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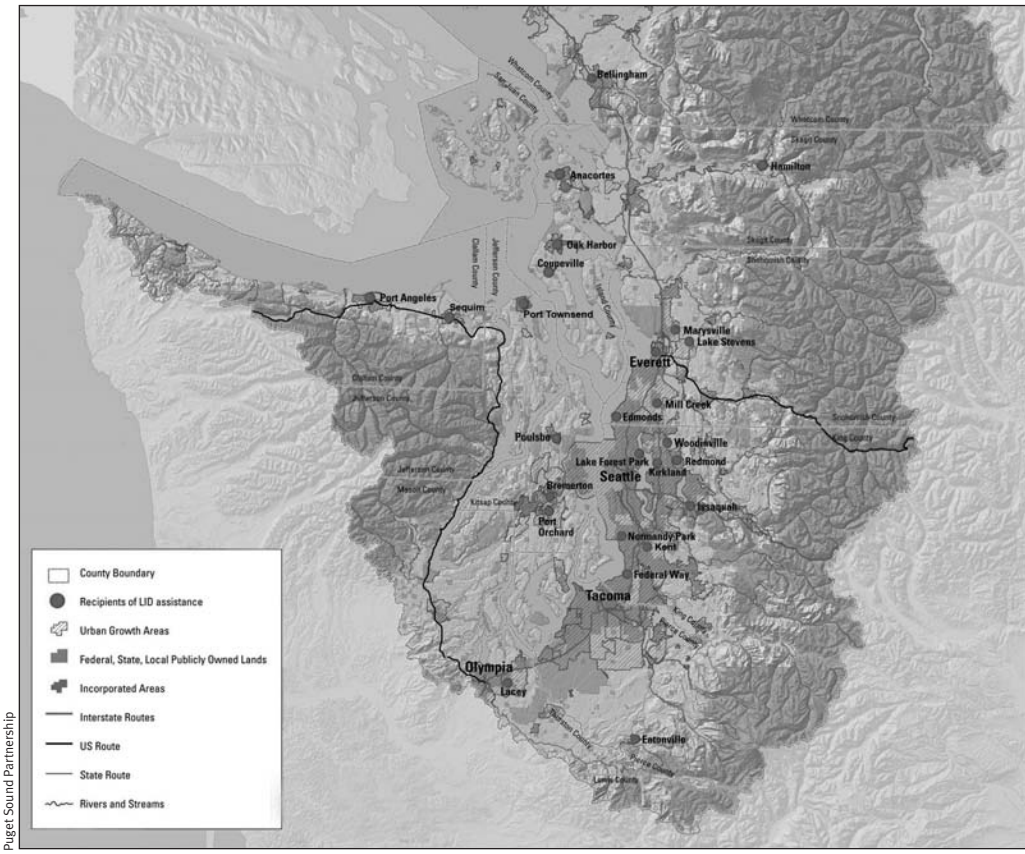
PRACTICE LOW-IMPACT DEVELOPMENT

Puget Sound Partnership Low Impact Development Local Regulation Assistance Project: Goals, Methodology, Products, and Lessons Learned

By Wayne E. Carlson, AICP

Between 2005 and 2009, the Puget Sound Partnership, through its consultant, AHBL Inc., provided free technical assistance to help 36 local governments in Washington State's Puget Sound basin integrate low-impact development (LID) into their codes.

This effort is believed to be the largest of its kind in the United States. The following introduction provides an overview of LID by describing what it is, where it originated, where it is being employed, and what the benefits are to its use. Next, the article turns to a sharing of lessons learned from the Puget Sound Partnership's technical assistance project between 2005 and 2009. Central to this discussion will be the identification of land-use and engineering requirements that often serve to inhibit or preclude the use of LID techniques and the strategies that were developed to integrate LID into local codes, standards, and regulations. The article concludes by identifying several communities in Washington State that have modified their codes and standards to facilitate the use of LID and the integration strategies that they chose to pursue.



Puget Sound Partnership

AN INTRODUCTION TO LID

Low-impact development is a stormwater management strategy that emphasizes the use of natural site features along with small-scale engineered facilities which are distributed in a manner that attempts to replicate natural hydrologic patterns.

A variety of LID technical guidance manuals are geared to specific climatologic

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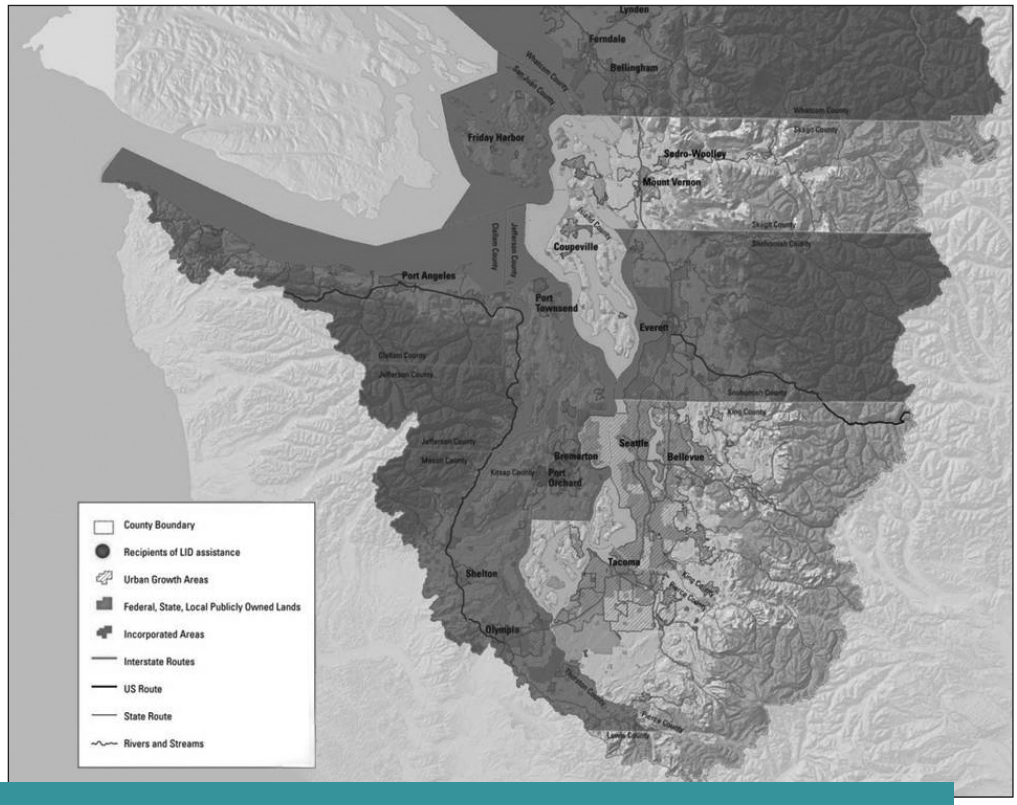
About the Author
Wayne Carlson, AICP, is a land-use planner and associate principal with AHBL, Inc. He has helped nearly 40 communities in Washington State amend codes and standards to facilitate the use of low-impact development practices. He holds a master of city and regional planning degree from The Ohio State University. His other work can be found in the *Journal of Planning Literature* and the *Justice System Journal*.



These maps show the cities, towns, and counties in the Puget Sound region of Washington that received assistance from the Puget Sound Partnership and AHBL, Inc.

conditions. Although the manuals for Prince George's County, Puget Sound, and Truckee Meadows, to name just a few, include different recommendations and design standards, there is broad consensus regarding the practices commonly agreed to embody LID. Generally agreed upon LID practices include the following:

- Conservation of natural areas through compact site design
- Bioretention/rain gardens
- Vegetated roofs
- Permeable paving
- Rainwater collection systems
- Minimal excavation foundations

Because conservation of natural site features and the use of "green stormwater infrastructure" are hallmarks of the LID approach, this "back to the future" approach to stormwater management often has an aesthetic appearance similar to the drainage strategies of yesteryear.

The birth of LID in the United States occurred during the late 1990s in Prince George's County, Maryland. LID was initially explored as a more economically viable stormwater management strategy to expensive, conventional, centralized facilities such as retention/detention ponds and vaults. As the practice spread from Prince George's County to areas including California, Texas, and the Puget Sound region of Washington, additional benefits to the approach gained widespread acceptance.

BENEFITS OF LID

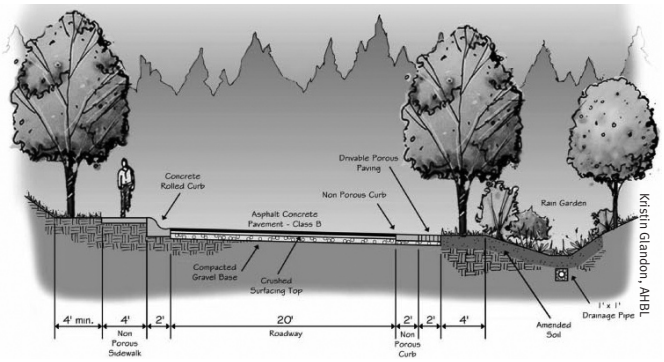
The benefits of using LID are becoming rapidly understood as the practices become more commonplace throughout the United States.

Water quality

First and foremost, LID represents a stormwater management strategy that is particularly effective for water quality treatment and stormwater flow control. Bioretention, for instance, works well for removing pollutants such as bacteria and heavy metals from stormwater.

Flow control

From a flow control perspective, the distributed site-based source controls, which are a hallmark of LID, allow for a closer replication of the hydrologic cycle because the stormwater from frequently occurring events is allowed to be more quickly returned through evapotranspiration and infiltration. Stormwater management systems that specifically address the frequent



Kristin Glandon, AHBL

This green street section shows how LID techniques can be used to reduce and treat stormwater runoff near its source.

(weekly or monthly rather than the 50- and 100-year storm) or micro-storms through distributed site-based controls have demonstrated effectiveness in preserving stream integrity.

Aesthetics

LID drainage features are widely considered to be more aesthetically attractive than storm ponds with 3:1 engineered side slopes surrounded by chain-link fencing.

Efficient use of land

LID practices such as bioretention also allow for landscape requirements to also be used to satisfy drainage needs. This results in more productive use of land.

Environmental benefits

LID tends to result in increases in the urban forest, which is related to improved air quality, cooler streams, and reductions in the urban heat island effect.

Cost

By managing stormwater as close to the source as possible, there are fewer necessary off-site, downstream drainage improvements. Comparisons assembled by the EPA show that the construction cost for LID is less than conventional design. Finally, because many LID practices are naturally occurring and repairable, the life cycle costs can be less than a conventional system.

ENGINEERING REQUIREMENTS AND LID

Even though the benefits to water quality, flow control, aesthetics, and cost are well established and understood, a local government's land-use and engineering codes and standards may unintentionally discourage or prohibit the use of LID.

Engineers are required to consider the probability of failure associated with their designs. That is why concepts such as "factor of safety" are engineering principles used in everything from pavement to stormwater system design.

This aspect of engineering may unwittingly contribute to a risk-adverse mindset that discourages many engineers from exploring new design strategies.

Because until recently most communities could not point to locally constructed examples of LID projects, engineers were slow to revise engineering standards to embrace LID. Instead, early LID projects had to overcome engineering conservatism, or worse, skepticism, through the construction of redundant designs that contained LID practices reinforced with a complete and redundant conventional engineering design.

As such, LID was slow to take root except where local government engineers were willing to support an unconventional design or where financial incentives were provided to the development community to pursue a redundant design.

Many of the earliest LID projects were designed and constructed prior to the adoption of locally or regionally specific LID design manuals. Moreover, many early LID projects were approved through engineering variances or deviations. Although different from classical land-use variances that require the demonstration of hardship, the standard of review for engineering variances is often lower and involves an equal or comparable engineering solution to the design problem. In short, many early LID projects involved what was essentially a negotiated design between the project's engineers and planners and the local government's engineers and planners.

After the initial LID pilot projects were designed and constructed, several local governments in the Puget Sound region came to understand that the widespread use of LID practices would only occur where regulatory uncertainty was minimized. LID practices needed to be permitted as-of-right with standards that were easily understood by everyone concerned with development—the applicant, the local government, and the public.

PUGET SOUND PARTNERSHIP LOCAL GOVERNMENT ASSISTANCE PROJECT

In 2005, the Puget Sound Partnership, which is headquartered in Olympia and was then known as the Puget Sound Action Team, began a program geared at facilitating the use of LID by providing direct technical assistance to local governments to revise local codes and standards related to stormwater management and land development practices. The objective of this effort was to significantly increase the use of the LID approach to stormwater management and LID practices for projects within the participating jurisdictions through code revisions that would both remove regulatory obstacles inhibiting LID and facilitate the increased use of the LID approach and best management practices (BMPs) throughout the Puget Sound basin.


Wayne Carlson, AHBL

In the Meadow on Hylebos residential subdivision in Pierce County, Washington, stormwater is allowed to sheet flow across a flat curb into a bioretention facility.

The integration of development controls among various municipal code chapters sometimes varied widely among jurisdictions. Through the preparation of a gap analysis between the design principles found in the *Low Impact Development Technical Guidance Manual for Puget Sound* (2005) and local government codes and engineering design standards, several common themes emerged:

- Lack of clustering provisions in local zoning or subdivision codes
- Road and subdivision standards that required vertical curb and gutter, closed conveyance, and tight-lining drainage directly into municipal systems
- Clearing and grading provisions that were wholly inconsistent with a strategy of preserving native soils
- Zoning standards that did not recognize the value of green stormwater infrastructure as passive open space

As a result of the gap analyses, participant jurisdictions made code amendments in the following locations:

Zoning Code

Landscape requirements including requiring nominal amounts of native vegetation were established by zone, allowing parking lot landscaping to be designed to allow for stormwater management, and provisions for maintaining tree canopy cover were added. Native vegetation recommendations were provided where LID was required and in "performance developments" such as planned unit developments. Requirements were established for pervious surfacing and integrating bioretention swales with required landscaping in parking areas where site and soil conditions make LID feasible.

Stormwater and Drainage Code

LID site assessment requirements were established and often integrated into local stormwater and drainage codes or occasionally in zoning codes. Conventional stormwater reduction goals and requirements were established that could be met through any combination of LID BMPs.

Clearing and Grading Chapter

Model language was prepared that sought to provide guidance for clearing and grading in a manner more consistent with the limited site disturbance principles that are central to the LID approach to stormwater management. An "LID Construction Controls" document outlines standards to protect LID BMPs during construction.

Public Works Standards

Road standards and detail drawings allow for more narrow driving lanes, reductions in impervious surface, alternative surfacing methods for shoulders and walkways, and bioretention facilities in roadside swales. Stormwater management regulations were revised to allow the use of the BMPs found in the *Low Impact Development Technical Guidance Manual for Puget Sound* and the *Stormwater Management Manual for Western Washington* (2005).

A "LID Project" Chapter

This chapter details design standards for projects designated as LID projects. Depending on local preference, LID projects were either encouraged through incentives or required outright.

ENCOURAGING LID THROUGH LAND DEVELOPMENT REGULATIONS

As the Puget Sound Partnership discovered approximately six years ago, land development regulations are important tools to encourage the widespread use of LID and can be used to require LID where local will exists.

In Washington, California, and elsewhere, the NPDES Municipal Stormwater Permits, which implement the Clean Water Act (CWA), have served as vehicles for implementing the CWA's "Maximum Extent Practicable" standard for both the water quality and flow control. In fact, in Washington, challenges to both the Phase I and Phase II NPDES Municipal Stormwater Permits resulted in rulings that require the Washington State Department of Ecology to modify the permit to require LID in the largest cities and counties unless infeasible. The permit applying to Phase II jurisdictions was modified to require that impediments to LID are removed.

Our experience in western Washington is that the single greatest tool to encourage LID is to have technical design standards in place that allow the applicant, agency, and public to understand if the design meets the technical requirements for water quality treatment and flow control under the local government's stormwater management manual. In western Washington, the design standards are embodied in the *Low Impact Technical Guidance Manual for Puget Sound* (2005).

As LID became more widely understood as a stormwater management strategy, the role of land development regulations to encourage or require LID became even more prevalent.

During our first meetings with the technical assistance participants in 2005, it became apparent that the mechanics of making changes to ordinances would require considerable care. The publicity of LID resulted in several instances where project applicants attempted to convince local government staff that their project proposals were "low-impact developments" and therefore worthy of approval or some form of incentive, regardless of the actual stormwater design and function.

No doubt some of the proposals would have likely warranted recognition as credible additions to the local inventory of LID projects in Washington. However, as one local government staff member lamented, some proposals claimed to be LID by offering little more than narrow roads—like a "wolf in sheep's clothing."

Land development regulations are important tools to encourage the widespread use of LID and can be used to require LID where local will exists.

LID involves surface water management techniques that do not always translate neatly into traditional zoning terms. While the partnership had successfully promoted the use of LID in the region for several years, the idea of specifically defining how much LID must be in place before a project is deemed an "LID project" was an unexpected twist to the project and never an objective of the initial regulatory assistance. There was also concern that defining an LID project might result in less use of LID BMPs if the use of such techniques could only occur in the context of an LID project. Because of these factors, it was not without some trepidation that the Partnership and AHBL team began the process of defining the minimum attributes of an LID project.

Completing this new task required extensive internal and interagency conversation to determine which minimum thresholds were most appropriate. The participants included staff from the Washington State Department of Ecology, Washington State University Extension, the University of Washington, the Puget Sound Partnership, and its consultant AHBL.

Washington State's Growth Management Act (GMA) applies to most counties in western Washington. GMA is growth management

Natasha Ali-Khan, AHBL

During the recent redevelopment of a public housing project in Seattle's High Point neighborhood, the city integrated LID techniques such as porous concrete and vegetated swales into the right-of-way.

legislation that directs counties and their cities to establish urban growth areas where future urban growth will occur.

The initial LID standard evaluated was a rural standard known as Ecology's 65/10/0 rule for allowing full dispersion of developed project runoff. The 65/10/0 standard was meant to apply to rural settings where the standards include a minimum of 65 percent vegetation preserved or replanted, a maximum of 10 percent impervious surface coverage, and zero percent effective impervious surface coverage. During preliminary conversations, it was concluded that the 65/10/0 rule was applicable to rural areas, but likely unattainable in most urban development scenarios.

As a result we established a sliding scale for minimum native vegetation retained or restored on-site, thereby balancing LID standards with urban density requirements mandated under GMA. The scale ranges from 35 percent for some residential zoning down to 10 percent for commercial and industrial settings.

We also felt that minimizing impervious surfaces of the development site was essential for a proposal to be considered an "LID project." A sliding scale of maximum impervious surface standards was developed by reviewing existing coverage limitations in a variety of jurisdictions for different zone designations while considering typical commercial, industrial, urban-residential, and rural-residential development patterns.

The biggest challenge, however, was to develop a proxy or measure of the distribution of surface water management facilities throughout a project site. We concluded that a single infiltration pond on a project site would not meet the intent of LID in managing stormwater as close to where it fell as possible. Acknowledging that stormwater detention requirements would most often need to be met using a mixture of LID and conventional BMPs, we ran a variety of modeling exercises to determine the extent to which the volume of conventional facilities could be reduced using LID practices while still meeting state stormwater management requirements.

The result was the preparation of tables that served as design guidelines for new development. So that designers did not have to run two complete sets of modeling (one for conventional and one for LID), we prepared one table that provides modeling assumptions for impervious surface area and turf for different residential and commercial zoning. This served as the "before" project for modeling purposes. A second table was developed that identified specific percentages that conventional detention volume must be reduced by using any combination of LID techniques found in the *Low Impact Development Technical Guidance Manual for Puget Sound*. In short, newly defined LID projects would include three primary elements: 1) minimum percentage of native vegetation retained or restored, 2) maximum allowable impervious surface area, and 3) minimum reduction in conventional stormwater detention using LID techniques from the region's LID manual. All would be achieved using a state-approved runoff model.

The role of the "LID project" was valuable for local governments that chose to provide incentives for LID projects. In jurisdictions where LID was incentive-based, the local definition of LID is often a single chapter that also contains the application requirements and the applicable incentives. Where applicants met the design standards for the LID project, an incentive was earned. Some of the more popular LID incentives included the following:

- Increased density
- Expedited project review by a dedicated team
- Reduced application fees
- Reduction of stormwater fees

In other instances, local governments elected to require the use of LID as the stormwater management strategy of choice. In those jurisdictions, the value of defining the LID project was in communicating how much LID was required to satisfy the local standard.

Other jurisdictions chose to require LID in sensitive basins such as shellfish-growing areas. Where jurisdictions required LID, the integration of the standards into local codes was typically not in the form of a single municipal code chapter. Instead, integration was in the form of a large number of small amendments occurring throughout the jurisdiction's municipal code, engineering design standards, and occasionally, comprehensive plan.

Langley, Washington

Title 15 of Langley's city code requires that "all reasonable and appropriate low impact development measures shall be incorporated into site design before conventional on-site detention and infiltration methods are considered." The city engineer is vested with the responsibility of determining whether all reasonable and appropriate measures were taken. The city uses the *Low Impact Development Technical Guidance Manual for Puget Sound* as the design criteria for LID BMPs. Specifically, LMC 15.01.025.B.14 adopts the manual as it now exists or *is hereafter amended*. The "hereafter amended" language is powerful because it means that Langley's standards will evolve with the science of LID.

Mason County, Washington

Chapter 17.80 of Mason County's code requires LID for all new projects in the Belfair and Allyn urban growth areas unless deemed infeasible by the county's public works director. Projects are required to meet flow control standards through the use of LID BMPs. The standard varies according to the infiltration rate of the underlying soil.

Redmond, Washington

LID was integrated into Redmond's standards through amendments to technical design guidance documents that are adopted administratively by the city's public works director. Specifically, LID was integrated through amendments to the Clearing, Grading, and Stormwater Management Technical Notebook (www.redmond.gov/insidecityhall/publicworks/utilities/technical07.asp). Although the changes to the standards were quickly adopted, because the amendments were not subject to the legislative process accompanying codes, public awareness of the availability of LID has been minimal.

Sammamish, Washington
Chapter 21A.85 of Sammamish's code outlines the incentives available to developments that integrate LID into project design. Consequently, these provisions do not define LID projects. The use of LID can be quite minimal or extensive with the incentives being proportionate to the amount of LID or "technique points" used. Incentives include increases in allowable building height, increases in density, and public recognition in the city's newsletter.

LESSONS LEARNED

Over the course of assisting 36 cities, towns, and counties amend local codes and standards to facilitate the use of the LID strategy, many lessons were learned.

Participation from all key departments is important. From the beginning, we realized the importance of including staff from all key departments of the local governments. This includes planning, public works, and fire safety staff. Ideally, this included approximately four to five staff members that perform project development review, community or long-range planning, engineering, maintenance, and fire/emergency response. It was very possible to have too few staff at the meetings (e.g., two) and equally possible to have too many (e.g., 10). Based on our work, somewhere within this range appears ideal.

Recommendations should be refined continually. Early on, in 2005, the project team was asked to define minimum elements of an LID project. This proved to be an ongoing endeavor, where new information from constructed projects and court decisions has led to continual refinements to the standards that are at the heart of this work.

Judicial review of non-LID standards can affect the recommendations. Decisions by the Pollution Control Hearing Board and the Washington State Supreme Court served to change both the nature of the recommendations and the method by which the recommendations are integrated into local codes and standards.

Voluntary and required standards are integrated into local codes in different ways. The voluntary or incentive-based approach to LID was often characterized by the preparation of a stand-alone code chapter. Where jurisdictions required LID, the integration approach typically resulted in a greater number of amendments, albeit smaller in scope, over a broad range of land-use, drainage, and engineering codes and standards.

Pilot projects can reduce skepticism. The construction of pilot projects served to make the adoption of the technical assistance considerably easier in later rounds. During the first two years of assistance, it was common for there to be both enthusiastic and pessimistic members within the working group of each local government. Increased confidence in the performance of LID practices diminished the incidence of skepticism in many jurisdictions.

Maintenance concerns must be addressed. Virtually every local government we worked with displayed concerns regarding maintenance. These concerns dwarfed other concerns often articulated about LID, such as cost, performance, protection of groundwater, and longevity. Maintenance concerns were typically greatest regarding bioretention swales on private property (especially single-family residences) and within the municipally owned street right-of-way. However, these concerns were addressed by providing new guidance and training for municipal maintenance staff, limiting individual bioretention cells on single-family residential properties, directing the siting of bioretention cells and swales to common areas that can be more readily maintained, and including language specifically allowing municipal staff to inspect LID facilities on private lands and charge property owners for needed maintenance performed.

> LID involves surface water management techniques that do not always translate neatly into traditional zoning terms.

Legislative calendars can delay adoption. Despite all the work that the project team and local government staff did, there was typically a lag time, sometimes long, between the completion of the recommended code amendments and review and adoption of the recommendations by the local legislative body. The lengthy calendaring process in some jurisdictions could only be diminished through concurrent education of decision makers by local agency staff. In those jurisdictions with lengthy legislative calendars and local agency staff that waited to educate decision makers after culmination of the project, it was not uncommon for the recommendations to languish a year prior to adoption.

LID is evolving. Many jurisdictions showed significant interest in and requested additional local, national, and international information on new monitoring results and research. Whereas LID practices may have initially been viewed with a degree of skepticism, the technical assistance recipients over the last two years in particular showed considerable interest in creating standards that reflected the latest in LID thinking.

A low-technology rainwater collection system in a residential environment. iStockphoto.com/Suzanne Carter-Jackson; design concept by Lisa Barton.

Correction

The last line of the July article was inadvertently cut due to a production error. The full last sentence should read: "The process for regulating charging stations is very similar." *Zoning Practice* regrets the error.

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HAS YOUR COMMUNITY EMBRACED LOW-IMPACT DEVELOPMENT FOR STORMWATER MANAGEMENT?