Stormwater Best Management Practice

Infrastructure Planning

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

Description

Infrastructure planning can be a useful stormwater management tool to reduce the deleterious effects of sprawl development. Sprawl development is the expansion of low-density development into previously undeveloped land. The American Farmland Trust (2018) estimated that the United States loses about 175 acres of farmland per hour to suburban and exurb development. Sprawl development requires local governments to extend public services to new residential communities whose tax payments often do not cover the cost of providing those services. It also diminishes the environmental services the previously undeveloped land provided, such as agricultural productivity, groundwater infiltration and maintenance of downstream waterbody health.

Community planners may consider using infrastructure planning as a stormwater management tool to direct new growth into previously developed areas and discourage low-density development. Generally, they do so by drawing an urban growth boundary around a community, beyond which they discourage or do not subsidize major public infrastructure investments. Meanwhile, communities provide economic and other incentives within the boundary to encourage growth in existing neighborhoods. By encouraging housing growth in areas that already receive public services—such as water, sewers, roads, schools and emergency services—communities save infrastructure development costs and reduce the impacts of sprawl development on urban streams and water quality.

Sprawl development negatively impacts water quality in several ways. One of the most significant impacts comes from the increase in impervious cover, including new rooftops, roads, driveways and compacted soils. This increase in impervious area directly increases the volume and peak flow rate of stormwater. Elevated stormwater flows erode stream channels, increase sediment and pollutant loads, degrade stream habitat, and reduce aquatic diversity (Paul & Meyer, 2001).

Sprawl development influences water quality in other ways. For example, sprawl often occurs at the edges of

Proper infrastructure planning can help limit sprawl development and improve stormwater quality.

urban areas outside of centralized water and sewer service areas. This requires new housing developments to use septic systems or other forms of on-site wastewater disposal to treat household sewage. Evidence has shown that on-site treatment systems with improper siting or poor design, installation, operation, or maintenance become significant sources of nutrients and bacteria that affect both surface waters and groundwater. The Preventing Stormwater Contamination from Septic System Failure fact sheet contains more information about septic systems. Additional information is also available on EPA's septic system webpage.

Applicability

Sprawl development occurs in all regions of the country and has motivated many efforts to counteract its impacts. However, these programs seldom focus on water quality considerations and instead concentrate on economic and transportation issues. Even so, effective infrastructure planning can reduce the impact of new development. Promoting infill and redevelopment of existing urban areas in combination with other site design techniques can decrease impervious area and

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the amount of pollution that sites discharge to urban waterbodies.

Site design techniques that can be part of smart infrastructure planning include:

- Zoning and development practices.
- Roadway practices.
- Green design and planning strategies.
- Promotion of green infrastructure.
- Protection of natural features.

Additional information on all of these topics can be found at EPA's National Menu of Best Management Practices (BMPs) for Stormwater

Siting and Design Considerations

Various infrastructure planning techniques exist to manage urban growth while conserving resources. Each technique recognizes that directing growth to areas with previous development or promoting higher-density development in areas where services exist prevents sprawl development and helps communities reduce the water quality impacts of economic growth. These techniques include:

- ***Urban growth boundaries**.* This method establishes a dividing line that defines where growth will occur and where preservation of agricultural or rural land will occur. Often, an urban service area exists within this boundary, creating a zone beyond which public services do not extend.
- ***Infill development/community redevelopment.*** This practice encourages new development on unused or underutilized land in existing urban areas. Communities may offer tax breaks or other economic incentives to developers to promote the redevelopment of vacant or damaged properties.
- ***Impact fees.*** When government entities assess higher impact fees on the development of natural spaces or farmland than on that of developed areas, impact fees can encourage redevelopment or infill development.
- ***Smart growth.*** This urban planning practice promotes high-density development characterized by walkable and bikeable neighborhoods, preserved green spaces, mixed-use development and mass transit.

Limitations

Intense development can create a new set of challenges for stormwater program managers. Stormwater management solutions can be more difficult and complex in dense urban areas than in suburban areas. The lack of space for structural stormwater controls and the high cost of available land where communities could install structural controls are just two problems that program managers likely face in managing stormwater in intensely developed areas.

Infrastructure planning often occurs on a regional scale and requires cooperation among all the communities within a given region to be successful. Stormwater managers should coordinate with other state and local agencies and community leaders to ensure that infrastructure plans direct growth to areas that will have the least impact on watersheds and water quality.

Effectiveness

Infrastructure planning can reduce the impervious cover and amount of compacted land of a community, which can be an effective means of reducing stormwater discharges. Although the ability to directly measure the water quality benefits of smart infrastructure planning is limited, given the lack of suitable control watersheds, modeling studies have shown that housing densities directly affect the generation of stormwater discharge within a watershed. Using a spreadsheet-based model, Jacob and Lopez (2009) showed that per capita pollutant loadings and stormwater discharge decreased significantly with higher density development. Similarly, researchers have shown that construction activities associated with residential development—mainly soil disturbances such as excavation and compaction—result in significantly lower infiltration rates and higher stormwater generation rates for non-impervious surfaces as well (Woltemade, 2010). Infrastructure planning techniques that reduce the total footprint of developed land through the use of higher densities can therefore help lessen total stormwater discharges.

Cost Considerations

Utilizing existing infrastructure and services rather than constructing new infrastructure can reduce costs while providing economic benefits. The following is a sampling of case studies from a Smart Growth America report summarizing the cost savings achieved by smart growth approaches (Fulton et al., 2013):

- An economic analysis for Champaign, Illinois, examined the costs and benefits of increasing the city's population by about 25 percent, from 75,000 people to 94,000 people. The analysis compared two scenarios: one in which all growth would occur inside the city's current service area and one in which a considerable portion of the growth would occur outside the service area. Over a 20-year period, the analysis projected that the smart growth scenario would provide the city with a net surplus of $33 million through savings in infrastructure and municipal service costs, compared to a $19-million deficit associated with the conventional suburban scenario.
- An analysis of infrastructure costs in Sarasota County, Florida, showed that smart growth development of the downtown area would generate enough tax revenue to pay off infrastructure costs in 3 years, compared to the 42 years that would be necessary for comparable suburban development.
- The State of Maryland conducted a study of a smart growth approach to statewide road construction projects and found that smart growth could save $1.5 billion per year for 20 years compared to conventional suburban development trends.
- The State of California commissioned a study of several different development scenarios to determine costs of development between 2010 and 2050. The study found that a smart growth development approach would save the state 20 percent compared to standard suburban development—with cost savings of $32 billion over the 40-year timespan considered.

Infill development potentially requires higher upfront costs than development on undeveloped land. Factors that may lead to higher upfront costs include demolition requirements, higher engineering and architectural costs, and higher construction costs associated with the taller buildings that are often necessary to accommodate larger populations on smaller footprints. However, residential and office infill development projects in urban environments retained their value better during the economic recession of the late 2000s. An analysis of home price changes between May 2012 and May 2013 found that price increases were greater in urban areas than suburban areas, providing further evidence that infill development provides better economic returns than new development (U.S. EPA, 2014).

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

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