

## **Section 3.12 Green Roofs (GR)**



**Typical Green Roof Installation**

Green Roofs or vegetated roofs are alternative roof surfaces that typically consist of waterproofing and drainage materials and an engineered growing media that is designed to support plant growth. Vegetated roofs capture and temporarily store stormwater runoff in the growing media. A portion of the captured stormwater evaporates or is taken up by plants, which helps reduce runoff volumes, peak runoff rates, and pollutant loads on development sites.

This standard is intended for situations where the primary design objective of the vegetated roof is stormwater management. Green roof installations provide many other environmental benefits such as energy efficiency, air quality improvements, and habitat. There are two different types of vegetated roof systems: *intensive* vegetated roofs and *extensive* vegetated roofs. Intensive systems have a deeper growing media layer that ranges from 6 inches to 4 feet thick, which is planted with a wider variety of plants, including trees. By contrast, extensive systems typically have much shallower growing media (2 to 6 inches), which is planted with carefully selected drought tolerant vegetation. This standard was developed for the installation of extensive green roof systems. Intensive systems are eligible to apply but the incentive payment rate remains the same. Please refer to Virginia Stormwater BMP Clearinghouse Design Specification No. 5 Vegetated Roof for details of each type.

### **Policies Regarding GR**

#### **A. Ranking and Priority**

- Public visibility and the potential to serve as an educational site.
- Sites with the ability to employ other stormwater management features that are less expensive shall be ranked lower.
- Flat roofs get a higher ranking due to their ability to more effectively treat stormwater.
- Preference will be given to landowners who have not previously received incentive

payments from the District for this BMP.

## **B. Criteria**

- Sites must be 200 square feet or larger.
- Plant establishment may be plugs/container; cuttings; seeding; vegetated mats; or modular/tray systems. Native species or mixes that are adapted to the site conditions and intended uses are encouraged to be used. Selected species must have the capacity to achieve adequate density and vigor within an appropriate time frame. Establishment of vegetation generally takes 1-2 years. Invasive or noxious species, as identified by DCR invasive species list ([http://www.dcr.virginia.gov/natural\\_heritage/invspinfo.shtml](http://www.dcr.virginia.gov/natural_heritage/invspinfo.shtml)), are prohibited.
- Species, density/rate of seeding or planting, minimum quality of planting stock and method of establishment shall be specified as part of the application. Only viable, high- quality seed or planting stock that is shallow-rooted, self-sustaining, and tolerant of direct sunlight, drought, wind, and frost should be used. Seeding or planting must be done at a time and in a manner that best ensures survival and growth of the selected species. The planting window extends from the spring to early fall, allowing plants to root thoroughly before the first killing frost. Green roofs should not be planted in the winter. Temporary irrigation is often necessary during dry months as the roof is established.
- North and east aspects are preferred for survivability of vegetation and reduction of irrigation.

## **C. Design**

- Green roof designs shall include the following components:
  - deck layer with adequate structural support
  - waterproofing layer
  - insulation layer
  - root barrier
  - drainage layer and system
  - root permeable filter fabric
  - growing media
  - plant cover – shallow-rooted, perennial, succulent plants are ideal
- Roof pitch shall be a minimum of ¼": 12" (2%) and no more than 2":12" (16%).
- Longest flow path shall be less than 75 feet.
- Drainage layer shall be a minimum of 2 inches of pea gravel or a mat system.
- Growing media shall have less than 15% organic matter. Compost amendments must be free of detectable levels of pesticides and other hazardous chemicals.
- The applicant is responsible for ensuring that the proposed installation and maintenance plan meets all applicable local policies and ordinances.
- Site constraints for construction and design should be identified (HVAC, Electrical, Roofing materials, Pitch/Slope, Access and Process for getting materials on the roof).

- Green roof installation can be used in concert with other stormwater management practices, such as rain gardens, wet/dry swales, and rain water harvesting.
- Green roof loadings should be less than 30 pounds per square foot.

#### **D. Plans and Specifications**

- A licensed professional engineer design certification and as-built certification is required.
- All technical design and construction details shall follow Manufacturers' recommendations and Virginia Stormwater BMP Clearinghouse Design Specification No. 5.
- A design and installation plan for the green roof must be submitted by the property owner, with an engineer's stamp, and approval by the local Building Office before funding is approved. The installed practice must be in accordance with the approved design unless changes were pre- approved by the local SWCD. What constitutes successful installation and planting establishment must be specified in the design plan. Information required in the plan includes:
  - Square footage of green roof including dimensions with roof slope/pitch
  - Stormwater Treatment Volume and Pollutant Removal
  - waterproofing specifications
  - structural design specifications
  - nonwoven geotextile fabric specifications
  - proposed growing medium depth and composition
  - proposed vegetation and seeding/planting rate
  - drainage system specifications
  - drainage and overflow system details
  - maintenance plan
  - irrigation considerations (permanent or temporary watering systems, hose bib connections, etc.)
  - other information as requested by the local SWCD

#### **E. Operation and Maintenance**

- Maintenance of the planted area will be conducted a minimum of twice annually by the landowner, or a designated sub-contracted agent of the landowner. Maintenance will include:
  - Irrigation during the establishment period or as determined by the planting plan
  - Invasive Removal
  - Replace dead, dying and diseased plants. Ensure no bare spots are present
  - Checking drainage systems to ensure no clogs, obstructions, or other damage impacting proper drainage flow
  - Assessing structural systems to ensure no damage
  - Assessing for leaks, soil erosion, and other functional issues

## I. Cost Share Rates/Incentives

- This BMP will offer incentive payments based on area planted. It is an incentive payment rate of \$10 per square foot, up to a maximum of \$10,000.00 per applicant.
- Incentive payments will be paid to the applicant (landowner) following approval of installation by the local SWCD.

## J. Helpful Technical References:

- Virginia Stormwater BMP Clearinghouse, Design Specification No. 5 Vegetated Roof <http://www.vwrrc.vt.edu/swc/NonProprietaryBMPs.html>
- Dunnett, N. and N. Kingsbury. 2004. *Planting Green Roofs and Living Walls*. Timber Press. Portland, Oregon.
- Weiler, S. and K. Scholz-Barth 2009. *Green Roof Systems: A Guide to the Planning, Design, and Construction of Landscapes over Structure*. Wiley Press. New York, NY. <http://www.pomegranate.org/wp-content/publications/Pomegranate-Center-Greenroof-Manual-2005.pdf>
- <http://www.greenroofs.com/Greenroofs101/index.html>  
<http://www.portlandoregon.gov/bes/article/331490>  
<http://www.portlandoregon.gov/bes/article/259381>  
<http://www.wbdg.org/resources/greenroofs.php>  
[http://agronomy.unl.edu/c/document\\_library/get\\_file?uuid=1f1f203c-034c-4f42-b7d6-0ca4300b0225&groupId=4128273&](http://agronomy.unl.edu/c/document_library/get_file?uuid=1f1f203c-034c-4f42-b7d6-0ca4300b0225&groupId=4128273&)
- Modular Roof: <http://www.thisoldhouse.com/toh/how-to/step/0,,20473692,00.html>
- The Green Roof Manual: A Professional Guide to Design, Installation, and Maintenance. By Edmund C. Snodgrass and Linda McIntyre
- <http://stormwater.allianceforthebay.org/take-action/structural-bmps/green-roofs/>

### National Standards

ASTM International. *Standard Test Method for Maximum Media Density for Dead Load Analysis of Vegetative (Green) Roof Systems. Standard E2399-05* [www.astm.org/Standards/E2399.htm](http://www.astm.org/Standards/E2399.htm)

ASTM International. *Standard Test Method for Saturated Water Permeability of Granular Drainage Media [Falling-Head Method] for Vegetative (Green) Roof Systems. Standard E2396-05* [www.astm.org/Standards/E2396.htm](http://www.astm.org/Standards/E2396.htm)

ASTM International. *Standard Test Method for Water Capture and Media Retention of Geocomposite Drain Layers for Vegetative (Green) Roof Systems. Standard E2398-05* [www.astm.org/Standards/E2398.htm](http://www.astm.org/Standards/E2398.htm)

ASTM International. *Standard Practice for Determination of Dead Loads and Live Loads Associated with Vegetative (Green) Roof Systems. Standard E2397-05* [www.astm.org/Standards/E2397.htm](http://www.astm.org/Standards/E2397.htm)

ASTM International. *Standard Guide for Selection, Installation, and Maintenance of Plants for Green Roof Systems. Standard E2400-06* [www.astm.org/Standards/E2400.htm](http://www.astm.org/Standards/E2400.htm)