Managing Rainwater

A Homeowners Improvement Guide for Low Impact Development (LID) in Bothell

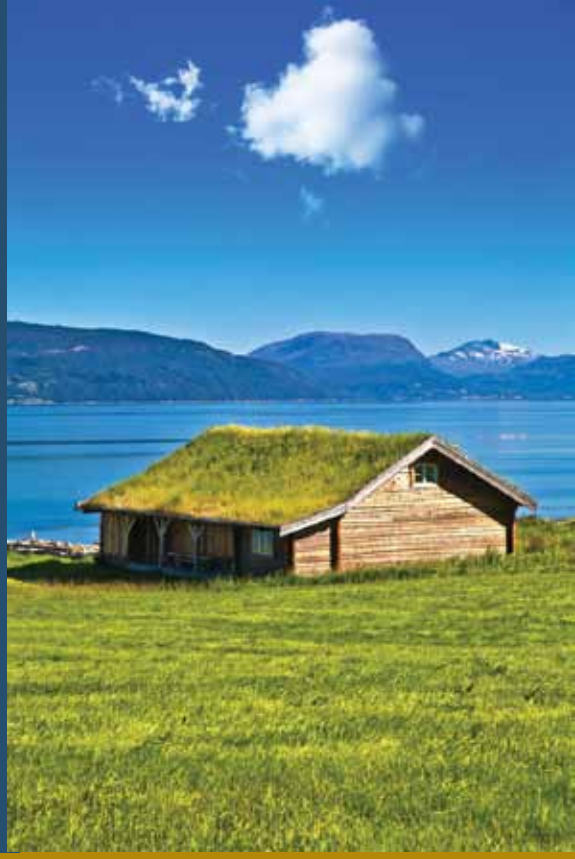
What is LID?
Why is LID important?
What are the Benefits?
What Should I Consider Before Deciding?

Rain Gardens
Green Roofs
Resources
Cisterns

Disconnecting Downspouts
Planting/Saving Trees
Permeable Paving
Improving Soil

What is LID?

It's an approach that helps your home look and work better for you and your neighborhood. Low Impact Development manages the rainwater that falls on your property by allowing some to evaporate back into the air, some to absorb into the ground, some to be captured and used later as needed, and the rest to slowly pass into the stormwater system and back into nearby streams. Many of these techniques also add value to your home though energy and efficiency cost savings, curb appeal, and general perception.



Why is LID Important?

Protecting Your Property

When it rains, water falls on hard surfaces like roads, roofs, and driveways and flows quickly into ditches and storm drains where it is deposited into the nearest lake, stream, or wetland. This rush of water can back up, flooding homes and property and causing erosion of hillsides and local streams.

Protecting Our Water

The water also picks up pollutants found on these hard surfaces from our daily activities (gasoline, motor oil, heavy metals, fertilizers, pesticides, chemical compounds, pet waste, etc.) and deposits them into the nearest lake, stream, or wetland making the water unsafe for us, our children, and the environment.

Because this pollution is caused by each one of us in our daily activities it is called non-point source pollution. Stormwater is the largest contributor of pollution to our local, regional, and national waterways and is listed as the major reason why Puget Sound is in trouble.

Low impact development techniques capture the water before it leaves your property, slows it down, and allows it to absorb into your soil where plants, materials, and tiny organisms filter and clean the water and allow it to recharge our groundwater systems.

What are the Benefits for Me?

When designed and installed properly, LID can benefit your home and neighborhood in a variety of ways.

Property Value

Several techniques beautify your home and property adding value and curb appeal. Many properties that are sold as "green homes" are sought after by homebuyers in the region for their efficiency and aesthetic value.

Saves Money

Many LID techniques are less expensive than installing standard pipes, storm drains, vaults and past conventional systems. A few techniques are more expensive for installation but provide efficiency benefits over time. The amount of excess water and pollution removed before it reaches the stream saves on tax dollars for increased infrastructure needs and pollution removal.

Reduce Flooding

Localized property flooding is often caused by clogged, slow moving, or inadequate drainage. LID techniques slow the water down and allow it to absorb into the soil over time. This also helps to protect our local streams from excessive water flow which can cause major flooding and erosion downstream.

Improve Water Quality

Non-point rain water pollution is caused by each of us and our daily activities. This means that each of us have the power to make a real difference. By adopting a few techniques on your property, you can join thousands of others in reducing your individual impacts.

Helps Protect Against and Remove Erosion

Erosion causes huge problems for property owners and the environment. Many people have lost their homes, lawns, outbuildings, and property value due to eroded soils. Erosion also causes major stream damage by suffocating fish beds and the small organisms that the fish need to survive.

Helps Recharge Local Groundwater Supplies

Many drainage problems on private property are caused by a lack of previously existing groundwater. When water is carried into a pipe and away from property, it can cause large pockets underground from the lack of previously existing water. This can cause sink holes, loss of well water for neighbors, foundation instability, and causes our streams to experience high volumes of water when it's not wanted, but not enough in the summer when it's desperately needed.

What Should I Consider Before Making a Decision?

Size of Project

The size and intent of your project will affect the cost, permitting process, amount of time, and design considerations. This guide is meant to help homeowners learn how to better manage the rain that falls on their property, whether they're making voluntary changes to improve their property conditions that don't require a permit or doing a small home or landscape remodel that requires drainage review.

Requirements

This guide provides a general overview of improving soil, planting trees, selecting and installing permeable paving, installing a green roof, and redirecting roof runoff to cisterns or rain gardens. Each technique page will mention if you are required to show plans or apply for a permit for a voluntary remodel.

For larger projects that are triggering required consideration of LID, this guide can provide some initial information and resources. For specific requirements, please refer to our Construction Design Standards which includes our Stormwater Design Manual located on our City website: http://www.ci.bothell.wa.us/Site/Content/Public%20Works/Bothell%20Standards/ Standards_ ALLSECTIONS_03-31-12.pdf

Decide What You Want

Be sure to assess your wants, needs, and constraints before designing details. It is important to rank your priorities and consider options that work with your existing landscape and features to save on costs. Be sure to include the cost of efficiency over time, maintenance, and conservation in your budget so you can assess the true value of each technique before choosing what will work best for you. 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. Environmental, social, and health costs are not listed in the price tag, so be sure to consider these factors when receiving quotes.

Buyer Beware

Often a lower purchase price can be due to a lack of quality, durability, or an increase in maintenance so be sure to do your homework. Identifying all the materials and products you want to use down to the specific brands will help you determine total cost and avoid expensive last minute decisions.

Also, be sure any installer pays close attention to local building codes to save yourself the hassle and expense of having to tear something out or relocate something out of a fire setback.

.

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

For information on native tree planting techniques and programs please visit our website, www.ci.bothell.wa.us and search "planting trees".

Permit Requirements

No permit is needed for this type of landscaping provided you are on your property and not located in the right-of-way. For plants in the right-of-way, please review Bothell Municipal Code 12.18.060

http://www.codepublishing.com/wa/bothell/ for rules and regulations regarding species, trimming, sidewalk access, garbage collection setbacks, and vehicle visibility. Please contact a City Planner (425) 486-2768 with any further questions regarding trees in the right-of-way.

"Northwest natives are often a good choice because they have few pest problems and provide habitat for native birds and wildlife..."

Permits

A Permit is only required if you are moving over 50 cubic yards of dirt or working in a critical area (area directly surrounding a lake, stream, or wetland). Please make an appointment with a City Civil Engineer at 425-486-2768 with any questions regarding the need for a permit.

Improving Soil with Compost & Mulch

Amending your soil with compost and mulch is a simple improvement that helps absorb rainwater and enhances your existing soil conditions. Attractive and healthy lawns and gardens require soil rich in life and nutrients. This technique makes plants healthier and saves you money by reducing irrigation and the need for expensive fertilizers and pesticides. Compost and mulch added to your soil feed the beneficial organisms that create structure and spaces within your soil so that rainwater can easily soak into the ground. These soil organisms also break down pollutants, and help move carbon dioxide from the atmosphere into long-term storage in your soil.

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.
- 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 http://your.kingcounty.gov/solidwaste/naturalyardcare/index.asp.

Compost & 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
Other Materials		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
		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)
	MULCH CHOICE		**BENEFITS**	**DRAWBACKS**
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
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.		Composted yard debris, bark, barnyard manure or biosolids	neat appearance	compost does not suppress weeds bark is low in nutrients
		Leaves and grass clippings	leaves and grass clippings are free	may spread weed seeds

Permit

The water during heavy rain events must flow back into our storm system so you may need to apply for a storm-water connection permit, right-of-way permit, or grading permit depending on your situation. Please make an appointment with a City Civil Engineer 425-486-2768 to discuss any permit related questions or concerns before beginning your project.

Disconnecting Downspouts

During a one-inch rain event, a 1,000 square foot roof receives 625 gallons of water. Diverting some of this water to a cistern, rain garden, or permeable pavement can slow these flows, reduce erosion, and minimize water pollution from your property.

Some areas of Bothell do not allow residents to disconnect their downspouts due to erosion, landslides, and poor soil conditions. If you live in Bothell south of the Sammamish River, please consult with a City Civil Engineer at 425-486-2768 before deciding to disconnect your downspouts. Also, the City requires you to connect back into our storm system to protect you and your neighbors during major flooding events. This means any technique must allow heavy flows to tie back into the stormwater system.

Getting Started

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

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.

Completing your research before you start, and making informed decisions can save a lot of hassle in the future. Please make an appointment with a City Civil Engineer 425-486-2768 to discuss any questions or concerns before beginning your project.

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**	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. Tip: For a more eco-friendly solution, go with a splashblock made from recycled concrete or post-consumer plastic.	low cost disperse runoff reduce scour prevent landscape erosion	limited varieties and designs available on the market
Rain gardens 	**Infiltration**	Described further on page 8 A shallow depression with a designed soil mix and native plants captures runoff and allows it to soak into the ground.	low long-term maintenance absorb and infiltrate more water than the same size area of lawn attractive and interesting landscape features	require regular maintenance
Permeable paving 	**Infiltration**	Described further on page 10 Permeable pavement, constructed as a **facility**, can accept rooftop runoff and soak it into the soil.	reusable, can be reconfigured extremely durable can serve as a patio, walkway, or driveway	can have high initial cost most manufacturers require professional installation
Cisterns 	**Capture/ detention**	Described further on page 12 Designed to catch roof runoff, cisterns are big rain barrels that hold hundreds of gallons of water.	low cost (rain barrels) reduce use of potable water for irrigation reduce runoff volume and delay peak flow	high initial cost (cisterns) can be expensive and time consuming to construct require regular maintenance
Conveyance furrows 	**Conveyance**	Conveyance furrows offer a more flexible option than piping. These shallow depressions can convey runoff away from buildings to a better discharge location such as a rain garden. Furrows can be vegetated or rock-lined, depending on aesthetic preference and the slope of the site. Deeper rock trenches can hold and infiltrate water.	low cost layout can be flexible does not require extensive disturbance of yard or lawn slow runoff and provide more benefits than piped conveyance options	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 hard surfaces 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.

Consult the WSU Rain Garden Handbook http://county.wsu.edu/mason/nrs/water/Documents/Raingarden_handbook.pdf with step-by-step instructions for design, placement, and construction details. Please be sure to call before you dig to ensure no utilities are located in your digging area (toll free 1-800-424-5555). Please call and make an appointment with a City Civil Engineer to discuss questions on plans, permits, and City regulations regarding rain gardens.

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.

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. Here are some plant examples well suited to rain gardens:

Native Plants for Rain Gardens in the Sun

Coastal Strawberry, Frageria chiloensis

Common Camas, Camassia quamash

Dense Sedge, Carex densa

Douglas Aster, Aster subspicatus

Northwest Cinquefoil, Potentilla gracilis

Oregon Iris, Iris tenax

Slough Sedge, Carex obnupto

Tufted Hair-grass, Deschampsia cespitosa

Western Columbine, Aquilegia formosa

Yarrow, Achillea millefolium

Native Plants for Rain Gardens in the Shade

Coastal Strawberry, Frageria chiloensis

Creeping Oregon Grape, Mahonia nervosa

Dagger-leaved Rush, Juncus ensifolius

Deer Fern, Blechnum spicant

False Solomon's Seal, Smilacina racemosa

Fringecup, Tellima grandiflora

Large-leaved Avens, Geum macrophyllum

Piggyback Plant, Tolmiea menziesii

Salal, Gaultheria shallon

Stream Violet, Viola glabella

Sword Fern, Polystichum munitum

Wood Sorrel, Oxalis oregano

Western Bleeding Heart, Dicentra Formosa

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 investment for many years to come.

Permit

A permit is required if you are moving over 50 cubic yards of soil or are connecting back to the stormwater system. Please make an appointment with a City Civil Engineer to discuss plans, permits, or other questions related to installing a rain garden.

Permit

A right-of-way permit is required to ensure your driveway adequately connects to the street. A grading permit may also be required, so it's best to make an appointment and submit plans to a City Civil Engineer 425-486-2768 for proper drainage and grading review.

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 avoids 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 local permeable paving experience for big projects to advise you, design and complete the work.

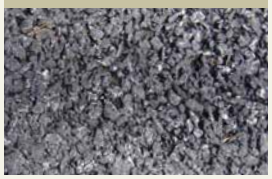
Maintenance

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.

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.	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	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").	works well on level sites for occasional parking areas or low-use walkways an eco-friendly option -often made with 100% recycled plastic	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.	even surface good for wheelchair accessibility accommodates relatively high traffic volumes long-lasting if installed correctly	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.	works well with pedestrian-only areas and for low-volume, low-speed areas such as overflow parking even surface good for wheelchair accessibility	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.	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	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

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.

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 irrgation 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. It also must have an overflow which ties back into the stormwater system. 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. New designs also allow these types of cisterns to be placed under porches, decks, and within crawl spaces to reduce issues with land use, property setbacks, etc.

Permits

Smaller cisterns and rain barrels do not require permits, but larger cisterns may require land use or building permits depending on their size and location. Please make an appointment with a City Civil Engineer to discuss any questions and determine whether a permit is required.

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

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, 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 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.

Permits

All green roof installations require approval from a licensed structural engineer to prove your roof can handle the additional load. An appointment should be made with a City Plans Examiner 425-486-2768 to review the engineering report and approve your design plans.

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 our City Website www.ci.bothell.wa.us for information on codes, permits, contact information, tools, and additional resources. For permitting, contact our City Civil Engineers at 425-486-2768 or visit our website for an additional contact list and design and construction standards: http://www.ci.bothell.wa.us/CityServices/PublicWorks/BothellStandards.ashx?p=1770*

- *Review Natural Yard Care information on soils, plants, fertilizers, pesticides, best maintenance practices, etc. on the King County documents page: http://your.kingcounty.gov/solidwaste/naturalyardcare/documents.asp*

- *Find home improvment ideas and technical information in the "Low Impact Development Technical Guidance Manual for Puget Sound" at www.psp.wa.gov*

Hotline

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

Special thanks goes to the City of Seattle Department of Planning and Green Building Program for allowing us to utilize portions of their guide.