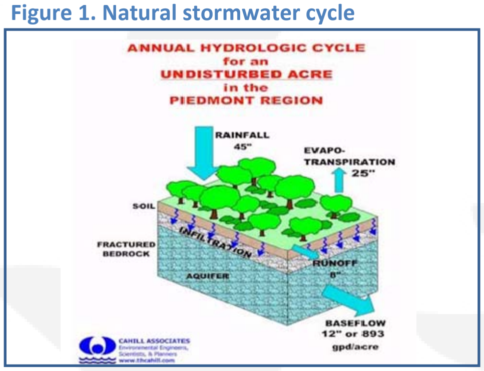
USCC factsheet:

Using Compost in Stormwater Management

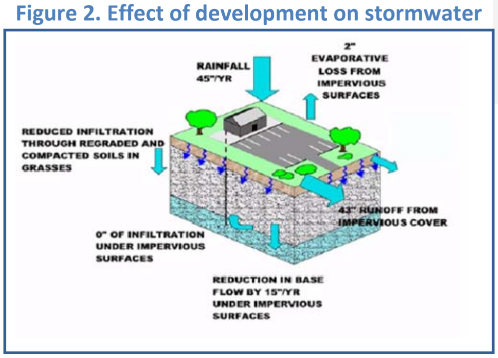
Precipitation falling on the Earth and flowing over and through the soil is a major source of water pollution. While the precipitation is natural, what happens to it after it falls is dramatically affected by human activity. For example, in the Piedmont Region of Pennsylvania, of the 45" of rain that falls during the average year, 25" would be expected to be returned to the atmosphere by vegetative evapotranspiration, 12" would infiltrate deeper into the ground, and only 8" would runoff over the surface. Yet after development, as much as 95% might leave as surface runoff (PA DEP, 2006).

Figure 1. Natural stormwater cycle



Increased runoff leads to increased erosion, more frequent and more intense flooding, habitat and species loss, higher pollutant loads, and water quality degradation. While the emphasis in stormwater management over the past 50 years has been on "peak rate" control, that is, detaining stormwater so that the highest rate of flow was no more that what would have been expected before the development (hence the ubiquitous detention basins in modern landscapes), there is a paradigm shift underway that recognizes that the most effective storm water management will be one that attempts to emulate natural processes. Thus management practices that emphasize the roles of soils and plants are gaining prominence. These practices are enhanced, and often even depend, on the incorporation of good quality compost into the practice.

Figure 2. Effect of development on stormwater



Stormwater management practices that utilize compost.

Stormwater management is generally segregated into two divisions, construction and post-construction. While construction practices have a greater impact in the short term, the post-construction design and implementation will continue to have impacts for decades. The move to reduce the environmental impact of development is called low-impact development, or LID. LID is defined as design and implementation of post-construction storm water hydrology that mimics pre-development patterns[1]. LID management practices seek to reduce both peak flow rates and runoff volume by slowing flows and increasing infiltration thereby decreasing pollutant loads entering water bodies. Incorporating compost into these practices can dramatically lower runoff volume due to improved water holding capacity, healthy vegetation/biomass, and increased infiltration.

LID Stormwater practices that include or benefit from the use of compost include:

Rain gardens and/or Bioretention Systems[2]

Figure 3. A rain garden in Maplewood, MN

[1] A good source of information on LID is the Low Impact Development Center, http://www.lowimpactdevelopment.org/

[2] A general description of this and other stormwater BMPs can be found at the EPA Menu of BMPs: http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm.

A rain garden is a landscaped feature designed to treat on-site stormwater runoff. Not only is it highly effective at removing pollutants, it decreases total stormwater entering the storm drain system and does so in an esthetically pleasing manner. Sometimes called bioretention or bioinfiltration beds, they are growing in popularity throughout the country. They typically feature native plants, several inches of wood mulch, and a planting mix that includes 20-30% compost.[3]

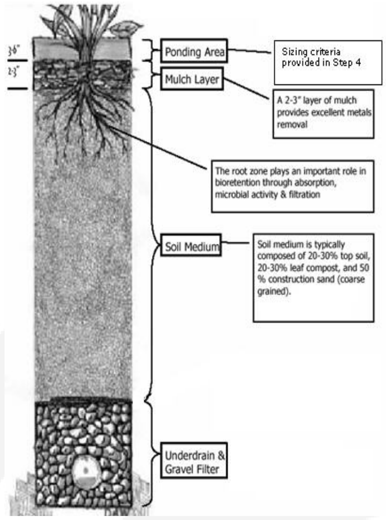


Figure 4. Section of a rain garden

Infiltration zones (including lawns, basins, filter strips, trenches, and others)

As noted above, under natural conditions a considerable amount of precipitation would typically infiltrate into the ground rather than run off over the surface. Once below the surface it either is taken up by plants or percolates further into the ground. In order to emulate that process stormwater designers are incorporating infiltration in many areas of the landscape. Some of this infiltration occurs directly in subsurface layers, being conveyed there through piping or via pervious surfaces, such as porous concrete. Other practices infiltrate the water through turf or other vegetation. For any vegetated infiltration practice to be effective for the long term it must be based on soil that is as healthy as possible. While there are many factors affecting soil health and quality, "the most critical factor is maintaining organic matter levels and carbon cycling through the soil" (Bierman,1998).

Even though soil organic matter is dynamic in nature, with constant additions and decay, having an initial adequate level of soil organic matter is the best way to assure long-term sustainability of a vegetated infiltration area. In many, if not most, situations, adding compost to the soil will be the most efficient way to achieve that minimum organic matter content.

The most aggressive example of this has been in the Pacific Northwest, home to the Soils for Salmon movement. They have been successful in instituting a post-construction soil standard that requires a minimum organic matter content in the soil of 5%. As stated in the introduction to the standard, "Healthy soil provides important stormwater management functions including efficient water infiltration and storage, adsorption of excess nutrients, filtration of sediments, biological decomposition of pollutants, and moderation of peak stream flows and temperatures. In addition, healthy soils support vigorous plant growth that intercepts rainfall, returning much of it to the sky through evaporation and transpiration" (WA DOE, 2005).

Vegetated/green roofs

Vegetated roofs, or green roofs, are another growing LID practice with the potential for huge environmental benefits. The organization Green Roofs for Healthy Cities lists over 50 public and private benefits that may be attributed to green roofs[4]. With regards to stormwater, unlike metal or asphalt roofs that can contribute to thermal and chemical water pollution, green roofs can significantly reduce total stormwater as well as improve the quality of the water. A mature compost is often included in the growing media component of a green roof. In order to meet the exacting specifications for the media, including weight, porosity, and stability, compost usually makes up 10-15% of the total volume.

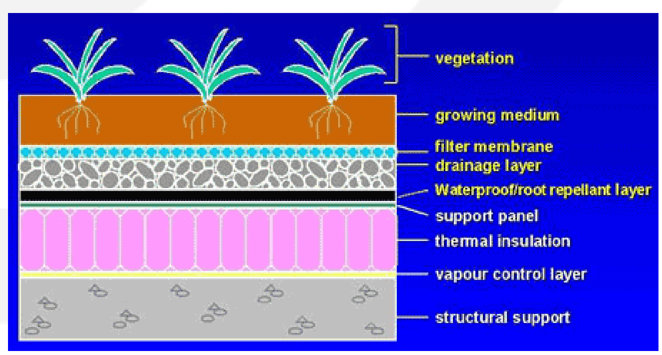


Figure 5. Layers of a vegetated roof

[3] A general design specification for rain gardens and other low-impact practices can be found at http://www.lid-stormwater.net/intro/homedesign.htm

[4] Visit http://www.greenroofs.org/ for more details about vegetated roofs.

Compost-based Erosion and Sedimentation Control Practices

The highest risk of erosion and sedimentation is while a project is under construction, especially in the beginning phases while the most earth-moving is going on. Without a protective "skin" of organic matter (both living and decaying) soils are easily erodible, with some variability depending on soil type and slope. Soil loss from construction sites can be 200 times that of forest lands, and 10 to 20 times that of agricultural lands (GA S&W Cons. Comm, 2002). Once pollutants, whether simply silt or specific contaminants, are picked up by water it is difficult to keep them from moving downstream. Therefore practices that prevent erosion are much more effective at preventing pollution than those that attempt to clean water after it has already gained a load of pollutants.

Preventing erosion with a compost blanket.

Figure 6. Applying a compost blanket in PA (photo credit: D. Caldwell)

Many studies have shown that compost can be highly effective for reducing and preventing erosion on an exposed slope.[5] Unlike most other stormwater BMPs compost has significant water holding capacity, so that low-to-medium intensity and duration rain events may produce no runoff at all (Persyn et al, 2004). Those that do produce runoff produce less, take longer before runoff starts and longer to reach peak flow (Glanville et al, 2003). Using compost of low nutrient value has the added benefit of releasing less phosphorous and nitrogen than hydroseeding, hydromulching, and seeded straw mulches, all common form of erosion prevention (Faucette et al, 2005). Compost not only helps prevent erosion immediately upon application, it also provides an effective substrate for seed growth, conserving moisture, suppressing weeds and providing slow release nutrients to support the establishment of vegetation, thus providing long term erosion prevention (Faucette et al, 2005). Compost blankets have a lower "C" factor compared to hydroseeding or rolled erosion control blankets, estimated to between .02 and .05, compared to .1 to .2 for competing practices.[6]

As of 2006 at least 32 state transportation departments, plus many Federal and local agencies, have adopted this as a best management practice. Generally these specifications are based on the generic one adopted by the American Association of State Highway and Transportation Officials (AASHTO) as MP-10, a version of which can be found at http://compostingcouncil.org/pdf/Erosion_Specs.pdf. These specifications take soil erodability and rainfall patterns into account to determine the proper depth of the blanket.

Although listed here as a construction practice, compost blankets are commonly seeded, becoming part of the post-construction landscape. At that point they are also acting as an infiltration practice as well as an erosion-prevention practice, reducing and delaying runoff and maintaining a vegetative cover on the soil.

David M. Crohn, Biosystems Engineering Specialist for the University of California Cooperative Extension, summarized how compost helps prevent erosion:

- Protecting the soil from the energy of falling rain
- Absorbing moisture
- Promoting infiltration
- Encouraging soil aggregate formation
- Promoting plant growth (Crohn, 2006)

Sediment Control – Filtering stormwater at a construction site

While preventing erosion is always the first choice, it is not always possible, and compost has also proved to be effective at filtering stormwater pollutants originating from construction sites. Typically this is done at the perimeter of the site, around storm inlets, and in storm

[5] For a good review of the research see Faucett et al, Evaluation of stormwater from compost and conventional erosion control practices in construction activities, in Journal of Soil and Water Conservation, v. 60 no. 6:288-297

[6] C refers to the Cover factor in the Revised Universal Soil Loss Equation, and is commonly used to compare effectiveness of different practices. C factors for compost and rolled erosion control blankets, Filtrexx Tech Link # 3303

channels. Both freestanding berms made of compost and compost "socks" (long tubes constructed of open weave or knit fabric and filled with composted mulch) have surpassed the traditional practices of silt fence and hay bales at reducing the pollutant loads of construction stormwater. Unlike the traditional practices, which work primarily as temporary stormwater detention devices allowing solids to settle out of the water, the berms and socks act as both detention and as true filters, removing not only the settleable solids but a significant percent of suspended solids as well as nutrients and hydrocarbons (Faucette, 2006). Berms have the advantages of a wide "footprint" with intimate soil contact that all but eliminates undercutting and very low disposal and cleanup costs, but have the disadvantages of lack of visibility in active construction zones and poor performance in direct flows. Socks have the advantages of visibility and ability to function in concentrated flows but slightly higher disposal costs.

Figure 7. Installing a 24" Filtrexx SiltSoxx. Photo by Cary Oshins

Researchers from Filtrexx International, a leader in developing compost-based stormwater water practices, and the independent Soil Control Lab, found that based on 45 tests of compost filter media the mean total solids removal was 92%, mean suspended solids removal was 30%, mean turbidity reduction was 24%, and mean motor oil removal rate was 89% (Faucette et al, 2006b). Moreover, the researchers found that by adding polymers to the filter media, removal efficiencies could be improved, sometimes dramatically. For example, turbidity reduction was increased from 21% to more that 77%, and soluble phosphorous removal increased from 6% to a remarkable 93%.

Continuing research has found a number of other applications for the compost socks. They have been used to construct sediment traps, sediment basins, ditch checks, water diversions, and streambank protectors. The key to the success of these practices is to understand the material used to fill the socks and how it functions—as filter media, growth media, or both. Especially if the device will be used as a filter, there needs to be a balance of pore space to allow water to pass through and surface area to trap pollutants. The material must be well stabilized so it does not release nutrients. Various states and agencies are developing specification for this material, and private providers of these systems, such as Filtrexx International, have detailed specifications to meet their certification standards.

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