FIELD GUIDE

MAINTAINING
Rain Gardens, Swales, and Stormwater Planters

This document is available on the Oregon State University Stormwater Solutions website.

Working group participants directly involved in creating this document include:

Maria Cahill, Green Girl LDS
Rob Emanuel, Clean Water Services
Tony Gilbertson, Clean Water Services
Corie Harlan, Metro
Dawn Hottenroth, Sherri Peterson, Henry Stevens, Environmental Services, City of Portland
Corey Petersen, Pacific Landscape Management
Damon Richardson, Pacific Sports Turf
Gail Shaloum, Clackamas County Water Environment Services
Candace Stoughton, East Multnomah Soil and Water Conservation District.

Editing by East Multnomah Soil and Water Conservation District.

Many thanks to those who reviewed the document and provided valuable feedback:
David Alba, Oregon Tilth
Benjamin Benninghof, Stephanie Rawson, Oregon Department of Environmental Quality
Erik Carr, Clackamas County Soil and Water Conservation District
William Fletcher, Oregon Department of Transportation
Heather Kent, Metro
Jeremy Person, City of Portland
Barbara Priest, BPriest + Associates
Laura Sloan, City of Portland
Jamie Stamberger, City of Gresham
# TABLE OF CONTENTS

## Introduction

Why is stormwater management important?.......................... 1
Types of Facilities............................................................... 1

## Preparation

Before going to the site ..................................................... 3
Safety Equipment.............................................................. 4
Hazards ........................................................................... 5
Trash .............................................................................. 5
Spills ............................................................................... 5
Animals/Wildlife ............................................................. 5
Poisonous Plants............................................................... 7

## Inspection and Maintenance

Inspections ...................................................................... 8
Maintenance Calendar ...................................................... 9
Trash and Debris ............................................................. 12
Erosion .......................................................................... 13
Sediment ......................................................................... 14
Vegetation ....................................................................... 17
Common Weeds/Invasive Plants ....................................... 18
Plant Replacement/Moisture Zones ................................. 21-22
Pruning ........................................................................... 23
Irrigation Systems .......................................................... 24
Structures ......................................................................... 24

## Appendices

Appendix A: Maintenance Checklist ................................. 27
Appendix B: Sample Maintenance Log............................... 30
Appendix C: Resources ...................................................... 32
Appendix D: Jurisdiction contacts ..................................... 34
Appendix E: Photo Credits ................................................ 35

---

Take note! Throughout this document, the following symbol is used to highlight issues of special concern.
Why is Stormwater Management Important?

Before our region was developed, forests and open spaces absorbed rainwater. As we built cities and towns and added hard surfaces (impervious surfaces), the amount and rate of rainwater runoff (also known as stormwater) entering rivers and stormwater pipes increased significantly. That rainwater also picks up pollutants as it flows across impervious areas. If not properly managed, rainwater can carry pollutants to rivers, erode and flood river banks or overload the storm sewer system.

Sustainable stormwater facilities (i.e. Low Impact Development-LID) attempt to mimic the natural water cycle. They function to slow and reduce the amount of stormwater that enters rivers and pipes as well as filter pollutants to protect our infrastructure and watersheds. Many communities require developers to install stormwater facilities, like rain gardens, swales and planters. Further, they require property owners to follow an Operations and Maintenance Plan to ensure that stormwater facilities continue to work over time.

Types of Stormwater Facilities

This field guide focuses on the three most common LID facilities used throughout the Portland metropolitan region. While maintenance guidance may apply to all types stormwater facilities, this manual specifically targets the following: rain gardens, swales, and stormwater planters.

Rain Gardens

A rain garden is a sunken, generally flat-bottomed garden bed that collects and treats stormwater runoff from impervious surfaces.
Swales
Swales are gently sloping depressions planted with dense vegetation or grass that treat stormwater runoff from impervious surfaces. As the runoff flows along the length of the swale, the vegetation slows and filters the water and allows it to soak into the soil. In areas where it is not advisable to have stormwater soak into the ground (poorly draining soils, steep slopes, limited space, contaminated soils, high groundwater levels, etc.) swales may include a liner that prevents water from soaking in. The runoff is then conveyed to a drywell, soakage trench or to the piped stormwater system. Swales can include check dams to help slow and detain the flow.

Stormwater planters
Planters are structures or containers that contain a layer of gravel, soil, and vegetation. Stormwater slowly soaks into the soil and then either makes its way into the ground below (infiltration planter) or into an underdrain system (flow through planter) that flows to the local stormwater pipes. Planters come in many sizes and shapes, and are made of stone, concrete, brick, plastic lumber, or wood. Careful consideration should be given before using infiltration planters in areas with poorly draining soils or in locations near structures such as buildings or streets.
Before going to the site
A little preparation before going to the site will ensure you have the information needed to properly maintain the facility. Review the operations and maintenance plan, the as-built or design report (locations of inlets/outlets, plantings, irrigation system, etc.), as well as past inspection and maintenance reports. Knowing what has occurred at the site in the past will help ensure you know what is likely to be needed when visiting the facility.
**Safety Equipment**
Always use the appropriate safety equipment when maintaining stormwater facilities.

- Boots/Protective footwear
- Eye protection
- Hearing protection

<table>
<thead>
<tr>
<th>Cut resistant gloves</th>
<th>Safety vest</th>
<th>Hard hat</th>
<th>Rake</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Cut resistant gloves" /></td>
<td><img src="image2" alt="Safety vest" /></td>
<td><img src="image3" alt="Hard hat" /></td>
<td><img src="image4" alt="Rake" /></td>
</tr>
</tbody>
</table>

- Always wear cut resistant gloves when working in facilities.
- Wear a safety vest when working near traffic or in parking lots.
- Wear a hard hat when cutting branches overhead.
- Use a rake to gather leaves, trash, etc. from the facility.
- A first aid kit should be available to workers in case they are injured on the job.
- Use a grabber rather than hands to pick up trash whenever possible.

**PREPARATION**
Hazards
There are a number of safety hazards that can occur in and around stormwater facilities.

Trash
Be sure to use gloves and grabbers to remove dangerous trash (needles, animal carcasses, etc.) and dispose of safely.

Spills
Chemical spills could easily introduce pollutants into facilities and the piped stormwater system. Workers should always have a spill kit on hand in order to prevent any spills from reaching the facility, local water bodies, or stormwater inlets.

**Spill kit**

Contains:
- Kitty litter (absorbent material to soak up the spilled substance)
- Absorbent pad
- Gloves
- Instructions on how to clean up a spill and contact information for agencies that need to be alerted in the event of a spill

Contact the local jurisdiction spill control hotline for assistance with spills.

- In addition, contact the Oregon Emergency Response System 1-800-452-0311 to report spills.

Animals/Wildlife
Animals found in stormwater facilities can pose a hazard to maintenance workers. Use caution when working in and around a facility to reduce the likelihood of surprise encounters.

- Do not handle animals or wildlife.
- Call an animal control specialist to remove if they are negatively affecting the facility function or pose a hazard to workers.

<table>
<thead>
<tr>
<th>Animals/wildlife</th>
<th>Bees, wasps, yellow jackets</th>
</tr>
</thead>
</table>

- Do not use poisons or other toxic baits in a stormwater facility.
- Contact Vector Control in your area for assistance on eradicating pests and vectors of disease.
- Some wildlife species that may be found in a facility are protected in the state of Oregon. Contact Oregon Department of Fish and Wildlife to determine what species are protected by law.

See Appendix C for a list of resources for managing hazards in stormwater facilities.
Needles found in a facility could pose a serious health risk if workers are stabbed by a sharp object. Use grabbers and gloves to remove needles and dispose of them using methods approved for medical waste.

Dead animals
Use grabbers, gloves and other protective equipment when removing dead animal carcass.
- Double-bag the carcass before disposing it in an appropriate garbage facility.

Prevent spills
When re-fueling equipment in the field, to protect water quality and ensure worker safety, use the following procedures:
- Do not fuel the tank while engine is hot or running.
- Conduct fueling operations over drip pans or other hard surfaces.
- Keep away from storm drain inlets, the stormwater system, and waterways.
- Do not “top off” fuel tanks.
- Keep clean absorbent materials on hand for minor spills.
- Make sure portable fuel tanks are leak free and are secured during transit.

See Appendix C for a list of resources for managing hazards in stormwater facilities.
Poisonous Plants

Danger! Use caution when removing these plants!
Always use protective gear (gloves, long sleeves, boots, eye protection, etc.) when removing poisonous plants from a facility to prevent plant material from touching the skin.

Poison oak (Toxicodendron Diversilobum)
Contact with poison oak or the oils from the plant can cause a painful rash.
• Use gloves and protective clothing when removing plants that can irritate the skin.
• All protective clothing should be washed or disposed of after use to prevent exposure to the toxic plant sap at a later time.

Poison hemlock (Conium maculatum L.)
Poison hemlock is toxic and can cause death if eaten! It also has photo toxins that make human skin ultra-sensitive to UV light.
• If you suspect someone has eaten poison hemlock, have them seek medical treatment immediately.
• Use gloves and protective clothing when removing the plant as it can irritate the skin.

Giant hogweed (Heracleum mantegazzianum)
Giant hogweed sap makes human skin ultra-sensitive to UV light. Large, watery, burn-like rashes appear 15-20 hours after contact. If skin is exposed to the plant or sap, cover the area and wash it as soon as possible.
Contact with the eyes can cause temporary and sometimes permanent blindness.

See Appendix C for a list of resources for managing hazards in stormwater facilities.
Inspections

All facilities need to be inspected and maintained seasonally to ensure they are functioning well and to determine what maintenance is needed. The local jurisdiction determines the frequency of required maintenance inspections, but you can always decide to inspect the facility on a more frequent basis.

Refer to the site O&M Plan or contact the local jurisdiction for maintenance activities and schedule specific to the site.

Make sure to document all inspections and maintenance activities in an inspection and maintenance log. The owner of the facility maintains the logs and copies may need to be submitted to the local jurisdiction.

Take Photos

Inspection documents should include photographs of the project site before and after completing maintenance activities. See Appendices for more information on:

- Appendix B: Sample inspection and maintenance log to track maintenance issues and the actions taken to remedy any problems.
- Appendix C: Resources on photo documentation.
- Appendix D: Contact information for jurisdictions in the Portland metropolitan area.
## Maintenance Calendar

Stormwater facilities need maintenance throughout the year to do their job. Below is a calendar that offers general guidelines on the appropriate time of year to do each maintenance activity.

<table>
<thead>
<tr>
<th>ACTIVITY</th>
<th>HOW OFTEN?</th>
<th>WHEN?</th>
<th>SPRING</th>
<th>SUMMER</th>
<th>FALL</th>
<th>WINTER</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>INSPECTION</td>
<td>After every major storm (1 in. in 24 hrs)*</td>
<td>Any time of year</td>
<td>☼</td>
<td>☀</td>
<td>☢</td>
<td>☤</td>
<td></td>
</tr>
<tr>
<td>Remove TRASH and debris (from the inlets and within the facility)</td>
<td>Monthly (and after every major storm; 1 in. in 24 hrs) (every visit)*</td>
<td>Any time of year</td>
<td>☼</td>
<td>☀</td>
<td>☢</td>
<td>☤</td>
<td></td>
</tr>
<tr>
<td>Fix EROSION problems</td>
<td>After every major storm (1 in. in 24 hrs)*</td>
<td>Any time of year</td>
<td>☼</td>
<td>☀</td>
<td>☢</td>
<td>☤</td>
<td></td>
</tr>
<tr>
<td>Remove accumulated SEDIMENT from the base of the facility</td>
<td>As needed (when sediment reaches 2-3 in. in depth, or once a year) *</td>
<td>Ideally in the dry season</td>
<td>☽</td>
<td>☀</td>
<td>☢</td>
<td>☤</td>
<td></td>
</tr>
<tr>
<td>Remove SEDIMENT and debris (from the inlets)</td>
<td>Monthly (and after every major storm; 1 in. in 24 hrs) (every visit)*</td>
<td>Any time of year</td>
<td>☼</td>
<td>☀</td>
<td>☢</td>
<td>☤</td>
<td></td>
</tr>
</tbody>
</table>

* Refer to the site O&M Plan or contact the local jurisdiction to determine the site maintenance activities and schedule.
## Maintenance Calendar

Stormwater facilities need maintenance throughout the year to do their job. Below is a calendar that offers general guidelines on the appropriate time of year to do each maintenance activity.

<table>
<thead>
<tr>
<th>ACTIVITY</th>
<th>HOW OFTEN?</th>
<th>WHEN?</th>
<th>SPRING</th>
<th>SUMMER</th>
<th>FALL</th>
<th>WINTER</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>VEGETATION</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WATER plants</td>
<td>Water plants once a month or more until established (re-set irrigation schedule seasonally)*</td>
<td>Summer months</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Remove WEEDS</td>
<td>As needed</td>
<td>Spring, Summer and Fall</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>See Weeds Section (p.18-20) and Appendix C for more information on weed management.</td>
</tr>
<tr>
<td>PLANT REPLACEMENT</td>
<td>As needed; inspect at a minimum, once per year*</td>
<td>Spring (March-May) or Fall (Oct-Nov)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Vegetation planted in the fall (rather than the spring) will have more time to establish before the dry season.</td>
</tr>
<tr>
<td><strong>PRUNING</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trees and Shrubs</td>
<td>As needed; inspect once per year*</td>
<td>Winter is ideal for pruning trees/shrubs.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>See Pruning Section (p.23) for more information.</td>
</tr>
</tbody>
</table>

* Refer to the site O&M Plan or contact the local jurisdiction to determine the site maintenance activities and schedule.
Maintenance Calendar
Stormwater facilities need maintenance throughout the year to do their job. Below is a calendar that offers general guidelines on the appropriate time of year to do each maintenance activity.

<table>
<thead>
<tr>
<th>ACTIVITY</th>
<th>HOW OFTEN?</th>
<th>WHEN?</th>
<th>SPRING</th>
<th>SUMMER</th>
<th>FALL</th>
<th>WINTER</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PRUNING</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Grasses and grass-like plants     | As needed; inspect once per year* | **Spring** -to prepare for new growth  
Fall -if plants are blocking inlets/outlets |        |        |      |        | Prune as needed to keep inlets and outlets clear or for desired aesthetics. Most grass-like natives do not require pruning unless desired for aesthetics or when blocking inlets or outlets. |
| **IRRIGATION SYSTEM**             |                            |                              |        |        |      |        |                                                                                                                                        |
| Check for leaks, breaks in the system | As needed; at a minimum, once per year* | During the spring before the dry season begins |        |        |      |        |                                                                                                                                 |
| Drain lines to prevent freeze/thaw damage | As needed; at a minimum, once per year* | Fall, before first freeze |        |        |      |        |                                                                                                                                 |
| **STRUCTURES**                    |                            |                              |        |        |      |        |                                                                                                                                        |
| Inspect and maintain STRUCTURES   | As needed; at a minimum, once per year* | Fall, before rainy season begins |        |        |      |        |                                                                                                                                 |

* Refer to the site O&M Plan or contact the local jurisdiction to determine the site maintenance activities and schedule.
Trash and Debris

Trash and debris can prevent runoff from entering a facility and can add pollutants. Remove all trash and other items that should not be in the facility.

To ensure the safety of workers, use a rake or grabbers to remove debris and trash from the facility. Use puncture resistant gloves to remove trash only as a last resort.

Dispose of trash in an appropriate solid waste bin.

Dispose of vegetation in a yard debris bin or send to a composting facility.

Examples of trash and debris found in facilities

Wooden pallets  Grass clippings  Leaf litter
Erosion

Erosion often occurs in stormwater facilities when the vegetation is insufficient to hold the soil or if the structures in the facility have problems. Adding additional plants or repairing energy dissipaters (e.g. concrete basins, riprap, splash pads) and check dams are common fixes.

Examples:

<table>
<thead>
<tr>
<th>Problem</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channelization/erosion in the flow path or on side slopes</td>
<td>Fill erosion channels with approved topsoil or soil mix and apply erosion control matting where appropriate. Add weed free mulch/yard debris compost on slopes of facility to prevent future erosion issues until plants fill in.*</td>
</tr>
<tr>
<td>Erosion at inlet</td>
<td></td>
</tr>
</tbody>
</table>

* Not all jurisdictions allow the use of mulch in LID facilities. Check with the local jurisdiction before using mulch.

* Contact local jurisdiction for possible solutions to erosion issues.
Sediment
Sediment buildup can prevent runoff from entering a facility or increase the amount of time it takes the water to soak into the soil. Most jurisdictions in our region require facilities to drain within 24-48 hours. Regularly removing sediment that has accumulated in the facility will allow water to flow through it as designed. It will also keep sediment out of the piped stormwater system.

Examples:

<table>
<thead>
<tr>
<th>Problem</th>
<th>Solution</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet with basin full of sediment</td>
<td>Removing debris and sediment from inlet of facility</td>
<td>Inlet cleaned out</td>
</tr>
<tr>
<td>Forebay full of sediment</td>
<td>Sediment has been removed and forebay is now clean</td>
<td></td>
</tr>
</tbody>
</table>
Examples:

<table>
<thead>
<tr>
<th>Problem</th>
<th>Problem</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plants choked with sediment</td>
<td>Sediment accumulated at bottom of facility.</td>
</tr>
</tbody>
</table>

Removing Sediment Manually

**Step 1:**
Worker scraping sediment manually from the bottom of a swale.

**Step 2:**
Put sediment in a bucket or wheel barrow and then dispose of it in an appropriate manner.

**Step 3:**
Loosen the soil surface at the bottom of the swale with a rake.

In small facilities, remove sediment with a shovel. In larger facilities, machinery may be used to remove sediment, but always use caution to prevent compaction of the soil.

**In general, sediment removal should occur during the dry season when it is not wet.**

But, in some instances, sediment that is removed from the bottom of a facility will be wet and needs to be dewatered before disposal. This prevents pollutants from dripping onto the hard surfaces nearby and entering the stormwater system and local water bodies. **DO NOT DRAIN WET SEDIMENT OUTSIDE THE FACILITY!**

**For example:**
The sediment has been scraped from the bottom of this facility and has been mounded in a pile in the inlet. Once the water has drained, the sediment can be removed and disposed of in an appropriate manner. To ensure compliance with erosion control laws, do not place sediment outside the facility to drain.
Sediment Disposal

- Sediment from stormwater facilities should be disposed of in garbage bins along with other solid waste/trash. Contact your solid waste hauler for guidance on the weight restrictions for garbage/solid waste bins.

- Sediment MAY NOT be added to yard debris bins.

Questions? Call the Oregon Department of Environmental Quality at 503-229-5263 or 800-452-4011 and ask for the Solid Waste duty officer.

**Disposal**

| Do not dispose of sediment in yard debris bins. | Sediment can be disposed of in garbage bins. |

Always visually inspect sediment before determining the appropriate disposal method. Note any onsite activities that may contaminate sediment (i.e., fueling, hazardous material storage/handling/disposal, auto maintenance). If sediment is off color, has an odor or sheen, have it tested to determine if it is hazardous. Contaminated sediment must be disposed of at a hazardous waste facility.

See Appendix C for contacts and resources on the disposal of sediment.
Vegetation

Watering Plants
As the plants in a stormwater facility establish (a two to three year period after planting), they will need watering during the summer dry season. In some cases a facility may need to be watered even after the plants are established. Using native plants in stormwater facilities is encouraged to reduce the need for supplemental watering after plant establishment.

Water high exposure areas (surrounded by pavement, little shade, significant wind, etc.) through the summer, even after the plant establishment period. For example, this facility is surrounded by pavement and may need supplemental watering during the summer even after the plants are established.

Water vegetation when plants show signs of drought stress (drooping leaves, leaf drop, leaves brown and brittle). This facility has not been watered in months and some of the plants may not recover due to severe drought stress.

How much water is needed? How often to water?
Deep, infrequent watering that moistens the top 12-18 inch root zone is recommended to keep plant alive and healthy and to promote deep roots.

For the first three years, deeply water plants once a month (or more) in hot, dry weather. Small plants may need more frequent watering in hot weather.

After 3-5 years, plants should be well-established, deep rooted and drought tolerant. Watering plants then becomes an infrequent task – only needed when plants begin show signs of stress.

Watering Tip
Water in the morning or evening. Water evaporates during midday heat.
Common Weeds/Invasive Plants

Weeds and invasive plants can overtake desirable plants needed for stormwater filtering and absorption. It is critical to remove any weeds and invasive plants from the facility so they don’t spread when the facility overflows into the stormwater system.

Mulch can be used to suppress weeds until the vegetation is established and fills the facility. (Check with the local jurisdiction to determine whether mulch may be used in LID facilities.)

Integrated Pest Management (IPM) is generally the preferred approach for managing weeds and invasive plants. IPM is an effective and environmentally sensitive approach to pest management. IPM programs use current, comprehensive information on the life cycles of pests and their interaction with the environment. This information, in combination with available pest control methods, is used to manage pest damage by the most economical means, and with the least possible hazard to people, property, and the environment.

Removing weeds by hand

Common Weeds and Invasive Plants

- **Himalayan blackberry**  
  *(Rubus armeniacus)*

- **Reed canary grass**  
  *(Phalaris arundinacea)*

- **Scotch broom**  
  *(Cytisus scoparius)*

- **Knotweed**  
  *(Polygonum spp.)*
Common Weeds and Invasive Plants

- **Canada thistle**  
  *Cirsium arvense*

- **Purple loosestrife**  
  *Lythrum salicaria*

- **Red clover**  
  *Trifolium pratense*

- **Nightshade**  
  *Solanum dulcamara*

- **Garlic mustard**  
  *Alliaria petiolata*

- **Hairy vetch**  
  *Vicia villosa*

- **Yellow flag iris**  
  *Iris pseudacorus*

- **Poison hemlock**  
  *Conium maculatum L.*
Common Weeds and Invasive Plants

English ivy  
*(Hedera helix)*

Morning glory  
*(Convolvulus sepium)*

Bird's-foot trefoil  
*(Lotus corniculatus L.)*

Removing weeds from stormwater facilities

1. Remove weeds by hand. Pull and dig out roots.

2. If this is not possible, contact the local jurisdiction and follow their recommendation for weed removal and control.

3. Remove all weeds and vegetative debris from the facility and dispose of properly. If weedy plant material is to be composted, send it to a high temperature/professional composting facility. This ensures weed seeds are destroyed.

4. Replace weeds with plants that are growing well in the facility. For more plant options, see the Plant Replacement Section for a list of plants that are known to grow well in stormwater facilities.

Because the use of herbicides can have negative impacts to water quality, it is important to use them only as necessary and with extreme caution. If using herbicides:

- Check with local jurisdiction on herbicide restrictions and application requirements.
- Always follow local Integrated Pest Management guidelines.
- Only use herbicides approved for aquatic use.
- Don’t apply herbicides when there is standing water in a facility.
- Only apply herbicides during dry weather and ideally before the weeds have gone to seed.
- Don’t apply herbicides below the high water mark.

See Appendix C for more resources on weeds, invasive plants and integrated pest management.
Plant Replacement

Facilities work best with dense vegetation to absorb and filter runoff. Most jurisdictions expect 75-90% plant coverage for established facilities. When additional plants are needed, consult the original planting plan for the facility (contact the facility owner or the local jurisdiction for the original plans). In addition, the local jurisdiction can offer plant suggestions. Make sure to select the right plant for the right moisture zone.

Examples:

<table>
<thead>
<tr>
<th>Problem</th>
<th>Solution</th>
<th>Animal Damage?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dead plants in facility</td>
<td>Install new plants to replace dead ones</td>
<td>Wrap saplings in 3 ft. diameter 14 gage steel wire cages fit snug to the ground.</td>
</tr>
</tbody>
</table>
Moisture Zones (Top, Slope, Bottom)

Always choose plants that can handle the moisture levels of the zone where it will be planted.

**Bottom** - Soil around roots may be saturated after every rain event.

**Slope** - Soil around roots may be moist and become saturated only during very large rain events.

**Top** - Soil around roots is generally not saturated.

The following is a list of plants that have proven to work well in rain gardens, swales and stormwater planters in the Portland metropolitan region (listed by moisture zone- Bottom, Slope, Top).

<table>
<thead>
<tr>
<th>Bottom</th>
<th>Slope and Top</th>
<th>Top</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rushes / Grasses / Sedges</td>
<td>Ground Covers</td>
<td>Ground Covers</td>
</tr>
<tr>
<td>Spreading rush (Juncus patens)</td>
<td>Coastal strawberry (Fragaria chiloensis)</td>
<td>Kinnickinnick (Arctostaphylos uva-ursi)</td>
</tr>
<tr>
<td>Slough sedge (Carex obnupta)</td>
<td>Dwarf redtwig dogwood (Cornus sericea Kelsyi)(2 ft)</td>
<td>Common Snowberry (Symphoricarpos albus )(6 ft)</td>
</tr>
<tr>
<td>Slender rush (Juncus tenuis)</td>
<td>Swamp rose (Rosa pisocarpa)(8 ft) **</td>
<td>Tall Oregon grape (Mahonia aquifolium)(5 ft)</td>
</tr>
<tr>
<td>Tufted hairgrass (Deschampsia caespitosa)</td>
<td>Douglas spiraea (Spiraea douglasii)(7 ft)</td>
<td>Red-flowering currant (Ribes sanguineum)(9 ft) *</td>
</tr>
<tr>
<td></td>
<td>Shrubs</td>
<td>Shrubs</td>
</tr>
<tr>
<td></td>
<td>Tall shrubs</td>
<td>Small/Medium Trees</td>
</tr>
<tr>
<td></td>
<td>**not suitable in height restricted areas</td>
<td>*not suitable in space limited areas</td>
</tr>
<tr>
<td></td>
<td>*not suitable in height restricted areas</td>
<td>*not suitable in space limited areas</td>
</tr>
</tbody>
</table>

See Appendix C for additional Resources for Selecting Plants.
Pruning

Prune vegetation as needed to ensure the facility functions well. Vegetation should not pose a safety hazard or block visibility within transportation corridors.

Examples:

<table>
<thead>
<tr>
<th>Problem</th>
<th>Problem</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>The grasses in the swale are flopping over and blocking the walkway. They need to be pruned.</td>
<td>Plants pruned too severely</td>
<td>Grasses pruned to 10 inches</td>
</tr>
<tr>
<td>Vegetation clogging an inlet.</td>
<td>Vegetation removed; the inlet is now open.</td>
<td></td>
</tr>
</tbody>
</table>

Height Guidelines

Overgrown trees and shrubs can create safety problems by blocking views of traffic signs, pedestrians and other vehicles. Vegetation needs to be pruned to allow for clear sightlines.

To ensure safe passage for everyone, tree limbs must hang no lower than:

- 7 ½ feet above a sidewalk
- 11 feet above residential streets
- 14 feet above main arterial streets.

From: “Pruning and Care of Young and Mature Trees”, Portland Parks and Recreation.

See Appendix C for additional resources on Pruning.
Irrigation System
If a facility has an irrigation system, maintaining it regularly will ensure it works correctly during the drought season when the plants may need to be watered. A well maintained irrigation system will support healthy plant development and reduce unnecessary water use.

General maintenance items on an irrigation system include:
- Inspect the system components for breaks, leaks and blockages and repair them as needed. It is best to do this while the system is running so leaks and other issues are easier to identify.
- Drain the irrigation lines in preparation for the winter season.
- Adjust the system to prevent overspray outside the facility.

Structures
Many of the structures in a facility can become damaged, vandalized, clogged or simply fail over time. All need to be inspected regularly and maintained if there is a problem.

Examples of structural problems:

<table>
<thead>
<tr>
<th>Problem</th>
<th>Solution</th>
<th>Problem</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elbow detached from stand pipe</td>
<td>Elbow re-attached to stand pipe</td>
<td>Liner not attached to wall of facility; downspout pipes not connected to one another</td>
<td>Liner attached to facility wall; splash block added to downspout to reduce erosion</td>
</tr>
</tbody>
</table>
When maintaining a facility, always determine whether it has a liner. If it does, use extra caution to ensure the liner is not punctured during routine maintenance.

Examples of structural problems:

<table>
<thead>
<tr>
<th>Problem</th>
<th>Solution</th>
<th>Problem</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stand pipe cover missing</td>
<td>Stand pipe with basket cover in place</td>
<td>Overflow pipe placed too high; excess stormwater runoff will overflow outside the facility and could cause a public safety hazard.</td>
<td>Overflow pipe at correct height (lower than the outlet) so stormwater can exit the facility safely through the goose neck outlet pipe.</td>
</tr>
<tr>
<td>These check dams have fallen apart and no longer slow down the flow of stormwater in the facility. Rebuild to slow and spread the flow.</td>
<td>This check dam is intact. It prevents erosion, improves filtration and allows water to soak into the ground.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Examples of structural problems (continued):**

<table>
<thead>
<tr>
<th>Problem</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>A check dam that has not been properly installed can cause erosion problems in the facility.</td>
<td>Properly installed check dam&lt;br&gt;  • Check dam material (in this case soil and rock) has been trenched into the swale.  &lt;br&gt;  • Notch in the center of the check dam directs water to overflow in the center of the check dam and not on the sides. (Graphics are not to scale and are not intended to function as check dam specifications. See the facility design plans or contact the local jurisdiction for guidance on check dam installation requirements)</td>
</tr>
<tr>
<td>Problems:&lt;br&gt;  • Check dam material (in this case soil and rock) has NOT been trenched into the swale. This can lead to erosion as the water finds its way around or under the check dam.  &lt;br&gt;  • No notch in the center of the check dam to direct flow away from sides of the swale.</td>
<td></td>
</tr>
<tr>
<td>In this facility, the first check dam has been built too high and is preventing water from entering the middle cell of the swale. Therefore, the facility is not able to manage all the runoff it was designed to treat.</td>
<td>In this facility, all the check dams are built at the correct height so the water flows into each cell of the swale for treatment.</td>
</tr>
</tbody>
</table>

*See Appendix A for a checklist of structural elements that need to be inspected and maintained in a facility.*

---

**All structural repairs need to be implemented by a qualified professional. Tasks that modify the function of the facility or that deviate from the approved plans may need to go through the plan review and permitting process with the local jurisdiction.**
Appendix A: Inspection/Maintenance Checklist*

This checklist reflects the inspection and maintenance activities that are generally recommended for rain gardens, swales and stormwater planters.

Before visiting the site

_____ Review the operations and maintenance plan.
_____ Review the as-built or design report (locations of inlets/outlets, plantings, irrigation, etc.)
_____ Review past inspection and maintenance reports (historical problems, previous observations, etc.)

Hazards

Spills

_____ Record the nature and extent of any spills and the response if it has or could negatively affect stormwater.

Animals/Wildlife

_____ Record any indication of rodents, mosquitoes, other insects or pests.
_____ Fill holes and burrows in and around facility.
_____ Contact animal control specialist to remove or trap animals if they are negatively affecting facility function.

Trash/Debris

_____ Remove trash, debris and other items and dispose of appropriately.

Erosion

_____ Fill erosion channels with approved topsoil or soil mix and stabilize using appropriate methods (erosion control matting, etc.). †
_____ Install or repair energy dissipater at inlet if erosion is occurring there. †
_____ Add/repair check dams (as appropriate). Re-construct check dams as needed to slow flows and spread stormwater across full surface of facility. †
_____ In facilities where mulch is appropriate (e.g. exposed soils), add 2-4 inches mulch above high water mark to prevent erosion. (Check with local jurisdiction on the use of mulch in facilities)
_____ Sweep catchment area to prevent sediment from entering facility (as appropriate).

Sediment

_____ Remove sediment from the surface of the facility when it reaches 2-3 inches in depth.
_____ Remove sediment from inlets (trench drains, curb cuts, area drains and pipes) so water is not prevented from entering facility.
_____ Rake areas of bare soil after removing sediment.
_____ Replace any plants that may have been removed during sediment removal. (see Vegetation section)

* Refer to the site O&M Plan or contact the local jurisdiction to determine the site inspection maintenance checklist required for the facility you are working on.
† Contact the local jurisdiction for possible solutions to erosion issues.
Vegetation

Watering
- If the facility has an irrigation system, adjust the irrigation schedule for each season.
- Inspect plantings during dry periods and look for signs of stress.
- Water plants as needed.
- Adjust irrigation system if there is evidence of overspray outside the facility.

Common Weeds and Invasive Plants
- Remove weeds from the facility (In facilities with liners, this includes volunteer trees that seed themselves into the facility whose roots could damage the underground plumbing and liner).
- To reduce future weeds, add 2-4 inches of mulch above the high water mark (Keeping mulch out of the wet zone prevents it from washing out of the facility and clogging outlets).

Plant Replacement
- Note dead vegetation and determine the reason plant died (lack of water, wrong plant for location, disease, etc.).
- Replace dead vegetation with plants appropriate for the moisture zone and solar exposure. To choose replacement vegetation, see the original planting plan, contact the local jurisdiction, or see the Plant Replacement Section of the Field Guide for plants that work well in LID stormwater facilities.
- Add vegetation to cover large areas of exposed soil or in flow path to prevent erosion.
- When adding new vegetation to the facility, spread 2-4 inches of mulch above the high water mark to reduce competition from weeds (To prevent mulch from washing out of the facility and clogging outlets, do not add mulch to the wet zone of the facility).
- Protect vegetation if there is evidence of animal damage.

Pruning
- Trim trees, shrubs and herbaceous plants as needed (Follow height guidelines on p. 23 of the Field Guide).
- Cut and remove grasses that are lying down (Cut to a height of 10 inches).
- Trim plants to clear inlets and outlets. Clear a 12 inch area at the inlet & outlet.
- Remove pruned material and dispose of appropriately or compost outside the facility.

Irrigation System
- Inspect the system components for breaks, leaks and blockages. Repair as needed.
- Drain the lines in preparation for the winter season.
**Structures**

- Note-document any structures that are damaged or broken.

**Pipes and Under Drains**

- Clean out sediment from clogged pipes, trench drains, underdrains and outlets.
- Replace outlet covers, as appropriate.
- Attach screens on outlet stand pipes to prevent pests and debris from entering storm pipes.
- Jet clean or rotary cut debris/roots from under drains so the pipes can drain and standing water is not present during dry weather.

**Liners**

- Re-attach liners to planter walls to protect building foundations.
- Repair and/or reposition downspout extensions and splash pads to direct stormwater away from building foundations.
- Cover exposed liners with 2 to 4 inches of soil to prevent solar damage.

**Check Dams**

- Replace pipes, as appropriate.
- Repair check dams as needed.
  - Check dams need to spread the flow of stormwater across the entire surface of the facility (or through the notch in the middle) to prevent erosion.
  - Make sure the check dam is at the right height. A check dam that is too high can force water to flow back out of the facility.
# Appendix B: Sample Inspection and Maintenance Log*

This maintenance log reflects the types of inspection and maintenance activities that are generally recommended for rain gardens, swales and stormwater planters.

<table>
<thead>
<tr>
<th>Site name:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Site address:</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Date: (mm/dd/yy)</th>
<th>Crew (names):</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Hours since last storm:</th>
<th># of staff hours at the facility:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>What did you see?</th>
<th>What did you do?</th>
</tr>
</thead>
</table>

## Safety Concerns
- Can you access the facility easily?
- Foreign/dangerous objects?
- Any spilled material/spill potential?
- Vandalism, undesirable activity?
- Evidence of the public entering facility?

## Trash
- Trash, debris, pet waste, etc.?

## Animals/Wildlife
- Any burrows or nests?
- Mosquito larvae?
- Animal droppings?

## Vegetation
- Overgrown vegetation?

*Refer to the site O&M Plan or contact the local jurisdiction to determine the site inspection maintenance log required for the facility you are working on.
<table>
<thead>
<tr>
<th>Vegetation</th>
<th>What did you see?</th>
<th>What did you do?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dead plant count (Trees, shrubs, grasses, etc.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Large areas of bare soil?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weeds? What species? (see Weeds/Invasives section)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>How much of facility covered in weeds?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vegetation or debris obstructing inlets/ outlets?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soil/Erosion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Erosion, undercutting, scouring?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sediment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>How many inches of accumulated sediment?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>How much of the surface area is covered by sediment?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any unusual odors, colors, sheen on the soil?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is the facility flowing and draining as designed?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standing water? (Hours since last rainfall)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Structures</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inlet/Outlet (rusting, cracked, misaligned?)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pipes (clogged, damaged, etc.?)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any problems with other structures? (liner, curb, check dams, grates, fence, etc.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other Observations</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix C: Resources

Photo documentation

Hazards

**Toxic and Poisonous Plants**
AMA Handbook of Poisonous and Injurious Plants (available for purchase online)

Animal and Wildlife


<table>
<thead>
<tr>
<th>Resources for vector control and animal/wildlife issues</th>
<th>Organization:</th>
<th>Phone:</th>
<th>Website:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bees/swarms</td>
<td>Oregon Beekeepers Association</td>
<td></td>
<td><a href="http://www.orsba.org/htdocs/home.php">http://www.orsba.org/htdocs/home.php</a></td>
</tr>
<tr>
<td>Coyotes and other urban wildlife</td>
<td>Portland Audubon Society</td>
<td>503-292-0304</td>
<td><a href="http://audubonportland.org/wcc">http://audubonportland.org/wcc</a></td>
</tr>
<tr>
<td>Other wildlife</td>
<td>Clackamas office</td>
<td>971-673-6000</td>
<td>Clackamas ODFW office (use if east of Willamette River) <a href="http://www.dfw.state.or.us/">http://www.dfw.state.or.us/</a></td>
</tr>
<tr>
<td></td>
<td>Oregon Department of Fish and Wildlife</td>
<td></td>
<td>Sauvie Island ODFW office (use if west of Willamette River) <a href="http://www.dfw.state.or.us/">http://www.dfw.state.or.us/</a></td>
</tr>
<tr>
<td>Vector Control</td>
<td>Clackamas County</td>
<td>503-655-8394</td>
<td><a href="http://www.clackamas.us/vector/">http://www.clackamas.us/vector/</a></td>
</tr>
<tr>
<td></td>
<td>Multnomah County</td>
<td>503-988-3464</td>
<td><a href="http://web.multco.us/health/pest-prevention-and-control">http://web.multco.us/health/pest-prevention-and-control</a></td>
</tr>
</tbody>
</table>
**Sediment**

**Sediment Disposal**
Contact Metro or the Oregon Department of Environmental Quality on the disposal of sediment.

Metro Recycling and Solid Waste Hotline 503-234-3000
http://www.oregonmetro.gov/index.cfm/go/index.cfm/go/by.web/id=571

Oregon Department of Environmental Quality
Call 503-229-5263 or 800-452-4011 and ask for the Solid Waste duty officer.

**Vegetation**

**Weeds, Invasive Plants and Integrated Pest Management**

- For information on early detection and rapid response (EDRR) weeds and recommended treatment methods, see the Oregon Department of Agriculture EDRR website: http://oregon.gov/ODA/PLANT/WEEDS/edrr.shtml
- Weed management schedule, Clean Water Services IPM Plan, Appendix A http://tinyurl.com/cesnydj


**Selecting Plants**

Portland Green Street Plant List:
http://www.portlandonline.com/bes/index.cfm?c=47962&a=380500

**Pruning**

Appendix D: Jurisdiction Contacts

Maintenance requirements for LID facilities vary by jurisdiction. Be sure to contact the appropriate local government representative to determine what is required for the facility.

<table>
<thead>
<tr>
<th>Jurisdiction</th>
<th>Department</th>
<th>Phone</th>
<th>Website</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clackamas County</td>
<td>Development Services</td>
<td>503-742-4567</td>
<td><a href="http://www.clackamas.us/wes/dreview.html">http://www.clackamas.us/wes/dreview.html</a></td>
</tr>
<tr>
<td>Water Environment Services</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clean Water Services (Washington County)</td>
<td>Service Delivery Planning Department</td>
<td>503-681-3600</td>
<td><a href="http://cleanwaterservices.org/pwgf">http://cleanwaterservices.org/pwgf</a></td>
</tr>
<tr>
<td>Gladstone</td>
<td>Public Works</td>
<td>503-656-7957</td>
<td><a href="http://www.ci.gladstone.or.us">http://www.ci.gladstone.or.us</a></td>
</tr>
<tr>
<td>Lake Oswego</td>
<td>Engineering/Public Works</td>
<td>503-635-0270</td>
<td><a href="http://www.ci.oswego.or.us">http://www.ci.oswego.or.us</a></td>
</tr>
<tr>
<td>Milwaukie</td>
<td>Public Works</td>
<td>503-786-7555</td>
<td><a href="http://www.ci.milwaukie.or.us/">http://www.ci.milwaukie.or.us/</a></td>
</tr>
<tr>
<td>Oregon City</td>
<td>Public Works</td>
<td>503-657-0891</td>
<td><a href="http://www.orcity.org">http://www.orcity.org</a></td>
</tr>
<tr>
<td>Sandy</td>
<td>Public Works</td>
<td>503-668-5533</td>
<td><a href="http://www.ci.sandy.or.us">http://www.ci.sandy.or.us</a></td>
</tr>
<tr>
<td>Troutdale</td>
<td>Stormwater</td>
<td>503-674-3300</td>
<td><a href="http://www.ci.troutdale.or.us">http://www.ci.troutdale.or.us</a></td>
</tr>
<tr>
<td>Wilsonville</td>
<td>Natural Resources</td>
<td>503-682-4960</td>
<td><a href="http://www.ci.wilsonville.or.us">http://www.ci.wilsonville.or.us</a></td>
</tr>
<tr>
<td>Wood Village</td>
<td>Public Works</td>
<td>503-489-6859</td>
<td><a href="http://www.ci.wood-village.or.us">http://www.ci.wood-village.or.us</a></td>
</tr>
</tbody>
</table>
## Appendix E: Photo Credits

All photos are credited left to right, top to bottom.

### Front

<table>
<thead>
<tr>
<th>Page</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>© Bureau of Environmental Services Portland OR, EMSWCD, EMSWCD, EMSWCD</td>
<td></td>
</tr>
</tbody>
</table>

### Table of Contents

<table>
<thead>
<tr>
<th>Page</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMSWCD</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Metro, EMSWCD</td>
</tr>
<tr>
<td>2</td>
<td>All three: Metro</td>
</tr>
<tr>
<td>3</td>
<td>Clackamas County Water Environment Services</td>
</tr>
<tr>
<td>4</td>
<td>morgueFile, EMSWCD, © BES Portland OR, EMSWCD, Owain Davies (Creative Commons), EMSWCD</td>
</tr>
<tr>
<td>5</td>
<td>© BES Portland OR, Creative Commons, Richard Barz (Creative Commons), Creative Commons</td>
</tr>
<tr>
<td>6</td>
<td>Joe Mabel (Creative Commons), Clean Water Services, EMSWCD, EMSWCD</td>
</tr>
<tr>
<td>7</td>
<td>EMSWCD, Pacific Landscape Management, Adam Rosenberg (Creative Commons), CWS, Maine Department of Agriculture, USDA APHIS PPQ Archive</td>
</tr>
<tr>
<td>8</td>
<td>EMSWCD</td>
</tr>
<tr>
<td>9-11</td>
<td>All graphics EMSWCD</td>
</tr>
<tr>
<td>12</td>
<td>EMSWCD, EMSWCD, EMSWCD, © BES Portland OR, CWS, CWS</td>
</tr>
<tr>
<td>13</td>
<td>Green Girl LDS, Green Girl LDS, Clackamas County Water Environment Services, CIWS, CWS</td>
</tr>
<tr>
<td>14</td>
<td>EMSWCD, © BES Portland OR, © BES Portland OR, EMSWCD, Green Girl LDS, CWS</td>
</tr>
<tr>
<td>15</td>
<td>© BES Portland OR, © BES Portland OR, EMSWCD, EMSWCD, EMSWCD, EMSWCD, EMSWCD</td>
</tr>
<tr>
<td>16</td>
<td>All four: EMSWCD</td>
</tr>
<tr>
<td>17</td>
<td>Both: EMSWCD</td>
</tr>
<tr>
<td>18</td>
<td>© BES Portland OR, CWS, Clackamas County SWCD, CWS</td>
</tr>
<tr>
<td>19</td>
<td>Clackamas County Water Environment Services, CWS, EMSWCD, Linda McMahan- OSU Extension, Liz West (Creative Commons), CWS, CWS</td>
</tr>
<tr>
<td>20</td>
<td>All three: Clean Water Services</td>
</tr>
<tr>
<td>21</td>
<td>All three: EMSWCD</td>
</tr>
<tr>
<td>22</td>
<td>Both: EMSWCD</td>
</tr>
<tr>
<td>23</td>
<td>© BES Portland OR, © BES Portland OR, © Parks and Recreation, Portland OR, CWS, CWS</td>
</tr>
<tr>
<td>24</td>
<td>Pacific Sports Turf, © BES Portland OR, © BES Portland OR, © BES Portland OR, © BES Portland OR</td>
</tr>
<tr>
<td>25</td>
<td>© BES Portland OR, EMSWCD, Green Girl LDS, East Multnomah SWCD, © BES Portland OR, EMSWCD</td>
</tr>
<tr>
<td>26</td>
<td>All five: EMSWCD</td>
</tr>
</tbody>
</table>

### Back Cover

<table>
<thead>
<tr>
<th>Credits</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>EMSWCD</td>
<td></td>
</tr>
</tbody>
</table>

### Abbreviations:

This page left intentionally blank.