Using Healthy Soils to Manage Stormwater

dirt.asla.org/2012/11/16/using-healthy-soils-to-manage-stormwater

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In cities, healthy soils could be a powerful tool for managing stormwater, but unfortunately the status-quo is compacted, degraded soil covered in asphalt, said Zolna Russell, ASLA, Floura Teer Landscape Architects, and Stu Schwartz, Center for Environmental Research and Education, at the 2012 Greenbuild conference in San Francisco. Outlining novel techniques — "subsoiling," which involves the use of agricultural de-compaction machinery, along with adding "soil amendments," otherwise known as compost — Russell and Schwartz made the case for rebuilding the ecosystem function of soils in urban areas and creating new opportunities to manage stormwater through the ground itself. They also noted that the Sustainable Sites Initiative™ (SITES®) would provide credit for approaches like these that boost soil health.

According to Russell, the ecosystem services of soils play a large part in determing the quality of our landscapes. Healthy soils provide water absorption, groundwater recharge, food for plants, habitat for decomposers, and sequester carbon. Without healthy soil, stormwater management needs to be accomplished through green infrastructure techniques that rely more heavily on plants.

Soils can be evaluated along many lines. Their "biology, fertility, and structure," which are all inter-related, are key to soil quality. Russell said "bugs, microbes, roots, naturally occuring chemicals all work together to affect the structure." Zooming down to dirt-level, healthy soils have "open spaces" that let oxygen flow and water to infiltrate. Infiltration, unfortunately, works less well as we move from a forest to an urban environment. In the dense urban core, there's often less interflow and groundwater recharge, even if there are parks and street trees.

The fact is then that "green in our urban environments doesn't necessarily mean the system functions." Lawns, for example, have the "bulk density of cement," which actually prevents root penetration and plant health. In contrast, "deep, rich soils with long roots are a sign of a functioning landscape."

So, given soil is so crucial to our ecosystems, why is it abused so much? She said unfortunately the common landscape architecture practice was to strip top soil and sell it, stockpile soils for later use in berms (degrading it in the process), amend old soils with compost, or import new soils, releasing lots of carbon in the process through hauling new soils in from other areas. In many of these human interactions with soil, soils are basically compacted, which means the essential ecological and hydrologic functions have been removed.

Schwartz said typical road building projects involve stripping vegetation, removing top soils, grading, and then compacting soil to form roads, foundations, and berms. Then, the "landscape is put back on top at the end." The "engineered topography" — the earthern berm — is where all that valuable topsoil goes. While these berms can be useful sound and visual barriers, it's a "wholesale disruption of the soil."

Residential developments are often just as bad, leaving "material formerly known as soil" in their wake. Thin layers of turf are rolled out over the degraded soil, meaning that the lawn will need lots of fertilizers and water to live — as there will be no soil for the grass roots to grow into. With heavy rains, this thin veneer of grass provides no help in capturing rainwater, so there's lots of runoff. "Modern practices are totally decoupled from the function of the landscape." Schwartz went on to say that rain gardens in residential areas are basically useless if all the soils are damaged.

Instead of impoverishing soils and then adding asphalt on top, Schwartz said developers could use permeable pavers or pavements. But then, while those systems can help infiltrate water, the soils underneath still need to be in good enough shape to soak up the water. "It has to be a whole system."

To address the challenges of soil quality in urban and suburban areas, a novel practice, subsoiling, may be the way to go. This practice involves adapting agricultural techniques to highly disturbed soils. In agricultural fields, farmers have long used decompactors to "reliably increase their crop yields." Once the soil has been ripped, "soil amendments" or compost can be added to restore landscape function.

While the decompactors themselves looks like "medieval equipment," with large hooks at the end of tractors, they are necessary for creating a deep enough rip. Schwartz outlined a pilot study his organization has done at a school in Baltimore, Maryland. Using a "5-bladed parabolic ripper" and adding 3-inches of "vegetated organic compost," creating a 2-to-1 soil to compost ratio with a 9-inch depth of incorporation, his team is demonstrating a

“new practice.” Schwartz showed photos clearly demonstrating how the new soils and lawn on top better handle stormwater and require no chemical fertilizer. A standard thin veneer of grass nearby flooded when it rained, while the ripped and decompacted soils with turf simply absorbed the water. The grass was deep and rich and even hard to get one’s hands into, whereas the standard lawn was patchy and fillled with weeds.

But not every site will be ideally suited to subsoiling. Russell said some sites may not have space for the equipment or be the appropriate size. She said some ideal early adopters would be long-term land holders like the U.S. department of defense, transportation department, or highway administrations. Sensitive watersheds would also be ideal spots for healthier soils that can absorb water. Other potential adopters include urban sites like schools or parks. She said athletic fields could also be a possibility, but recompaction could happen there. Some sites may also not work because of tree roots, utility lines, or naturally poor soils (for example, you can’t really aerate heavy clay soils). She noted that with these systems, “no one size fits all.”

Russell and Schwartz said for subsoiling to work an integrated design process must be used, bringing in all contractors early on in the process. Maintenance practices also need to be figured out in the beginning and their costs factored into project scopes. Russell said she’s seen too many projects put in thousands of dollars worth of plants, only to see them die because the soil wasn’t providing the right support. So including measures that maintain long-term soil health is need for the system to pay for itself. She said keeping soils healthy over the long-term also means you don’t have to create retention ponds or lay down pipe infrastructure. There’s no need for fertilizer, irrigation. Still, to achieve those benefits, landscape architects should factor in maintenance over the long haul.

To maintain this new sustainable design practice, there then needs to be lots of testing throughout the design and build process. At the beginning of the project, there should be soil testing and aftewards, too. Doing research will also help landscape architects and engineers get regulatory approval. In many communities, these practices may be illegal.

Demand for landscapes with hydrologic function is only growing. In many cities, the demand is driven by the need to meet local stormwater regulations, which call for managing stormwater on site or paying a hefty fine. The goal is to get local policymakers and designers to see healthy soils as a “cost effective stormwater management technique.” Schwartz said: “we really want this to go mainstream.”

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