Semi-Arid Green Infrastructure Toolbox

Bioretention in public, commercial, and residential properties

What is bioretention?

Bioretention includes a family of practices that treat stormwater naturally by filtering runoff through vegetation and soil before it either recharges groundwater through deep infiltration or is discharged to a surface drainage system such as culverts or ditches. Bioretention systems typically include an overflow device to bypass runoff volumes larger than the storage capacity of the practice to prevent ponding and scour of the bioretention surface.

Parking lots and other commercial or public spaces are excellent locations to implement bioretention practices where they can be implemented to manage stormwater runoff originating from the parking areas, rooftops and other paved surfaces. Placing bioretention in commercial or public parcels integrated with other site features can reduce the required space dedicated to stormwater management and in some cases reduce other infrastructure costs.

Specific locations/settings where bioretention can be incorporated into the roadway right of way include:

- Parking lot islands
- setbacks at parcel boundaries
- landscaping areas around buildings

Benefits

Bioretention practices provide a number of benefits in a parking areas and commercial setting including:

- provide shade to parked cars and site users
- Reducing downstream flooding
- Recharging groundwater
- Improving water and air quality
- Reduce heat island effect from pavement and buildings

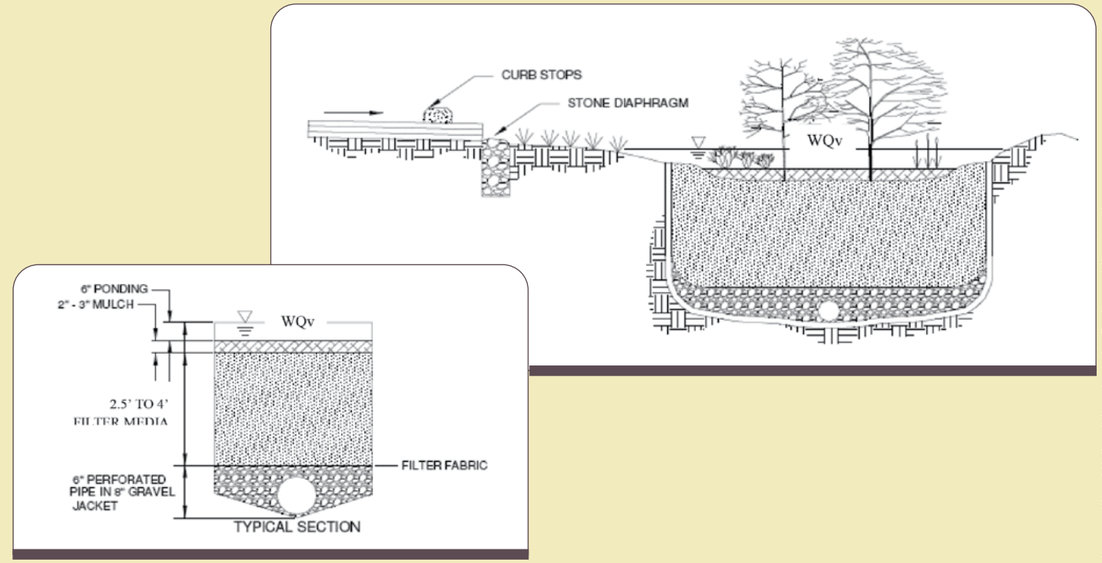
Siting and Design considerations

- Bioretention practices should be placed adjacent to and downslope of impervious surfaces. In commercial settings this is often in parking islands and in dedicated landscaping areas. Consideration should be made for placement over underground utilities and to accommodate required lighting, signs, and landscaping dimensions. If existing soils exhibit limited permeability (typically less than 0.5 inches/hour) an underdrain must be connected to a downstream drainage system or outlet. Care should be taken to avoid selecting sites that receive significant sediment load or are downstream of eroding areas.

Maintenance requirements

Like all infrastructure bioretention practices require regular maintenance to perform as designed. Specific maintenance tasks include:

- Regularly clearing out debris from inlets and outlets
- Inspecting for long term ponding (evidence of practice failure)
- Replacement of wood/rock mulch and dead vegetation
- Avoiding placing snow piles on the practice or the encouragement of pedestrian traffic which can cause compaction



Source: City of Kalispell Standards for Design and Construction

Schematic of a parking lot bioretention installation exhibiting a gravel stone diaphragm in lieu of a curb system with openings or curb cuts. Note that the underdrain system, as shown, is not necessary if existing soil is sufficiently permeable.

Source: Watershed Management Group, Tucson , AZ

In this library parking lot an irrigated bioretention system has been incorporated into a wide parking lot island. Note the stone channel used to distribute runoff throughout the bed.

Source: USEPA Region 8

Bioretention can be integrated into parking lots such as this example of a grassed bioretention are in Fargo, ND.

Plants well-suited to bioretention projects in the northern plains:

Alder-leaved serviceberry
Amelanchier alnifolia 'Regent'

Snowberry
Symphoricarpos albus

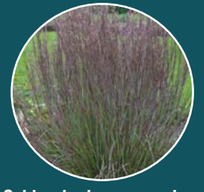
Tatarian dogwood
Cornus alba 'Argenteo-marginata'

Prunus virginiana
Choke Cherry

Rocky Mountain juniper
Juniperus scopulorum

Silver buffaloberry
Shepherdia argentea

Sand cherry
Prunus besseyi 'Pawnee Buttes'



Schizachyrium scoparium
Smoke Signal

Calamagrostis acutiflora
Karl Foerster

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How to plan, implement, and maintain bioretention in commercial and public parcels

Planning and Design: Design guidance and criteria for bioretention in the commercial and public spaces varies from one community to another due to variations on climate, soils, vegetation, and local development standards. Generally bioretention is designed to capture and treat the runoff from a specific rainfall depth. A common precipitation depth is 1 inch. There are a variety of design manuals and sizing tools/calculations which may be appropriate for your project site. Refer to guidance provided by available municipal design manuals such as those provided by the Mile High Flood District for more guidance on bioretention sizing, material selection, and dimensions. In areas in which stakeholders are not well versed in low impact development it may be beneficial to implement a public education program including public meetings or informational signs where practices are installed to provide information on how bioretention functions.

Maintenance: Maintenance of bioretention on commercial and public spaces requires additional consideration related to transportation and roadway maintenance activities. For example where snowplows are used to clear parking areas they may push snow to the roadway edge. Bioretention media is susceptible to compaction from piled snow which can significantly reduce its permeability leading to ponded water and structural failure. Other considerations include: planning for maintenance activities such as removing debris which frequently collects in the shallow bed, ensuring a supply of materials and vegetation stock/seed, and setting up a regular inspection and maintenance schedule. For bioretention systems on private property consideration should be given to public oversight to ensure that maintenance is conducted such as code provisions for inspection and maintenance assurances.

Design Criteria:		
	Maximum contributing area	1 Acre typically
	Maximum ponding depth	12 inches
	Filter media	Engineered soil media specific to bioretention, see applicable state or local specification
	Media depth	2 feet or more depending on pollutants of concern and vegetation rooting needs
	Underdrain system	Required if existing soils won't drain ponding within 6 hours
	Gravel layer	Washed #57 or similar typically 6-12 inch depth or more if additional runoff storage desired
	Bypass	Can be accomplished with an overflow riser attached to the underdrain or by designing the system such that when the practice is full flow cannot enter the curb cut and must continue along a standard gutter system

Vegetation selection: Vegetation in bioretention areas undergo significant stress including periods of inundation and generally dry conditions between precipitation events. As a result native species which thrive in similar conditions are often used. The use of non-native plants is generally avoided due to concerns about colonization and potential displacement of native species in surrounding areas. Vegetation placed in bioretention in commercial and public spaces should consider the impact of close interaction with the public and maintaining visual aesthetics for businesses.

Do		Don't	
Limit contributing drainage to 1 acre or less ☑	Consider alternative, preferably native, plant species to replace those which do not thrive ☑	Install in areas where temporary ponding could negatively impact adjacent structures and subgrade integrity ☒	Disturb or otherwise expose upstream drainage area to easily erodible materials ☒
Regularly inspect for loss of integrity of structural components ☑	Trim and remove vegetation to retain vehicular sight lines and storage capacity ☑	Install over top of critical underground infrastructure ☒	Allow or promote regular pedestrian access to vegetated area ☒
Remove trash and debris at inlets and outlets after every precipitation event to prevent clogging ☑	Replace mulch layer annually ☑	Install without evaluating existing soil infiltration/permeability ☒	Fail to remove collected sediment which collects on top of mulch layer ☒
Remove and replace dead or dying vegetation ☑	Provide irrigation to vegetation during establishment and if necessary for the life of the practice ☑	Install in areas with shallow groundwater levels (typically at least 2 feet below bottom of underdrain or soil media) ☒	Place plowed snow on bioretention surface ☒

Additional examples of bioretention

Source: Utah DEQ, USEPA Region 8

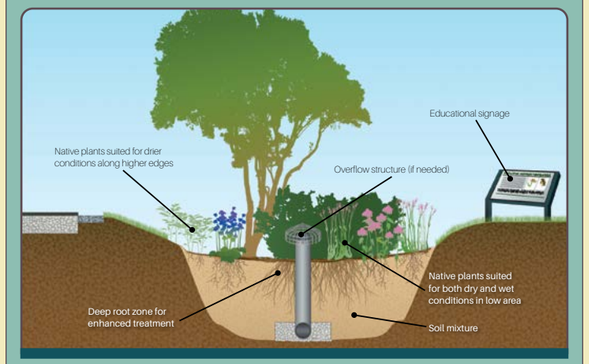
The University of Utah built bioretention areas to capture and filter stormwater runoff and for educational purposes as part of their Sustainable Campus Initiative.

Source: Watershed Management Group

This bioretention cell in a parking island features curb openings and native vegetation

Source: City of Boise, ID

Bioretention installed in setback between commercial business and adjacent roadway. This practice treats runoff from the parking lot, out of view. Note the overflow structure in the foreground which is connected to a drainage system.



Schematic showing common components of bioretention installed in commercial and public parcels