WESTMINSTER

OPERATION AND MAINTENANCE MANUAL

POROUS LANDSCAPE DETENTION FACILITIES

Project Name

Permit Number ENG##-####

Owner's Contact Information

Name: Owner's Name

Phone: Owner's Phone

Email: Owner's Email

Address: Owner's Address

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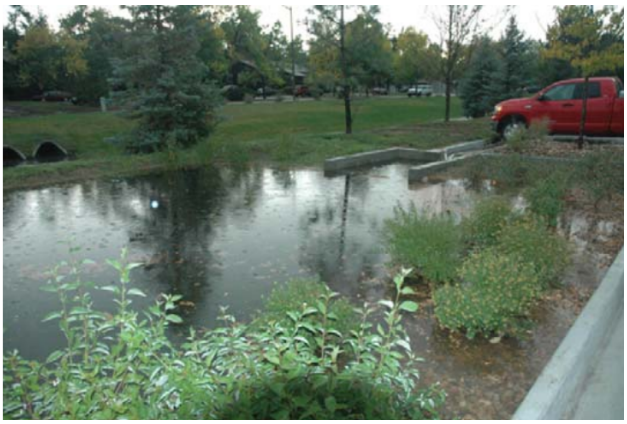
1.0 INTRODUCTION

Porous Landscape Detention Facilities (PLD), which include bioretention and sand filter facilities, are stormwater treatment facilities that remove pollutants by filtering runoff through specialized filter media. During rainfall events, runoff is temporarily ponded on top of the basin as it slowly infiltrates through the filter media

Components of PLD include:

- Inflow points (inlets)
- Forebay/Energy Dissipater
- Filter Media
- Underdrain
- Overflow Outlet Structure
- Embankment/Containment Walls



Typical bioretention with ponded runoff during rain event

Typical Sand Filter

2.0 PROJECT DESCRIPTION

Provide a brief description of the project including total size, basins, and general location of PLD(S). Reference approved drainage report along with the date of approval.

3.0 COMPLIANCE WITH STORMWATER TREATMENT FACILITY REQUIREMENTS

All property owners are responsible for ensuring that stormwater treatment facilities installed on their property are properly maintained and that they function as designed. In some cases, this maintenance responsibility may be assigned to others through special agreements. The maintenance responsibility for a stormwater treatment facility may be designated on the subdivision plat, the official development plan (ODP), and/or within a maintenance agreement for the property. Property owners should be aware of their responsibilities regarding stormwater treatment facility maintenance.

4.0 PREVENTATIVE MEASURES TO REDUCE MAINTENANCE COSTS

The most effective way to maintain your stormwater treatment facility is to prevent the pollutants from entering the facility in the first place. Common pollutants include sediment, trash & debris, chemicals, dog wastes, runoff from stored materials, illicit discharges into the storm system and many others. A thoughtful maintenance program will include measures to address these potential contaminants, and will save money and time in the long run. Key points to consider include:

- Educate property owners/residents to be aware of how their actions affect water quality, and how they can help reduce maintenance costs.
- Keep properties, streets and gutters, and parking lots free of trash, debris, and lawn clippings. Grass clippings should be mulched or bagged. Educate landscape companies.
- Ensure the proper disposal of hazardous wastes and chemicals.
- Plan lawn care to minimize the use of chemicals and pesticides.
- Sweep paved surfaces and put the sweepings back on the lawn.
- Be aware of leaking fluids from vehicles and equipment. Use absorbents such as cat litter to soak up drippings – dispose of properly.
- Re-vegetate disturbed and bare areas to maintain vegetative stabilization.
- Clean out the upstream components of the storm drainage system, including inlets, storm sewers and outfalls.
- Do not store materials outdoors (including landscape materials) unless properly protected from runoff (e.g. sediment control log).

5.0 ANNUAL REPORTING OF INSPECTION & MAINTENANCE

The following must be provided to City of Westminster on an annual basis:

- **Verification that the Stormwater facilities have been properly inspected and maintained; and**
- **Submittal of the required Inspection and Maintenance Forms.**

The annual inspection and maintenance forms will be facilitated through the City's online inspection software (Permitrack, https://www.mypermitrack.com/sehsvc/) and shall be submitted to the City of Westminster prior to May 31st of each year.

6.0 INSPECTING POROUS LANDSCAPE DETENTION FACILITIES

6.1 Access and Easements

Inspection or maintenance personnel may utilize the stormwater facility map located in **Appendix A** containing the location(s) of the access points and maintenance easements of the PLD(s) within the development. Utilization of these access points and maintenance easements ensures safety of personnel and reduces stress on vegetation.

6.2 Safety

Keep safety considerations at the forefront of inspection procedures at all times. Likely hazards should be anticipated and avoided. Never enter a confined space (outlet structure, manhole, etc.) without proper training or equipment. A confined space should never be entered without at least one additional person present. Confined spaces may not have adequate oxygen available or may contain dangerous gases.

If a toxic or flammable substance is discovered, leave the immediate area and contact 911. Nasal passages become desensitized to strong chemical odors within a few minutes. Continued exposure to strong chemicals may cause light headedness and headaches. It is important to leave the area if you encounter strong chemical odors.

Potentially dangerous (e.g., fuel chemicals, hazardous materials) substances found in the areas must be referred to emergency response immediately for response by the Hazardous Materials Unit. The emergency contact number is 911.

Vertical drops may be encountered in areas located within and around the facility. Avoid walking on top of retaining walls or other structures that have a significant vertical drop.

If any hazard is found within the facility area that poses an immediate threat to public safety, contact 911 immediately.

6.3 Field Inspection Equipment

It is imperative that the appropriate equipment is taken to the field with the inspector(s). This ensures the safety of the inspector and allows the inspections to be performed as efficiently as possible. Below is a list of the equipment that may be necessary to perform Stormwater Treatment Facilities inspections:

- Protective clothing (pants and long-sleeved shirt) and boots;
- Safety equipment (vest, hard hat, confined space entry equipment);
- Communication equipment
- Site Operation and Maintenance Manual including Stormwater Treatment Facility maps;
- Equipment to access and perform inspections via online software (tablet, phone, etc.);
- Manhole Lid Remover; and
- Shovel.
- Equipment necessary to store/dispose of material (trash bag, wheel barrel, 5-gallon bucket, etc.)

Some of the items identified may not be needed for the inspection. However, this equipment should be easily accessible (e.g. in your vehicle).

6.4 Stormwater Treatment Facilities Locations

Inspection or maintenance personnel may utilize the stormwater facility map, located in **Appendix A**, which contains the location(s) of the PLD(s) within this development.

6.5 PLD Features

PLD(s) have a number of features that are designed to serve a particular function. Many times the proper function of one feature depends on another. It is important for maintenance personnel to understand the function of each of these features to prevent damage to any feature during maintenance operations. The table below shows a list of the most common features within a bioretention basin and the corresponding maintenance items that can be anticipated

TABLE PLD-1
Typical Inspection and Maintenance Requirements Matrix

Maintenance Types	PLD Features					
	Inflow Points (inlets)	Landscaping	Filter Media	Underdrain System	Outlet Structure	Embank-ment
Sediment Removal	X	X	X		X	
Mowing/ Weed Control		X	X			X
Trash & Debris Removal	X	X	X		X	X
Overgrown Vegetation Removal		X	X			X
Erosion		X	X			X
Removal/Replacement			X	X		
Structural Repair	X				X	

6.5.1 Inflow Point (Inlet)

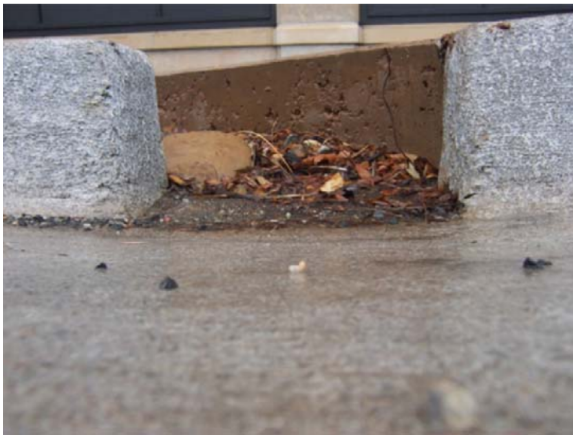
Runoff can enter bioretention/sand filter facilities through a pipe, roof downspout, surface channel, curb-cut or as "distributed" surface overflow.

Check Inlet Elevation

Runoff must be allowed to flow freely into the facility, however the flow path can be obstructed by sediment, debris and landscape materials.

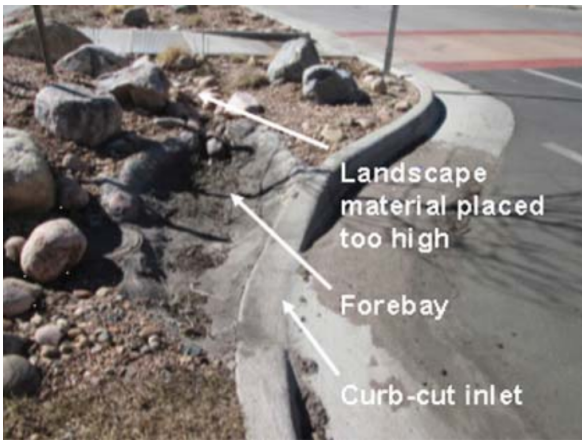
- Check that inflow point is at least 3 inches above the top of the filter media.
- Remove sediment/debris from the inlet and dispose of it in a landfill.

- If landscape materials are higher than the inflow point, remove materials so that there is a 3 inch drop into the basin.



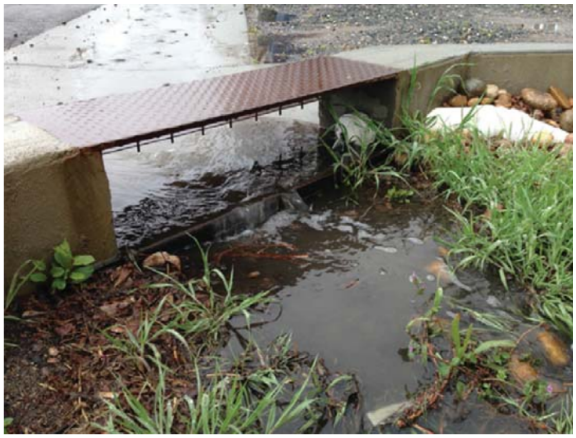
"Curb-cut" inlet with debris blocking the flow path. Landscaping material is higher than the inlet elevation, preventing flow from entering the basin. The excess landscape material near the inlet should be removed to 3 inches below the inlet.

X



Bioretention with curb-cut inlet. Landscape material (downstream of forebay) is placed too high and runoff cannot enter the basin. Landscape material should be lowered about 3 inches below the inlet elevation

X



Bioretention with curb-cut inlet showing 3 inches of "fall" into basin.

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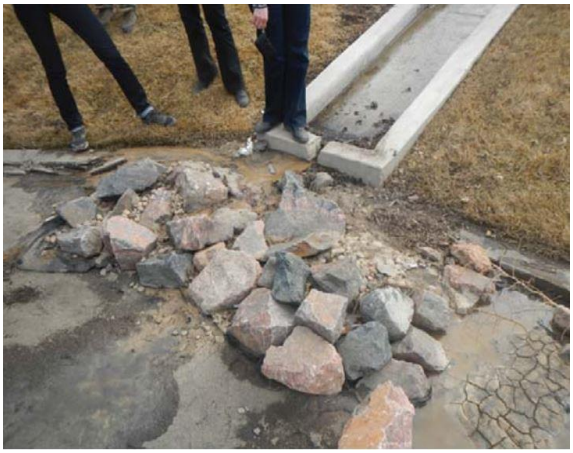
6.5.2 Forebay/Energy Dissipation

The forebay or energy dissipater (if present) will be located directly downstream of the inflow point. The forebay is designed to remove large sediment and debris prior to runoff entering the filter media. Riprap often times serves as an energy dissipater to reduce erosion of the filter media near the inflow point.

Sediment/Trash/Debris Removal

- Remove any sediment, trash, or other debris that has accumulated in the forebay or riprap.
- Dispose of sediment, trash and debris in landfill.
- Most forebays are small and can be maintained using a shovel.
- Sediment removal from riprap and larger forebays may require use of a vacuum truck.

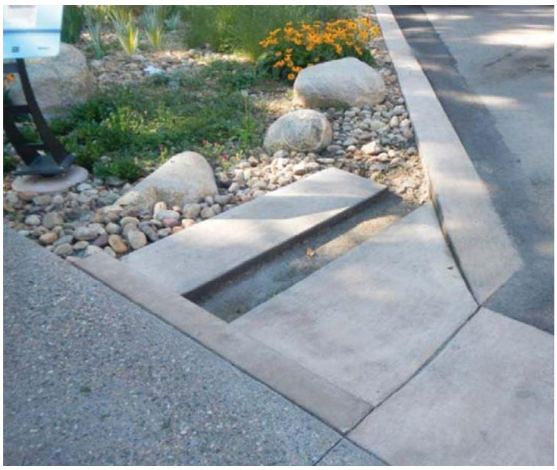


Sand filter with riprap energy dissipater. Sediment that has accumulated near the riprap should be removed periodically.

X

Bioretention forebay that needs sediment and debris removed.

X



Bioretention forebay that has been properly cleaned.

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6.5.3 Filter Media

The filter media is generally 18-36 inches deep and removes pollutants as runoff flows downward through it. For sand filters, the filter media is a specified mix of sand. For bioretention, the filter media is a specified mix of sand, silt/clay, shredded mulch, or other materials.

Infiltration Testing

Filter media removes sediment from runoff and that sediment will eventually clog the filter. An infiltration test should be conducted during each inspection to determine if the filter is too clogged. Several infiltration testing methods are described below.

Method 1

- Visit the site within 24 hours of 0.5 inches (or more) of rainfall. If water is still ponded on top of the filter media, the filter media may be clogged.

Method 2

- Obtain a round, metal cylinder at least 12 inches long.
- Insert (pound) cylinder 2-3 inches into filter media.
- Fill cylinder with 10 inches of water.
- After 1 hour, measure depth of water remaining in cylinder.
- If depth is greater than 5 inches, filter may be clogged.

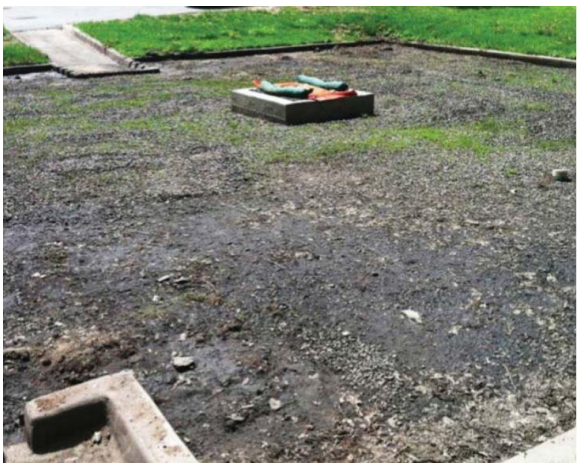
Method 3

- Use infiltration testing tool (such as "TURF-TEC" Infiltrometer) to measure infiltration rate.
- If infiltration rate is less than 1 inch/hour, then filter media may be clogged.

Filter Clogging

If infiltration tests suggest the filter media is clogged, then maintenance to restore adequate infiltration rates must be performed.

- First, scarify (rake) the top 2-3 inches of media to loosen sediment at surface. Perform additional infiltration tests to see if infiltration rates have been restored.
- If there is an obvious "cake-layer" of sediment on top of the filter media, remove the top 1-2 inches of sediment and filter media and dispose of materials in a landfill.
- Once 3-6 inches of filter media have been removed over time (perhaps 5-10 years), add additional filter media back to original elevation. (See filter media material specifications in **Appendix A**).



Sand filter with obvious "cake-layer" of sediment built up over time. This sand filter needs to be maintained by removing 1-2 inches of filter media and sediment throughout the entire basin.

X

Filter Media Replacement

If filter media needs to be replaced, make sure to obtain and install the appropriate materials. * Contact the City of Westminster if you need assistance with this selection. Never drive heavy equipment onto the filter media, it will cause compaction and clog the system.

Sand Filters

- Sand filter media must be washed and clean.
- Use AASHTO C-33 or CDOT Class B material.

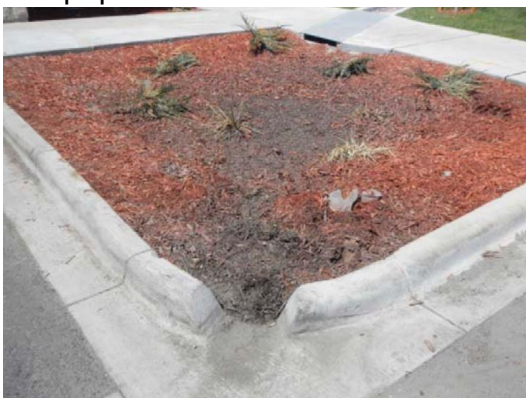
Bioretention

- Check the City of Westminster stormwater design criteria or bioretention media specification in **Appendix A**.
- DO NOT USE 100% topsoil or clay-grown sod.

Filter Media Grading

The filter media should be flat to allow for even distribution of runoff throughout the basin.

- Check for uneven drainage/erosion.
- If filter media is not flat, manually re-grade using rakes or light-weight equipment.



Bioretention with uneven filter media grading. Maintenance is required to re-grade so that filter media is flat.

X

Filter Media/Final Landscaping Elevation

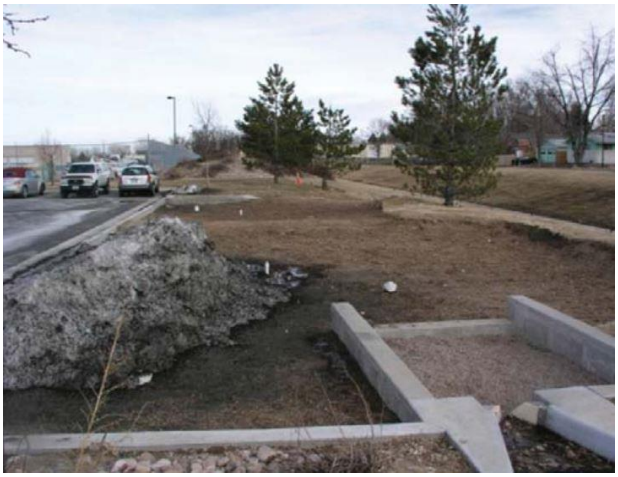
It is common for final landscaping (mulch, rock, etc.) to be placed higher than the inlet elevation in bioretention facilities. This prevents runoff from entering the basin and should be corrected.

- Verify that final landscaping is at least 3 inches below the inlet.
- If landscaping is higher than the inlet, maintenance is necessary to remove landscaping material to the correct elevation.

Snow Storage

Storing snow on top of PLD(s) can clog the filter media.

- Look for indications of snow storage on filter media.
- If snow is being stored on filter media, contact the snow plowing company to discuss alternative snow storage areas.
- It may also be beneficial to install a sign indicating "no Snow Storage" near facility.



Snow should not be stored on bioretention/sand filter facility

X

6.5.4 Underdrain

Underdrains are used in areas where infiltration of runoff into the groundwater beneath the basin is low or not allowed. Underdrains are designed to completely drain the stormwater facility within 12-24 hours and discharge into the outlet structure. NOTE: Not all facilities will have underdrains.

- Underdrains should be inspected to verify they are not clogged.
- During runoff event, check to see if water is flowing freely out of the underdrain, OR
- Use pipe inspection TV to see if debris is clogging underdrain.
- If underdrain clogging is suspected, the underdrain should be cleaned using a jet-vac truck.

Cleanouts

- Verify that cleanout caps are installed and water tight.

Orifice Plate

- Verify that the orifice plate (as shown in picture below) is installed on the end of the underdrain to control rate of discharge.

Water flowing freely from the underdrain discharge point within the outlet structure.

✓

6.5.5 Overflow Outlet Structure

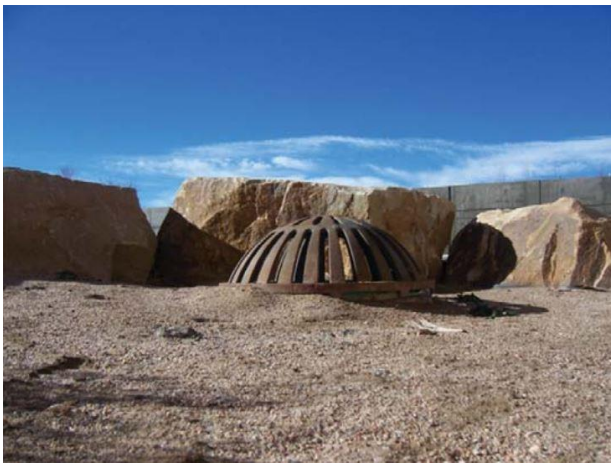
The outlet structure is where runoff that exceeds the facility's storage capacity discharges back to the storm sewer system untreated. It is also the location where the underdrain (if present) will discharge into.

It is a violation of Westminster City Code to modify the outlet structure without approval from the City of Westminster Community Development Department.

Outlet Overflow Elevation

It is important that the overflow elevation of the outlet structure is correct so that water can pond within the facility until it infiltrates through the filter media.

- Measure the distance between the filter media and overflow elevation and compare to the "water quality capture volume" (See **Appendix A**)
- If measured depth is less than design depth, the outlet structure must be modified (Coordinate with the City of Westminster)



Sand filter overflow elevation equal to elevation of the filter media. This facility will not store water on top of the filter media. Original design showed distance of 9 inches between filter media and overflow elevation.

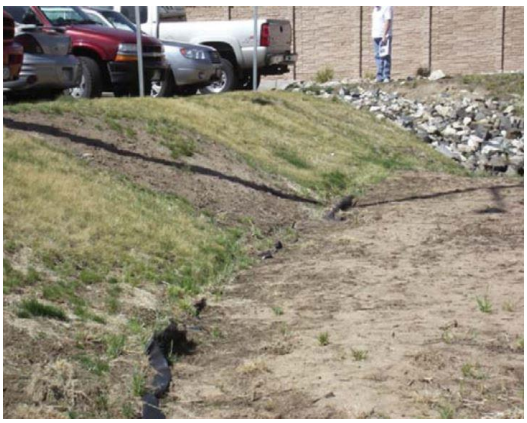
X

6.5.6 Embankments/Containment Walls

Embankments and containment walls allow runoff to pond within the facility to a specific design depth, and also provide protection against pedestrian and vehicle traffic that may compact the filter media over time. Embankments are generally formed with concrete.

Embankment Erosion

- Check for signs of scarce vegetation and/or erosion on embankments. Erosion can add excess sediment to the filter media, resulting in clogging.
- Areas with sparse vegetation should be re-seeded. Temporary erosion control matting and irrigation may be necessary until vegetation is re-established.



Sand filter with sparse vegetation on embankment.

X

Containment Walls

- Check that containment walls fully enclose the entire facility and are not damaged.
- Modifications should be made to repair or install new containment walls if these requirements are not met.

Bioretention cell with partial, concrete containment wall. Runoff will not pond to the proper design depth because the containment wall is not complete

X

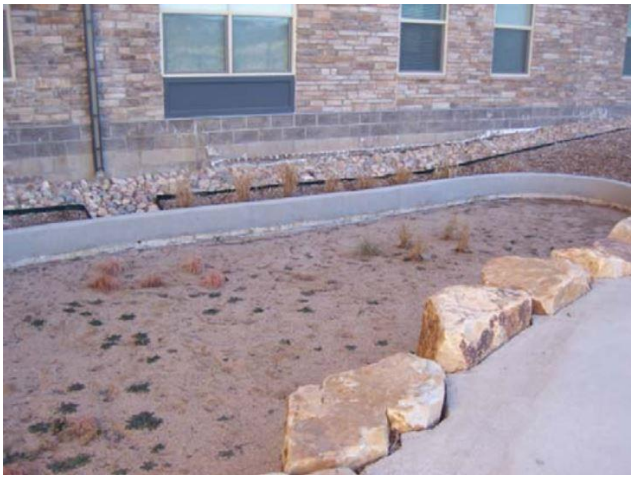
Sand filter with partial "curb" containment wall. Tracks indicate vehicles are parking/driving on top of the sand filter which can cause compaction to filter media

X

6.5.7 Vegetation (Bioretention Only)

Adequate vegetation in bioretention cells provides several important benefits including aesthetic appeal, increased runoff and pollutant reduction and reduced clogging due to root penetration.

- Check that vegetation is healthy and well-dispersed.
- If vegetation is sparse, contact a landscape company to re-vegetate. Temporary erosion control matting and irrigation may be necessary until vegetation is re-established.
- Minimize the use of fertilizers and pesticides on bioretention vegetation. Manually remove weeds when necessary.

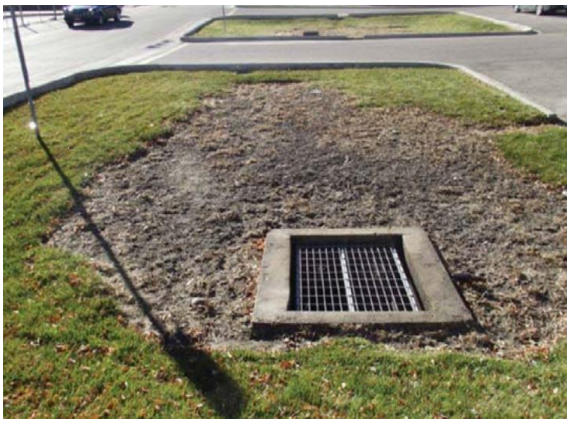


Bioretention with sparse vegetation

X

Dead/Unhealthy Vegetation

- Dead or unhealthy vegetation may be caused by standing water problems in the facility.
- Standing water problems may be caused by clogging of the filter media and/or underdrain system.
- Perform filter media and underdrain tests and maintenance prior to re-vegetating.



Bioretention with dead vegetation

X

Bioretention with healthy and well-dispersed vegetation

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6.6 Inspection and Maintenance Forms

PLD inspections are facilitated within the City's post-construction inspection software, Permitrack (https://www.mypermitrack.com/). The property owner or designee will be set up with login information to this software to conduct inspections. If you are having troubles accessing this inspection software, please reach out the City of Westminster Community Development, Engineering Division (303-658-2400). Each inspection shall be reviewed and submitted by the property owner or property manager to the City of Westminster per the requirements of this Operation and Maintenance Manual. **Refer to section 3.0 for Annual Reporting requirements.**

7.0 MAINTENANCE ACTIVITIES

A typical Porous Landscape Detention Facility Maintenance Program will consist of three broad categories of work. Within each category of work, a variety of maintenance activities can be performed. A maintenance activity can be specific to each feature within the facility, or general to the overall facility.

7.1 Routine Maintenance Activities

The majority of this work consists of regularly scheduled mowing and trash and debris pickups for stormwater treatment facilities during the growing season. This also includes activities such as weed control. These activities normally will be performed

numerous times per year. These items can be completed without any prior correspondence with the City of Westminster; however, completed inspection forms shall be submitted to the City of Westminster by March 31st of each year.

TABLE PLD-2
Summary of Routine Maintenance Activities

Maintenance Activity	Minimum Frequency	Issues to Look For	Maintenance Action
Mowing	Twice annually	Excessive grass height/aesthetics	2"-4" grass height
Trash/Debris Removal	Twice Annually	Trash & debris in bioretention basin	Remove and dispose of trash and debris
Overflow Outlet Works Cleaning	As needed after significant rain events – twice annually min.	Clogged outlet structure; ponding water above outlet elevation	Remove and dispose of debris/trash/ sediment to allow outlet to function properly
Weed Control	As needed, based upon inspection	Noxious weeds; unwanted vegetation	Treat w/ herbicide or hand pull (Consult local weed specialist)

7.2 Minor Maintenance Activities

This work consists of a variety of isolated or small-scale maintenance or operational problems. Most of this work can be completed by a small crew, tools, and small equipment. These items require prior correspondence with the City of Westminster and require inspection/maintenance forms to be submitted to the City. Contact the City of Westminster at 303-658-2400.

TABLE PLD-3
Summary of Minor Maintenance Activities

Maintenance Activity	Minimum Frequency	Issues to Look For	Maintenance Action
Sediment/Pollutant Removal	As needed; based on infiltration test	Sediment build-up/decrease in infiltration rate.	Remove and dispose of sediment

Maintenance Activity	Minimum Frequency	Issues to Look For	Maintenance Action
Erosion Repair	As needed based upon inspection	Rills/gullies forming on embankments.	Repair eroded areas, revegetate & address source of erosion
Jet Vac/Cleaning underdrain system	As needed based upon inspection	Sediment build-up/non-draining system	Clean drains/ Jet Vac if needed

7.3 Major Maintenance Activities

This work consists of larger maintenance/operational problems and failures within the stormwater facilities. All of this work requires consultation with the City of Westminster to ensure the proper maintenance is performed. This work requires that the engineering staff review the original design and construction drawings to assess the situation and determine the necessary maintenance. This work may also require more specialized maintenance equipment, design/details, surveying, or assistance through private contractors and consultants.

TABLE PLD-4
Summary of Major Maintenance Activities

Maintenance Activity	Minimum Frequency	Issues to Look For	Maintenance Action
Major Sediment/Pollutant Removal	As needed based upon inspections	Large quantities of sediment/ reduced pond capacity	Remove and dispose of sediment & repair vegetation as needed
Major Erosion Repair	As needed based upon inspections	Severe erosion including gullies, excessive soil displacement, & areas of settlement/holes	Repair erosion, determine cause, and address to avoid future erosion
Structural Repair	As needed based on inspections	Deterioration and/or damage to structural components – broken concrete,	Structural repair to restore the structure to its original design

Maintenance Activity	Minimum Frequency	Issues to Look For	Maintenance Action
		damaged pipes, outlet structure	
Bioretention Basin Rebuild	As needed, due to failure of facility	Removal of filter media and underdrain system.	Contact City of Westminster

APPENDIX A

SITE PLANS

(NOTE: Add Plans. Don't need to include this page**)**

Plan and Profile Sheet shall include:

- ☐ Location and labels for all major features of PLD(s) (inlet pipe, overflow outlet structure, outlet pipe, etc.)
- ☐ Line work for underdrains
- ☐ Line work for right-of-way lines, lot lines, easements, and tracts
- ☐ Other utilities in vicinity of bioretention facility
- ☐ Contours
- ☐ Cross-reference to Porous Landscape Detention Facility Operation and Maintenance sections

Detail Sheet shall include:

- ☐ WQCV provided by bioretention facility
- ☐ WQCV drain time
- ☐ Bioretention and/or sand filter media specifications
- ☐ Duplicate the following tables from the Operation and Maintenance Manual document:
  - TABLE BF-1 – Typical Inspection and Maintenance Requirements Matrix
  - TABLE BF-2 – Summary of Routine Maintenance Activities
  - TABLE BF-3 – Summary of Minor Maintenance Activities
  - TABLE BF-4 – Summary of Major Maintenance Activities
- ☐ Overflow outlet structure detail/typical cross section
- ☐ Typical bioretention facility cross section (include label for depth of WQCV)
- ☐ Underdrain detail including labels for the depth and type of fill materials, diameter of perforated pipe, and location of cleanouts.
- ☐ Rundown cross section and details (if applicable)