City of South Portland Stormwater Manual

Design Specifications

Soil Quality Restoration

Adopted from Iowa Stormwater Management Manual
http://www.intrans.iastate.edu/pubs/stormwater/index.cfm

Overview

How it Works and What it Does

Healthy soils have tremendous capacity for infiltrating and storing water. Healthy soils also have active microbial life that will break down and utilize many pollutants transported by urban stormwater runoff. Soil quality restoration helps urban landscapes absorb, infiltrate, and purify runoff. Directing stormwater flows onto landscapes with good soil quality reduces the volume of runoff that is generated.

Soil quality restoration involves a combination of steps. Reducing compaction, increasing pore space, improving organic matter content, and re-establishment of soil dwelling populations (microbes, worms, insects, etc) are the main components of soil quality restoration. Soil quality restoration is most beneficial to soils that have been altered and compacted through recent land-disturbing activities on construction sites, but almost any urban landscape can benefit from soil quality restoration techniques. The goal of soil quality restoration (and the other infiltration-based stormwater management practices) is to make our modern urban landscapes mimic the hydrologic functionality of our historic landscapes, at least for the water quality volume (1 inch of rain or less).

Soil Quality Restoration can reclaim compacted, marginal urban soils.
Source: Iowa Stormwater Management Manual

Soil quality is best maintained by minimizing land-disturbing activities. Design new developments to fit the existing topography to the greatest extent possible. Use a "building

envelope" to confine grading activities, construction traffic, stockpiling of materials, and other construction activities within a cordoned-off area. Where land-disturbing activities can't be avoided, perform soil quality restoration as part of the final landscaping.

Difficulty Level

Soil Quality Restoration can be designed and constructed using common materials and installed with light equipment but does require some specialized skills. Landscaping professionals should be consulted to identify sources of materials and installation options.

Drainage Plan and Basic / Post-Construction Stormwater Management Plan Requirements

Soil Quality Restoration is an excellent approach to minimizing stormwater runoff from any urban compacted soils, and will also provide aesthetic benefits since it promotes healthier, more resistant lawns and landscaping.

A healthy soil profile with 45% pore space should typically be able to infiltrate anywhere from 0.6 inches to 2 inches of water per hour into the soil profile. The water-holding capacity of most native soils should be around 0.2 inches of water per inch of soil profile. Therefore, a soil with 45% porosity should be able to store at least 2.4 inches of rainfall in the first foot of soil profile, provided it is entirely above the seasonal high groundwater level.

A soil management plan should be created for each new development. Soil management plans are needed to improve landscapes once mass grading is completed and infrastructure is installed. Utilizing Soil Quality Restoration under an approved Soil Management Plan can meet the requirement for storage and treatment of the 0.2 inches of runoff from the landscaped portion of a site (under Post-Construction Management Plan requirements) or can help meet the requirements under a drainage plan, except when in a combined sewer overflow drainage area.

Soil management plans will typically involve eight-steps:

- Determine soil conditions (pre- and post-construction).
- Identify areas where soils and vegetation will not be disturbed.
- Determine areas where topsoil will be stripped and stockpiled.
- Determine tillage needs to address compaction post-construction.
- Determine the organic matter content needed.
- Quantify compost amendments needs and specify methods of amending.
- Specify methods for establishing vegetative cover (i.e. sodding, seeding rates).
- Specify erosion control components needed until vegetation is well established.

Site Suitability

Soil Quality Restoration is applicable to almost all soils. See depth to groundwater, below.

Proximity to Structures

There are limited concerns with Soil Quality Restoration adjacent to structures or utilities. Mechanical tillage should be conducted with care near foundation walls, and all necessary efforts to avoid buried utilities must be taken. Depth of tillage beyond 4-6 inches should include contacting DIG Safe in order to map below grade utilities. Consult with a landscaping professional or builder for advice.

Depth to Groundwater

As Soil Quality Restoration is designed to promote infiltration into natural soils, the soil profile should be above the seasonal high groundwater table. Conditions such as extended periods of high water table could render soil quality restoration not feasible, although such sites would typically not be developed.

General Design Guidance

Design Overview

1. If applicable, review grading, landscaping, and soil management plans to ensure soil quality restoration is included in the project design.
2. Determine existing organic matter content of soil. A soil lab can provide this testing, such as Maine Soil Testing Laboratory (http://anlab.umesci.maine.edu/)
3. Calculate amount of compost amendment needed to achieve a minimum 5% organic matter and minimum 40% pore space.

Installation

First and foremost, existing soil quality should be protected, whenever possible. By minimizing land-disturbing activities, soil profiles are left intact and compaction does not occur. Compaction, which increases bulk density and reduces pore space, is a primary culprit in the creation of hydrologically-dysfunctional landscapes. Never compact, place fill, or perform deep till under the drip line of trees to be saved.

Stripping and removing topsoil is another cause of post-construction soil quality problems. Topsoil contains the organic matter that is the key to soils being able to absorb water. High organic matter gives soils the ability to absorb water like a sponge. Low organic matter content means soils will be able to absorb less rainfall before runoff is generated. If soil disturbance cannot be avoided, topsoil should be stripped, stockpiled (with appropriate erosion control), and put back in place as part of final grading. Topsoil will typically need to be amended with compost to achieve the desired organic matter content of 5-10%.

Organic matter content of 10% is desirable, and 5% is the minimum acceptable level. A general rule of thumb to achieve 10% organic matter is to add 1 part compost to 2 parts topsoil (or 25-35% compost amendment by volume). To achieve 5% organic matter content, add 1 part compost to 5 parts topsoil (or about 15-20% compost amendment by volume). These simplified methods assume compost will have a minimum organic matter content of 35%.

Where land-disturbing activities will occur (or may have occurred in the past), deep tillage should be performed as part of final grading. Tillage should be done to a 6-8" depth and specified in the soil management plan. Compacted soils should always be tilled to a minimum depth of 4 inches before the addition of topsoil/compost mixture. Apply compost as specified in the soil management plan to achieve at least 5% organic matter content. Do not re-compact the site while top dressing. Use low ground-contact pressure equipment for the spreading of topsoil and/or compost. Hand rakes or low pressure landscaping rollers may be used to smooth soil during final seeding.

Perform deep tillage when soil moisture conditions are optimum. Optimum conditions are when soil moisture content is ~40%. Rotary tillage, should only be used for shallow tillage as this breaks down soil structure, kills worms, and creates small pore spaces that can re-consolidate. Ideally use ripping tillage tools and equipment for tillage.

Materials

- Light excavation and tillage equipment.
- Compost meeting Maine Department of Transportation Standards 717.09, which states:

> *Minimum organic matter shall be 35% as determined by loss on ignition.*
> *Particle size shall be 100% less than 25 mm (1 in).*
> *Soluble salts shall be less than 4.0 mmhos/cm.*
> *pH shall be between 4.5 and 8.0.*
> *Material shall be Stable (>5) as measured by the Dewar Self Heating Test*
>
> *Organic humus may be a natural peat from sedge, sphagnum or reed origin, or a compost from source separated materials that may include leaf and yard trimmings, food scrapes, food processing residues, manure and other agricultural residuals, or biosolids. Organic humus shall contain no visible admixture of refuse or other physical contaminates or any material toxic to plant growth.*

Maintenance

Monitor the site after rainfall events to ensure no erosion is occurring. Monitor weekly and after rains of 0.5 inches until vegetation is well established.

Long-term maintenance preserves organic matter content. Do not remove lawn clippings. Leave clippings on the yard to decompose and recycle nutrients and organic matter. Annual applications of 1/4 to 1/2 inches of compost will maintain or increase organic matter. If earthworms are not present, inoculate the green space with worms in conjunction with a compost application.