



Green Roof Toolkit

Green roof rebate program administered through the Anacostia Watershed Society with funding from the District Department of Energy & Environment

Green roof overview

Green Roof Types

There are three types of green roofs: extensive, intensive, and semi-intensive. Although the designs will differ, the basic layers remain the same.

Extensive

- Growing medium is 3-4 inches thick
- Additional roof load is between 15-30 pounds per square foot
- Fewer varieties of plants, usually *Sedum*
- Requires less irrigation, drought resistant
- Low maintenance
- Cost is about \$10 to \$30 per square foot (above the cost of a conventional roof)
- Fewer design elements

Intensive

- Growing medium is 8-12 inches thick
- Additional roof load is as much as 40-150 pounds per square foot
- Greater varieties of plants-includes shrubs and small trees
- Requires consistent irrigation during the summer months
- Routine maintenance
- Cost can be greater than \$40 per square foot (above the cost of a conventional roof)
- Highly designed usable green space

Semi-intensive

- Growing medium is 4-8 inches thick
- Additional roof load is 25-50 pounds per square foot
- More plant varieties, including wildflowers and drought-tolerant herbaceous perennials
- Requires periodic irrigation
- Requires periodic maintenance

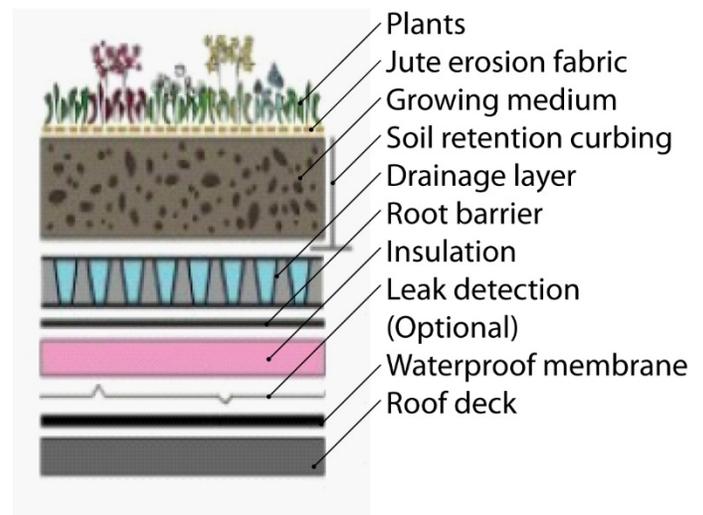
- Cost is about \$20-\$40 per square foot (above the cost of a conventional roof)

Green Roof Composition

A green roof is more than plants placed on a rooftop. A green roof is highly-engineered contiguous system of plantings, drainage layers, and water tight membranes. This system is designed to protect the structural integrity of the building while providing significant environmental, economic, and aesthetic benefits.

No two green roofs are exactly the same. While every green roof uses the same components, manufacturers can vary greatly.

Green roof section



Green roofs are a highly sustainable roofing technology, providing numerous economic, environmental and social benefits.

Economic Benefits

Reduce life cycle costs. Green roofs may last up to 3 times as long as a conventional roof.

Reduce waste and decrease the need for landfill expansion. The extended life of a green roof reduces long term construction waste and cost of construction.

Increase property values. As an added amenity, green roofs attract higher rents and higher tenant retention.

Save on energy. Green roofs may reduce energy costs by 10-20 percent through keeping the floor directly below the roof 3-4°F cooler and reducing the need for expensive HVAC systems.

Provide sound insulation. Four inches of substrate reduces noise pollution by 40 decibels adding to the desirability of the building.

Credits for stormwater impact fees. Green roofs provide possible credits for stormwater impact fees, saving money on regulatory fees.

Environmental Benefits

Reduce the urban heat island effect. On a hot day, an urban area can be 10°F hotter than the surrounding countryside. Green roofs stay 40-50°F cooler than conventional roofs which reduces the ambient air temperature.

Reduce stormwater runoff. In summer, green roofs retain 70-100 percent of stormwater and 40-50 percent during the winter. This reduces the volume and velocity of stormwater, which reduces erosion and sedimentation of our local watercourses.

Improve air quality. Green roof vegetation metabolizes airborne particles such as smog, sulfur dioxide, and

carbon dioxide.

Create wildlife habitat. Green roofs provide urban green infrastructure, which helps to enhance species biodiversity.

Social Benefits

Education opportunities. Green roofs provide areas for instruction in ecology, science, biology, and math.

Provide space for food production. Green roofs create opportunities for urban agriculture. This opportunity may increase food security within urban areas.

Provide aesthetic appeal. The vegetation and natural beauty of green roofs offer a respite from the concrete hard-scape of urban areas.

Create usable green space. Green roofs may provide green space throughout urban areas where open space is limited.

Create jobs and economic security. The establishment of a green roofing industry creates new jobs in manufacturing, construction, design, installation, maintenance and horticulture.

Not all buildings are green roof compatible. If your building meets the following criteria, you are green roof ready!

New Construction

Incorporating a green roof into the original design will save money and time. It is important to ensuring that the roof is constructed to hold at least 30 pounds per square foot, is able to provide safe and legal roof access, and will be funded with money that has been set aside.

Questions to Ask Before Performing a Small Green Roof Retrofit

- Are you planning to replace your roof or waterproofing membrane within the next year?
- Does your building have LEGAL roof access, a roof veranda or deck?
- If you do not have a roof deck, was your building built after 1960?
- If your building was built before 1960 and doesn't have a roof deck, have you had structural reinforcing or new roof joists installed in the past ten years?
- Is your rooftop sunny with relatively few or no trees growing above?
- Can you afford to spend \$10-30 per square foot, in addition to replacing your roof with a specialized waterproofing membrane, approximately \$7-12 per square foot?

If the answer is "NO," a green roof may not be right for your building at this time.

Questions to Ask Before Performing a Large Commercial or Multi-family Residential Green Roof Retrofit

- Are you planning to replace your roof or waterproofing membrane within the next year?
- Is your rooftop relatively flat with fewer than 30 degrees of pitch?
- Do you currently have an IRMA or ballasted roof system?

- If not, does your roof have public roof access, a roof veranda or deck?
- If not, can the building support 25 pounds per square foot, beyond snow and wind loads?
- Is your rooftop sunny with relatively few or no trees growing above?
- Can you afford to spend approximately \$8-15 per square foot, in addition to replacing your roof with a specialized waterproofing membrane approximately \$7-15 per square foot?

If the answer is "NO," a green roof may not be right for your building at this time.

A green roof is vegetation and additional layers above a waterproof membrane atop usable space. Choosing the right waterproof membrane is integral to the success of a green roof.



Waterproof Membranes and Green Roofs

Installing a green roof over a waterproof membrane will significantly extend the life of the membrane. It will also extend the life of the roof. There are several factors to consider when choosing a waterproof membrane for a green roof. Factors to consider: durability, environmental friendliness, tensile strength, and root resistant properties.

To be used in conjunction with a green roof, the waterproof membrane should be made of an inert material that cannot be penetrated by roots or an additional root barrier must be installed. Waterproof membranes that are commonly used in conjunction with green roofs are:

- PVC (45-90 single-ply);
- TPO (Thermoplastic Polyolefin single-ply);
- EPDM (Ethylene Propylene Diene Monomer single-ply);
- Built-up hot applied high-polymer asphalt;

Waterproof membranes come in three forms: liquid applied, roll out plastic, or bituminous sheets.

Is Your Roof Membrane Ready for a Green Roof Installation?

In addition to ensuring the compatibility of the waterproof membrane, the age of the membrane at the time of green roof installation is important. A green roof should not be installed on a membrane more than a couple of years old and must be in good condition. For a membrane that is a couple years old, check thoroughly for leaks prior to a green roof installation

Flood testing may be used prior to an installation. This is to discover any breaches in the membrane. This method is used on flat roofs and requires water to be pooled on the roof for 24 hours. This is to see if there are punctures

in the membrane, which could cause future leaks.

Electronic field vector monitoring (EFVM) technology may be utilized after a green roof is installed to detect any breaches in the membrane which may lead to leakage. This technology works on both flat and sloped roofs and reduces the possibility of overloading the roof.

A **leak detection layer** may also be installed with the green roof to further ensure leaks are detected and located immediately.

All green roof projects require a building permit. Permits are obtained through the Department of Consumer and Regulatory Affairs (DCRA).



Pre-application and Application Process

The Property's Zoning District

Are you in a zoning overlay district? Zoning overlay districts have additional requirements and restrictions that must be met to receive a permit. Visit the DC Office of Zoning at <http://dcoz.dc.gov>. To find your Zone District go to <http://maps.dcoz.dc.gov> then, input the building address.

Obtain the Online Permit

In the winter of 2014, the online permitting process began at the DCRA homepage: <http://dcra.dc.gov/service/get-building-permit>. Click the "start your application online" hyperlink, then click on, "Prepare a New Building Permit Application."

After providing the project information, the next page is titled: Application for Construction Permit on Private Property. For a roof replacement, check the last box: Water and Damp Proofing. After filling out the online form, print it, and get the necessary signatures.

Obtain A Plat

A plat is a scaled drawing of a lot, showing lot lines and record dimensions.

- You will need the Square, Suffix, and Lot (SSL) number for each property.
- Cost of a regular plat is \$30.00. Turnaround time is a minimum of 10 work days.
- To order, go IN PERSON to the Office of the Surveyor or see "Obtain an Online Plat" below:

1100 4th Street SW, Room 3174
Washington, DC 20024
(p) 202.442.4400

Obtain an Online Plat

From the online services on the DCRA's homepage <http://dcra.dc.gov>. Under Surveyor Services select, "Get

a Building Plat," then follow the directions.

File Permit Application and Environmental Intake Form (EIF)

Make sure that all required information is provided and applicable boxes are checked.

Permit Issuance

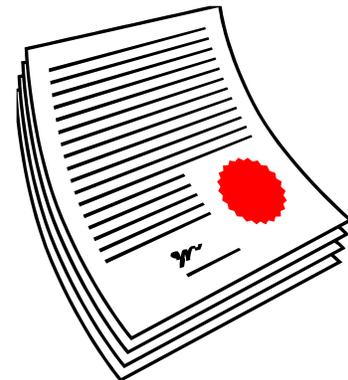
Timeline (DCRA's goal to review)

1 - 999 SQ FT | within 24 hours
1000 - 2999 SQ FT | within 14 days
3000 + SQ FT | within 30 days

Permit Fees

There are different fees for new construction, alterations, or repairs to existing construction. There are also reduced permit fees for green building, such as green roofs.

Extensive green roofs have growth medium depths of 2-4 inches, limiting the design and plant variety suitable for the system.



Extensive Green Roof Plants

Green roof plants are characteristically tough. They have been chosen because they have evolved in desert or high alpine conditions that resemble that of the green roof environment. While many plants will survive on a green roof, there are basic plant qualities that make some plants more desirable for extensive green roofs.

Ideal Extensive Green Roof Plant Characteristics

- **Low growth height**

Plants that are able to withstand extreme conditions including temperature extremes and high winds.

- **Rapid growth and spread**

Ensures complete coverage, increased stormwater retention, eliminates viable space for weed establishment, and helps anchor growth medium.

- **High drought tolerance**

Reduces need for costly irrigation systems and potential plant replacement.

- **Fibrous root system**

Protects roof membrane.

- **Low maintenance**

Reduces the time and financial costs of the roof year after year.

- **Non-invasive**

No airborne seed generation prevents green roof plants from invading other landscapes.

- **Self-propagating**

Reduces the number of plants needed to cover a green roof, reducing the cost of the roof.

Preferred Extensive Green Roof Plant List

The following plants thrive on green roofs. At least five or six different varieties of plants should be incorporated into each roof design. This will help to create diversity of color and flowering times. Please click on links below to find out additional information about each plant, such as flower color and blooming period.

Plants for Green Roofs in Full Sun

[Allium schoenoprasum](#) (chives)

[Sedum album](#)

[Sedum album f. 'Murale'](#)

[Sedum kamtsch. var. flor.](#)

['Weihenstephaner Gold'](#)

[Sedum reflexum](#) 'Blue Spruce'

[Talinum calycinum](#)

Plants for Green Roofs in Full Shade

[Delosperma nubigenum](#) 'Basutoland'

[Sedum kamtschaticum](#)

[Sedum sexangulare](#)

[Sedum spurium](#) 'Fuldaglut'

[Sedum hybridum](#) 'Immergrünchen'

[Sedum spurium](#) 'John Creech'

[Sedum spurium](#) 'White Form'

Information from www.greenroofplants.com and Snodgrass, Edmond C. and Lucie L Snodgrass. *Green Roof Plants*. Portland: Timber Press, 2006

Extensive green roofs, when properly installed, should require relatively limited maintenance. They are NOT maintenance free.



Green Roof Maintenance

Weeding

Weeds and native grasses are carried to the roof by wind, birds, and insects. These invasive plants can be problematic as they compete with the green roof flora for moisture, nutrients, and sunlight.

In order to keep the green roof healthy, all invasive plants (weeds) must be removed regularly. *When weeding, be sure to pull out the roots.*

Watering

- For sedum-planted roofs, rain is often adequate.
- Water once a week for a newly planted roof.
- Water once a month for an established green roof in times of extreme drought.
- Supplemental watering can often be done through a sprinkler attached to a garden hose.
- For green roofs planted with more traditional landscaping, more frequent watering may be needed.

Fertilizing

Once a year, lightly apply a specially blended organic fertilizer to help keep a green roof looking at its peak.

Sometimes, due to wind shear and other factors, soil media is blown away. Supplemental soil media may be needed, preferably with jute netting as wind protection.

Safety During Green Roof Maintenance

Wear sun protection, protective eyewear, closed toe shoes, hard hat, gloves, a harness, and tieback system if there is no railing or if working outside of a railing system.

Drink plenty of water (especially on hot days).

Ensure ladders are well secured and held by someone when in use.

“NEVERs” of Green Roof Maintenance

Never walk backward on a roof.

Never work on the roof alone.

Never use chemical weed killers.

Never use a sharp or pointy weeding tool - the point may damage the waterproof membrane.

Never cover a green roof with a protection tarp for more than 3-4 hours - they can smother or “bake” the green roof plants.

Never use a flame-based weed torch system - the flame can damage the system layers.

Never place stakes deeper than the soil depth directly down through green roof

Never over-water: excess irrigation can result in mold growth.

Additional Resources

University of Maryland’s Plant Diagnostic Website:

<http://plantdiagnostics.umd.edu>.

Plant Disease Diagnostic Clinic:

<http://plantclinic.cornell.edu>.

Green Roofs for Healthy Cities:

<http://www.greenroofs.org>.

Greenroof & Greenwall Project Database:

<http://www.greenroofs.com>.

