LID Plant Guidance

Humid Continental (Warm) 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.

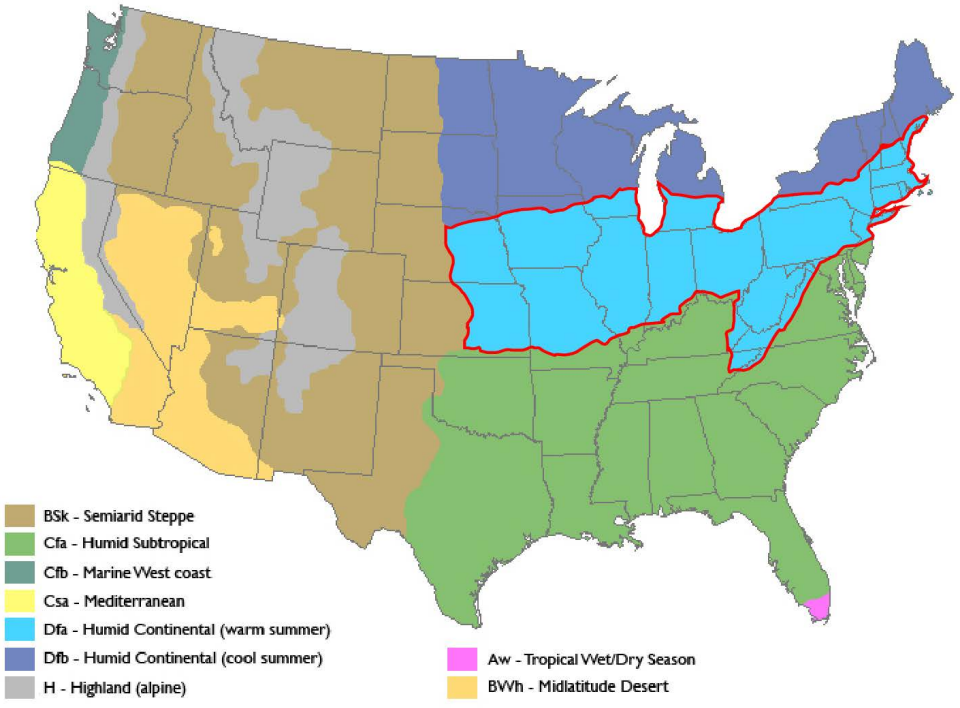
LID designs can natural resource area conservation, incorporate reduction of the development envelope, and minimization of impervious surfaces. LID Best Management Practices (BMP) are landscape and infrastructure controls for stormwater management. The selection of drought tolerant, native plantings 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

Humid Warm Climate

The Köppen Climate system divides the United States into nine zones. The Humid Continental Warm climate zone encompasses the lower northeastern United States. It is characterized by dramatic temperature changes of up to 100° F between seasons, with long harsh winters and shorter, hot summers. Temperature variations are especially significant in areas far from the coast. The Humid Continental climate is subdivided into two zones, warm and cool, due to the relative differences between summer temperatures for the two zones (although both zones have hot summers). Vegetation used for LID BMPs must be able to survive the extreme temperature differences between seasons in this climate of frigid, icy winters to hot summers. Using locally adapted native plants for the region's soils and climate will result in higher success rates, and less overall maintenance inputs than non-native ornamentals.



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 designs 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*

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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. Bioretention should also be designed so that complete drainage occurs every several days. This reduces mosquito breeding, and thus reduces the spread of disease through mosquitoes.

LID vegetation has been shown to produce benefits even in cold conditions when adaptable (UNHSC, 2012). Additionally, many native plants can add aesthetic value as well as functional value when used in LID design in this climate.

Vegetated Swales

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

Courtesy of the City of Chicago, IL

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).

Swales must accommodate intense summer rains as well as substantial volumes of water coming from snowmelt. While peak flow from snowmelt may be less than rain events, the total volume can be higher. Therefore, plant choices must be durable enough to handle peak flood conditions of rainfall as well as prolonged flow from snowmelt. The depth and grade of swales installed in the Humid Continental Warm region should reflect a moderate growing season, and vegetation must be tolerant of soil frost depths.

Vegetated Filter Strips

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

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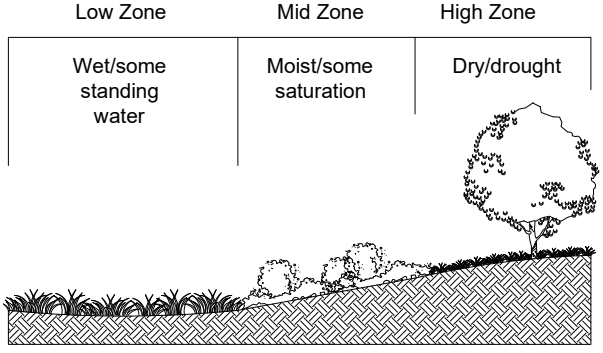
Vegetated filter strips are heavily planted, narrow depressions that collect sheet flow runoff from adjacent impervious areas. Vegetated filter strips can connect to other LID BMPs, vegetated areas, or receiving waterbodies as well as effectively treating runoff from isolated impervious areas such as roofs and parking lots (USACE 2013, 2-33). LIDs in this zone must consider high volumes water volumes caused by storms and/ or snowmelt. Vegetated filter strips should be designed to treat high volumes of water prior to discharge in adjacent waterways to reduce pollutant loads. Strategies designed to reduce water flow velocity will also assist in reducing road washout and erosion. Vegetated filter strips are not meant to hold water for long, so they will require plants that can endure dry periods.

LID Planting Considerations

Because LID BMPs are strategically designed to slow and infiltrate runoff, plants selected for use must be able to accommodate periodic flooding as well as prolonged dry conditions. Selecting low maintenance, native vegetation ensures that a LID BMP will work within the Humid Continental (warm) climate and be more efficient and use less resources. Strategic planting should include assessment of plant growth speed and habits to anticipate maintenance requirements in the growing season. Shrubs, grasses, perennials, and groundcovers should be used to stabilize slopes, slow and absorb runoff, and filter pollutant loads. Understanding how a LID BMP vegetation functions is important to the overall effectiveness of the stormwater system. Depressions of LID can be divided into three general moisture zones: low, mid, and high. The lowest sections collect and hold water for the longest amount of time. Flows from snowmelt and heavy rainfall must be accommodated. Vegetation in the lowest zone must be able to handle prolonged saturated periods as well as the dry conditions between rainfall. Mid zone plantings should provide slope stabilization and be able to withstand potentially high runoff volumes. Plants selected for the highest zone of a Humid Continental Warm BMP require less tolerance to extreme wet conditions, but must still be able to survive with limited water. Soil frost depths must also be assessed for plant viability.



References / More Information

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

Missouri Botanical Garden. http://www.missouribotanicalgarden.org/

University of New Hampshire Stormwater Center, 2012. *Biennial Report*. https://www.unh.edu/unhsc/sites/unh.edu.unhsc/files/docs/UNHSC.2012Report.10.10.12.pdf

Special Considerations for the Humid Continental Warm Zone

There are many opportunities in this climate zone to develop highly diverse LID infrastructure systems due to the consistent precipitation year round. Conversely, the seasonal fluctuations of this zone require flexible LID systems that are able to endure a variety of soils, temperatures, and conditions. Pollutants of concern in this area may include salts directly adjacent to roadways during the winter, agricultural runoff, and generic stormwater runoff from impervious surfaces in urban areas. Strategic planting based on plant growth cycles and dormancy periods can facilitate year-round stormwater treatment. Doing so will save time, reduce costs and infrastructure demands, and improve overall water quality. Maintenance plans include mowing and pruning, especially during summer months. Certain plant species in this zone are similar to the Humid Continental Cool zone, but growth habits are slightly larger and/or more upright. Mosquitoes also are a concern for this area during spring and summer months when ponding is common. Vegetated LID BMPs should be designed to drain quickly to avoid standing water. If LIDs are accessible to wildlife, deer and rabbit resitance should be considered. Below are some suggested vegetation species applicable for the Humid Continental Warm zone. Proposed LID designs include but are not limited to suggested plant species shown below. Coordination with local plant nurseries and natural resource services will be essential to successful LID planning. 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
Stonecrop Sedum *Sedum ternatum*	Forb	< 1'	1'	X	X		X	X		4-8	Wide ranging, full ground coverage, tolerates moisture better than most sedums, highly drought tolerant, but takes several seasons to fill in
Blackeyed Susan *Rudbeckia hirta*	Forb	3'	1-2'	X	X		X	X		2-9	Spreading, clump forming forb with minimal maintenance, deer resistant
Purple Coneflower *Echinacea purpurea*	Forb	3'	1-2'	X	X		X	X		2-10	Clump forming forb with minimal maintenance, deer resistant
New England Aster *Symphyotrichum novae-angliae*	Forb	2-6'	1-2'	X	X		X	X		2-9	Grows best in wet or moist soils but can tolerate dry periods, does well in loose soils, deer resistant
LID Plant Suggestions	**Form**	**Height**	**Width**	**High Zone**	**Mid Zone**	**Low Zone**	**Sun**	**Part Sun**	**Shade**	**Hardiness**	**Notes / Maintenance**
Buffalo Grass *Bouteloua dactyloides*	Grass	1'	1'	X			X			4-10	Drought tolerant, does well as a low-mow or no-mow turf
Bottlebrush Grass *Elymus hystrix*	Grass	2-3'	1-2'	X	X		X	X		5-9	Drought tolerant, deer resistant
Little Bluestem *Schizachyrium scoparium*	Grass	2-4'	1-2'	X	X		X			3-9	Deer resistant
Muhly Grass *Muhlenbergia capillaris*	Grass	2-5'	2'	X	X		X	X		4-8	Muhly is common native grass which is well adapted to periods of saturation to drought.
Indian Grass *Sorghastrum nutans*	Grass	3-5'	1-2'	X	X		X			4-9	Drought tolerant, good for native wildlife
Big Bluestem *Andropogon gerardii*	Grass	4-6'	2-3'	X	X		X			4-9	Needs some shade from direct afternoon sun, deer resistant
Tussock Sedge *Carex stricta*	Grass	1-3'	1-2'		X	X	X	X		3-8	Good for pollinators, deer resistant
Bluejoint Reedgrass *Calamagrostis canadensis*	Grass	3-6'	3-6'		X	X	X	X		2-6	Spreading, good for stabilizing soils
Wild Rice *Zizania aquatica*	Grass	1'	1'			X	X			3-8	Does best in wet soils
Sallow Sedge *Carex lurida*	Grass	2-3'	1-2'			X	X	X	X	3-8	Tolerates long periods of saturation, deer resistant
Blue Joint Grass *Calamagrostis canadensis*	Grass	4'	2-3'			X	X	X		3-6	Spreads in moist soils, good for stabilizing stream banks, drought resistant when established
Switch Grass *Panicum virgatum*	Grass	3-6'	2-3'			X	X	X		5-9	Drought tolerant

LID Plant Suggestions	Form	Height	Width	High Zone	Mid Zone	Low Zone	Sun	Part Sun	Shade	Hardiness	Notes / Maintenance
Blackhaw Viburnum *Viburnum prunifolium*	Shrub	12-15'	6-12'	X			X	X		3-9	Drought tolerant, can survive near black walnut trees
Smooth Hydrangea *Hydrangea arborescens*	Shrub	3-5'	3-5'		X			X		3-9	Drought tolerant, can survive near black walnut trees
Black Chokeberry *Aronia melanocarpa*	Shrub	3-6'	3-6'		X		X	X		3-8	Drought tolerant
Chokecherry *Prunus virginiana*	Shrub	20-30'	15-20'	X	X		X	X		2-7	Drought tolerant
Winterberry *Ilex verticillata*	Shrub	3-12'	3-12'		X	X	X	X		3-9	Drought tolerant, prefers well-drained soils
Possumhaw *Ilex decidua*	Shrub	7-15'	5-12'		X	X	X	X		5-9	Drought tolerant
Wild Black Currant *Ribes americanum*	Shrub	3-6'				X	X	X	X	3-6	Prefer moist soils, require watering during dry periods
LID Plant Suggestions	**Form**	**Height**	**Width**	**High Zone**	**Mid Zone**	**Low Zone**	**Sun**	**Part Sun**	**Shade**	**Hardiness**	**Notes / Maintenance**
American Hornbeam *Carpinus caroliniana*	Tree	20-35'	20-35'	X	X			X	X	3-9	Drought tolerant, height varies depending on cultivar
Arrowwood Viburnum *Viburnum dentatum*	Tree	6-10'	6-10'		X		X	X		2-8	Can survive near black walnut
Bottlebrush Buckeye *Aesculus parviflora*	Tree	8-12'	8-15'		X			X	X	4-8	Good for pollinators
American Hazelnut *Corylus americana*	Tree	10-16'	8-13'		X		X	X		4-9	Prefer well-drained soils, require watering during dry periods, prune suckers yearly
American Elderberry *Sambucus canadensis*	Tree	5-12'	5-12'		X	X	X	X		3-9	Require watering during periods of drought, prune in early spring
Common Witch Hazel *Hamamelis virginiana*	Tree	15-20'	15-20'		X	X	X	X		3-8	Prefers moist, well-drained soils, does not do well in compacted soils, moderately deer resistant
Ohio Buckeye *Aesculus glabra*	Tree	20-40'	20-40'		X	X	X	X		3-7	Prefers moist soils, shade tolerant
River Birch *Betula nigra*	Tree	40-70'	40-60'		X	X	X	X		4-9	Drought tolerant
Sugar Maple *Acer saccharum*	Tree	40-80'	30-60'		X	X	X	X		3-8	All maples act as a water pump in low areas and bare areas can develop under the canopy due to this
Red Maple *Acer rubrum*	Tree	40-70'	30-50'			X	X	X		3-9	All maples act as a water pump in low areas and bare areas can develop under the canopy due to this