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GROUND-WATER AVAILABILITY

Most sand and gravel aquifers that yield large amounts of water to municipal wells have been identified and developed by the towns. These aquifers yield at least 300 gal/min of water to municipal wells. However, there are several undeveloped aquifers which have similiar potential yields located in the towns of Brimfield and Holland. Also, ground water is available in aquifers which have estimated yields to wells of less than 100 gal/min; for example, the aquifers in the valleys of the major tributary streams, such as Cady, Hammett, Hachet and Hollow Brooks.

The potential yields of the sand and gravel aquifers in the study area are shown in figure 12. The map delineates four zones of different transmissivities that were determined using the methods of Walton (1962) and Rosenshein and others (1968) and data from over 500 wells and borings in the basin.

Figure 13 shows how transmissivity was calculated from lithologic log data. Each layer of sediment indicated on a lithologic log was assigned a hydraulic conductivity based on its average grain-size and sorting characteristics. A coarse-grained sediment has a higher hydraulic conductivity than a fine-grained one, and a sediment that is well sorted has a higher hydraulic conductivity than a poorly sorted one with the same average grain size. The transmissivity of a layer is the product of the hydraulic conductivity of the sediment and the saturated thickness. The total transmissivity is the sum of the transmissivities for each layer described in the lithologic log.

Transmissivity of unconsolidated sediments in the French-Quinebaug Rivers basin ranges from less than 1 ft^2/d to approximately 4,000 ft^2/d. The lowest transmissivities are characteristic of fine-grained lacustrine sediments of silt and clay, and poorly sorted deposits, such as till. The highest transmissivities are characteristic of thick deposits of coarse-grained glacial outwash, such as those in the Quinebaug River valley. Although lacustrine sediments may be thick, they do not yield water readily and thus are not important sources of ground water. Till is capable of supplying wells with up to 10 gal/min. However, till does not yield water readily because of its low hydraulic conductivity, and deposits generally are relatively thin, making it an adequate, but limited source of ground water for domestic wells and an inadequate source of water for municipal wells. Outwash deposits yield large amounts of water to wells and thus are the most productive aquifers in the basin. Where of sufficient thickness, they can supply adequate amounts of water for both domestic and municipal wells.

Throughout the study area, bedrock is commonly used as a source of water for domestic wells. Yields of bedrock wells in the French-Quinebaug Rivers basin range from 0.5 gal/min to 210 gal/min, with the average yield being 10 gal/min. The highest-yielding wells, with yields greater than 100 gal/min are located in the town of Leicester, and are some of the very few municipal bedrock wells in Massachusetts. Yields of bedrock wells are highly variable from place to place and are dependent on two factors: The number and size of the fractures the wells intersect, and the degree of interconnection between the fractures. Therefore, there commonly seems to be no relation between the depth of a bedrock well and the amount of water it yields.

A. Values of hydraulic conductivity of saturated stratified materials used to estimate transmissivity in The French-Quinebaug Rivers basin

Material	Hydraulic conductivity[1] (K), in feet per day
Gravel	
Coarse	300-700
Medium	200-300
Fine	180-200
Fine to coarse	150-400
Sand and gravel	200
Coarse	90-150
Medium	70-80
Fine	20-30
Fine to coarse	40-150
Fine to medium	40-100
Silt and clay	less than 10

B. EXAMPLE: Estimating transmissivity from lithologic data

Depth (Log Oxford Well 14)	Material	Saturated thickness (feet)		Hydraulic conductivity (feet per day)		Transmissivity (feet squared per day)
0–6	Sand and gravel					
6–21 (10)	Water table Fine sand	11	X	30	=	330
21–36	Fine sand, some clay	15	X	10	=	150
36–40	Fine sand, some gravel	4	X	30	=	120
40–47	Sand and gravel	7	X	200	=	1,400
47–47.5	Clay	0.5	X	10	=	5
47.5–53	Sand and gravel	5.5	X	200	=	1,100
53–56	Medium sand	3	X	80	=	240
56–59	Coarse sand and gravel	3	X	200	=	600
59–63	Sand and gravel	4	X	200	=	800
		Total Transmissivity				4,745

[1]When range is shown, higher values were used when lithologic log indicated that the material was clean and well graded or that it yielded water readily when pumped (from Brackley and Hansen, 1977).

FIGURE 13.—**Transmissivity estimated from lithologic logs of wells and test borings.**

EXPLANATION

AREAS OF AVAILABLE GROUND WATER AND ESTIMATED YIELD TO PROPERLY DESIGNED AND CONSTRUCTED WELLS

- Generally greater than 300 gallons per minute from an aquifer having an estimated transmissivity greater than 4,011 feet squared per day
- Generally between 100 and 300 gallons per minute from an aquifer having an estimated transmissivity between 1,337 and 4,011 feet squared per day
- Generally between 10 and 100 gallons per minute from an aquifer having an estimated transmissivity between 134 and 1,337 feet squared per day
- Generally less than 10 gallons per minute from till or bedrock having an estimated transmissivity between 0.1 and 134 feet squared per day
- Municipal well or well field finished in unconsolidated deposits
- Municipal well or well field finished in bedrock
- Well or boring finished in unconsolidated deposits
- Well or boring finished in bedrock
- Well or boring that reached bedrock or refusal
- Basin boundary

Base from U.S. Geological Survey Paxton, 1965, Monson, Southbridge, Wales, 1967
East Brookfield, Leicester, Oxford, Warren, Webster, 1969, Worcester South, 1973

FIGURE 12.—**Ground-water availability.**

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