MANAGING ROOF RUNOFF FOR LOW-IMPACT DEVELOPMENT

The roof on your house is likely the largest impervious surface on your lot. In addition to the harm stormwater can cause to local waterways, the rainwater that runs off your roof can cause drainage problems around your foundation.

LID techniques for managing roof water can help you prevent drainage problems and reap the benefits of roof water. LID options for roofs include:

- Directing downspouts for maximum infiltration on site
- Rainwater harvest
- Green roofs (also called vegetated roofs or eco-roofs).

Directing Downspouts
An important LID principle is to direct rooftop water so that it is managed on your site as much as possible. Taking an active role in deciding where your downspouts drain can also prevent problems caused by stormwater collecting along the foundation of your house.

Choosing to direct your downspouts for maximum absorption in your yard is one of the easiest LID strategies. Consider these basic principles:

- Don't allow your downspouts to discharge onto your driveway. This will increase the amount of pollution running off your property, and will affect the function of pervious paving systems.
- Wherever possible, tie your downspouts into an on-site stormwater feature such as a rain garden or dry stream.
- If your downspout discharges on a slope, consider installing a planting bed with lots of compost to intercept and absorb as much runoff as possible. You could also plant a sloped biodetention hedgerow.
- To disperse downspout flow into lawns or landscapes, use a splash block or perforated pipe to get the flow at least two feet away from the house foundation and spread it out into "sheet flow" that can infiltrate slowly. Be sure that the flow will disperse and absorb on your property, not rush off onto neighbors or streets and cause problems. If you have drainage problems around your foundation, make sure your downspouts discharge at least 10 feet away from your house, and that your landscape is graded so that water flows away from the house.
- If your downspout drains across your lawn, keep up good natural lawn-care practices by adding compost and aerating annually to make your lawn as pervious as possible.

Rainwater Harvest Options

Rainwater harvesting combines two important LID goals: reduce peak stormwater flows from rooftops, and conserve water that comes from drinking-water supplies.

Rainwater harvesting is nothing new—people have been collecting water from rooftops for centuries, especially in areas with limited water supply. In our region, rooftop water is harvested and used for private residences as well as large commercial buildings.

You might be surprised by how much rainwater collects on your roof. A half-inch of rain falling on a 1,000 square-foot roof generates about 300 gallons of water. When you consider how many inches of rain you receive every rainy season, you quickly recognize that it would take a lot of storage capacity to capture all the rain that hits your roof.

Options for harvesting rainwater include:

- Rain barrels (usually 40 to 80 gallons of capacity) to collect water for outdoor use.
- Cisterns to collect water for outdoor use and non-drinking uses (e.g., flushing toilets).
- Cisterns combined with treatment systems to collect water for all household uses, including drinking. These systems are becoming more widely used in areas that have limited drinking water available, such as on the San

How to Use Rain Barrel Water

Even a few rain barrels can provide water for a lot of outside watering and clean-up jobs.

- You can attach a hose to the barrel's spigot—or just fill watering cans—to water patio containers, trees, and other landscaping plants.
- Never use moss killers or other chemicals on your roof that could contaminate your rain barrel water.
- Rain barrel water is great for cleaning paintbrushes, washing muddy boots, and other messy outdoor clean-up tasks. (Cleaning jobs should be done using a bucket so you can prevent pollution by controlling where the wastewater is disposed.)
- Rain barrel water can be safely used by children playing in sand boxes or wanting to "help" with watering tasks where they might spill and waste potable water.
- Make sure your children know never to drink rain barrel water.
Juan Islands. This guide will not address filtration, but offers information for further investigation in the resources section.

Managing stormwater: Rain barrels and cisterns only help slow stormwater flow if they are empty at the start of a winter storm. You can accomplish this, and still save water in the summer, by attaching a garden hose in winter and opening the valve so that water rushing into the barrel from your gutters is slowly dispersed into your lawn or landscape. In late spring, close the valve to store water for summer.

Once rain barrels and cisterns are full, the roof water needs to be redirected to prevent overflowing. The best option is to use a downspout diverter that returns the water to downspouts when the storage tank is full (see resources). Downspouts should then be directed into a stormwater feature or fully dispersed in the landscape.

Rain barrels: Rain barrels are available in a variety of sizes and are made from a variety of materials, including recycled oak whiskey barrels and recycled plastic storage drums. You can make your own or buy one ready made. Some water utilities sell them at a subsidized price to their customers. Use only barrels that you know were used for food or food-grade materials—never use drums that stored chemicals or petroleum products.

Rain barrels should have a tight-fitting lid to protect children and prevent mosquitoes from breeding, as well as a built-in, easy-to-clean screen on top to filter large debris. Rain barrels are sold in a range of colors. You can paint yours to blend in to your home’s exterior.

Rain barrels are heavy when full, so they need to sit on level, packed earth or gravel, or elevated on leveled concrete blocks. Don’t place them where they would block doorways if they fell over in an earthquake. Some municipalities require them to be strapped to the house for this reason.

Capacity: Given their limited size, rain barrels do not offer the capacity of cisterns. However, you can increase the storage capacity to harvest enough water to meet many summer watering needs, especially if you also use drought-tolerant plants.
- Place rain barrels at each downspout.
- Link two or more rain barrels together to increase the storage at each downspout.
- You can buy ready-made linking kits or make your own (see resources).
- For a house with four downspouts, linking two 75-gallon barrels at each downspout could store 600 gallons of water for summer use.
- The simplest and least expensive step up from a rain barrel to a larger (300–500-gallon) storage capacity may be to buy poly tanks sold by agricultural suppliers. For safety, choose one with a broad base. Provide a perfectly level foundation of cement or packed gravel.

Capturing the roof runoff:
- Position your first rain barrel directly below your downspout, and any linking barrels immediately adjacent to the first.
- Elevate the rain barrels by placing them on stable concrete blocks. This will help with water flow when you harvest your water in the summer.
- Install a downspout diverter into your downspout. Some diverters automatically close when the rain barrel is full so that your roof runoff once again flows to the bottom of the downspout. Others require you to monitor fullness and close the diverter yourself.
- Once the rain barrels are full, the water should flow to the bottom of your downspout and ideally be diverted to an on-site stormwater feature.
- Keep your gutters and downspouts clean to prevent leaves from clogging your downspout diverter.

Cost: Rain barrels range in price depending on whether they’ve been made from discarded barrels or fabricated for the retail market; whether you make your own or buy one already made; and whether your water utility offers barrels at a subsidized price. Expect to pay $20 to $200 (and even more) for a standard barrel with 40 to 80 gallons of capacity. Downspout diverters that automatically close when the rain barrel is full are sold through garden-supply companies for $20 to $30, or you can make a simpler device on your own. Linking systems are sold as kits for $10 to $15, or you can make your own for much less with a few simple supplies from your hardware store.

Cisterns: An investment in a cistern system to collect and store rainwater will take your harvesting options to a whole new level over rain barrels. While the concepts and materials for cistern systems are simple, designing a system for your household’s use can be complex. When planning a cistern system, hire an experienced, well-qualified rainwater-harvest designer or engineer.
Cisterns are made from a variety of materials, including plastic, fiberglass, concrete, metal and wood. Each tank can hold hundreds or even thousands of gallons of water. Most systems rely on several tanks to meet their water needs. Tanks can be above ground or buried. They can be artfully designed to add to your home’s aesthetics or hidden under a deck or by vegetation.

Untreated cistern water can be used for a variety of household tasks, including laundry and toilet flushing, as well as landscape irrigation. Harvesting water for these needs requires installing pumps as part of the overall design.

**Cost:** Cistern systems can be expensive, but can pay for themselves over time with water savings. Costs will vary tremendously depending on system components and design. In new construction, cistern systems can save money by decreasing some stormwater infrastructure costs. In one example, supplying a home with a 10,000-gallon storage capacity for laundry and toilets added about $8,000 to construction costs.

**Green Roofs**

Green roofs are designed to absorb and slow down roof runoff. They have many benefits, including:

- Stormwater reduction
- Aesthetic improvements & habitat value
- Indoor noise reduction
- Heating/cooling cost savings
- Longer-lasting roofs
- Reducing the "urban heat island effect." (Conventional roofs are much hotter than green roofs.)

**Importance of residential roofs:** In cities, many businesses and government agencies are taking the lead on building or retrofitting with green roofs. But residential roof surface area is six to eight times greater than commercial roof surface area in cities. Residential roofs account for even more roof surface area in suburban and rural areas. As more homes convert to green roofs, the benefits of this LID technique will really become evident in our region.

In parts of Europe, green roofs have been common in residential construction for many decades. Green roofs are catching on in the U.S., with many more qualified designers and installers available to direct you. When planning new construction or roof replacement, think green!

**How green roofs work:** There are two types of green roofs: extensive and intensive. Extensive systems are very shallow and much lighter than intensive systems. They are more practical for residential construction or roof replacement, so this guide will only consider extensive systems.

Green roofs are a combination of biology and engineering. The plants and soil absorb and filter stormwater; all the other components manage the water to protect your house.

**Components:** Green roofs are composed of several layers. Starting from the inside working out, they include: [insert diagram]

- Roof deck (often plywood)
- Sub-membrane layer to cushion and protect the membrane
- Waterproof membrane
- Drainage layer to store and manage water
- Soil filter fabric to retain soil
- Special engineered soil mix
- Plant layer

Each of these components must be carefully designed for your individual project. For each component, there may be many choices that an experienced, qualified green-roof designer and installer can discuss with you.

**Weight:** Extensive green roofs are similar in weight to a tile or slate roof. Your home, garage or shed must be able to support a load of 20 to 75 pounds per square foot (in addition to snow load), depending on your choices for the depth of engineered soil mix and plant species. Shallow engineered soil depths will be lighter in weight but support fewer plant species.

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"Green roofs are a way of repaying the earth for taking up a parking space."

--- Patrick Carey, Hady Design

**New Research Shows Green Roof Promise**

While Germany and other European countries have detailed specifications for green roof designs, in the U.S. researchers are still testing different approaches to find the best mix of components for different climates.

For Puget Sound, research led by Magnusson Klemencic Associates during 2005-2007 shows green roofs might be able to manage stormwater flows even better than expected. In their tests, runoff volume was reduced by 65 to 94 percent, and runoff rates were reduced up to 76 percent, even during extreme rainfall.

Their team’s research also found better overall success using:

- Engineered soil mix of 4 to 6 inches maximum depth;
- Succulent groundcover plants, such as stonecrops (Sedum species) and hens & chicks (Sempervivum species); and
- Granular drainage layer, which significantly slowed the water runoff.
Many structures may already be adequately engineered to handle the weight of an extensive green roof. If not, retrofitting remedies such as roof trusses, deeper roof joists, and columns through existing walls might be required. Whether doing new construction or a retrofit, plan early with your contractor if you want to integrate a green roof into your project.

**Roof pitch:** Green roofs can be installed on houses with pitches up to 40 degrees, but pitches ranging from 5 to 20 degrees are more suitable. Steeper roofs will require an additional grid to hold some of the components in place. Results from some studies suggest that flatter roofs retain more stormwater than steeper roofs.

**Longer life:** Green roofs aren't subjected to UV degradation or the usual level of thermal expansion and contraction of the membrane, so they last much longer than conventional roofs—at least 50 years for most designs. When it's time to replace the waterproof membrane, all other components—including plants—can be stockpiled and reapplied, thereby saving substantially on replacement costs.

**Maintenance:** Green roofs require monitoring to inspect system components about twice per year. For instance, drain inlets must be cleared of any debris. The plants will require regular maintenance early on until they are established with at least 90 percent coverage. Weeds must be removed by hand before they go to seed, and weeding must be done with care to prevent soil disruption or loss. Lightweight mineral mulches may be used to discourage weeds initially, but successful plant establishment is the key to maintaining a functioning roof system.

Depending on the plant mix and soil depth, occasional summer irrigation may be required, especially during the first few years of establishment. Choose hardy, drought-tolerant species able to survive in difficult conditions such as harsh winds, drought, full sun and limited soil to help you avoid more fussy plant care. The toughest choices are specific species of stonecrop (Sedum) and hens & chicks (Sempervivum).

**Costs:** Depending on the system, all components of extensive green roofs usually range in cost from $17.50 to $22 per square foot installed (2007 figures). In new construction, green roof systems often aren't substantially more expensive than high-quality conventional roofing, including metal roofs. When considering long-term costs and benefits, green roofs may be less expensive because of their durability. They will also save substantially on energy bills, and add other value to your home, as well.

**Choosing a consultant:** Before working with a green-roof designer, you will need to hire a licensed structural engineer and/or an architect to make sure your building is designed to support a green roof.

Once you get the green light to proceed, search for an experienced, qualified green-roof design and installation firm. Depending on the availability of consultants in your area, you may want to first hire an experienced designer who can then help you find a qualified installer.

- Ask how many green roofs the firm has designed and installed. Find out the specific role your contact served in designing or installing a green roof.
- Ask which components and services are included in the price.
- Ask for references and documentation of past projects—and follow up to check on their success.
- Ask what professional credentials team members have, especially their experience with residential roofs. You'll want your team members have qualifications in the full range of specialties, including waterproof membranes, all green-roof components, engineered soil mix, appropriate plant species, and irrigation. Currently, Green Roofs for Healthy Cities is working to certify green-roof installers and designers (see www.greenroofs.org “find a member” to see which courses your consultant has taken).
- Be sure that your installer is licensed by the manufacturer to apply the chosen waterproof membrane on a residential roof, and that the manufacturer will provide a written warranty for your roof once installed.

The more knowledge you have when you interview potential contractors, the better you'll be able to find the best firm for your project.

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Get Smart About Roofs

Educate yourself so you can make the best decisions for your green roof.

Begin by exploring websites:
- www.greenroofs.com
- www.greenroofs.org
- www.ecobuilding.org
- www.greenroofs.ca
- www.ecoroofseverywhere.org
- www.hadj.net

To boost your knowledge, consider taking a workshop listed on one of these sites or offered in your region by a consultant or local agency.