Water Department	OR 11[a], 14[a], 15[a]	1,390	73.8	139.2	65.6	101.0	1.68	1.76	Use of OR 42 and OR 43 began in June 1976
	OR 42[a], 43[a]	880	—	—	12.8	48.0			
Otis Air Force Base	OT 23[a]	1,350	42.2	59.9	70.6	66.2	1.33	1.59	Water-main break in 1976 caused increased pumping
	OT 155[a]	1,700	29.8	30.2	71.2	73.3			
Provincetown Water Department	P [78[d(7)]]	800	59.2	115.5	47.8	115.8	1.87	1.79	
	P [115[d(3)]]	550	51.5	93.2	79.7	103.8			
Sandwich Water District	SA [249[e(2)]]	260	1.0	11.9	6.9	9.5	.67	1.11	Use of SA 249 ended in January 1978
	SA 27[a], 37[a]	940	38.5	55.5	45.5	60.4			
South Sagamore Water District	SS [7[h(10)]], [22[h(7)], 232[g(8)]]	375	13.0	17.0	12.7	15.9	not available	not available	SS 7 used only as backup
Yarmouth Water Department	Y [103[e(4)]]	1,000	.1	20.5	78.5	111.0	6.04	6.35	
	Y 41[a], 42[a], 43[a]	870	20.6	95.5	45.7	81.0			Use of Y 126 and Y 127 began in July 1976 Y 103 pumped to waste during winter 1976 Y 193, Y 194, and Y 195 planned to be operational in June 1978 Use of Y 41 ended in late 1974 due to sodium chloride contamination
	Y 64[a], 65[a]	600	76.2	100.5	58.1	73.1			
	Y 53[a], 54[a], 144[a], 146[a]	1,300	127.1	169.5	108.3	153.8			
	Y 61[a], 63[a]	600	44.2	75.2	43.3	66.9			
	Y 58[a], 128[a]	825	13.6	84.0	27.7	79.4			
	Y 126[a], 127[a]	1,000	—	—	—	34.3			
	Y 193[a], 194[a], 195[a]	1,300	—	—	—	—			

[1]Explanation of codes on well numbers:
[a] 24-inch-diameter well, gravel-packed screen
[b] 18-inch-diameter well, gravel-packed screen
[c] 12-inch-diameter well, gravel-packed screen
[d] 8-inch-diameter well, gravel-packed screen
[e] 6-inch-diameter well, gravel-packed screen
[f] 12-inch-diameter gravel well
[g] 4-inch-diameter driven well
[h] 2½-inch-diameter driven well
[ ] Wells connected to a common suction header
( ) Number of wells in well field

[2]Total pumping capacity is defined differently by the various water-supply organizations. The three most common definitions are: (1) The maximum yield of individual wells when pumped separately, (2) the maximum yield of individual wells when pumped simultaneously with other wells in the system, or (3) the safe and practical pumping rate in the opinion of the water manager.

WATER QUALITY

Wells that yield a sufficient quantity of water for domestic use can be drilled at most locations on the Cape. However, the quality of water in some areas may be unsuitable for some uses without treatment (Frimpter and Gay, 1979). Excessive concentrations of iron, manganese, and hydrogen sulfide, and contamination by seawater, road salt, and liquid and solid waste disposal have been reported. Hydrogen sulfide and iron are present in ground water where sand dunes have covered marsh deposits, such as in much of Provincetown. The presence of undesirable concentrations of iron, as well as poorly permeable layers in the deeper parts of the aquifer in many areas, reduces the potential for development of large supplies from deep wells. Representative physical and chemical properties of the Cape's ground water are given in table 4. Nitrogen from septic systems, municipal sewage disposal, and fertilizers has caused increased levels of nitrate in ground water. Frimpter and Gay (1979, p. 9-10) show trends toward increasing nitrate concentration in some public-supply wells on Cape Cod.

Table 4.—*Physical and chemical properties of Cape Cod's ground water (Adapted from Frimpter and Gay, 1979, p. 4)*

[Data are in milligrams per liter except as indicated. A dash indicates concentration limit not established.]

Constituent or property	Concentration Limit[1]	Median	Number of analyses
Specific conductance (microsiemens per centimeter at 25°C).	—	123	202
pH (units)	—	6.1	202
Dissolved oxygen	—	7.0	48
Hardness (Ca + Mg as $CaCO_3$)	—	20	202
Calcium	—	3.6	202
Magnesium	—	2.4	202
Sodium	—	13.2	112
Potassium	—	.9	112
Iron (micrograms per liter)	300	41	75
Manganese (micrograms per liter)	50	19	83
Bicarbonate	—	11	202
Sulfate	250	6.6	202
Chloride	250	19	202
Fluoride	[2]2.2 at 57°F	.0	202
Silica	—	9.1	200
Dissolved solids (sum of constituents).	500	70	196
Nitrate (N)	10	.12	84
Ammonia (N)	—	.01	73
Phosphorus	—	.05	75
Total organic carbon	—	5.5	10

[1]Recommended limits for drinking water (U.S. Environmental Protection Agency, 1975, 1979).
[2]Annual average of maximum daily air temperature for Cape Cod, in degrees Fahrenheit.

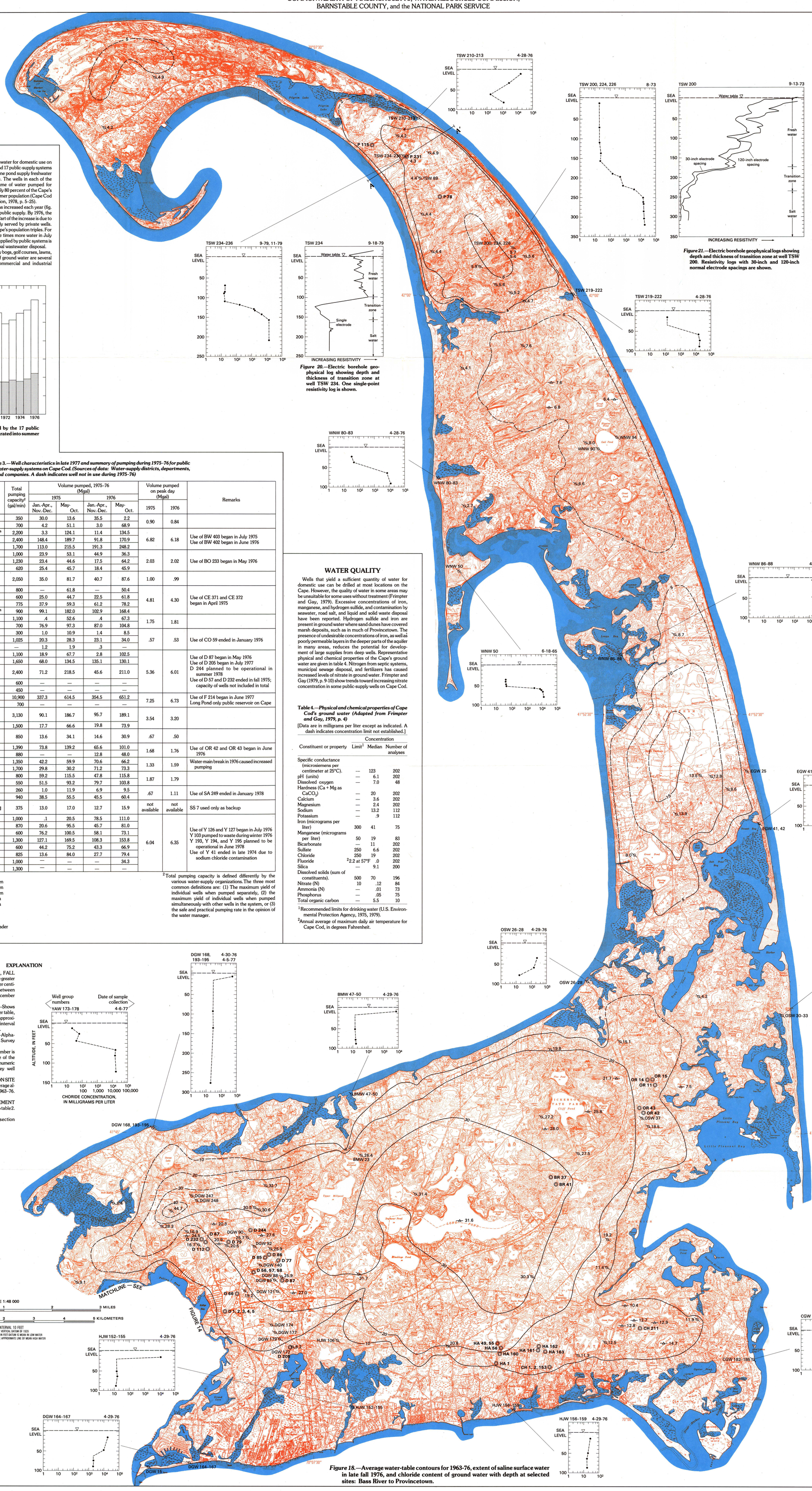

Figure 18.—Average water-table contours for 1963-76, extent of saline surface water in late fall 1976, and chloride content of ground water with depth at selected sites: Bass River to Provincetown.

Figure 20.—Electric borehole geophysical log showing depth and thickness of transition zone at well TSW 234. One single-point resistivity log is shown.

Figure 21.—Electric borehole geophysical logs showing depth and thickness of transition zone at well TSW 200. Resistivity logs with 30-inch and 120-inch normal electrode spacings are shown.

Base from U.S. Geological Survey
Topographic quadrangles

GROUND-WATER RESOURCES OF CAPE COD, MASSACHUSETTS

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1986

INTERIOR—GEOLOGICAL SURVEY, RESTON, VA.—1986—W85284