Low Impact Development Design Strategies

A guide for the communities of the West-of-Hudson portion of the New York City Water Supply System Watershed

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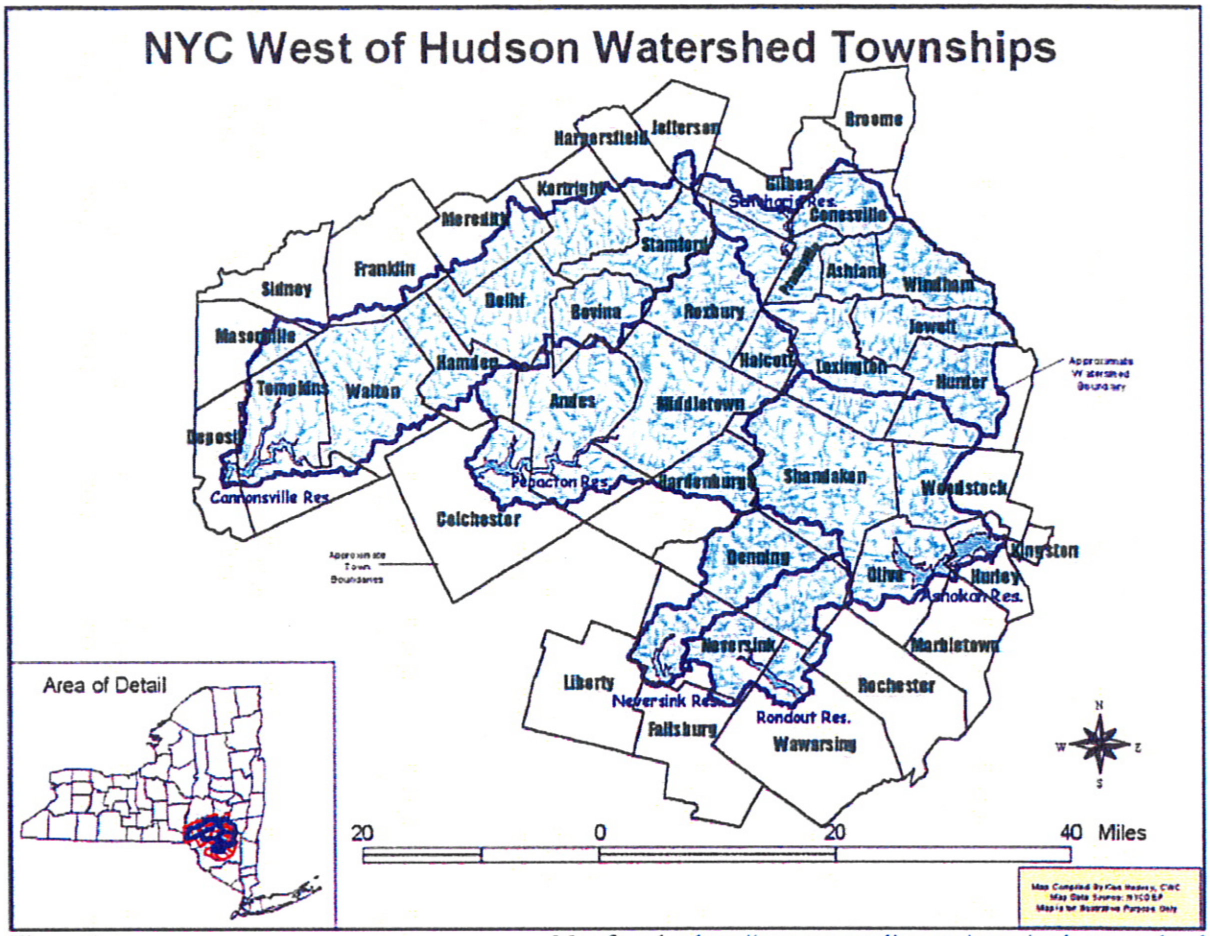

Figure 1 Map found at http://www.cwconline.org/maps/woh_towns.html

INTRODUCTION

The New York City (NYC) Water Supply System's watershed is divided into two distinct areas, one on each side of the Hudson River. The West-of-Hudson (WOH) portion will be the subject of this guidance document, and is comprised of communities that feature similar blends of mountainous landscapes and their stream-carved, steep-sloped valleys. The WOH watershed is further divided into the Catskill and Delaware systems, but the greatest benefits can and will result from looking at the WOH as a whole. For many residents and tourists, it is the natural, recreational and scenic resources associated with the landscape that makes the area appealing. These same features that produce natural playgrounds and stunning views also make it difficult to effectively manage stormwater while allowing communities to foster new development and economic growth.

Being a part of the NYC Water Supply System has meant that these communities are involved in and bound by numerous rules and regulations focused on protecting New York City's potable water in addition to New York State standards for stormwater runoff related to construction activities. This used to mean that construction activities on opposite sides of the watershed boundary might face substantially different requirements, even if they were in the same municipality and had similar site conditions. However, the NYCDEP Watershed Rules and Regulations[1] were updated in April 2010 to guide land development

[1] Found at http://www.nyc.gov/html/dep/pdf/recrules/regulations.pdf

towards maintaining pre-construction hydrologic conditions through employment of Low Impact Development (LID) practices to control stormwater runoff from development sites. In August 2010, New York State also adopted new requirements[2] that incorporate the better site design and green infrastructure ideals of LID. The purpose of this guide is to assist developers and local officials in dealings with NYS and NYC regulations, as well as considering amending local codes to be more compatible with said regulations.

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[2] Found at http://www.dec.ny.gov/chemical/29072.html

OVERVIEW OF PRINCIPLES

1. Low Impact Development (LID)

Low Impact Development (LID) is a strategy that seeks to facilitate development without adversely impacting the on-site hydrologic functions, or, in the case of a retrofit, returning the site as close to pre-development hydrologic conditions as is possible. LID designs capture and/or treat stormwater at its source by preserving and utilizing natural features, often using small-scale practices throughout a development site, reducing peak runoff by slowing down the flow of water, thereby allowing rainwater to soak into the ground or evaporate into the air. Other techniques involve the collection of rainwater for irrigation or future use, rather than quickly moving that water off-site.

2. Green Infrastructure (GI)

Green infrastructure is defined slightly differently based on the source and the context. This document uses the NYSDEC definition, as written in the NYS Stormwater Management Design Manual and shown here:

> "In the context of stormwater management, the term green infrastructure includes a wide array of practices at multiple scales to manage and treat stormwater, maintain and restore natural hydrology and ecological function by infiltration, evapotranspiration, capture and reuse of stormwater, and establishment of natural vegetative features.
>
> On a regional scale, green infrastructure is the preservation and restoration of natural landscape features, such as forests, floodplains, and wetlands, coupled with policies such as infill and redevelopment that reduce overall imperviousness in a watershed or ecoregion. On the local scale, green infrastructure consists of site- and neighborhood-specific practices and runoff reduction techniques. Such practices essentially result in runoff reduction and/or establishment of habitat areas with significant utilization of soils, vegetation, and engineered media rather than traditional hardscape collection, conveyance and storage structures. Some examples include green roofs, trees and tree boxes, pervious pavement, rain gardens, vegetated swales, planters, reforestation, and protection and enhancement of riparian buffers and floodplains."[3]

3. Better Site Design (BSD)

Better Site Design is, speaking generally, a set of principles that aims to reduce the environmental impact of development projects. NYSDEC released a BSD document in 2008[4] that was prepared by Horsley Witten Group with assistance from Center for Watershed Protection. That guide uses the following definition for BSD: "Incorporates non-structural and natural approaches to new and redevelopment projects to reduce effects on watersheds by conserving natural areas, reducing impervious cover and better integrating stormwater treatment." The term can refer to a particular development project, but in the context of this guide it will allude to the principles of BSD written into municipal codes. Interested parties should consult with the NYSDEC guide for more information on benefits, obstacles, specific practices and case studies related to BSD.

4. Benefits of using LID, GI and BSD

Utilizing the techniques described previously is likely to lead to a variety of benefits for the local community and developers over both the short and long term. The likelihood of benefits is due to the following characteristics of LID, GI and BSD practices:

Flexible, systems-based approaches – Methods work at a small scale and are based upon and tailored to specifics of an individual site. This approach makes LID practices far more adaptable than conventional methods because numerous strategies can be employed to perform different

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[3] Found at http://www.dec.ny.gov/chemical/29072.html

[4] Found at http://www.dec.ny.gov/docs/water_pdf/bsdcomplete.pdf

functions of the natural environment. Also, because little space is needed for many of these practices, one or more can be applied to nearly every site and structure.

Effectively achieves multiple objectives – Simple, practical and applicable almost anywhere, LID techniques can be integrated into other components of infrastructure as a means to save money. Municipalities that use Combined Sewer Overflow systems can integrate LID techniques for stormwater management to save money by drastically reducing peak flows and improving the quality of water entering the system. This is also effective in a separated sewer system.

Economical and adds value to the landscape – LID strategies are often less costly to implement than traditional techniques for stormwater management because of the emphasis on natural processes and longer life-cycle than with traditional methods. Implementing LID techniques will reduce or eliminate the need for stormwater ponds, which means that space can be utilized in a different way. Limiting site disturbance makes for a more attractive piece of property, adds value and expedites sales. (Mohamed 2006)

Makes sense – The LID approach saves money for involved parties and benefits the environment by bringing people, ecological systems, and economic values together, all while meeting the updated environmental regulations for water quality protection.

The Somerset Subdivision[5] in Prince George's County, Maryland serves as an example of how a developer benefits from using LID practices and controlling stormwater on-site. The Somerset Subdivision is an 80-acre development with almost 200 homes on lots of approximately 10,000 square feet, or slightly less than ¼ of an acre. Rain gardens and other bioretention methods were utilized on individual lots, and grass swales were strategically located, primarily along streets. Slowing the water down and allowing it to soak into the ground resulted in a stormwater pond being unnecessary and allowed for six (6) additional lots to be developed. These techniques saved the developer roughly 32% on the project, equating to about $4,000 per lot and nearly $800,000 in total.

As noted above, implementation of LID strategies is often beneficial for developers, but the same is true for municipalities and individuals. According Roseen et al. [6], "Municipal use of GI reported cost reductions of 21% to as high as 44%. Of significant importance is the shifting of monies from infrastructure to jobs associated with the maintenance activities." The same paper also noted 33-50% reductions in energy demands for homeowner heating and cooling, as well as reduced time to sell of approximately 50% and increased property values of 12-16%.

LID practices can also aid in flood mitigation and minimizing any related damage. The EPA (2007) noted that, "Strategies designed to manage runoff on-site or as close as possible to its point of generation can reduce erosion and sediment transport as well as reduce flooding and downstream erosion. As a result, the costs for cleanups and streambank restoration can be reduced or avoided altogether." A case example showcasing the effectiveness of LID practices in reducing runoff volumes was documented in Burnsville, Minnesota[7], where bioretention practices were used to protect Crystal Lake from excess phosphorous and

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[5] *Reducing Stormwater Costs through Low Impact Development (LID) Strategies and Practices*, US Environmental Protection Agency, December 2007, EPA 841-F-07-006

[6] Found at http://www.unh.edu/unhsc/sites/unh.edu.unhsc/files/pubs_specs_info/JEE%20FTL%203-30-12.b.pdf

[7] Found at http://www.burnsville.org/DocumentCenter/Home/View/450

other stormwater runoff. Seventeen rain gardens were installed in one neighborhood that drains to Crystal Lake, while another neighborhood one street over, also draining to Crystal Lake, was used as a control. Data was collected for two seasons prior to installation and two seasons post-installation for each neighborhood, with the results showing a 90% reduction in runoff volume for the neighborhood that installed rain gardens.

In conclusion, municipal adoption of LID strategies will streamline processes and should also save costs and mitigate flooding, while creating jobs and increasing property home values and area appeal by using economical, effective, and flexible practices that can be applied to nearly any site.

LOW IMPACT DEVELOPMENT PRINCIPLES IN THE WOH

Importance to the area

LID, GI and BSD have the potential to greatly benefit the WOH. This is because the strategies that are previously detailed, while effective in nearly any situation, are especially critical when trying to work within the natural constraints of the often steep-sloped and poor-soiled lands found in the hills and valleys of the Catskill and Delaware systems.

Additionally, low-density rural development has been shown to negatively impact water quality in ways traditionally associated with more urban environments[8], including in the NYC Water Supply System. Non-point source pollution from lawn chemicals and fertilizers, septic systems, sump pumps and fecal contamination is finding its way into rural waterbodies. This is true even when the percentage of forest cover remains high and rate of human use remains low, as is the case in the WOH, as noted in a study[9] conducted by researchers at SUNY ESF, led by Myrna Hall and Renee Germain, and the Global Institute of Sustainable Forestry Yale University School of Forestry and Environmental Studies, led by Mary Tyrrell and Neil Sampson.

This can possibly be explained in part by the pattern of rural, low density development being associated with a higher rate of impervious surface coverage per housing unit[10]. According to the previously mentioned study conducted by SUNY ESF and Yale University researchers, the amount of impervious surface coverage is "overwhelmingly" the most important factor for the Catskill and Delaware systems in projecting water quality change into the future. Those factors, along with the following trends that are being observed in the Catskill and Delaware systems, represent potential threats to continual high water quality for the project area in the coming years:

- Average parcel size is declining[11,12];
- The majority of new lots are 5.0-9.9 acres in size[13];
- High rate of impervious surface coverage on lots of that size[14].

One lesser threat was identified through the stakeholder survey conducted between January and April of 2011. The results of this survey show that there is a low to moderate level of experience with LID designs and a misconception of impediments to implementation, despite the efforts made to date. Future educational events and programs must stress to residents of the project area, and especially members of municipal boards, that protecting local water quality has local benefits, and that LID methods have been

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[8] Mehaffey, M. H., M. S. Nash, T. G. Wade, C. M. Edmonds, D. W. Ebert, K. B. Jones, AND A. H. Rager. Linking Land Cover and Water Quality in New York City's Water Supply Watersheds. Journal of Environmental Monitoring & Assessment 107:29-44, (2005).

[9] Found at http://environment.yale.edu/gisf/files/Chapt_1_4.pdf

[10] Stone, B., 2004. Paving over paradise: how land use regulations promote residential imperviousness. Landscape Urban Plan. 69, 101-113.

[11] Tyrrell, M.L., Hall, M.H.P., and Sampson, R.N., 2004. Dynamics models of land use change in Northeastern USA: Developing tools, techniques and talents for effective conservation. Yale School of Forestry and Environmental Studies, New Haven, Connecticut. GISF Research Paper 003.

[12] LaPierre, S. and R. Germain. 2005. Parcelization of private lands in the New York City Watershed. J. For. 103(3): 139-145.

[13] Caron, J. 2008. The Changing Face of a Forested Watershed: Parcelization in the New York City Watershed. Masters Thesis, SUNY ESF, Syracuse, NY.

[14] Hall, M.H., Tyrrell, M., Germain, R., Sampson, N., and Hall, C.A.S, in progress. Predicting future water quality from land use change projections in the Catskill-Delaware Watersheds. SUNY College of Environmental Science and Forestry, Syracuse, New York.

shown to protect water sources without preventing development, while often less expensive than traditional methods of development and stormwater management.

Maintenance issues associated with LID projects were also cited as an impediment in the survey of stakeholders. For this reason, Appendix C contains information from the Mountaintop Better Site Design Roundtable's Low Impact Development Manual[15] regarding inspections, monitoring and general upkeep related to construction projects.

Implementing LID practices, GI, and BSD principles in codes should address the issues outlined above and protect water quality into the future. These practices are now part of the required permitting and regulatory processes of New York State and New York City that are detailed in the next section. Making local land use policies and laws that are compatible with those requirements will make the process easier for developers and for local boards while preserving the most integral and desirable features of the natural areas.

[15] Found at http://www.gcswcd.com/images/stories/pdf/wap/mbsdw/lid_guide_final_9_28_11.pdf