Stormwater Best Management Practice

Site Design and Planning Strategies

Minimum Measure: Post Construction Stormwater Management in New Development and Redevelopment
Subcategory: Innovative BMPs for Site Plans

Description

Urban development can significantly alter the natural features and hydrology of a landscape. Development and redevelopment usually create impervious surfaces like sidewalks, parking lots, roadways, buildings and compacted open spaces. Rainwater cannot soak into these hard surfaces and instead flows across them, collecting sediment, used motor oil, pesticides, fertilizers and other pollutants. In most urban areas, a complex pipe system conveys this contaminated stormwater into streams and coastal waters.

Historically, the goal of stormwater planning has been to prevent localized flooding by moving large amounts of water off-site as quickly as possible. This traditional approach can lead to downstream effects related to water quantity and quality. Stormwater that flows directly into storm drains cannot soak into soil and recharge aquifers. Larger storms have led to increased stormwater volumes and velocities that can cause flooding of pivotal streets, which leads to safety concerns, traffic nightmares, stream bank erosion and water quality impairments. Additionally, traditional stormwater management approaches can be costly and may strain municipal budgets as the need for expanding storm sewer systems and maintaining the existing systems increases.

Concerned by the environmental impacts and rising costs of traditional stormwater management approaches, many communities are implementing alternative site design strategies that aim to restore natural hydrologic processes. These strategies include approaches like green infrastructure, conservation development, better site design and smart growth. The goals of these various design approaches are to lessen the stormwater impacts while still providing opportunities for development.

Green Infrastructure

Green infrastructure is defined in the Clean Water Act as "...the range of measures that use plant or soil systems, permeable pavement or other permeable surfaces or substrates, stormwater harvest and reuse, or landscaping to store, infiltrate, or evapotranspirate stormwater and reduce flows to sewer systems or to surface waters." Implementing green infrastructure can include integrating green infrastructure practices throughout a site, such as green spaces, native landscaping, and a variety of micro-scale stormwater controls that capture and manage stormwater on-site, and other techniques described below. These features reduce peak stormwater flows by allowing rainwater to soak into the ground, evaporate into the air, or collect in storage receptacles for irrigation and other beneficial uses. As a result of using green infrastructure, developers can more closely maintain pre-development hydrology at a site. Evidence has also shown that green infrastructure practices are cost-effective and, in some cases, cheaper than traditional stormwater management techniques (U.S. EPA, 2007).

Examples of green infrastructure practices include the following:

- *Bioretention practices* are relatively small-scale, landscaped depressions containing plants and a soil mixture that absorbs and filters stormwater. For more information, see the Bioretention fact sheet.
- *Cisterns and rain barrels* collect and store rainwater from rooftops. By storing and diverting stormwater, these devices help reduce the flooding and erosion that stormwater discharges cause. Because they contain no salts or sediment, they can supply water for garden or lawn irrigation, reducing water bills and conserving municipal water supplies. For more information, see the On-Lot Treatment fact sheet.
- *Green roofs* are rooftops with a vegetation cover. Having been in use for decades in Europe and parts of the U.S., green roofs help with temperature regulation both internal and external to the building, mitigate the urban heat island effect and reduce stormwater flows. The vegetated cover also protects and insulates the roof, extending its life and reducing energy costs. For more information, see the Green Roofs fact sheet.

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- *Permeable pavements* reduce stormwater discharge by allowing water to soak through the paved surface into the ground beneath. Permeable pavement encompasses a variety of media, from porous concrete and asphalt to plastic grid systems and interlocking paving bricks suitable for driveways and pedestrian malls. For more information, see the Permeable Pavements fact sheet.
- *Grassed swales* are open channels on which erosion-resistant, flood-tolerant grasses grow. In applications alongside roadways as stormwater conveyances, grassed swales can slow and filter stormwater flows and promote infiltration. Grassed swales and other biofiltration devices like grass filter strips improve water quality and reduce in-stream erosion by slowing the velocity of stormwater before it enters a stream. For more information, see the Grassed Swales fact sheet.
- Using infrastructure planning to increase development density and maximize green space.
- Protecting natural features such as forests and green spaces.
- Protecting or creating stream buffers.
- Reducing the footprint of necessary impervious surfaces (e.g., right-sizing road and sidewalk widths, right-sized parking lots, minimizing or removing cul-de-sacs, replacing paving materials with pervious alternatives).
- Incorporating green infrastructure practices (e.g., bioretention practices, permeable pavements, green roofs) into development plans.

Conservation Development

Conservation development is an approach to design that mitigates the effects of urbanization. It prioritizes the conservation of existing natural resources, including aquatic habitat, forested areas and green spaces. For example, conservation development often uses compact, clustered lots surrounding a common open space. The goal of conservation development is to disturb as little land area as possible while allowing for the maximum number of residences that zoning laws permit (Pejchar et al., 2007).

Before new construction, conservation developers evaluate natural topography, natural drainage patterns, soils and vegetation. Developers maintain areas that are important for the site's natural hydrology, such as forested areas, streams and wetlands, while they integrate other stormwater controls into developed areas. By maintaining natural hydrological processes, conservation development creates conditions that slow, absorb and filter stormwater on-site.

To ensure that future development does not threaten these natural features, municipalities should consider providing for long-term resource protection. For example, conservation easements, transfer of development rights and other "in perpetuity" mechanisms ensure that protective measures remain in place long after site development. For more information, see the National Association of Conservation Districts and Land Trust Alliance web sites.

Better Site Design

Better site design aims to reduce impervious cover, preserve natural lands and capture stormwater on-site. Better site design techniques focus on modifying municipal codes and ordinances that are inflexible and require large uniform lots, wide roads and a large number of parking spaces. Better site design techniques that reduce impervious cover include protecting natural features, right-sizing streets and sidewalks, minimizing cul-de-sacs, incorporating green parking techniques, and reducing the size of driveways and housing lots.

Better site design techniques that reduce stormwater discharge include preserving natural lands; preserving native vegetation and clusters of trees; employing landscaping techniques that flatten slopes; and using riparian or forested buffers along streams, wetlands and steep slopes. Designers can also use green infrastructure practices such as bioretention practices, grassed swales and filter strips to manage stormwater and protect downstream water resources.

Development Districts

Development districts are areas zoned by communities specifically for property development. Development districts are concentrated areas of mixed-use development, typically 5 acres or larger. They may have a high concentration of impervious area, but also a smaller footprint than areas that follow traditional development patterns. A development district with a good design can contribute to many water quality

benefits. For example, redevelopment (i.e., development of an existing urban area) reduces the need to disturb natural areas for new construction. In addition, many development districts incorporate practices to manage stormwater on-site, such as tree-lined streets, rain gardens and green roofs. Compact development districts also lend themselves to more environmentally friendly transportation options, like biking or walking, and shorter and less frequent automobile trips, which can also reduce stormwater pollutants. For more information, see the Zoning fact sheet.

Smart Growth

Smart growth is a set of development strategies that seek to balance economic growth, urban renewal and conservation. In newly developing areas, smart growth promotes compact, town-centered communities that consist of open green space, businesses and affordable housing, interconnected by pedestrian walkways and bicycle lanes. Smart growth emphasizes walkable communities and alternative forms of transportation, which can help alleviate the environmental consequences of automobile use. Smart growth also advocates the revitalization of inner cities and older suburbs. Reusing existing infrastructure often costs less than new construction and helps slow the spread of impervious surfaces.

The Smart Growth Network developed 10 core principles that guide smart growth:

- Mix land uses.
- Take advantage of compact building design.
- Create a range of housing opportunities and choices.
- Create walkable neighborhoods.
- Foster distinctive, attractive communities with a strong sense of place.
- Preserve open space, farmland, natural beauty and critical environmental areas.
- Strengthen and direct development toward existing communities.
- Provide a variety of transportation choices.
- Make development decisions predictable, fair and cost-effective.
- Encourage community and stakeholder collaboration in development decisions.

While not explicitly a guiding principle, stormwater management can benefit from smart growth. Combining compact, high-density development with an emphasis on preserving open spaces reduces the spread of impervious surfaces within a watershed, helping to reduce stormwater discharge. Infill and redevelopment that reuse existing infrastructure can be more cost-effective than new development, which requires expensive new infrastructure. The “fix it first” management philosophy advocates repairing and upgrading existing infrastructure before spending money on new infrastructure.

For more information on programs and funding opportunities, visit EPA’s Smart Growth website.

Integrated Stormwater Planning/Long-Term Stormwater Planning

The above design strategies can benefit stormwater management and other municipal services subject to Clean Water Act (CWA) regulations, such as wastewater treatment programs. For example, in areas with combined sewer systems, practices that reduce stormwater discharge can also reduce the burden on local wastewater treatment plants and reduce the frequency and magnitude of combined sewer overflows (CSOs). Furthermore, with adequate planning, municipalities may be able to achieve desired results at lower costs. For example, municipalities can often reduce the nutrient load to downstream waterbodies by improving stormwater management or wastewater treatment—one option is often more cost-effective than the other. However, stormwater and wastewater departments often operate separately, leading to missed opportunities for more effective and lower-cost comprehensive management solutions. EPA’s CSO Control Plans and Remedies web page provides resources to help incorporate green infrastructure planning as part of a larger CSO control program.

EPA’s integrated planning approach offers an opportunity for municipalities to propose to meet multiple CWA requirements simultaneously by identifying efficiencies from wastewater and stormwater programs

and sequencing investments so that the highest-priority projects come first. This approach can also lead to more sustainable, comprehensive solutions that improve water quality and provide multiple benefits that enhance community vitality. The integrated planning approach does not change existing regulatory or permitting standards or delay necessary improvements; rather, it is an option to help municipalities meet their CWA obligations while optimizing infrastructure investments through an appropriate sequencing of work.

As the name suggests, EPA's voluntary long-term stormwater planning approach specifically focuses on stormwater management in the long-term. As communities continue to grow and develop their local economies, they look for sustainable and effective approaches to reduce these existing and emerging sources of pollution. Communities can consider developing a comprehensive long-term community stormwater plan that integrates stormwater management with communities' broader plans for economic development, infrastructure investment and environmental compliance. Through this approach, communities can prioritize actions related to stormwater management as part of capital improvement plans, integrated plans, master plans or other planning efforts.

Additional Resources

- What is Green Infrastructure?
- What is EPA Doing to Support Green Infrastructure?
- Green Infrastructure Modeling Tools
- Green Infrastructure Design and Implementation
- Green Infrastructure Funding Opportunities
- Tools, Strategies and Lessons Learned from EPA Green Infrastructure Technical Assistance Projects
- Green Streets Program
- Manage Flood Risk with Green Infrastructure
- Build Resiliency to Drought
- Green Infrastructure Webcast Series

Additional Information

Additional information on related practices and the Phase II MS4 program can be found at EPA's National Menu of Best Management Practices (BMPs) for Stormwater website

References

Pejchar, L., Morgan, P. M., Caldwell, M. R., Palmer, C., & Daily, G. C. (2007). Evaluating the potential for conservation development: Biophysical, economic, and institutional perspectives. *Conservation Biology, 21*, 69–78.

U.S. Environmental Protection Agency (U.S. EPA). (2007). *Reducing stormwater costs through low impact development (LID) strategies and practices*.

Disclaimer

This fact sheet is intended to be used for informational purposes only. These examples and references are not intended to be comprehensive and do not preclude the use of other technically sound practices. State or local requirements may apply.