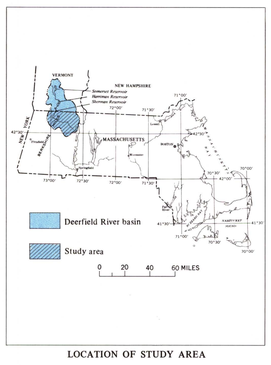
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

Prepared in cooperation with the
COMMONWEALTH OF MASSACHUSETTS
WATER RESOURCES COMMISSION

HYDROLOGIC INVESTIGATIONS
ATLAS HA-506 (SHEET 1 OF 2)

INTRODUCTION



LOCATION OF STUDY AREA

PURPOSE AND SCOPE

The purpose of this atlas is to provide information on the quantity, quality, and availability of water to aid in planning, developing, and managing water resources within the Massachusetts part of the Deerfield River basin. The investigation was made as part of a statewide program of river basin studies.

LOCATION AND PHYSICAL DESCRIPTION

From its headwaters in south-central Vermont, the Deerfield River flows southward into Massachusetts, where it joins the Connecticut River at Greenfield. It drains 664 square miles, 348 square miles in Massachusetts. Drainage is in well-defined channels. The natural flow regimen of the Deerfield River has been altered by the operation of Somerset and Harriman Reservoirs in Vermont and by the operation of associated downstream hydroelectric generating stations.

In Massachusetts, the river flows through the Berkshire Hills in a narrow valley bordered by steep slopes, rising to more than 1,000 feet above the river; near the Connecticut River the terrain is a flat lacustrine plain bordered by gently rolling hills. Altitudes range from 2,841 feet to 120 feet, with a mean altitude of 1,557 feet. Lakes and ponds are relatively few, only 16 being considered great ponds (more than 10 acres). Most were created or enlarged by earthen dams. Water covers only 1 percent of the land surface area, whereas forests cover 84 percent, 12 percent is open country, and 3 percent is urban.

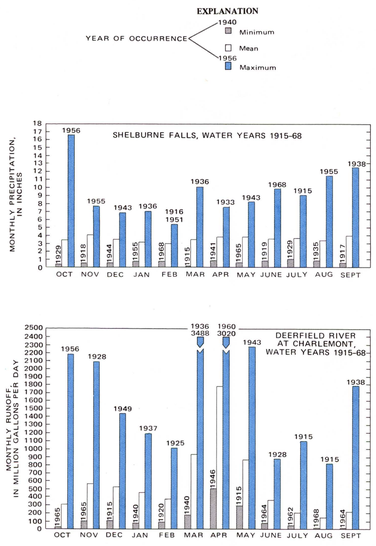
The main ground-water reservoirs are in alluvial material adjacent to streams and in the Connecticut Valley lowlands near Greenfield and Deerfield. Bedrock is exposed at higher elevations or is covered with varying thicknesses of till.

The study area includes a major part of Franklin County and lesser parts of Berkshire and Hampshire Counties. In 1970, the population was approximately 30,000, with over half concentrated in Greenfield (18,084). Smaller towns of more than 1,000 population are Deerfield (3,762, of which approximately 1,400 live inside the study area), Buckland (1,874), Shelburne (1,819), and Colrain (1,390), and Ashfield (1,264).

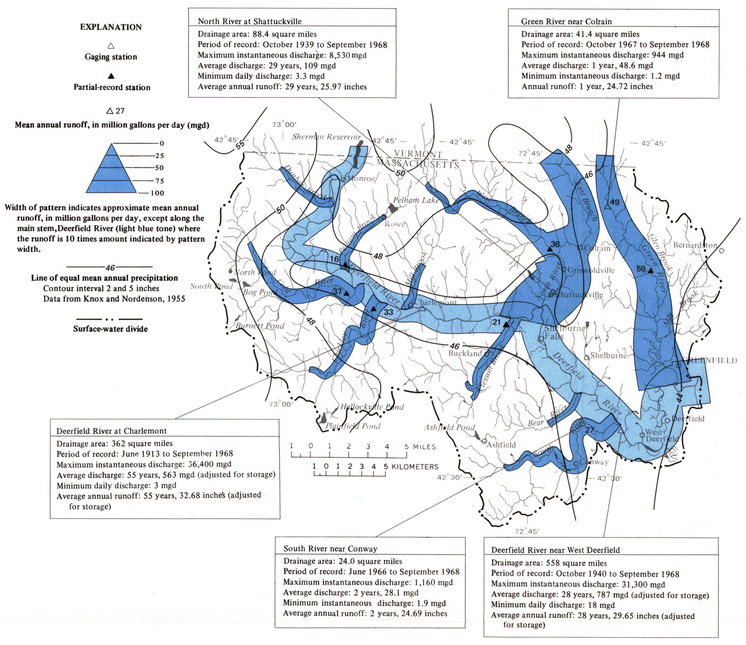
ACKNOWLEDGMENTS

The assistance and information in the form of well logs, water-level data, chemical data, and water-use data supplied by the Massachusetts Department of Public Works, town officials, local well drillers, and individuals is gratefully acknowledged. Other agencies and organizations supplying information are the New England Power Company, the Massachusetts Department of Public Health, the U.S. Soil Conservation Service, and the U.S. Department of Commerce, Bureau of the Census.

PRECIPITATION AND RUNOFF

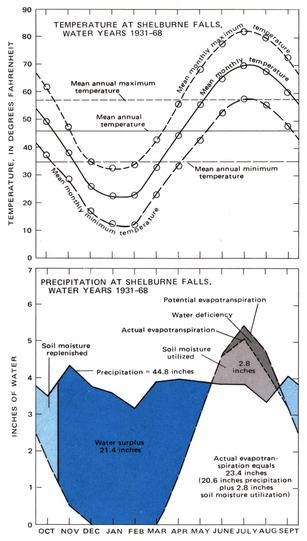


SNOWMELT IN SPRING AND EVAPOTRANSPIRATION IN SUMMER AND FALL CAUSE ANNUAL CYCLICAL TRENDS IN MEAN MONTHLY RUNOFF, EVEN THOUGH MEAN MONTHLY PRECIPITATION IS FAIRLY EVENLY DISTRIBUTED THROUGHOUT THE YEAR.—Annual snowfall ranges from a little over 80 inches in hilly northwestern sections to about 55 inches in the lowlands near Greenfield. About 70 percent of the precipitation occurs as rain from mid-April to mid-November and the remaining 30 percent as snow from mid-November to mid-April.



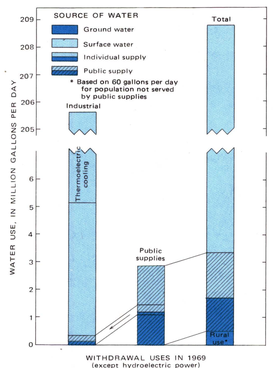
A MEAN ANNUAL RUNOFF OF 420 MILLION GALLONS PER DAY (1.21 MILLION GALLONS PER DAY PER SQUARE MILE) FROM MASSACHUSETTS IS AUGMENTED BY 470 MILLION GALLONS PER DAY (1.49 MILLION GALLONS PER DAY PER SQUARE MILE) FLOWING INTO THE STUDY AREA FROM VERMONT.—Mean annual flows at ungaged sites in New England greater than 10 square miles are computed from Johnson's (1970) equation.

EVAPOTRANSPIRATION

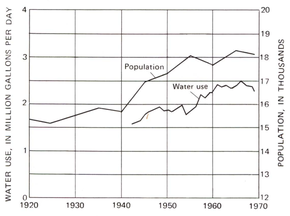


TEMPERATURE AND SUNLIGHT CONTROL THE POTENTIAL EVAPOTRANSPIRATION RATES.—The evapotranspiration cycle at Shelburne Falls is applicable to the valley areas; in the higher terrain, where temperatures are lower and precipitation higher than those shown here (see precipitation map), water deficiencies will be lower than indicated or may be zero.

WATER USE



EIGHT PUBLIC WATER SYSTEMS SERVE 72 PERCENT OF THE POPULATION BUT SUPPLY ONLY 1.4 PERCENT OF THE TOTAL WATER USED IN THE STUDY AREA.—Water for public use is drawn about equally from surface-water and ground-water sources. Ashfield, Deerfield, and Greenfield use both surface water and ground water. Colrain and Shelburne Falls use surface water and have ground water as a standby supply. Monroe relies on surface water, and Bernardston and Griswoldville rely solely on ground water. The 0.2 mgd (million gallons per day) of ground water withdrawn for use in Bernardston is exported outside the basin. The small areal extent of unconsolidated aquifers capable of supplying several hundred gallons per minute per well limits expansion of some public water supplies except by surface-water impoundments.



LONG-TERM INCREASES IN WATER USE FOR GREENFIELD CORRESPOND TO INCREASES IN POPULATION.—In 1969, Greenfield obtained 59 percent of its water from surface-water and 41 percent from ground-water sources. Of the total, domestic use was 85 percent and industrial use was 15 percent.

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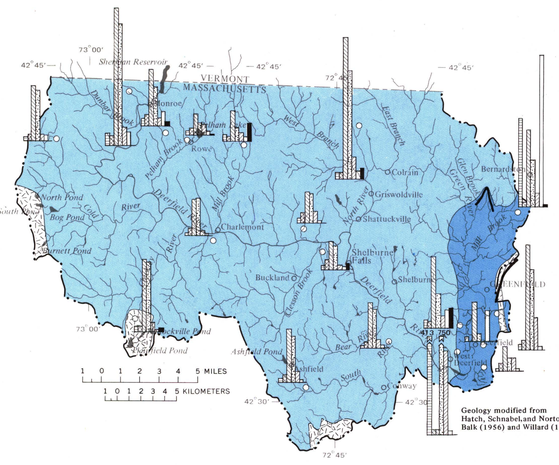
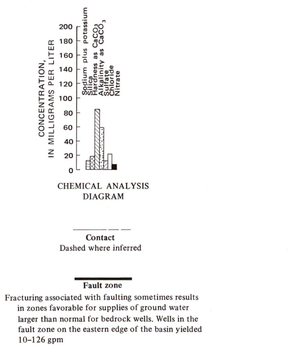
GROUND WATER AVAILABILITY AND QUALITY

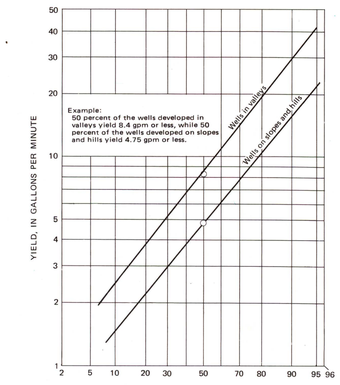
CONSOLIDATED AQUIFERS



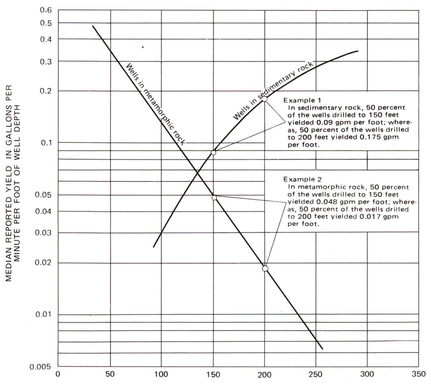
Geology modified from Hatch, Schnabel, and Norton (1968), Balk (1956) and Willard (1952)

BEDROCK UNDERLYING THE DEERFIELD RIVER BASIN YIELDS WATER OF VARIABLE QUALITY IN SMALL TO MODERATE QUANTITIES TO WELLS.



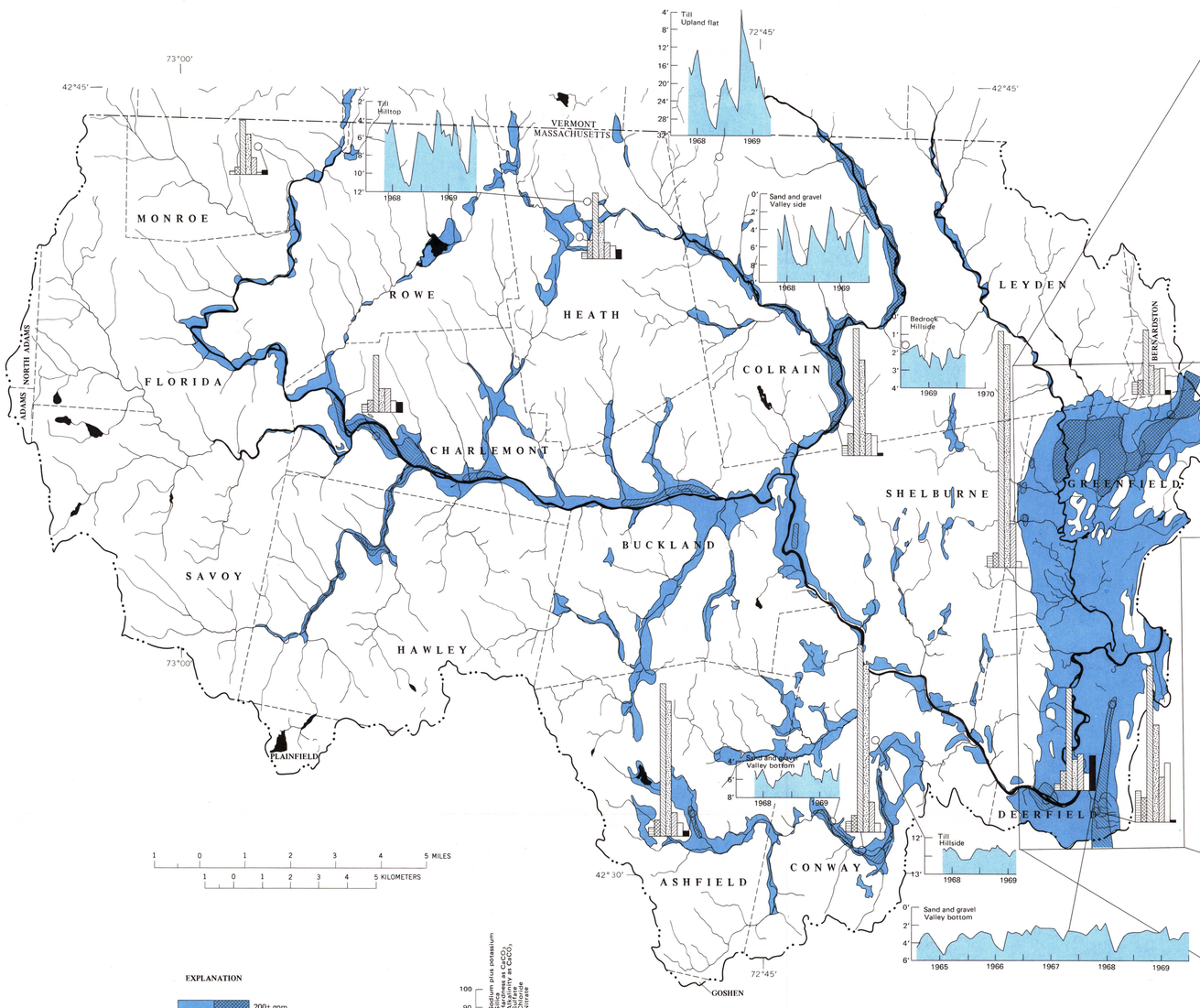


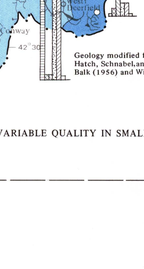
REPORTED PUMPING RATE OF LOCAL WELLS SHOWS THERE IS A BETTER CHANCE OF OBTAINING HIGHER CAPACITY WELLS IN VALLEYS THAN ON SLOPES AND HILLS.

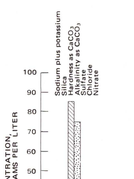


REPORTED YIELD OF WELLS DEVELOPED IN CONSOLIDATED ROCK VARY WITH ROCK TYPE AND DEPTH.—Wells in metamorphic and crystalline rock receive water from fractures, which are commonly smaller and less numerous at depth. Wells in sedimentary rock receive water from pore spaces and fractures. Larger yield with depth can be a result of coarser texture and larger pore space at depth (Willard, 1952).

UNCONSOLIDATED AQUIFERS





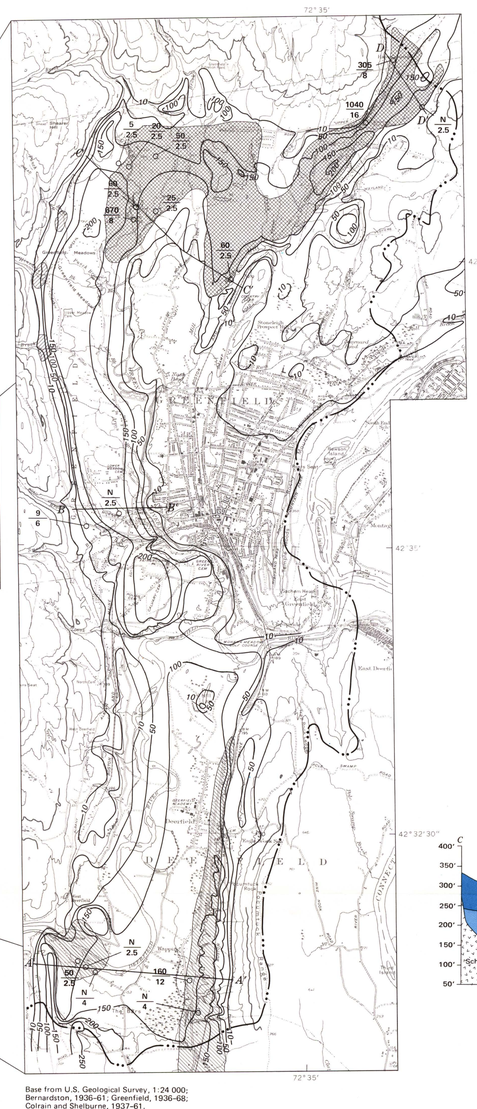


YIELDS OF MORE THAN 1 MILLION GALLONS PER DAY HAVE BEEN OBTAINED FROM WELLS IN COARSE SAND AND GRAVEL.—The lowland area of Greenfield and Deerfield is underlain by thick deposits of unconsolidated material, mostly fine sand, silt, and clay, which yield little water to wells. Large quantities of water may be obtained where sand and gravel occur with sufficient saturated thickness and areal extent.

Elsewhere, large withdrawals of ground water from favorable areas adjacent to the river and its tributaries will probably result in much water being derived from induced stream infiltration.

Fluctuations of the water-table provide an index to seasonal and long-term changes in storage. Storage that was depleted during a period of below-average precipitation in the middle 1960's has recovered.

Dissolved solids in water from unconsolidated materials range from about 50 to 200 mg/l (milligrams per liter). A dissolved-solids content greater than 100mg/l is associated with undesirably high concentrations of hardness and alkalinity. Locally, the concentration of iron and manganese in ground water may also be undesirably high.



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HYDROLOGY AND WATER RESOURCES OF THE DEERFIELD RIVER BASIN, MASSACHUSETTS

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