LID Best Management 4.0 Practices

Introduction 4.1
Amending Construction Site Soils 4.2
Dispersion 4.3
Bioretention 4.4
Trees 4.5
Permeable Pavement 4.6
Vegetated Roofs 4.7
Minimal Excavation Foundations 4.8
Rainwater Harvesting 4.9
LID BMP design guidance provided in the Manual is based on the following sources:

- Other LID guidance manuals
  - Yakima Regional LID Stormwater Design Manual
  - LID Technical Guidance Manual for Puget Sound
- Research from academic institutions
- TRC, SAG, and the Consultant design experience
Organization of LID BMP Design Guidelines

Each BMP chapter organized with the following structure:

- Description
- Applications & Limitations
- Design
- Sizing
- Infeasibility Criteria
- Construction
- Maintenance
Maintenance guidelines provided for each LID BMP in Chapter 4

Appendix D provides:

- Typical maintenance goals and objectives
- Types of maintenance agreements and training
- Matrices with maintenance activities and schedules for
  - Bioretention
  - Amended Construction Site Soils
  - Permeable Pavement
  - Vegetated Roofs
  - Rainwater Harvesting
Chapter 4 – LID BMP Design

Eastern Washington Applications & Limitations

- Improve soil structure, porosity, and reduced bulk density
- Increase infiltration
- Increase moisture holding capacity
- Increase cation exchange capacity, pollutant absorption, and filtration
- Buffer soil pH
- Improve plant growth, disease resistance, and aesthetics
- Reduce pesticides and peak season irrigation
Eastern Washington Applications & Limitations

- Min 10’ flow path required
- Can be used for variety of impervious surfaces (walkways, driveways, roofs, etc.)
- Suitable for public and private projects
- May help meet landscape requirements if designed with appropriate vegetative cover

Types

- Natural
- Engineered
Eastern Washington Applications & Limitations

- Applicable to many geology types and climates, including semi-arid and cold climates
- Public infrastructure and private property projects
- Integrate with site landscaping

Types

- Bioretention cells
- Bioretention swales
- Infiltration planters
Eastern Washington Applications & Limitations

- Evergreen trees provide greater stormwater benefit than deciduous
- Require adequate soil volume and quality to reach healthy mature size
- Protect trees when located near snow plowing or snow storage areas

Optional Considerations

- Soil Cell Systems – Suspend pavement and provide high soil volume for large trees
- Structural Soil
PERMEABLE PAVEMENT

Eastern Washington Applications & Limitations

• Design in eastern Washington to account for freezing and snow removal
• Underdrains and/or liners can be used in non-infiltratable areas
• Successful track record in cold weather climates (Chicago, New Hampshire, Minnesota, Michigan, New York...)

Types

• Porous asphalt
• Pervious concrete
• Permeable interlocking concrete pavements (PICP)
• Grid systems

Chapter 4 – LID BMP Design
Eastern Washington Applications & Limitations

• Special consideration for freezing, heat and wind required
• Used increasingly on office, industrial, and warehouse structures
• Applications for residential retrofit limited
• Can include roof terraces

Types

• Extensive (<6” growing media)
• Intensive (≥6” growing media, can include trees and shrubs)
Eastern Washington Applications & Limitations

- Residential or commercial structures up to 3 stories high
- Good application for accessory structures (i.e., decks, porches)
- Can be used in broad range of soil and groundwater conditions with appropriate pin penetration into suitable underlying soils
- Highest flow control credits for sites with roof runoff dispersed on up-gradient side of structure per BMP F6.41 in 2004 SMMEW
Eastern Washington Applications & Limitations

- Residential and commercial cistern uses with high irrigation or non-potable water demands
- Indoor and outdoor reuse of harvested stormwater can help offset high water demand in summer
- Orifice-controlled cisterns can help reduce Combined sewer overflows (CSOs), as well as localized flooding
Appendix A: Glossary

Appendix B: Evaluating Soil Infiltration Rates

Appendix C: Sizing of LID Facilities

Appendix D: Plant List

Appendix E: Detail Drawings

Appendix F: LID Planning & Design Checklist

Appendix G: Maintenance of LID Facilities

Appendix H: References
Appendix E – Detail Drawings
Bioretention without underdrain

NOTES:
1. SIZE AND DEPTH PER SMMEW BMP T5.30 (BIO-INFILTRATION SWALES) OR LOCAL EQUIVALENT.
2. PROVIDE OVERFLOW STRUCTURE PER LOCAL JURISDICTION.
3. THE VOLUME CONTAINED BY THE SWALE MUST BE SUFFICIENT TO TREAT THE WATER QUALITY VOLUME PRIOR TO OVERFLOWING.
4. UNDER-DRAIN MUST BE SUFFICIENT TO DRAIN FACILITY COMPLETELY WITHIN 72 HOURS.
5. TREES OR DEEP ROOTED VEGETATION ARE NOT RECOMMENDED OVER PIPE.
Appendix E – Detail Drawings
Bioretention in typical roadway sections


Bioretention in typical roadway sections
Drawing #103
## Appendix G - Example Matrix

**Bioretention - Routine Maintenance**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Objective</th>
<th>Schedule</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Watering: Maintain drip irrigation system</td>
<td>Establish vegetation with a minimum 80% survival rate.</td>
<td>Twice annually (May and July) or as indicated by plant health.</td>
<td>Plants should be selected to be drought tolerant and not require watering after establishment (2-3 years). Watering may be required during prolonged dry periods after plants are established.</td>
</tr>
<tr>
<td>without breaks or blockages. Hand water as</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>needed for specific plants.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clean curb cuts: Remove any accumulation of</td>
<td>Maintain proper flow of stormwater from paved/impervious areas to</td>
<td>Twice annually</td>
<td></td>
</tr>
<tr>
<td>debris from gutter and entrance to</td>
<td>bioretention facility.</td>
<td>(October and January)</td>
<td></td>
</tr>
<tr>
<td>bioretention area.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Remove and/or prune vegetation</td>
<td>Maintain adequate plant coverage and plant health. Reduce shading of</td>
<td>Once or twice annually.</td>
<td>Depending on aesthetic requirements, occasional pruning and removing dead plant material may be necessary.</td>
</tr>
<tr>
<td></td>
<td>under-story if species require sun. Maintain soil health and infiltration</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>capability. Maintain clearances from utilities and sight distances.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weeding: Remove undesired vegetation by</td>
<td>Reduce competition for desired vegetation. Improve aesthetics.</td>
<td>Prior to major weed species discharging seeds (usually twice annually)</td>
<td>Periodic weeding is necessary until plants are established. The weeding schedule should become less frequent if the appropriate plant species and planting density have been used and, as a result, undesirable plants excluded.</td>
</tr>
<tr>
<td>hand.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mulching: Replace or add mulch with hand</td>
<td>Replenish organic material in soil, reduce erosion, prolong good soil</td>
<td>Once annually or every</td>
<td>Consider replacing mulch annually in bioretention facilities where high pollutant loading is likely (e.g. contributing areas that include quick marts). Use compost in the bottom of the facility and wood chips on side slopes and rim (above typical water levels).</td>
</tr>
<tr>
<td>tools to a depth of 2-3 inches.</td>
<td>moisture level, and filter pollutants.</td>
<td>two years.</td>
<td></td>
</tr>
<tr>
<td>Trash removal</td>
<td>Maintain aesthetics and prevent clogging of infrastructure.</td>
<td>Twice annually.</td>
<td></td>
</tr>
</tbody>
</table>
### Appendix G - Example Matrix

**Bioretention – Non-Routine Maintenance**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Objective</th>
<th>Schedule</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintain access to infrastructure: Clear vegetation within 1 foot of inlets and outfalls, maintain access pathways.</td>
<td>Prevent clogging of infrastructure and maintain sight lines and access for inspections.</td>
<td>Once annually.</td>
<td></td>
</tr>
<tr>
<td>Sediment removal: Shovel or rake out sediment within vegetated areas. Vectored catch basins or other sediment structures.</td>
<td>Reduce sediment transport and clogging of infrastructure. Maintain desired plant survival and appearance of facilities. Maintain proper elevations and ponding depths.</td>
<td>Determined by inspection.</td>
<td>If sediment is deposited in the bioretention area, immediately determine the source within the contributing area and stabilize.</td>
</tr>
<tr>
<td>Clean under-drains: Jet clean or rotary cut debris/roots from under-drains.</td>
<td>Maintain proper subsurface drainage, ponding depths, and dewatering rates.</td>
<td>Determined by inspection of clean-outs.</td>
<td></td>
</tr>
<tr>
<td>Clean intersection of pavement and vegetation: Remove excess vegetation with a line trimmer, vacuum sweeper, rake or shovel.</td>
<td>Prevent accumulation of vegetation at pavement edge and maintain proper sheet flow of stormwater from paved/impenetrable areas to bioretention facility.</td>
<td>Determined by inspection.</td>
<td>Bioretention facilities should be designed with a proper elevation drop from pavement to vegetated area to prevent blockage of storm flows by vegetation into infiltration area.</td>
</tr>
<tr>
<td>Replace vegetation: Raseed or replant bare spots or poor performing plants.</td>
<td>Maintain dense vegetation cover to prevent erosion, encourage infiltration and exclude unwanted weed species.</td>
<td>Determined by inspection.</td>
<td>If specific plants have a high mortality rate, assess the cause and replace with appropriate species.</td>
</tr>
<tr>
<td>Replace soil: Remove vegetation (save as much plant material as possible for replanting) and excavated soil with backhoe, excavator or, if small facility, by hand.</td>
<td>Maintain infiltration, soil fertility, and pollutant removal capability.</td>
<td>Determined by inspection (visual, infiltration, pollutant, and soil fertility tests).</td>
<td>Soil mixes for bioretention facilities are designed to maintain long-term fertility and pollutant processing capability. Estimates from metal attenuation research suggest that metal accumulation should not present an environmental concern for at least 20 years in bioretention systems. Replacing mulch in bioretention facilities where heavy metal and hydrocarbon deposition is likely provides an additional level of protection for prolonged performance.</td>
</tr>
<tr>
<td>Rebuild or reinforce structures: Various activities to maintain walls, intake and outfall pads, weirs, and other hardscape elements.</td>
<td>Maintain proper drainage, and aesthetics and prevent erosion.</td>
<td>Determined by inspection.</td>
<td></td>
</tr>
<tr>
<td>Re-grade or re-contour side slopes: Maintain proper slope with hand tools, backhoe or excavator, replant exposed areas.</td>
<td>Prevent erosion where side slopes have been disturbed by foot or auto traffic intrusion.</td>
<td>Determined by inspection.</td>
<td></td>
</tr>
</tbody>
</table>
Questions/Comments