Interview With an Urban Hydrology Guru: Derek Booth, Ph.D.

By Laura Funkhouser

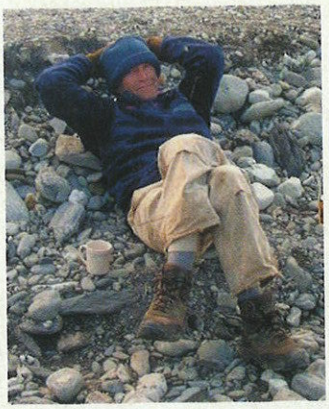
Derek Booth, Ph.D., will present in two of the three full-day StormCon workshops that will be held in Seattle, WA, on Friday, December 1, 2006. Learn more about the workshops at www.StormCon.com/seattle.

Booth is a senior geologist with Stillwater Sciences Inc. and a professor at the University of Washington where he holds joint faculty appointments in civil engineering and earth and space sciences. Prior to this, he was director of the Center for Water and Watershed Studies at the university, and was geologist and manager of the Basin Planning Program for King County. He maintains active research into the causes of stream channel degradation and the effectiveness of stormwater mitigation strategies. He has also authored or coauthored several dozen papers and technical reports on both regional geology and the physical effects of urban development on aquatic systems.

The article that you coauthored in 1997 ("Urbanization of Aquatic Systems—Degradation Thresholds, Stormwater Detention, and the Limits of Mitigation" with C. Rhett Jackson for the Journal of the American Water Resources Association) has been cited at least 198 times and seems to have crystallized a lot of the thinking at the time into a sort of urban hydrology manifesto that called for a better understanding of hydrology from a watershed perspective.

It was one of the first articles published in the formal literature to call for a watershed approach to urban hydrology. The idea itself was not new. The EPA had a series of conferences on the watershed approach—Watershed '93 was one of the first large EPA conferences on this theme—which provided national leadership in this approach. But this article was one of the first formally published articles to apply the ideas in an urban setting.

Tom Schueler founded the Center for Watershed Protection at about the same time. The Center for Watershed Protection has probably done the most to raise the practice of urban watershed assessment and protection to a high level, but it has never published in the formal literature because its focus is on the practice and direct work with communities.



Your article discusses the significant impacts on aquatic systems caused by development, with a focus on hydrologic (i.e., water-quantity) issues. Why was it important for you to look at those problems rather than those associated with water quality at that time?

For one good reason, and one not so good reason, the work we did avoided water quality altogether. The good reason is because in our part of the world when we look at the consequence of development on people and biota we see major debilitating influences that we can trace back to changes in flow and quantity caused by a 10% increase in impervious area.

At this degree of development, we're talking about a landscape of 1- to 5-acre parcels plus a couple of little strip malls. This is the urban fringe, not the fully built-out suburbia. So we're at a level where we do see significant consequences to the downstream [areas] that are almost exclusively driven by the quantity of the water, and commonly not by toxic substances in the water.

As you move to progressively more densely populated areas with increased traffic and imperviousness, you see the impacts to water quality. You already see the consequences of quantity, but with increased density now you add insult to injury.

In the more densely populated areas you are right to worry about the issues of quality.

During the time that we wrote this article we were working in an environment that was in between the two environments—natural and urban—King County was rapidly growing by consuming densely forested areas. We were observing the problem of converting the natural environment. The issues that were being imposed on the natural landscape were much more in the purview of the natural hydrologists.

The novel thing we were in a position to do was apply the scientific hydrology tool and ask what is happening, whereas previously most people had brought an urban hydrologic approach to this kind of situation.

Andrew Reese just wrote an article for Stormwater *magazine ("Voodoo Hydrology," July/August 2006) touching on some of the points you made about quantification. How has the conversation on urban hydrology changed since your article in '97?*

It is perhaps a sorry commentary on the state of the field. Fields are supposed to change. That's an article that could have been written by someone else 10 or 15 years ago. He's describing models that in 1997 were already identified as having limitations. It wasn't fresh news. This is not a criticism of Andrew Reese—who accurately and interestingly described the state of the field—the practice itself hasn't changed and it's a reminder that the standard tools that urban hydrologists still use around the country are not very sophisticated and don't work very well and require many assumptions that don't work but are just convenient.

There is real hydrology that can be done out there, but it is more expensive to do. There are a few jurisdictions that require it and a few hydrologists who know

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how to apply it.

The Pacific Northwest was very unusual in having on staff in the municipal government people who could use more sophisticated hydrology methods and who really understood hydrology and understood how to use these models and took pioneering steps to apply these to urban environments.

The discovery, on one level shocking and on one level expected, was that the models that everyone uses don't work very well. It's not shocking to anyone who lives downstream from a development; who was promised by engineers, developers, and planners that everything would be fine; and who saw what happened with their own eyes. And regulators would say, "They did everything by the book." [The discovery was] that the book doesn't work very well.

Why does the practice of urban hydrology lag that of natural hydrology?

People who study hydrology—in one sense they're engineers, but they are a particular type of engineer—are by and large interested in the tremendous variability and complexity of water moving throughout the environment. The urban landscape is not terribly interesting in that regard. With few exceptions, most hydrologists who are really passionate about the science won't work in an urban setting because most of the complexity is gone.

The really sophisticated models follow the scientific model in explaining the incredibly complex natural environment. It is presumed that you can get away with simpler models in the urban setting. It attracts people with a more engineering bent in being much more of an interface to the question of how you route water through structures.

When you look at the state of the practice as a whole and you look at what's being done—the rational method has been around since 1851 and the SCS method has been around since the '60s—and for the readership [of *Stormwater* magazine] those are the state of the practice. That's not a very sterling level of achievement. That we can apply a model that's 50 years old and wrong is not a good place to stop.

If there's a Moore's Law here, I think it's working in reverse. I was at a conference in southern California about a year ago—a California Stormwater Quality Association conference—and the new term I heard was *hydromodification.* That's exactly what we were talking about in 1997. There are obviously whole communities, whether or not they are publishing, that are aware of these things—particularly that single rainfall event models are not capturing the whole story.

A few of us are doing work from the academic side or private consulting and are taking it further than we took it in 1997. I don't think the field has taken huge leaps since then and it has not penetrated the state of practice, but there's definitely awareness of it.

It doesn't seem characteristic of engineers to reinvent the wheel.

Engineers aren't inventors. They solve problems with models that are tried and true and with a known outcome so that no one can criticize you. It's also supported by liability. Your firm assumes tremendous legal liabilities. There is not great incentive to do something novel if you think you can do it better if you think there is a potential for increased risk. The new things start with researchers who have nothing else to do and only slowly work their way into the practice. So we continue to lose under old standards that ruin downstream aquatic systems because no one gets sued for doing development the same way it's always been done.

What is the current stormwater management trend in Seattle?

The current focus in Seattle and throughout the Puget Sound region is improving the onsite management of stormwater through site design, vegetation and soil retention, and distributed infiltration. These strategies are collectively known as "low-impact development," and they are particularly well suited to this region because we have commonly quite low rainfall intensities that make infiltration feasible across a wide range of soil types. We also have abundant evidence that more "traditional" methods of stormwater management, notably detention ponds or vaults, simply do not achieve their stated goals of downstream protection, particularly where existing high-quality biological conditions exist.

What are you going to cover about in the BMPs and monitoring and testing workshops in Seattle?

In the BMP workshop, I've been asked to talk about approaches to flow control—what are they, what goals should they be seeking to attain, and how successful are they at attaining them? Historically, the focus of such facilities has been to minimize downstream flooding, but they now must achieve a broader range of geomorphic and ecological outcomes as well. Most of our approaches, and the metrics used to evaluate them, have not evolved to meet these new needs as well.

In the monitoring workshop, I plan on reviewing the attributes of physical in-stream habitat that are important to fish, sensitive to urban impacts, and readily (and reliably) measured. The list of such metrics is shorter than one might think, suggesting that many habitat-monitoring plans collect more data than are truly useful for the intended management application.