FEBRUARY 2015

EXECUTIVE SUMMARY

Accelerating Cost-Effective Green Stormwater Infrastructure:

LEARNING FROM LOCAL IMPLEMENTATION

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Ineffective stormwater management is a serious problem nationwide, and green stormwater infrastructure (GSI) is an important part of the solution

Conventional stormwater management strategies based around "gray" collection and conveyance systems—networks of gutters, storm drains, and sewers—have not solved persistent stormwater problems. Instead they have shifted, and in many cases exacerbated, the impacts of stormwater runoff, trading urban flooding for pollution and hydromodification of nearby rivers, streams, lakes, and estuaries.

A different approach to stormwater management is needed. Effective management requires a holistic approach that employs a locally tailored mix of on-site and off-site retention, treatment, and use along with pollutant source controls to protect local waters and meet other community and regulatory objectives.

GSI is a crucial piece of the stormwater-management puzzle. GSI works by addressing stormwater where rain or snow falls. It uses distributed installations to mimic natural stormwater retention and treatment processes. The goal is to minimize the quantity and maximize the quality of runoff that flows to local waters. GSI can be a powerful tool for managing stormwater while achieving a host of additional benefits.

With this in mind, the U.S. Environmental Protection Agency (EPA) and state regulators are beginning to encourage, and sometimes to require, expanded use of GSI to meet Clean Water Act goals. Requirements for using GSI in development projects, and increasingly stringent water-quality requirements for discharges to local waters, are helping to drive local GSI planning and implementation efforts.

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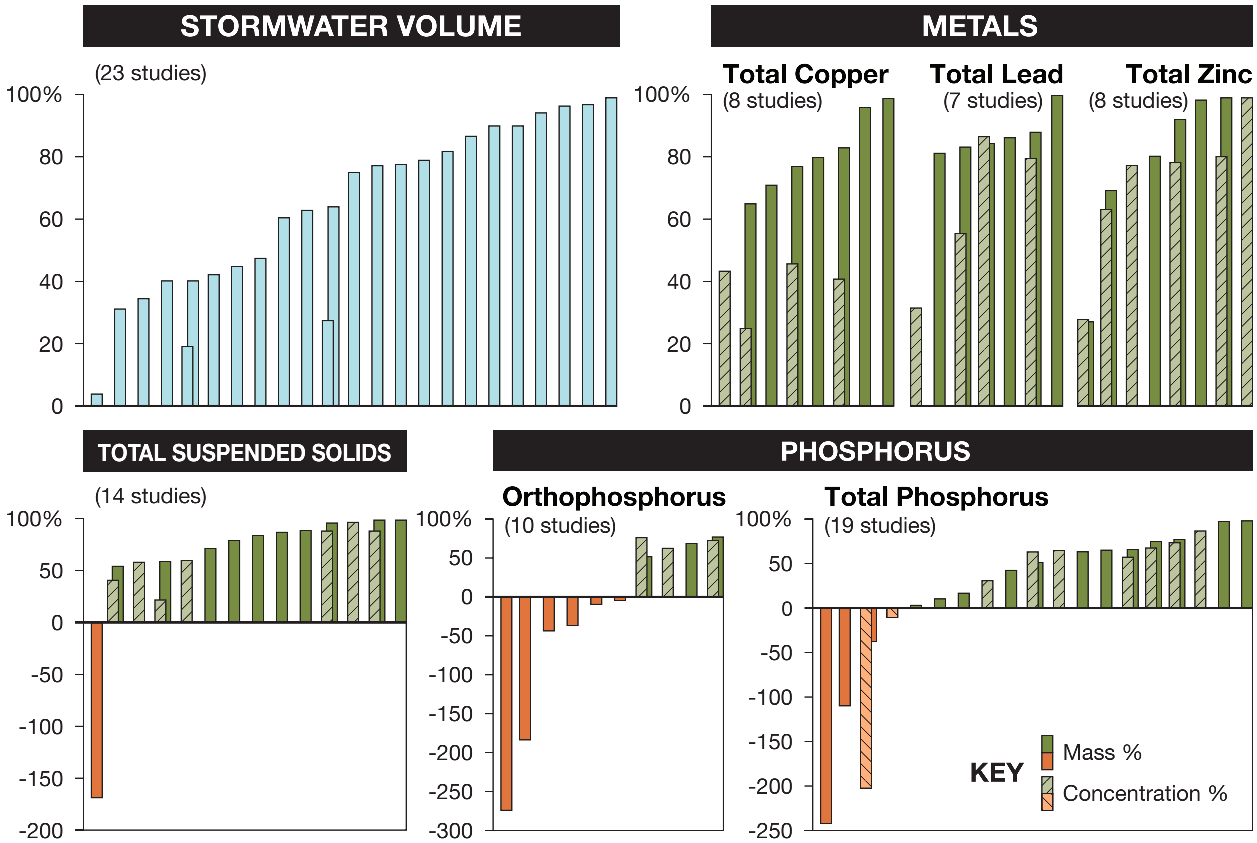
Barriers to GSI implementation include uncertainty about performance and cost

Although its importance as a component of future stormwater management is difficult to overstate, there are many potential barriers to widespread, timely, efficient, and effective GSI implementation. These include informational, technical, legal, institutional, social, political, and financial barriers. This report focuses on the challenges posed by information limitations, which impede cost-effective GSI deployment by perpetuating uncertainty about performance and cost.

While robust information is important in any field, it is especially critical here because GSI is evolving technology. Good performance cannot simply be assumed. Each installation is a local experiment in which site-specific conditions and design specifications heavily influence what runoff-volume and pollutant reductions are actually achieved, whether these reductions are adequate to meet community objectives and regulatory requirements, and at what initial and long-term cost.

Many communities are still analyzing how to most efficiently use local resources to implement GSI. Cost-effectiveness is a primary consideration for stormwater managers who are trying to decide how to employ GSI in their communities. Uncertainty about either life-cycle costs or performance—both of which linger today—can impede decision making, leading communities to underinvest in GSI or to overspend on less cost-effective GSI. Either result is problematic for a community with limited funds and unaddressed stormwater needs.

Stormwater volume and pollutant reductions reported for bioretention systems vary widely. (See the full report for a detailed explanation and data for additional pollutants.)



While many cities with combined sewer systems already recognize that distributed GSI offers clear financial benefits over exclusively gray infrastructure, most municipalities with separate storm sewer systems (MS4s) do not yet face such obvious fiscal incentives. However, as stormwater permits trend toward stronger retention and water-quality requirements, more communities with MS4s will likely be weighing specific compliance scenarios that include different types, placements, and amounts of GSI. Reducing uncertainty about performance and costs would help clarify financial incentives and speed cost-effective GSI deployment across the board.

Monitoring and sharing data can reduce uncertainty and open the door for greater design standardization

Monitoring locally implemented GSI and sharing the results can provide information that is crucial for addressing the uncertainty that surrounds GSI performance and cost. Monitoring data, and the lessons they can teach, reduce uncertainty, aid the development of cheaper and more reliable GSI designs, and give decision makers the information they need to more cost-effectively plan and deploy GSI at a scale sufficient to meet community and regulatory objectives.

As experience implementing different GSI designs under a variety of local site conditions accumulates, understanding of what variables are most important to proper function in different contexts, and how much GSI actually costs to install and maintain, will improve. This knowledge will enable development of GSI designs that achieve better reliability at lower cost.

Greater design standardization would help reduce costs further. Site variability makes true plug-and-play GSI designs impracticable. However, standardization could take the form of libraries of customizable basic designs and specifications that consistently deliver good performance for common sets of site conditions and community objectives.

MORE DATA, FROM MORE GSI INSTALLATIONS IN MORE PLACES, ARE NEEDED

Analysis of context-rich monitoring data from GSI installations across the country would bring to light connections between site conditions, design parameters, cost, and performance, easing the path to more widespread, more cost-effective implementation.

Currently, actual performance data for GSI are still very limited. Available data come from relatively few GSI installations that cover a limited range of site conditions and geographic areas, and pollutant data can contain important holes (e.g., little data about dissolved-metals).

Bioretention data are illustrative. Although bioretention basins are some of the most common forms of GSI currently being implemented, bioretention monitoring results reported in peer-reviewed literature and the International Stormwater Best Management Practices Database (ISBMPD) come from just 40 field sites in the United States. Approximately 78% of these sites are on the east coast, and more than 33% are in North Carolina. A 2013 review of the ISBMPD concluded that design-related content was “relatively limited” and failed to identify any statistically significant relationships between bioretention design variables and pollutant-reduction performance. It focused on 6 pollutants and 3 design variables, but noted that the effects of a fourth, likely very important, parameter (soil media composition) could not be evaluated at all due to “inconsistent and incomplete” information. Similarly, there were not enough data available to meaningfully analyze 2 of the 6 pollutants initially targeted. Many of the 30 bioretention studies in the ISBMPD lacked one or more types of relevant design or water-quality data.

Increasing the quantity and quality of data in the ISBMPD would speed identification of the most cost-effective GSI designs for different sets of site constraints.

State and federal regulators can boost local data collection and sharing to accelerate cost-effective GSI deployment

Without a concerted effort to reduce uncertainty about cost and performance, GSI deployment over the coming decades will be less extensive and less effective than communities need it to be. More and better data are crucial to reducing uncertainty and accelerating the development of GSI technology. Specifically, it is essential to increase collective learning from early GSI installations through sustained monitoring of performance, maintenance needs, and costs, paired with effective data sharing.

So far the extent of data collected and shared has been limited. Local implementers often informally collect information for their own tracking and management purposes (or, if not, they should). However, these data are rarely formally recorded or made accessible to others.

Although state and federal regulators are already promoting GSI, they have the authority to play a more active role in accelerating and improving it. More and more frequently, stormwater permits and combined sewer overflow (CSO) consent decrees now include requirements for municipalities to manage runoff using GSI. In connection with these requirements, regulators should require GSI monitoring, capturing relevant qualitative and quantitative information in an accessible, centralized database.

Specific recommendations include the following:

RECOMMENDED ACTIONS FOR STATE AND FEDERAL REGULATORS:

1. As an initial step, incentivize and highlight the importance of voluntary GSI monitoring and data contribution to the International Stormwater Best Management Practices Database (ISBMPD).
2. Identify quantitative and qualitative GSI monitoring priorities through intensive discussions with stakeholders.
3. Adopt standardized GSI monitoring and reporting protocols and guidance.
4. Attach monitoring and reporting requirements to GSI required by National Pollutant Discharge Elimination System (NPDES) permits and consent decrees.
   - Require all implementers to gather and report relevant site, design, and cost data; qualitative performance data; maintenance data; and lessons learned according to standardized protocols.
   - Assign additional requirements for collection and reporting of quantitative performance data to a subset of GSI installations, consistent with identified monitoring priorities.
5. Capture required GSI monitoring data in the ISBMPD. Options for accomplishing this include:
   - Requiring individual implementers to submit data directly to the ISBMPD.
   - Collecting data in state or regional databases that regularly feed accumulated data into the ISBMPD.
   - Coordinating data submission with implementation of the NPDES Electronic Reporting Rule by redesigning the NPDES Integrated Compliance Information System to facilitate carryover of monitoring data to the ISBMPD.
6. Feed water-quality-related GSI monitoring data into the National Stormwater Quality Database.
7. Prioritize sustained financial and technical support for quantitative GSI performance monitoring, database upkeep, and timely meta-analysis of accumulated monitoring data.

Opportunities to improve knowledge about GSI are inherent in local implementation efforts. Leveraging such efforts to expand organized monitoring and information sharing would reduce uncertainty about performance and cost, helping to speed widespread, cost-effective GSI deployment to achieve social and environmental goals.

The full report is available online at
http://www.law.berkeley.edu/cost-effective-GSI.htm

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