

13 Capture Stormwater to Prevent Flooding

I. Summary

Issue:

Storms can cause localized flash flooding of buildings and streets. The city applies rigorous stormwater standards to buildings that add new sewer connections, but stormwater from existing buildings must still be addressed.

Recommendation:

Design sidewalks to capture stormwater and continue supporting the NYC Green Infrastructure Plan.

II. Proposed Legislation, Rule or Study

Proposed Sidewalk Standard:

The Department of Transportation (DOT) and Department of Parks and Recreation (DPR) should revise their sidewalk rules, specifications, and details to conform to the standard below. In addition, information on agency websites should be coordinated and made consistent. (Note: this proposal references water detention provisions from the Green Codes Task Force Proposal UE3.)

Sidewalks shall include a continuous permeable strip at the curbside. The permeable strip shall conform to the following requirements:

1. **Dimensions:** The permeable strip shall have a width of at least 1/3 of the sidewalk width (the distance between the lot line and the curb) and be no less than three feet wide along the curbside length of the sidewalk from lot line to lot line. Strip shall be adjacent to the curb, unless existing trees occur elsewhere.
2. **Tree Planting Zone:** The permeable strip shall include a tree planting zone with a minimum length and depth as defined by DPR in the Tree Planting Standards: Sample Tree Pit Configurations, p. 20. The tree planting zone shall be backfilled with topsoil per the same reference standards, p. 9-11. Plantings may include single trees or grouped trees with or without shrubs or ground covers.
3. **Existing Trees:** Where existing trees are encountered in construction of a new permeable strip, the root mass shall be left undisturbed within the Critical Root Zone. Structural soil shall be placed outside of the Critical Root Zone.
4. **Tree Planting Spacing:** Trees shall be planted either individually or in groups with a minimum distance of 10 feet on center to a maximum of 25 feet on center. Other spacing requirements shall be as defined by DOT, DPR, FDNY and MTA, with the exception that

a pattern book shall be developed to determine tree spacing from intersections based on sight lines, traffic direction and traffic control.

5. Builder's Pavement Plan: The builder's pavement plan shall show all existing and proposed trees on the block and indicate the species of the trees.
6. Requirements for Non-Planted Permeable Strips:
 - a. Surface material shall be permeable based on DOT material options applicable to neighborhood classification that are in the process of development by DOT.
 - b. Backfill Beyond Planting Zone: Between planting zones and within the full extent of the permeable strip, the backfill shall be Structural Soil as defined by DPR Tree Planting Standards: CU Structural Soil (p. 4-7) with a depth of no less than 24 inches from finished grade. The use of recycled concrete aggregate shall not be permitted due to its potential to alter the pH of the soil beyond the acceptable range for trees.
7. Requirements for Planted Permeable Strips:
 - a. Within this planting strip, no turf grass shall be permitted. Plants shall consist of native meadow plantings and low herbaceous grasses or native ground covers, except that street trees within the planting strip shall have a 3-foot diameter/square mulch bed at their base.
 - b. Meadow shall be mowed once per year or other grasses shall be trimmed in mid-winter.

Exceptions

1. Sidewalk zones where the distance between the curb and the lot line is less than 9'0" wide.
2. Areas within any sidewalk which contain sub-grade structures, including but not limited to subway vents or structures, critical utility infrastructure, sidewalk vaults, and electrical vaults.
3. Areas within curb cuts.
4. Historic sidewalks constructed of brick, granite, or bluestone slabs.
5. Locations where the groundwater level or impervious bedrock is within 5' below sidewalk grade.
6. School sidewalks.

Policy Recommendation:

Continue the implementation of the NYC Green Infrastructure Plan.

III. Supporting Information

Expanded Issue and Benefits:

From NYC Natural Hazard Mitigation Plan (2009):

Intense rainfall, producing several inches of rain in a short period, is most likely to cause flash flooding and other problems, such as sewer back-ups

*into residences. These floods are unrelated to the 100-year floodplain designation. According to DEP's rain gauges, the July 18, 2007 storm produced 1.93 inches of rain in one hour in northern Queens. The August 8, 2007 storm, which resulted in levels of flooding throughout the City not seen for decades, produced more than three inches of rain in a two-hour period. **Based on historic probability, that level of rainfall has a chance of occurring about once every 25 years.** Over the last several years, storms of intense magnitude have been occurring somewhat more frequently than expected, and climatologists warn that the trend may continue as the effects of climate change are felt.*

Given the history of flooding in New York City, it is certain future floods will occur. Based on analysis of records from the National Climatic Data Center of NOAA, New York City has experienced flooding 60 times during the 15-year period between 1993 and 2007. Using simple historic frequency to indicate the future flooding potential, New York City will likely experience an average of four floods per year.

1. Create a Green Sidewalk specification, maintained by the Departments of Transportation (DOT) and Parks and Recreation (DPR).

Since sidewalks comprise 8% of the city's land area, creating a single consistent sidewalk standard that includes permeable strips and water storage capacity can have an enormous cumulative effect on stormwater discharge. However, city rules and regulations for sidewalks are inconsistent and, in some cases, impede the development of green sidewalks.

DOT is responsible for regulating sidewalks, while the DPR is responsible for regulating the trees planted in those sidewalks. Their jurisdiction overlaps and is inconsistent on issues such as the location of street trees, the size of tree pits, materials within tree pits, and the extent of structural soil within tree pits. In addition, the Department of Design and Construction ("DDC") has two sets of specifications for tree pit soil and plantings, while School Construction Authority ("SCA") standards are relatively consistent with DOT tree pit specifications. All told, between the various city agencies and public authorities, there are at least 10 sets of inconsistent and sometimes conflicting specifications and drawings for sidewalk trees and tree pits.

This proposal would provide one standard sidewalk specification that would increase tree cover, reduce stormwater runoff, and decrease greenhouse gas emissions. It would require that the outer third of all sidewalks be permeable with at least 24" of structural soil below, referred to as a "linear tree pit." As structural soil is 30% void, it can serve as a repository for stormwater; almost all the rain in a 2" storm would be captured by a sidewalk designed to the proposed specification. By reducing stormwater runoff, the permeable strip will reduce flooding in sewers, subways, and roads, and reduce the pollution carried into waterways. It will also provide more root space for trees, ensuring a healthier tree canopy.

The proposed specification also directs that trees be planted closer together, increasing the number of trees in sidewalks. This will reduce urban heat island effect, increase natural shading and cooling through evapo-transpiration, and provide more pleasant sidewalks.

2. Continue the implementation of the NYC Green Infrastructure Plan.

This 2010 plan presents an alternative approach to improving water runoff quality that integrates “green infrastructure,” such as swales and green roofs, with traditional, or “gray infrastructure.” Appropriate deployment of green infrastructure assists in the retention and detention of stormwater to reduce surface flooding, can be easily integrated with existing systems, and can foster optimization of investments in targeted, cost-effective gray infrastructure.

Cost:

No cost estimation was performed for this proposal.

Implementation:

Sidewalks

There are no known implementation issues for this proposal regarding sidewalks. Multiple local suppliers carry structural soil and there are many manufacturers of permeable pavements.

Green and Blue Roofs

The following implementation-related considerations are quoted from the DEP Guidelines for the Design and Construction of Storm Water Management Systems (July 2012).

Advantages:

- Well suited for lot line to lot line buildings.
- Requires no additional land area.
- No excavation required.
- Easy to install.
- Extends the life of the roof by protecting roofing membranes from ultraviolet radiation.
- Commercially available products.
- Readily coupled with other storage techniques, such as subsurface storage or cisterns.
- Compatible with other rooftop uses.
- Green roofs add economic value to developments when used as passive recreational features or rooftop farms.
- Green roofs provide co-benefits, such as heat island reductions, energy conservation and climate change offsets, air quality improvements, and increased wildlife habitat value.

Limitations:

- Roofs with steep slopes (greater than 2% slopes for blue roofs and greater than 5% for green roofs) will provide limited storage.
- Regular inspection and maintenance of roof surface and roof drains are required.
- Limited benefit on sites where roof area makes up only a small portion of the total impervious area.
- Additional loading on roof may add to the cost of the building structure.

Subsurface Detention Systems

Subsurface systems are suitable in most urban environments. Subsurface systems can be installed below a variety of generally level areas, such as landscape areas, parking spaces, open lots, driveways, walkways, patios, and public plazas.

Limitations are associated with available space and subsurface conditions. Non-building areas are most suitable for subsurface systems. Permeable soil is required to adequately drain the stormwater.

Limiting Impervious Area

According to the DEP Guidelines for the Design and Construction of Storm Water Management Systems (July 2012), “Urban stormwater runoff results from rain, snow, sleet and other precipitation that lands on rooftops, parking lots, streets, sidewalks, and other surfaces. Of specific concern are impervious surfaces, as they do not allow water to infiltrate into the ground or be utilized by plants, both of which are key elements of the natural water cycle. Rather, impervious surfaces shed water, which then becomes runoff that eventually enters the city sewer system or is discharged directly to adjacent waterbodies. “Greening” a site with vegetation, as well as using pervious materials, reduces impervious surfaces. Non-paved areas reduce a site’s weighted runoff coefficient and calculated developed flow.”

Through the city Zoning Resolution, the Department of City Planning requires a minimum percentage of planting in front yards in residential areas. However, there are no requirements for planting or pervious area in backyards. According to a study by the Sustainable Yards project, conducted with CUNY assistance, residential yards make up 27% of the city’s total area, not counting parks or street and sidewalk medians. Even in dense Manhattan, one fifth of the island’s total area is yard space. Limiting the portion of impervious or paved area in backyards may significantly reduce stormwater runoff and the risk of surface flooding.

Sources:

1. NYC Green Infrastructure Plan
http://www.nyc.gov/html/dep/html/stormwater/nyc_green_infrastructure_plan.shtml
2. New York City Department of Parks and Recreation: Tree Planting Standards, April 2008.
<http://www.nycgovparks.org/permits/trees/standards.pdf>
3. New York City Department of Design and Construction (NYCDDC). 2010. Water Matters: A Design Manual for Water Conservation
4. New York City Department of Environmental Protection (NYCDEP). 2010. NYC Green Infrastructure.
5. New York City Office of Long-Term Planning and Sustainability (OLTPS). 2008. PlaNYC Sustainable Storm Water Management Plan 2008
6. New York City School Construction Authority (NYCSCA). 2007.
7. New York City Department of Environmental Protection. July 2012. Guidelines for the Design and Construction of Storm Water Management Systems.
http://www.nyc.gov/html/dep/pdf/green_infrastructure/stormwater_guidelines_2012_final.pdf
8. New York State Department of Health (NYSDOH). 1996. Individual Residential Wastewater Treatment Systems Design Handbook.
9. Newsweek, October 4, 2010. “How Green is the Big Apple?”
10. Wall Street Journal, October 6, 2010. “NYC Is Made of Asphalt, Concrete...and Yards?”