Reining in the Storm -- One Building at a Time

A Basic Guide to Low Impact Development

About this Guide

This guide is an introduction to Low Impact Development technology. It is intended for use by public officials, policy makers, and interested members of the community. Web links to more in-depth information on LID design are listed on the back page of this guide.

LID in a Nutshell

LID is a comprehensive, site-based planning and design strategy to manage both quantity and quality of stormwater runoff. As a practical, low-cost alternative to conventional stormwater management, LID does a better job of protecting natural and economic resources. LID offers improved control over the volume, velocity and quality of surface runoff, particularly from the frequent small storms that deliver the lion’s share of pollutants to local rivers, reservoirs.

LID uses small, economical landscape features, known as integrated management practices. These practices are distributed to minimize surface runoff at its source. LID practices intercept, retain, and filter runoff until it infiltrates into the soil or evaporates into the atmosphere, thereby reducing the volume and rate of runoff. The intended result is that a developed site should have no adverse effect on the flow of the stream to which the site drains during and after storms, i.e., the natural rising and falling of the stream, as reflected in the predevelopment hydrograph, remains unchanged.

LID views stormwater as a resource. By controlling the quality and quantity of runoff, the health and supply of surface and ground water sources should be better protected from the impacts of development-caused pollution.

(This residential example of LID includes rain gardens and grassed swales.)

Source: The Low Impact Development Center
LID: A Stormwater Strategy

Stormwater pollution has caused the near-collapse of downstream water-based economies and has increased the health risks of drinking water supplies, fishing and swimming.

Causes of Stormwater Pollution

When it rains, stormwater picks up pollutants and carries them to local streams, rivers and reservoirs. Sources of water quality and quantity problems are varied and include:

- Land-disturbing activities, such as construction or tilling of fields, with absent or inadequate erosion and sediment controls,
- Uncontained animal waste, resulting in runoff laden with nutrients and disease-causing pathogens,
- Excess fertilizer applied to lawns or fields and washed via stormwater to local waterways, and
- Absent or inadequate stormwater controls, allowing runoff to flow quickly and in large volumes from rooftops, roads and parking lots to streams, rivers and reservoirs. Frequent, concentrated flows erode stream banks, scour stream beds, degrade the aquatic environment, and send tons of dirt downstream. In addition, these flows inhibit the ground infiltration needed for recharge of aquifers.
**Downstream Benefits LID**

In slowing, filtering, and retaining stormwater on a site, LID:

- Prevents pollutants such as nutrients and sediment from flowing off land and harming downstream neighbors and industries,
- Enhances the infiltration of stormwater and the ability of rainfall to recharge aquifers,
- Helps ensure a steady supply of ground water and preserves the base flow of streams during years of drought conditions,
- Reduces water utility rate-payers’ costs of removing sediment,
- Protects the food chain by reducing opportunities for sediment to smother aquatic life,
- Helps protect against the oversupply of nutrients and associated oxygen-deprived dead zones in waterways,
- Improves conditions for fishing, swimming and boating, and
- Protects the health of drinking water supplies by reducing opportunities for sediment to carry pathogens such as cryptosporidium and giardia to drinking water intakes.

**Basic Principles of LID**

Five basic design principles represent the spectrum of true Low Impact Development:

**Conservation:** The very first step of LID is to assess a site to identify and protect features that provide valuable natural functions associated with controlling stormwater. These areas may include drainage paths, streamside forests, permeable soils, steep slopes, and wetlands. Conservation of sensitive areas is a cost-effective first step in maintaining the natural processes for controlling runoff and protecting water quality.

**Minimization of Impacts:** A second step is to look for opportunities to limit clearing, grading and the addition of impervious surfaces. Buildings, roads and parking lots should be located so as to protect the water-related characteristics of a site and to enhance the connectivity of undisturbed natural areas.

**Direction of Runoff to Natural Areas:** Drainage systems for hard surfaces such as parking lots and rooftops can be disconnected from other hard surfaces in order to help slow and filter stormwater. Gutters and downspouts can direct rain to planting beds. LID treats stormwater as a precious resource, as it is captured and allowed to infiltrate, evaporate or be reused.
Use of Small-Scale Controls: Also called Integrated Management Practices, LID practices are integrated into the landscape and the built features of a site. Examples of LID practices include rain gardens, vegetated swales, cisterns, green roofs, and amended soils for better infiltration. When working together as a system, small-scale LID practices are designed to reproduce natural processes that occur during rainfall, such as infiltration, detention, retention, evaporation, and groundwater recharge.

Pollution Prevention and Education: LID includes erosion and sediment control and prevention of soil compaction during site preparation and construction. Oversight to ensure proper installation and maintenance of LID practices should be institutionalized. While maintenance is minimal or non-existent for many LID practices, other practices should be monitored.

Community education, including ongoing programs for owners and operators of properties with LID practices is essential. Homeowners or a responsible management entity will need to ensure ongoing maintenance of certain stormwater infiltration practices.

Rain Gardens: A Landscape Feature Requiring Special Soils
Source: Low Impact Development Center

In general, the public lacks understanding of what happens to rain water or stormwater once it “disappears” down a storm drain or roadside ditch. LID offers an opportunity for localities to advance stormwater education such that stormwater is viewed as a resource rather than an unwanted commodity.
LID education offers citizens an opportunity to help reduce the impacts of polluted stormwater on rivers, streams, lakes and drinking water reservoirs. Citizens have an opportunity to see how the restoration of natural processes can minimize the runoff pollutants that cause big problems with big price tags.

**LID Practices in Use**

LID technology includes conservation design during site planning as well as small-scale stormwater practices. Some examples include:

- Conservation and preservation of valuable natural areas of a site,
- Selective clearing and grading, including tree preservation,
- Minimization of paved surfaces, such as use of narrower streets,
- Permeable pavement to allow infiltration of stormwater,
- Vegetated water quality swales to carry, store, and filter runoff,
- Bioretention areas, such as rain gardens, to store and filter runoff,
- Infiltration trenches to promote seepage of rainfall into the soil,
- Vegetated filter strips to pre-treat runoff, slow flow and filter out pollutants,
- Cisterns to capture rain water for reuse or slow release,
- Green rooftops to absorb and filter rain water, and
- Amendment of soils to improve the ability of rain to infiltrate.

A combination of practices reflecting site characteristics may also include disconnecting impervious areas while connecting pervious surfaces, minimizing disturbances, minimizing smooth surfaces, detaining flows, and flattening grades in impact areas. The use of LID practices can provide an attractive and cost-effective alternative to curb and gutter and other conventional stormwater structures.

**LID as an Integrated System**

As mentioned, LID designs employ a variety of practices, both structural and nonstructural. Each practice has a task to perform, either by itself or in series with other practices. Working together as a system, LID management practices filter and control the amount and speed of rain water that flows off a site.

*LID practices function as an integrated system. Source: The Low Impact Development Center*
A LID Practice for Almost Any Site

LID is a versatile approach to stormwater management. LID strategies can be applied to large-scale new development, small infill lots, existing built sites as stormwater retrofit, and projects on agricultural lands.

While some tightly-constrained sites may not lend themselves to replication of true pre-development hydrologic conditions, there are LID practices that can improve stormwater management on just about any site. LID is a flexible tool, and practices can be combined with conventional stormwater controls for a hybrid design where appropriate.

LID is not a one-size-fits-all solution, and goals will vary according to site conditions. Each practice or system of practices is specified to reflect soil, slope and other site conditions and must be properly sized, designed, installed and maintained.

Experience with LID

While the LID approach may be new to some, LID practices have been in use for many years. Decades-old rain gardens continue to perform without any intervention on the part of the owner. In other cases, poor design, construction or maintenance has resulted in poor performance.

Overseas, the LID approach has been institutionalized in some countries. In the U.S. and abroad, engineers and planners continue to benefit from the on-the-ground experience with LID practices.
LID Advantages Over Existing Stormwater Controls

Conventional stormwater management is primarily designed to convey and store runoff from infrequent, larger storms. LID mitigates pollution from the small, frequent storms not always captured by conventional stormwater management.


LID Costs and Economic Benefits

LID costs reflect local site conditions. In general, the lifecycle costs of LID are lower than those of conventional stormwater infrastructure. In some cases, LID can lower construction costs; in other cases, initial LID construction costs can be equal to or higher than the costs of conventional development. In all cases, LID helps protect downstream taxpayers from bearing the costs of upstream development.

LID delivers a number of economic benefits:

- LID practices often improve the aesthetics and marketability of property while providing the benefits of stormwater infrastructure.
- LID reduces lifecycle costs of construction, operation, and maintenance of stormwater infrastructure.
- LID is preventative in nature and, as a result, is more cost effective than cleaning up waterways after the fact.
- LID mitigates impacts of small frequent storms not always addressed by conventional stormwater control methods.

State and local governmental agencies can meet existing mandates of stormwater regulations and other programs through use of LID. LID is a recommendation of a number of regional and local programs.

LID is also used to tackle problems associated with combined sewer overflows. LID can help localities implement Total Maximum Daily Loads. (waterway clean up plans)

Next Steps

At present, most jurisdictions require waivers of standards in order for LID practices to be implemented in place of conventional stormwater controls. To offer LID as a practical stormwater management option, localities should:
• Take advantage of model ordinances, field data, and technical resources available to assist localities in pursuing LID as a local option,
• Update codes, ordinances, and public facilities design standards manuals to include practices and quantitative data pertaining to the effects of LID on stormwater quantity and quality,
• Offer plan reviewers and policy-makers opportunities to become familiar with new standards so that LID designs can be reviewed “by the book,”
• Ensure that the submittal of a LID application will not increase the time and costs associated with plan review and approval,
• Request that LID be pursued as a first option, and
• Offer incentives, such as fast-track review, for LID plans.

For more Information about LID:

U.S. Environmental Protection Agency
LID publications, links
www.epa.gov/owow/nps/lid/

Low Impact Development Center
LID tools, research, training, program development, design
www.lowimpactdevelopment.org/