LID Plant Guidance

Highland (Alpine) Climate

Low Impact Development (LID) aims to reduce the impact of human development on a site's hydrologic system. Strategies used include infiltration and evapotranspiration which work to slow runoff in order to prevent flooding and use native vegetation to reduce urban pollutants. In wet regions, LID is used to limit how much water goes into large, conventional end-of-pipe stormwater infrastructure, while in dry regions, LID can store water aiding in overall water savings.

LID designs can natural resource area conservation, incorporate reduction of the development envelope, and minimization of impervious surfaces. LID Best Management Practices (BMP) are landscape and infrastructure controls for stormwater management. The selection of drought tolerant, native plantings is critical to enhance BMP functions and efficiencies. Because LID BMPs are designed to accommodate rain events, the vegetation used in LID systems needs to be adapted to both dry periods and flooding. To perform effectively, LID BMPs must be planned and maintained properly to provide pollutant removal and protection of predevelopment hydrological functions. This factsheet can be used by engineers, landscape architects, planners, landscapers, and developers in selecting appropriate vegetation in the development and implementation of LID BMPs for individual climatic regions.

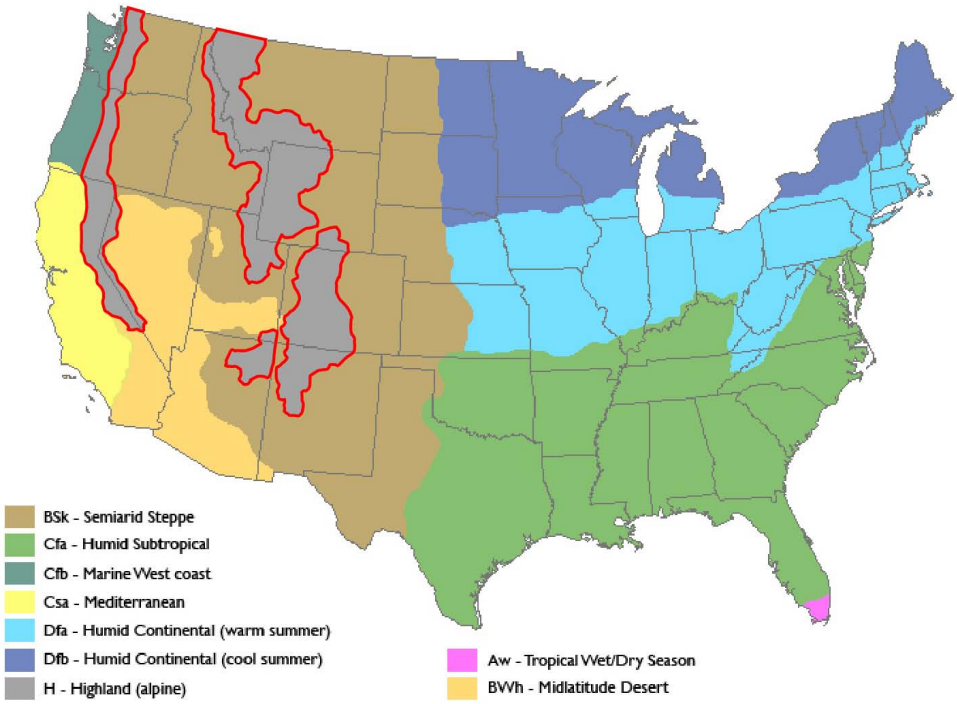
Key Concepts

- Cost-effective
- Easy to maintain
- Aesthetic
- Maintain runoff near site
- Pollution removal
- Species management
- Noise and dust abatement
- Reduce heat islands

Highland (Alpine) Climate

The Köppen Climate system divides the United States into nine zones. Highland zone encompasses areas of high elevation (from 6,000 to over 10,000 feet), also known as "Mountain" climate. Highland is characterized by high amounts of wind, snow, and ice. Temperatures tend to remain below freezing from October until May, and the summer highs are no greater than 50 or 60 °F. This zone is arid, especially in winter. At higher elevations, the climate no longer sustains tree cover and the mountain landscape consists of rock and snow, with serpentine soils where only grasses and other smaller groundcovers can persist.

Vegetation used for LID BMPs must adapt to the Highland climate's dry conditions, limited amount of CO_2, and abrupt changes in temperature. Most plants that thrive here are low groundcovers or shrubs that can survive in shallow soils. Plants in this zone are typically well adapted to wet or dry conditions, with some grasses, select groundcovers, and several shrubs able to thrive in both dry and moist conditions.



Army Low Impact Development Technical User Guide. Washington, DC: U.S. Army Corps of Engineers, 4 January 2013.

US EPA. "Managing Wet Weather with Green Infrastructure." 2008.

LID BMPs

According to the Army Low Impact Development Technical User Guide (2013), there are seven primary types of structural LID BMPs. Of those seven types, there are three that require extensive planting to function properly: bioretention, vegetated swales, and vegetated filter strips. Selecting the right vegetation for the BMP ensures overall plant success as well as maximizing the benefits gained from the LID system.

Bioretention

- ✓ *Holds stormwater to prevent flooding*
- ✓ *Allows water to infiltrate soil/ underdrain*
- ✓ *Filters out pollutants and sediments*

Courtesy of Bremington, Washington

Bioretention collects and holds stormwater runoff in flat-bottomed, shallow depressions or basins. The basins are vegetated and designed to filter pollutants as stormwater infiltrates into the soil or underlying drain.
Bioretention cells are designed for water infiltration, filtration, or a combination of both. Cells make use of the physical properties of water, soils, and vegetation to reduce or remove pollution from stormwater runoff (U.S. Army Corps of Engineers 2013, 2-26).
Since bioretention areas have flat bottoms, most of the plants used need to tolerate heavy saturation for the times when it is at full capacity. In this climate, saturated conditions are rare, however during snowmelt (typically from April to July), and during autumn storms, plants will need to tolerate wet conditions. It is important to capture and treat runoff from impervious surfaces before allowing discharge into natural water bodies. Use of bioretention cells are ideal for reducing pollutant loads in this climate.

Vegetated Swales

- ✓ *Allows water to infiltrate soil/ underdrain*
- ✓ *Filters out pollutants and sediments*
- ✓ *Slows runoff*

Courtesy of Kitsap County, Washington

Vegetated swales are broad, shallow channels that direct stormwater surface runoff to a waterbody or stormwater system. Swales are densely planted with grasses, shrubs, and trees to slow and filter stormwater and snowmelt while enabling transpiration and infiltration. There are three types of vegetated swales: grass, wet, and bio-swales (USACE 2013, 2-30).
Aggregate can be added below the surface for increased infiltration. On slopes and where soils are loose and rocky, deep-rooting vegetation will help prevent erosion and stabilize slopes. Plants must handle peak flood conditions from rainfall as well as prolongued flow from snowmelt.

Vegetated Filter Strips

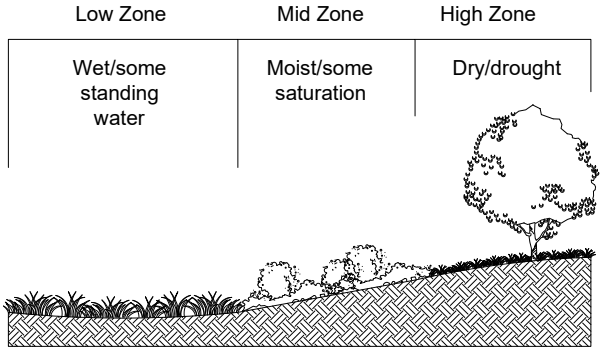
- ✓ *Filters out pollutants and sediments*
- ✓ *Slows runoff*

Courtesy of Aspen, Colorado

Vegetated filter strips are heavily planted, narrow depressions that collect sheet flow runoff from adjacent impervious areas. Vegetated filter strips can connect to other LID BMPs, vegetated areas, or receiving waterbodies as well as treating runoff from isolated impervious areas such as roofs and parking lots (USACE 2013, 2-33).
Vegetated filter strips should be designed to maintain adequate water transport volume and reduction of velocity to mitigate periods of fast and high flow. Vegetated filter strips are not meant to hold water for long, so they will require plants that can endure cold, dry periods.

LID Planting Considerations

Because LID BMPs are strategically designed to slow and infiltrate runoff, plants selected must be able to accommodate periodic flooding as well as prolonged dry conditions. Selecting low maintenance, native vegetation ensures that a LID will work within the Highland climate, be more efficient, and use less resources. Shrubs, grasses, perennials, and groundcovers should be used strategically to stabilize slopes, slow and absorb runoff, and filter pollutant loads. It is important to ensure that plant choice and installation timing consider plant growth rates and establishment periods, since vegetation in Highland areas is typically slow growing and exposed to a short growing season. Understanding how LID vegetation functions is important to the effectiveness of the stormwater system. Depressions of LID areas can be divided into three general moisture zones: low, middle, and high. The lowest sections collect and hold water for the longest amount of time. Vegetation in low zones must be able to accommodate prolonged saturation as well as dry conditions that arise during periods of below-freezing temperatures. The mid zone plantings should provide slope stabilization and be able to withstand potentially high runoff volumes. Plants selected for the highest zone of a Highland BMP require less tolerance to extreme wet conditions, but must be able to survive with limited water during dry periods.



References / More Information

US Department of Agriculture. *Plants Database*. http://www.plants.usda.gov

ISC-Audubon. *Köppen Climate Classification*. http://www.thesustainabilitycouncil.org/alpine-biome.html

Strahler, Arthur N., Strahler, Arthur H., Elements of Physical Geography. John Wiley & Sons, 1984. http://www.blueplanetbiomes.org/climate.htm

Irene Shonle, Ph.D., Colorado State University Extention. *Native Plant Reference List.* http://www.ext.colostate.edu/mg/gardennotes/582.html

Washington State Department of Ecology. E*astern Washington Low Impact Development Guidance Manual.* http://www.wastormwatercenter.org/ew-lid-guidance-manual

Special Considerations for the Highland Zone

Bioretention LIDs are especially important in this climate to retain heavy runoff from melting snow, in addition to rain events, in order to prevent downstream flooding and pollutant loading. The selected vegetation must also handle high velocity water flows. Because road salting during winter months is common, selecting plants for saline tolerance is another priority in the Highland zone. Vegetation in bioretention and swales located nearest roads and parking lots that are heavily salted should be salt-tolerant. Native and fire-resistant plants may be required by municipalities in order to lessen fire risk, especially in suburban and rural areas. Elevation must be considered for plants in this zone. Below are some suggested vegetation species applicable for the Highland climate zone. Proposed LID designs include but are not limited to suggested plant species shown below. Proposed LID plantings and planting locations shall be in accordance with applicable AT/FP (Anti-terrorism/Force Protection) guidelines and UFC 4-010-01 DoD Minimum Antiterrorism Standards for Buildings.

LID Plant Suggestions	Form	Height	Width	High Zone	Mid Zone	Low Zone	Sun	Part Sun	Shade	Hardiness	Notes / Maintenance
Arizona Fescue *Festuca arizonica*	Grass	1-2'	1'	X			X	X		3-9	Does not tolerate foot traffic (6,000-10,000 ft)
Indian Rice Grass *Oryzopsis hymenoides*	Grass	1-2'	1'	X	X		X			4-9	Drought tolerant, tolerates gravelly soils (3,000-10,000 ft)
June Grass Koeleria macrantha	Grass	1-2'	1'	X	X		X	X		3-9	Drought tolerant, does will in rocky soils, does not tolerate extended periods of moisture (4,000-11,000 ft)
Bear Grass *Xerophyllum tenax*	Grass	4'	2-3'		X		X	X		5-9	Drought tolerant, good for soil stabilization (6,000-10,000 ft)
LID Plant Suggestions	**Form**	**Height**	**Width**	**High Zone**	**Mid Zone**	**Low Zone**	**Sun**	**Part Sun**	**Shade**	**Hardiness**	**Notes / Maintenance**
Prairie Sagewort *Artemisia frigida*	Groundcover	1-2'	2'	X			X			3-10	Spreading, good slope stabilizer, may choke out other plants if not cut back (3,000-8,000 ft)
Moss Campion *Silene acaulis*	Groundcover	0.5'	1'	X	X		X			2-9	Spreading, does well in rocky soils (6,000-12,000 ft)
Pygmy Bitterroot *Lewisia pygmaea*	Groundcover	0.5'	0.5'		X	X	X			5-7	Does well in gravelly soils (4,000-11,000 ft)
Small-leaf Pussytoes *Antennaria parvifolia*	Groundcover	0.5'	1'			X	X	X		4-7	(4,000-11,000 ft)

LID Plant Suggestions	Form	Height	Width	High Zone	Mid Zone	Low Zone	Sun	Part Sun	Shade	Hardiness	Notes / Maintenance
Heartleaf Arnica *Arnica cordifolia*	Forb	1-2'	1'	X	X					4-9	Self-seeding, requires watering during dry periods (5,000-11,000 ft)
Sulphur Flower *Eriogonum umbellatum*	Forb	1-3'	1-2'	X			X	X		4-9	Does well in gravelly soils, good slope stabilizer, drought tolerant (6,000-10,000 ft)
Alpine Phacelia *Phacelia sericea*	Forb	1-2'	1-2'	X			X			5-10	Tolerates rocky soils (6,000-11,000 ft)
Nodding Onion *Allium cernuum*	Forb	1'	0.5'	X	X		X	X		3-9	Drought tolerant (5,000-10,000 ft)
Harebell *Campanula rotundifolia*	Forb	1'	< 1'	X	X		X	X		5-9	Short-lived, self-seeding (3,000-10,000 ft)
Prairie Smoke *Geum triflorum*	Forb	1.5'	1'	X	X		X			3-7	Drought tolerant (up to 6,000 ft)
Rocky Mountain Penstemon *Penstemon strictus*	Forb	2-3'	2'	X	X		X	X		3-8	Other varieties of penstemon may have similar characteristics (6,000-10,000 ft)
Scarlet Gilia *Ipomopsis aggregata*	Forb	1'	< 1'		X		X			5-8	Grows taller at lower elevations, short-lived (3,000-8,000 ft)
Blue columbine *Aquilegia caerulea*	Forb	1-3'	1-3'		X			X		3-9	Requires some watering during dry periods (3,000-9,000 ft)
Whipple's Penstemon *Penstemon whippleanus*	Forb	1-3'	1'		X	X	X	X		4-8	Other varieties of penstemon may have similar characteristics (5,000-9,000 ft)
Windflower *Anemone multifida*	Forb	2'	1'		X	X	X	X		2-6	Self-seeding, may need to be thinned every 3-4 years (2,000-8,000 ft)
Pearly Everlasting *Anaphalis margaritacea*	Forb	1-3'	1-2'		X	X	X	X		3-8	Tolerates sandy or gravelly soils, can spread in good conditions, cut back if too much spreading occurs (2,000-9,000 ft)
Golden Columbine *Aquilegia chrysantha*	Forb	1-3'	1-3'		X	X	X	X		3-8	Requires some watering during dry periods (3,000-11,000 ft)
LID Plant Suggestions	**Form**	**Height**	**Width**	**High Zone**	**Mid Zone**	**Low Zone**	**Sun**	**Part Sun**	**Shade**	**Hardiness**	**Notes / Maintenance**
Black Hills Spruce *Picea glauca 'Densata'*	Tree	25-50'	15-25'		X	X	X	X		2-8	Native to the Black Hills; if this cultivar is not available, some white spruces have similar native ranges and characteristics (6,000-8,000 ft)
Quaking Aspen *Populus tremuloides*	Tree	40-80'	25'		X	X	X			2-6	Grows taller at lower elevations (3,000-10,000 ft)