

# CHANGES IN BASEFLOW CONDITIONS OVER A 42 YEAR OBSERVATION PERIOD FOR THE LITTLE RIVER EXPERIMENTAL WATERSHED IN SOUTH GEORGIA

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Hydrology is the driving force of sediment, nutrient, and pesticide movement. Separation of streamflow hydrographs into rapid surface runoff and baseflow can vastly improve our understanding of chemical transport. In addition, characterizing these two components of streamflow can also greatly improve overall watershed hydrologic budgets which are critical for accurate evapotranspiration estimation. For validation of hydrology in model simulations, direct runoff and baseflow components of the streamflow hydrographs typically need to be separated. Incorrect representation of baseflow patterns can lead to erroneous results in watershed analysis.

Here we examine annual and seasonal variations in baseflow within the Little River Experimental Watershed (LREW) from 1972 to 2013. The LREW is located near Tifton, Georgia, in the South Atlantic Coastal Plain of the U.S.A. (N31°26'13", W83°35'17"). The LREW is part of the Gulf Atlantic Coastal Plain LTAR (Maddox 2013). The hydrology, precipitation, and water quality of the LREW have been monitored by the Southeast Watershed Research Laboratory (SEWRL) since 1967 (Bosch and others 2007). The climate is humid subtropical with a long growing season. Annual precipitation averages 1192 mm yr<sup>-1</sup>. Mean annual temperature is around 18.7°C, with the coldest month of the year being January with an average temperature of 10.6°C and the warmest being July with an average temperature of 26.8°C.

Streamflow during the months of December through April in watersheds throughout the Southeastern Coastal Plain is typically much greater than during the months of May through November. Greater precipitation and lower evapotranspiration rates during the winter and spring months create higher soil-moisture and greater aquifer recharge, increasing surface runoff responses and groundwater contributions to streamflow. Baseflow, the portion of streamflow coming from vadose zone and groundwater sources, makes up a large fraction of the streamflow during the winter and spring periods. Thus, baseflow is extremely important to sustaining streamflow throughout the Southeastern Coastal Plain. Increasing demands on groundwater, changes in land-use, and changes in precipitation patterns due to climate change are all expected to impact baseflow conditions and streamflow volume.

Historical precipitation and streamflow data were obtained from the SEWRL database (Bosch and others 2007). The period of record examined was from 1972 to 2013. This analysis was limited to examination of data from the largest watershed, Watershed B, a 334 km<sup>2</sup> drainage area. Daily precipitation and streamflow data extrapolated from the subdaily data were examined. Data were partitioned into annual and seasonal periods for hydrograph

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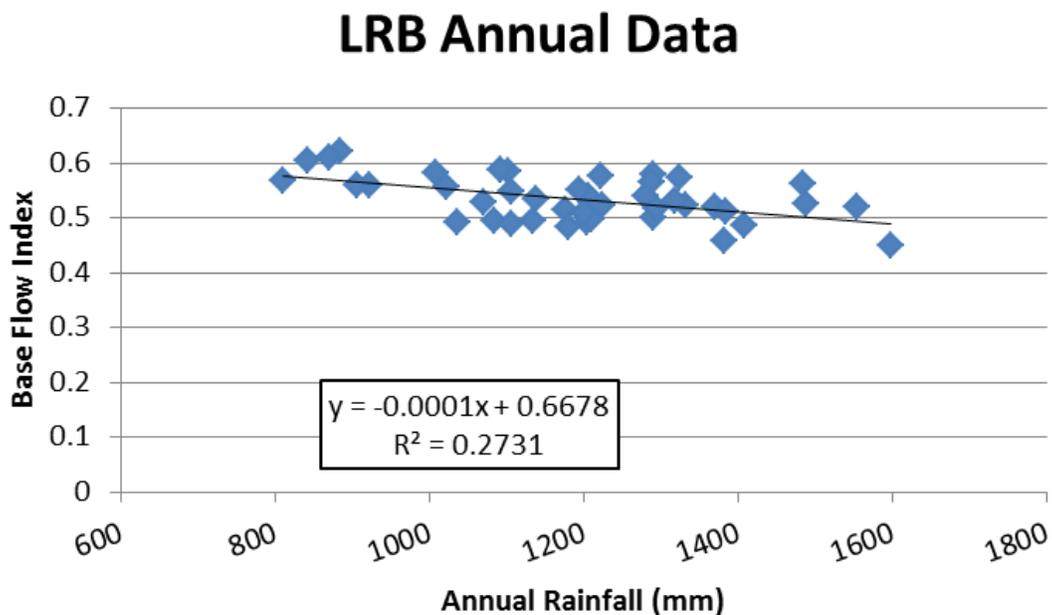
**Table 1—Results of annual and seasonal baseflow analysis for Little River Station B, 1972-2013.**

Period	Winter	Spring	Summer	Fall	Yearly
Baseflow Index	0.55	0.57	0.42	0.47	0.54
Standard Deviation	0.07	0.09	0.09	0.13	0.04

analysis. The seasonal periods selected, based upon prior research, were December through February (winter), March through May (spring), June through August (summer), and September through November (fall). The digital filter method used for separation of high and low frequency signals was used for separation of baseflow (Lim and others 2005). The two parameter Eckhart digital filter was used with a maximum baseflow index (BFImax) of 0.80 and an alpha value of 0.98. The baseflow index is the ratio of baseflow to total streamflow.

Examination of the 42 years of annual flow data produced an average baseflow index of 0.54 (Table 1). Average seasonal baseflow indexes varied from 0.57 for the spring to 0.42 for the summer (Table 1). Variability of the annual data was low as were the variability of the winter, spring, and summer seasons. Variability of the fall was higher.

Baseflow was found to decrease as a function of increasing rainfall (Fig. 1). This is attributed to the saturated conditions which accompany high precipitation, subsequently leading to rapid surface runoff. Trends in baseflow were examined for both the annual and seasonal data. Annual baseflow was found to be decreasing over the 42 year period. Analysis of precipitation data indicated annual precipitation over the 42 year period was also decreasing ( $\alpha=0.05$ ). Since higher annual precipitation appears related to lower baseflow, a decreasing annual precipitation would be expected to yield lower baseflow conditions, conflicting observed long-term baseflow trends. Examination of seasonal precipitation patterns indicated decreasing long-term trends for the winter and spring precipitation and increasing trends for the summer



**Figure 1—Baseflow index as a function of annual rainfall illustrating a decreasing trend in baseflow as a function of increasing annual rainfall (significant at  $\alpha=0.05$ ).**

and fall precipitation. This shift in seasonal precipitation patterns would explain the long-term decrease in baseflow.

Overall, baseflow was found to produce 54 percent of annual streamflow, 13 percent less than prior published results. Baseflow was the largest during the months from December through May (55-57 percent) and the least during the months from June through November (42-47 percent). Annual baseflow was found to decrease with increasing annual precipitation. Data indicated a decreasing long-term trend in annual precipitation, decreasing baseflow, and increasing variability. Data also indicate a shift in seasonal precipitation from the winter and spring to the summer and fall which is believed to contribute to reduced baseflow in the watershed.

## LITERATURE CITED

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