**A Year of Hydrological Data on Cumberland Valley Springs T.M. Hurd**

The recently received Alexander Stewart Foundation grant to Big Spring Watershed Association has funded a dye trace (postponed until drier weather) to help determine the source areas of Big Spring's water. As an initial part of this study, I worked with hydrogeologists (Otz Hydro, Switzerland) to install and monitor water level on Big Spring and the upper Yellow Breeches directly across the valley, as the latter is thought to contribute water to Big Spring through what hydrogeologists call "interbasin flow" (loss of water from one watershed to another) (Chichester 1996). Noting the timing and magnitude of spring discharge relative to increases in flow in the Yellow Breeches, and even in basins up-gradient such as Burd Run in Shippensburg, could help us understand potential pathways and flow rates that groundwater may be taking to the springs. As Green Spring and Mt. Rock spring "bracket" Big Spring on the map of Cumberland Valley, and are to be sampled for dye, they were also included in our analyses.

We installed data-logging level gauges on Big Spring, Green Spring, Mt. Rock, and the Yellow Breeches in Walnut Bottom. These instruments measured water depth every 15-20 minutes between November 2003 and December 2004, capturing stream responses to major storm events[1]. These levels are being calibrated to discharge, but offer some interesting information as they stand, particularly in light of the fact that 2004 was the 3rd wettest year on record, and 2003 was the 4th, according to precipitation records kept at Shippensburg University (Dr. Tom Feeney – personal communication).

A large snowmelt and precipitation event on December 11, 2003 brought the Yellow Breeches up over half a meter. Big Spring continued recovery from the previous drought with a small step-up in level, some three hours after peak flow in the Yellow Breeches. Mount Rock also responded with a small step-up, but within two hours of peak flow in the Yellow Breeches. Green Spring peaked in discharge even earlier than the Yellow Breeches, suggesting that Green Spring may be more closely connected to surface features such as sinkholes with more rapid flow to the spring.

The next major event came with a strong, localized rain even on July 12, 2004. Jean Coates, secretary of BSWA, called me to let me know that Big Spring was running turbid since the early morning event, but that all of the turbidity appeared to be coming from the west spring of the two that form the surface flow of Big Spring. When I arrived, turbidity was indeed much greater in the main spring (121-137 NTU), while the other spring was gin-clear (1.4-1.7 NTU), as was Mt. Rock (1.1 NTU), suggesting different pathways (perhaps even drainage areas?) of the two contributing springs. Upon re-reading Jim Chestney's writings on early trout fishing in the old mill pond, he had described how Big Spring began running turbid in the early 1900s, following disturbance of a clay brick quarry above the spring. Interestingly, he too noted that one spring was not affected during these events (Chestney 1997). Neither turbidity nor flow of Mt. Rock was affected by the July 12 event. Green Spring on the other hand flooded dramatically, and became turbid (70 NTU). When I stopped at Green Spring hatchery, Chuck Finui, the hatchery owner, noted how fish hatchery road had become a torrent and how they had lost large numbers of valuable trout earlier that morning. They had measured over 4" of rain. These

patterns might suggest that there is hydrologic similarity or even linkage between Green Spring and the western spring of Big Spring, and Mt. Rock spring and the eastern contributing spring. On the way to the springs, I stopped at a large sinkhole near the 174 exit of I81 in Shippensburg. It had obviously drained a massive volume of runoff directly into the aquifer, and was still draining turbid surface runoff to the extent that I watched the water circle before going down! Dr. Tom Feeney, of the Geography Earth Science Department at Shippensburg University, has studied this sinkhole and noted a possible connection to Big Spring, although we are not able to find documentation about this. Whether or not there is a connection to the springs, this sinkhole is draining an increasing area of developed surface, with direct deposit of contaminants to the groundwater via culverts under Interstate 81.

Two more large rain events occurred on September 18 and 28, 2004. The Yellow Breeches came up about 1 meter each time, with the springs responding in smaller steps. On September 18, all streams crested within ½ hour of one another, probably due to surface water inputs. Big Spring stepped up flow again slightly on September 21, suggesting a possible delayed response. On September 28, Big Spring and Green Spring both crested within one hour of the peak Yellow Breeches flow, while Mt. Rock did not rise until 7-8 hours later. After this event, it took Big Spring until October 17 to drop 5 cm back to where it had been in August.

Although it is difficult to draw too many conclusions before dye tracing and further geochemical analysis, it is clear that the hydrology of Big Spring is complex. Source springs appear to behave like the springs up and down the valley on their respective sides, except that flow to Big Spring and Mt. Rock may be more diffuse than flow to Green Spring. While there often is a fairly rapid rise in discharge following peak discharge in the Yellow Breeches, there is not obvious preferential, or pipe-like flow, between the two systems, and Big Spring takes days to weeks to drop in water-level, consistent with the previous observations that Big Spring level correlates with the water table level (Putnam et al. 2004). These results suggest that when the dye trace is conducted, we might look for source waters from up-valley (possibly the aforementioned sinkhole) as well as from across the valley (losing reaches of the Yellow Breeches), and that time to break-through at the springs could be relatively long due to diffuse flow through a larger, regional flow system.

[1] Some data are missing for Green Spring, and the large drop on level on Big Spring in late summer 2004 was due to removal of boards at the Mill Dam by PAFB for electroshocking

**Big Spring source springs, July 12, 2004, showing contrasting turbidity between east (far) and west (near) springs.**

**Mt. Rock, July 12, 2004, showing almost no turbidity and water level gauge**

**References**

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