

GREEN ROOF TOOLKIT

GREEN ROOF OVERVIEW

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

Green Roof Types

Extensive

- 3 - 4" of growing medium
- 15 - 30 pounds per square foot (additional roof load)
- Less variety of plants - usually Sedum
- Requires little irrigation - drought resistant
- Low maintenance
- Costs about \$10.00 to \$30.00 per square foot (above the cost of a conventional roof)
- Few design elements

Semi - intensive

- 4 - 8" of growing medium
- 25 - 50 pounds per square foot (additional roof load)
- More plant variety - wildflowers, drought-tolerant herbaceous perennials
- Requires periodic irrigation
- Periodic maintenance
- Costs about \$20.00 - \$40.00 per square foot (above the cost of a conventional roof)
- Incorporates design elements

Intensive

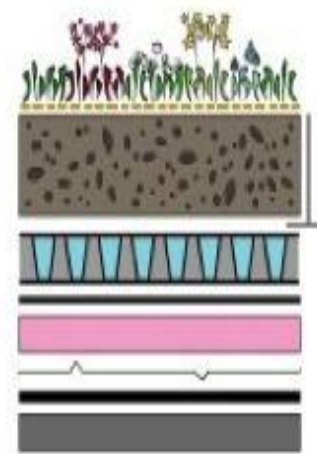
- 8 - 12" of growing medium
- 40 - 150+ pounds per square foot (additional roof load)
- High variety of plants - includes shrubs and trees
- Requires consistent irrigation (summer months)
- Regular maintenance
- Costs about \$40.00+ per square foot (above the cost of a conventional roof)
- Highly designed usable green space

Green Roof Composition

A green roof is not simply plants placed on a rooftop, but rather a highly-engineered, contiguous system of plantings designed to protect the structural integrity of the building while providing significant environmental, economic and aesthetic benefits.

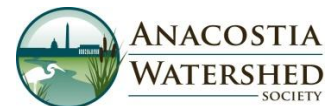
No one green roof system fits all. While every green roof has the same components and minimum requirements, manufacturers can vary greatly.

Green Roof cross section



- Plants - sedum & herbs
- Jute erosion fabric (optional)
- Growing medium
- Soil retention curbing
- Drainage, root barrier
- Geotextile filter fabric
- Insulation (optional)
- Leak detection (optional)
- Waterproof membrane
- Roof deck

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GREEN ROOF TOOLKIT

GREEN ROOF BENEFITS

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

ECONOMIC

Reduce the life cycle cost of the roof. Green roofs may last 3 times as long as a conventional roof.

Reduce waste and decrease the need for land-fill expansion. The extended life of green roofs reduces construction waste and cost.

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

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

Provide sound insulation. 4" 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

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

Reduce stormwater runoff. In summer, green roofs retain 70-100% of stormwater and 40-50% in the winter, reducing the volume and velocity of stormwater and reducing erosion and sedimentation of our water sources.

Improve air quality. Green roofs filter airborne particles such as smog, sulfur dioxide and carbon dioxide through vegetation foliage.

Create wildlife habitat. Green roofs provide urban green infrastructure for native species repatriation and maintaining species biodiversity.

SOCIAL

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

Provide space for food production. Green roofs create opportunities for urban agriculture and help increase food security in urban areas.

Provide aesthetic appeal. The vegetation and natural beauty of green roofs provide 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.

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GREEN ROOF TOOLKIT

ARE YOU GREEN ROOF READY?

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

New Construction

By incorporating a green roof into the original design of new construction and additions you will save time and money. Ensuring that the roof is built to hold at least 30 pounds per square foot for the added weight of the green roof, incorporating safe and legal roof access into the design and ensuring there are sufficient funds will facilitate the installation.

Retrofits to small buildings and single family residential homes

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 last 10 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 answers to the questions above are "NO," green roofing may not be right for your building or might not be feasible at this time.

Green roof retrofits to commercial and multi-family residential buildings

Are you planning to replace your roof or waterproofing membrane within the next year?

Is your rooftop relatively flat with no more than 30 degrees of pitch?

Do you currently have an IRMA or ballasted roof system?

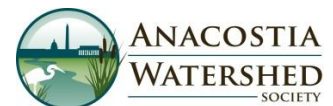
If not, does your roof have public roof access, a roof veranda or deck?

If not, can the building support 25 pounds per square foot, beyond snow and wind loading?

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?

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GREEN ROOF TOOLKIT

WATERPROOF MEMBRANE

Green roofs are defined as the vegetation and additional layers above the waterproof membrane. However, choosing the right waterproof membrane is important to the proper function of the green roof.

Waterproof Membranes and Green Roofs

Installing a green roof over a waterproof membrane will significantly extend the life of the membrane and the life cycle cost of the roof.

There are several factors to consider when choosing a waterproof membrane to be used in conjunction with a green roof beyond waterproofing such as durability, environmental friendliness, tensile strength and root resistance.

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 with the green roof. 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

2 layers of high polymer SBS modified bitumen with root barrier

Based on widespread installations and a reliable service record, modified bitumen and PVC membranes are the best for use in conjunction with a green roof.

Is your membrane ready for green roofing?

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 in good condition.

For a membrane that is a couple of years old, check thoroughly for leaks prior to green roof installation

Flood testing prior to installation may be used 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 to see if there are any punctures in the membrane which could lead to leaks in the future.

EFVM (Electronic Field Vector Monitoring) 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.

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GREEN ROOF TOOLKIT

GREEN ROOF PERMIT PROCESS

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

Pre-Application and Application

Find out 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](#) website for a complete list of overlay zones.

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 working days.
- To order you must go **IN PERSON** to the Office of the Surveyor:

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

Fill out permit application and Environmental Intake Form (EIF)

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

Build Permit Application Environmental Intake Form

Ensure all requirements are met

Follow requirements in link below for type of permit applying for:

Building Permit Application Requirements by Permit Type (DCRA document)

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

Please view link below to determine the cost of the building permit for your green roof project.

Building Permit Fees

Obtaining the permit

You will be contacted when the permit is ready for pick-up.

First get an invoice from Issuance Counter and pay for the permit in the Cashier's office.

Show your Cashier's receipt to obtain the permit.

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Adapted from a document by DC Greenworks by the Anacostia Watershed Society for DDOE

GREEN ROOF TOOLKIT

EXTENSIVE GREEN ROOF PLANTS

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

Choosing extensive green roof plants

Although there are numerous choices for extensive green roof plants due to different design considerations such as stormwater management, energy conservations, habitat formation, heat island mitigation, aesthetics and creation of usable green space, there are basic qualities in certain plants that make them ideal for extensive green roofs.

Ideal extensive green roof plant characteristics:

- **Low growth height**
Plants withstand high winds and lowers fire hazard.
- **Rapid growth and spreading**
Ensures complete coverage, increased stormwater retention, elimination of viable space for weed establishment and helps anchor growth medium.
- **High drought tolerance**
Reduces need for costly irrigation systems and 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 5 or 6 different varieties of plants should be incorporated into each roof design 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 roof areas with full sun exposure:

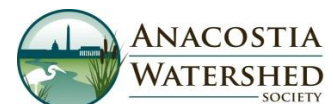
Allium schoenoprasum (chives)
Sedum album
Sedum album f. 'Murale'
Sedum kamtsch. var. flor. 'Weihenstephaner Gold'
Sedum reflexum 'Blue Spruce'
Talinum calycinum

Plants for green roof areas with full shaded areas:

Delosperma nubigenum 'Basutoland'
Sedum kamtschaticum
Sedum sexangulare
Sedum spurium 'Fuldaglut'
Sedum spurium 'John Creech' **Sedum hybridum**
Sedum hybridum 'Immergrünchen'
Sedum spurium 'White Form'

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

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GREEN ROOF TOOLKIT

GREEN ROOF MAINTENANCE

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

What a green roof needs

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.*

Water

- 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.

Nutrients

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 green roof system.

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

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