Selected Findings on Volume Control

Volume-Based Hydrology
Andrew J. Reese
Stormwater Magazine, September 2009

"Volume Based Hydrology starts with the premise that it is the increased volume of runoff due to urban development that is causing a set of problems, and that any other focus-variable (velocity, peak flow, impervious percent, event mean concentration reduction, etc.) is mostly a one-off approach from the real problem: increased volume. If we focus first on volume, then the other variables will fall more readily into line." (p. 54)

"Second, there is a growing body of knowledge that the treatment of runoff is not as effective as the removal of runoff (and the mass of pollutants it carries) needing treatment. We can theoretically assign some very high pollution removal value (some would say 100% except for quick return dissolved constituents) for runoff that is captured and infiltrated or evaporated or fed into the root systems of plants and trees." (p. 56)

"Third, it is now becoming apparent, at least in humid climates, that volume of flow over time, and not simple peak flow, is the right variable when considering erosion in many open-channel systems. In fact, peak flow controls may exacerbate the erosion problem, forcing larger volumes of flow into the channel cross section instead of allowing them to flow partially along floodplain paths." (p. 56 to 57)

"Fourth, the ability of random detention pond placement to actually control downstream peak flow has always been suspect. The goal in peak-flow-based hydrology is peak matching. The mantra for years was that site post-development peak should be equal to or less than the predevelopment peak. It is not working. In the end, the problem is as much a volume and timing concern as it is a site-based peak flow problem." (p. 57)

Urban Stormwater Management in the United States
Committee on Reducing Stormwater Discharge Contributions to Water Pollution
National Research Council
National Academy of Sciences, 2008

"The protection of aquatic life in urban streams requires an approach that incorporates all stressors. Urban Stream Syndrome reflects a multitude of effects caused by altered hydrology in urban streams, altered habitat, and polluted runoff. Focusing on only one of these factors is not an effective management strategy. For example, even without noticeably elevated pollutant concentrations in receiving waters, alterations in their hydrologic regimes are associated with impaired biological condition. More comprehensive biological monitoring of waterbodies will be critical to better understanding the cumulative impacts of urbanization on stream condition." (p. 6)

“The full distribution and sequence of flows (i.e., the flow regime) should be taken into consideration when assessing the impacts of stormwater on streams. Permanently increased stormwater volume is only one aspect of an urban-altered storm hydrograph. It contributes to high in-stream velocities, which in turn increase streambank erosion and accompanying sediment pollution of surface water. Other hydrologic changes, however, include changes in the sequence and frequency of high flows, the rate of rise and fall of the hydrograph, and the season of the year in which high flows can occur. These all can affect both the physical and biological conditions of streams, lakes, and wetlands. Thus, effective hydrologic mitigation for urban development cannot just aim to reduce post-development peak flows to predevelopment peak flows.” (p.6)

“Nonstructural Stormwater Control Measures (SCMs) such as product substitution, better site design, downspout disconnection, conservation of natural areas, and watershed and land-use planning can dramatically reduce the volume of runoff and pollutant load from a new development. SCMs that harvest, infiltrate, and evapotranspirate stormwater are critical to reducing the volume and pollutant loading of small storms.” (p. 9)

Fundamental of Urban Runoff Management
Earl Shaver, Richard Horner, Joseph Skupien, Chris May, Graeme Ridley
North American Lake Management Society, 2007

“In summary, the above section presented the following ideas and information:
• Land use changes can increase impervious land cover, decrease soil permeability and vegetated cover, reduce initial abstractions, and shorten runoff response times.
• Such changes can result in increased volumes, rates, durations, and frequencies of surface runoff and waterway flows.
• Such increases can adversely impact waterways through channel enlargement, bank undercutting, aquatic habitat destruction, increased sediment loadings, and increased water temperatures.
• Such impacts have been extensively documented through research.” (p. 2-40 to 2-41)

“As discussed in detail in Chapter 2, land development and redevelopment projects that increase site imperviousness and drainage system efficiency will cause increases in both the site’s total runoff volume and the peak runoff rate. As described in Chapter 2, both research and analysis have shown that increases in either of these quantities can cause downstream flooding, erosion, and habitat damage. As such, to be effective, it will be necessary for an urban runoff management program to address the increases in both runoff volume and peak runoff rate.” (p. 10-252)