Managing Rainfall vs. Runoff

Employing LID practices to control precipitation before it washes over polluted hardscapes

By Stephen M. Benz, P.E., LEED AP

Low-impact development (LID) is the latest buzz term in the world of land development. According to the Low Impact Development Center, LID is "a new, comprehensive land planning and engineering design approach with a goal of maintaining and enhancing the predevelopment hydrologic regime of urban and developing watersheds."

When you think of LID, practices such as permeable pavement, green roofs, infiltration landscapes and biofilters probably come to mind. Most of these elements are adept at managing small volumes of rainfall but do not hold up to the peak-rate, low-frequency, high-intensity-event "design storm" methodologies that storm water engineers use.

We intuitively understand that LID practices are good for the environment; trouble is, the traditional peak-rate-design-storm hydrologic design methods in use today do not generally recognize the intrinsic value of LID practices.

Responding to Rainfall

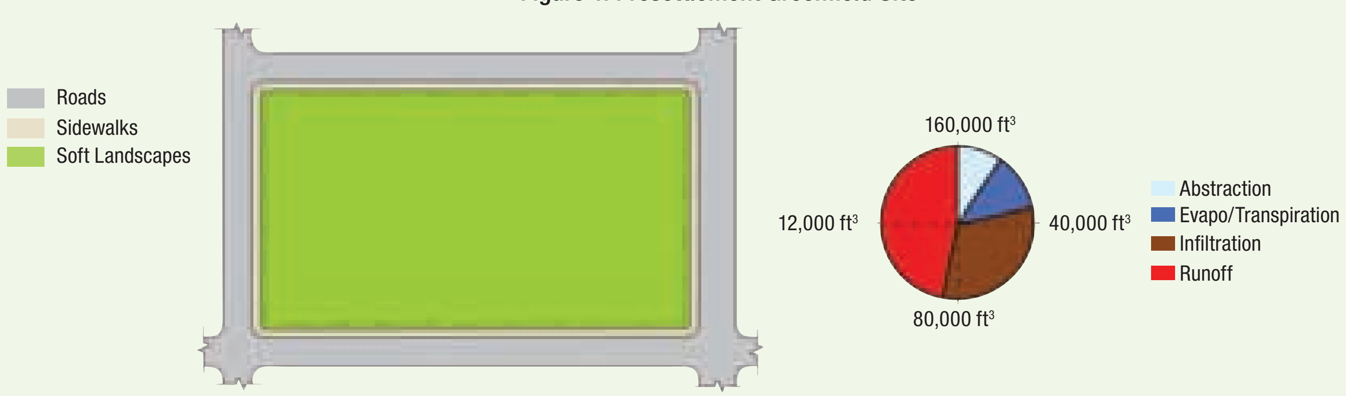
There is a fundamental disconnect between the way we look at the goals of storm water management today and the broader issue of environmental sustainability. The design-storm approach evaluates the effects of flooding, resulting in the application of best management practices that protect downstream systems by regulating and detaining peak rates of discharge from a developed site. The methodology focuses on high-intensity, infrequent rainfall events.

In this scenario, the focus is placed on storm water runoff itself, conceding that the development can and will create a storm water problem that, in turn, must be fixed. Ultimately, this approach degrades site ecology. Left unchecked, impervious areas starve groundwater supplies of rainwater recharge and lower regional aquifer levels. Furthermore, loss of site vegetation prevents copious amounts of plant evapotranspiration, and the cumulative adverse effects of more frequent storm water discharges are seen in downstream receiving streams.

Contrast this scenario to an undeveloped greenfield site where rain falls to earth, infiltrates, evaporates, is stored in ponds and depressions and taken up by plants. What is left is, by definition, storm runoff.

What if the problem was avoided in the first place? LID practices respond to low-intensity, high-frequency rainfall events. By building projects employing LID practices, rainwater volume in the more frequent low-intensity storms (typically less than 1 in. per day) can be returned to the ground and directly to the atmosphere rather than washing over impervious surfaces, carrying urban pollution downstream. The message is becoming clear—manage

Figure 1: Presettlement Greenfield Site



Block Plan **Annual Water Balance**

rainwater, not just storm water.

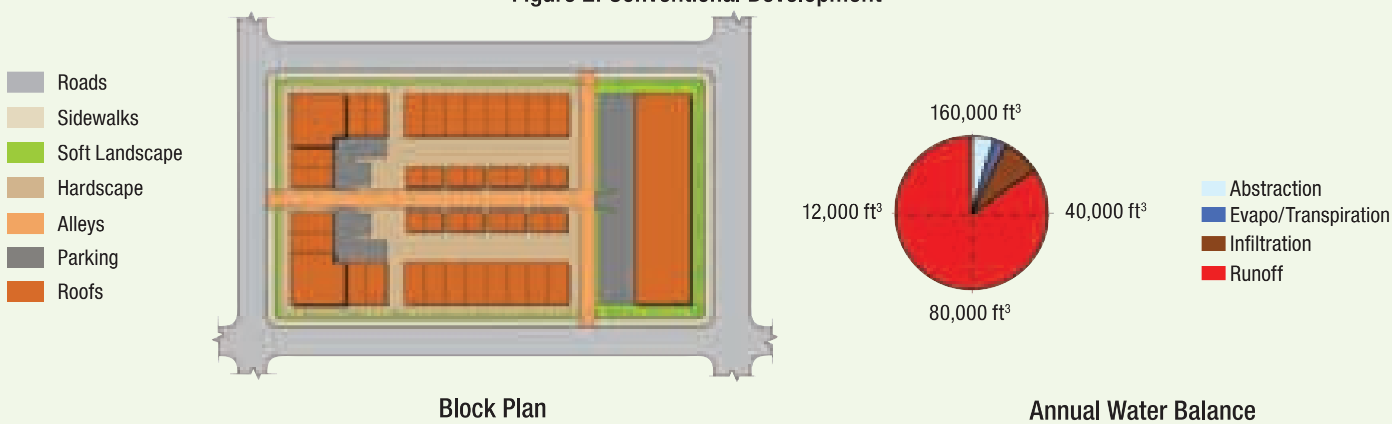
One challenge facing a rainwater management approach is the current practice of matching peak rates of flow for predevelopment and post-development site conditions. The hydrologic tools used to evaluate peak rates are not well-suited to evaluate LID practices and do not promote the value of these techniques. New hydrologic methodologies considering low-intensity, high-frequency storms are needed to deal with small storms and the benefits of using LID.

Case Studies

For the proposed 450-acre Southworks mixed-use development by Lake Michigan on Chicago's South Side, engineers at Sasaki Associates, Watertown, Mass., used an innovative approach to evaluate and understand LID measures. Using a new, home-grown, graphic-based analysis tool, Sasaki calculated the site's annual water balances for various development scenarios based on a "small-storms-hydrology" methodology (see Figures 1, 2 and 3).

Proposed city block configurations were tested to determine how closely the performance of the LID-based project could emulate pre-settlement,

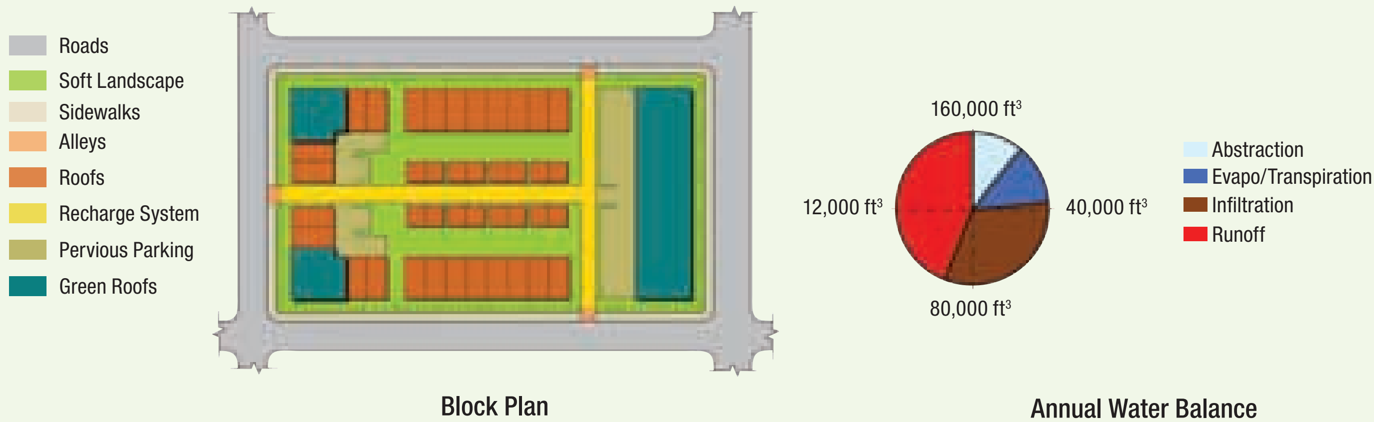
Figure 2: Conventional Development



or greenfield, conditions with respect to the site's rainwater profile—abstraction (storage), infiltration, evapotranspiration and runoff. Figure 1 (see page 10) shows annual water balance volumes for the pre-settlement greenfield site, which were used as an optimum target. Figure 2 (see page 11) depicts the conventional development, including hardscapes and traditional impervious surfaces and roofs. Figure 3 illustrates LID alternatives such as green roofs, infiltration alleys and permeable pavements. In Figure 3, the benefits of using LID are obvious.

But LID is not just for greenfield sites. At the Massachusetts Institute of Technology's Stata Center, site designers incorporated various LID techniques—infiltration landscapes, biofilters for water quality enhancement and rainwater harvesting for toilet flushing and irrigation, for example—into this ultra-urban campus setting. This tightly integrated water-receiving landscape removes more than 90 percent of the annual runoff volume and urban storm water pollution from the city's storm water sewer system. By acknowledging that rainwater has significant resource value, the Stata Center landscape cleanses and stores the resource for reuse as a priority over discharging its storm water to the Charles River.

Figure 3: LID Alternatives



The Square 54 development in Washington, D.C., is another example of LID rainwater management in an ultra-urban setting. Located downtown, this commercial and residential development sits atop a new parking garage. Rainwater is captured before it drains to the city's combined sewers, where it is then treated and circulated through an aquatic treatment landscape. This water landscape system is comprised of plants and pools designed to treat the captured rainwater so that it can be used for onsite irrigation and makeup water.

MIT's Stata Center demonstrates that LID techniques can be effective in urban settings.

The Future of LID

Perhaps the biggest challenge facing wholesale acceptance of LID practices in today's market is an understanding of their value and quantification of their benefits. Effectively using these practices is not business as usual; it warrants nontraditional application of water management strategies. The time for rainwater management is here. SWS

Stephen M. Benz, P.E., LEED AP, is principal for Sasaki and sits on the Sustainable Site Technical Advisory Group, U.S. Green Building Council. Benz can be reached at 617.923.5311 or by e-mail at sbenz@sasaki.com.

For more information, write in 5003 on this issue's Reader Service Card.

WEBresources >>>

Related search terms from www.waterinfolink.com:
LID, rainwater management, runoff

For more information related to this article, visit www.estormwater.com/lm.cfm/st050903