Overview of the *Advanced Stormwater Standards Compilation*

Since the Vermont Stormwater Management Manual (VSMM) was published in April of 2002, substantial advances in the range of stormwater treatment practices and site design approaches have been made nationally. In 2012, the Vermont Department of Environmental Conservation Stormwater Program staff worked with Stone Environmental to identify state of the art stormwater management approaches and specific practices, with the goal of informing future discussions about updating VSMM.

Following an initial screening of concepts and approaches, four key topics were identified:

- Site characterization standards and guidelines for infiltration-based practices
- Alternate approaches to the Channel Protection Volume (CPv) standard
- Integrating Low-Impact Development (LID) concepts into the VSMM
- Maintenance plans (requirements and implementation)

For each topic, the current practice in Vermont as contained in the VSMM is presented first, followed by a summary of current practice in a range of other jurisdictions as contained in stormwater BMP manuals, state-level regulations and guidance, and other sources.

Site Characterization and Infiltration Practices

With regard to siting and testing for infiltration-based practices, Vermont's minimum infiltration rate threshold and required minimum separation distances to groundwater and bedrock were consistent with current practice in many of the jurisdictions reviewed. However, the minimum required test pit and infiltration test spacing for infiltration basins (one per 200 square feet of basin area) is far higher and more effort-intensive than the widely adopted minimum spacing in other jurisdictions of one per 5,000 square feet. Often, other jurisdictions set a minimum number of test pits or soil borings per practice (for instance, two tests for an infiltration trench or three tests for an infiltration basin)—an approach that may be especially helpful for siting smaller infiltration practices.

Channel Protection Volume Alternatives

The primary purpose of a Channel Protection Volume (CPv) standard is to protect stream banks from excessive erosion caused by the increase in peak runoff rates from newly created impervious surfaces. The rationale for this criterion is that runoff will be stored and released in a gradual manner, such that critical erosive velocities will rarely be exceeded in downstream channels.

The CPv standard is an improvement over two-year peak discharge control, which did not protect channels from downstream erosion and could actually contribute to erosion since banks were effectively exposed to a longer duration of erosive bankfull and sub-bankfull events. There is an inherent conflict, however, between design processes and practices that emphasize decentralization and infiltration (as with LID and GSI) and a requirement like CPv, where designers usually must centralize the collection of runoff in order to detain it.

A number of different strategies have been used in other jurisdictions that attempt to resolve the conflict, especially as these jurisdictions move closer to implementing runoff reduction frameworks. Under the runoff reduction approach, channel protection is achieved through using site design strategies that minimize the amount of runoff generated, coupled with practices that reduce runoff volume through infiltration, extended filtration, soil amendments, rainwater harvesting and reuse, and evapotranspiration. The goal of runoff reduction is usually to ensure that no runoff occurs from a particular design storm (often the 90th percentile rainfall event, or the first inch of rainfall regardless of percentile) in the post-development condition. In New York, for example, the CPv standard requires 24-hour extended detention only for the portion of the one-year, 24-hour storm event that cannot be treated using runoff reduction strategies—volume

reductions achieved using GSI can be deducted from CPv.

Integrating Low Impact Development Concepts

Since 2002, the stormwater management field has made substantial progress in understanding the performance and benefits of LID concepts, non-structural site design strategies, and structural best management practices. The shift in overall attitude of the stormwater management community away from the sole use of structural BMPs and towards embracing LID approaches and practices—at least in concept—is illustrated vividly in current stormwater manuals and policies. Federal guidance includes a robust series of U.S. EPA resources related to LID and "green infrastructure", and all of the state-level stormwater management manuals reviewed except Vermont's contain explicit references to and definitions for "Low Impact Development", "Better Site Design", or a substantially equivalent philosophy of site development.

The 2002 VSWMM 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 wide range of GSI practices have come into wider use over the last decade, but are not explicitly included as acceptable practices in the VSWMM. Structural treatment practices that have become more widely accepted—and that have been installed in Vermont despite not being explicitly included in VSWMM—include pervious pavement, green roofs, and runoff reclamation (cisterns, rain barrels, etc.).

While each of the states reviewed has integrated LID principles and practices into its manual to some extent, the true integration of LID as a standard development methodology is far from universally adopted, and states have each taken unique paths towards implementation. In New Hampshire and New York, for instance, stormwater BMP manuals provide summaries of the problems associated with conventional stormwater management approaches, and chapters on "non-structural site design techniques" and "green infrastructure practices." However, the states' regulations do not mandate LID approaches, and few or no tools are available to applicants that facilitate adoption of these practices or allow applicants to demonstrate that they are including non-structural LID site design approaches in their projects. At the other end of the spectrum, Rhode Island's stormwater management regulations, BMP manual, and associated permit application forms represent an example of state-level integration of LID as the "industry standard".

States that have successfully shifted their regulatory and permitting systems towards using LID, "Better Site Design", or other similar frameworks for designing and permitting development / redevelopment projects, have done so only after an extensive deliberative process. Thus, the convening of a broad-based advisory group, including regulators, researchers, design professionals, maintenance providers, and others in the stormwater management field, to support integration of LID concepts into an existing framework is highly recommended.

Maintenance Plan Options

Timely and effective inspection and maintenance are crucial to ensuring satisfactory performance of stormwater treatment over the design life of a system. However, operation and maintenance requirements across the state regulations, manuals, and policies reviewed ranged from non-existent to requirements for system-specific directions complete with maintenance instruction and inspection templates. Vermont's regulations require that all permitted stormwater collection, treatment, and control systems be properly operated and maintained—but the regulatory guidance and recommended reporting forms are not always consistent with requirements included in General Permits. Inspection and maintenance requirements should be made consistent across all of Vermont's rules, permits, and webpages.

For More Information

The full *Advanced Stormwater Standards Compilation* final report is available at: http://www.anr.state.vt.us/dec/waterq/stormwater/docs/sw_advanced_standards_compilation.pdf.