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The Gaia Institute

24 September 2007

Honorable James F. Gennaro
Chair of the New York City Council Committee on Environmental Protection
City Hall
New York, NY 10007

Re: Oversight - Rising Waters: What Can the DEP Do About Flooding?

Dear Chair Gennaro and Members of the Committee on Environmental Protection,

The Problem:

Flooding in New York City is caused by intense storms that discharge large amounts of water in a short time period of time, mainly in lower lying areas. Contributing to this problem are large portions of impervious cover, low coverage of permeable landscapes, or both.

Major flooding results from precipitation events in excess of an inch per hour. Because of this intensity, best management practices will need to capture substantial volumes of water. How to do this is relatively simple: infiltration and on-site containment structures.

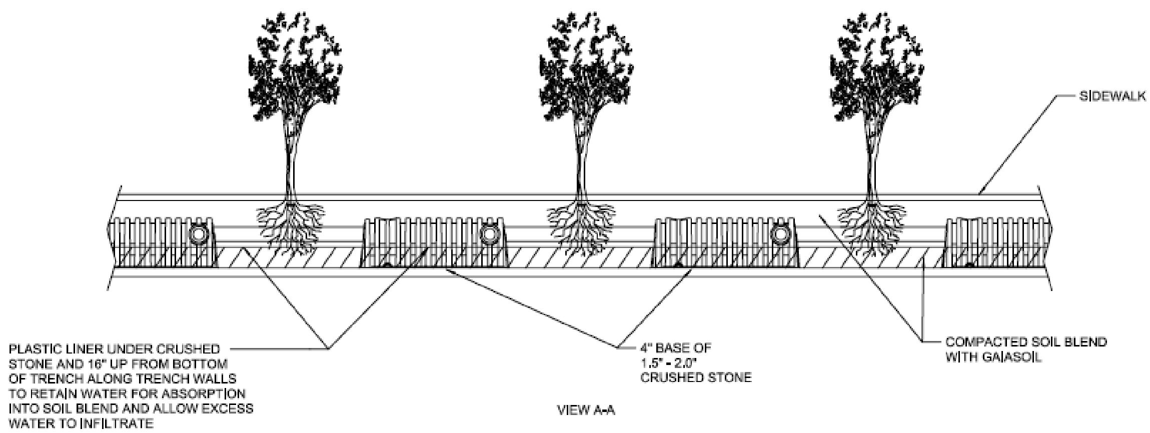
Water can either be moved through infiltration into soil, into man-made structures along streets or under parking areas or playgrounds, held on green roofs, or shunted into constructed wetlands or bluebelts. To maximize ecological benefits, widely distributed soils or appropriately scaled vessels are needed to get water off the streets and into the ground.

To make such practices work Citywide, performance criteria are needed for stormwater catchment. To balance out the local water budgets that now contribute to flooding of this urban landscape, infrastructure and buildings will need to be designed and retrofitted to hold specific quantities of runoff:

1) Streets will have to capture a minimum of about 30 gallons per linear foot of roadway;
2) Rooftops will have to capture about an inch of water per square foot; and,
3) Parking areas, playgrounds or other large open areas would need to store a minimum of 250,000 gallons per acre.

The problem that confronts us, and the opportunities, are large. There are 6,300 linear miles of roadway in New York City. An inch of runoff from each linear foot of a hundred foot wide road (100 square feet) is about 60 gallons of water. There are cost-effective, commercially available stormwater catchment structures which can be dug in the below grade landscape to captures specific water quantities. Some of the available structures include RainStore, RainTank, StormChambers, and others. They are useful because they all can be used to create storage volume below ground which can be widely distributed in urban landscapes to capture water and allow it to slowly infiltrate it into the ground.

A simple performance criterion for street edge design would specify a catchment capacity of an inch of runoff from the adjacent roadway. For a hundred foot wide roadway, this criterion would result in the requirement for a volume of 60 gallons per linear foot, or 600 gallons for every ten-foot length of roadway. The enhanced tree pit pictured below sits between two stormwater capture devices. This composite structure would capture 60 to 100 gallons of water per linear foot of roadway.



About 10% of the area of New York City is covered by buildings, or about 30 square miles, or 20,000 acres. An inch of runoff from a building one hundred feet on a side (10,000 square feet,) is about 6,000 gallons. Each inch of runoff from acre of rooftop moves 27,000 gallons into the sewer system. At the same time, every centimeter of water evaporated each day off a 400 square foot green area is the equivalent of 18 tons of air conditioning.

Solutions:

By evaluating how much water a given storm interceptor sewer line can carry without flooding, it is possible to evaluate how much extra the line carries under flood conditions. This ‘over-capacity’ or ‘flood producing excess’ can be quantified. Then, strategies for partitioning this over-capacity water to retrofitted parking and play areas, enhanced tree pits, bluebelts and green roofs can be developed for storms of ten, twenty, and even fifty and one hundred year frequencies. Informed decisions on development and construction choices and incentives packages can then be made based on the costs of capturing water versus estimates of the liabilities of property damage from flooding.

An acre of parking area, or playground, or ball field, outfitted with StormChambers or similar below grade stormwater containment devices, can hold a million gallons of water. The photo below shows a StormChamber array being put in place beneath the Sims Group metal recycling facility on the Bronx River. This particular array is designed to capture about 480,000 gallons of water, or about 5” of runoff from the metal recycling work area.

By enhancing tree pits with StormChambers, or similar structures, every 25-foot length of adjacent roadway would have a storage capacity of about 2,000 gallons of water. The Mayor's plan to plant a million trees, if coupled with below ground storage, as described here, would have a stormwater storage capacity of two billion gallons; roughly one-tenth of the annual total combined sewer overflow.

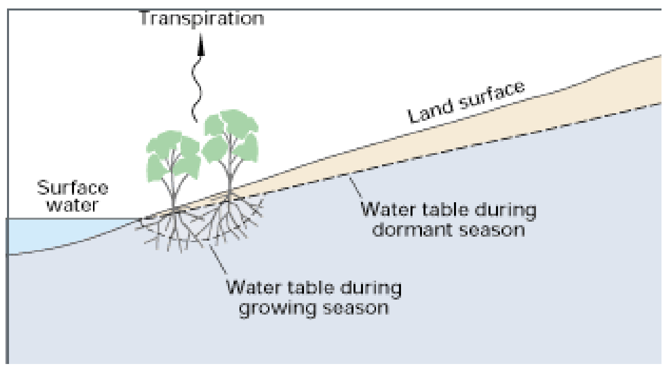
The green roof shown below was constructed on the St. Simon Stock Grammar School. This 3,400 square foot area covered with six inches of lightweight soil holds about two inches of water, about 1.25 gallons per square foot, or up to an estimated 4,000 gallons per storm event.

Designing for the Whole Water Budget: Capture & Removal

The complement to water capture is water loss. Water captured and stored below grade will eventually flow to the surrounding estuary. Water that feeds plants, however, has another positive benefit: for every 1F° that vegetation cools the City, air conditioning efficiency increases by 1%, giving evaporation of water a very substantial economic value.

There is a further advantage to increased vegetation in some low-lying areas, such as southeastern Queens. When the water table rises, flooding can occur when big storms arrive, in part because the water table is close to the surface and there is little room to store more water. To move water out of the water table, trees are needed in good numbers.

The major regulator of the water table is vegetation. Following leaf out, water tables region-wide and worldwide-drop until leaf fall. Acre-feet of water can be evaporated. The diagram below shows how this works:



Source: http://ga.water.usgs.gov/edu/watercycleevapotranspiration.html

Every acre of planted landscape, green roof, or parkland can drop the water table below by an acre-foot in about ten to twenty days. The more water fed to plantings, the more water they will, quite literally, blow off. Every 8 blocks of street tree plantings will drop the water table by an acre-foot, or 330,000 gallons of water.

Wetland systems or water features, like those that DEP constructed in Staten Island, could also help to evaporate water here. Because many wetlands have been lost here and elsewhere in the City, because of their ecological value, and because of flooding threats, a strategy worth investigating would be to construct wetlands and/or other moisture loving plant communities, and use shallow wells to supply them with an abundant water supply. With excess water, plants will evaporate more, and thus help to create room for water storage below ground. Irrigation could also be applied to green or blue roofs to increase cost effective cooling, and at the same time address high water table issues.

Finally, sites for planting evergreen trees like white pine and Atlantic white cedar could help to lower to water table even through milder winters, adding protection, and beauty to local landscapes.

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