Examples of State-Level Approaches to Implementing LID and GSI

Since the VSMM was initially published, the stormwater management field as a whole has made substantial progress in understanding the performance and benefits of Low-Impact Development (LID) concepts and green stormwater infrastructure (GSI) best management practices. The 2002 VSMM contains a series of stormwater runoff credits to reduce required treatment volumes for implementing what are essentially principles of LID site design, but the credits are voluntary and thus may not be widely used. In addition, a range of GSI practices have come into wider use over the last decade, but are not explicitly included as acceptable practices in the VSMM.

All of the state-level stormwater management manuals reviewed in the Advanced Stormwater Standards Compilation, except Vermont's, contain explicit references to and definitions for "Low Impact Development", "Better Site Design", or a substantially equivalent philosophy of development site design. While each of the states reviewed has integrated LID and GSI principles and practices into its manual to some extent, their true integration as a standard development methodology is far from universally adopted, and the states have each taken an individual and unique path towards implementation. The four state-level approaches highlighted here showcase the wide range of strategies that are being explored or implemented in New England, the Mid-Atlantic, and the Midwest, in response to the need to evolve how stormwater is managed in developed and developing areas.

Rhode Island's Mandatory LID Checklist

Rhode Island's 2011 stormwater management regulations, BMP manual, and associated permit application forms represent an example of state-level integration of LID as the "industry standard" for development and redevelopment. All applicable development proposals (including any development disturbing one acre or more) must now include a Stormwater Management Plan for review by the Department of Environmental Management.

Rhode Island's Stormwater Design and Installation Standards Manual Appendix A (available at www.dem.ri.gov/pubs/regs/regs/water/swmanual.pdf, p. 211). is a Stormwater Management Checklist, which forms part of the required Storm Water Management Plan submittal. This checklist is a guide for engineers and designers to refer to during all stages of a project to ensure that they are meeting all applicable requirements (Rhode Island DEM and CRC, 2011). "LID site planning and design strategies must be formally documented according to the Stormwater Management checklist included in Appendix A. Site planning and design should be done in unison with the design and layout of stormwater and wastewater infrastructure in attaining management and land use goals. The LID site planning and design objectives can be split into three main categories:

1. Avoid the Impacts – Preserve, and where possible restore, natural features;
2. Reduce the Impacts – Reduce impervious cover; and
3. Manage the Impacts at the Source – Design site specific runoff reduction, treatment, and source controls" (Rhode Island DEM and CRC, 2011)

Maryland's Environmental Site Design Methodology

Maryland's 2007 Stormwater Management Act (Environment Article 4 §201.1 and §203) and subsequent regulations (COMAR 26.17.02) require the implementation of environmental site design (ESD) at development sites to the maximum extent practicable (MEP) through the use of better site design techniques, alternative surfaces, non-structural techniques, and small-scale treatment practices. Approved ESD treatment practices include:

- Alternative Surfaces: Green roofs, permeable pavements, and reinforced turf
- Nonstructural Practices: Disconnection of rooftop runoff, disconnection of non-rooftop runoff, and sheet flow to conservation area

- Micro-scale Practices: Rainwater harvesting, micro-bioretention, rain gardens, submerged gravel wetlands, landscape infiltration, swales, enhanced filters, infiltration berms, and drywells

Prior to this legislation, the use of nonstructural techniques, such as disconnection, was encouraged through optional site design "credits" established in the 2000 Maryland Stormwater Manual. With the new legislation came an opportunity to not only expand on the ESD practices first introduced in the Manual, but to also establish a planning process to improve implementation. In 2009, the Maryland Department of the Environment developed and adopted technical requirements for ESD to the MEP in Chapter 5 of the updated the Stormwater Design Manual (available at www.mde.state.md.us/programs/Water/StormwaterManagementProgram/MarylandStormwaterDesignManual).

The new technical design criteria for ESD are based on the runoff curve number (RCN) hydrology method and a simplified process to determine stormwater requirements needed to replicate runoff characteristics similar to "woods in good condition" using look-up tables. A target rainfall (PE) is determined by correlating the RCN for "woods" with proposed impervious area (%I) and on-site HSGs. PE is used to calculate ESDv, which is the volume needed to replicate runoff conditions for woods. ESDv can be addressed by achieved using the approved ESD treatment practices cumulatively over the entire site. The ESDv is designed for the 1-yr, 24-hr storm, or 2.7 inches, therefore, it generally encompasses the water quality, recharge, and channel protection criteria originally established in the 2000 Manual. Only when the required ESDv cannot be met to the MEP are traditional structural practices allowed. How the ESD to the MEP fits into flood control regulations, redevelopment incentives, and retrofitting is determined at the local level.

A comprehensive plan review process is also now outlined in the Manual that outlines phased plan submissions at three stages of design (Concept, Site Development, and Final stormwater management plans) to ensure compliance with the ESD to the MEP standard. Since 2010, the state has published technical guidance on various procedures and calculations relevant to implementing ESD, including model ordinances to assist communities in adopting the new criteria; these documents are available at: www.mde.state.md.us/programs/Water/StormwaterManagementProgram/SedimentandStormwaterHome/Pages/Programs/WaterPrograms/SedimentandStormwater/home/index.aspx).

Virginia's Runoff Reduction Approach

The runoff reduction approach seeks to maintain the same predevelopment runoff volume delivered to a stream after a site is developed (Chesapeake Stormwater Network, 2009). In its simplest terms, this means achieving the same predevelopment runoff coefficient for every storm, up to a designated storm event. Runoff reduction is defined as the total runoff volume that is reduced through canopy interception, soil infiltration, evaporation, rainfall harvesting, engineered infiltration, extended filtration, or evapotranspiration. Runoff reduction approaches are generally characterized by three design steps—and the process is very similar to that outlined for Rhode Island above:

- Avoid unnecessary site disturbance and minimize the creation of impervious surface;
- Reduce runoff volumes through the use of management practices that provide infiltration, extended filtration, soil amendments, rainwater harvesting and reuse, evapotranspiration; and,
- Employ additional structural controls, as needed, to reduce the peak rate of discharge or reduce the pollutant load concentrations in the runoff volume.

Virginia's Stormwater Management Regulations, effective September 2011 and scheduled for full implementation in July 2014, replace the existing water quality protection criteria (choice of performance criteria or technology criteria) with a new compliance method (the Runoff Reduction Method) and pollution removal threshold. Total Phosphorus (TP) is used as an indicator pollutant to determine compliance with water quality criteria, with a phosphorus load limit for new development of 0.41 lb./acre/year (there are also water quality criteria for redevelopment and linear projects). The new regulations require a "treatment volume" to be calculated by multiplying the composite runoff index X

1" of rainfall (90th percentile storm event in VA) X entire site area (including managed turf and forest/open space land cover categories). The Virginia Runoff Reduction Method (RRM, a Microsoft Excel spreadsheet), calculates TP loads and BMP treatment volumes required to be met on the site. (See http://chesapeakestormwater.net/wp-content/plugins/download-monitor/download.php?id=121 for more details regarding Virginia's stormwater management regulations.)

States that are currently closest to or are actively implementing a full-blown runoff reduction program have typically invested significant time and staff resources in a stepwise, deliberative stakeholder process in order to tailor the approach to their specific water quality concerns. In nearly every case, a spreadsheet-based or other credit calculator tool is developed to aid in the design and review processes. Virginia's runoff reduction spreadsheet tool (available at http://chesapeakestormwater.net/training-library/state-specific-resources/virginia/) was selected by a stakeholder group working on Minnesota's Minimal Impact Design Standards for further development and application to site design in that state (see below).

Minnesota's Minimal Impact Design Standards (MIDS)

In 2009, the Minnesota Legislature allocated funds to "develop performance standards, design standards or other tools to enable and promote the implementation of low impact development and other stormwater management techniques." (Minnesota Statutes 2009, section 115.03, subdivision 5c). Minnesota's recently finalized (June 2013) Minimal Impact Design Standards (MIDS) represent the next generation of stormwater management – and the intent is to implement LID as the primary method for new development in Minnesota.

The MIDS contain three main elements:

1. A higher clean water performance goal for new development and redevelopment that will provide enhanced protection for Minnesota's water resources.

- For new, nonlinear developments that create more than one acre of new impervious surface on sites without restrictions, stormwater runoff volumes will be controlled and the post-construction runoff volume shall be retained on site for 1.1 inches of runoff from impervious surfaces statewide.
- Nonlinear redevelopment projects on site without restrictions that create one or more acres of new and/or fully reconstructed impervious surfaces shall capture and retain on site 1.1 inches of runoff from the new and/or fully reconstructed impervious surfaces.
- Linear projects on sites without restrictions that create one acre or greater of new and/or fully reconstructed impervious surfaces, shall capture and retain the larger of the following:
    - 0.55 inches of runoff from the new and fully reconstructed impervious surfaces
    - 1.1 inches of runoff from the net increase in impervious area
    - Mill and overlay and other resurfacing activities are not considered fully reconstructed.
- If an applicant is unable to achieve the full Performance Goal due to site restrictions as attested by the local authority and documented by the applicant, a Flexible Treatment Options Approach is available.

2. New modeling methods and credit calculations that will standardize the use of a range of "innovative" structural and nonstructural stormwater techniques.

3. A credits system and ordinance package that will allow for increased flexibility and a streamlined approach to regulatory programs for developers and communities.

As part of the MIDS development effort, existing credit tracking systems and calculators were evaluated to determine which existing tools from other jurisdictions best addressed several criteria:

- provide an incentive for incorporating low impact development (LID) techniques onto a site
- determine the stormwater volume control required on the site
- determine TP and TSS removal

- provide volume and pollutant removal credit for BMPs in parallel and in series
- focus on pollutant removals for sites with Hydrologic Soil Group D soils
- not replace existing models, such as HydroCAD, for calculating and showing conformance to stormwater peak runoff rate requirements

The Virginia credit tracking calculator was chosen as performing most of these functions, and was adapted to Minnesota's needs in the creation of a MIDS calculator. The resulting MIDS calculator has a graphical user interface, rather than being solely spreadsheet-based, and will be available at www.pca.state.mn.us/index.php/water/water-types-and-programs/stormwater/stormwater-minimal-impact-design-standards-mids.html.

For More Information

For more details on each of these approaches, see Section 4 of the Advanced Stormwater Standards Compilation at www.anr.state.vt.us/dec/waterq/stormwater/docs/sw_advanced_standards_compilation.pdf.