Nettle Brook Streamflow in 1996

Jamie Shanley
U.S. Geological Survey

Year 3. Nettle Brook is a small mountain stream draining a steep 11-hectare catchment. It lies between the two main branches of Stevensville Brook on the west slope of Mt. Mansfield. In 1996 we completed the third full water year of streamflow monitoring at Nettle Brook. The hydrologic water year runs from October through the following September; here we report on Water Year 1996 which ended on September 30, 1996.

Water Year 1995 was a tough act to follow, an unusual year with the big January thaw, minimal spring runoff, summer drought, and August flood. But 1996 had its share of extreme and unusual conditions. Just like the weather, to which hydrology is so intimately tied, it is preferable to compare conditions to "average" rather than "normal;" variability *is* the norm.

The water year in review. Streamflow for the Water Year is plotted in Fig. 1. Note the logarithmic scale; flow rates range over 4 orders of magnitude. (It can be misleading to speak of orders of magnitude of flow on very small streams. If the stream were to dry up - and it has come close - it would pass through an infinite number of them!) Despite its small size and steep slopes, Nettle Brook appears to have sufficient groundwater storage capacity to sustain permanent flow. By comparison, streams draining catchments 2 and 3 times larger at the Hubbard Brook watershed in New Hampshire frequently go dry in the summer months.

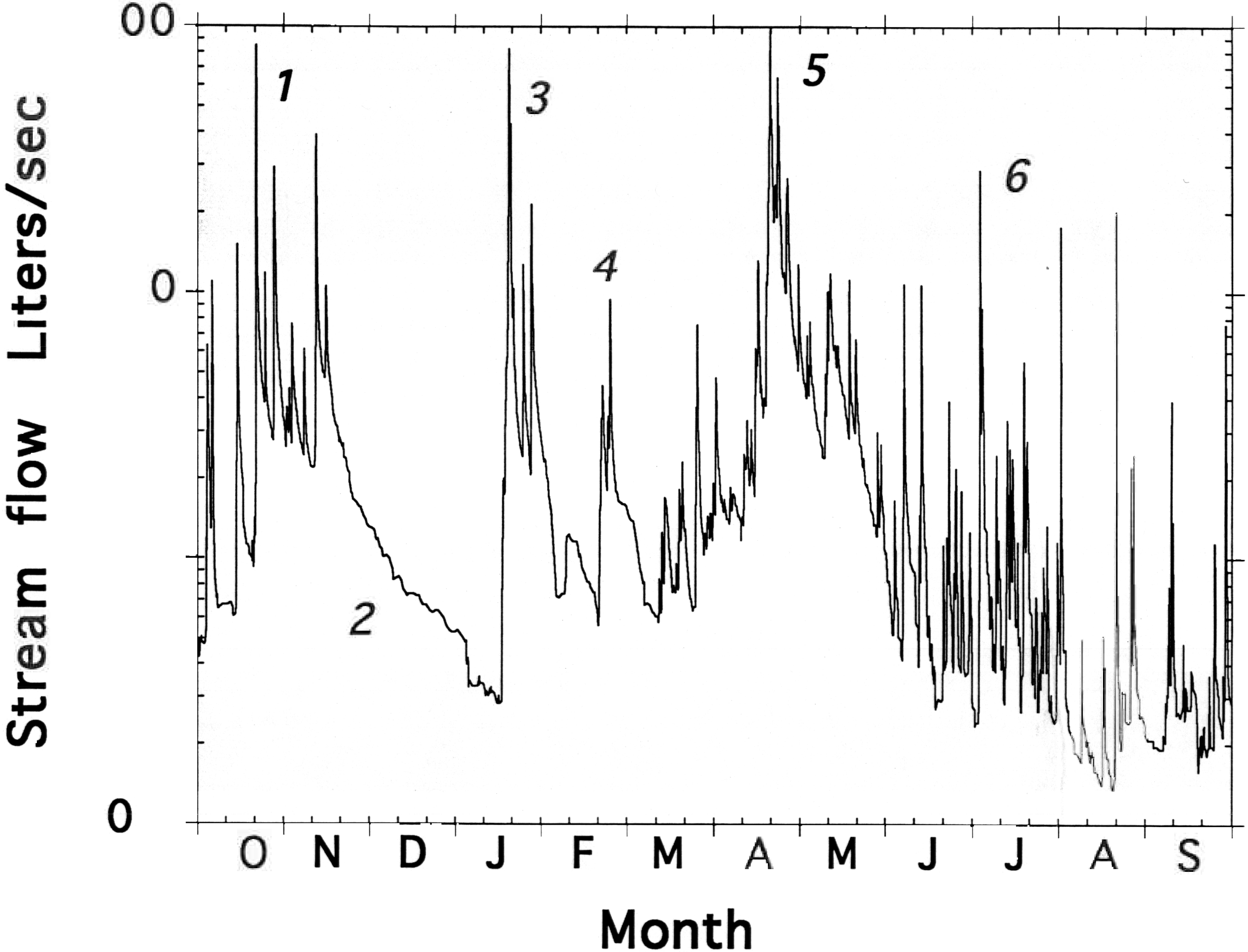
Special features of the water year are depicted with numbers in Fig. 1: (1) Heavy fall rains follow on the August 1995 flood, causing some high peak flows and thorough recharge to the groundwater aquifer. (2) An early snowpack and consistent cold temperatures in late fall and early winter cause a steady depletion of groundwater storage and low base flow levels. (3) An unusually strong January thaw - temperatures in the 60's and heavy rain. This is the same event that caused devastating flooding in the mid-Atlantic states, where record snowpacks melted very quickly. Note that the main thaw was followed by 2 smaller thaws. (4) A significant February thaw. (5) Heavy snows in March and April replenished the snowpack, leading to a snowmelt that was heavier and later than average. Peak flow did not occur until April 21. (6) A very rainy June and July kept streamflow higher than average; a drier August finally led to the typical low summer base flow.

Snowmelt. The 1996 snowmelt was somewhat less than 1994 snowmelt in terms of total volume of runoff, but its peak flow was about the same (Fig. 2). Regionwide, the 1994 and 1996 spring melts were well above average, while the 1995 melt was well below average. The 1996 snowmelt was notable for its late peak (April 21); a series of late-season storms kept augmenting the snowpack.

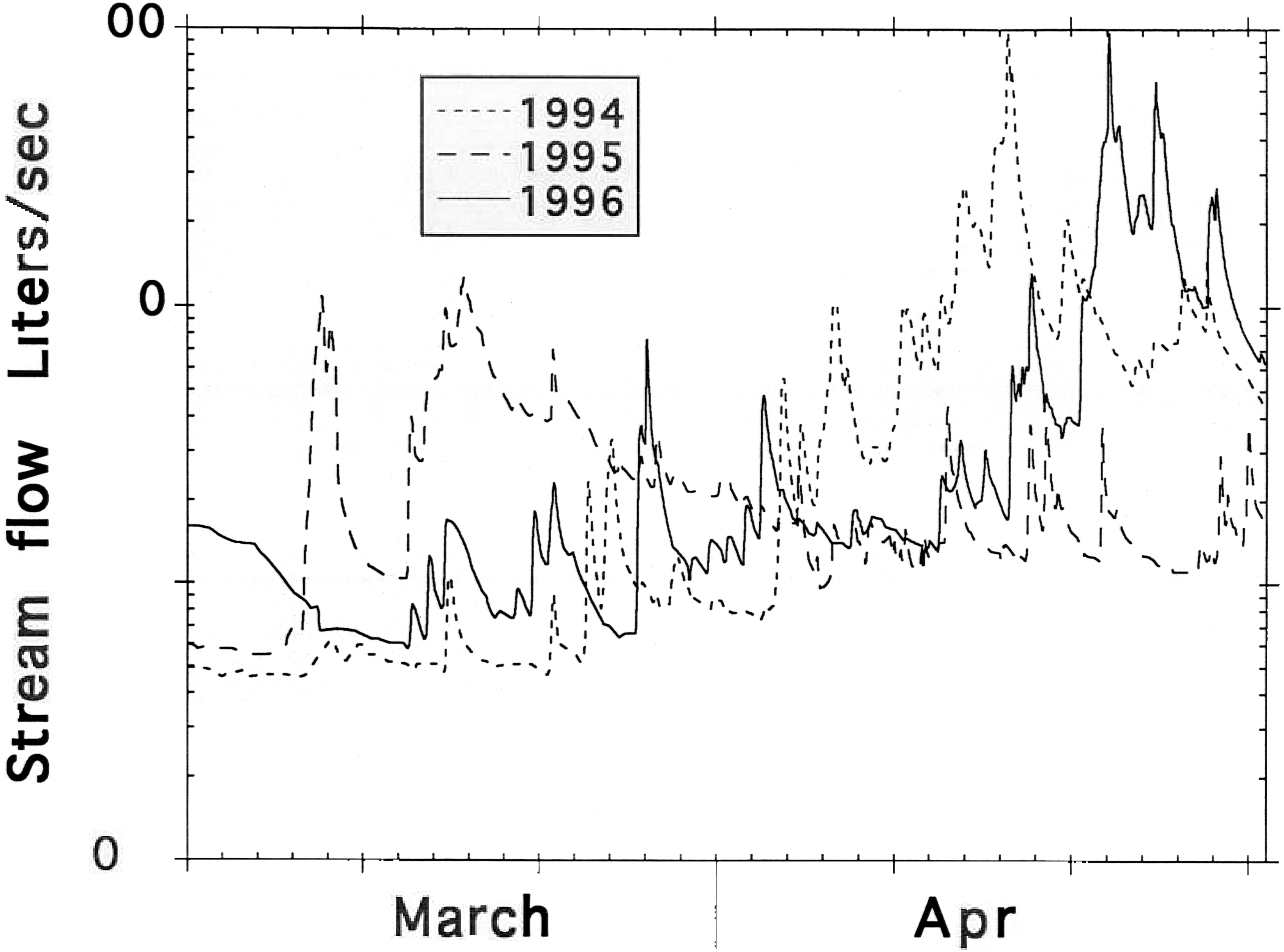
Flow duration. One way to compare water years is flow duration curves (Fig. 3). Flow duration curves indicate the percentage of time flow exceeds a given amount. The size, physical characteristics, and climatic conditions in a catchment determine the shape of the flow duration curve. For example, the curve for a flashy watershed (thin soils, steep topography) would have a steep exponential decline in the low percentiles, indicating that high flows rapidly dissipate. The curve for a less flashy system, such as a large river basin or the Lake Champlain outlet, would be more horizontal (high flows - e.g., flooding on Lake Champlain - last for days and dissipate gradually).

Because of the strong control that basin size and physical characteristics have on the shape of the flow duration curves, the 3 annual curves in fig. 3 are close together. However, it is clear from the figure that 1996 is the wettest year; its curve plots higher than the other 2 years for much of the range. For example, at the 20th percentile, the 1996 flow is approximately double that of 1994.

All in all, it was another normal year - lots of departures from average!



mb Ne xp mb gh



F g Comp ydr g: ph d
B ok

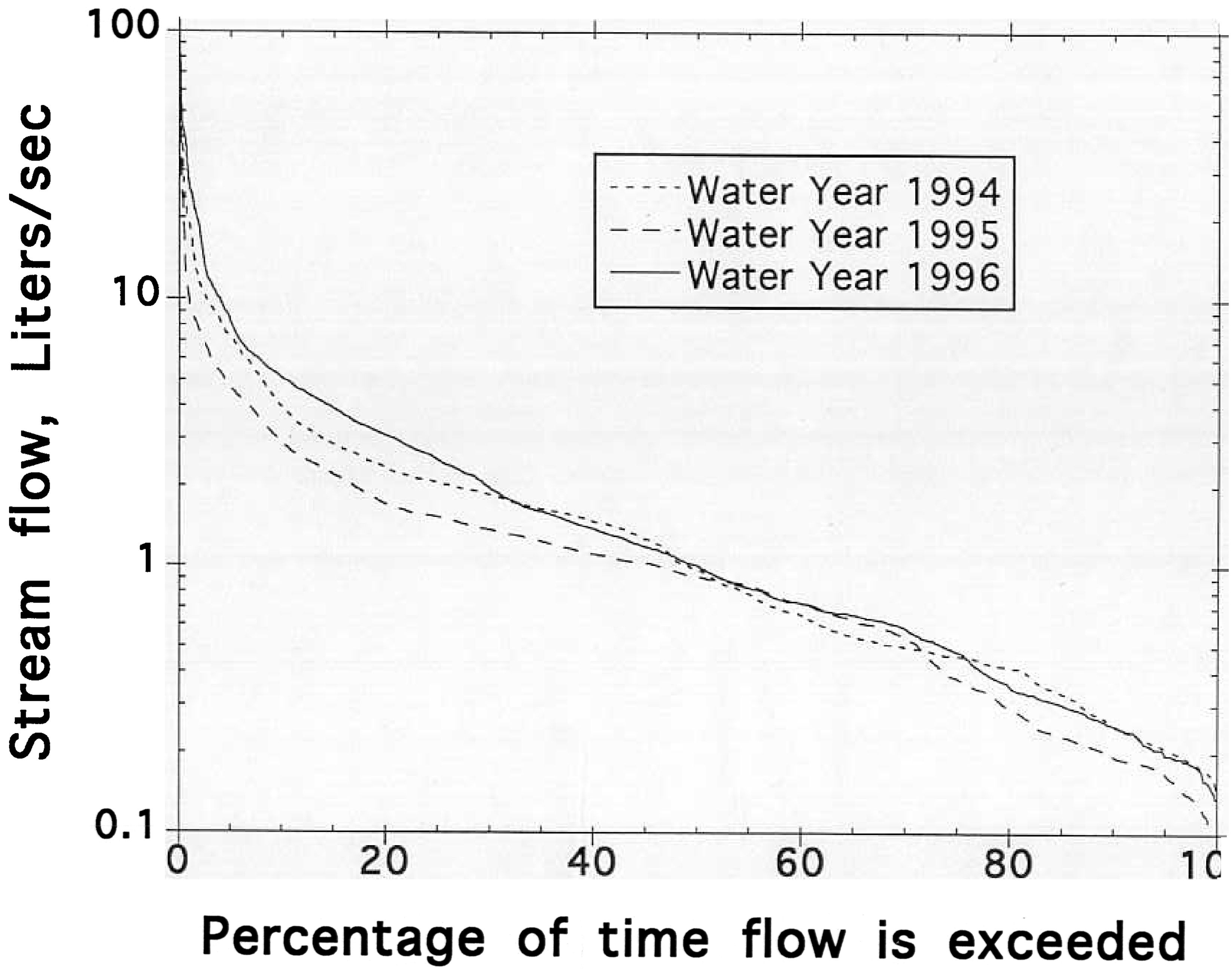


Fig. 3. Flow duration for water years 1994, 1995, and 1996 at Nettle Brook.