

Project Report, 2016 VWRRC Student Grant: Sensors reveal the timing and pattern of stream flow in headwaters after storms

Project Title: Headwater stream length dynamics during storm events in the Valley and Ridge province

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We installed 50 stream intermittency sensors that detect the presence or absence of water along the stream network of a small headwater catchment in the Valley and Ridge physiographic province of southwest Virginia. We previously mapped the “wet” or active, flowing stream length several times by walking the network at different flow conditions. However, mapping the catchment in this manner requires several hours and, thus, does not permit the simultaneous observation of stream length on the rising limb, peak, and falling limb of storm events along the entire network. The stream intermittency sensors facilitate the examination of stream length dynamics during storms by recording the presence or absence of water every 15 minutes. We are keeping the sensors in the catchment for one year to determine the spatial pattern and timing of stream wetting and drying across different seasons and precipitation rates. One of our primary questions is whether the stream network is longer for the same discharge on the falling limb of a storm than on the rising limb.

Results thus far indicate that flow duration in response to storms is spatially variable throughout the catchment. Interesting, the onset of flow following rainfall occurs at approximately the same time across many of the sensors, but the duration of flow after the storm ends differs considerably. Reaches with a wide, sediment-filled valley floor carry water for far shorter periods of time than confined channel segments with steep valley side slopes. During our earlier field surveys, we only observed flow in a few of the tributaries for the wettest conditions mapped. The sensors now show that these tributaries actually flow more frequently during much smaller storms, but only for brief periods of time. The high temporal sampling resolution of the sensors allows a more accurate estimate of flow duration in these ephemeral streams, which we otherwise risk underestimating with only field surveys.

Headwater streams carry water, sediment, organic matter, and pollutants to downstream waterways. Much of this transmission occurs episodically during storms when stream levels are high. However, storm events are difficult to study in headwaters, as the rise and fall of stream flow occurs rapidly in these small catchments. Stream intermittency sensors help assign an accurate flow duration to headwater reaches, which is not always possible with field surveys. Based on terrain metrics such as valley width and drainage area, we hope to use the sensor data to help predict where and when streams in similar settings will carry flow for a given storm to aid watershed management efforts.