Briefing and Ancillary Materials for Rocky Branch Watershed Tour

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Watershed Issues in Rocky Branch Watershed

While a panoply of problems exist in RBW, for introductory purposes they can be generally categorized into flooding, water/environmental quality, and community interactions. Flooding issues, in turn, can be divided into hydrologic and hydraulic (H&H) approaches and concerns. This tour will begin with two stops in the headwaters of RBW (Figure 1) with an examination of flood-water generation (hydrology). It will then move to Maxcy Gregg Park where we will discuss flood hydrology and water quality. The last several stops will cover water quality and issues of flood hydraulics; that is, the flood conveyance through channels.

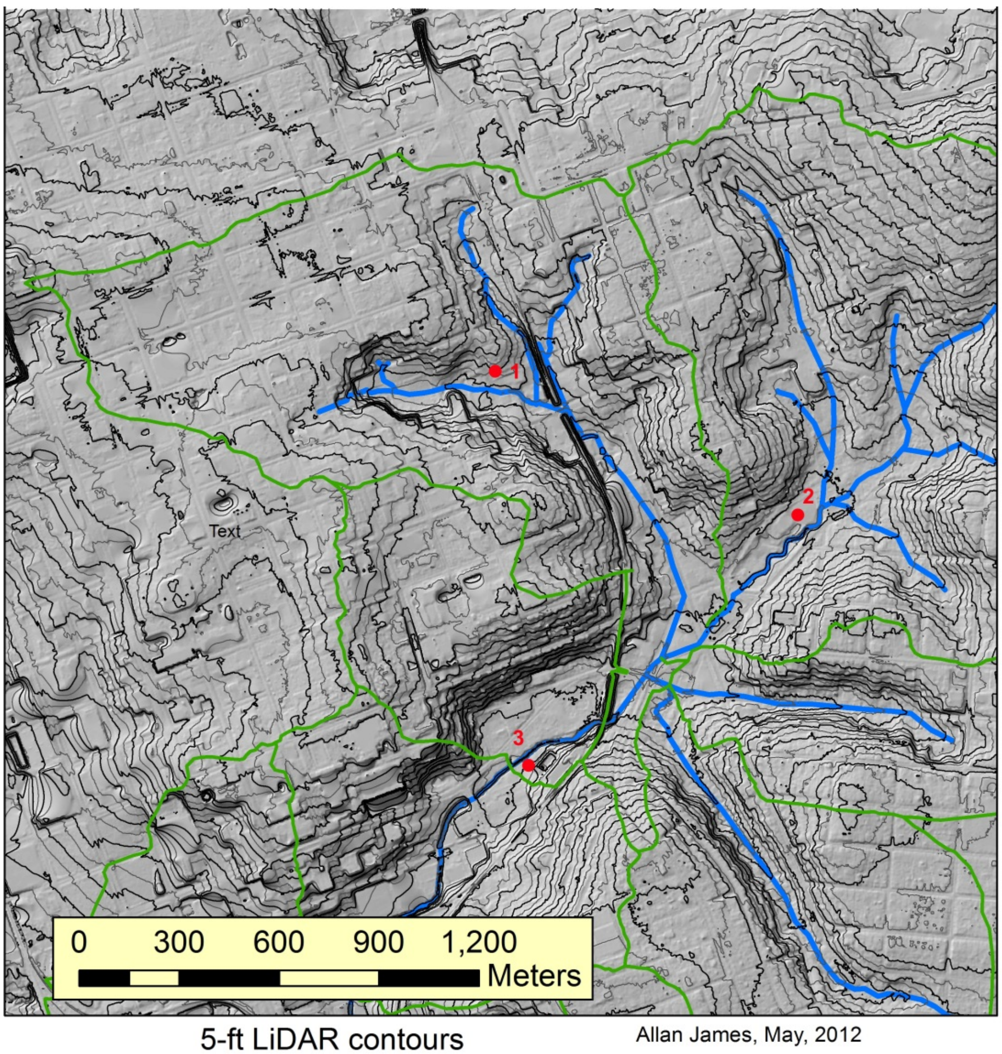

Figure 1. Topographic map of upper RB Creek with shaded relief and contours showing first three stops. Channels and divides mapped by manual interpretation of contours. Contours and shaded relief derived from USGS 'LiDAR' data for Richland County; that is, a new high-resolution elevation data set.

Principles of Urban Flood Hydrology

Flood hydrology is the study of the quantity and timing of water being delivered to a stream. It involves an understanding of the relationships between water delivered by rainfall and the pathways that it takes on the landscape, which include infiltration into the soil and runoff on the surface. Floods are generated when substantial proportions of precipitation run off on the surface rather than infiltrating (seeping) into the soil. Surface runoff is relatively rapid and generates floods down slope. Under natural conditions (left side of Figure 2), forested surfaces promote high infiltration rates so little runoff occurs and flooding only occurs during rare intense storms. Devegetation, soil compaction, pavement, storm sewers, buildings, rain gutters, and other urban changes reduce infiltration greatly, however, generating large amounts of surface runoff and flooding, even during moderate rainfall events (right side of Figure 2).

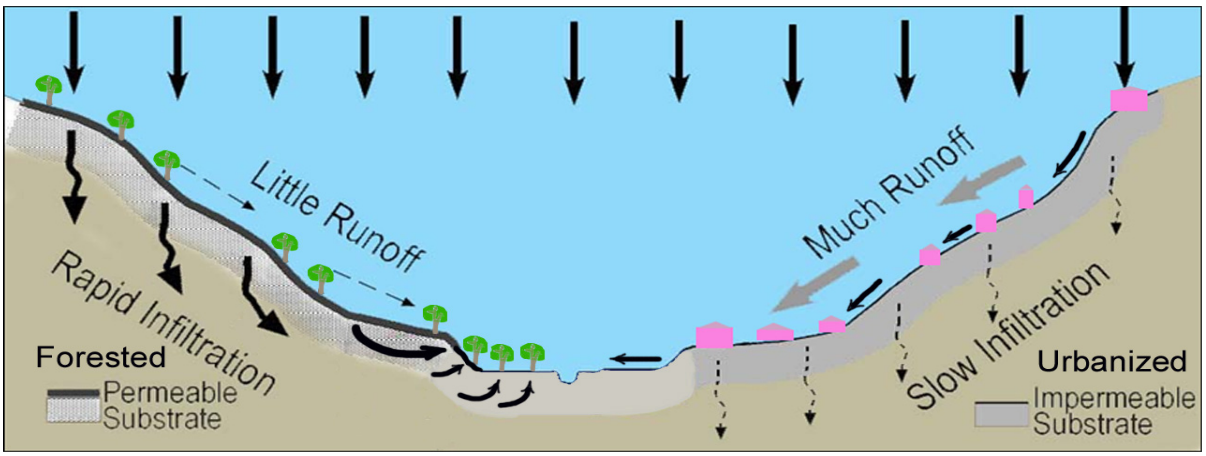

Figure 2. Schematic diagram contrasting infiltration and surface runoff from natural surfaces at left with urbanized surfaces at right. (James, 2012).

Percent impervious area is a common measure of the degree of urbanization effects that has gone on in a watershed. Impervious (or impermeable) surfaces include pavement and buildings that can be mapped from aerial photographs. Storm sewers also deliver rainwater downstream very rapidly and generate flooding. Percent area under impervious surface and percent area with storm sewer have been linked to increased flooding (Figure 3).

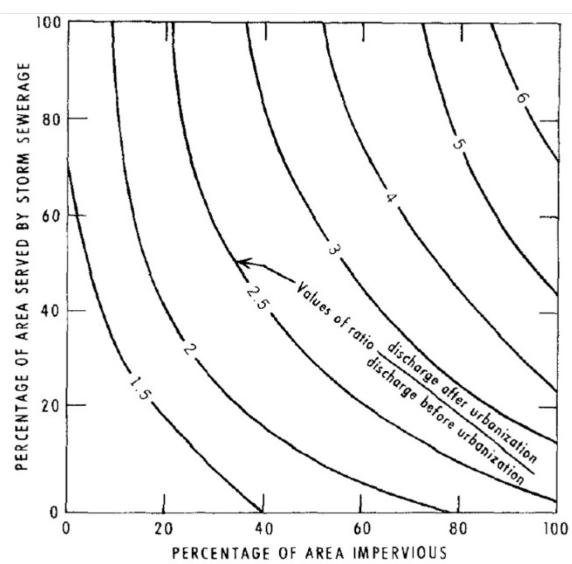

Figure 3. Relationship between percent areas impervious and storm sewered and increase in flooding. (Leopold, 1968).

The approach to the first stop in the Gregg Street Basin (Figure 4) provides a good look at the degree of impervious surface in some of the upper basin.

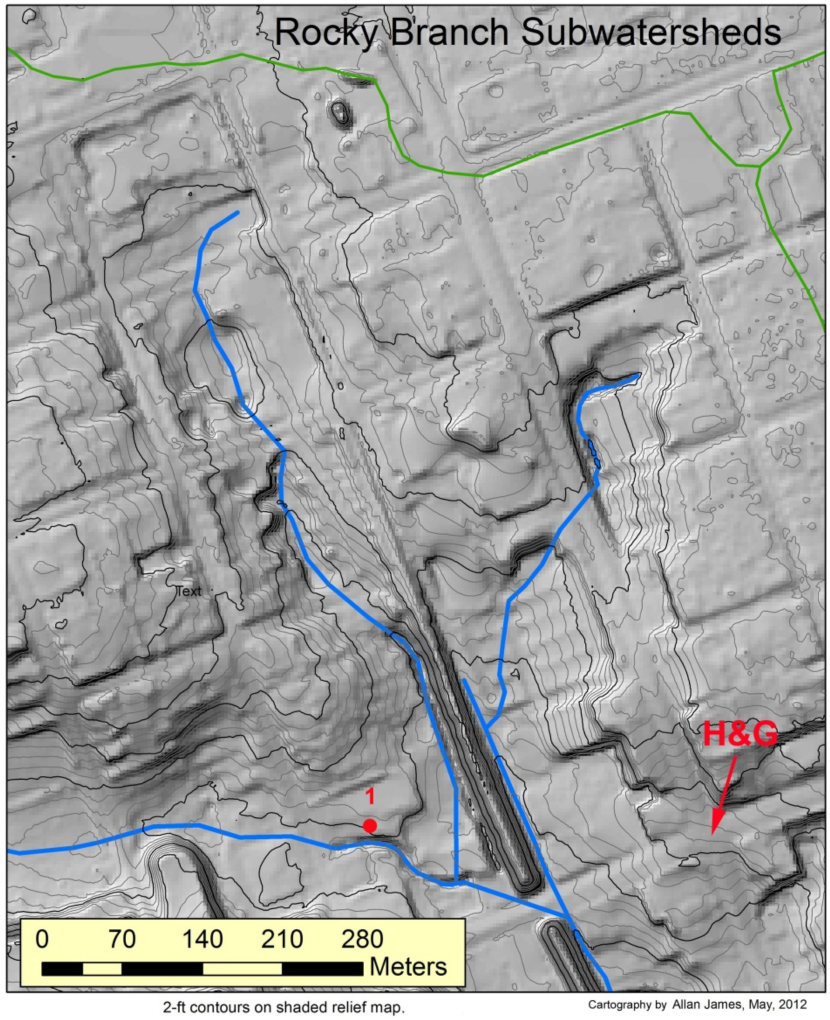

Figure 4. Gregg Street Basin in upper northwest RBC. The first stop is shown by #1. Most of the channel upstream of the the site location is underground in storm sewers. “H&G” is intersection of Harden and Gervais Streets. High linear ridge is the railroad embankment crossing Gervais Street. LiDAR-derived shaded relief and contours with channels and divides (at top) manually interpreted.

The second stop is at the footbridge across the MLK branch of RBC in Martin Luther King, Jr. Park (Figure 5). This would be a good site to know stream discharge, but establishing a gage has some problems with shifting controls downstream as a thick grove of riparian vegetation is rapidly getting established. Perhaps as a consequence of the vegetation, sand dunes have been deposited above the bridge. This reveals the high loads of bed sediment that were being delivered to the storm sewers below Five Points, and may indicate that the flood conveyance system was being compromised by sediment. Could we take advantage of the sediment detention here by maintaining the vegetation downstream and periodically removing the sediment to maintain the channel? We will walk downstream from the footbridge to the storm-water detention pond at the south end of the park. This dry structure is design to store flood water here and release it late after the peak of the flood. Success of this strategy assumes that peak delivery of flood water from the Gregg Street Basin will pass Five Points before the water stored here is released. Unfortunately, no calibrated runoff model exists for the RBW, so this assumption cannot be tested.

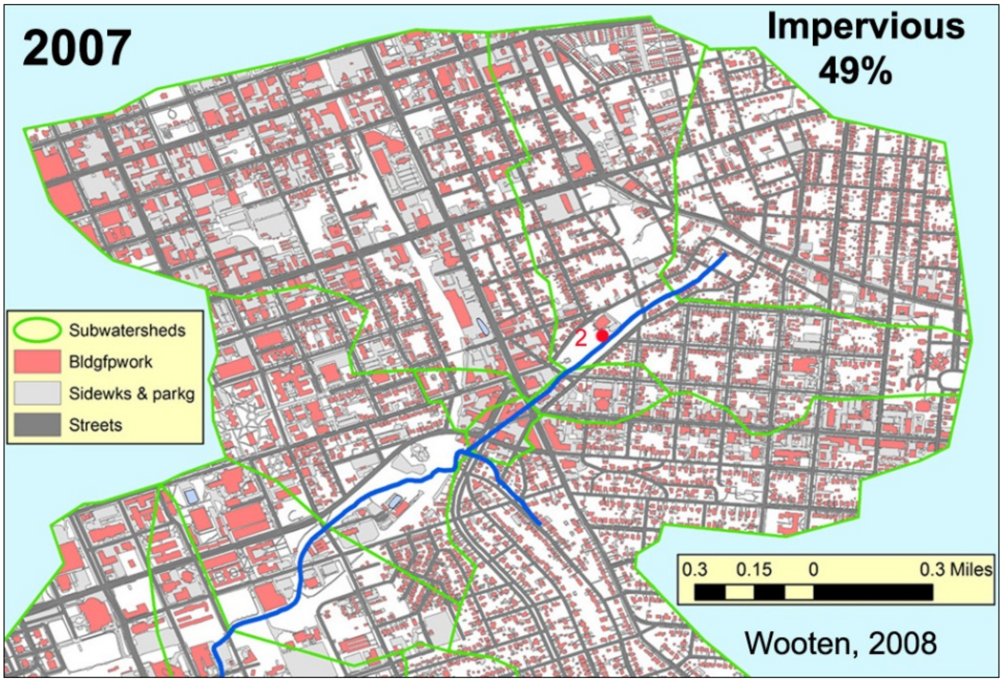

Figure 5. Map of impervious surfaces in the upper RBW. Data from Wooten, 2008. The "#2" is second stop at footbridge in MLK Park.

Water Quality (Stop 3)

Water quality is important now only for maintaining water resources, but also for protecting public health, maintaining viable aquatic habitats, and protecting the aesthetics of urban environments. Many processes determine water quality and several features of water or stream environments may be measured that characterize water quality. For example, we can directly measure dissolved oxygen (DO), electrical conductivity (EC), pH, and other variables with a sonde. We can also sample the macro invertebrates present in the stream to see if species that are sensitive to poor quality water are missing.

Some preliminary sampling of macro invertebrates and water chemistry have been made at this site through cooperations with the U.S. Geological Survey and the Environmental Protection Agency. This is important because Maxdy Gregg Park is immediately downstream of the heavily urbanized Five Points area. In addition, a USGS stream gage has operated here and downstream at the Pickens Street bridge for many years so a record of flooding has been examined.

Flooding and Urban Development in the Lower Creek. (Final stops including drive-bys and Olympia Park)

The sale of land near Assembly Ave. and Dreyfus St. for a development in lower RBC was recently approved by the Columbia City Council. This was a contentious issue that led to the original formation of the RBW Alliance. Building structures in floodways is generally not wise policy and often violates floodplain regulations. Unfortunately, this site slated for development is already highly prone to flooding (note sign on Dreyfus St. indicating height of 100-year flood), due to a railroad culvert downstream that impedes flows. Thus, the development will take place in a floodplain that is deeply inundated during large floods and behaves like a lake, so the normal floodway regulations do not apply.

The hydraulics of a channel system; that is, the fluid mechanics and dynamics of flow, become much more important in the lower basin and are key to understanding flood problems there. Accurate hydraulic models require knowledge of the size of channel cross sections, roughness elements that resist flow, water surface slopes, and other factors that control flow energy. They also require accurate hydrologic information (how much water) to apply as inputs to the hydraulic model. The hydraulics of flow in the lower RBW are severely constricted at present by railroad crossings. In particular, flooding in the immediate Assembly Street area are presently governed by the culvert through the abandoned railroad embankment parallel to Bluff Road. Removal of the embankment would alleviate flooding in the Assembly Street area but would pass a larger flood wave downstream, so it would require enlarging the bridge opening at Olympia Avenue to prevent greater flooding in the Olympia Park area. These channel improvements should be seriously considered. However, there are two limitations to keep in mind. First, if the development fills the floodplain at the old baseball stadium, benefits of removing the RR culvert may be moot. Second, hydraulic modeling (AMEC) indicates that flood reductions in the Assembly Street area would extend upstream a limited distance and would not reduce flooding in the area of Whaley, Catawba, Main, and Sumter Streets. Moreover, hydraulic changes in the lower RBC would have no effect on flooding in the Five Points area which is driven by upper basin hydrology and local hydraulics in that area.

The best solution for reducing flood risks and improving water quality throughout the RBW is to manage the watershed in such a way as to reduce the generation of storm-water runoff. These methods include low-impact development (LID) and green infrastructure; e.g., rain gardens, rain barrels, permeable pavement materials, storm-water detention structures, green rooftops, etc. For these methods to be effective they must be deployed very widely across the watershed. This calls for participation by a large number of people and is best accomplished by voluntary programs with incentives and community education coupled with disincentives for large conventional pavement projects. LID is cheaper than conventional methods, so education and incentive programs for developers can be highly successful.