

## SOME ORIGINAL DATA ON WATERFLOW AND FORESTS

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SOME time ago, I came into the possession of some data that I hoped would add perhaps to our knowledge of the effect of forests on waterflow, from the statistical standpoint. Data of this description are so scarce in this country that I considered that any which promised results should be worked up, no matter how incomplete it might be.

The city of Fall River takes its water from a large pond, some three miles in length and a mile wide, called North Watuppa Pond. Owing to certain legal restrictions, which it is not necessary here to describe, they are obliged to let a certain percentage of the waterflow through a weir into South Watuppa Pond, a body of water which is used by the mill interests of the city as a reservoir. In 1899 the Water Board of the City commenced an extensive investigation, the purpose of which was to determine the total amount of water which each year is delivered to the mills, the amount used by the city through its mains, the amount lost by evaporation, the amount supplied to the pond through direct precipitation, and the amount supplied to the pond by the streams emptying into it. This investigation covered three years and the results were very interesting. They published the data and conclusions in 1902 as a *Report of the Reservoir Commission*, by Arthur T. Safford, consulting engineer. To obtain part of their necessary data they built weirs at the mouths of the various brooks entering Watuppa Pond, and at these weirs took daily measurements of the waterflow for three years, 1899, 1900, 1901. It is these weir measurements that furnish the waterflow data.

In the spring of 1908, the Massachusetts State Forester's office made a forest working plan for the 5,000 acres of land included in the watershed of North Watuppa Pond, and as a necessary part of the working plan we made a forest map of the watershed. From this forest map we derive the necessary data for the forest

area and types of forest land on the eight brook watersheds. Although six years elapsed between the collection of the two classes of data, due allowance has been made on the forest areas for woodland cut in the intervening time.

In the large table the daily waterflow for three years has been combined and averaged for each month. Then each of these figures has been reduced or measured by a factor which would make the watershed of each brook equal to one square mile. In the second column we have expressed in percentage the departure of the monthly flow from the average flow of the twelve months. The departures from the mean give a better means of comparison than the figures of actual flow. We include also a table of rainfall for the same three years.

#### DESCRIPTION OF WATERSHEDS

##### *South Nat Brook*

Watershed, 105 acres.                      Woodland, 25%.

Although only one-quarter of the watershed of this brook is forested it is in this section that it has its source. The forest is of large hardwoods growing on a moist and almost swampy flat. The entire watershed is very level and the brook flows for about four-fifths of its course through level meadows and mowings before emptying into the pond. The soil is deep and loamy.

##### *Terry Brook*

Watershed, 140 acres.                      Woodland, 65%.

This brook flows through a level watershed its course being bordered on both sides by maple swamp. Of the forest land about one-third is maple swamp. The soil is shallow and rocky and many out-cropping ledges testify to the nearness of the underlying rock.

##### *Queen Gutter Brook*

Area, 402 acres.                              Woodland, 95%.

This watershed is long and narrow and has a well defined slope. The soil is gravelly and deep. The bed of the brook is swampy and wooded with red maple. The greater part of the wooded land, however, consists of sprout oak and some pine.

*North Nat Brook*

Watershed, 135 acres.      Woodland, 18%.

This brook has its source on a small shallow pond and flows for its entire course through open meadow land. The forest land of sprout oak is in a far corner of the watershed where it can have but little influence on the flow of the brook. The topography is flat and the soil deep.

*Run Brook*

Watershed, 125 acres.      Forest area, 100%.

This watershed has a well defined slope and a rocky gravelly soil. The forest is sprout hardwoods much of which has been cut off. The course of the brook is short and it takes its rise in out-cropping springs situated not far above the weir.

*Ralph Brook*

Watershed, 215 acres.      Forest area, 40%.

The watershed of this brook is generally flat with a deep loamy soil. The brook has most of its course through open land. It has one source in a maple swamp and another in a small pond hole in the midst of some large hardwoods. The conditions of the watershed resemble greatly those of South Nat Brook, but the flow is much more regular.

*Blossom Brook*

Watershed, 1,372 acres.      Woodland, 85%.

Not only is this watershed thoroughly forested but nearly one-half of it is swamp, so that conditions would seem ideal for a regular flow of the stream; but Mr. Stafford suspects that much of the precipitation on this watershed passes into the pond underground and that the weir measurements only represent a part of the actual run-off, especially in dry weather.

## CONCLUSIONS

Although the flow of all these brooks is so extremely irregular as to allow little choice, I have classified those which seem to be somewhat more regular than the others as follows:—

Irregular are South Nat, Terry, and North Nat, and Queen Gutter, and regular flowing are, Run, Ralph, and Blossom. Of the irregular brooks North and South Nat brooks have very little forest on their watersheds, whereas Terry and Queen Gutter are well forested. Queen Gutter has a well defined slope on its watershed, whereas the watersheds of the other brooks are quite flat.

In case of the regular flowing brooks the watersheds of Run and Blossom brooks, are entirely forested whereas Ralph Brook is only one-half forested. Blossom and Run brooks have a considerable area of swamp on which to depend for storage but Run brook has no swamp land in its watershed.

The reader can easily see from the nature of the above facts that it would be exceedingly hazardous to venture to draw any conclusions from them. A different story would probably be the result of these measurements had they been taken in a mountainous country with a rocky slope, but in a country of comparatively slight slopes and a deep gravelly soil the effect of a forest cover would not seem to be very large in the run-off of streams.

It is interesting to note how much more consistent, from month to month, is the flow of the streams than the precipitation. An excess of seventeen per cent in the rainfall of September does not seem to have had much effect on the run-off of that month or the next.

AVERAGE FLOW PER DAY AND PER SQUARE MILE OF WATERSHED OF THE BROOKS ON THE NORTH  
WATUPPA WATERSHED SHOWING MONTHLY DEPARTURES FROM MEAN MONTHLY FLOW MEASUREMENTS  
OF THREE YEARS

Months	All Brooks	Depart.	South Nat.	Depart.	Terry	Depart.	Queen Cutter	North Nat.	Run	Blossom	Ralph	Rainfall	Per cent
	1000 gals.	Per cent	1000 gals.	Per cent		Per cent		Per cent	Per cent	Per cent	Per cent	Inches	Per cent
January	1,349	+83	2,652	+174	2,216	+60	1,017	935	861	+25	1,413	4.12	+24
February	1,555	+49	1,524	+57	2,247	+62	1,181	625	813	+19	1,614	3.30	+50
March	3,057	+201	2,925	+202	4,399	+217	2,691	1,262	1,758	+156	3,292	6.00	+155
April	2,256	+122	1,716	+77	3,012	+118	2,077	1,221	1,852	+170	2,448	4.22	+150
May	1,968	+94	1,642	+70	2,274	+64	1,741	828	1,461	+112	2,307	5.06	+84
June	332	-67	184	-81	644	-54	413	188	482	-30	649	2.40	-51
July	160	-84	20	-98	47	-97	61	61	83	-88	236	2.96	-89
August	54	-95	1	-100	0	-100	1	6	26	-96	82	2.04	-98
September	90	-91	88	-90	14	-99	20	53	46	-93	135	4.36	+17
October	185	-82	200	-79	60	-95	15	171	146	-80	264	3.33	-11
November	280	-72	201	-79	332	-76	55	155	225	-67	346	2.77	-68
December	750	-26	1,194	+23	1,227	-11	517	652	490	-28	744	4.12	+12
Mean	1,015		968		1,386		813	514	687		1,126	3.72	

