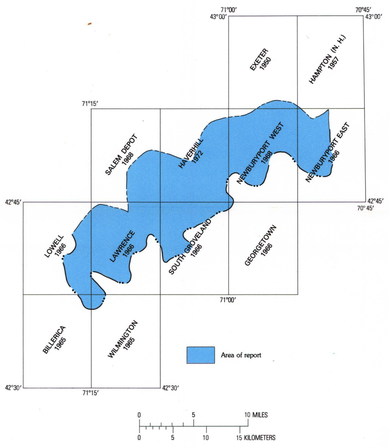
GROUND WATER
AVAILABILITY

TRANSMISSIVITY OF STRATIFIED GLACIAL DEPOSITS OF THE LOWER MERRIMACK RIVER BASIN.—Continental glaciers, during the Pleistocene Epoch, scoured bedrock surfaces and deposited a discontinuous mantle of till, an unconsolidated and unstratified mixture of clay, silt, sand, gravel, cobbles, and boulders. During melting of glacial ice, soil and rock fragments from within the glacier were transported, sorted, and deposited by meltwater as stratified sand and gravel in stream channels and as silt and clay in ponds and lakes. The unconsolidated glaciofluvial deposits of sand and gravel constitute the principal aquifers in the basin.

Transmissivities of deposits shown on the map are based on analyses of lithologic logs and specific-capacity of wells. Transmissivity estimates were made from lithologic logs of more than 500 wells and borings in stratified glacial deposits. Average hydraulic conductivity values were assigned to materials (based partly on data from Thomas and others, 1967, and J. R. Williams, written commun., 1974) and were multiplied by their saturated thickness to derive transmissivity. Transmissivity values were calculated from specific-capacity data for 13 well tests by methods devised by Walton, 1962; Meyer, 1963; Narasimhan, 1967. Where possible, the calculated transmissivity values were used to refine those estimated from lithologic logs.

Transmissivity of unconsolidated deposits ranges from less than 10 ft²/d for till and marine silt and clay to more than 10,000 ft²/d for sand and gravel. Aquifers that sustain well yields that exceed 300 gal/min (transmissivity greater than 4,000 ft²/d) lie primarily along the Merrimack River and its major tributaries; highest transmissivity values are in northwestern Amesbury. Most aquifers having transmissivity exceeding 4,000 ft²/d have been located during test drilling and have been developed for municipal and light industrial use. It is unlikely that many additional wells that could yield more than 300 gal/min can be developed in the basin. Restricted aquifers that are less than 50 feet thick and can sustain wells yielding less than 100 gal/min occur in many stream valleys and swampy areas throughout the basin.

Water from bedrock of igneous and metamorphic origin is generally available in quantity and quality suitable for single family domestic supplies. Water in bedrock occurs in secondary pore spaces, such as joints and fractures, which are commonly narrow and represent only a small percentage of total aquifer volume. Consequently, bedrock-aquifer transmissivity varies greatly with location, and overall storage capacity is generally low. Nearly all wells constructed in bedrock intercept some water-bearing fractures; however, bedrock well yields range from a fraction of a gallon per minute, in places where the fractures are small and poorly interconnected, to more than 100 gal/min, where they are numerous and well interconnected, as in some fault zones. The median yield of 41 bedrock wells is 10 gal/min.



INDEX TO TOPOGRAPHIC MAPS

Topographic base maps from U.S. Geological Survey 1:24,000 series are named on the index map; date is most recent topographic survey.

SCALE 1:48 000

1 ½ 0 1 2 3 MILES

1 5 0 1 2 3 4 5 KILOMETERS

CONTOUR INTERVAL 10 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929
DEPTH CURVES IN FEET—DATUM IS MEAN LOW WATER
SHORELINE SHOWN REPRESENTS THE APPROXIMATE LINE OF MEAN HIGH WATER
THE MEAN RANGE OF TIDE IS APPROXIMATELY 9.3 FEET

Base from U.S. Geological Survey, 1966

EXPLANATION

TRANSMISSIVITY OF AQUIFER MATERIALS

Transmissivity is the rate at which water of prevailing kinematic viscosity is transmitted through a unit width of aquifer under a unit hydraulic gradient, expressed in feet squared per day (Lohman and others, 1972). Potential well yields are based on available drawdown and transmissivity estimates and are for properly designed and constructed individual wells at sites that have been located after exploratory drilling. Yield can be higher than estimated for wells near surface-water sources that have good hydraulic connection with the aquifer.

Areas of stratified glacial deposits

- Transmissivity greater than 4,000 ft²/d (potential well yield greater than 300 gal/min)
- Transmissivity 1,400 to 4,000 ft²/d (potential well yield 100 to 300 gal/min)
- Transmissivity less than 1,400 ft²/d (potential well yield less than 100 gal/min)

Areas of till and bedrock outcrops

- Till is a poorly sorted glacial material of characteristically low transmissivity. Wells in till generally yield only a few gallons per minute but can be suitable sources of domestic supply. These wells, generally 2 to 4 feet in diameter and less than 25 feet deep, are susceptible to contamination if improperly constructed or located close to surface or near-surface contamination sources. Some minor stratified glacial deposits are included in these areas because they have little or no saturated thickness and have potential well yields similar to till or bedrock. Distribution of surficial deposits and bedrock is modified from that shown on geologic maps referenced on this sheet and from surficial geologic map of Lowell quadrangle, Massachusetts-New Hampshire (R. H. Jahns, written commun., 1960), surficial geologic map of parts of Billerica quadrangle, Massachusetts (R. H. Jahns and others, written commun., 1960), and surficial geologic maps of parts of South Groveland quadrangle, Massachusetts, Haverhill, Newburyport East, and Newburyport West quadrangles, Massachusetts-New Hampshire, and Exeter and Salem Depot quadrangles, New Hampshire-Massachusetts (E. A. Sammel and J. E. Cotton, written commun., 1964).

BEDROCK

Bedrock underlies the entire study area. Wells in bedrock yield up to 110 gal/min but generally yield about 10 gal/min. Bedrock wells are deeper, have more available drawdown, and are generally less susceptible to contamination than wells in till.

PUMPING CENTERS IN STRATIFIED DRIFT

Number, if present, is reported pumping capacity,in million gallons per day

- 1.23 ○ Municipal or institutional well or well field
- 0.45 ○ Industrial well or well field

WELLS OR BORINGS USED TO DETERMINE TRANSMISSIVITY

Indicates the extent of municipal and other testing and distribution of data used to estimate transmissivity.

- ○ Well or boring finished in unconsolidated deposits
- ● Well or boring finished in bedrock
- Basin boundary

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HYDROLOGY AND WATER RESOURCES OF THE LOWER MERRIMACK RIVER BASIN, MASSACHUSETTS, FROM CONCORD RIVER, LOWELL, TO PLUM ISLAND, NEWBURYPORT

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