ECOROOF

Q & A

Questions Answers

Portland's Ecoroof Program is a cooperative effort of the Bureau of Environmental Services and the Office of Sustainable Development. The program promotes ecoroofs by researching ecoroof technologies and providing information and technical assistance to community members.

WHAT IS AN ECOROOF?

An ecoroof is a lightweight, low-maintenance vegetated roof system used in place of a conventional roof. The City of Portland is encouraging the use of ecoroofs as part of its efforts to promote sustainable development. This means using practices that respect natural systems and limit impacts on the environment. Sustainable development practices promote environmental, economic, and social health today, while also protecting and sustaining the well-being of future generations.

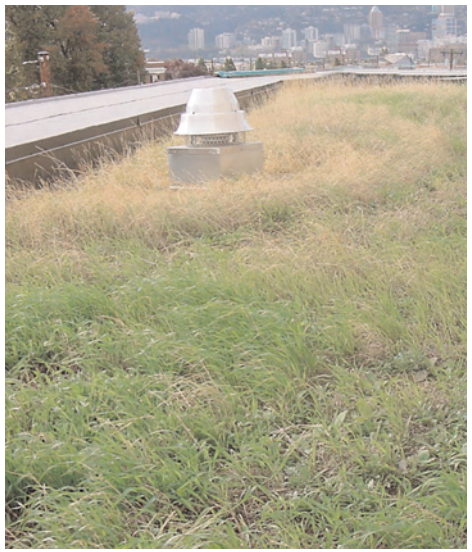
Ecoroof opportunities come in all sizes:
Large commercial buildings, residential homes and garages, or as small as a toolshed or kiosk.

❶ What are the benefits of Ecoroofs ?

Based on documented experience and studies, an ecoroof offers several important benefits not found in conventional roofing:

- Captures and evaporates from 10 to100 percent of the precipitation that falls on it. This reduces the volume and speed of stormwater runoff leaving the site, helping prevent sewer overflows and protect receiving rivers and streams.
- Lowers the temperature of stormwater runoff, which helps maintain the cool stream temperatures needed by fish.
- Improves outdoor air quality by decreasing air temperatures and reducing smog.
- Increases vegetation and wildlife habitat on urban sites that typically have neither.
- Provides insulation and lowers cooling costs for the building.
- Provides an attractive alternative to a conventional roof.
- Lasts twice as long as a conventional roof, saving replacement costs and materials
- Creates a market for recycled materials, such as compost, mulch, soil and other ecoroof components.
- Creates jobs in multiple industries.
- Is an approved stormwater management technique under Portland's Stormwater Management Manual requirements for new development and redevelopment.
- Can earn floor area bonuses for proposed buildings in Portland's Central City Plan District. Increasing the building space that would otherwise be allowed.

Ecoroofs are a proven technology and have been used in Europe for over 40 years. They are now gaining recognition in the US for the environmental, economic, and social benefits they provide.



❷ Where can an Ecoroof be used ?

- Ecoroofs can be located on flat or pitched roof structures at a slope up to 40 percent (or 5 in 12 pitch). They can be used on most types of commercial, multifamily, and industrial structures, as well as single-family homes and garages.
- Ecoroofs can be used for new construction or to re-roof an existing building.

❸ What does an Ecoroof cost ?

It is important to note that there is a wide range of costs, depending on many factors. Installation of an ecoroof costs from $10 to $25 per square foot (sf). This includes materials, labor, and structural upgrades. A conventional roof installation ranges from $3 to $20 per sf. As the ecoroof market develops, costs may decrease.

	Ecoroof (cost per square foot)	**Conventional Roof** (cost per square foot)
New construction (including structural support)	$10 to $15	$3 to $9
Re-roofing	$15 to $25	$5 to $20

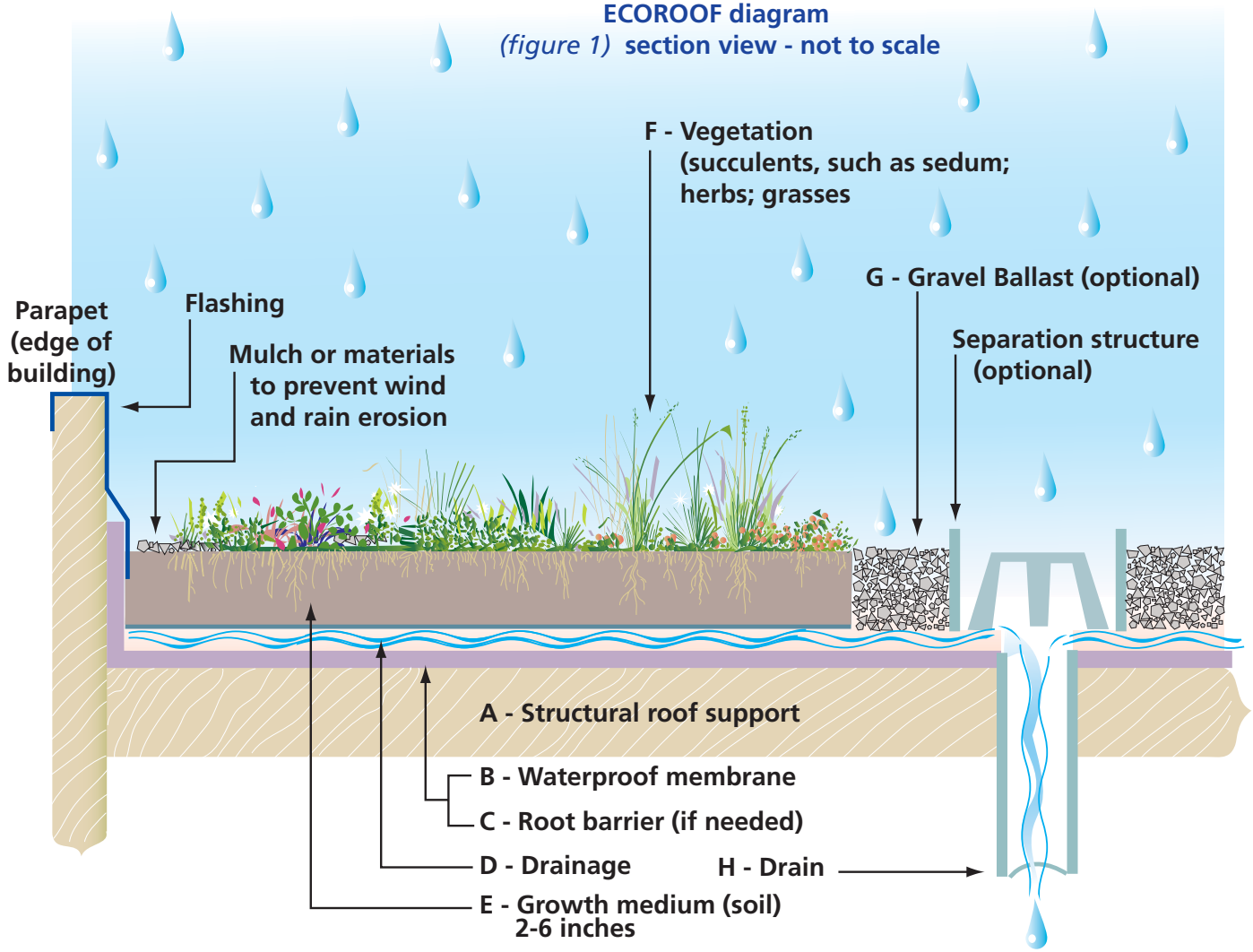
Source: Bureau of Environmental Services estimates based on City of Portland demonstration projects, and information obtained from roof contractors.

Although ecoroofs initially cost more than conventional roofs, they are competitive on a life-cycle basis because of reduced maintenance and replacement costs (see question #5).

❹ What Are the Components of an Ecoroof ?

Ecoroof configurations vary, but typically include the elements shown in the diagram and described on pages 4-8.

ECOROOF diagram
(figure 1) **section view - not to scale**



A - STRUCTURAL ROOF SUPPORT

For Re-Roofing

The structural roof support must be sufficient to hold the additional weight of the ecoroof. Check with an architect, structural engineer, or roof consultant to determine the condition of the existing building structure and what might be needed to support an ecoroof. This might include additional decking, roof trusses, joists, columns, and/or foundations.

Generally, the building structure must be adequate to hold an additional 10 to 25 pounds per square foot (psf) saturated weight, depending on the vegetation and growth medium that will be used. (This is in addition to snow load requirements.) An existing rock ballast roof may be structurally sufficient to hold a 10-12 psf ecoroof. (Ballast typically weighs 10-12 psf.)

For New Construction

The project architects and structural engineers can address the structural requirements of an ecoroof during the design process. Greater flexibility and options are available for new buildings than for re-roofing.

The procedures for the remaining components (B through I) are the same for both re-roofing and new construction.

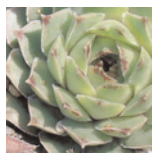
B - WATERPROOF MEMBRANE (IMPERMEABLE LINER)

Waterproof membranes are made of various materials, such as modified asphalts (bitumens), synthetic rubber (EPDM), hypolan (CPSE), and reinforced PVC. Some of the materials come in sheets or rolls and some are in liquid form. They have different strengths and functional characteristics. Many of these products require root inhibitors (refer to C) and other materials to protect the membrane. Numerous companies manufacture waterproofing materials appropriate for ecoroofs.

C - ROOT BARRIER (IF NEEDED)

Root barriers are made of dense materials that inhibit root penetration.

The need for a root barrier depends on the waterproof membrane selected. Modified asphalts usually require a root barrier, while synthetic rubber (EPDM) and reinforced PVC generally do not. Check with the manufacturer to determine if a root barrier is required for a particular product.






D - DRAINAGE LAYER (IF NEEDED)

There are numerous ways to provide drainage. Products range from manufactured perforated plastic sheets to a thin layer of gravel. Some ecoroof designs do not require any drainage layer other than the growth medium itself, depending on roof slope and size (for example, pitched roofs and small flat roofs).

E - GROWTH MEDIUM (SOIL)

The growth medium is generally 2 to 6 inches thick and well drained. It weighs from 10 to 25 pounds per square foot when saturated. A simple mix of 1/3 topsoil, 1/3 compost, and 1/3 perlite may be sufficient for many applications. Some companies have their own growth medium specifications. Other components could include:

- Digested fiber
- Expanded clay or shale
- Pumice
- Coir

These soils are prone to wind erosion when exposed. It is important to ensure good plant coverage and/or mulch.

Ecoroofs are an evolving industry, with new materials and approaches continually being developed. In Europe, for example, recycled clay roof tile is being used as a growing medium and a modular design has recently been developed by a US firm.

spring blooms

late summer color

F - VEGETATION

Ecoroof vegetation should have the following attributes:

- Drought-tolerant, requiring little or no irrigation after establishment
- A growth pattern that allows the plant to thoroughly cover the soil
- Self-sustaining, without the need for fertilizers, pesticides, or herbicides
- Able to withstand heat, cold, and high winds
- Very low-maintenance, needing little or no mowing or trimming
- Perennial or self-sowing
- Fire resistant

A mix of sedum/succulent plant communities is recommended because they possess many of these attributes. Herbs, forbs, grasses, and other low groundcovers can also be used to provide additional benefits and aesthetics; however, these plants may need more watering and maintenance to survive and keep their appearance.

Installation

Four methods (or combinations of them) are generally used to install the vegetation: vegetation mats, plugs/potted plants, sprigs, and seeds.

1 **Vegetation mats** are sod-like, pre-germinated mats that achieve immediate full plant coverage. They provide immediate erosion control, do not need mulch, and minimize weed intrusion. They also need minimal maintenance during the establishment period and little ongoing watering and weeding.

2 **Plugs or potted plants** may provide more design flexibility than mats. However, they take longer to achieve full coverage, are more prone to erosion, need more watering during establishment, require mulching and more weeding.

3 **Sprigs** are hand broadcast. They require more weeding, erosion control, and watering than mats.

4 **Seeds** can be either hand broadcast or hydraseeded. Like sprigs, they require more weeding, erosion control, and watering than mats.

New modular units with soil and vegetation have been developed and are now available.

For plugs, sprigs, and seeds, it is extremely important to protect the growth medium from erosion (e.g., using mulch, netting, or gravel) until it is fully covered by vegetation.

Spraying seed mix for new ecoroof

G - GRAVEL BALLAST (IF NEEDED)

Gravel ballast is sometimes placed along the perimeter of the roof and at air vents or other vertical elements. The need for ballast depends on operational and structural design issues. It is sometimes used to provide maintenance access, especially to vertical elements requiring periodic maintenance. In many cases, very little, if any, ballast is needed.

- In some situations, a header or separation board may be placed between the gravel ballast and adjacent elements (such as soil or drains).
- If a root barrier (C) is used, it must extend under the gravel ballast and growth medium, and up the side of the vertical elements.

H - DRAIN

As with a conventional roof, an ecoroof must safely drain runoff from the roof. It may be desirable to drain the runoff to a rainwater harvesting system such as (rainbarrels or cisterns), or other stormwater facilities such as planters and swales.

I - IRRIGATION

Irrigation is likely to be needed during the establishment period and possibly during drought conditions, regardless of the planting method used. This can be accomplished either through hand watering, a manually operated low-tech irrigation system (such as spray heads or soaker hoses), or an automated irrigation system. To minimize water needs, early autumn is the best planting season. The goal is to minimize the need for irrigation by paying close attention to plant selection, soil and various roof characteristics.








❺ What Are the Operations, Maintenance, and Replacement Needs?

Similar to conventional roofs, ecoroofs require some degree of care to maintain optimum function.

VEGETATION/GROWTH MEDIUM

Periodic inspection (at least twice a year) is needed for any type of roof to ensure drain inlets are not blocked. For ecoroofs it is also important to check the health and coverage of the vegetation; some replacement or filling may periodically be needed. Depending on the design, some plants may "brown out" or almost disappear from sight; however, they are still viable and will revive in the rainy season.

Depending on the planting method, weeding and mulching may be needed during the establishment period and periodically thereafter over the life of the ecoroof.

FIRE SAFETY

Sedum and other succulents are naturally fire resistant, almost eliminating fire concerns. Other types of vegetation could be of concern and need to be watered, mowed, and/or maintained to prevent fire. Depending on the seasonal rains in Portland, it is best to mow a dry grass roof before July 4th.

ACCESS

Most buildings require roof access for operations and maintenance. Access is needed for mechanical units, window washing, elevator repair and other activities. These should be identified during the design phase, and access paths of gravel or other inert materials provided. In cases where access is needed only occasionally, paths may not be required because the vegetation can tolerate some foot traffic.

The typical lifespan for an ecoroof is about 40 years.

LEAKAGE

An ecoroof is considered less likely to leak than a conventional roof. If a leak does occur, it has been speculated that it may be more difficult to pin point the leak on an ecoroof than a traditional roof. However, because ecoroofs are thin, they can be removed and replaced in mats or sections.

REPLACEMENT

According to various sources the typical lifespan for an ecoroof is about 40 years, significantly longer than a conventional roof. This is because the membranes are of good quality and the plants and growth medium protect the membrane from weathering. Replacing an ecoroof involves:

- Removing and stockpiling the vegetation, growth medium, irrigation pipes, and drainage layers. (It may be possible to simply move these materials to one side, rather than removing them entirely.)
- Removing and replacing the waterproof membrane.
- Reinstalling the stockpiled growth medium, vegetation, and other components.









⑥ Where Can You See Examples of Ecoroofs?

The City of Portland has helped install ecoroofs as demonstration projects including one at the Environmental Services treatment plant.

Property:	To arrange a tour, contact:
• Hamilton West Apartments Building (SW 12th and Clay)	Ecoroof Program (Environmental Services) 503-823-7267 or 503-823-7740
• Buckman Terrace Apartments (NE 16th and Sandy)	Ecoroof Program (Environmental Services) 503-823-7267 or 503-823-7740
• Jean Vollum Natural Capital Center (NW 10th and Flanders)	Ecotrust: 503-227-6225
• Whitaker Pond Shelter (NE 47th and Columbia Slough)	Education (Environmental Services) 503-823-7185
• Columbia Boulevard Treatment Plant	Main Desk: 503-823-2400
• Multnomah County Building 501 SE Hawthorne Blvd	Open to public 8:30 am - 5:00 pm Check with security on the main floor.
• B&O Building SE Washington Street and 2nd Avenue	Pat Lamb - 503-233-6600
• Hawthorne Hostle 3031 SE Hawthorne Blvd	Viewable from sidewalk
• People's Food Co-op 3039 SE 21st Avenue	Viewable from sidewalk

❼ What Permits Are Needed?

For Re-Roofing

- A building may need upgraded structural support for an ecoroof, although many existing buildings are structurally sound enough. In either case, a signed document from a structural engineer is required in order to receive a building permit from Portland's Office of Planning and Development Review (OPDR).
- An ecoroof may require alteration of downspouts or other piping, requiring a plumbing permit from OPDR.

For New Construction

- For new development and redevelopment projects, an ecoroof permit is obtained through the standard application process.
- The ecoroof and other stormwater management elements must be reviewed by the Bureau of Environmental Services to verify the ecoroof is constructed to meet the City's Stormwater Management Manual requirements or for Floor Area Bonus approval.

❽ Where Can You Get More Information and Assistance?

- Ecoroof Program (Bureau of Environmental Services): 503-823-7267 or 503-823-7740
- Stormwater design techniques (Bureau of Environmental Services): call 503-823-7740 or http://www.cleanrivers-pdx.org
- Green building approaches (Office of Sustainable Development): call 503-823-7222 or http://www.sustainableportland.org
- Building code and permitting information (Office of Planning and Development Review): http://www.opdr.ci.portland.or.us or call 503-823-7310 (for building code information) or 503-823-PLAN (for zoning information)

DESIGN AND INSTALLATION ASSISTANCE

Some vendors, design consultants, and installation contractors known to the City at the time of this printing are listed here. These providers offer a variety of services. Some may be limited to providing information about their specific products (such as impermeable liners), while others may be able to manage the entire project, including design, specifications, arranging for installation, and plant procurement. The list is for informational purposes only and does not constitute a recommendation by the Bureau of Environmental Services or City of Portland.

ECOROOF CONTACTS

This is a list of contacts, which have spoken of experience or demonstrated it to the Bureau of Environmental Services (BES). Experience which is in regard to design, construction or another type of direct experience with ecoroofs. This list is for informational purposes only and does not constitute a recommendation by BES or the City of Portland. If you would like to be on this list please submit your contact information and specific information about your involvement with ecoroofs.

VENDORS
MANUFACTURER REPS

American Hydrotech Inc.
Seattle: 206-441-6125
Illinois: 800-877-6125
www.hydrotechusa.com

Bain Associates Inc.
Portland: 503-452-0788
Jbherman@aol.com

Garland Company Inc.
Portland: 800-762-8225 ext. 655
Mobile: 503-860-4420
Seattle: 800-762-8225 ext. 515
www.garlandco.com

Green Grid
Chicago, Il: 312-424-3319
Greengridroofs.com

Green Tech
888-323-4397

W.P. Hickman
503-231-0280
206-841-7663

Sarnafil SA
Mass: 800-451-2505 ext. 257
www.sarnafilus.com/GreenRoofs.htm

Soprema Inc.
503-524-3382
800-356-3521
www.sopremaworld.com

Tremco Incorporated
Portland OR: 503-234-6407
Ohio: 800-321-7906
www.tremcosealants.com

CONTRACTORS

Anderson Roofing Co., Inc.
503-294-0202, Doug Christie
anderson.roofing@comcast.net

All About Roofs
503-538-5066

Green Seasons Turf and Tree Inc.
503-263-4567

Northwest Raingardens
877-887-1149

Oregon Landscape Contractors Association
503-253-9091
www.oregonlandscape.org

Teufel Landscape
503-646-1111

CONSULTANTS

AEI
Portland: 503-452-8003
www.alpha-eng.com

Greenroof Design Consultant
770-674-4624
www.Greenroofs.com

Green Roofing Consultant
Quebec, CAN 418-682-2478
Ma_boivin@videotron.ca

Greenworks
Portland: 503-222-5612
Mf@greenworkspc.com

HOK Architects
Washington D.C: 202-339-8728
www.thehokplanninggroup.com

Katrin Scholz-Barth Consulting
Washington D.C.: 202-544-8453
Katrin@Scolz-Barth.com

Lango Hanson
Portland: 503-295-2437
Kurt@LangoHanson.com

Murase Associates
Portland: 503-242-1477

North American Wetland Engineering
Forest Lake, MN: 651-433-2115
Nawe@visi.com

PIVOT design & consulting LLC
Portland: 503-235-5429
eshriner@mindspring.com

Rana Creek Habitat Restoration
Carmel Valley, CA: 831-659-3811
Ranacreek@earthlink.net
Ranacreek.com

Roofscapes Inc.
Philadelphia, PA: 215-247-8784
www.roofmeadow.com

Schaber and Associates, Inc
503-655-8921
Kschaber@rci-online.org
www.Rci-online.org

Soderstrom Architechs, P.C.
503-228-5617
www.sdra.com

Lando & Associates, Landscape Architects
Portland: 503-233-6600
www.lando-landscapearchitecture.com

NURSERIES - SOIL PROVIDERS

Oregon Association of Nurserymen
503-653-8733
www.oan.org

Pro-Gro
Sherwood: 800-682-3501
www.pro-gromixes.com

Squaw Mountain Gardens
Estacada, OR
503-630-5458
hennchicks@aol.com

ADDITIONAL WEB SITES

www.Greenroofs.com
www.Enn.com
www.Greenroofs.ca
www.ecoroofseverywhere.org

ENVIRONMENTAL SERVICES
CITY OF PORTLAND

working for clean rivers

Dan Saltzman, Commissioner

Dean Marriott, Director

ECOROOFS
Questions & Answers

is available online
www.cleanrivers-pdx.org

503-823-7740

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