PREPARED IN COOPERATION WITH
THE COMMONWEALTH OF MASSACHUSETTS
WATER RESOURCES COMMISSION
AND BERKSHIRE COUNTY

SURFACE WATER

STREAMFLOW CHARACTERISTICS

STREAMFLOW

Investigation of streamflow in the basin consisted of collecting and analyzing data from three stream-gaging stations (see map), and from 47 low-flow partial-record sites. A fourth stream-gaging station, on the North Branch Hoosic River at North Adams, 17 miles north of the Coltsville station was used as the index station for correlation purposes because the Coltsville station and the Great Barrington station on the Housatonic River are regulated by mills upstream.

For purposes of comparison and correlation, 30 years of record, ending in 1961, was used as the standard or base period. Records for this period at North Adams were used to extend the records of the Green River gaging station near Great Barrington and the 47 low-flow sites to the base period.

The amount of water that becomes streamflow depends upon where, when, and how the precipitation falls. Most of the precipitation in the winter months accumulates upon the land surface as snow. In the early spring air temperatures rise and the snow cover melts. After the ground becomes saturated, the snowmelt, together with the spring rain, runs off and increases streamflow. Streamflow decreases through the spring as longer days and higher air temperatures increase evaporation. Generally the amount of precipitation is about the same in the spring and summer, but as the growing season progresses, the plants transpire more and more water. This transpiration process combined with the higher temperatures and evaporation rates of the summer season produce the lowest streamflow in the late summer and early fall. During periods of no precipitation most of the flow in the streams is ground-water effluent.

RUNOFF

An average of about 24 inches of surface-water runoff, an estimated 219 billion gallons of water, flows out of the basin each year. This amounts to about 52 percent of the average annual precipitation. Annual runoff, in inches, represents the depth to which the basin would be covered if all the streamflow in one year uniformly covered the basin. The pattern of average annual runoff is shown on the map.

The mean annual flow, in cfs per sq mi (cubic feet per second per square mile) and in mgd per sq mi (million gallons per day per square mile), for each low-flow partial-record site is listed in table 1. The site locations are shown on the map. The overall mean flow in the basin is 1.72 cfs per sq mi or 1.11 mgd per sq mi.

FLOW DURATION

The flow-duration curve provides a convenient means for studying the flow characteristics of streams and for comparing one basin with another, and is used for investigating problems dealing with water supply, power developments, and dilution and disposal of sewage or industrial wastes. Flow-duration curves for the four gaging stations are shown in figure 2.

TABLE 1.— *Mean flow at low-flow partial-record sites*

Subbasin number	Low-flow partial-record site	Drainage area (sq mi)	Mean flow: cfs sq mi	Mean flow: mgd sq mi
22	East Branch Housatonic River near Dalton	27.0	[1]	
56	Town Brook at Lanesborough	11.5	1.72	1.11
58	Secum Brook near Lanesborough	5.72	1.74	1.12
52	Daniels Brook at Pittsfield	2.66	1.81	1.17
53	Churchill Brook at Pittsfield	1.16	1.86	1.21
54	Parker Brook at Pittsfield	3.24	1.85	1.19
26	Mt. Lebanon Brook near Lebanon Mountain Rd., at Shaker Village	.56	1.74	1.12
27	North Branch Mt. Lebanon Brook at Shaker Village	.48	1.75	1.12
28	Mt. Lebanon Brook at Berkshire Downs, Shaker Village	1.25	1.75	1.14
24	Smith Brook near Brickhouse Mountain Rd., at Pittsfield	1.05	1.78	1.14
25	Smith Brook at West St. at Pittsfield	2.48	1.81	1.17
50	Southwest Branch Housatonic River at Pittsfield	20.3	1.80	1.16
49	Sykes Brook at Pittsfield	.80	1.81	1.18
47	Yokun Brook near Lenox	5.92	1.79	1.16
17	Basin Pond Brook near East Lee	3.15	1.95	1.26
16	Greenwater Brook at East Lee	7.65	1.97	1.28
6	Hop Brook near Tyringham	4.03	1.86	1.20
7	Hop Brook tributary near Tyringham	.76	1.84	1.18
8	Hop Brook at Tyringham	14.0	1.90	1.23
46	Hop Brook near South Lee	22.1	1.92	1.24
60	West Brook near South Lee	4.12	1.80	1.17
13	Muddy Brook near Great Barrington	2.58	1.65	1.07
12	Stony Brook near Great Barrington	2.11	1.71	1.10
14	Konkapot River near Great Barrington	6.39	1.69	1.09
31	Baldwin Brook near State Line	2.27	1.56	1.01
32	Baldwin Brook at West Center Rd., near State Line	2.63	1.56	1.01
29	Cone Brook at Sleepy Hollow Rd., near Richmond	3.96	1.68	1.09
30	Cone Brook near Swamp Rd., near Richmond	5.83	1.69	1.09
44	Williams River near Great Barrington	42.6	1.59	1.03
33	Green River above Austerlitz, N.Y.	3.22	1.55	1.00
34	Green River below Austerlitz, N.Y.	8.60	1.54	.99
35	Green River at Green River, N.Y.	11.7	1.54	.99
36	Scribner Brook near Alford	1.96	1.56	1.01
40	Sages Ravine Brook near Taconic, Conn.	3.41	1.53	.99
37	Karner Brook near Mt. Washington Rd., near South Egremont	1.78	1.51	.98
38	Karner Brook at Jug End Rd., near South Egremont	2.26	[2]	
39	Fenton Brook near South Egremont	2.96	1.54	1.00
43	Schenob Brook at Sheffield	50.0	[2]	
11	Ironworks Brook near Sheffield	8.30	1.61	1.04
9	Soda Creek at Fink Rd., near Sheffield	1.59	1.59	1.03
10	Soda Creek at County Rd., near Sheffield	2.59	[2]	
59	Housatonic River at Ashley Falls	471.	[3]	
4	Rawson Brook near Wallace Hill Rd., near Monterey	2.37	1.83	1.19
5	Rawson Brook near Monterey	8.25	1.81	1.17
61	Konkapot River at Hartsville	22.6	1.72	1.11
1	Umpachene Brook at Southfield	8.56	1.82	1.18
42	Konkapot River at Ashley Falls	61.0	1.75	1.13

[1] Regulated flow
[2] Diversions for municipal water supply
[3] Evapotranspiration exceeded runoff
cfs sq mi—cubic feet per second per square mile
mgd sq mi—million gallons per day per square mile

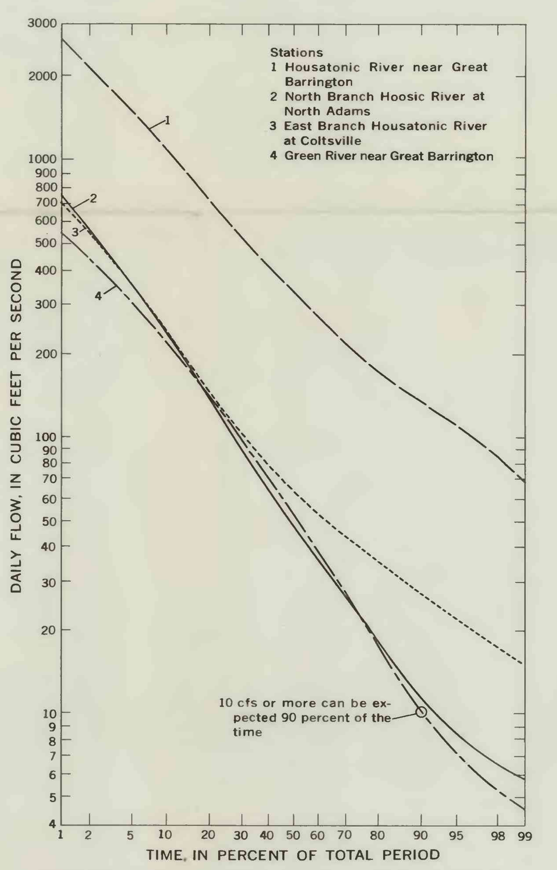


FIGURE 2.— *Flow duration curves for base period 1932-61 for gaging stations*

The duration curve, as compiled, shows the long period distribution of flow without regard to the chronological sequence of flow. The curve obscures the effects of years of high or low flow as well as seasonal variations within the year.

VARIABILITY OF STREAMFLOW

Streamflow is variable from time to time and place to place. In a drainage basin, the topography, geology, and size are constant factors; and the variation in flow is generally dependent upon precipitation, vegetation, and temperature. Figure 1 shows the month to month variations in streamflow at the Housatonic River gaging station near Great Barrington and is typical of all the streams in the basin.

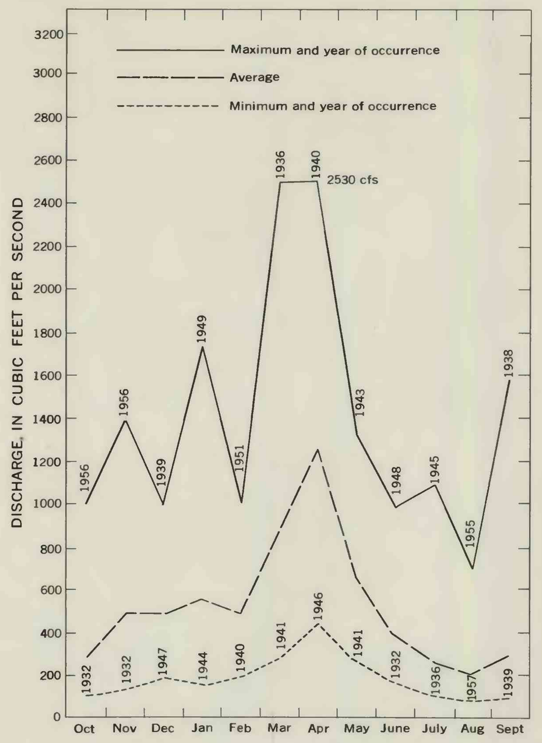


FIGURE 1.— *Graph showing variation in mean monthly discharge of Housatonic River near Great Barrington for water years 1932-61*

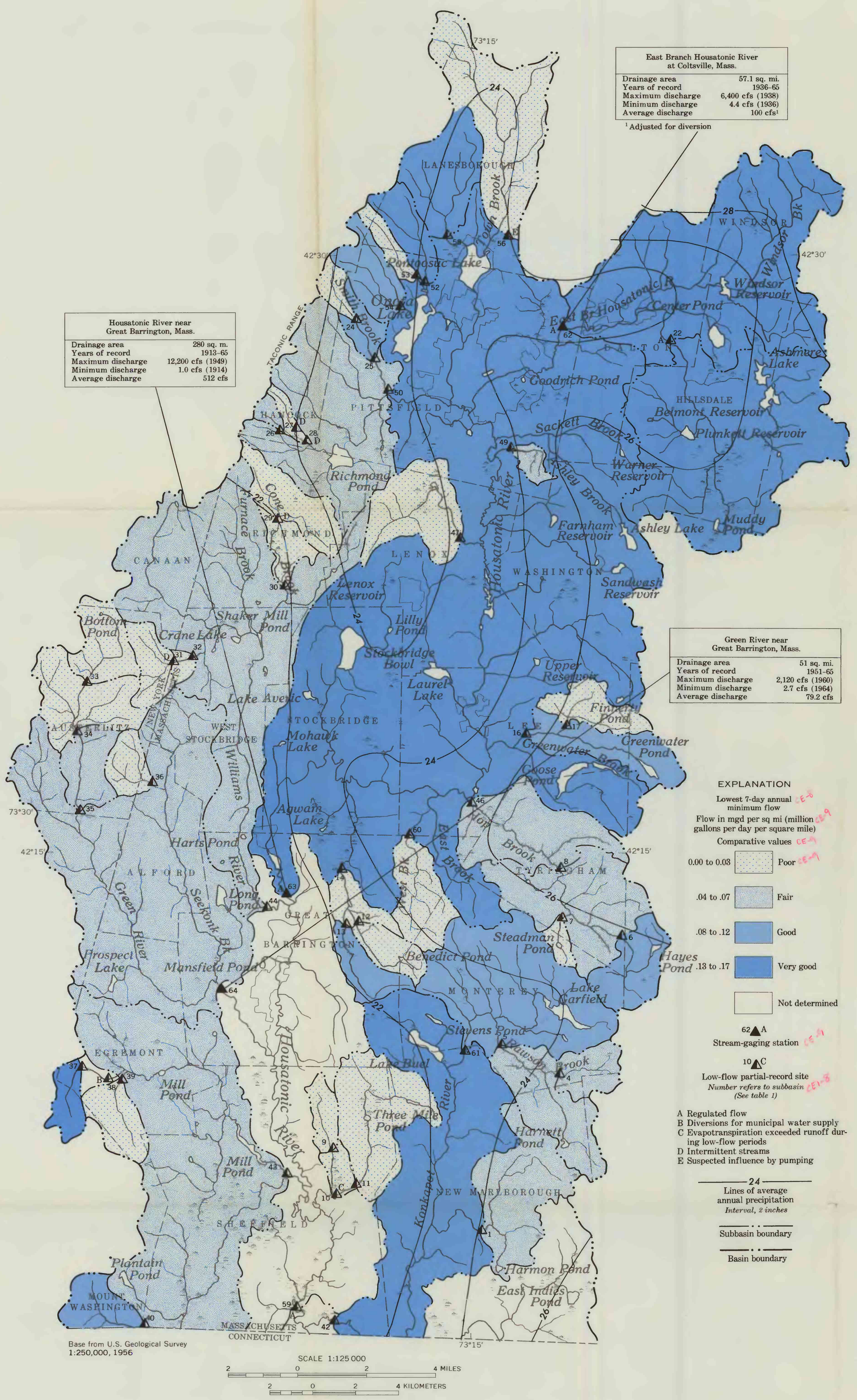
LOW STREAMFLOW

Low-flow frequency curves show the magnitude and frequency of minimum flows. They differ from flow duration curves in that they give information on the chronological sequence of flows.

Frequency curves of lowest annual mean discharges for nine selected consecutive periods for each gaging station are shown on figure 3. The 7-day period used in the studies minimizes the effect of diurnal fluctuation and changes in storage. As the time periods increase, the average flow for the minimum period also increases.

Low-flow frequency curves, which represent the potential capability of various streams, are useful to municipal water planners in the search for water supplies. The 7- and 14-day curves represent the flow available with a small amount of storage, such as provided by a dam in the main channel of a stream. Curves for periods of 30 days and longer represent the flow that would be available if larger storage facilities were provided. The curves define the chance of occurrence of a flow less than that required to hold the biochemical oxygen demand of a stream below a minimum level, in studies for disposal of industrial wastes and municipal sewage into streams. In programs for attracting industry, the curves show how much water is available for projected needs.

In planning the use of water today the probable minimum 7-day flow of a river or stream is important to know. This flow usually occurs in late summer or early fall when all the streamflow is ground water effluent. The utilization of the streams in the basin depends largely on the amount of flow during this minimum 7-day period.



MAP SHOWING AVERAGE ANNUAL RUNOFF, LOCATIONS AND DRAINAGE AREAS OF STREAM-GAGING STATIONS, LOW-FLOW PARTIAL-RECORD STATIONS, AND ESTIMATED LOWEST ANNUAL MINIMUM 7-DAY FLOWS

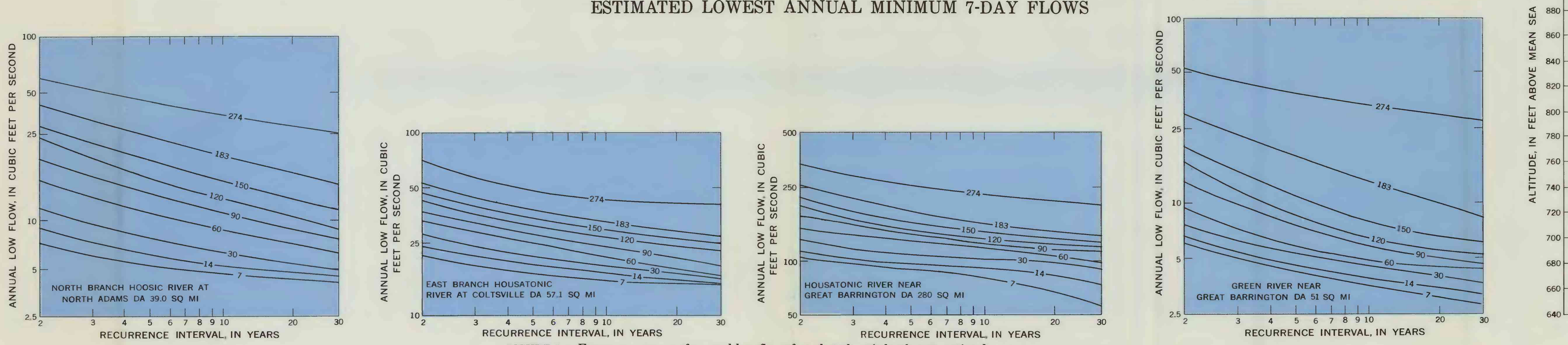


FIGURE 3.— *Frequency curves of annual low flows for selected periods of consecutive days*

GEOLOGY AND LOW FLOW

The low-flow measurements for this report were made after six or more consecutive days of no precipitation. At this time streamflow is essentially ground-water runoff (effluent). The geology of a basin has a profound effect on low flow in streams; and, thus, at first glance, low-flow measurements may be considered as indicators of potential aquifer (ground-water reservoir) yields. However, in the glaciated valleys of the basin, the surface sediments (valley fill) adjacent to the stream channels may largely control the low flow in the streams. Fine grained lake sediments at the surface will result in low ground-water runoff, and coarse sand and gravel sediments will result in high ground-water runoff. In the practical search for ground-water supplies, however, the surficial lake sediments may be underlain at depth by sand and gravel deposits which are good water suppliers; whereas, the surficial sand and gravel sediments may be thin, of little extent, and may constitute a small water supply. Also, the hydraulic properties of the surficial deposits may completely obscure the water-yielding potential of the underlying bedrock. In valleys where bedrock is near or at the surface and surficial deposits are thin or absent, such as in the upper parts of some tributary stream channels, all low flow may be coming out of the rock. However, because of the hydraulic inhomogeneity of the bedrock, most of the flow may be emitted through a few open fractures that intercept the stream channel.

Data available for this work were not sufficient to make a quantitative evaluation of the relationship between low flows and aquifer yields. Some factors, other than geology, affecting low flows are soil moisture conditions, stream bank storage, hydraulic gradient of the water table, periodicity of precipitation, seasonal variations and trends in precipitation, evapotranspiration rates, hydraulic properties of the aquifers (as inferred above), and relative storage of water in the ground.

Despite not making a quantitative evaluation between low flows and aquifer yields, a qualitative evaluation can be made. To accomplish this the basin was divided into 47 subbasins with each low-flow partial-record site as the outlet for each individual subbasin, as shown on the map. The estimated lowest 7-day annual minimum flow for each subbasin was categorized into comparative values on the map, thus inferring the relative worth of each subbasin for ground-water yield. By considering the geologic environment and by logically accounting for all other low-flow control factors, the map may be a useful aid for ground-water exploration.

Generally the individual comparative values shown on the map reasonably reflect geohydrologic conditions in the respective subbasins. However, there are some exceptions. For example, geohydrologic data available for Town Brook subbasin (no. 56) indicate an area of good ground-water yield; however, the comparative value shows it to be poor. Knowing this subbasin to be comparatively good for aquifer yields, it is reasoned that streamflow here is affected by pumping in the municipal well belonging to the town of Lanesborough. That is, the effects of pumping (about 0.3 mgd) induce water from Town Brook into the adjacent well; thereby reducing streamflow. Secum Brook (no. 58), 1½ miles to the west, has similar geologic characteristics and is shown to have a very good comparison value.

The unpredictability of bedrock hydrology is demonstrated in Karner Brook (no. 37) and Sages Ravine Brook (no. 40) subbasins. Both subbasins are underlain by schist with little or no surficial cover. Schist is generally a poor water-yielding rock; however, the comparative value for Karner Brook subbasin is very good, whereas, the value for Sages Ravine Brook subbasin is good. Most of the other subbasins underlain by schist are rated poor to fair. Locally, the schist in the Karner basin probably is jointed or fractured, facilitating ground-water runoff, and the schist in the Sages Ravine basin probably is jointed or fractured to a somewhat lesser degree.

The comparative values for two subbasins (nos. 24 and 25) along Smith Brook conform with the geohydrologic environment. The upper subbasin (no. 24) is underlain by schist with little or no surficial cover and the comparative value is poor. The lower subbasin (no. 25) is underlain largely with limestone, generally the best of the water-yielding rocks; and the stream channel fill is sand and gravel. The comparative flow for this subbasin, along the same brook, is good. Another conformance with the geohydrologic environment is shown in Basin Pond Brook subbasin (no. 17) and in Greenwater Brook subbasin (no. 16). Basin Pond Brook subbasin is underlain by gneiss, a poor water-yielding rock, with little or no surficial cover, and the comparative value is poor. The adjacent Greenwater Brook subbasin is underlain with limestone and the valley fill is sand and gravel; the comparative value is good.

Where applicable, the low-flow evaluations on the map were used as indicators in selecting favorable areas for ground-water exploration as shown in a later section.

FLOODS

With few exceptions, floods generally have caused little damage in the upper part of the Housatonic River basin. The most severe floods in recent times were those of November 1927, March 1936, September 1938, January 1949, and August 1955. The greatest flood on record was the 1949 "New Year's Flood." Although the flood of August 1955 was outstanding in the lower Housatonic Basin in Connecticut, the upper reaches in Massachusetts only had moderately high flows. A typical flood profile is shown in figure 4.

From M. A. Benson's (1962) study of floods in New England, figures of discharge were used to plot flood-frequency curves. The curves are shown in figure 5. A knowledge of the magnitude and frequency of floods that may be expected to occur is essential for the design of bridges, culverts, or other structures that may be affected by floods, and for floodplain development.

STORAGE NEEDED TO AUGMENT LOW FLOWS

Storage-required frequency curves are used to show the frequency with which storage equal to or greater than selected amounts would be required to maintain selected rates of regulated flow.

Water users frequently require streamflow data for ungaged sites. To estimate the amount of storage needed at places where no gaging-station records are available requires that an estimate be made of the median 7-day annual low flow. To help meet this need in the basin, storage-required frequency data have been estimated at 27 of the low-flow partial-record sites. These data are summarized in table 2.

Regional draft-storage curves based on storage-required frequency data from the four gaging stations, are shown in figure 6.

Through use of these curves the amount of storage required to provide selected rates of allowable draft (outflow rate) can be estimated from the median 7-day annual low flow and the size of the drainage area (table 2).

For example, in table 2, low-flow site no. 25, Smith Brook at West Street in Pittsfield, has an estimated median 7-day annual low flow of 0.115 mgd per sq mi. Using the curves in figure 6, a storage of 6.9 mgd per sq mi would be required at the 20-year recurrence interval to give an allowable draft or outflow rate of 0.2 mgd per sq mi.

The method used for obtaining storage requirements neglects losses due to evaporation and seepage from the reservoir. These losses depend on the characteristics at each specific reservoir site and they must be determined for each individual problem. Also, the method of estimating storage requirements from low-flow frequency curves gives amounts of storage that are about 10 percent less than those given by mass curves. Therefore, the storage-required figures would have to be increased by about 10 percent before being used in a final design.

Storage-draft relations can be used by water managers who are concerned with seeking new or additional sources of surface-water supply for municipal and industrial use, or who are appraising the potential water supply for regional growth and development.

The availability of streamflow for water supply and waste dilution, without low-flow augmentation or storage, is often a problem in summer and fall, especially in years of drought. Knowledge of low streamflow and its frequency of occurrence is a necessity in the economic design of sewage disposal systems to insure that our streams can dispose of sewage plant effluent without creating offensive conditions.

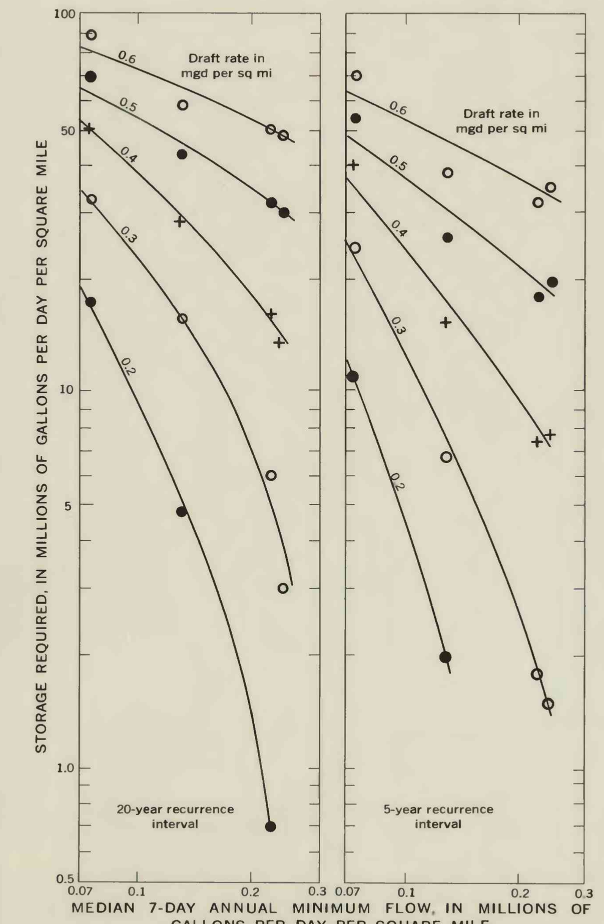


FIGURE 6.— *Regional draft-storage curves for 5-year and 20-year recurrence interval*

TABLE 2.— *Storage-required frequency at selected low-flow partial-record sites as estimated from the regional draft-storage curves (storage is uncorrected for reservoir seepage and evaporation)*

Basin no.	Low-flow partial-record site (downstream order)	Drainage area (sq mi)	Estimated median 7-day annual minimum flow (mgd/sq mi)	Recurrence interval (yrs)	Storage required (million gallons per sq mi for indicated draft rate, in million gallons per day per sq mi): 0.2	0.3	0.4	0.5	0.6
58	Secum Brook near Lanesborough, Mass.	5.72	0.168	5	—	4.3	12.5	25.5	41.0
				20	2.7	10.5	22.5	39.5	59.0
52	Daniels Brook at Pittsfield, Mass.	2.66	.219	5	—	2.1	8.6	20.5	35.5
				20	.9	5.8	16.0	32.5	51.0
53	Churchill Brook at Pittsfield, Mass.	1.16	.095	5	5.5	14.5	26.5	39.0	55.0
				20	10.5	24.5	40.0	55.0	73.0
54	Parker Brook at Pittsfield, Mass.	3.24	.124	5	2.3	8.5	18.5	32.0	48.0
				20	5.7	17.0	30.5	47.0	66.0
26	Mt. Lebanon Brook near Lebanon Mountain Rd., at Shaker Village, Mass.	.56	.093	5	6.0	15.5	27.0	40.0	56.0
				20	11.0	25.0	40.5	55.5	73.5
24	Smith Brook near Brickhouse Mountain Rd., at Pittsfield, Mass.	1.05	.092	5	6.2	15.5	27.5	40.0	56.0
				20	11.0	25.0	41.0	56.0	74.0
25	Smith Brook at West St., at Pittsfield, Mass.	2.48	.115	5	3.0	9.9	20.5	34.0	50.0
				20	6.9	19.0	33.0	49.5	68.0
50	Southwest Branch Housatonic River at Pittsfield, Mass.	20.3	.074	5	11.5	24.0	36.0	47.0	63.0
				20	17.0	32.0	49.5	62.0	79.0
49	Sykes Brook at Pittsfield, Mass.	.80	.081	5	8.5	20.0	32.0	44.0	60.0
				20	14.0	29.0	46.0	59.5	77.0
16	Greenwater Brook at East Lee, Mass.	7.65	.142	5	—	6.3	15.5	28.5	45.0
				20	4.2	14.0	26.5	43.5	62.5
6	Hop Brook near Tyringham, Mass.	4.03	.122	5	2.4	8.8	19.0	32.5	51.0
				20	6.0	17.5	31.5	48.0	67.0
8	Hop Brook at Tyringham, Mass.	14.0	.079	5	9.5	21.0	33.0	45.0	60.5
				20	15.0	30.0	47.0	60.0	77.0
46	Hop Brook near South Lee, Mass.	22.1	.076	5	10.5	22.5	34.5	46.5	62.5
				20	16.0	31.0	48.5	61.0	78.0
13	Muddy Brook near Great Barrington, Mass.	2.58	.155	5	—	5.2	14.0	27.0	43.0
				20	3.3	12.0	24.5	41.0	60.0
12	Stony Brook near Great Barrington, Mass.	2.11	.073	5	12.0	24.5	36.5	47.5	63.5
				20	17.5	32.5	50.0	62.5	79.5
32	Baldwin Brook at West Center Rd., near State Line, Mass.	2.63	.098	5	5.1	14.0	25.5	38.5	54.5
				20	9.7	23.5	38.5	54.0	72.0
44	Williams River near Great Barrington, Mass.	42.6	.098	5	5.1	14.0	25.5	38.5	54.5
				20	9.7	23.5	38.5	54.0	72.0
34	Green River below Austerlitz, N.Y.	8.60	.078	5	9.8	21.5	33.5	45.5	61.0
				20	15.5	30.5	47.5	60.5	77.5
35	Green River at Green River, N.Y.	11.7	.099	5	5.0	13.5	25.0	38.0	54.0
				20	9.5	23.0	38.0	53.5	72.0
36	Scribner Brook near Alford, Mass.	1.96	.079	5	9.5	21.0	33.0	45.0	60.5
				20	15.0	30.0	47.0	60.0	77.5
40	Sages Ravine Brook near Taconic, Conn.	3.41	.136	5	—	6.9	16.5	30.0	46.0
				20	4.7	15.0	28.0	45.0	64.0
37	Karner Brook near Mt. Washington Rd., near South Egremont, Mass.	1.78	.160	5	—	4.8	13.5	26.5	42.0
				20	3.1	11.5	23.5	40.5	59.5
39	Fenton Brook near South Egremont, Mass.	2.96	.081	5	8.8	20.0	32.0	44.0	60.0
				20	14.0	29.0	46.0	59.5	77.0
4	Rawson Brook near Wallace Hill Rd., near Monterey, Mass.	2.37	.076	5	10.5	22.5	34.5	46.5	62.0
				20	16.0	31.0	48.5	61.0	78.0
5	Rawson Brook near Monterey, Mass.	8.25	.082	5	8.5	19.5	31.5	43.5	59.5
				20	14.0	28.5	45.5	59.0	76.5
61	Konkapot River at Hartsville, Mass.	22.6	.169	5	—	4.2	12.5	25.0	41.0
				20	2.6	10.5	22.5	39.0	58.0
42	Konkapot River at Ashley Falls, Mass.	61.0	.184	5	—	3.4	11.0	23.5	39.0
				20	2.0	8.6	20.0	37.0	55.5

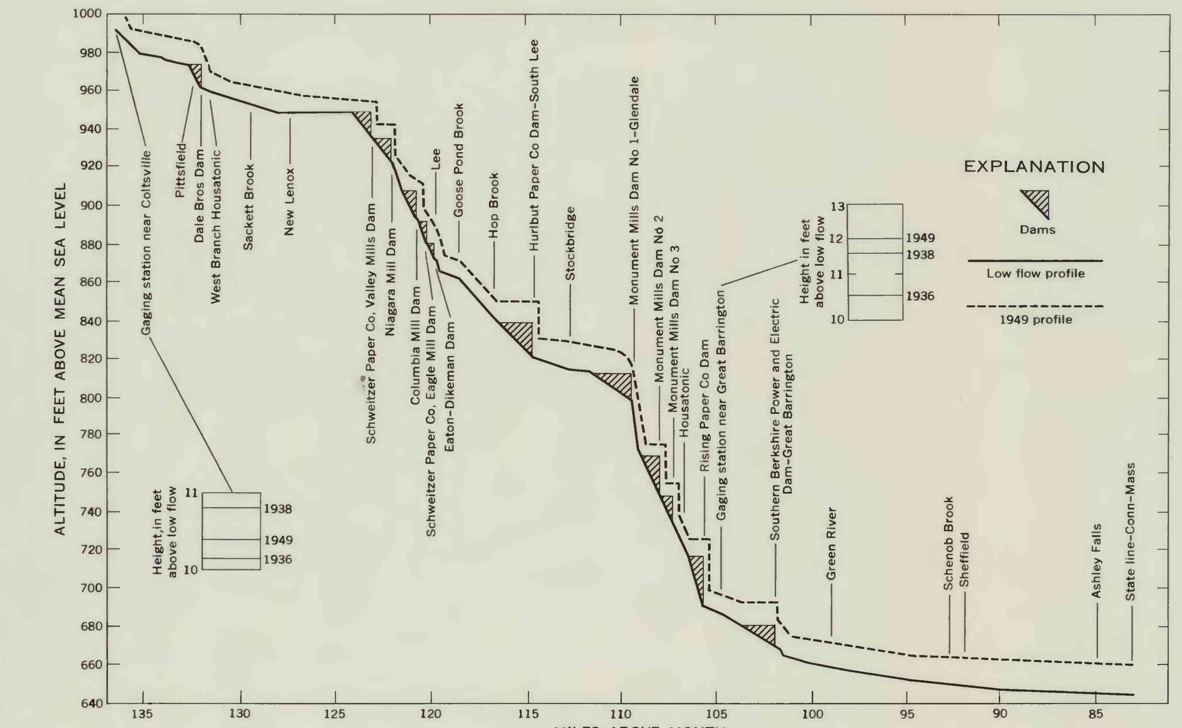


FIGURE 4.— *Flood profile showing high-water elevations for the January 1949 flood on the Housatonic River*

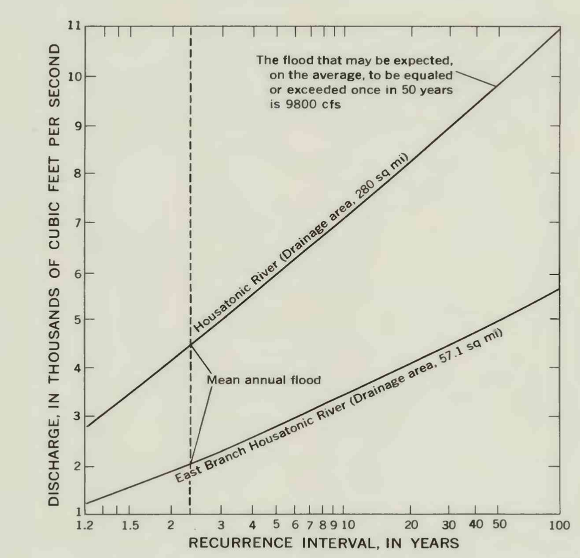


FIGURE 5.— *Graph showing magnitude and frequency of floods on East Branch Housatonic River at Coltsville and Housatonic River near Great Barrington*

INTERIOR—GEOLOGICAL SURVEY, WASHINGTON, D.C.—1968

HYDROLOGY AND WATER RESOURCES OF THE HOUSATONIC RIVER BASIN, MASSACHUSETTS

By
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