Additional Resources

Living Roofs
Bellingham Green Roofs
www.bellinghamgreenroofs.com
Portland’s Ecoroof Program
www.portlandonline.com/ecoroof
Green Roofs
www.greenroofs.com
Green Roofs for Healthy Cities
www.greenroofs.org

Pervious Pavement
National Ready Mixed Concrete Association (NRMCA)
www.nrmca.org
Asphalt Pavement Alliance
www.pavegreen.com
Pervious Concrete Pavement
www.perviouspavement.org

Rain Gardens
Puget Sound Rain Gardens
www.raingarden.wsu.edu
Rain Garden Network
www.raingardenetwork.com
12,000 Rain Gardens in Puget Sound
www.12000raingardens.org
Rain Garden Handbook for Western WA Homeowners
county.wsu.edu/mason/nrs/water/Documents/Raingarden_handbook.pdf

Rainwater Reuse
American Rainwater Catchment Systems Association
www.arcsa.org
Harvest H2O
www.harvesth2o.com
Rainwater Collection in Washington State
www.ecy.wa.gov/programs/wr/hq/rwh.html

City of Bellingham
www.cob.org/environment
Planning (360)778-8300  Public Works (360)778-7900

Building Green in Bellingham

A Case Study of Low Impact Development Strategies at the Lightcatcher Building

Living Roof . Rain Gardens . Pervious Pavement . Rainwater Reuse
Low Impact Development (LID)

Low Impact Development (LID) is a way of managing stormwater by mimicking natural processes and allowing rainwater to soak in. This reduces runoff and filters pollutants. A variety of LID strategies were incorporated into the design at the Lightcatcher Building, including a living roof, rain gardens, pervious pavement and rainwater reuse.

Design, Installation, & Maintenance

Costs
In some cases, LID techniques may result in higher implementation costs due to expensive plant materials, additional site preparations, soil amendments, construction of underdrains, increased project management costs and potential additional maintenance requirements.

Benefits
Case studies show that LID techniques can result in reduced costs for site grading, paving and preparation, and may eliminate the need for extensive stormwater infrastructure such as underground storage tanks. Considering the cost over the total lifespan of the project, including ongoing maintenance, total capital cost savings for the Lightcatcher Building ranged from 15-18%.

Monitoring the Effectiveness of the Living Roof:

City of Bellingham staff collected data to evaluate the effectiveness of this Low Impact Development (LID) technique compared with conventional development techniques. Staff looked at water quality, water runoff temperatures, and air temperature.

Water Quality, Water Temperature and Air Temperature

Results of the study show that the living roof reduces runoff from the roof of the Lightcatcher Building when compared to a conventional roof. The data also show that the air temperature is slightly cooler over the living roof during the winter and early spring months. The runoff water temperatures were not significantly different during the period of this study.

Vegetation

The living roof on the Lightcatcher Building consists of pre-vegetated modules and an area where six inches of soil was planted on site. Both styles were equally successful. Plants survived throughout the dry summer season without additional water. Minimal weeding occurs twice a year. The plants used are very well suited to the western Washington climate.

Costs
In some cases, LID techniques may result in higher implementation costs due to expensive plant materials, additional site preparations, soil amendments, construction of underdrains, increased project management costs and potential additional maintenance requirements.
### RAINWATER REUSE

**Rainwater reuse** is also called rainwater catchment, rainwater harvesting, and rainwater collection. Rainwater can be collected from rooftops and stored in rain barrels or cisterns for reuse on lawns and landscapes, and for flushing toilets.

#### Benefits

**Conserves Drinking Water, Saves Money & Energy**
It costs money and takes both water and energy to produce safe drinking water. Instead of flushing treated drinking water down the toilet, collected rainwater can be used. During dry, summer months, water consumption in Bellingham often doubles due to outdoor watering. Using collected rainwater for irrigation reduces the strain on the city's water supply.

**Provides Natural Water for Plants**
Rainwater is naturally “soft” and free of minerals and chemicals, making it ideal for plants and lawns.

**Prevents Stormwater Runoff**
Capturing rainwater prevents it from becoming stormwater that can wash pollutants off roadways and other hard surfaces and carry them to our creeks, lakes, Bellingham Bay and Puget Sound.

#### Types

**Active Systems (Rain Barrels & Cisterns)**
Active rainwater catchment systems use equipment to collect, filter, store, and deliver harvested water, extending the time period when this water can be used both outdoors and indoors. Collection systems can range from 55-gallon rain barrels to meet outdoor watering needs to 10,000-gallon or larger tanks to meet domestic and landscape water needs. Systems can be installed above ground where water is delivered via gravity flow, or below ground where water is delivered via an electric pump.

**Passive Systems**
Passive rainwater catchment systems use land shaping to direct, collect, and infiltrate rainwater directly into the soil. Passive systems reduce stormwater runoff and support plant growth. Examples include rain gardens and pervious pavements.

### LIVING ROOFS

**Living roofs** are also called green roofs, vegetated roofs or ecoroofs. Plants, soil, a drainage layer and a waterproof membrane can be installed on roofs that are engineered to hold the extra weight. The plants chosen are adapted to the climate of each individual roof, including sun, wind, and rainfall patterns.

#### Benefits

**Absorbs Rainwater to Decrease Runoff**
Stormwater runoff carries pollutants from our streets, yards and parking lots down through storm drains and into Bellingham Bay. Living roofs absorb rainwater, preventing it from becoming stormwater.

**Provides Insulation & Energy Savings**
Plants and soils insulate the building, decreasing the need to heat and cool the building. This lowers energy costs and reduces the building’s carbon footprint.

**Creates Habitat & Green Space**
Living roofs increase habitat for birds and insects and provide green space for people in urban environments.

**Lowers Urban Temperatures & Filters Air**
In urban areas, roofs, streets and other unvegetated areas absorb heat. This increases temperature creating an urban heat island. Heat islands can increase rain and growing seasons, and decrease air and water quality. Plants cool urban heat islands, absorb carbon dioxide and filter pollution out of the air.

#### Types

**Intensive vegetated roofs** have deep soil (6 inches or more) and are often planted with ground cover, shrubs, and trees.

**Extensive vegetated roofs** have shallow soil (1 to 5 inches) and shorter, ground cover plants.
Rain Gardens

Rain gardens, also called bioinfiltration or bioretention facilities, are shallow depressions landscaped with plants. They act like native forests by collecting and absorbing stormwater runoff and removing pollutants. Well-designed rain gardens can be used as an alternative to detention ponds, the conventional facility used to manage stormwater runoff.

Benefits

Filters Pollutants
As water soaks through the ground, the plants, microbes and soils remove or retain pollutants like oil and grease from pavement, and pesticides and fertilizers from landscaping.

Recharges Groundwater
When water is collected and allowed to soak into the ground, it recharges local groundwater supplies.

Provides Habitat & Green Space
Rain gardens provide habitat for beneficial insects and birds and provide green space for people in urban environments.

Reduces Flooding and Erosion
The soils and plants in rain gardens mimic natural conditions by holding water, allowing it to infiltrate, and slowly releasing it. The slow release of water reduces flooding and erosion in streams.

Types

Bioretention Cells & Swales
These facilities are engineered to collect and treat stormwater. They are designed with certain soils and plants adapted to the local area. Their size and depth are calculated based on the amount of water that comes in, the types of soils on the site and the pollutants they are treating. They may have an under-drain. Cells are designed to infiltrate water only, while swales have gentle side slopes and flow depths and are designed to convey water.

Bioretention Areas
These are depressions with native soils where water naturally flows and collects, and some infiltrates. They are not engineered as treatment facilities. These work well on a small scale with good soils.

Pervious Pavement

Pervious pavement, also called porous or permeable, can support traffic loads while allowing water to drain through it to the drain rock and soils below.

Benefits

Absorbs Rainwater to Decrease Runoff
Roadways and other impervious surfaces are the primary source of pollutants that are found in our creeks, lakes and Puget Sound. Pervious pavement absorbs rainwater, preventing it from becoming stormwater.

Withstands Weathering
Snow melts off faster, and rain dries faster on pervious pavements. They also have a greater resistance to cracking from freezes and thaws.

Recharges Groundwater
Water filters through the pervious pavement, infiltrating into the ground below, where it recharges local groundwater supplies.

Types

There are many options for pervious pavements including porous concrete, porous asphalt and pavers filled with gravel or plants.