

{ green home }
healthy homes for a healthy environment



managing rainwater





- a. cistern
- b. green roof
- c. permeable pavement
- d. soil amendment
- e. rain garden
- f. downspout disconnect
- g. trees and plants

green

What is a Green Remodel?

It's an approach to home improvement with the goal of not only making your home look better, but work better—for both you and the environment. Want a healthier home? A cleaner planet? A green remodel helps you realize a range of far-reaching benefits from a single smart design. With careful planning, you can create a home that combines beauty, efficiency, comfort and convenience with health and conservation.

This guide focuses on ways that homeowners can manage the stormwater that flows onto and through their property. Practices that slow, filter, or eliminate runoff are collectively referred to as “green stormwater infrastructure” (GSI). GSI uses plants and soil to manage stormwater on site or collect it for reuse. Examples of GSI include permeable paving, rain gardens, green roofs, cisterns and more.

why

Why Consider a Green Remodel?

REDUCE ECOLOGICAL IMPACT

Installing green stormwater infrastructure minimizes pollutants and debris entering local creeks, rivers, lakes, and Puget Sound. These pollutants are harmful to aquatic life and recreational activities such as swimming and fishing. When you capture or slow runoff, you protect water quality, wildlife, and help to restore natural ecological functions to your landscape. A green approach with a home remodeling project will benefit you, your community, and the environment.

MAKE A HEALTHIER HOME

Rain that falls on hard surfaces like roofs and driveways collects quickly, typically leaving sites through ditches and pipes. This stormwater runoff can back up during big storms and flood homes, cause sewer overflows, and erode hillsides and stream banks. By capturing, slowing and cleaning the runoff from your home you can filter out pollution and allow rain to seep into the ground, recharging groundwater and streams while avoiding property damage. The techniques described in this guide present attractive and functional solutions.

managing rainwater

Millions of people depend on Puget Sound for natural resources, transportation, and recreation. This iconic water body defines Western Washington, but it is also a fragile ecosystem threatened by human activity. Stormwater runoff has been identified as the single biggest threat to Puget Sound – nearly three feet of rain per year runs off our roads, driveways, sidewalks, lawns, and rooftops, carrying fertilizer, petroleum, and other harmful pollutants. This polluted runoff degrades natural habitats, harms wildlife, and lowers water quality. A collective effort among homeowners can have a positive impact on the Sound's health and our health.

Fortunately, better options exist for managing stormwater. A number of manufacturers and contractors offer products and services for building green stormwater infrastructure. These tools can make your house more beautiful while improving ecological function.



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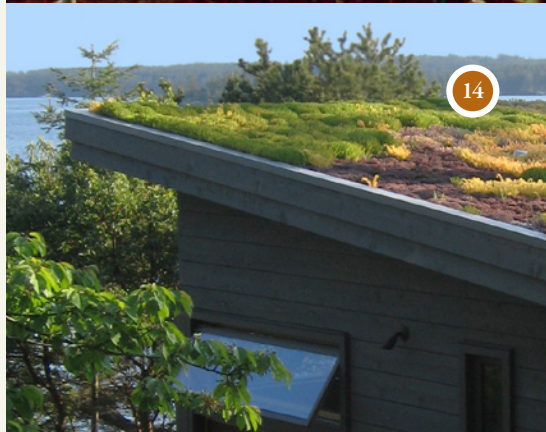
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rethink remodel

Using this Guide

This guide will help homeowners learn how to better manage the rain that falls on their property, whether they're making voluntary landscape changes that don't require a permit or doing a home or landscape remodeling project that requires drainage review.

For voluntary projects that don't require a permit this guide provides a general overview of improving soil, planting trees, selecting and installing permeable paving, and directing roof runoff to cisterns or rain gardens. Detailed factsheets are available at Seattle Public Utilities' RainWise website, www.seattle.gov/util/rainwise.

For home or landscape projects that require a drainage review Seattle's Stormwater Code was revised in 2009 to require "green stormwater infrastructure [the methods described in this guide] to the maximum extent feasible" on all single-family residential projects. All other projects (non-single-family residential) with 7,000 square feet or more of land disturbing activity or 2,000 square feet or more of new or replaced impervious surface (roofs or pavement), must also implement green stormwater infrastructure.

- Homeowners and contractors can find guidance on the Department of Planning and Development's Client Assistance Memos (CAMs) on soil, trees, bioretention (rain gardens), permeable paving, etc., and in the Directors Rules that define the stormwater code, all available at www.seattle.gov/dpd/Codes/StormwaterCode.
- More design specifications and resources (such as plant lists and permeable paver information) can be found at Seattle Public Utilities' green stormwater infrastructure website, www.seattle.gov/util/greeninfrastructure.

Remodeling your home as

well as your landscape?

See the Green Home Remodel

series for tips. You'll find them

online at www.seattle.gov/dpd/

greenbuilding or call

(206) 615-1171 for

paper copies.



Health & Safety

Are the materials and maintenance products non-toxic? Do the design and materials reduce the risk of trips, slips, and other injuries?

Functionality

Do the design and materials fit your intended purposes? Can the materials be reused for a future project? Does your design have multiple uses? For example, can your cistern be incorporated into a deck for your home to create more living space?

Reduce Maintenance

Do the materials and product require low maintenance? Can the product or materials be maintained without toxic chemicals?

Beauty

Do the design and materials appeal to you? Will they still look good years from now? Do they enhance your landscape and home's outdoor elements?

Ecological Benefit

Do the materials enhance and protect the natural environment? Do the products protect water quality by helping to absorb or retain stormwater? Are they free of toxic chemicals that can enter the soil, water or air? Do they contain recycled content? Can they be recycled or reused? Are they manufactured locally? Do they avoid or reduce environmental harm during their production or disposal?

Decide What you Want

Planning a landscape, plumbing or roof project can be overwhelming. Where do you start? Generally, the closer you work with your landscape and home's existing features, the less you'll spend on your project. The most effective remodeling projects begin when you thoroughly assess your wants, needs, and constraints. By identifying your priorities and considering your options carefully, you can make sure your chosen materials and products meet your goals.

Expand Your Definition of Cost

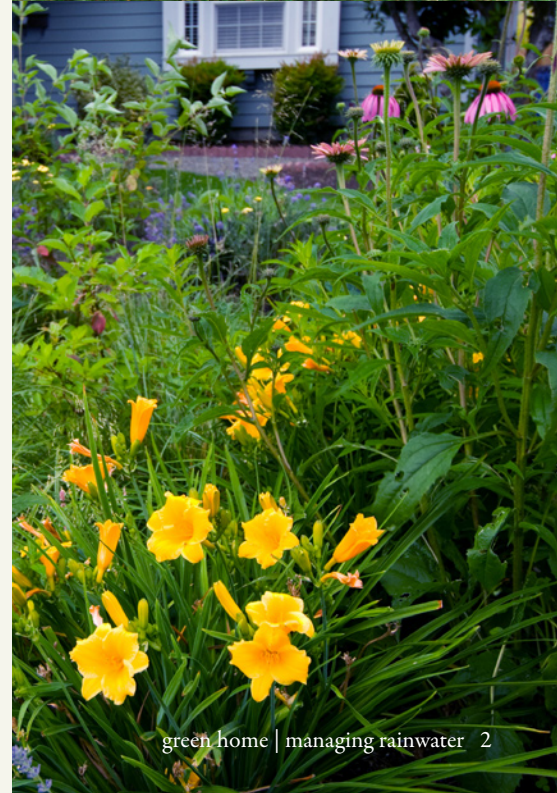
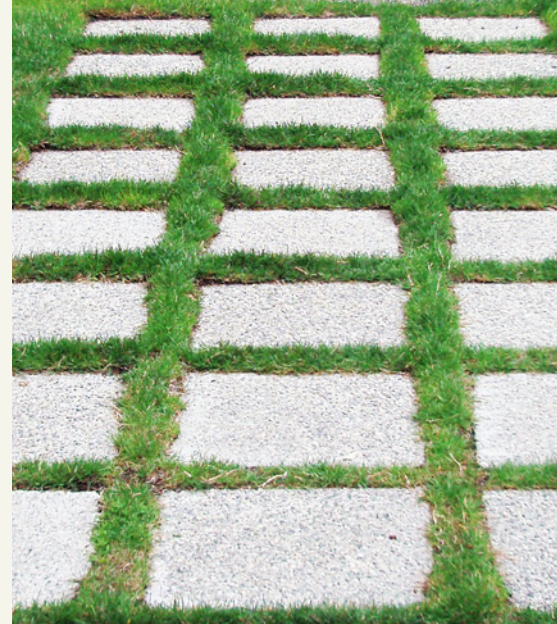
Initial prices only give a peephole view of a design or product's true cost. Investing in green infrastructure can often be more cost effective than conventional remodel projects. Green remodeling focuses on long-term savings, ease of maintenance and conservation. A higher purchase price may mean a better deal in the long run. For example, while a green roof initially costs more than a conventional roof, it lasts 1.5 to 2 times as long while adding insulation to your home. Long-lasting products require less frequent replacement. A low purchase price may be simply a good deal, or it may signify a lack of quality or durability. Or it may mean that some environmental, health or social costs are not reflected on the price tag.

Not only can your green remodel look great, it can have a positive impact on the environment. Your green remodel can filter air and water pollutants, decrease heat gain from summer sun, stabilize soil to prevent erosion, provide wildlife habitat, reduce the public cost of stormwater infrastructure, and provide flood control.

Do Your Homework

Research can uncover some of these hidden costs, and help you make more informed choices. By asking questions of retailers and avoiding suspect products, you're sending a market signal that these "big picture" costs matter, as well. Finding green products can sometimes be a challenge, but is becoming easier as the green building industry grows. Start early to look for businesses that carry the products you like. Find testimonials and reviews online but be aware of biases in information sources. Identify all the materials and products you want to use for your landscape or roof, down to the specific brands and specific material types. This will help you to determine their cost and availability while avoiding expensive and last-minute decisions.

Familiarize yourself with and follow local building codes to save yourself the hassle and costs of having to tear something out later. By complying, you address safety, health, and energy efficiency issues – all goals of a green remodel. If you have questions about permits in Seattle or whether a particular material or design complies with code, contact the Department of Planning and Development's Land Use Q & A at www.seattle.gov/dpd/research/landuseQA.





managing rainwater

Why is managing rainwater at home important?

In forests, meadows, and other natural areas, rainwater is slowed down by trees, shrubs, and grasses before reaching the soil. As the water percolates into the ground, plant roots filter out pollution before it seeps down into the groundwater that feeds streams and rivers. When development replaces these natural drainage systems with impervious surfaces like roofs, roads, and sidewalks, rain becomes stormwater runoff, which carries pollution into our waterways and can cause flooding.

Single family properties make up about 65% of Seattle's land area, and about one half of these lots are typically covered with impervious surfaces — this adds up to a lot of impervious surfaces. During rain storms, stormwater can back up and flood homes, cause sewer overflows into local water bodies, and erode stream banks. This is a problem that homeowners can reduce by managing rainwater on-site using relatively simple technology.

Water Quality

Clean water is fundamental for healthy people and ecosystems. Stormwater pollution from our drainage systems has contributed to a decline in salmon populations and production of shellfish. Contaminated runoff can also damage estuaries, wetlands, and water-related recreation areas. Pollutants carried by stormwater include:

- Fertilizers, pesticides and other chemicals from gardens and homes
- Bacteria from pet wastes
- Soil from construction sites and other bare ground
- Soaps from car or equipment washing
- Oil, grease, metals, rubber, and coolants from vehicles

If we can prevent rainwater from becoming stormwater by keeping it on site, our collective efforts can reduce that volume of runoff and pollutants entering our natural systems—benefitting our communities, businesses, rivers, lakes, wildlife, and the overall health of Puget Sound.

Adaptation to Climate Change

Climate change models predict more frequent and heavier winter storms in the Pacific Northwest. While on-site stormwater management has immediate benefits, it is expected to become even more important over time. In addition, the more rainwater collected and used on-site, the less potable water needed for irrigation and other uses. This may become more important as water resources become scarcer.

Green Stormwater Infrastructure

This guide will help you navigate through a variety of materials, techniques, and products that can help your home make better use of rainwater.

Hardscape Solutions

Hardscape features you can use to reduce stormwater include cisterns, rain barrels, and permeable paving. In some cases, it can be effective to disconnect your downspout from the sewer system, if you can redirect that roof runoff into a cistern or rain garden. The purpose of these types of features is to capture, store, slow or infiltrate runoff while enhancing the existing elements of your home.

Landscape Solutions

Landscape features include soil amendment and mulching, trees, rain gardens, groundcover, shrubs and other types of vegetation. Trees, shrubs, and perennials help filter and infiltrate more water than a typical lawn. Leaf litter and plant debris feed soil microbes that improve infiltration, break down pollutants, and provide natural fertility to your yard. Installing landscape features is a practical way to manage stormwater because you can retrofit an existing yard to better drain runoff. Landscape features can cleanse, absorb, infiltrate and slow runoff.

planting trees

Preserving existing trees and planting new ones are easy and effective ways to manage rainwater at home. Trees and plants, especially evergreens, do a good job of catching rainfall on their leaves and needles, detaining rainwater and returning much of it to the atmosphere. Tree roots and leaf litter feed soil microbes that prevent erosion and allow more rainwater to soak in.

Trees in your yard can also help improve air quality and moderate the microclimate around your home by providing cool shade during hot summer months and protecting your home from cold winds in winter. Because of their beauty and functional value, trees are known to add to property values — a well-placed mature tree can add thousands to the sale price of a home.

Getting Started

Site trees in places where they can thrive over time. You may want to consider factors like: is there enough room to accommodate the full canopy at maturity? Is there enough room for root growth away from underground foundation and utilities? You may also consider whether to plant an evergreen or deciduous tree:

- **Evergreens** keep their leaves or needles all year and are much more effective at reducing stormwater runoff. Evergreens planted north and west of your home block winter winds and hot afternoon sun.
- **Deciduous** trees help reduce stormwater runoff during non-winter months. These trees placed south and east of your home welcome winter sunlight and provide shade in summer.

Northwest natives are often a good choice because they have few pest problems and provide habitat for native birds and wildlife, including unseen but crucial soil microbes. However, many non-native trees are well adapted to our climate and can provide fruit, nuts, or other benefits. Weigh all of these factors carefully when selecting and planting trees – they'll be with you for a long time!

Maintenance

Newly planted trees need to be watered weekly for at least the first 2-3 years and areas around trees should be weeded and mulched annually (see **Improving Soil with Compost and Mulch** on page 5 for more information). To protect tree health, avoid excavating, paving, or driving in the critical root zone (the area underneath the canopy).

Resources

Learn how to plant trees properly by downloading the RainWise factsheet on Planting Trees at www.seattle.gov/util/rainwise. For information on tree giveaway programs, visit www.seattle.gov/trees.



To learn more about tree selection, planting, and maintenance, visit www.seattle.gov/trees and Seattle Urban Forestry at www.seattle.gov/transportation/forestry.htm.





improving soil with compost and mulch

An attractive and healthy lawn and garden requires soil rich in life and nutrients. Improving your soil makes plants healthier and saves you money by reducing irrigation, fertilizer, and pesticide needs. Compost and mulch added to your soil feed the beneficial soil organisms that create structure and spaces within the soil so that rain water can easily soak into the ground. These soil organisms also break down pollutants, and help move carbon dioxide (a greenhouse gas) from the atmosphere into long-term storage in the soil. Amending your soil with compost and mulch is a simple improvement that helps to reduce stormwater runoff and improve the quality of our environment.

Getting Started

Spread 2-4 inches of **compost** over the entire area before planting, then mix the compost 6-8 inches deep into the soil to provide water, air and nutrients to plant roots. You should mix in compost before:

- Planting lawns, perennials, trees and shrubs.
- Replanting annual beds (every time).
- Repotting container plants.

Adding **mulch** (organic material applied to the surface of the soil) to new or existing plantings helps reduce evaporation, limit weed growth, maintain an even soil temperature, and limit erosion that can choke streams and fish. The best mulches are arborist wood chips (available from tree services), fall leaves or grass clippings. Apply mulch to these depths:

- Grass clippings: ½ to 1 inch
- Compost, leaves, straw, bark (medium ground): 1 to 2 inches
- Coarsely shredded wood chips, bark, or tree trimmings: 2 to 4 inches

Things to remember about mulching:

- Apply annually or as needed to maintain a mulch layer 2 inches thick around annuals and perennials, or 3-4 inches around woody plants and trees. Keep mulch one inch away from stems and trunks of plants.
- Mulch in spring to conserve moisture and prevent weed seedlings from sprouting.
- Mulch in fall to protect soil from erosion, winter weeds, and cold snaps.
- You can also “mulch” your lawn by leaving the grass clippings, which improves lawn rooting depth and drought resistance.

Maintenance

Routinely mulching and adding compost to your soil helps keep plants healthy year round, and can eliminate the need for fertilizer. If you use fertilizers, choose organic forms of the nutrients you need, which are less likely to wash off into streams. Test soil before you apply fertilizer, and add only the amount that the results recommend (free testing is available to most King County residents through the King Conservation District — see www.kingcd.org/pro_far_soi.htm). Avoid using pesticides as they may hurt beneficial soil life, wildlife, and human health. You can find better alternatives at www.seattle.gov/util/services/yard.

Resources

Download the factsheet **Improving Your Soil with Compost and Mulch** from the RainWise website at www.seattle.gov/util/rainwise, and the **Growing Healthy Soil** guide at www.seattle.gov/util/services/yard. For immediate expert advice call the **Natural Lawn & Garden Hotline** at (206) 633-0224 or e-mail help@gardenhotline.org.

Protect water quality as you grow. Organic fertilizers combined with Integrated Pest Management keep our water resources free of chemicals and pollutants. Visit the Natural Lawn & Garden Care website at www.seattle.gov/util/Services/Yard/index.asp



compost and mulch types

	SOIL AMENDMENT CHOICE		BENEFITS	DRAWBACKS
Best All-Purpose Materials		Compost made from yard debris or barnyard manure Tips: yard trimmings can be composted at home	recycled and readily available contains balanced nutrients	homemade compost can contain weeds, pests, and diseases (commercially available composts eliminate these problems)
		Leaves (composted or fresh)	no cost rich in nutrients	usually contain some weed seeds
		Aged bark or sawdust	improves drainage in clay soils good for trees and shrubs	if not composted until dark brown in color, they can tie up nutrients and inhibit plant growth mix with compost for better results
Other Materials		Peat moss	improves moisture and nutrient storage in sandy soils	does not support soil life compost works better and is usually less expensive
		Coconut coir	Improves moisture and nutrient storage in sandy soils	does not support soil life
		Topsoil mixes	good for raised beds on top of compacted or poorly drained soil	may contain poor fill soil or weed (best to use mixes containing only compost and clean sand)
Shrubs and Trees The best mulches for shrubs and trees are coarse, woody materials that protect the soil for a year or longer, slowly releasing nutrients for steady plant growth.		Wood chip and shredded prunings ("arborist wood chip mulch")	low or no cost, reuses a potential waste product also works for perennials if soil is amended provides more nutrients than bark	may spread weed seeds
		Fresh bark	readily available	inhibits growth of some plants
		Wood shavings	often free	cannot wood shavings from chemically treated lumber best if aged
		Composted yard debris, bark, barnyard manure or biosolids	neat appearance	compost does not suppress weeds bark is low in nutrients
Annuals/Perennials/Berries & Roses Annuals and perennials benefit from mulches like compost which feed plants quickly, and can be mixed into the soil without tying up nutrients.		Leaves and grass clippings	leaves and grass clippings are free	may spread weed seeds



Stormwater from downspout disconnects must enter a conveyance, infiltration or capture system. See the RainWise website, www.seattle.gov/util/rainwise for more.



disconnecting downspouts

In a one-inch storm, a 1,000 square foot roof receives 625 gallons of water. If your downspout ties into your drainage system, this water may well contribute to combined sewer overflows or other water quality problems. A disconnected downspout combined with a rain garden, cistern, or permeable pavement facility can slow peak flows, reduce stream erosion, and minimize sewer overflows.

Getting Started

Disconnecting downspouts require proper procedures to avoid risks of flooding, erosion and landslides. Does the water have path to move safely away from your house? What happens in a big storm? These are questions you need to answer before disconnecting your downspout.

Consider where rainwater would flow from your downspout. Effective downspout disconnection requires adequate grading and vegetation to convey water away from the house and let it soak into the ground. Make sure that even in heavy rainfall water can still overflow downhill to the street drains without flooding sidewalks or your neighbor's property. Avoid directing runoff toward foundations, contaminated soils, steep slopes and landslide areas. If you can't disconnect all of your downspouts, even one could help infiltrate hundreds of gallons per year.

Doing research before you start and making informed decisions can save a lot of hassle in the future. See the **RainWise** website, www.seattle.gov/util/rainwise for a factsheet on safely **Disconnecting Downspouts**.

Maintenance

Disconnected downspouts require simple but regular maintenance. Routinely check your gutters for leaks and remove any accumulated leaves and debris at least twice a year, and more often if you have overhanging trees. Take care of the downspout discharge locations and make sure that they have appropriate erosion control and proper drainage.



ways to manage downspout runoff

Downspout runoff can be managed in various ways. Splashblocks and conveyance furrows direct rainwater to **infiltration** areas or **capture** systems.

MATERIAL	SYSTEM TYPE	DESCRIPTION/TIPS	BENEFITS	DRAWBACKS
Splashblocks 	Conveyance	<p>Rainwater pouring out of downspouts can cause erosion and moisture problems around your foundation. Splashblocks help disperse runoff away from your home and prevent landscape erosion.</p> <p>Tip: For a more eco-friendly solution, go with a splashblock made from recycled concrete or post-consumer plastic.</p>	<p>low cost</p> <p>disperse runoff</p> <p>reduce scour</p> <p>prevent landscape erosion</p>	limited varieties and designs available on the market
Rain gardens 	Infiltration	<p>Described further on page 9</p> <p>A shallow depression with a designed soil mix and native plants captures runoff and allows it to soak into the ground.</p>	<p>low long-term maintenance</p> <p>absorb and infiltrate more water than the same size area of lawn</p> <p>attractive and interesting landscape features</p>	require regular maintenance
Permeable paving 	Infiltration	<p>Described further on page 11</p> <p>Permeable pavement, constructed as a facility, can accept rooftop runoff and soak it into the soil.</p>	<p>reusable, can be reconfigured</p> <p>extremely durable</p> <p>can serve as a patio, walkway, or driveway</p>	<p>can have high initial cost</p> <p>most manufacturers require professional installation</p>
Cisterns 	Capture/detention	<p>Described further on page 13</p> <p>Designed to catch roof runoff, cisterns are big rain barrels that hold hundreds of gallons of water.</p>	<p>low cost (rain barrels)</p> <p>reduce use of potable water for irrigation</p> <p>reduce runoff volume and delay peak flow</p>	<p>high initial cost (cisterns)</p> <p>can be expensive and time consuming to construct</p> <p>require regular maintenance</p>
Conveyance furrows 	Conveyance	<p>Conveyance furrows offer a more flexible option than piping.</p> <p>These shallow depressions can convey runoff away from buildings to a better discharge location such as a rain garden.</p> <p>Furrows can be vegetated or rock-lined, depending on aesthetic preference and the slope of the site.</p> <p>Deeper rock trenches can hold and infiltrate water.</p>	<p>low cost</p> <p>layout can be flexible</p> <p>does not require extensive disturbance of yard or lawn</p> <p>slow runoff and provide more benefits than piped conveyance options</p>	rocks can collect sediment over time and require weeding



rain gardens

You can improve the look of your home and help the environment by incorporating rain gardens into your yard. A **rain garden** is simply a shallow depression that uses soils and plants to manage runoff from impervious areas such as your roof or driveway. The plants and compost-amended soil can hold several inches of rainwater and allow the stormwater to slowly seep into the ground.

The first inch of rainfall, also known as the first flush, is responsible for most of the pollutants in stormwater runoff. A rain garden is designed to temporarily hold this first flush and slowly filter out many of the common pollutants in the water, such as oil, chemicals, and pet waste that would otherwise flow into the nearest combined sewer system or stormwater system.

Rain gardens mimic a native forest's drainage system by collecting, absorbing, and filtering stormwater runoff. They can be shaped and sized to fit your yard and landscaped with plants that fit with surrounding elements, improving the appearance of your home.

Getting Started

Initial research and careful planning can help you avoid damage and future reconstruction costs – saving you time and hassle in the long run. There are several things you need to assess before you start digging and planting. Is your yard fairly level? Do you have a big enough area free of big tree roots and utilities? Is there a way for roof or driveway runoff to flow to your rain garden? What kind of soils and slopes do you have?

Rain gardens are best sited where runoff can flow freely to them, and where there is a safe path for overflow in bigger storms. Their effectiveness will depend on your property's soil type and amendments. You may also want to consider the location of the rain garden that will best fit and enhance the appearance of your home.

For a detailed factsheet on getting started and safety precautions, visit www.seattle.gov/util/rainwise. There, you will find the useful **WSU Rain Garden Handbook** which offers complete design and construction details.

Photo lower left: © Ryan Moss (www.RyanMoss.com)



Rain Garden Plants

To plan a successful rain garden, you'll need to familiarize yourself with plants that tolerate both saturated and drought conditions. Rain gardens have three planting zones characterized by different soil conditions. Select plants according to their water needs and sun exposure for these planting zones:

- Zone 1 – Deepest or flat bottom area: plants in this zone absorb and filter stormwater and prefer soil saturation or shallow inundation.
- Zone 2 – Slopes: for plants that can tolerate occasional inundation. Use these plants to achieve good coverage to hold side slopes in place.
- Zone 3 – Upland area: plants at or above grade level prefer drier conditions. This zone allows the widest range of showy ornamental plants.

Visit www.seattle.gov/dpd/Permits/GreenFactor/GreenFactorTools for **Seattle's Green Factor Plant List**, which includes drought-tolerant plants for the various planting zones.

Maintenance

Once a rain garden is built, new plants need to be watered regularly for the first two to three years until they are well established. Mulching annually conserves water and reduces weeds until the plants close in over the soil. You can also help the plants to establish by weeding in the spring, summer, and fall months. If you use native plants and mulch with leaf litter or arborist wood chip mulch, there should be no need for fertilizers, herbicides or pesticides. Keep the inlet and outlet clear of debris and well protected from erosion with rocks. Appropriate care and regular maintenance can protect your green investment for many years.

Resources

Looking for help with a rain garden? The **RainWise** website (www.seattle.gov/util/rainwise) maintains a roster of contractors educated by the City on green stormwater infrastructure practices. This site also has a factsheet on "Caring for your new rain garden" and links to Washington State University's *Rain Garden Handbook for Western Washington*.

For more technical information, the City of Portland has online publications including plant lists and sample planting plans. Visit www.portlandonline.com/bes, then click on Sustainable Stormwater Management, found under Programs, then Reports and Publications on the left.

Building rain gardens on private property usually does not require a city permit, unless they are part of a required mitigation or if they require alteration of side sewer.

Check permit requirements at Seattle DPD's Side Sewer desk:

684-5362 or SideSewerInfo@seattle.gov





permeable paving

Using permeable pavement for driveways, walkways, and patios can add character to your site while maintaining access and durability for vehicle and foot traffic. Permeable pavement can improve water quality by infiltrating or slowing runoff and breaking down pollutants that would otherwise enter local streams and Puget Sound.

The simplest solution can be converting unnecessary pavement into permeable landscaping with lawn or garden beds. For areas that require pavement, there are a variety of environmentally friendly choices. **Permeable pavements** contain void spaces which allow stormwater to flow from the pavement surface to the subbase and into underlying soils. Options include interlocking concrete pavers, concrete or plastic grids, and poured-in-place permeable asphalt and concrete – all of which can be used to improve the aesthetics of your home and protect the health of your neighborhood and environment.

Runoff Control Systems

Permeable pavement surfaces are most practical for do-it-yourself home remodels. These systems consist of a permeable surface layer and a clean angular gravel subbase of at least 3 inches installed over the approved subgrade. Permeable pavement surfaces are designed to manage only the rain that falls directly on the pavement.

Permeable pavement facilities are typically used for Stormwater Code credit on larger projects. They are similar to surfaces, except they have a deeper gravel subbase (at least 6 in.) and may have an underdrain in poorly infiltrating native soils. This more intensive design allows permeable pavement facilities to receive runoff from surrounding surfaces.

Getting Started

Certain characteristics make some sites more suitable for permeable pavement than others. Analyze your site: does it have gentle slopes (<5%, or less than 1 ft. drop per 20 horizontal ft.)? Do the subgrade soils have a percolation rate of at least ¼ inch per hour? What are the intended traffic loads and frequency? Is there an overflow route for runoff from big storms to flow to street drains or a rain garden? Understanding the site helps with design decisions and avoiding flood risks.

Driveways and parking areas need careful design and installation to support the weight of cars and trucks. Patios and walkways are better tasks for do-it-yourself installation, but you still need to follow the manufacturer's directions exactly. If you install the pavement yourself, remember to excavate at least 3 inches below the pavement and fill in with angular rock or gravel to provide a stable base and help drain the surface. Consider hiring a qualified professional with green experience for big projects to advise you, design, or do the work.

Maintenance

The maintenance requirements of permeable surfaces will depend on the materials used and the location of the installation. For permeable concrete and asphalt, it is recommended that the surface be vacuumed or pressure-washed two to four times a year, or as required to ensure that the surface does not become clogged. Concrete and plastic grid systems will require semi-annual inspection by the homeowner to discourage weed growth and to ensure that the system rings are not exposed. Exposed areas should be raked and weeds should be removed without the use of herbicides.

Resources

See the "Reducing pavement and permeable paving options" factsheet and **Materials and Suppliers** link on the **RainWise** website (www.seattle.gov/util/rainwise) to learn about Seattle area sources for permeable pavement materials. The best way to decide what you want is to see the various products, and talk to suppliers and installers.

For projects with more than 750 square feet of new or replaced pavement, contact the DPD Side Sewer desk (684-5362 or SideSewerInfo@Seattle.gov) for information about drainage review, grading permits (if greater than 2,000 square feet) and additional design requirements.



Photo top left: © The Watershed Company. Belgard permeable pavers on a residential patio.

permeable paving choices

PAVER TYPE	DESCRIPTION	BENEFITS	DRAWBACKS	TYPICAL LOAD
Pavers 	Interlocking concrete pavers have tabs that space them apart to allow water through the joints, shapes that interlock to provide stability and the aesthetic of brick and stone pavers.	<ul style="list-style-type: none"> low maintenance available in a variety of styles reusable; can be reconfigured extremely durable ideal for driveways or high-use patios and walks 	some manufactures require professional installation	medium - high
Concrete open celled paving grids 	Concrete lattice with open area for drainage to be used with grass or crushed stone has a traditional yet modern appeal.	works well on level sites for occasional parking areas or low-use walkways	<ul style="list-style-type: none"> requires routine landscape maintenance of lawn, weeding, reseeding, and irrigation (for grids with grass) can be difficult to avoid compaction which can kill vegetation uneven surface can be difficult for wheelchair travel 	medium-low
Plastic lattices 	Plastic grid system, sometimes with filter fabric, to be used with grass or crushed stone ("grasscrete" and "gravelcrete").	<ul style="list-style-type: none"> works well on level sites for occasional parking areas or low-use walkways an eco-friendly option -often made with 100% recycled plastic 	<ul style="list-style-type: none"> requires routine landscape maintenance of lawn, weeding, reseeding, and irrigation (for grids with grass) can be difficult to avoid compaction which can kill vegetation only certain products are suitable for wheelchair travel 	low
Permeable concrete 	Permeable concrete is made with larger pea gravel and fewer fines to achieve a pebbled, open surface that allows stormwater infiltration.	<ul style="list-style-type: none"> even surface good for wheelchair accessibility accommodates relatively high traffic volumes long-lasting if installed correctly 	<ul style="list-style-type: none"> like conventional concrete, permeable concrete is energy-intensive to make and has a large carbon footprint good installation depends on contractor's experience difficult and expensive to install in small batches 	medium-high
Permeable asphalt 	Open-graded asphalt with reduced fines and stable air pockets allow water to drain to the soils below.	<ul style="list-style-type: none"> works well with pedestrian-only areas and for low-volume, low-speed areas such as overflow parking even surface good for wheelchair accessibility 	<ul style="list-style-type: none"> wears out faster than concrete or pavers good installation depends on contractor's experience difficult and expensive to install in small batches 	medium
"Hollywood driveways" 	An attractive approach to improving your driveway, this approach consists of a vegetated strip running between two parallel strips of concrete, spaced so that a vehicle's wheels can drive on them.	<ul style="list-style-type: none"> cheaper than driveways constructed with solid concrete reduces impervious surface since less concrete is needed adds green space and character to your driveway low maintenance 	<ul style="list-style-type: none"> long driveways may be hard to follow or back up on works better on straight driveways where the automobile can stay on the tracks if used on a driveway or alley that requires turning, the center strip will become compacted over time 	medium-low

* For detailed and current information on **Approved Pervious Wearing Course Materials**, visit www.seattle.gov/util/greeninfrastructure.



cisterns for rainwater harvesting

Capturing rainwater helps keep your lawn or garden green while reducing water consumption. It is also a simple and effective way to keep your rooftop runoff out of the public drainage system, reducing impacts to wildlife and receiving waters.

Rainwater harvesting uses rain barrels or cisterns (larger systems that hold 200-1000 gallons or more), to capture and store rainwater for beneficial use. These storage systems installed near downspouts or in your yard can capture roof runoff for non-potable uses, enough to significantly reduce or even eliminate the need to use municipal water for landscape purposes, especially when combined with drought-tolerant plants. Plants flourish with irrigation from rainwater as it does not contain chlorine, an additive to keep water safe for drinking. Cisterns and rain barrels also offer the added benefits of reducing stormwater peak flows during winter and water demand during summer.

If you are considering rainwater for indoor use (such as toilet flushing, irrigation and clothes washing), read the factsheet “Rainwater Harvesting and Connection to Plumbing Fixtures”, which is available along with more rainwater harvesting design resources at www.seattle.gov/util/services/yard. Look under “Natural Lawn and Garden Care” and then “Rainwater Harvesting.”

Greywater harvesting is the capture and reuse of non-sewage domestic wastewater from baths, showers, and washing machines. This water is typically used for flushing and irrigation purposes. Because greywater typically has more bacteria and nutrients than rainwater, its reuse has more code requirements. For more information on how to harvest and use greywater, visit www.seattle.gov/dpd/codes/stormwatercode/CAMs.

Getting Started

Before you buy any type of cistern, consider how much rainwater is available from your roof and how much you intend to use. A cistern or rain barrel requires an outdoor, level, and solid base as well as a place to safely discharge the rainwater when the barrel overfills (for roof runoff calculations, follow the “Rain Water Harvesting” link on the RainWise website). To protect the quality of harvested rainwater, avoid roofing materials that contain copper, zinc, or asphalt, as they can release contaminants into your collection system. To learn more about safety precautions, visit www.savingwater.org/outside_watering.htm.

Underground cisterns require pumps to operate, but are out of sight and do not compete with other uses in your yard.

While smaller systems generally do not require land use or building permits, large cisterns may. For further information on methods, materials, contractors and permits, see the RainWise website: www.seattle.gov/util/rainwise.

Maintenance

Keep your gutters clean and sloped so they dry quickly between rains and ensure that no particulate matter or other parts of the roof are entering the gutter and downspout to the rain barrel or cistern. Rainwater harvesting systems require relatively low maintenance, however components of your system should be inspected twice a year. In the fall you'll need to clean leaves and other debris off the top to keep the screen from clogging and make sure the overflow is not blocked. In the winter when rains are heaviest, you may want to reconnect your downspouts if you do not have sufficient vegetation or a raingarden to capture the overflow runoff.

Resources

Want to learn more? Visit **Seattle Public Utilities' Rainwater Harvesting** website at www.seattle.gov/util/Services/Yard/Natural_Lawn_&_Garden_Care/Rain_Water_Harvesting.

Worried about mosquitoes?

Don't be. Rain barrels and

cisterns have screens to keep

out mosquitoes. Opaque cistern

materials also reduce the growth

of algae and other organisms.



green roofs

People notice green roofs — plants on top of buildings are unexpected and visually striking. In addition to their aesthetic appeal, green roofs offer a variety of functional benefits, including:

- capturing and slowing roof runoff
- reducing energy costs by acting as an additional insulating layer
- adding more green space to your property
- providing habitat for birds and beneficial insects
- improving air quality
- potential for LEED™ credits
- food production (under special conditions)

While green roofs (also known as eco-roofs or living roofs) can appear to be wild pockets of rooftop nature, they are in fact highly engineered systems. Specifics vary depending on the project, but generally green roofs consist of a membrane and drainage layer topped with a soil-like growing medium and hardy plants. Residential-scale versions usually have a shallow soil profile and are planted with sedums and other low-growing succulents. Note: if a green roof is needed to meet Stormwater Code requirements (not applicable for single-family residential uses), it must have at least 4" of growing medium.

Getting Started

Before any construction can take place, it is important to determine if your structure can support a green roof. A structure's capacity to hold weight depends on its design and condition. When saturated, extensive green roofs range from 10-50 lbs per square foot and intensive green roofs range from about 80-120 lbs per square foot. Low-pitched roofs are best suited to green roof applications, but check with a licensed structural engineer to ensure your roof can handle the additional load.

To better understand what a green roof entails ask your green roof designer or contractor the right questions. What type of system is proposed? What are the maintenance requirements? Is there a warranty?

Vegetation used on single family home green roofs should be drought tolerant and self-sustaining. Green roof plants typically include succulents, grasses, herbs, and wildflowers that are adapted to harsh conditions. Visit the www.seattle.gov/dpd/permits/greenfactor/greenfactortools for a plant list including recommended species for Seattle green roofs.

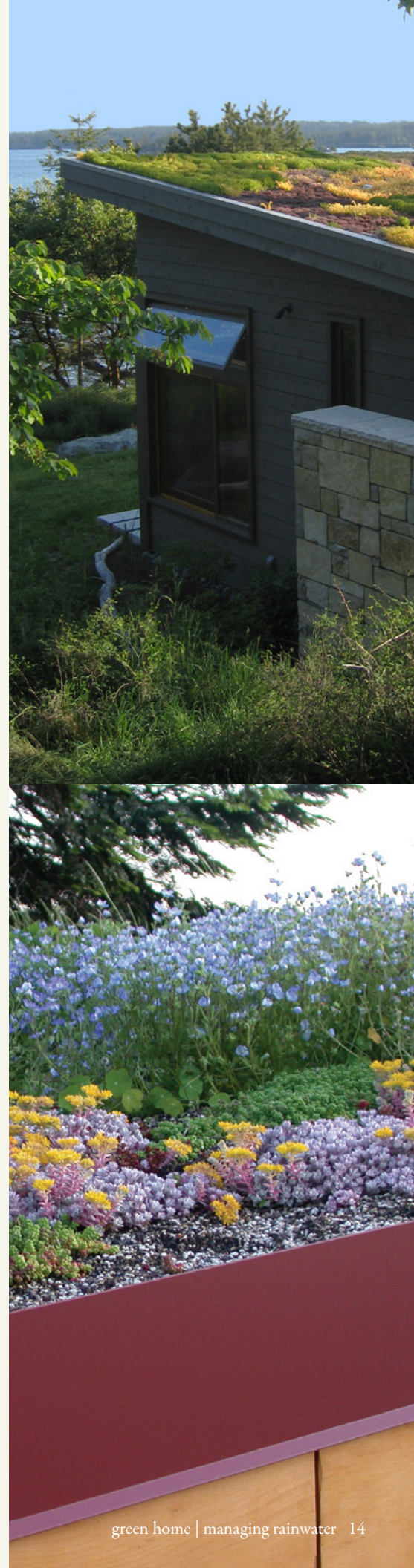
Maintenance

Once a well-designed green roof is established, its maintenance requirements are usually minimal, including inspection of the waterproof membrane, weeding (twice a year), and maintenance of the drainage layer flow paths. Even though green roof plants are selected for hardiness and drought-tolerance, they still require irrigation during establishment (the first two to three years). Once the plants are well established, extensive green roofs only need occasional water in the hottest periods of summer. When creating a planting plan, select species that won't require fertilizer after establishment – fertilizer in rooftop runoff could cancel out a green roof's beneficial impacts.

Resources

Visit www.seattle.gov/dpd/greenbuilding and search for "green roof technical brief" for more info on green roof design and case studies.

Photo top right: © The Berger Partnership. Photo bottom right: © Robert Harrison Architects.





RainWise incentives program

To support homeowners' efforts toward making Seattle a greener living environment, the City is helping residents reduce stormwater runoff from their property in target combined sewer overflow (CSO) basins using green stormwater infrastructure.

As of 2010, residents in the pilot basin in Ballard are eligible for incentives. The City will pay most of the cost of installing rain gardens and cisterns depending on how many square feet of roof runoff is controlled. The City also plans to expand to other areas for rebate eligibility and will update the RainWise website accordingly.

To find out if you qualify for incentives and how to apply, visit the RainWise website, www.seattle.gov/util/rainwise and click "RainWise Rebates". General project requirements are as follows:

- Rain Gardens or cisterns must be installed on properties within a target CSO basin. Check website for eligible neighborhoods.
- Work must be done by a licensed contractor. You can find a contractor on the RainWise Tools website.
- Pre- and post-construction must be approved by a Seattle Public Utilities inspector. An infiltration test and completed forms are also required.
- Rebate request forms must be received within 90 days after approval of the installation by the SPU inspector.



resources

Print

- *Green Roof Plants: a Resources and Planting Guide* by Edmund Snodgrass and Lucie Snodgrass (Timber Press, 2006). A useful reference for photographs and cultural information for over 200 species of plants suitable for use on extensive green roofs
- *Rain Gardens: Managing Water Sustainably in the Garden and Designed Landscape* by Nigel Dunnett (Timber Press, 2007). A great introduction to various methods of rain gardening and water harvest systems.

Online

- Visit the RainWise website at www.seattle.gov/util/rainwise for the latest tools and detailed factsheets on green stormwater infrastructure, materials, vendors, and incentives information.
- For online Client Assistance Memos and permitting information, visit the Seattle Department of Planning & Development at www.seattle.gov/dpd/camlist/camlist.asp. Paper copies can be obtained by visiting the 20th floor of the Seattle Municipal Tower (located at 700 5th Avenue, just north of Seattle City Hall).
- Download the Natural Lawn & Garden guides and companions, or order printed copies by going to www.seattle.gov/util/Services/Yard/Natural_Lawn_&_Garden_Care
- Download "Soils for Salmon: Integrating Stormwater, Water Supply, and Solid Waste Issues in New Development and Existing Landscapes" by David K. McDonald to learn more about soils best management practices. www.soilsforsalmon.org/why.htm
- Find home improvement ideas and technical information in the "Low Impact Development Technical Guidance Manual for Puget Sound" at www.psp.wa.gov
- The "Stormwater Flow Control and Water Quality Treatment Technical Requirements Manual" provides technical standards for green stormwater infrastructure techniques. Download the manual by visiting www.seattle.gov/dpd/Codes/StormwaterCode/DirectorsRules/default.asp
- Visit www.seattle.gov/dpd/GreenBuilding for other guides in the Green Home Remodel series.

Hotline

Get personalized answers to your natural landscaping questions and order Natural Lawn Care guides by contacting the Natural Lawn & Garden hotline at info@lawnandgardenhotline.org or calling (206) 633-0224.



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This information can be made available on request to accommodate people with disabilities and those who need language assistance.

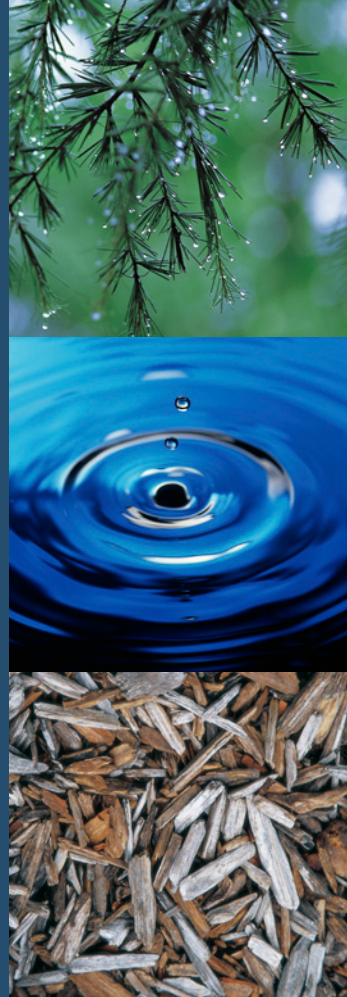




city green building

Seattle Department of Planning & Development

City of Seattle
Department of Planning & Development
700 5th Ave, Suite 2000
P.O. Box 34019
Seattle, WA 98124-4019



The City of Seattle's Green Home Guides cover common remodeling topics, from lighting to roofing, and give helpful hints on materials and strategies to create a home that's healthy, saves money, and is easy on the environment:
www.seattle.gov/dpd/greenbuilding/singlefamilyresidential/resources/remodelingguides

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