Semi-Arid Green Infrastructure Toolbox

Bioretention in the right-of-way

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.

Transportation rights of way provide a number of areas where bioretention practices can be implemented to manage stormwater runoff originating from the paved travel lanes, adjacent parking spaces and roadside sidewalks. Placing bioretention in the right-of-way (ROW) may preserve adjacent open lands which would otherwise need to be dedicated to stormwater management. Specific locations/settings where bioretention can be incorporated into the roadway right of way include:

- Medians and traffic islands
- Curb "bump-outs" and back of curb bioretention beds
- Tree trenches located at the back of curb

Benefits

- Bioretention practices provide a number of benefits in a roadway setting including:
  - Create inviting and pleasant streetscapes
  - Reducing downstream flooding
  - Recharging groundwater
  - Improving water and air quality
  - Reduce heat island effect

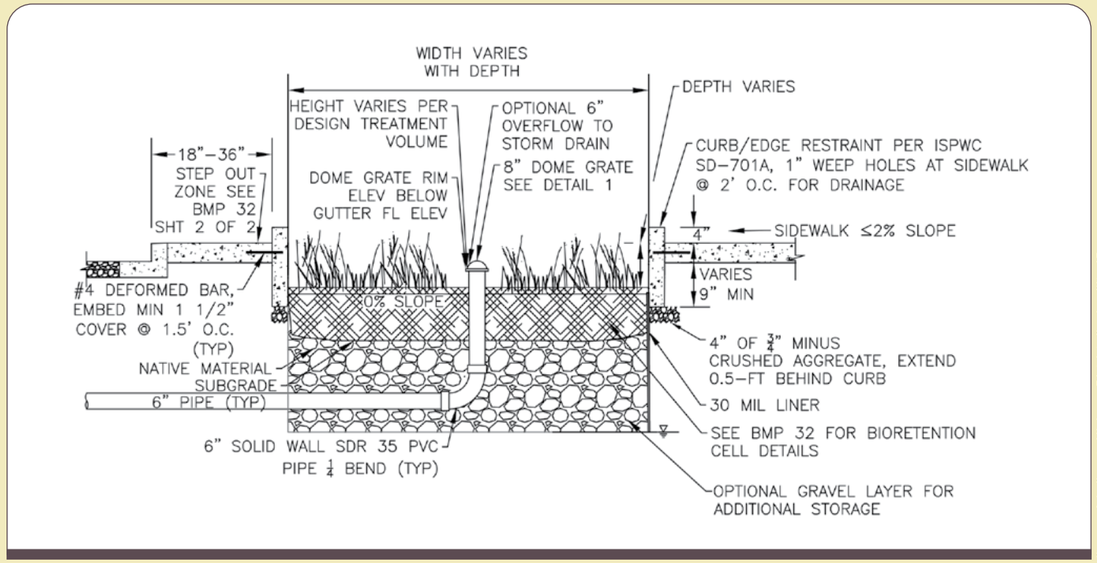
from pavement and buildings

Siting and Design considerations

- Bioretention practices should be placed adjacent to and downslope of impervious surfaces. In roadway settings this is often in traffic medians and outside of the roadway edge. Consideration should be made for placement over underground utilities. If existing soils exhibit limited permeability (typically less than 0.5 inches/hr.) 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 which can cause compaction



Source: Ada County Highway District, Garden City, ID.

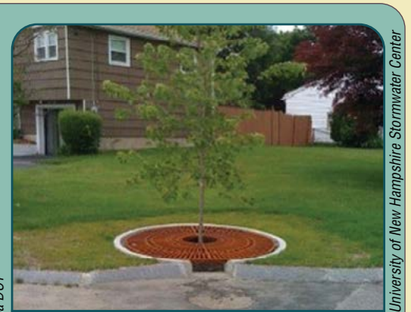
Planter Box configuration of a bioretention system exhibiting 6 in. vertical curb with openings and adjacent sidewalk. Note that an underdrain system is required if existing soil is low permeability.

Source: Watershed Management Group , Tucson , AZ

Shallow bioretention in a verge using flat curb. Runoff from the street flows directly into the bioretention area.

Source: Virginia DOT

Bioretention placed within a vegetated median on a highway. This configuration requires that a portion of the roadway be sloped toward a depressed median.



Source: University of New Hampshire Stormwater Center

Bioretention may be integrated in the ROW in many forms. This low cost tree trench retrofit consists of a section of RCP culvert in which a streetside tree is planted in a soil media. Roadway runoff is routed into the tree trench where it infiltrates to provide water to the tree.

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 the ROW

Planning and Design: Design guidance and criteria for bioretention in the ROW varies from one community to another due to variations on climate, soils, vegetation, and local street design 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 site. Refer to guidance provided by available municipal design manuals such as those provided by 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 within the right of way requires additional consideration related to transportation and roadway maintenance activities. For example where snowplows are used regularly 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 which don't block traffic, ensuring a supply of materials and vegetation stock/seed, and setting up a regular inspection and maintenance schedule.

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 designing the system so that when it is full, excess will run off

**Bioretention in the ROW is typically much smaller*

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 the right of way should consider the impact on vehicular sight lines, pedestrian safety, and frequency of maintenance required.

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 cause 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 ☒

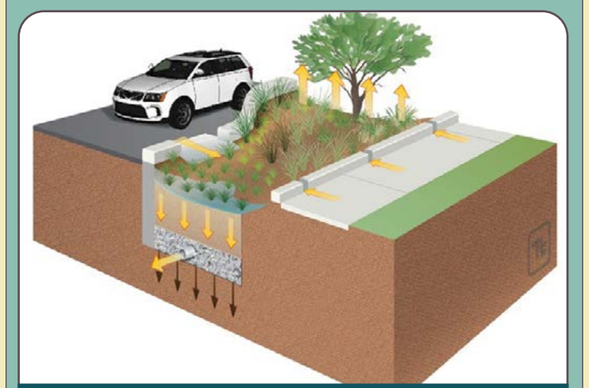
Additional examples of bioretention in the ROW:

Source: Watershed Management Group

Where vertical curbs are needed curb openings or cuts can be implemented to allow runoff to flow into bioretention systems

Covered curb cut flumes can be used where sidewalks are adjacent to roadway

In arid areas stone may be used as surface cover in lieu of mulch



Planter box/tree trench schematic including an underdrain