Not Just Plants

By Vaikko Allen

Bringing unit process-based engineering back to LID

The first time I came across the term "low impact development" (LID) was in the June 1999 "Low Impact Development Design Strategies" manual released by Prince Georges County, Md. Since that time, the term has grown in popularity, and, depending on who you ask, can mean different things, but it is commonly used to mean the prevailing approach to post-construction storm water management, which calls for using runoff-reduction opportunities as a first priority and then flow-through bioretention or other vegetated treatment systems to filter the remaining portion of the design storm.

The predecessor of the LID movement, and persisting in parallel with it, is the classic engineering approach of identifying specific pollutants and hydrologic conditions of concern and selecting storm water management systems with the fundamental unit processes and operations necessary to mitigate them. In many cases, both approaches will produce similar designs because runoff-retention strategies effectively address most pollutants and also mitigate hydrologic conditions of concern. However, where runoff reduction is not feasible, I see the two approaches diverging.

Largely owing to the ancillary benefits associated with landscape-based systems ranging from heat island effect mitigation to increased property values, the default LID approach is to select systems that incorporate plants and soil where retention is infeasible. Usually, this means using the same bioretention systems that retain the design storm in higher permeability soil areas, but with an added underdrain to discharge runoff from the design storm that cannot be infiltrated. Requirements for these systems tend to be narrative, typically covering soil, plant and mulch composition, and minimum dimensions instead of specific water quality outcomes. As a result, thousands of flow-through bioretention systems with underdrains have been installed in the past few years as major Phase I NPDES permits are rewritten to require an LID-based approach to post-construction storm water control. Many of these permits and implementation manuals identify storm water control measures that retain storm water or have plants and soil as LID and exclude non-vegetated treatment systems from use because they do not meet that definition.

This would be fine if the flow-through vegetated treatment systems were always the best non-retention option, but this is not necessarily the case for water quality. More research is emerging that documents significant nutrient export from conventional bioretention soil blends meeting local specifications, particularly when they call for compost soil amendments. Depending on source materials, dissolved metals and other pollutants also may be released as these systems go through a prolonged flushing period when relatively dilute storm water rinses pollutants from the media matrix. Ironically, installing bioretention systems with underdrains in nutrient-sensitive watersheds actually may be contributing to enrichment problems.

Perhaps it is worth a reminder that the LID approach originally was conceived to satisfy the central goal of mimicking pre-development hydrology by reducing runoff. When this goal is met, water quality benefits naturally follow. When runoff-reduction strategies have been exhausted and there still is work to be done, however, we need to return to classic unit process-based engineering principles to select treatment systems. This may mean that we skip conventional landscape-based flow-through treatment in nutrient-sensitive watersheds in favor of systems with more optimized physical, biological and chemical unit processes necessary to capture nitrogen and phosphorus. Some of these options may not be vegetated and may not provide the same ancillary benefits as distributed landscape-based systems, but they may help us avoid unintended negative consequences. In light of the fundamental goal of all NPDES permits to reduce the discharge of pollutants to the maximum extent practicable, this seems like a good tradeoff. SWS

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