Reforestation

Description: Reforestation refers to trees planted in groups in urban areas such as: parks, schools, public lands, vacant land, and neighborhood open spaces, to provide shade and stormwater retention and to add aesthetic value.

Advantages/Benefits:

- Reduces effective impervious cover
- Reduces stormwater runoff
- Provides aesthetic value
- Provides rainfall interception
- Shade provides cooling and energy savings
- Provides habitat
- Provides pollutant removal
- Provides flow attenuation

Disadvantages/Limitations:

- Poor quality urban soils may require soil amendments or remediation
- Long-term maintenance is required for high tree survival rates
- Must be implemented over large areas to see significant reduction in stormwater runoff
- Time required for trees to mature
- Poor soils, improper planting methods, conflicts with paved areas and utilities, inputs from road salt, lack of water, or disease can lead to low survival rate

Selection Criteria:

Twice the forest Rv factor for the corresponding soil type.

Equal to the forest Rv factor if amended soils are used in conjunction with reforestation.

***This GIP is subject to MWS approval**

Land Use Considerations:

X	**Residential**
X	**Commercial**
X	**Industrial**

Maintenance:

- Trees may require irrigation in dry periods

L	**Maintenance Burden**

L = Low M = Moderate H = High

SECTION 1: DESCRIPTION

Trees are often one of the most economical stormwater control measures. Trees also reduce the urban heat island effect, improve the urban aesthetic and improve air quality. Site reforestation involves planting trees at a development site with the explicit goal of establishing a mature forest canopy that will intercept rainfall, increase evapotranspiration rates, and enhance soil infiltration rates. Data and modeling show that urban trees can remove over 50% of the moisture in the soil beneath their canopy.

SECTION 2: PERFORMANCE

The overall runoff reduction credits for reforestation through lower runoff coefficients are summarized in **Table 9.1**.

Table 9.1. Runoff Volume Reduction Provided by Reforestation

	Level 1 Design				Level 2 Design			
Hydrologic Soil Group	A	B	C	D	A	B	C	D
Runoff Volume Reduction (RR)	96%	94%	92%	90%	98%	97%	96%	95%
Impervious area may be routed to the reforestation area following the guidance and applying the Runoff Coefficient Credits detailed in GIP-09. The reforestation area should be treated as a vegetated filter strip for the application of this GIP.								

SECTION 3: PHYSCIAL FEASIBILITY & DESIGN APPLICATIONS

Reforestation can be implemented on development sites where development density, topography and soils are suitable. Key considerations for reforestation include:

Soils. Reforestation can be used on most soils. Mulch can be used around trees as an added filtration mechanism. The use of amended soils results in additional credit. Soils and mulch play a significant role in pollutant removal and tree health. Selection of soils and mulch intended to improve stormwater controls should allow water to infiltrate into the soil, with planting soil characteristics and volume tailored to meet the needs of a healthy tree.

Available Space. The minimum contiguous area of reforestation must be greater than 5,000 square feet. The reforestation area must be protected by a perpetual stormwater easement or deed restriction which stipulates that no future development or disturbance may occur within the area.

Utilities. Designers must ensure that future tree canopy growth in the reforestation area will not interfere with existing overhead public utility lines. Public underground utilities and associated easements shall not be located within the reforestation footprint. Local utility design guidance shall be consulted in order to determine clearances required between stormwater infrastructure and other dry and wet utility lines. Private utilities should not be located within the reforestation area when possible.

Applications. Reforestation refers to trees planted in groups in urban areas such as: parks, schools, public lands, vacant land, and neighborhood open spaces, to provide shade and stormwater retention and to add aesthetic value. Vegetation management plans must account for Health Department codes regarding overgrown lots and safety concerns of the residents.

SECTION 4: DESIGN CRITERIA

4.1 Stormwater Quality

Level 1 Reforestation involves using soil types currently on a site, without soil amendments. Level 2 Reforestation requires the use of amended soils. Soil Amendment guidance is located in **Appendix 9-A**. Trees should be planted following tree selection criteria in **Table 9.2**.

Table 9.2. Design Specifications for Reforestation

Item	Specifications for Level 1 and Level 2
Area	Minimum contiguous area of 5,000 sq. ft.
Tree Type	⁾ No more than 20% of any single tree species. ⁾ 2/3 of trees must be large canopy. ⁾ Native species to be utilized. See the following resources for additional guidance: o GIP-01 Appendix 1-D o http://landfire.cr.usgs.gov/viewer/ o http://www.se-eppc.org/pubs/middle.pdf
Density	⁾ 300 large canopy trees – species that normally achieve an overall height at maturity of thirty feet or more per acre ⁾ 10 shrubs substitute for 1 large canopy tree ⁾ 2 small canopy trees substitute for 1 large canopy tree
Canopy Rate	Achieve 75% forest canopy within first 10 years
Size	Tree - Minimum tree size 6-8 ft in height Shrub – 18-24 inches or 3-gallon size
Ground Cover	Entire area should be covered with 2-4 inches of organic mulch or a native seed mix

4.2 Reforestation Planting Plan

A landscaping plan must be provided for the reforestation area. Minimum plan elements shall include the proposed planting plan for the reforestation area, the list of planting stock, sources of plant species, sizes of plants, and the planting sequence along with post-nursery care and initial maintenance requirements.

The planting plan must be prepared by a qualified Landscape Architect. The Landscape Architect shall certify the planting plan with certification statement, located on the reforestation planting plan. Standard certification statement can be found in **Appendix 9-B**.

SECTION 5: CONSTRUCTION

5.1 Construction Erosion Prevention and Sediment Control

Construction Stage EPSC Controls. Reforestation areas should be fully protected by EPSC measures as specified in the plans. These areas should remain outside the limits of disturbance during construction to prevent soil compaction by heavy equipment. In addition, the reforestation area shall be clearly identified on all construction drawings and EPSC plans during construction.

5.2 Construction Sequence

The following is a typical construction sequence for a reforestation area, although steps may be modified to reflect different site conditions.

Step 1. The designer and the installer should have a preconstruction meeting, checking the boundaries of the contributing drainage area to ensure they conform to original design. The designer should clearly communicate, in writing, any project changes determined during the preconstruction meeting to the installer and the plan review/inspection authority.

Step 2. Reforestation may only begin after the entire contributing drainage area has been stabilized with vegetation. Any accumulation of sediments that does occur within the reforestation area must be removed during the final stages of grading. EPSC for construction of the reforestation area should be installed as specified in the erosion and sediment control plan.

Step 3 (Optional). Incorporate compost amendments according to **Appendix 9-A**.

Step 4. Install plantings and ground cover per approved plan. The construction contract should contain a care and replacement warranty extending at least two growing seasons, to ensure adequate growth and survival of the plant community.

Step 5. Conduct the final construction inspection and develop a punch list for facility acceptance. Then log the GPS coordinates for reforestation area and submit them to MWS.

SECTION 6: AS-BUILT REQUIREMENTS

After the reforested area has been constructed, the owner/developer must have an as-built certification conducted by a registered Professional Engineer. The as-built certification verifies that the GIP was installed per the approved plan. The following items shall be provided in addition to the as-built requirements found in SWMM Volume 1.

1. Landscape Architect letter certifying that the SCM plantings have been installed in general conformance with the approved plans and, with proper maintenance, should achieve 75% canopy coverage within the first ten years.
2. Supporting documents such as invoices and compost certification.

SECTION 7: MAINTENANCE

The requirements for the Maintenance Document are in Appendix C of Volume 1 of the Manual. They include the execution and recording of an Inspection and Maintenance Agreement or a Declaration of Restrictions and Covenants, and the development of a Long-Term Maintenance Plan (LTMP) by the design engineer. The LTMP contains a description of the stormwater system components and information on the required inspection and maintenance activities. The property owner must submit annual inspection and maintenance reports to MWS.

Mowing is permitted but not encouraged between the trees while they are being established. Eventually, the canopy should shade out the grass and forest undergrowth will be established removing the need to mow. Vegetation management plans should consider if residents would prefer the site mowed in perpetuity.

Additional maintenance activities include:

- Watering the trees as needed during dry periods
- Repairing areas of erosion or reseeding areas that are bare
- Removing trash and debris from area
- Replanting any trees that die throughout the year. (The construction contract should contain a care and replacement warranty extending at least two growing seasons, to ensure adequate growth and survival of the plant community.)
- Addressing areas of standing water which might breed mosquitoes

- Picking up branches that have fallen
- Grooming trees or shrubs as needed
- Removing any trees or limbs damaged in storms that might pose a danger

SECTION 8: REFERENCES

Balousek. 2003. Quantifying decreases in stormwater runoff from deep-tilling, chisel-planting and compost amendments. Dane County Land Conservation Department. Madison, Wisconsin.

Chollak, T. and P. Rosenfeld. 1998. Guidelines for Landscaping with Compost-Amended Soils. City of Redmond Public Works. Redmond, WA. Available online at: http://www.ci.redmond.wa.us/insidecityhall/publicworks/environment/pdfs/compostamendedsoils.pdf.

City of Chesapeake. 2010. Chesapeake Landscape Specifications Manual: Tree and Shrub Planting Guidelines. Approved on October 16, 2008 and amended effective August 1, 2010. Available online at: http://www.chesapeake.va.us/services/depart/planning/pdf/ord-Landscape-Specifications-Manual_adopted-0901608.pdf.

City of Portland. 2008. "Soil Specification for Vegetated Stormwater Facilities." Portland Stormwater Management Manual. Portland, Oregon.

Virginia Dept. of Conservation and Recreation. 2010. Design Specification No. 4: Soil Compost Amendment Version 1.7, Appendix 4-A, Initial Minimum Design Criteria for Reforestation, Disconnection, Filter Strips, and Grass Channels. Available online at: http://csnetwork.squarespace.com/all-things-stormwater/soil-compost-amendments.html.

Figure 9.1 MWS Tree Planting Event

APPENDIX 9-A

DESIGN CRITERIA FOR AMENDING SOILS WITH COMPOST

SECTION 1: DESCRIPTION

Soil restoration is a practice applied after construction, to deeply till compacted soils and restore their porosity by amending them with compost. These soil amendments can reduce the generation of runoff from compacted urban lawns and may also be used to enhance the runoff reduction performance.

SECTION 2: DESIGN CRITERIA

2.1 Determining Depth of Compost Incorporation

Table 9-A.1 presents some general guidance for compost amendments and incorporation depths.

Table 9-A.1. Compost and Incorporation Depths

	Level 2
Compost (in)	12
Incorporation Depth (in)	24
Incorporation Method	Subsoiler

Once the area and depth of the compost amendments are known, the designer can estimate the total amount of compost needed using the following estimator equation:

Equation 7.1. Compost Quantity Estimation

$$C = A * D * 0.0031$$

Where: C = compost needed (cu. yds.)

A = area of soil amended (sq. ft.)

D = depth of compost added (in.)

2.2 Compost Specifications

The basic material specifications for compost amendments are outlined below:

- Compost shall be derived from plant material and provided by a member of the U.S. Composting Seal of Testing Assurance (STA) program. See www.compostingcouncil.org for a list of local providers.
- The compost shall be the result of the biological degradation and transformation of plant-derived materials under conditions that promote anaerobic decomposition. The material shall be well composted, free of viable weed seeds, and stable with regard to oxygen consumption and carbon dioxide generation. The compost shall have a moisture content that has no visible free water or dust produced when handling the material. It shall meet the following criteria, as reported by the U.S. Composting Council STA Compost Technical Data Sheet provided by the vendor:

a. 100% of the material must pass through a half inch screen
b. The pH of the material shall be between 6 and 8
c. Manufactured inert material (plastic, concrete, ceramics, metal, etc.) shall be less than 1.0% by weight
d. The organic matter content shall be between 35% and 65%
e. Soluble salt content shall be less than 6.0 mmhos/cm
f. Maturity should be greater than 80%
g. Stability shall be 7 or less
h. Carbon/nitrogen ratio shall be less than 25:1
i. Trace metal test result = "pass"
j. The compost must have a dry bulk density ranging from 40 to 50 lbs./cu.ft.

APPENDIX 9-B

STANDARD NOTES

Required Reforestation Note:

J I hereby certify that this reforestation planting plan is in keeping with the requirements listed in GIP-9 Section 4. Only native species and/or non-invasive species of plants were used in the design of this reforestation planting plan. This plan will achieve at least 75% canopy coverage within the first ten years, and has the minimum amount of required trees.