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SALT CONTAMINATION OF THE WATER SUPPLY AT AUBURN, MASSACHUSETTS

By
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ILLUSTRATIONS

TABLES

Salt contamination of the water supply at Auburn, Massachusetts

By

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Chloride concentration in water from the four gravel-packed wells that supply 750,000 gallons per day to the Auburn water system is substantially more than the natural chloride concentration of ground water--less than 5 mg/l (milligrams per liter)--in this region (Jackson, 1905). In fact, according to available records, water from well 2 (location, fig. 1) has exceeded the limit of 250 mg/l chloride suggested for public drinking-water supplies (U.S. Public Health Service, 1962) since 1966. In July 1971 the concentration reached 510 mg/l (table 1). At this time, water from well 2 provided about 15 percent of the total municipal supply.

Town health officials, who have been concerned over the increase in chloride concentration in the public water supply, are also concerned over the sodium concentration of the supply, which ranged from 72 to 105 mg/l in 1971 (table 2).

Sodium concentration in drinking water and water for cooking is a factor in formulating diets for various levels of sodium restriction. A basic restricted-sodium diet allows the ingestion of 500 mg per day sodium. A low-sodium diet allows about 225 mg per day (Davidson and others, 1954, p. 16). Ingestion of 2.5 liters of water per day containing 200 mg/l sodium would, alone, equal the maximum daily sodium intake prescribed for basic restricted-sodium diets (Davidson and others, 1954, p. 16).

Table 1.--Chloride concentration of water from municipal wells

(Analyses by Massachusetts Department of Public Health unless otherwise indicated.)

Well no.----	1	2	3	4
Date				
1955	15	15	--	--
1961	--	--	45	--
4-25-64	96	220	55	--
1-11-65	72	109	53	--
4-12-65	79	138	50	--
7-12-65	76	190	62	--
12-30-65	--	--	--	4.5-8.5
1-10-66	60	111	94	--
1-19/1-24-66	--	--	--	4.5-6.0
4-17-66	96	230	68	--
7-28-66	--	--	--	6.0
8- 8-66	--	250	--	--
10- 4-66	78	200	69	--
1-17-67	78	274	68	--
4-11-67	94	340	63	--
4-21-67	--	--	--	8.0
6-12-67	--	--	--	6.0
7-10-67	150	*	68	14
1-11-68	170	--	--	--
2- 5-68	225	--	130	75
4- 8-68	210	--	90	43
6-25-68	43	--	91	36
1-14-69	130	--	116	32
4-29-69	155	--	40	115
7-23-69	143	--	95	47
1-19-70	145	--	105	38
4-13-70	205	--	105	50
8- 4-70	220	--	185	70

*Shut down from about 5-67 to fall 1968.

Table 1.--Chloride concentration of water from municipal wells.--Continued

Well no.----	1	2	3	4
Date				
1-11-71	160	320	150	--
7- 6-71	190	468	128	54
Analyses by Massachusetts Department of Public Works				
7- 8-71	188	510	128	50
7-13-71	170	468	128	56
7-29-71	190	444	134	46

Table 2.--Sodium concentration of water from municipal wells.

Well no.----	1	2	3	4
Date				
8- 4-70	72	--	84	15
1-11-71	72	105	100	--

As a result of complaints from local officials and interested organizations, the Massachusetts Department of Public Works requested the U.S. Geological Survey to investigate the sources of chloride and sodium in water from Auburn's supply wells.

Wells 1, 2, and 3 (fig. 1) are 200 to 500 feet south of the Massachusetts Turnpike along the west side of Dark Brook, which flows northward from Eddy Pond, past the wells, and beneath the turnpike. Drainage from State Route 12 and Interstate 290 is carried by a ditch to a point on the ground near well 2. An open ditch carries drainage from the south side of the turnpike past wells 1 and 2 to Dark Brook.

Well 1, installed in 1950 or 1951, is 43 feet deep, is screened from 37 to 43 feet, and originally produced 475 gpm (gallons per minute). Well 2, installed at the same time, is 40 feet deep, is screened from 30 to 40 feet, and originally produced 200 gpm. Well 3, added in 1961, is 50 feet deep, is screened from 40 to 50 feet, and originally produced 250 gpm. Chloride concentration of water from wells 1 and 2 was 15 mg/l in 1955, but in the years after 1957, when the turnpike was opened to traffic, the concentration increased (table 1). Maximum measured chloride concentration in water from well 1 was 225 mg/l in February 1968. Since that time, the measured concentration has ranged from 43 mg/l in June 1968 to 220 mg/l in August 1970. The concentration in July 1971 ranged from 170 to 190 mg/l. Maximum measured chloride concentration in water from well 2 was 510 mg/l in July 1971.

Records of chloride concentration of water from well 2 are not available from May 1967 to September 1968, when the well was shut down, and from September 1968 to January 1971, when samples were not collected. The measured chloride concentration of water from well 3 ranged from 45 mg/l in 1961 to 185 mg/l in August 1970. The measured concentration was 128 mg/l in the early part of July 1971.

Well 4, near Dunn Brook in the northern part of town 250 feet east of Interstate 290, was installed in 1965-66; it is 40 feet deep, is screened from about 30 to 40 feet, and originally produced 300 gpm. Measured chloride concentration ranged from an initial value of less than 10 mg/l to 115 mg/l in 1969, the year after Interstate 290 was opened to traffic. Since that time, chloride concentration has ranged from 38 to 70 mg/l. The range in July 1971 was from 46 to 50 mg/l.

Random samples taken in July 1971 (fig. 1) indicate that much of the surface water in Auburn is high in chloride, and in places the chloride concentration exceeds the recommended limits of the U.S. Public Health Service (1962) for drinking water.

Measured chloride concentration of water was greatest in well 1 in 1968, well 2 in 1971, well 3 in 1970, and well 4 in 1969. Without a continuous record of chloride concentration of water from each of the four wells, the intermittent measurements presented in table 1 do not necessarily indicate the full range of concentration. Weather conditions--snow and rain in winter, and spring thaw--that govern application and removal of salt, and the pumping schedules of the wells, have much to do with chloride concentration during any one sampling period. In general, however, the chloride concentration of water from each well has risen significantly over the years.

The high chloride content of water from the wells is probably largely caused by downward percolation of melting water containing salt from sodium chloride and calcium chloride applied to the turnpike, Interstate Route 290, State Routes 12 and 20, and local streets, and by infiltration of salt water that drains from the roads to the brooks that flow past the wells.

High chloride concentration may also be caused by sewage and effluent from dumps and industrial plants. The town is unsewered, and all waste is disposed of through cesspools, septic tanks, and leaching fields. In some areas ground water and surface water contaminated by these wastes may have a chloride content of as much as 50 mg/l. However, the fact that initial chloride concentration of water from wells 1, 2, and 4 was within the range of uncontaminated ground water suggests that when these wells were installed wastes had not contaminated the aquifer near them. Pumping of well 3, whose water had an initial chloride concentration of 45 mg/l in 1961, may have induced infiltration from Dark Brook, which receives many of these wastes.

Exact figures for the amount of deicing chemicals applied to the turnpike in this area are not available from the Turnpike Authority, but estimates can be made by using Massachusetts Department of Public Works figures adjusted for differences between quantities applied by State highway departments and toll authorities (Hanes and others, 1970). The following estimates are given for the 3.5 lane miles of turnpike draining to Dark Brook near, but downstream from, wells 1-3 and the 12.8 lane miles upstream from well 4.

Year	Salt applied to turnpike in drainage area above wells 1 and 3, in tons	Salt applied to turnpike in drainage area above well 4, in tons
1967-68	80	292
1968-69	111	405
1969-70	161	587
1970-71	222	814

Salt applied by the Massachusetts Department of Public Works to Routes 12 and 20 and Interstate 290 in the drainage area of Dark Brook above wells 1, 2, and 3 and in the drainage area of Dunn Brook above well 4 is as follows (data supplied by William Foley, Snow and Ice Control Engineers, District 3, Massachusetts Department of Public Works):

Year	Salt applied to State and Federal highways in drainage area above wells 1 and 3, in tons	Salt applied to State and Federal highways in drainage area above well 4, in tons
1967-68	115	176 (1-290 not open to traffic)
1968-69	274	557
1969-70	268	510
1970-71	310	647

Salt applied to these roads can not only enter the ground and brooks near wells 1-3, but can drain to the vicinity of the wells by ditches.

Local streets are salted by the town highway department, and the amount of salt applied, based on data supplied by R. E. Witcher, Superintendent, is as follows:

Year	Salt applied to streets in drainage area above wells 1, 2, and 3, in tons	Salt applied to streets in drainage area above well 4, in tons
1967-68	65	183
1968-69	38	107
1969-70	37	104
1970-71	60	170

Salt-storage areas in the drainage basin next to Eddy Pond, at the head of Dark Brook (Massachusetts Department of Public Works), and near Auburn Pond (Auburn Highway Department) in the area draining to well 4, also contribute to salt contamination. Samples collected in 1971 from Eddy Pond and from Auburn Pond near the storage sites had chloride concentrations of 92 and 26 mg/l, respectively.

Detailed studies of geology and ground water at and near the highways, wells, and stream would be required to show the pattern of salt transport to the wells.

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