Stormwater Best Management Practices
Inspection and Maintenance Plan (IM Plan)

for:

*Insert Development Name*

Located at:

*Insert Address*

Prepared for:

*Insert Property Owner Name, Address and Phone no.*

Prepared by:

*Insert Name; Address and Phone No.*

Reference:

This plan is adapted from various maintenance manuals developed in the Colorado Front Range.
Stormwater Best Management Practices
Inspection and Maintenance Plan

Table of Contents

I. Compliance with Stormwater Best Management Practices Maintenance Requirements

II. Inspection & Maintenance- Annual Reporting

III. Preventative Measures to Reduce Maintenance Costs

IV. Access and Easements

V. Safety

VI. Field Inspection Equipment

VII. Inspecting Stormwater Best Management Practices
   a. Inspection Procedures
   b. Inspection Report
   c. Verification of Inspection and Form Submittal

VIII. Maintaining Stormwater Best Management Practices
   a. Maintenance Categories
   b. Maintenance Personnel
   c. Maintenance Forms

Maintenance Agreement

Appendix A - General Location and Description of Stormwater Best Management Practices

Appendix B - BMP Standard Operating Procedures (SOP)

Appendix C - Inspection Forms

Appendix D - Maintenance Forms

Appendix E - Annual Inspection and Maintenance Reporting Form

Appendix F - Erosion and Stormwater Quality Control Plan/As-Builts

Appendix G - BMP Maintenance Cost Estimates

Appendix H - PE Certification
Stormwater Best Management Practices
Inspection and Maintenance Plan

I. Compliance with Stormwater Best Management Practices Maintenance Requirements

All property owners are responsible for ensuring that stormwater best management practices (BMPs) or 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 facility may be designated on the subdivision plat, the site development plan, and/or within a maintenance agreement for the property. Property owners should be aware of their responsibilities regarding stormwater facility maintenance and need to be familiar with the contents of this Inspection and Maintenance Plan (IM Plan). Maintenance agreement(s) associated with this property are provided.

In some cases, the Town of Monument may agree to provide the required inspection and maintenance for some stormwater facilities that once the warranty period has ended will become public. In these cases, a Town of Monument maintenance agreement will be included for those facilities that are agreed to be included in the Town of Monument routine maintenance program.

II. Inspection & Maintenance – Annual Reporting

Requirements for the inspection and maintenance of stormwater facilities, as well as reporting requirements are included in this Stormwater Best Management Practices Inspection and Maintenance Plan.

Verification that the stormwater BMPs have been properly inspected and maintained; submittal of the required Inspection and Maintenance Forms shall be provided to the Town on an annual basis. The annual reporting form shall be provided to the Town prior to May 31st of each year.

Copies of the Inspection and Maintenance forms for each of the stormwater BMPs are located in Appendix C and D. A standard annual reporting form is provided in Appendix E. Each form shall be reviewed and submitted by the property owner or property manager to the Town of Monument Public Works.

III. Preventative Measures to Reduce Maintenance Costs

The most effective way to maintain your water quality facility is to prevent the pollutants from entering the facility. Common pollutants include sediment, trash & debris, chemicals, pet wastes, runoff from stored materials, illicit discharges into the storm drainage 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 in your maintenance program 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.
- Ensure the proper use, storage, and disposal of hazardous wastes and chemicals. Promptly clean up and spilled materials and dispose of properly.
- Plan lawn care to minimize and properly use chemicals and pesticides.
- Sweep paved surfaces and put the sweepings back on the lawn.
- Be aware of automobiles leaking fluids. Use absorbents such as cat litter to soak up drippings – dispose of properly.
- Encourage pet owners to clean up pet wastes.
- Re-vegetate disturbed and bare areas to maintain vegetative stabilization.
- Clean any private storm drainage system components, including inlets, storm sewers, and outfalls.
- Do not store materials outdoors (including landscaping materials) unless properly protected from runoff.

IV. Access and Right to Enter

All stormwater management facilities located on the site should have a designated access location. The Town has the right to enter for the purpose of inspecting and for maintaining BMPs whenever the owner has failed to do so.

V. 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, number of personnel, and equipment.

Potentially dangerous (e.g., fuel, chemicals, hazardous materials) substances found in the areas must be referred to emergency services at 911 (non-emergency number is 444-7000). If a toxic or flammable substance is discovered, leave the immediate area and contact the local emergency services at 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 a vertical drop is greater than 48" in height, make the appropriate note/comment on the maintenance inspection form.

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

VI. Field Inspection Equipment

It is imperative that the appropriate equipment is taken to the field with the inspector(s). This is to ensure the safety of the inspector and allow the inspections to be performed as efficiently as possible. Below is a list of the equipment that may be necessary to perform the inspections of all Stormwater BMPs:
• Protective clothing and boots.
• Safety equipment (vest, hard hat, confined space entry equipment [if certified to perform confined space entry]).
• Communication equipment.
• IM Plan for the site.
• Clipboard.
• Stormwater BMP Inspection Forms (See Appendix C).
• Manhole Lid Remover
• Shovel.

Some of the items identified above need not be carried by the inspector (manhole lid remover, shovel, and confined space entry equipment), but should be available in the vehicle driven to the site. Specialized equipment may require specific training related to that equipment and should only be used by trained individuals.

VII. Inspecting Stormwater BMPs
The quality of stormwater entering the waters of the state relies heavily on the proper operation and maintenance of permanent BMPs. Stormwater BMPs must be periodically inspected to ensure that they function as designed. The inspection will determine the appropriate maintenance that is required for the facility.

A. Inspection Procedures

All Stormwater BMPs are required to be inspected a minimum of once per year. Inspections should follow the inspection guidance found in the SOP for the specific type of facility. (Appendix B of this manual).

B. Inspection Report

The person(s) conducting the inspection activities shall complete the appropriate inspection report for the specific facility. Inspection reports are located in Appendix C. A copy of each inspection form shall be kept by the owner a minimum of 5 years and a copy shall be provided to the Town of Monument Public Works Department.

The following information explains how to fill out the Inspection Forms:

General Information

This section identifies the facility location, person conducting the inspection, the date and time the facility was inspected, and approximate days since the last rainfall. Property classification is identified as single-family residential, multi-family residential, commercial, or other.

The reason for the inspection is also identified on the form depending on the nature of the inspection. All facilities must be inspected on an annual basis at a minimum. In addition, all facilities should be inspected after a significant
precipitation event to ensure the facility is draining appropriately and to identify any damage that occurred as a result of the increased runoff.

**Inspection Scoring**

For each inspection item, a score must be given to identify the urgency of required maintenance. The scoring is as follows:

0 =  No deficiencies identified.

1 =  Monitor – Although maintenance may not be required at this time, a potential problem exists that will most likely need to be addressed in the future. This can include items like minor erosion, concrete cracks/spalling, or minor sediment accumulation. This item should be revisited at the next inspection.

2 =  Routine Maintenance Required – Some inspection items can be addressed through the routine maintenance program. This can include items like vegetation management or debris/trash removal.

3 =  Immediate Repair Necessary – This item needs immediate attention because failure is imminent or has already occurred. This could include items such as structural failure of a feature (outlet works, forebay, etc), significant erosion, or significant sediment accumulation. This score should be given to an item that can significantly affect the function of the facility.

N/A This is checked by an item that may not exist in a facility. Not all facilities have all of the features identified on the form (forebay, micro-pool, etc.).

**Inspection Summary/Additional Comments**

Additional explanations to inspection items, and observations about the facility not covered by the form, are recorded in this section.

**Overall Facility Rating**

An overall rating must be given for each facility inspected. The overall facility rating should correspond with the highest score (0, 1, 2, 3) given to any feature on the inspection form.

**C. Verification of Inspection and Form Submittal**

The Stormwater BMP Inspection Form provides a record of inspection of the facility. Inspection Forms for each facility type are provided in Appendix C. Verification of the inspection of the stormwater facilities and the facility inspection form(s) shall be provided to the Town of Monument Public Works Department on an annual basis. The verification and the inspection form(s) shall be reviewed and submitted by the property owner or property manager on behalf of the property owner.
Refer to Section II of this Manual regarding the annual reporting of inspections.

VIII. Maintaining Stormwater BMPs

Stormwater BMPs must be properly maintained to ensure that they operate correctly and provide the water quality treatment for which they were designed. Routine maintenance performed on a frequently scheduled basis, can help avoid more costly rehabilitative maintenance that results when facilities are not adequately maintained.

A. Maintenance Categories

Stormwater BMP maintenance programs are separated into three broad categories of work. The categories are separated based upon the magnitude and type of the maintenance activities performed. A description of each category follows:

Routine Work

The majority of this work consists of scheduled mowings and trash and debris pickups for stormwater management facilities during the growing season. This includes items such as the removal of debris/material that may be clogging the outlet structure well screens and trash racks. It also includes activities such as weed control, mosquito treatment, and algae treatment. These activities normally will be performed numerous times during the year. These items can be completed without any prior correspondence with the Town of Monument Public Works Department; however, inspection and maintenance forms shall be completed with the information also being reported on the annual report forms that are submitted to the Town.

Restoration Work

This work consists of a variety of isolated or small-scale maintenance and work needed to address operational problems. Most of this work can be completed by a small crew, with minor tools, and small equipment. These items do not require prior correspondence with the Town of Monument Public Works Department, but do require that completed maintenance forms be submitted to Town of Monument Public Works Department with the annual report forms.

Rehabilitation Work

This work consists of large-scale maintenance and major improvements needed to address failures within the stormwater BMP. This work requires consultation with the Town of Monument Public Works Department and may require an engineering design with construction plans to be prepared for review and approval by the Town. This work may also require more specialized maintenance equipment, surveying, construction permits or assistance through private contractors and consultants. These items require prior correspondence with the Town of Monument Public Works Department and require that
completed maintenance forms be submitted to the Town of Monument Public Works Department with the annual report forms.

B. Maintenance Personnel

Maintenance personnel should be qualified to properly maintain stormwater BMPs, especially for restoration or rehabilitation work. Inadequately trained personnel can cause additional problems resulting in additional maintenance costs.

C. Maintenance Forms

The Stormwater BMP Maintenance Form provides a record of maintenance activities and includes general cost information to assist property owners in budgeting for future maintenance. Maintenance Forms for each facility type are provided in Appendix D. Maintenance Forms shall be completed by the property owner, management company, or contractor completing the required maintenance items. The form shall then be reviewed by the property owner or an authorized agent of the property owner and submitted on an annual basis by May 31st to the following address:

Town of Monument  
Public Works Department  
645 Beacon Lite Road  
Monument, CO 80132

Refer to Section II of this Manual regarding the annual reporting of inspections and maintenance activities performed.
MAINTENANCE AGREEMENT
APPENDIX A

GENERAL LOCATION AND DESCRIPTION OF STORMWATER BEST MANAGEMENT PRACTICES
General Location and Description of Stormwater Best Management Practices

I. General Site Description

Insert General Site Description (example below)

Residential Site A, Pine Creek Filing 122, is located in Colorado Springs on Lakeview Drive approximately one half mile east of Pine Road. The 78-acre site consists of 331 single-family residential units.

II. General Stormwater Management Description

Insert General Description of stormwater facilities for the site (example below)

All stormwater is conveyed via curb and gutter and conventional reinforced concrete pipe (RCP) storm sewer to two extended detention basins than provide water quality treatment. Flows from the extended detention basins are conveyed in a major drainage way to a regional detention storage facility owned and maintained by the Town of Monument.

III. Stormwater Facilities Site Plan

Inspection or maintenance personnel may utilize the documents in Appendix F for locating the stormwater facilities within this development.

IV. On-Site Stormwater Management Facilities

List all facilities for each of the types (see examples provided below)

a. **Volume Reduction Facilities**

   Residential Site A utilizes Level I MDCIA – All impervious surfaces are routed over grass buffer strips. Gutter downspouts are disconnected from the storm conveyance system and are routed over grassed areas.

b. **Storage Facilities (Detention)**

   Detention for Residential Site A is provided in a Regional Detention Pond, the Pine Creek Pond X, located at Pine Road and Harvest St.

c. **Water Quality Facilities**

   Residential Site A utilizes 2 extended detention basins for providing water quality capture volume for the site.

d. **Source Control Best Management Practices**

   Residential Site A does not include any nonstructural BMPs.
APPENDIX B

BMP STANDARD OPERATING PROCEDURES (SOP)
Standard Operating Procedures for Inspection and Maintenance

Grass Buffers and Grass Swales (GB-GS)

December 2009
# TABLE OF CONTENTS

| GB-GS-1 | BACKGROUND................................................................................................................. | 3 |
| GB-GS-2 | INSPECTING GRASS BUFFERS AND SWALES (GB-GS)......................................................... | 3 |
| GB-GS-3 | MAINTAINING GRASS BUFFERS AND SWALES (GB-GS)....................................................... | 7 |

| GB-GS-2.1 | ACCESS AND EASEMENTS................................................................................................. | 3 |
| GB-GS-2.2 | STORMWATER BEST MANAGEMENT PRACTICE (BMP) LOCATIONS........................................... | 3 |
| GB-GS-2.3 | GRASS BUFFER- GRASS SWALE (GB-GS) FEATURES.......................................................... | 3 |
| GB-GS-2.3.1 | Grass Swale Bottom and Side Slopes/Grass buffer Strips............................................... | 4 |
| GB-GS-2.3.2 | Inflow Points............................................................................................................... | 5 |
| GB-GS-2.3.3 | Underdrain System ..................................................................................................... | 5 |
| GB-GS-2.3.4 | Grade Control Level Spreader....................................................................................... | 6 |
| GB-GS-2.3.5 | Irrigation...................................................................................................................... | 6 |
| GB-GS-2.3.6 | Miscellaneous............................................................................................................. | 6 |
| GB-GS-2.4 | Inspection Forms......................................................................................................... | 7 |
| GB-GS-3.1 | MAINTENANCE PERSONNEL............................................................................................ | 7 |
| GB-GS-3.2 | EQUIPMENT.................................................................................................................. | 7 |
| GB-GS-3.3 | MAINTENANCE FORMS................................................................................................... | 8 |
| GB-GS-3.4 | MAINTENANCE CATEGORIES AND ACTIVITIES.................................................................. | 8 |
| GB-GS-3.5 | ROUTINE MAINTENANCE ACTIVITIES............................................................................. | 8 |
| GB-GS-3.5.1 | Trash/Debris................................................................................................................ | 9 |
| GB-GS-3.5.2 | Mowing.......................................................................................................................... | 10 |
| GB-GS-3.5.3 | Irrigation...................................................................................................................... | 10 |
| GB-GS-3.5.4 | Weed Control............................................................................................................... | 10 |
| GB-GS-3.5.5 | Mosquito Treatment..................................................................................................... | 10 |
| GB-GS-3.5.6 | Level Spreader (Grass Buffer only)............................................................................... | 11 |
| GB-GS-3.5.7 | Rodent Damage.......................................................................................................... | 11 |
| GB-GS-3.6 | RESTORATION MAINTENANCE ACTIVITIES...................................................................... | 11 |
| GB-GS-3.6.1 | Sediment Removal....................................................................................................... | 12 |
| GB-GS-3.6.2 | Erosion Repair............................................................................................................ | 12 |
| GB-GS-3.6.3 | Vegetation Removal..................................................................................................... | 13 |
| GB-GS-3.6.4 | Revegetation.............................................................................................................. | 13 |
| GB-GS-3.6.5 | Irrigation (Automatic)............................................................................................... | 13 |
| GB-GS-3.6.6 | Level Spreader........................................................................................................... | 13 |
| GB-GS-3.6.7 | Fertilization/Soil Amendment.................................................................................... | 14 |
| GB-GS-3.6.8 | Vehicle Tracks............................................................................................................. | 14 |
| GB-GS-3.7 | REHABILITATION MAINTENANCE ACTIVITIES............................................................... | 14 |
| GB-GS-3.7.1 | Major Sediment/Pollutant Removal............................................................................... | 15 |
| GB-GS-3.7.2 | Major Erosion Repair.................................................................................................. | 16 |
| GB-GS-3.7.3 | Structural Repair....................................................................................................... | 16 |
| GB-GS-3.7.4 | Rebuild....................................................................................................................... | 16 |
GB-GS-1  BACKGROUND

Grass Buffers and Grass Swales are common types of Stormwater BMPs utilized within the Front Range of Colorado. Grass Buffers and Grass Swales promote filtration, infiltration, and settling to reduce runoff volume.

**Grass Buffers** are uniformly graded and densely vegetated areas of turf grass. They are designed to accommodate sheet flow rather than concentrated or channelized flow. They are typically located adjacent to impervious areas such as parking lots or along highways and roads. Grass Buffers are designed to evenly distribute runoff across the width of the buffer to achieve uniform sheet-flow conditions. A flow spreader may be incorporated for this purpose. In some cases, grass buffers may have under drain systems.

**Grass Swales** are densely vegetated drainage ways with low-pitched side slopes that collect and convey runoff. Design of their longitudinal slope and cross section forces the flow to be slow and shallow, thereby facilitating sedimentation while limiting erosion. Berms or check dams may be installed perpendicular to the flow to decrease the slope and slow down the flow. Grass swales are used in open space and landscaped areas to collect and convey overland flows, and can be used as an alternative to curb and gutter to collect and convey street flows. Some grass swales are designed with under drain systems.

GB-GS-2  INSPECTING GRASS BUFFERS AND SWALES (GB-GS)

**GB-GS-2.1 Access and Easements**

Inspection and maintenance personnel may utilize the figures located in Appendix E containing the locations of the access points and potential maintenance easements of the GB-GSs within this development.

**GB-GS-2.2 Stormwater Best Management Practice (BMP) Locations**

Inspection and maintenance personnel may utilize the figures located in Appendix E containing the locations of the GB-GSs within this development.

**GB-GS-2.3 Grass Buffer - Grass Swale (GB-GS) Features**

GB-GSs are unique stormwater quality facilities, in that they are typically viewed as landscaping or ground cover, and are often overlooked as water quality treatment facilities. GB-GSs have a number of features that are designed to serve a particular function. It is important for maintenance personnel to understand the function of each of these features. Below is a list of the common features of a Grass Swale or Grass Buffer and the corresponding maintenance inspection items that can be anticipated:
### Table GB-GS-1

#### Typical Inspection & Maintenance Requirements Matrix

<table>
<thead>
<tr>
<th></th>
<th>Sediment Removal</th>
<th>Mowing Weed control</th>
<th>Trash &amp; Debris Removal</th>
<th>Erosion Removal/Replacement</th>
<th>Structural Repair</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swale Bottom</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Side Slope</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Buffer Strip</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Inflows</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Underdrain System</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Grade Control/Level Spreader</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Irrigation System</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

**GB-GS-2.3.1 Grass Swale Bottom and Side Slopes; Grass Buffer Strips**

Grass Swales and Grass Buffers require general maintenance of the turf grass and repair of any rill or gully development. The bottom and side slopes of grass swales and the area of grass buffer strips should be maintained with dense vegetative cover, and should not be eroded or bare. Inspection over the first few years will help to determine if any problems are developing.

*The typical maintenance items that are required at the side slopes and bottoms of grass swales and within grass buffer areas are as follows:*

- **a. Sediment Accumulation** – The purpose of the grass swale or buffer is to slow down flow and allow sedimentation to occur. To prevent a loss in performance of the swale or buffer, sediment that accumulates must be removed on a timely basis.

- **b. Vegetation Sparse** – Grass Swales and Buffers rely on a healthy, dense cover of grass to decrease the flow velocities and promote sedimentation and infiltration. Grasses that are diseased, dying or otherwise damaged should be replaced. All bare areas should be reseeded or patched. Causes which contribute to the damaged grass cover, including lack of adequate irrigation, traces of pedestrian or vehicular traffic, uncontrolled weeds etc., should be identified and remedied.

- **c. Erosion Present** – Lack of adequate vegetative cover or excessive flow velocities may result in rill or gully development, and erosion of the swale or buffer strip. Erosion will require maintenance to prevent further damage to the area and to prevent sediment transport.

- **d. Standing Water/Boggy Areas** – Grass swales and buffers are generally intended to drain and be dry in between rain events. If areas of standing water...
are present, the swale or buffer may need to be evaluated for proper grade to ensure drainage. In some cases, where under drains are used, the under drains should be inspected to ensure that they are not clogged.

GB-GS-2.3.2 Inflow Points

Inflow points are the points of stormwater discharge into the swale or buffer. Inflow points are typically pipe outfalls, other grass swales or buffers, or curb cuts from upstream impervious areas, such as parking lots. Some form of energy dissipation is typically provided immediately downstream of the inflow point into the grass swale or buffer. Energy dissipation devices may include riprap aprons, or flow spreader devices.

*The typical maintenance items that are required at inflow points are as follows:*

a. *Riprap Displaced/Rundown Damaged* – Often, because of the repeated impact/force of water, the riprap can shift and settle. If any portion of the riprap rundown or apron appears to have settled, if soil is present between the riprap, or if the riprap has shifted, maintenance may be required to ensure future erosion is prevented.

b. *Erosion Present/Outfall Undercut* – In some situations, an energy dissipater may have not been provided, or may not have been sized, constructed, or maintained appropriately and erosion has occurred. Any erosion within the vicinity of the inflow point will require maintenance to prevent damage to the structure(s) and sediment transport within the facility.

c. *Sediment Accumulation* – Because of the turbulence in the water created by the energy dissipater, sediment often deposits immediately downstream of the inflow point. To prevent a loss in performance, sediment that accumulates in this area must be removed on a timely basis.

GB-GS-2.3.3 Underdrain System

Some grass swales and buffers that have a flatter slope or soils which do not allow adequate percolation or are in areas with a continuous base flow may have been installed with an underdrain system. Underdrains typically consist of a layer of geotextile fabric, gravel storage area and perforated PVC pipe. The geotextile fabric is utilized to prevent the filter material from entering the underdrain system. The gravel storage area allows for storage of treated stormwater runoff prior to the discharge of the runoff through the perforated PVC pipe.

*The typical maintenance activities that are required for the underdrain system are as follows:*

With proper maintenance of the grassed areas, there should be a minimum amount of maintenance required on the underdrain system. Generally the only maintenance performed on the underdrain system is jet-vac cleaning in the event that it becomes clogged.
GB-GS-2.3.4 Grade Control Level Spreader

Grass swales that are installed in areas with steep longitudinal slopes often necessitate the use of grade control checks or drop structures. Grade control structures are typically either concrete walls or rip rap structures that serve to provide a reinforced drop at specific locations in the channel, reducing the longitudinal slope between the control structures.

Level Spreaders are installed on the upstream of grass buffers to evenly distribute flows along the design length. Level spreaders may consist of slotted curbing, modular block porous pavement, level walls or other spreader devices.

The typical maintenance activities that are required for grade control structures and level spreaders are as follows:

a. Erosion present – Grade control structures and level spreaders are provided to reduce the potential for erosion of the grassed swale or buffer areas. Erosion within the vicinity of the control structure or level spreader indicates that the structure is not functioning as intended and requires maintenance to prevent future erosion and damage.

b. Structural damage – Structural damage can occur at anytime along the life of the facility. Typically, structural damage occurs with the deterioration of concrete, including cracking, spalling or settling and the erosion and deterioration of the riprap structures. Level spreaders may settle unevenly creating low areas, which concentrate the flows.

GB-GS-2.3.5 Irrigation

Grass Buffers and Grass Swales depend on healthy, dense turf grass to function, and therefore require an irrigation system, to provide a consistent water supply. Typically, the condition of the grass cover will provide evidence of the effectiveness and maintenance needs of the irrigation system.

The typical maintenance activities that are required for irrigation systems are as follows:

Irrigation systems will generally require routine periodic maintenance and adjustment to ensure that proper amounts of water are being applied given the weather conditions, and that they are providing coverage to all areas of the grass to eliminate bare spots.

GB-GS-2.3.6 Miscellaneous

There are a variety of inspection/maintenance issues that may not be attributed to a single feature within the GB-GS. This category on the inspection form is for maintenance items that are commonly found in the GB-GS, but may not be attributed to an individual feature.
a. **Access** – Access needs to be maintained.

b. **Public Hazards** – Public hazards include items such as containers of unknown/suspicious substances, and exposed metal/jagged concrete on structures. If any hazard is found within the facility area that poses an immediate threat to public safety, contact the local emergency services at 911 immediately.

c. **Burrowing Animals/Pests**– Prairie dogs and other burrowing rodents may cause damage to the GB-GS features and negatively affect the vegetation within the GB-GS.

d. **Other** – Any miscellaneous inspection/maintenance items not contained on the form should be entered here.

**GB-GS-2.4 Inspection Forms**

GB-GS Inspection forms are located in Appendix C. Inspection forms shall be completed by the person(s) conducting the inspection activities. Each form shall be reviewed and submitted by the property owner or property manager to the Monument Public Works Director per the requirements of the Operations and Maintenance Manual. These inspection forms shall be kept a minimum of 5 years and made available to the Town of Monument upon request.

**GB-GS-3 MAINTAINING GRASS BUFFERS & GRASS SWALES (GB-GS)**

**GB-GS-3.1 Maintenance Personnel**

Maintenance personnel should be experienced to properly maintain GB-GSs. Inadequately trained personnel can cause additional problems resulting in additional maintenance costs.

**GB-GS-3.2 Equipment**

It is imperative that the appropriate equipment and tools are taken to the field with the operations crew. The types of equipment/tools will vary depending on the task at hand. Below is a list of tools, equipment, and material(s) that may be necessary to perform maintenance on a GB-GS:

1.) Mowing Tractors
2.) Trimmers (extra string)
3.) Shovels
4.) Rakes
5.) All Surface Vehicle (ASVs)
6.) Engineers Level (laser)
7.) Erosion Control Blanket(s)
8.) Mulch
9.) Sod or Seed
10.) Illicit Discharge Cleanup Kits
11.) Trash Bags
12.) Approved Inspection and Maintenance Plan

Some of the items identified above may not be needed for every maintenance operation. However, this equipment should be available to the maintenance operations crews should the need arise.

**GB-GS-3.3 Maintenance Forms**

The GB-GS Maintenance Form provides a record of each maintenance operation performed by maintenance contractors. The GB-GS Maintenance Form shall be filled out in the field after the completion of the maintenance operation. Each form shall be reviewed and submitted by the property owner or property manager to the Monument Public Works Director per the requirements of the Inspection and Maintenance Plan. The GB-GS Maintenance form is located in Appendix B.

**GB-GS-3.4 Maintenance Categories and Activities**

A typical GB-GS Maintenance Program will consist of three broad categories of work: Routine, Restoration (minor), and Rehabilitation (major). Within each category of work, a variety of maintenance activities can be performed on a GB-GS. A maintenance activity can be specific to each feature within the GB-GS, or general to the overall facility. This section of the SOP explains each of the categories and briefly describes the typical maintenance activities for a GB-GS.

A variety of maintenance activities are typical of GB-GSs. The maintenance activities range in magnitude from routine trash pickup to the reconstruction of the GB-GS or underdrain system. Below is a description of each maintenance activity, the objectives, and frequency of actions.

**GB-GS-3.5 Routine Maintenance Activities**

The majority of this work consists of scheduled mowing, trash and debris pickups and landscape care for the GB-GS during the growing season. It also includes activities such as weed control. These activities normally will be performed numerous times during the year. These items do not require any prior approval by the Monument Public Works Director, however, completed inspection and maintenance forms shall be submitted to the Monument Public Works Director for each inspection and maintenance period.

The Routine Maintenance Activities are summarized on the following page, and further described in the following sections.
<table>
<thead>
<tr>
<th>Maintenance Activity</th>
<th>Minimum Frequency</th>
<th>Indication Action is Needed:</th>
<th>Maintenance Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trash/Debris Removal</td>
<td>Twice annual and before mowing</td>
<td>Trash &amp; debris in GB-GS</td>
<td>Remove and properly dispose of trash and debris</td>
</tr>
<tr>
<td>Mowing</td>
<td>Routine – as necessary to maintain 2” – 4” grass height</td>
<td>Excessive grass height/aesthetics</td>
<td>2”-4” grass height for turf grass; 4” to 6” for native grass</td>
</tr>
<tr>
<td>Irrigation (Automatic)</td>
<td>Three times annually</td>
<td>Areas of insufficient or excess watering; broken or missing parts</td>
<td>SPRING: start up system; test for even coverage and correct timer settings SUMMER: test for even coverage and correct timer settings FALL: drain and winterized system (follow watering regulations)</td>
</tr>
<tr>
<td>Irrigation (Not Automatic)</td>
<td>As needed to maintain healthy grass</td>
<td>Areas of insufficient or excess watering</td>
<td>Water as needed to maintain healthy grass; (follow watering regulations)</td>
</tr>
<tr>
<td>Weed Control</td>
<td>Minimum twice annually</td>
<td>Noxious weeds; Unwanted vegetation</td>
<td>Treat w/herbicide or hand pull; consult a local Weed Inspector</td>
</tr>
<tr>
<td>Mosquito Treatment</td>
<td>As needed, based upon inspections</td>
<td>Standing water/ mosquito habitat</td>
<td>Perform maintenance to eliminate standing water; Treat w/ EPA approved chemicals</td>
</tr>
<tr>
<td>Level Spreader (Grass Buffer only)</td>
<td>As needed, based upon inspections</td>
<td>Evidence of uneven flow/localized erosion</td>
<td>Look for cause; repair, fill or revegetate areas of erosion</td>
</tr>
<tr>
<td>Rodent Damage</td>
<td>As needed, based upon inspections</td>
<td>Holes, small piles of dirt, raised burrows</td>
<td>Evaluate damage; contact Parks Dept. or Division of Wildlife for guidance</td>
</tr>
</tbody>
</table>

**GB-GS-3.5.1  Trash/Debris Removal**

Trash and debris must be removed from the GB-GS area to allow for proper functioning and to improve aesthetics. This activity must be performed prior to mowing operations.

*Frequency – Routine – Prior to mowing operations and a minimum of twice annually.*
GB-GS-3.5.2 Mowing

Routine mowing of the turf grass embankments is necessary to maintain an appropriate grass height and to improve the overall appearance of the GB-GS. Turf grass should be mowed to a height of 2 to 4 inches (4 – 6 inches for native grass) and shall be bagged to prevent potential contamination of the filter media.

Frequency – Routine – as necessary to maintain grass height.

GB-GS-3.5.3 Irrigation

Irrigation systems should be maintained in proper working order to provide an adequate water supply to support the grass cover. When automatic irrigation systems are not available, alternate methods for providing a water supply during times of drought must be provided.

Automatic irrigation systems should be maintained routinely throughout the growing season to ensure that they are providing the appropriate amounts of water, and are providing complete coverage of the area. Sprinkler heads should be adjusted as necessary, and checked for broken or missing parts.

Frequency - Routine as needed throughout the growing season, plus the following:

- SPRING: Start up the system and test for even coverage and correct timer settings.
- SUMMER: Test for even coverage and correct timer settings.
- FALL: Drain and winterize the system.

GB-GS-3.5.4 Weed Control

Noxious weeds and other unwanted vegetation must be treated as needed throughout the GB-GS. This activity can be performed either through mechanical means (mowing/pulling) or with herbicide. Consultation with a local Weed Inspector is highly recommended prior to the use of herbicide. Herbicides should be utilized sparingly and as a last resort. All herbicide applications should be in accordance with the manufacturer’s recommendations.

Frequency – Routine – As needed based upon inspections.

GB-GS-3.5.5 Mosquito Treatment

GB-GS facilities are intended to drain, and should not have areas of standing water which creates mosquito habitat. Causes of the standing water or boggy conditions should be investigated and remediated as necessary to eliminate the standing water. Only EPA approved chemicals should be applied in accordance with the recommendations of the manufacturer.

Frequency – As needed based upon inspections.
GB-GS-3.5.6 Level Spreader (Grass Buffer only)

Evidence of uneven flow and localized erosion downstream of the level spreader indicate that the flow is not evenly distributed along the length of the spreader. Areas of erosion should be repaired, filled and re-vegetated. Causes for the Erosion should be investigated and repaired.

Frequency – As needed based upon inspections.

GB-GS-3.5.7 Rodent Damage

Small holes, piles of dirt, and raised burrows are evidence of rodent damage. Damaged areas should be repaired and re-vegetated. Consultation with an animal control specialist or the Division of Wildlife may be required for persistent problems.

Frequency – As needed based on inspections.

GB-GS-3.6 Restoration Maintenance Activities

This work consists of a variety of isolated or small-scale maintenance/operational problems. Most of this work can be completed by a small crew, hand tools, and small equipment. These items do not require approval by the Monument Public Works Director. Completed inspection and maintenance forms shall be submitted to the Monument Public Works Director for each inspection and maintenance activity.

Reservation Maintenance Activities are summarized on the following page, and are described in the following sections.
Table GB-GS-3

Summary of Restoration Maintenance Activities

<table>
<thead>
<tr>
<th>Maintenance Activity</th>
<th>Minimum Frequency</th>
<th>Indication Action is Needed:</th>
<th>Maintenance Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sediment Removal</td>
<td>As needed.</td>
<td>Sediment build-up.</td>
<td>Remove and properly dispose of sediment</td>
</tr>
<tr>
<td>Erosion Repair</td>
<td>As needed, based upon inspection</td>
<td>Rills and gullies forming on slopes and other areas</td>
<td>Repair eroded areas &amp; revegetate; address cause</td>
</tr>
<tr>
<td>Vegetation Removal</td>
<td>As needed, based upon inspection</td>
<td>Trees, willows, shrubs impeding flow</td>
<td>Remove vegetation; restore correct grade and surface</td>
</tr>
<tr>
<td>Revegetation</td>
<td>As needed, based upon inspection</td>
<td>Areas without grass</td>
<td>Replace grass by sodding or seeding</td>
</tr>
<tr>
<td>Irrigation (Automatic)</td>
<td>As needed, based upon inspection</td>
<td>Evidence of broken or missing parts</td>
<td>Replace parts and test system</td>
</tr>
<tr>
<td>Level Spreader (Grass Buffer Only)</td>
<td>As needed, based upon inspection</td>
<td>Evidence of uneven flow; erosion; or rills/gullies</td>
<td>Repair sections of level spreader and address cause</td>
</tr>
<tr>
<td>Fertilization or Soil Amendment</td>
<td>As needed, minimize fertilization</td>
<td>Grass with pale color; areas with poor grass growth not due to irrigation problems</td>
<td>Consult with turf specialist; Test soil</td>
</tr>
<tr>
<td>Vehicle Tracks (Along Roadways)</td>
<td>As needed, based upon inspection</td>
<td>Depressions from vehicle tracks; vegetation damage</td>
<td>Repair and fill depressions; sod or seed damaged areas</td>
</tr>
</tbody>
</table>

GB-GS-3.6.1 Sediment Removal

Sediment removal is necessary to ensure proper function of the grass swale or buffer. Care should be taken when removing sediment to prevent damage to the turf grass and surrounding areas. Excessive amounts of sediment are an indication of upstream erosion or lack of adequate BMPs during construction activities. Causes for contributions of excess sediment should be investigated and addressed.

*Frequency – As needed based upon inspections.*

GB-GS-3.6.2 Erosion Repair

The repair of eroded areas is necessary to ensure the proper functioning of the GB-GS, to minimize sediment transport, and to reduce potential impacts to other features. Erosion can vary in magnitude from minor repairs to vegetation and embankments, to rills and gullies in the embankments and inflow points. The
Repair of eroded areas may require the use of excavators, riprap, concrete, and sod. Extreme care should be taken when utilizing motorized or heavy equipment to ensure damage to the underdrain system does not occur. Major erosion in a GS-GB is generally the result of excessive velocities caused by steep slopes. It may be necessary to make design improvements to the swale or buffer when erosion becomes a major maintenance item.

*Frequency* – As necessary, based upon inspections.

**GB-GS-3.6.3 Vegetation Removal**

Weeds, Shrubs, Willows and other unwanted vegetation that develops in the grass swale or buffer area may impede the flow and cause standing water or back flow problems. It is necessary to remove unwanted vegetation as soon as it appears. Remove the unwanted vegetation, and restore the correct grade. Revegetate with seed or sod.

*Frequency* – As necessary, based upon inspections.

**GB-GS -3.6.4 Revegetation**

Bare areas should be repaired as soon as possible. Repair bare areas with grass or sod. Causes of the problem, such as inadequate water supply or diseased grasses, should be investigated and resolved.

*Frequency* – As necessary, based upon inspections.

**GB-GS-3.6.5 Irrigation (Automatic)**

Irrigation systems require routine maintenance in accordance with the manufacturer’s recommendations (valves, timer, etc.), and maintenance of the pipe and heads to ensure that even coverage is being applied, and that there are no missing or broken parts. Timing systems should be checked to verify that the correct amount of water is being applied to the grassed areas for the seasonal conditions.

*Frequency* – As necessary, based upon inspections.

**GB-GS-3.6.6 Level Spreader**

Level Spreaders that are no longer level, or have developed damaged areas of cracking or spalling, allow flows to concentrate in these depressed areas instead of being distributed over the length of the structure. Also, build up of grasses along the edge of the spreader may create an uneven flow distribution. Rills, gullies and other erosion that develops downstream of level spreaders should be repaired and reseeded or sodded. Causes of the erosion should be investigated and addressed.

*Frequency* – As necessary, based upon inspections.
GB-GS-3.6.7  **Fertilization/Soil Amendment**

Grass Buffers and Swales rely on healthy, dense turf in order to function properly. Grasses that appear to be diseased, dying or unhealthy may require amendments. Fertilizers should be applied in the minimum amounts Recommended by the manufacturer.

*Frequency* – As necessary, based upon inspections.

GB-GS-3.6.8  **Vehicle Tracks**

GB-GSs that are adjacent to roadway sections may be damaged by vehicle tracks. Rutted areas should be filled in and re-vegetated as soon as possible. Frequent problems associated with vehicle traffic (such as around corners) may require a barrier or sign to avoid vehicular traffic within the grassed areas.

*Frequency* – As necessary, based upon inspections.

**GB-GB-3.7 Rehabilitation Maintenance Activities**

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

Rehabilitation Maintenance Activities are summarized on the following page, and are described in the following sections.
Table GB-GS-4
Summary of Rehabilitation Maintenance Activities

<table>
<thead>
<tr>
<th>Maintenance Activity</th>
<th>Minimum Frequency</th>
<th>Look for:</th>
<th>Maintenance Action</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Major Sediment/Pollutant Removal</strong></td>
<td>As needed – based upon scheduled inspections</td>
<td>Large quantities of sediment</td>
<td>Remove and dispose of sediment. Repair vegetation as needed</td>
</tr>
<tr>
<td><strong>Major Erosion Repair</strong></td>
<td>As needed – based upon scheduled inspections</td>
<td>Severe erosion including gullies, excessive soil displacement, areas of settlement, holes</td>
<td>Repair erosion – find cause of problem and address to avoid future erosion</td>
</tr>
<tr>
<td><strong>Structural Repair</strong></td>
<td>As needed – based upon scheduled inspections</td>
<td>Deterioration and/or damage to structural components – level spreader, grade control structures, irrigation components, and ponding water.</td>
<td>Structural repair to restore the structure to its original design</td>
</tr>
<tr>
<td><strong>GB-GS Rebuild</strong></td>
<td>As needed – due to complete failure of PLD</td>
<td>Removal of filter media and underdrain system</td>
<td>Contact Town of Monument Director of Development Services</td>
</tr>
</tbody>
</table>

**GB-GS-3.7.1 Major Sediment/Pollutant Removal**

Major sediment removal consists of removal of large quantities of pollutants/sediment /landscaping material. Stormwater sediments removed from GB-GSs do not meet the regulatory definition of “hazardous waste”. However, these sediments can be contaminated with a wide array of organic and inorganic pollutants and handling must be done with care to insure proper removal and disposal. Sediments should be transported by motor vehicle only after they are dewatered. All sediments must be taken to a licensed landfill for proper disposal. Should a spill occur during transportation, prompt and thorough cleanup and disposal is imperative. Vegetated areas need special care to ensure design volumes and grades are preserved or may need to be replaced due to the removal activities.

*Frequency* – Non-routine – Repair as needed, based upon inspections.
GB-GS-3.7.2   Major Erosion Repair

Major erosion repair consists of filling and re-vegetating areas of severe erosion. Determining the cause of the erosion as well as correcting the condition that caused the erosion should also be part of the erosion repair. Care should be given to ensure design grades and volumes are preserved.

Frequency – Non-routine – Repair as needed, based upon inspections.

GB-GS-3.7.3   Structural Repair

A GB-GS generally includes level spreader and grade control structure that can deteriorate or be damaged during the service life of the facility. These structures are constructed of steel and concrete that can degrade or be damaged and may need to be repaired or re-constructed from time to time. Major repairs to structures may require input from a structural engineer and specialized contractors. Consultation with the Monument Director of Development Services shall take place prior to all structural repairs.

Frequency – Non-routine – Repair as needed, based upon inspections.

GB-GS-3.7.4   GB-GS Rebuild

In very rare cases, a GB-GS may need to be rebuilt. Generally, the need for a complete rebuild is a result of improper construction, improper maintenance resulting in structural damage to the underdrain system, or extensive contamination of the GB-GS. Consultation with the Monument Director of Development Services shall take place prior to any rebuild project.

Frequency – Non-routine – As needed based upon inspections.

Reference:
This Manual is adapted from the SEMSWA (2007) and the Douglas County, Colorado (2005), Standard Operating Procedure for Extended Detention Basin (EDB) Inspection and Maintenance
Standard Operating Procedures for Inspection and Maintenance

Porous Landscape Detention (PLDs)

December 2009
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>TABLE</th>
<th>Page No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLD-1 BACKGROUND</td>
<td>3</td>
</tr>
<tr>
<td>PLD-2 INSPECTING POROUS LANDSCAPE DETENTION (PLD)</td>
<td>3</td>
</tr>
<tr>
<td>PLD-2.1 ACCESS AND EASEMENTS</td>
<td>3</td>
</tr>
<tr>
<td>PLD-2.2 STORMWATER BEST MANAGEMENT PRACTICE (BMP) LOCATIONS</td>
<td>3</td>
</tr>
<tr>
<td>PLD-2.3 POROUS LANDSCAPE DETENTION (PLD) FEATURES</td>
<td>3</td>
</tr>
<tr>
<td>PLD-2.3.1 Inflow Points</td>
<td>4</td>
</tr>
<tr>
<td>PLD-2.3.2 Landscaping</td>
<td>5</td>
</tr>
<tr>
<td>PLD-2.3.3 Filter Media</td>
<td>5</td>
</tr>
<tr>
<td>PLD-2.3.4 Underdrain System</td>
<td>6</td>
</tr>
<tr>
<td>PLD-2.3.5 Overflow Outlet Works</td>
<td>7</td>
</tr>
<tr>
<td>PLD-2.3.6 Embankments</td>
<td>7</td>
</tr>
<tr>
<td>PLD-2.3.7 Miscellaneous</td>
<td>8</td>
</tr>
<tr>
<td>PLD-2.4 INSPECTION FORMS</td>
<td>8</td>
</tr>
<tr>
<td>PLD-3 MAINTAINING POROUS LANDSCAPE DETENTION (PLD)</td>
<td>8</td>
</tr>
<tr>
<td>PLD-3.1 MAINTENANCE PERSONNEL</td>
<td>8</td>
</tr>
<tr>
<td>PLD-3.2 EQUIPMENT</td>
<td>8</td>
</tr>
<tr>
<td>PLD-3.3 PLD MAINTENANCE FORMS</td>
<td>9</td>
</tr>
<tr>
<td>PLD-3.4 PLD MAINTENANCE CATEGORIES AND ACTIVITIES</td>
<td>9</td>
</tr>
<tr>
<td>PLD-3.5 ROUTINE MAINTENANCE ACTIVITIES</td>
<td>10</td>
</tr>
<tr>
<td>PLD-3.5.1 Mowing</td>
<td>10</td>
</tr>
<tr>
<td>PLD-3.5.2 Trash/Debris Removal</td>
<td>10</td>
</tr>
<tr>
<td>PLD-3.5.3 Overflow Outlet Works Cleaning</td>
<td>11</td>
</tr>
<tr>
<td>PLD-3.5.4 Weed Control</td>
<td>11</td>
</tr>
<tr>
<td>PLD-3.6 RESTORATION MAINTENANCE ACTIVITIES</td>
<td>11</td>
</tr>
<tr>
<td>PLD-3.6.1 Sediment/Pollutant Removal</td>
<td>12</td>
</tr>
<tr>
<td>PLD-3.6.2 Erosion Repair</td>
<td>13</td>
</tr>
<tr>
<td>PLD-3.6.3 Jet-Vac Cleaning Drains</td>
<td>13</td>
</tr>
<tr>
<td>PLD-3.7 REHABILITATION MAINTENANCE ACTIVITIES</td>
<td>13</td>
</tr>
<tr>
<td>PLD-3.7.1 Major Sediment/Pollutant Removal</td>
<td>14</td>
</tr>
<tr>
<td>PLD-3.7.2 Major Erosion Repair</td>
<td>15</td>
</tr>
<tr>
<td>PLD-3.7.3 Structural Repair</td>
<td>15</td>
</tr>
<tr>
<td>PLD-3.7.4 PLD Rebuild</td>
<td>15</td>
</tr>
</tbody>
</table>
PLD-1  BACKGROUND

Porous Landscape Detention (PLD) is a common type of Stormwater BMP utilized within the Front Range of Colorado. PLDs consist of a low-lying vegetated area underlain by a sand bed with an underdrain pipe. A shallow surcharge zone exists above the PLD for temporary storage of the Water Quality Capture Volume (WQCV). During a storm, accumulated runoff ponds in the vegetated zone and gradually infiltrates into the underlying sand bed, filling the void spaces of the sand. The underdrain gradually dewatered the sand bed and discharges the runoff to a nearby channel, swale, or storm sewer. The PLD provides for filtering, adsorption, and biological uptake of constituents in stormwater. The popularity of PLDs has increased because they allow the WQCV to be provided on a site that has little open area available for stormwater management.

PLD-2  INSPECTING POROUS LANDSCAPE DETENTION (PLD)

PLD-2.1  Access and Easements

Inspection or maintenance personnel may utilize the figures located in Appendix F containing the locations of the access points and potential maintenance easements of the PLDs within this development.

PLD-2.2  Stormwater Best Management Practice (BMP) Locations

Inspection or maintenance personnel may utilize the figures located in Appendix F containing the locations of the PLDs within this development.

PLD-2.3  Porous Landscape Detention (PLD) Features

PLDs 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. Below is a list and description of the most common features within a PLD and the corresponding maintenance inspection items that can be anticipated:

---

1 Design of Stormwater Filtering Systems, Centers for Watershed Protection, December 1996
## Table PLD-1

### Typical Inspection & Maintenance Requirements Matrix

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Inflow Points</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Landscaping</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Filter Media</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Underdrain System</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Overflow Outlet Works</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Embankment</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### PLD-2.3.1 Inflow Points

Inflow points or outfalls into PLDs are the point of stormwater discharge into the facility. An inflow point is commonly a curb cut with a concrete or riprap rundown. In limited cases, a storm sewer pipe outfall with a flared end section may be the inflow point into the PLD.

An energy dissipater (riprap or concrete wall) is typically immediately downstream of the discharge point into the PLD to protect the PLD from erosion. In some cases, the storm sewer outfall can have a toe-wall or cut-off wall immediately below the structure to prevent undercutting of the outfall from erosion.

The typical maintenance items that are required at inflow points are as follows:

- **a. Riprap Displaced** – Many times, because of the repeated impact/force of water, the riprap can shift and settle. If any portion of the riprap rundown or apron appears to have settled, soil is present between the riprap, or the riprap has shifted, maintenance may be required to ensure future erosion is prevented.

- **b. Erosion Present/Outfall Undercut** – In some situations, the energy dissipater may not have been sized, constructed, or maintained appropriately and erosion has occurred. Any erosion within the vicinity of the inflow point will require maintenance to prevent damage to the structure(s) and sediment transport within the facility. It is imperative that material utilized to correct erosion problems within the filter media meets the requirements for filter media as shown on the approved construction drawings.

- **d. Sediment Accumulation** – Because of the turbulence in the water created by the energy dissipater, sediment often deposits immediately downstream of the inflow point. To prevent a loss in performance of the upstream infrastructure, sediment that accumulates in this area must be removed on a timely basis.
e. Structural Damage – Structural damage can occur at anytime during the life of the facility. Typically, for an inflow, the structural damage occurs to the concrete or riprap rundown or pipe flared end section (concrete or steel). Structural damage can lead to additional operating problems with the facility, including loss of hydraulic performance.

PLD-2.3.2 Landscaping

The landscaped area consists of specific plant materials and associated landscaping mulch in the bottom of the PLD. These plantings provide several functions for the PLD. Planting not only provides an aesthetic value for the PLD, but in many cases assists with biological uptake or removal of pollutants.

The plants are carefully selected for use in the PLDs. Plants utilized in PLDs must be able to grow in dry sandy soils but also be able to withstand frequent inundation by stormwater runoff. These plants also must be able to withstand a variety of pollutants commonly found in stormwater runoff. In addition, plants utilized in PLDs cannot have a deep extensive root system that may cause maintenance difficulty or damage to the facility.

The typical maintenance activities that are required within the landscape areas are as follows:

a. Woody Growth/Weeds Present – Undesirable vegetation can grow in and around the landscaped area in the PLD that can significantly affect the performance of the facility. This type of vegetation includes dense areas of shrubs (willows), grasses and noxious weeds. If undesired vegetation is not routinely mowed/removed, the growth can cause debris/sediment to accumulate, resulting in blockage of the filter media. Also, shrub, grass and weed roots can cause damage to the filter media and underdrain system. Routine management is essential to prevent more extensive and costly future maintenance.

b. General Landscape Care – The landscape elements of the PLD are the same as any other landscape area and need to be provided with regular care. Landscape mulch will need to be removed and replaced to ensure the aesthetics of the PLD.

PLD-2.3.3 Filter Media

The filter media is the main pollutant removal component of the PLD. The filter media consists of 18-inches of a mixture of washed sand and peat. The filter media removes pollutants through several different processes, including sedimentation, filtration, absorption, infiltration and microbial uptake.

Sedimentation is accomplished by the slow release of stormwater runoff through the filter media. This slow release allows sediment particles to be deposited on the top layer of the filter media where they are easily removed through routine maintenance. Other pollutants are also removed through this process because many pollutants utilize sediment as a transport mechanism.
Filtration is the main pollutant removal mechanism of PLDs. When the stormwater runoff migrates down through the filter media, many of the particulate pollutants are physically strained out as they pass through the filter bed of sand and are trapped on the surface or among the pores of the filter media.²

Absorption results from the peat utilized in the filter media. Organic materials have a natural ability to attach to soluble nutrients, metals and organic pollutants. This attachment then prevents these pollutants from leaving the PLD.

PLDs that are not lined with an impervious liner allow for infiltration into the native soils. This process also allows for additional pollutant removal.

Microbes that naturally occur in the filter media can assist with pollutant removal by breaking down organic pollutants.

The typical maintenance activities that are required within the filter media areas are as follows:

a. Infiltration Rate Check – The infiltration rate of the PLD needs to be checked in order to ensure proper functioning of the PLD. Generally, a PLD should drain completely within 12-hours of a storm event. If drain times exceed the 12-hour drain time then maintenance of the filter media shall be required.

b. Sediment Removal – Although PLDs should not be utilized in areas where large concentrations of sediment may enter the PLD, it is inevitable that some sediment will enter the PLD.

c. Filter Replacement - The top layers of the filter media are the most susceptible to pollutant loading and therefore may need to be removed and disposed of properly on a semi-regular basis when infiltration rates slow.

PLD-2.3.4 Underdrain System

The underdrain system consists of a layer of geotextile fabric, gravel storage area and perforated PVC pipes. The geotextile fabric is utilized to prevent the filter media from entering the underdrain system. The gravel storage area allows for storage of treated stormwater runoff prior to the discharge of the runoff through the perforated PVC pipe.

The typical maintenance activities that are for the underdrain system are as follows:

With proper maintenance of the landscape areas and filter media, there should be a minimum amount of maintenance required on the underdrain system. Generally the only maintenance performed on the underdrain system is jet-vac cleaning.

² Design of Stormwater Filtering Systems, Centers for Watershed Protection, December 1996
Overflow Outlet Works

Generally, the initial runoff ("first flush") or WQCV during the storm event contains the majority of the pollutants. PLDs are designed to treat only the WQCV and any amount over the WQCV is allowed to go to a detention facility without water quality treatment. The overflow outlet works allows runoff amounts over the WQCV to exit the PLD to the detention facility. The outlet works is typically constructed of a reinforced concrete box in the embankment of the PLD. The concrete structure typically has a steel grate to trap litter and other debris from entering the storm sewer system. Proper inspection and maintenance of the outlet works is essential in ensuring the long-term operation of the PLD.

The most typical maintenance items that are found with overflow outlet works are as follows:

a. Structural Damage - The overflow outlet structure is primarily constructed of concrete, which can crack, spall, and settle. The steel grate on the overflow outlet structure is also susceptible to damage.

b. Woody Growth/Weeds Present – The presence of plant material not part of the original landscaping, such as wetland plants or other woody growth, can clog the overflow outlet works during a larger storm event, causing flooding damage to adjacent areas. This plant material may indicate a clogging of the filter media and may require additional investigation.

c. Trash/Debris – Trash and debris can accumulate in the upper area after large events, or from illegal dumping. Over time, this material can clog the PLD outlet works.

Embankments

Some PLDs utilize irrigated turf grass embankment to store the WQCV.

The typical maintenance activities that are required with the embankments areas are as follows:

a. Vegetation Sparse – The embankments are one of the most visible parts of the PLD, and therefore aesthetics is important. Adequate and properly maintained vegetation can greatly increase the overall appearance of the PLD. Vegetation can reduce the potential for erosion and subsequent sediment transport to the filter media, thereby reducing the need for more costly maintenance.

b. Erosion – Inadequate vegetative cover may result in erosion of the embankments. Erosion that occurs on the embankments can cause clogging of the filter media.
PLD-2.3.7 Miscellaneous

There are a variety of inspection/maintenance issues that may not be attributed to a single feature within the PLD. This category on the inspection form is for maintenance items that are commonly found in the PLD, but may not be attributed to an individual feature.

a. Access – Access needs to be maintained.

b. Graffiti/Vandalism – Vandals can cause damage to the PLD infrastructure. If criminal mischief is evident, the inspector should forward this information to the local emergency agency.

c. Public Hazards – Public hazards include items such as containers of unknown/suspicious substances, and exposed metal/jagged concrete on structures. If any hazard is found within the facility area that poses an immediate threat to public safety, contact the local emergency services at 911 immediately.

d. Other – Any miscellaneous inspection/maintenance items not contained on the form should be entered here.

PLD-2.4 Inspection Forms

PLD inspection forms are located in Appendix C. Inspection forms shall be completed by the person(s) conducting the inspection activities. Each form shall be reviewed and submitted by the property owner or property manager to the Monument Public Works Director per the requirements of the Operations and Maintenance Manual. These inspection forms shall be kept a minimum of 5 years and made available to the Town of Monument upon request.

PLD-3 MAINTAINING POROUS LANDSCAPE DETENTION (PLD)

PLD-3.1 Maintenance Personnel

Maintenance personnel should be experienced to properly maintain PLDs. Inadequately trained personnel can cause additional problems resulting in additional maintenance costs.

PLD-3.2 Equipment

It is imperative that the appropriate equipment and tools are taken to the field with the operations crew. The types of equipment/tools will vary depending on the task at hand. Below is a list of tools, equipment, and material(s) that may be necessary to perform maintenance on a PLD:

1.) Mowing Tractors
2.) Trimmers (extra string)
3.) Shovels
4.) Rakes
5.) All Surface Vehicle (ASVs)
6.) Skid Steer
7.) Back Hoe
8.) Track Hoe/Long Reach Excavator
9.) Dump Truck
10.) Jet-Vac Machine
11.) Engineers Level (laser)
12.) Riprap (Minimum - Type M)
13.) Geotextile Fabric
14.) Erosion Control Blanket(s)
15.) Sod
16.) Illicit Discharge Cleanup Kits
17.) Trash Bags
18.) Tools (wrenches, screw drivers, hammers, etc)
19.) Confined Space Entry Equipment
20.) Approved Inspection and Maintenance Plan
21.) ASTM C-33 Sand
22.) Peat
23.) Wood Landscaping Mulch

Some of the items identified above may not be needed for every maintenance operation. However, this equipment should be available to the maintenance operations crews should the need arise.

**PLD-3.3 PLD Maintenance Forms**

The PLD Maintenance Form provides a record of each maintenance operation performed by maintenance contractors. The PLD Maintenance Form shall be filled out in the field after the completion of the maintenance operation. Each form shall be reviewed and submitted by the property owner or property manager to the Monument Public Works Director per the requirements of the Inspection and Maintenance Plan. The PLD Maintenance form is located in Appendix D.

**PLD-3.4 PLD Maintenance Categories and Activities**

A typical PLD Maintenance Program will consist of three broad categories of work: Routine, Restoration (minor), and Rehabilitation (major). Within each category of work, a variety of maintenance activities can be performed on a PLD. A maintenance activity can be specific to each feature within the PLD, or general to the overall facility. This section of the SOP explains each of the categories and briefly describes the typical maintenance activities for a PLD.
A variety of maintenance activities is typical of PLDs. The maintenance activities range in magnitude from routine trash pickup to the reconstruction of the PLD filter media or underdrain system. Below is a description of each maintenance activity, the objectives, and frequency of actions:

**PLD-3.5 Routine Maintenance Activities**

The majority of this work consists of scheduled mowings, trash and debris pickups and landscape care for the PLD during the growing season. It also includes activities such as weed control. These activities normally will be performed numerous times during the year. These items do not require any prior approval by the Monument Public Works Director; however, completed inspection and maintenance forms shall be submitted to the Monument Public Works Director for each inspection and maintenance activity. The Routine Maintenance Activities are summarized below, and further described in the following sections.

**Table PLD-2**

Summary of Routine Maintenance Activities

<table>
<thead>
<tr>
<th>Maintenance Activity</th>
<th>Minimum Frequency</th>
<th>Look for:</th>
<th>Maintenance Action</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Twice annually</td>
<td>Excessive grass height/aesthetics</td>
<td>2”-4” grass height</td>
<td></td>
</tr>
<tr>
<td>Trash/Debris Removal</td>
<td>Twice annually</td>
<td>Trash &amp; debris in PLD</td>
<td>Remove and dispose of trash/debris</td>
</tr>
<tr>
<td>Overflow Outlet Works Cleaning</td>
<td>As needed - after significant rain events – twice annually minimum</td>
<td>Clogged outlet structure; ponding water above outlet elevation</td>
<td>Remove and dispose of debris/trash/sediment to allow outlet to function properly</td>
</tr>
<tr>
<td>Weed Control</td>
<td>As needed, based upon inspection</td>
<td>Noxious weeds; Unwanted vegetation</td>
<td>Treat w/herbicide or hand pull; consult a local Weed Inspector</td>
</tr>
</tbody>
</table>

**PLD-3.5.1 Mowing**

Routine mowing of the turf grass embankments is necessary to improve the overall appearance of the PLD. Turf grass should be mowed to a height of 2 to 4- inches and shall be bagged to prevent potential contamination of the filter media.

*Frequency – Routine - Minimum of twice annually or depending on aesthetics.*

**PLD-3.5.2 Trash/Debris Removal**

Trash and debris must be removed from the entire PLD area to minimize outlet clogging and to improve aesthetics. This activity must be performed prior to mowing operations.
**Frequency** – Routine – Prior to mowing operations and minimum of twice annually.

**PLD-3.5.3 Overflow Outlet Works Cleaning**

Debris and other materials can clog the overflow outlet work’s grate. This activity must be performed anytime other maintenance activities are conducted to ensure proper operation.

**Frequency** - Routine – After significant rainfall event or concurrently with other maintenance activities.

**PLD-3.5.4 Weed Control**

Noxious weeds and other unwanted vegetation must be treated as needed throughout the PLD. This activity can be performed either through mechanical means (mowing/pulling) or with herbicide. Consultation with a local Weed Inspector is highly recommended prior to the use of herbicide. Herbicides should be utilized sparingly and as a last resort. All herbicide applications should be in accordance with the manufacturer’s recommendations.

**Frequency** – Routine – As needed based on inspections.

**PLD-3.6 RESTORATION MAINTENANCE ACTIVITIES**

This work consists of a variety of isolated or small-scale maintenance/operational problems. Most of this work can be completed by a small crew, hand tools, and small equipment. These items do not require approval by the Monument Public Works Director. Completed inspection and maintenance forms shall be submitted to the Monument Public Works Director for each inspection and maintenance period. In the event that the PLD needs to be dewatered, care should be given to ensure sediment, filter material and other pollutants are not discharged. All dewatering activities shall be properly permitted.

### Table PLD-3
**Summary of Restoration Maintenance Activities**

<table>
<thead>
<tr>
<th>Maintenance Activity</th>
<th>Minimum Frequency</th>
<th>Look for:</th>
<th>Maintenance Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sediment/Pollutant Removal</td>
<td>As needed; Based on infiltration test</td>
<td>Sediment build-up; decrease in infiltration rate</td>
<td>Remove and dispose of sediment</td>
</tr>
<tr>
<td>Erosion Repair</td>
<td>As needed, based upon inspection</td>
<td>Rills/gullies forming on embankments</td>
<td>Repair eroded areas &amp; revegetate; address cause</td>
</tr>
<tr>
<td>Jet Vac/Cleaning underdrain system</td>
<td>As needed, based upon inspection</td>
<td>Sediment build-up /non draining system</td>
<td>Clean drains; Jet-Vac if needed</td>
</tr>
</tbody>
</table>
PLD-3.6.1 Sediment/Pollutant Removal

Sediment/Pollutant removal is necessary to ensure proper function of the filter media. The infiltration rate of the PLD needs to be checked in order to ensure proper functioning of the PLD. Generally, a PLD should drain completely within 12-hours of a storm event. If drain times exceed the 12-hour drain time then maintenance of the filter media shall be required.

Generally, the top 3-inches of filter media should be removed at each removal period. Additional amounts of filter media may need to be removed if deeper sections of the filter media are contaminated. New filter media will need to replace the removed filter media. It is critical that only sand that meets the American Society for Testing and Materials (ASTM) C-33 standard be utilized in the replacement of the filter media.

**ASTM C-33 Sand Standard**

<table>
<thead>
<tr>
<th>US Standard Sieve Size (Number)</th>
<th>Total Percent Passing (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.5 mm (3/8 inch)</td>
<td>100</td>
</tr>
<tr>
<td>4.75 mm (No. 4)</td>
<td>95-100</td>
</tr>
<tr>
<td>2.36 mm (No. 8)</td>
<td>80-100</td>
</tr>
<tr>
<td>1.18 mm (No. 16)</td>
<td>50-85</td>
</tr>
<tr>
<td>0.60 mm (No. 30)</td>
<td>25-60</td>
</tr>
<tr>
<td>0.30 mm (No. 50)</td>
<td>10-30</td>
</tr>
<tr>
<td>0.15 mm (No. 100)</td>
<td>2-10</td>
</tr>
</tbody>
</table>

In addition, only Peat Moss that meets current Town specifications and percentages shall be utilized with the filter media.

Other types of sand or soil material may lead to clogging of the PLD. The minor sediment removal activities can typically be addressed with shovels, rakes, and smaller equipment. Major sediment removal activities will require larger and more specialized equipment. Extreme care should be taken when utilizing motorized or heavy equipment to ensure damage to the underdrain system does not occur. The major sediment removal activities will also require surveying with
an engineer’s level, and consultation with the Monument Director of Development Services to ensure design volumes/grades are achieved.

Stormwater sediments removed from PLDs do not meet the regulatory definition of “hazardous waste”. However, these sediments can be contaminated with a wide array of organic and inorganic pollutants and handling must be done with care. Sediments should be transported by motor vehicle only after they are dewatered. All sediments must be taken to a licensed landfill for proper disposal. Should a spill occur during transportation, prompt and thorough cleanup and disposal is imperative.

**Frequency** – Non-routine – As necessary, based upon inspections and infiltration tests. Sediment removal in the forebay and trickle channel may be necessary as frequently as every 1-2 years.

PLD-3.6.2  **Erosion Repair**

The repair of eroded areas is necessary to ensure the proper functioning of the PLD, to minimize sediment transport, and to reduce potential impacts to other features. Erosion can vary in magnitude from minor repairs to filter media and embankments, to rills and gullies in the embankments and inflow points. The repair of eroded areas may require the use of excavators, earthmoving equipment, riprap, concrete, and sod. Extreme care should be taken when utilizing motorized or heavy equipment to ensure damage to the underdrain system does not occur. Major erosion repair to the pond embankments, spillways, and adjacent to structures will require consultation with the Monument Director of Development Services.

**Frequency** – Non-routine – As necessary, based upon inspections.

PLD-3.6.3  **Jet-Vac/Clearing Drains**

A PLD contains an underdrain system that allows treated stormwater runoff to exit the facility. These underdrain systems can develop blockages that can result in a decrease of hydraulic capaTown and create standing water. Many times the blockage to this infrastructure can be difficult to access and/or clean. Specialized equipment (jet-vac machines) may be necessary to clear debris from these difficult areas.

**Frequency** – Non-routine – As necessary, based upon inspections.

**PLD-3.7  REHABILITATION MAINTENANCE ACTIVITIES**

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

<table>
<thead>
<tr>
<th>Maintenance Activity</th>
<th>Minimum Frequency</th>
<th>Look for:</th>
<th>Maintenance Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major Sediment/Pollutant Removal</td>
<td>As needed – based upon scheduled inspections</td>
<td>Large quantities of sediment; reduced pond capacity</td>
<td>Remove and dispose of sediment. Repair vegetation as needed</td>
</tr>
<tr>
<td>Major Erosion Repair</td>
<td>As needed – based upon scheduled inspections</td>
<td>Severe erosion including gullies forming, excessive soil displacement, areas of settlement, holes</td>
<td>Repair erosion – find cause of problem and address to avoid future erosion</td>
</tr>
<tr>
<td>Structural Repair</td>
<td>As needed – based upon scheduled inspections</td>
<td>Deterioration and/or damage to structural components – broken concrete, damaged pipes &amp; outlet works</td>
<td>Structural repair to restore the structure to its original design</td>
</tr>
<tr>
<td>PLD Rebuild</td>
<td>As needed – due to complete failure of PLD</td>
<td>Removal of filter media and underdrain system</td>
<td>Contact Town of Monument Public Works Director</td>
</tr>
</tbody>
</table>

**PLD-3.7.1 Major Sediment/Pollutant Removal**

Major sediment removal consists of removal of large quantities of pollutants/sediment/filter media/landscaping material. Extreme care should be taken when utilizing motorized or heavy equipment to ensure damage to the underdrain system does not occur. Some PLDs also contain an impermeable liner that can be easily damage if care is not taken when removing the filter media. Stormwater sediments removed from PLDs do not meet the regulatory definition of “hazardous waste”. However, these sediments can be contaminated with a wide array of organic and inorganic pollutants and handling must be done with care to ensure proper removal and disposal. Sediments should be transported by motor vehicle only after they are dewatered. All sediments must be taken to a licensed landfill for proper disposal. Should a spill occur during transportation, prompt and thorough cleanup and disposal is imperative.
Vegetated areas need special care to ensure design volumes and grades are preserved or may need to be replaced due to the removal activities.  
*Frequency – Non-routine – Repair as needed, based upon inspections.*

**PLD-3.7.2 Major Erosion Repair**

Major erosion repair consists of filling and revegetating areas of severe erosion. Determining the cause of the erosion as well as correcting the condition that caused the erosion should also be part of the erosion repair. Care should be given to ensure design grades and volumes are preserved. Extreme care should be taken when utilizing motorized or heavy equipment to ensure damage to the underdrain system does not occur.  

*Frequency – Non-routine – Repair as needed, based upon inspections.*

**PLD-3.7.3 Structural Repair**

A PLD generally includes a concrete overflow outlet structure that can deteriorate or be damaged during the service life of the facility. These structures are constructed of steel and concrete that can degrade or be damaged and may need to be repaired or re-constructed from time to time. Major repairs to structures may require input from a structural engineer and specialized contractors. Consultation with the Monument Director of Development Services shall take place prior to all structural repairs.  

*Frequency – Non-routine – Repair as needed, based upon inspections.*

**PLD-3.7.4 PLD Rebuild**

In very rare cases, a PLD may need to be rebuilt. Generally, the need for a complete rebuild is a result of improper construction, improper maintenance resulting in structural damage to the underdrain system, or extensive contamination of the PLD. Consultation with the Monument Director of Development Services shall take place prior to any rebuild project.  

*Frequency – Non-routine – As needed based upon inspections.*

Reference:  
This Manual is adapted from the SEMSWA (2007) and the Douglas County, Colorado (2005), Standard Operating Procedure for Extended Detention Basin (EDB) Inspection and Maintenance
Standard Operating Procedures for Inspection and Maintenance

Sand Filter Basins (SFBs)

December 2009
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>SFB-1</th>
<th>BACKGROUND</th>
<th>Page No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SFB-2</td>
<td>INSPECTING EXTENDED DETENTION BASINS (SFBs)</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>SFB-2.1 ACCESS AND EASEMENTS</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>SFB-2.2 STORMWATER BEST MANAGEMENT PRACTICE (BMP) LOCATIONS</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>SFB-2.3 SAND FILTER EXTENDED DETENTION BASIN (SFB) FEATURES</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>SFB-2.3.1 Inflow Points/Splitter Box</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>SFB-2.3.2 Sedimentation Chamber</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>SFB-2.3.3 Filter Media</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>SFB-2.3.4 Underdrain System</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>SFB-2.3.5 Overflow Outlet Works</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>SFB-2.3.6 Embankments</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>SFB-2.3.7 Emergency Overflow</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>SFB-2.3.9 Miscellaneous</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>SFB-2.4 INSPECTION FORMS</td>
<td>8</td>
</tr>
<tr>
<td>SFB-3</td>
<td>MAINTAINING SAND FILTER BASINS (EDBS)</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>SFB-3.1 MAINTENANCE PERSONNEL</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>SFB-3.2 EQUIPMENT</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>SFB-3.3 SAFETY</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>SFB-3.4 SFB MAINTENANCE FORMS</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>SFB-3.5 MAINTENANCE CATEGORIES AND ACTIVITIES</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>SFB-3.6 ROUTINE MAINTENANCE ACTIVITIES</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>SFB-3.6.1 Mowing</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>SFB-3.6.2 Trash/Debris Removal</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>SFB-3.6.3 Splitter Box/Overflow Outlet Works Cleaning</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>SFB-3.6.4 Woody Growth Control/Weed Control</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>SFB-3.7 RESTORATION MAINTENANCE ACTIVITIES</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>SFB-3.7.1 Sediment Removal/Pollutant Removal</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>SFB-3.7.2 Erosion Repair</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>SFB-3.7.3 Jet-Vac Cleaning Drains</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>SFB-3.8 REHABILITATION MAINTENANCE ACTIVIES</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>SFB-3.8.1 Major Sediment/Pollutant Removal</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>SFB-3.8.2 Major Erosion Repair</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>SFB-3.8.3 Structural Repair</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>SFB-3.8.4 SFB Rebuild</td>
<td>16</td>
</tr>
</tbody>
</table>
SFB-1 BACKGROUND

Sand Filter Basins (SFBs) are a common type of stormwater best management practice (BMP) utilized within the Front Range of Colorado. A SFB consists of a sedimentation chamber, a flat surfaced area of sand (sometimes covered with grass or sod), a filtration chamber, and a flat sand filter bed with an underdrain system. A surcharge zone exists within the sedimentation and filtration chambers for temporary storage of the Water Quality Capture Volume (WQCV). During a storm, runoff enters the sedimentation chamber, where the majority of sediments are deposited. The runoff then enters the filtration chamber where it ponds above the sand bed and gradually infiltrates into the underlying sand filter, filling the void spaces of the sand. The underdrain gradually dewatered the sand bed and discharges the runoff to a nearby channel, swale, or storm sewer. SFBs provide for filtering and absorption of pollutants in the stormwater. The popularity of SFBs has grown because they allow the WQCV to be provided on a site that has little open area available for stormwater management. However, there are limitations on their use due to potential clogging from large amounts of sediment.

SFB-2 INSPECTING SAND FILTER BASINS (SFBs)

SFB-2.1 Access and Easements
Inspection and maintenance personnel may utilize the figures located in Appendix F containing the locations of the access points and potential maintenance easements of the SFBs within this development.

SFB-2.2 Stormwater Best Management Practice (BMP) Locations
Inspection and maintenance personnel may utilize the figures located in Appendix F containing the locations of the SFBs within this development.

SFB-2.3 Sand Filter Extended Detention Basin (SFB) Features
SFBs 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. Below is a list and description of the most common features within a SFB and the corresponding maintenance inspection items that can be anticipated:

---

### TABLE SFB-1
Typical Inspection & Maintenance Requirements Matrix

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Inflow Points/Splitter Box</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Sedimentation Chamber</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Filter Media</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Underdrain System</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Overflow Outlet Works</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Embankment</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**SFB-2.3.1 Inflow Points/Splitter Box**

Inflow points or outfalls into SFBs are the point of stormwater discharge into the facility. An inflow point is commonly a curb cut with a concrete or riprap rundown or a storm sewer pipe outfall with a flared end section.

SFBs are designed to treat only the WQCV. The WQCV is a volume of water that runs off a site during an 80th percentile event. Any amount over the WQCV is allowed to go to a detention facility without water quality treatment. The splitter box is generally constructed of reinforced concrete. The splitter box typically has a lower wall that has a height that will trap the required WQCV. Volumes over the WQCV are allowed to spill over the wall and enter a storm sewer system that conveys the runoff to a detention facility. Proper inspection and maintenance of the splitter box is essential in ensuring the long-term operation of the SFB.

An energy dissipater is typically immediately downstream of the splitter box, at the discharge point into the SFB, to protect the sedimentation and filtration chambers from erosion. In some cases, the splitter box outfall can have a toe-wall or cut-off wall immediately below the structure to prevent undercutting of the outfall from erosion.

*The typical maintenance activities that are required at inflow points are as follows:*

a. **Riprap Displaced** – Many times, because of the repeated impact/force of water, the riprap can shift and settle. If any portion of the riprap apron appears to have settled, soil is present between the riprap, or the riprap has shifted, maintenance may be required to ensure future erosion is prevented.

b. **Sediment Accumulation** – Because of the turbulence in the water created by the energy dissipater, sediment often deposits immediately downstream of the
inflow point. To prevent a loss in performance of the upstream infrastructure, sediment that accumulates in this area must be removed on a timely basis.

_c._ **Structural Damage** – Structural damage can occur at anytime during the life of the facility. Typically for an inflow, the structural damage occurs to the pipe flared end section (concrete or steel). Structural damage can lead to additional operating problems with the facility, including loss of hydraulic performance.

**SFB-2.3.2 Sedimentation Chamber**

The sedimentation chamber is located adjacent to the splitter box and generally consists of a flat irrigated turf grass area followed by a water trapping device that allows water to be briefly held in the sedimentation chamber before being released into the filtration chamber. This slowing of the runoff allows sediments to be deposited in the sedimentation chamber and not the filtration chamber where they can cause clogging of the filter media.

_The typical maintenance activities that are required within the sedimentation chamber are as follows:_

_a._ **Mowing/woody growth control/weeds present** - Routine mowing of the turf grass within the sediment chamber is necessary to improve the overall appearance and to ensure proper function of the SFB. Turf grass should be mowed to a height of 2 to 4- inches and shall be bagged to prevent potential contamination of the filter media. If undesirable vegetation is not routinely mowed/removed, the growth can cause debris/sediment to accumulate, resulting in blockage of the filter media. Also, shrub, grass and weed roots can cause damage to the filter media and underdrain system. Routine management is essential to prevent more extensive and costly future maintenance.

**SFB-2.3.3 Filter Media**

The filter media is the main pollutant removal component of the SFB. The filter media consists of 18-inches of washed sand. The filter media removes pollutants through several different processes, including sedimentation, filtration, infiltration and microbial uptake.

Sedimentation is accomplished by the slow release of stormwater runoff through the filter media. This slow release allows for sediment particles that were not deposited in the sedimentation chamber to be deposited on the top layer of the filter media where they are easily removed through routine maintenance. Other pollutants are also removed through this process because they are attached to sediment.

Filtration is the main pollutant removal mechanism of SFBs. When the stormwater runoff migrates down through the filter media, many of the particulate pollutants are physically strained out as they pass through the filter bed of sand and are trapped on the surface or among the pores of the filter media.

SFBs that are not lined with an impervious liner allow for infiltration into the native soils. This process also allows for additional pollutant removal.
Microbes that naturally occur in the filter media can assist with pollutant removal by breaking down organic pollutants.

The typical maintenance activities that are required within the filter media areas are as follows:

a. Mowing/woody growth control/weeds present - Noxious weeds and other unwanted vegetation must be treated as needed throughout the SFB. This activity can be performed either through mechanical means (mowing/pulling) or with herbicide. Consultation with a local Weed Inspector is highly recommended prior to the use of herbicide. Herbicides should be utilized sparingly and as a last resort. All herbicide applications should be in accordance with the manufacturer’s recommendations.

b. Sediment/Pollutant Removal – Although SFBs should not be utilized in areas where large concentrations of sediment and other pollutants will enter the SFB, it is inevitable that some sediment and other pollutants will enter the SFB. Most sediment will be deposited in the sedimentation chamber, however finer suspended particles will migrate to the filter media. These sediments need to be removed to ensure proper infiltration rates of the stormwater runoff.

c. Filter Replacement - The top layers of the filter media are the most susceptible to pollutant loading and therefore may need to be removed and disposed of properly on a semi-regular basis when infiltration rates slow.

d. Infiltration Rate Test - An infiltration test may be necessary to ensure proper functioning of the filter media. The infiltration test can be conducted by filling the sand filter with water to the elevation of the overflow wall in the splitter box. The sand filter needs to drain completely within 24-hours of the filling. If the drain time for the basin is longer than 24-hours, the filter is in need of maintenance.

SFB-2.3.4 Underdrain System

The underdrain system consists of a layer of geotextile fabric, gravel storage area and perforated PVC pipes. The geotextile fabric is utilized to prevent the filter media from entering the underdrain system. The gravel storage area allows for storage of treated stormwater runoff prior to the discharge of the runoff through the perforated PVC pipe.

The typical maintenance activities that are required for the underdrain system are as follows:

With proper maintenance of the filter media and sediment chamber, there should be a minimum amount of maintenance required on the underdrain system. Generally, the only maintenance performed on the underdrain system is jet-vac cleaning.

SFB-2.3.5 Overflow Outlet Works

Some SFBs include an overflow outlet works in place of the splitter box. The overflow outlet works allows runoff amounts that exceed the WQCV to exit the SFB to the detention facility. The outlet works is typically constructed of reinforced concrete into the embankment of the SFB. The concrete structure
typically has steel orifice plates anchored/embedded into it to control stormwater release rates. The larger openings (flood control) on the outlet structure typically have trash racks over them to prevent clogging. Proper inspection and maintenance of the outlet works is essential in ensuring the long-term operation of the SFB.

The typical maintenance activities that are required for the overflow outlet works are as follows:

a. Structural Damage - The overflow outlet structure is primarily constructed of concrete, which can crack, spall, and settle. The steel grate on the overflow outlet structure is also susceptible to damage.

b. Mowing/woody growth control/weeds present – The presence of plant material not part of the original landscaping, such as wetland plants or other woody growth, can clog the overflow outlet works during a larger storm event, causing flooding damage to adjacent areas. This plant material may indicate a clogging of the filter media and may require additional investigation.

SFB-2.3.6 Embankments

Some SFBs utilize irrigated turf grass embankments to store the WQCV.

The typical maintenance activities that are required for the embankments areas are as follows:

a. Vegetation Sparse – The embankments are one of the most visible parts of the SFB and, therefore, aesthetics is important. Adequate and properly maintained vegetation can greatly increase the overall appearance of the SFB. Also, vegetation can reduce the potential for erosion and subsequent sediment transport to the filter media, thereby reducing the need for more costly maintenance.

b. Erosion – Inadequate vegetative cover may result in erosion of the embankments. Erosion that occurs on the embankments can cause clogging of the filter media.

c. Trash/Debris – Trash and debris can accumulate in the upper area after large events, or from illegal dumping. Over time, this material can clog the SFB filter media and outlet works.

d. Mowing/woody growth control/weeds present – The presence of plant material not part of the original landscaping, such as wetland plants or other woody growth, can result in difficulty in performing maintenance activities. These trees and shrubs may also damage the underdrain system of the SFB. This plant material may indicate a clogging of the filter media and may require additional investigation.

SFB-2.3.7 Emergency Overflow

An emergency spillway is typical of all SFBs and designed to serve as the overflow in the event the volume of the pond is exceeded. The emergency spillway is typically armored with riprap (or other hard armor), and is sometimes
buried with soil or may be a concrete wall or other structure. The emergency spillway is typically a weir (notch) in the basin embankment. Proper function of the emergency spillway is essential to ensure flooding does not affect adjacent properties.

The typical maintenance activities that are required for the emergency overflow areas are as follows:

a. Riprap Displaced – As mentioned before, the emergency spillway is typically armored with riprap to provide erosion protection. Over the life of an SFB, the riprap may shift or become dislodged due to flow.

b. Erosion Present – Although the spillway is typically armored, stormwater flowing through the spillway can cause erosion damage. Erosion must be repaired to ensure the integrity of the basin embankment, and proper function of the spillway.

c. Mowing/weed/woody growth control – Management of woody vegetation is essential in the proper long-term function of the spillway. Larger trees or dense shrubs can capture larger debris entering the SFB and reduce the capacity of the spillway. These trees and shrubs may also damage the underdrain system of the SFB.

d. Obstruction/Debris – The spillway must be cleared of any obstruction (man-made or natural) to ensure the proper design capacity.

SFB-2.3.8 Miscellaneous

There are a variety of inspection/maintenance issues that may not be attributed to a single feature within the SFB. This category on the inspection form is for maintenance items that are commonly found in the SFB, but may not be attributed to an individual feature.

a. Access – Access needs to be maintained.

b. Graffiti/Vandalism – Vandals can cause damage to the SFB infrastructure. If criminal mischief is evident, the inspector should forward this information to the local emergency agency.

c. Public Hazards – Public hazards include items such as vertical drops of greater than 4-feet, containers of unknown/suspicious substances, and exposed metal/jagged concrete on structures. If any hazard is found within the facility area that poses an immediate threat to public safety, contact the local emergency services at 911 immediately.

d. Other – Any miscellaneous inspection/maintenance items not contained on the form should be entered here.

SFB-2.4 Inspection Forms

SFB Inspection forms are located in Appendix C. Inspection forms shall be completed by the person(s) conducting the inspection activities. Each form shall be reviewed and
submitted by the property owner or property manager to the Monument Public Works Director per the requirements of the Inspection and Maintenance Manual. These inspection forms shall be kept a minimum of 5 years and made available to the Town of Monument upon request.

SFB-3 MAINTAINING SAND FILTER BASINS (SFBs)

SFB-3.1 Maintenance Personnel

Maintenance personnel should be qualified to properly maintain SFBs. Inadequately trained personnel can cause additional problems resulting in additional maintenance costs.

SFB-3.2 Equipment

It is imperative that the appropriate equipment and tools are taken to the field with the operations crew. The types of equipment/tools will vary depending on the task at hand. Below is a list of tools, equipment, and material(s) that may be necessary to perform maintenance on a SFB:

1.) Mowing Tractors
2.) Trimmers (extra string)
3.) Shovels
4.) Rakes
5.) All Surface Vehicle (ASVs)
6.) Skid Steer
7.) Back Hoe
8.) Track Hoe/Long Reach Excavator
9.) Dump Truck
10.) Jet-Vac Machine
11.) Engineers Level (laser)
12.) Riprap (Minimum - Type M)
13.) Geotextile Fabric
14.) Erosion Control Blanket(s)
15.) Sod
16.) Illicit Discharge Cleanup Kits
17.) Trash Bags
18.) Tools (wrenches, screw drivers, hammers, etc)
19.) Confined Space Entry Equipment
20.) Approved Inspection and Maintenance Plan
21.) ASTM C-33 Sand

Some of the items identified above may not be needed for every maintenance operation. However, this equipment should be available to the maintenance operations crews should the need arise.

SFB-3.3 Safety

Vertical drops may be encountered in areas located within and around the SFB. Avoid walking on top of retaining walls or other structures that have a significant vertical drop. If a vertical drop is identified that is greater than 48-inches in height, make the appropriate note/comment on the maintenance inspection form.

SFB-3.4 SFB Maintenance Forms

The SFB Maintenance Form provides a record of each maintenance operation performed by maintenance contractors. The SFB Maintenance Form shall be filled out in the field after the completion of the maintenance operation. Each form shall be reviewed and submitted by the property owner or property manager to the Monument Public Works Director per the requirements of the Inspection and Maintenance Plan. The SFB Maintenance form is located in Appendix D.

SFB-3.5 SFB Maintenance Categories and Activities

A typical SFB Maintenance Program will consist of three broad categories of work: Routine, Minor and Major. Within each category of work, a variety of maintenance activities can be performed on a SFB. A maintenance activity can be specific to each feature within the SFB, or general to the overall facility. This section of the SOP explains each of the categories and briefly describes the typical maintenance activities for a SFB.

A variety of maintenance activities are typical of SFBs. The maintenance activities range in magnitude from routine trash pickup to the reconstruction of the SFB filter media or underdrain system. Below is a description of each maintenance activity, the objectives, and frequency of actions:

SFB-3.6 Routine Maintenance Activities

The majority of this work consists of scheduled mowing, trash and debris pickups for the SFB during the growing season. It also includes activities such as weed control. These activities normally will be performed numerous times during the year. These items typically do not require any prior correspondence with the Monument Public Works Director, however, completed inspection and maintenance forms shall be submitted to the Monument Public Works Director for each inspection and maintenance.

The Routine Maintenance Activities are summarized below, and further described in the following sections.
TABLE SFB-2
Summary of Routine Maintenance Activities

<table>
<thead>
<tr>
<th>Maintenance Activity</th>
<th>Minimum Frequency</th>
<th>Look for:</th>
<th>Maintenance Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mowing</td>
<td>Twice annually</td>
<td>Excessive grass height/aesthetics</td>
<td>2”-4” grass height</td>
</tr>
<tr>
<td>Trash/Debris Removal</td>
<td>Twice annually</td>
<td>Trash/debris in SFB</td>
<td>Remove and dispose of trash and debris</td>
</tr>
<tr>
<td>Splitter Box/Overflow Outlet Works Cleaning</td>
<td>As needed - after significant rain events – twice annually minimum</td>
<td>Clogged outlet structure; ponding water</td>
<td>Remove and dispose of debris/trash/sediment to allow outlet to function properly</td>
</tr>
<tr>
<td>Woody growth control /Weed removal</td>
<td>Minimum twice annually</td>
<td>Noxious weeds; Unwanted vegetation</td>
<td>Treat w/herbicide or hand pull; consult a local Weed Inspector</td>
</tr>
</tbody>
</table>

SFB-3.6.1 Mowing

Routine mowing of the turf grass embankments and turf grass located in the sedimentation chamber is necessary to improve the overall appearance of the SFB and ensure proper performance of the sediment chamber. Turf grass should be mowed to a height of 2 to 4-inches and shall be bagged to prevent potential contamination of the filter media.

Frequency – Routine - Minimum of twice annually or depending on aesthetics.

SFB-3.6.2 Trash/Debris Removal

Trash and debris must be removed from the entire SFB area to minimize outlet clogging and to improve aesthetics. This activity must be performed prior to mowing operations.

Frequency – Routine – Prior to mowing operations and minimum of twice annually.

SFB-3.6.3 Splitter Box/Overflow Outlet Works Cleaning

Debris and other materials can clog the splitter box/overflow outlet work’s grate. This activity must be performed anytime other maintenance activities are conducted to ensure proper operation.

Frequency - Routine – After significant rainfall event or concurrently with other maintenance activities.
SFB- 3.6.4   Woody Growth Control/Weed Removal

Noxious weeds and other unwanted vegetation must be treated as needed throughout the SFB. This activity can be performed either through mechanical means (mowing/pulling) or with herbicide. Consultation with a local County Weed Inspector is highly recommended prior to the use of herbicide. Herbicides should be utilized sparingly and as a last resort. All herbicide applications should be in accordance with the manufacturer’s recommendations.

Frequency – Routine – As needed based on inspections.

SFB-3.7    Restoration Maintenance Activities

This work consists of a variety of isolated or small-scale maintenance/operational problems. Most of this work can be completed by a small crew, hand tools, and small equipment. These items do not require prior approval from the Monument Public Works Director. Completed inspection and maintenance forms shall be submitted to the Monument Public Works Director for each inspection and maintenance period. In the event that the SFB needs to be dewatered, care should be given to ensure sediment, filter material and other pollutants are not discharged. All dewatering activities shall be appropriately permitted.

TABLE SFB-3
Summary of Restoration Maintenance Activities

<table>
<thead>
<tr>
<th>Maintenance Activity</th>
<th>Minimum Frequency</th>
<th>Look for:</th>
<th>Maintenance Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sediment/Pollutant Removal</td>
<td>As needed; typically every 1 –2 years</td>
<td>Sediment build-up in sedimentation chamber and filter media; decrease in infiltration rate</td>
<td>Remove and dispose of sediment</td>
</tr>
<tr>
<td>Erosion Repair</td>
<td>As needed, based upon inspection</td>
<td>Rills/gullies on embankments or sedimentation in the forebay</td>
<td>Repair eroded areas &amp; revegetate; address cause</td>
</tr>
<tr>
<td>Jet-Vac/Cleaning Underdrains</td>
<td>As needed, based upon inspection</td>
<td>Sediment build-up /non-draining system</td>
<td>Clean drains; Jet-Vac if needed</td>
</tr>
</tbody>
</table>

SFB-3.7.1    Sediment Removal/Pollutant Removal

Sediment removal is necessary to ensure proper function of the filter media. The infiltration rate of the SFB needs to be checked in order to ensure proper functioning of the SFB. Generally, a SFB should drain completely within 12-hours of a storm event. If drain times exceed the 12-hour drain time than maintenance of the filter media shall be required.
At a minimum, the top 3-inches of filter media should be removed at each removal period. Additional amounts of filter media may need to be removed if deeper sections of the filter media are contaminated. New filter media will need to be placed back into the SFB when the total amount of sand removed reaches 9-inches. This may take multiple maintenance events to accomplish. It is critical that only sand that meets the American Society for Testing and Materials (ASTM) C-33 standard be utilized in the replacement of the filter media.

**ASTM C-33 Sand Standard**

<table>
<thead>
<tr>
<th>US Standard Sieve Size (Number)</th>
<th>Total Percent Passing (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.5 mm (3/8 inch)</td>
<td>100</td>
</tr>
<tr>
<td>4.75 mm (No. 4)</td>
<td>95-100</td>
</tr>
<tr>
<td>2.36 mm (No. 8)</td>
<td>80-100</td>
</tr>
<tr>
<td>1.18 mm (No. 16)</td>
<td>50-85</td>
</tr>
<tr>
<td>0.60 mm (No. 30)</td>
<td>25-60</td>
</tr>
<tr>
<td>0.30 mm (No. 50)</td>
<td>10-30</td>
</tr>
<tr>
<td>0.15 mm (No. 100)</td>
<td>2-10</td>
</tr>
</tbody>
</table>

Other types of sand and soil material may lead to clogging of the SFB. The minor sediment removal activities can typically be addressed with shovels, rakes and smaller equipment. Major sediment removal activities will require larger and more specialized equipment. Extreme care should be taken when utilizing motorized or heavy equipment to ensure damage to the underdrain system does not occur. The major sediment removal activities will also require surveying with an engineer’s level, and consultation with the Monument Director of Development Services to ensure design volumes/grades are achieved.

Stormwater sediments removed from SFBs do not meet the regulatory definition of “hazardous waste”. However, these sediments can be contaminated with a wide array of organic and inorganic pollutants and handling must be done with care to ensure proper removal and disposal. Sediments should be transported by motor vehicle only after they are dewatered. All sediments must be taken to a licensed landfill for proper disposal. Should a spill occur during transportation, prompt and thorough cleanup and disposal is imperative.
**Frequency** – Non-routine – As necessary, based upon inspections. Sediment removal in the sedimentation chamber may be necessary as frequently as every 1-2 years.

**SFB-3.7.2 Erosion Repair**

The repair of eroded areas is necessary to ensure the proper functioning of the SFB, to minimize sediment transport, and to reduce potential impacts to other features. Erosion can vary in magnitude from minor repairs to filter media and embankments, to rills, and gullies in the embankments and inflow points. The repair of eroded areas may require the use of excavators, earthmoving equipment, riprap, concrete, and sod. Extreme care should be taken when utilizing motorized or heavy equipment to ensure damage to the underdrain system does not occur. Major erosion repair to the pond embankments, spillways, and adjacent to structures will require consultation with the Monument Director of Development Services.

**Frequency** – Non-routine – As necessary, based upon inspections.

**SFB-3.7.3 Jet-Vac/Clearing Drains**

A SFB contains an underdrain system that allows treated stormwater runoff to exit the facility. These underdrain systems can develop blockages that can result in a decrease of hydraulic capability and also create standing water. Many times the blockage to this infrastructure can be difficult to access and/or clean. Specialized equipment (jet-vac machines) may be necessary to clear debris from these difficult areas.

**Frequency** – Non-routine – As necessary, based upon inspections.

**SFB-3.8 Rehabilitation Maintenance Activities**

This work consists of larger maintenance/operational problems and failures within the stormwater management facilities. All of this work requires approval from the Monument Director of Development Services to ensure the proper maintenance is performed. This work requires that Engineering staff review the original design and construction drawings to assess the situation and assign the necessary maintenance activities. This work may also require more specialized maintenance equipment, design/details, surveying, or assistance through private contractors and consultants. In the event that the basin needs to be dewatered, care should be given to ensure sediment, filter material and other pollutants are not discharged. Proper permitting is required prior to any dewatering activity.
<table>
<thead>
<tr>
<th>Maintenance Activity</th>
<th>Minimum Frequency</th>
<th>Look for:</th>
<th>Maintenance Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major Sediment/Pollutant Removal</td>
<td>As needed – based upon scheduled inspections</td>
<td>Large quantities of sediment in the sedimentation chamber and/or filter media; reduced infiltration rate/capacity</td>
<td>Remove and dispose of sediment. Repair vegetation as needed</td>
</tr>
<tr>
<td>Major Erosion Repair</td>
<td>As needed – based upon scheduled inspections</td>
<td>Severe erosion including gullies, excessive soil displacement, areas of settlement, holes</td>
<td>Repair erosion – find cause of problem and address to avoid future erosion</td>
</tr>
<tr>
<td>Structural Repair</td>
<td>As needed – based upon scheduled inspections</td>
<td>Deterioration and/or damage to structural components – broken concrete, damaged pipes &amp; outlet works</td>
<td>Structural repair to restore the structure to its original design</td>
</tr>
<tr>
<td>SFB Rebuild</td>
<td>As needed – due to complete failure of SFB</td>
<td>Removal of filter media and underdrain system</td>
<td>Contact Director of Development Services</td>
</tr>
</tbody>
</table>

SFB-3.8.1 Major Sediment/Pollutant Removal

In very rare cases the filter media of the SFB may be contaminated so badly that the entire 18-inches of the filter media may need to be removed.

Major sediment/pollutant removal consists of removal of large quantities of sediment/filter media. Extreme care should be taken when utilizing motorized or heavy equipment to ensure damage to the underdrain system does not occur. The sediment/filter media needs to be carefully removed, transported and properly disposed. Vegetated areas need special care to ensure design volumes and grades are preserved or may need to be replaced due to the removal activities. Stormwater sediments removed from SFBs do not meet the regulatory definition of “hazardous waste”. However, these sediments can be contaminated with a wide array of organic and inorganic pollutants and handling must be done with care to insure proper removal and disposal. Sediments should be transported by motor vehicle only after they are dewatered. All sediments must be taken to a licensed landfill for proper disposal. Should a spill occur during transportation, prompt and thorough cleanup and disposal is imperative.

*Frequency – Non-routine – As needed, based upon inspections.*
SFB-3.8.2  Major Erosion Repair

Major erosion repair consists of filling and re-vegetating areas of severe erosion. Determining the cause of the erosion as well as correcting the condition that caused the erosion should also be part of the erosion repair. Care should be given to ensure design grades and volumes are preserved. Extreme care should be taken when utilizing motorized or heavy equipment to ensure damage to the underdrain system does not occur.

Frequency – Non-routine – Repair as needed, based upon inspections.

SFB-3.8.3  Structural Repair

A SFB generally includes a splitter box or concrete overflow outlet structure that can deteriorate or be damaged during the service life of the facility. These structures are constructed of steel and concrete that can degrade or be damaged and may need to be repaired or re-constructed from time to time. Major repairs to structures may require input from a structural engineer and specialized contractors. Consultation with the Monument Director of Development Services shall take place prior to all structural repairs.

Frequency – Non-routine – Repair as needed, based upon inspections.

SFB-3.8.4  SFB Rebuild

In very rare cases a SFB may need to be rebuilt. Generally, the need for a complete rebuild is a result of improper construction, improper maintenance resulting in structural damage to the underdrain system, or extensive contamination of the SFB. Consultation with the Monument Director of Development Services shall take place prior to any rebuild project.

Frequency – Non-routine – As needed, based upon inspections.

Reference: This Manual is adapted from the SEMSWA (2007) and the Douglas County, Colorado (2005), Standard Operating Procedure for Extended Detention Basin (EDB) Inspection and Maintenance
Standard Operating Procedures for Inspection and Maintenance

Extended Detention Basins (EDBs)

December 2009
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>EDB-1</th>
<th>BACKGROUND ..................................................................................................................</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>EDB-2</td>
<td>INSPECTING EXTENDED DETENTION BASINS (EDBS) .........................................................</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>EDB-2.1 ACCESS AND EASEMENTS ..................................................................................</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>EDB-2.2 STORMWATER BEST MANAGEMENT PRACTICE (BMP) LOCATIONS ............................</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>EDB-2.3 EXTENDED DETENTION BASIN (ED) FEATURES ..................................................</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>EDB-2.3.1 Inflow Points ...........................................................................................</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>EDB-2.3.2 Forebay ......................................................................................................</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>EDB-2.3.3 Trickle Channel (Low-Flow) ....................................................................</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>EDB-2.3.4 Bottom Stage ............................................................................................</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>EDB-2.3.5 Micro-pool ...............................................................................................</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>EDB-2.3.6 Outlet Works .............................................................................................</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>EDB-2.3.7 Emergency Spillway ..................................................................................</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>EDB-2.3.8 Upper Stage (Dry Storage) ......................................................................</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>EDB-2.3.9 Miscellaneous .........................................................................................</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>EDB-2.4 INSPECTION FORMS .......................................................................................</td>
<td>11</td>
</tr>
<tr>
<td>EDB-3</td>
<td>MAINTAINING EXTENDED DETENTION BASINS (EDBS) ....................................................</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>EDB-3.1 MAINTENANCE PERSONNEL ...........................................................................</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>EDB-3.2 EQUIPMENT ....................................................................................................</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>EDB-3.3 SAFETY ..........................................................................................................</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>EDB-3.4 MAINTENANCE FORMS ....................................................................................</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>EDB-3.5 MAINTENANCE CATEGORIES AND ACTIVITIES ...............................................</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>EDB-3.6 ROUTINE MAINTENANCE ACTIVITIES ............................................................</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>EDB-3.6.1 Mowing .......................................................................................................</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>EDB-3.6.2 Trash/Debris Removal ..............................................................................</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>EDB-3.6.3 Outlet Works Cleaning ...............................................................................</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>EDB-3.6.4 Weed Control ............................................................................................</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>EDB-3.6.5 Mosquito/Algae Treatment ......................................................................</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>EDB-3.7 RESTORATION MAINTENANCE ACTIVITIES ..................................................</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>EDB-3.7.1 Sediment Removal ...................................................................................</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>EDB-3.7.2 Erosion Repair .........................................................................................</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>EDB-3.7.3 Vegetation Removal/Tree Thinning ..........................................................</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>EDB-3.7.4 Clearing Drains/Jet-Vac ...........................................................................</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>EDB-3.8 REHABILITATION MAINTENANCE ACTIVIES .................................................</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>EDB-3.8.1 Major Sediment Removal .......................................................................</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>EDB-3.8.2 Major Erosion Repair ..............................................................................</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>EDB-3.8.3 Structural Repair .....................................................................................</td>
<td>18</td>
</tr>
</tbody>
</table>
EDB-1 BACKGROUND

Extended Detention Basins (EDBs) are one of the most common types of Stormwater BMPs utilized within the Front Range of Colorado. An EDB is a sedimentation basin designed to “extend” the runoff detention time, but to drain completely dry sometime after stormwater runoff ends. The EDB’s drain time for the water quality portion of the facility is typically 40 hours. The basins are considered to be “dry” because the majority of the basin is designed not to have a significant permanent pool of water remaining between runoff events.

EDBs are an adaptation of a detention basin used for flood control, with the primary difference is the addition of forebays, micropools and a slow release outlet design. Forebays are shallow concrete “pans” located at the inflow point to the basin and are provided to facilitate sediment removal within a contained area prior to releasing into the pond. These forebays collect and briefly hold stormwater runoff resulting in a process called sedimentation, dropping sediment out of the stormwater. The stormwater is then routed from the forebay into the concrete trickle channel and upper basin, the large grassy portion of the basin. The EDB uses a much smaller outlet that extends the emptying time of the more frequently occurring runoff events to facilitate pollutant removal. An EDB should have a small micropool just upstream of the outlet. This micropool is designed to hold a small amount of water to keep sediment and floatables from blocking the outlet orifices.

EDB-2 INSPECTING EXTENDED DETENTION BASINS (EDBs)

EDB-2.1 Access and Easements

Inspection or maintenance personnel may utilize the figures located in Appendix E containing the location(s) of the access points and potential maintenance easements of the EDB(s) within this development.

EDB-2.2 Stormwater Best Management Practice (BMP) Locations

Inspection or maintenance personnel may utilize the figures located in Appendix E containing the location(s) of the EDB(s) within this development.

EDB-2.3 Extended Detention Basin (EDB) Features

EDBs have a number of features that are designed to serve a particular function. Many times the proper function of one feature depends on another. For example, if a forebay is not properly maintained, it could negatively affect the performance of a feature downstream (trickle channel, micropool, etc.). Therefore, it is critical that each feature of the EDB is properly inspected and maintained to ensure that the overall facility functions as it was intended. Below is a list and description of the most common features within an EDB and the corresponding maintenance inspection items that can be anticipated:
### TABLE EDB-1
**Typical Inspection & Maintenance Requirements Matrix**

<table>
<thead>
<tr>
<th>EDB Features</th>
<th>Sediment Removal</th>
<th>Mowing / Weed control</th>
<th>Trash &amp; Debris Removal</th>
<th>Erosion</th>
<th>Overgrown Vegetation Removal</th>
<th>Standing Water (mosquito/algae control)</th>
<th>Structure Repair</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inflow Points (outfalls)</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Forebay</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Low-flow channel</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Bottom Stage</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Micropool</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Outlet Works</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Emergency Spillway</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Upper Stage</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Embankment</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**EBD-2.3.1 Inflow Points**

Inflow Points or Outfalls into EDBs are the point source of the stormwater discharge into the facility. An inflow point is commonly a storm sewer pipe with a flared end section that discharges into the EDB. In some instances, an inflow point could be a drainage channel or ditch that flows into the facility.

An energy dissipater (riprap or hard armor protection) is typically immediately downstream of the discharge point into the EDB to protect from erosion. In some cases, the storm sewer outfall can have a toe-wall or cut-off wall immediately below the structure to prevent undercutting of the outfall from erosion.

*The typical maintenance items that are found with inflow points are as follows:*

a. **Riprap Displaced** – Many times, because the repeated impact/force of water, the riprap can shift and settle. If any portion of the riprap apron appears to have settled, soil is present between the riprap, or the riprap has shifted, maintenance may be required to ensure future erosion is prevented.

b. **Erosion Present/Outfall Undercut** – In some situations, the energy dissipater may not have been sized, constructed, or maintained appropriately and erosion has occurred. Any erosion within the vicinity of the inflow point will require maintenance to prevent damage to the structure(s) and sediment transport within the facility.

c. **Sediment Accumulation** – Because of the turbulence in the water created by the energy dissipater, sediment often deposits immediately downstream of the inflow point. To prevent a loss in hydraulic performance of the upstream...
infrastructure, sediment that accumulates in this area must be removed in a timely manner.

d. Structural Damage – Structural damage can occur at anytime during the life of the facility. Typically, for an inflow, the structural damage occurs to the pipe flared end section (concrete or steel). Structural damage can lead to additional operating problems with the facility, including loss of hydraulic performance.

e. Woody Growth/Weeds Present – Undesirable vegetation can grow in and around the inflow area to an EDB that can significantly affect the performance of the drainage facilities discharging into the facility. This type of vegetation includes trees (typically cottonwoods) and dense areas of shrubs (willows). If woody vegetation is not routinely mowed/removed, the growth can cause debris/sediment to accumulate, resulting in blockage of the discharge. Also, tree roots can cause damage to the structural components of the inflow. Routine maintenance is essential for trees (removing a small tree/sapling is much cheaper and “quieter” than a mature tree). In addition, noxious weeds growing in the facility can result in the loss of desirable native vegetation and impact adjacent open spaces/land.

EDB-2.3.2 Forebay

A forebay is a solid surface (pad), typically constructed of concrete, immediately downstream of the inflow point. The forebay is designed to capture larger particles and trash to prevent them from entering the main portion of the EDB. The solid surface is designed to facilitate mechanical sediment removal (skid steer). The forebay typically includes a small diameter discharge pipe or v-notch weir on the downstream end and designed to drain the forebay in a specified period of time to promote sedimentation. The forebays vary in size and depth depending on the design and site constraints.

The typical maintenance items that are found with forebays are as follows:

a. Sediment/Debris Accumulation – Because this feature of the EDB is designed to provide the initial sedimentation, debris and sediment frequently accumulate in this area. If the sediment and debris is not removed from the forebay on a regular basis, it can significantly affect the function of other features within the EDB. Routine sediment removal from the forebay can significantly reduce the need for dredging of the main portion of the EDB using specialized equipment (long reach excavators). Routine removal of sediment from the forebay can substantially decrease the long-term sediment removal costs of an EDB.

b. Concrete Cracking/Failing – The forebay is primarily constructed of concrete, which cracks, spalls, and settles. Damage to the forebay can result in deceased performance and impact maintenance efforts.

c. Drain Pipe/Weir Clogged – Many times the drainpipe or weir can be clogged with debris, and prevent the forebay from draining properly. If standing water is present in the forebay (and there is not a base flow), the forebay is most likely
not draining properly. This can result in a decrease in performance and create potential nuisances with stagnant water (mosquitoes).

d. Weir/Drain Pipe Damaged – Routine maintenance activities, vandalism, or age may cause the weir or drain pipe in the forebay to become damaged. Weirs are typically constructed of concrete, which cracks and spalls. The drainpipe is typically smaller in diameter and constructed with plastic, which can fracture.

EDB-2.3.3 Trickle Channel (Low-Flow)

The trickle channel conveys stormwater from the forebay to the micro-pool of the EDB. The trickle channel is typically made of concrete. However, grass lined (riprap sides protected) is also common and can provide for an additional means of water quality within the EDB. The trickle channel is typically 6-9 inches in depth and can vary in width.

The typical maintenance items that are found with trickle channels are as follows:

a. Sediment/Debris Accumulation – Trickle channels are typically designed with a relatively flat slope that can promote sedimentation and the collection of debris. Also, if a trickle channel is grass lined it can accumulate sediment and debris at a much quicker rate. Routine removal of accumulated sediment and debris is essential in preventing flows from circumventing the trickle channel and affecting the dry storage portion of the pond.

b. Concrete/Riprap Damage – Concrete can crack, spall, and settle and must be repaired to ensure proper function of the trickle channel. Riprap can also shift over time and must be replaced/repaired as necessary.

c. Woody Growth/Weeds Present – Because of the constant moisture in the area surrounding the trickle channel, woody growth (cottonwoods/willows) can become a problem. Trees and dense shrub type vegetation can affect the capaTown of the trickle channel and can allow flows to circumvent the feature.

d. Erosion Outside of Channel – In larger precipitation events, the trickle channel capaTown will likely be exceeded. This can result in erosion immediately adjacent to the trickle channel and must be repaired to prevent further damage to the structural components of the EDB.

EDB-2.3.4 Bottom Stage

The bottom stage is at least 1.0 to 2.0 feet deeper than the upper stage and is located in front of the outlet works structure. The bottom stage is designed to store the smaller runoff events, assists in keeping the majority of the basin bottom dry resulting in easier maintenance operations, and enhances the facilities pollutant removal capabilities. This area of the EDB may develop wetland vegetation.

The typical maintenance items that are found with the bottom stage are as follows:
a. Sediment/Debris Accumulation – The micro-pool can frequently accumulate sediment and debris. This material must be removed to maintain pond volume and proper function of the outlet structure.

b. Woody Growth/Weeds Present - Because of the constant moisture in the soil surrounding the micro-pool, woody growth (cottonwoods/willows) can create operational problems for the EDB. If woody vegetation is not routinely mowed/removed, the growth can cause debris/sediment to accumulate outside of the micro-pool, which can cause problems with other EDB features. Also, tree roots can cause damage to the structural components of the outlet works. Routine management is essential for trees (removing a small tree/sapling is much cheaper and “quieter” than a mature tree).

c. Bank Erosion – The micro-pool is usually a couple feet deeper than the other areas of the ponds. Erosion can be caused by water dropping into the micro-pool if adequate protection/armor is not present. Erosion in this area must be mitigated to prevent sediment transport and other EDB feature damage.

d. Mosquitoes/Algae Treatment – Nuisance created by stagnant water can result from improper maintenance/treatment of the micro-pool. Mosquito larvae can be laid by adult mosquitoes within the permanent pool. Also, aquatic vegetation that grows in shallow pools of water can decompose causing foul odors. Chemical/mechanical treatment of the micro-pool may be necessary to reduce these impacts to adjacent homeowners.

e. Petroleum/Chemical Sheen – Many indicators of illicit discharges into the storm sewer systems will be present in the micro-pool area of the EDB. These indicators can include sheens, odors, discolored soil, and dead vegetation. If it is suspected that an illicit discharge has occurred, contact the supervisor immediately. Proper removal/mitigation of contaminated soils and water in the EDB is necessary to minimize any environmental impacts downstream.

EDB-2.3.5 Micro-pool

The micro-pool is a concrete or grouted boulder walled structure directly in front of the outlet works. At a minimum, the micropool is 2.5 feet deep and is designed to hold water. The micro-pool is critical in the proper function of the EDB; it allows suspended sediment to be deposited at the bottom of the micro-pool and prevents these sediments from being deposited in front of the outlet works causing clogging of the outlet structure, which results in marshy areas within the top and bottom stages.

The typical maintenance items that are found with micro-pools are as follows:

a. Sediment/Debris Accumulation – The micro-pool can frequently accumulate sediment and debris. This material must be removed to maintain pond volume and proper function of the outlet structure.

b. Woody Growth/Weeds Present - Because of the constant moisture in the soil surrounding the micro-pool, woody growth (cottonwoods/willows) can create
operational problems for the EDB. If woody vegetation is not routinely mowed/removed, the growth can cause debris/sediment to accumulate outside of the micro-pool, which can cause problems with other EDB features. Also, tree roots can cause damage to the structural components of the outlet works. Routine management is essential for trees (removing a small tree/sapling is much cheaper and “quieter” than a mature tree).

c. Mosquitoes/Algae Treatment – Nuisance created by stagnant water can result from improper maintenance/treatment of the micro-pool. Mosquito larvae can be laid by adult mosquitoes within the permanent pool. Also, aquatic vegetation that grows in shallow pools of water can decompose causing foul odors. Chemical/mechanical treatment of the micro-pool may be necessary to reduce these impacts to adjacent homeowners.

d. Petroleum/Chemical Sheen – Many indicators of illicit discharges into the storm sewer systems will be present in the micro-pool area of the EDB. These indicators can include sheens, odors, discolored soil, and dead vegetation. If it is suspected that an illicit discharge has occurred, contact the supervisor immediately. Proper removal/mitigation of contaminated soils and water in the EDB is necessary to minimize any environmental impacts downstream.

EDB-2.3.6 Outlet Works

The outlet works is the feature that drains the EDB in specified quantities and periods of time. The outlet works is typically constructed of reinforced concrete into the embankment of the EDB. The concrete structure typically has steel orifice plates anchored/embedded into it to control stormwater release rates. The larger openings (flood control) on the outlet structure typically have trash racks over them to prevent clogging. The water quality orifice plate (smaller diameter holes) will typically have a well screen covering it to prevent smaller materials from clogging it. The outlet structure is the single most important feature in the EDB operation. Proper inspection and maintenance of the outlet works is essential in ensuring the long-term operation of the EDB.

The typical maintenance items that are found with the outlet works are as follows:

a. Trash Rack/Well Screen Clogged – Floatable material that enters the EDB will most likely make its way to the outlet structure. This material is trapped against the trash racks and well screens on the outlet structure (which is why they are there). This material must be removed on a routine basis to ensure the outlet structure drains in the specified design period.

b. Structural Damage - The outlet structure is primarily constructed of concrete, which can crack, spall, and settle. The steel trash racks and well screens are also susceptible to damage.

c. Orifice Plate Missing/Not Secure – Many times residents, property owners, or maintenance personnel will remove or loosen orifice plates if they believe the pond is not draining properly. Any modification to the orifice plate(s) will significantly affect the designed discharge rates for water quality and/or flood
control. Modification of the orifice plates is not allowed without approval from the Town.

d. Manhole Access – Access to the outlet structure is necessary to properly inspect and maintain the facility. If access is difficult or not available to inspect the structure, chances are it will be difficult to maintain as well.

e. Woody Growth/Weeds Present - Because of the constant moisture in the soil surrounding the outlet works, woody growth (cottonwoods/willows) can create operational problems for the EDB. If woody vegetation is not routinely mowed/removed, the growth can cause debris/sediment to accumulate around the outlet works, which can cause problems with other EDB features. Also, tree roots can cause damage to the structural components of the outlet works. Routine management is essential for trees (removing a small tree/sapling is much cheaper and “quieter” than a mature tree).

EDB-2.3.7 Emergency Spillway

An emergency spillway is typical of all EDBs and designed to serve as the overflow in the event the volume of the pond is exceeded. The emergency spillway is typically armored with riprap (or other hard armor) and is sometimes buried with soil. The emergency spillway is typically a weir (notch) in the pond embankment. Proper function of the emergency spillway is essential to ensure flooding does not affect adjacent properties.

The typical maintenance items that are found with emergency spillways are as follows:

a. Riprap Displaced – As mentioned before, the emergency spillway is typically armored with riprap to provide erosion protection. Over the life of an EDB, the riprap may shift or dislodge due to flow.

b. Erosion Present – Although the spillway is typically armored, stormwater flowing through the spillway can cause erosion damage. Erosion must be repaired to ensure the integrity of the basin embankment, and proper function of the spillway.

c. Woody Growth/Weeds Present – Management of woody vegetation is essential in the proper long-term function of the spillway. Larger trees or dense shrubs can capture larger debris entering the EDB and reduce the capaTown of the spillway.

d. Obstruction Debris – The spillway must be cleared of any obstruction (man made or natural) to ensure the proper design capacity.
EDB-2.3.8  Upper Stage (Dry Storage)

The upper stage of the EDB provides the majority of the water quality flood detention volume. This area of the EDB is higher than the micro-pool and typically stays dry, except during storm events. The upper stage is the largest feature/area of the basin. Sometimes, the upper stage can be utilized for park space and other uses in larger EDBs. With proper maintenance of the micro-pool and forebay(s), the upper stage should not experience much sedimentation; however, bottom elevations should be monitored to ensure adequate volume.

The typical maintenance items that are found with upper stages are as follows:

a. Vegetation Sparse – The upper basin is the most visible part of the EDB, and therefore aesthetics is important. Adequate and properly maintained vegetation can greatly increase the overall appearance and acceptance of the EDB by the public. In addition, vegetation can reduce the potential for erosion and subsequent sediment transport to the other areas of the pond.

b. Woody Growth/Undesirable Vegetation – Although some trees and woody vegetation may be acceptable in the upper basin, some thinning of cottonwoods and willows may be necessary. Remember, the basin will have to be dredged to ensure volume, and large trees and shrubs will be difficult to protect during that operation.

c. Standing Water/Boggy Areas – Standing water or boggy areas in the upper stage is typically a sign that some other feature in the pond is not functioning properly. Routine maintenance (mowing, trash removal, etc) can be extremely difficult for the upper stage if the ground is saturated. If this inspection item is checked, make sure you have identified the root cause of the problem.

d. Sediment Accumulation – Although other features within the EDB are designed to capture sediment, the upper storage area will collect sediment over time. Excessive amounts of sedimentation will result in a loss of storage volume. It may be more difficult to determine if this area has accumulated sediment without conducting a field survey.

Below is a list of indicators:
1. Ground adjacent to the trickle channel appears to be several inches higher than concrete/riprap
2. Standing water or boggy areas in upper stage
3. Uneven grades or mounds
4. Micro-pool or Forebay has excessive amounts of sediment

e. Erosion (banks and bottom) – The bottom grades of the dry storage are typically flat enough that erosion should not occur. However, inadequate vegetative cover may result in erosion of the upper stage. Erosion that occurs in the upper stage can result in increased dredging/maintenance of the micro-pool.
f. Trash/Debris – Trash and debris can accumulate in the upper area after large events, or from illegal dumping. Over time, this material can accumulate and clog the EDB outlet works.

g. Maintenance Access – Most EDBs typically have a gravel/concrete maintenance access path to either the upper stage or forebay. This access path should be inspected to ensure the surface is still drivable. Some of the smaller EDBs may not have maintenance access paths; however, the inspector should verify that access is available from adjacent properties.

EDB-2.3.9 Miscellaneous

There are a variety of inspection/maintenance issues that may not be attributed to a single feature within the EDB. This category on the inspection form is for maintenance items that are commonly found in the EDB, but may not be attributed to an individual feature.

a. Access – Access needs to be maintained.

b. Graffiti/Vandalism – Damage to the EDB infrastructure can be caused by vandals. If criminal mischief is evident, the inspector should forward this information to the local enforcement agency.

c. Public Hazards – Public hazards include items such as vertical drops of greater than 4-feet, containers of unknown/suspicious substances, exposed metal/jagged concrete on structures. If any hazard is found within the facility area that poses an immediate threat to public safety, contact the local emergency services at 911 immediately!

d. Burrowing Animals/Pests – Prairie dogs and other burrowing rodents may cause damage to the EDB features and negatively affect the vegetation within the EDB.

e. Other – Any miscellaneous inspection/maintenance items not contained on the form should be entered here.

EDB-2.4 Inspection Forms

EDB Inspection forms are located in Appendix C. Inspection forms shall be completed by the person(s) conducting the inspection activities. Each form shall be reviewed and submitted by the property owner or property manager to the Monument Public Works Director per the requirements of the Inspection and Maintenance Plan. These inspection forms shall be kept a minimum of 5 years and made available to the Town of Monument upon request.
EBD-3  MAINTAINING EXTENDED DETENTION BASINS (EDBs)

EBD-3.1 Maintenance Personnel

Maintenance personnel must be qualified to properly maintain EDBs. Inadequately trained personnel can cause additional problems resulting in additional maintenance costs.

EBD-3.2 Equipment

It is imperative that the appropriate equipment and tools are taken to the field with the operations crew. The types of equipment/tools will vary depending on the task at hand. Below is a list of tools, equipment, and material(s) that may be necessary to perform maintenance on an EDB:

1.) Loppers/Tree Trimming Tools
2.) Mowing Tractors
3.) Trimmers (extra string)
4.) Shovels
5.) Rakes
6.) All Surface Vehicle (ASVs)
7.) Skid Steer
8.) Back Hoe
9.) Track Hoe/Long Reach Excavator
10.) Dump Truck
11.) Jet-Vac Machine
12.) Engineers Level (laser)
13.) Riprap (Minimum - Type M)
14.) Filter Fabric
15.) Erosion Control Blanket(s)
16.) Seed Mix (Native Mix)
17.) Illicit Discharge Cleanup Kits
18.) Trash Bags
19.) Tools (wrenches, screw drivers, hammers, etc)
20.) Chain Saw
21.) Confined Space Entry Equipment
22.) Approved Inspection and Maintenance Plan

Some of the items identified above may not be needed for every maintenance operation. However, this equipment should be available to the maintenance operations crews should the need arise.
EDB-3.3 Safety

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 a vertical drop is identified within the EDB that is greater than 48” in height, make the appropriate note/comment on the maintenance inspection form.

EDB-3.4 Maintenance Forms

The EDB Maintenance Form provides a record of each maintenance operation performed by maintenance contractors. The EDB Maintenance Form shall be filled out in the field after the completion of the maintenance operation. Each form shall be reviewed and submitted by the property owner or property manager to the Monument Public Works Director per the requirements of the Inspection and Maintenance Plan. The EDB Maintenance form is located in Appendix D.

EDB-3.5 Maintenance Categories and Activities

A typical EDB Maintenance Program will consist of three broad categories of work: Routine, Restoration (minor), and Rehabilitation (major). Within each category of work, a variety of maintenance activities can be performed on an EDB. A maintenance activity can be specific to each feature within the EDB, or general to the overall facility. This section of the SOP explains each of the categories and briefly describes the typical maintenance activities for an EDB.

A variety of maintenance activities are typical of EDBs. The maintenance activities range in magnitude from routine trash pickup to the reconstruction of drainage infrastructure. Below is a description of each maintenance activity, the objectives, and frequency of actions:

EDB-3.6 Routine Maintenance Activities

The majority of this work consists of regularly scheduled mowing and trash and debris pickups for stormwater management facilities during the growing season. This includes items such as the removal of debris/material that may be clogging the outlet structure well screens and trash racks. It also includes activities such as includes weed control, mosquito treatment, and algae treatment. These activities normally will be performed numerous times during the year. These items can be completed without any prior correspondence with the Monument Public Works Director; however, completed inspection and maintenance forms shall be submitted to the Monument Public Works Director for each inspection and maintenance activity.

The Maintenance Activities are summarized below, and further described in the following sections.
### TABLE – EDB-2
Summary of Routine Maintenance Activities

<table>
<thead>
<tr>
<th>Maintenance Activity</th>
<th>Minimum Frequency</th>
<th>Look for:</th>
<th>Maintenance Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mowing</td>
<td>Twice annually</td>
<td>Excessive grass height/aesthetics</td>
<td>Mow grass to a height of 4” to 6”</td>
</tr>
<tr>
<td>Trash/Debris Removal</td>
<td>Twice annually</td>
<td>Trash &amp; debris in EDB</td>
<td>Remove and dispose of trash and debris</td>
</tr>
<tr>
<td>Outlet Works Cleaning</td>
<td>As needed - after significant rain events – twice annually min.</td>
<td>Clogged outlet structure; ponding water</td>
<td>Remove and dispose of debris/trash/sediment to allow outlet to function properly</td>
</tr>
<tr>
<td>Weed control</td>
<td>Minimum twice annually</td>
<td>Noxious weeds; Unwanted vegetation</td>
<td>Treat w/ herbicide or hand pull; Consult the local weed specialist</td>
</tr>
<tr>
<td>Mosquito Treatment</td>
<td>As needed</td>
<td>Standing water/mosquito habitat</td>
<td>Treat w/ EPA approved chemicals</td>
</tr>
<tr>
<td>Algae Treatment</td>
<td>As needed</td>
<td>Standing water/Algal growth/green color</td>
<td>Treat w/ EPA approved chemicals</td>
</tr>
</tbody>
</table>

**EDB-3.6.1 Mowing**

Occasional mowing is necessary to limit unwanted vegetation and to improve the overall appearance of the EDB. Native vegetation should be mowed to a height of 4-to-6 inches tall. Grass clippings should be collected and disposed of properly.

*Frequency – Routine - Minimum of twice annually or depending on aesthetics.*

**EDB-3.6.2 Trash/Debris Removal**

Trash and debris must be removed from the entire EDB area to minimize outlet clogging and to improve aesthetics. This activity must be performed prior to mowing operations.

*Frequency – Routine – Prior to mowing operations and minimum of twice annually.*

**EDB-3.6.3 Outlet Works Cleaning**

Debris and other materials can clog the outlet work’s well screen, orifice plate(s) and trash rack. This activity must be performed anytime other maintenance activities are conducted to ensure proper operation.
**Frequency** - Routine – After significant rainfall event or concurrently with other maintenance activities.

**EDB-3.6.4 Weed Control**

Noxious weeds and other unwanted vegetation must be treated as needed throughout the EDB. This activity can be performed either through mechanical means (mowing/pulling) or with herbicide. Consultation with the local Weed Inspector is highly recommended prior to the use of herbicide.

**Frequency** – Routine – As needed based on inspections.

**EDB-3.6.5 Mosquito/Algae Treatment**

Treatment of permanent pools is necessary to control mosquitoes and undesirable aquatic vegetation that can create nuisances. Only EPA approved chemicals/materials can be used in areas that are warranted.

**Frequency** – As needed.

**EDB- 3.7 Restoration 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 do not require prior correspondence with the Monument Public Works Director and require completed inspection and maintenance forms to be submitted to the Monument Public Works Director for each inspection and maintenance activity.

**TABLE – EDB-3**

**Summary of Restoration Maintenance Activities**

<table>
<thead>
<tr>
<th>Maintenance Activity</th>
<th>Minimum Frequency</th>
<th>Look for:</th>
<th>Maintenance Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sediment Removal</td>
<td>As needed; typically every 1 – 2 years</td>
<td>Sediment build-up; decrease in pond volume</td>
<td>Remove and dispose of sediment</td>
</tr>
<tr>
<td>Erosion Repair</td>
<td>As needed, based upon inspection</td>
<td>Rills/gullies forming on side slopes, trickle channel, other areas</td>
<td>Repair eroded areas; Revegetate; address source of erosion</td>
</tr>
<tr>
<td>Vegetation Removal/Tree Thinning</td>
<td>As needed, based upon inspection</td>
<td>Large trees/wood vegetation in lower chamber of pond</td>
<td>Remove vegetation; restore grade and surface</td>
</tr>
<tr>
<td>Drain Cleaning/Jet Vac</td>
<td>As needed, based upon inspection</td>
<td>Sediment build-up</td>
<td>Clean drains; Jet Vac if needed</td>
</tr>
</tbody>
</table>
EDB-3.7.1  Sediment Removal

Sediment removal is necessary to maintain the original design volume of the EDB and to ensure proper function of the infrastructure. Regular sediment removal (minor) from the forebay, inflow(s), and trickle channel can significantly reduce the frequency of major sediment removal activities (dredging) in the upper and lower stages. The minor sediment removal activities can typically be addressed with shovels and smaller equipment. Major sediment removal activities will require larger and more specialized equipment. The major sediment activities will also require surveying with an engineer’s level, and consultation with the Monument Director of Development Services to ensure design volumes/grades are achieved.

Stormwater sediments removed from EDBs do not meet the criteria of “hazardous waste”. However, these sediments are contaminated with a wide array of organic and inorganic pollutants and handling must be done with care. Sediments from permanent pools must be carefully removed to minimize turbidity, further sedimentation, or other adverse water quality impacts. Sediments should be transported by motor vehicle only after they are dewatered. All sediments must be taken to a landfill for proper disposal. Prompt and thorough cleanup is important should a spill occur during transportation.

Frequency – Nonroutine – As necessary based upon inspections. Sediment removal in the forebay and trickle channel may be necessary as frequently as every 1-2 years.

EDB-3.7.2  Erosion Repair

The repair of eroded areas is necessary to ensure the proper function of the EDB, minimize sediment transport, and to reduce potential impacts to other features. Erosion can vary in magnitude from minor repairs to trickle channels, energy dissipaters, and rilling to major gullies in the embankments and spillways. The repair of eroded areas may require the use of excavators, earthmoving equipment, riprap, concrete, erosion control blankets, and turf reinforcement mats. Major erosion repair to the pond embankments, spillways, and adjacent to structures will require consultation with the Monument Director of Development Services.

Frequency – Nonroutine – As necessary based upon inspections.

EDB-3.7.3  Vegetation Removal/Tree Thinning

Dense stands of woody vegetation (willows, shrubs, etc) or trees can create maintenance problems for the infrastructure within an EDB. Tree roots can damage structures and invade pipes/channels thereby blocking flows. Also, trees growing in the upper and lower stages of the EDB will most likely have to be removed when sediment/dredging operations occur. A small tree is easier to remove than a large tree, therefore, regular removal/thinning is imperative. All trees and woody vegetation that is growing in the bottom of the EDB or near structures (inflows, trickle channels, outlet works, emergency spillways, etc)
should be removed. Any trees or woody vegetation in the EDB should be limited to the upper portions of the pond banks.

*Frequency* – Nonroutine – As necessary based upon inspections.

**EDB-3.7.4 Clearing Drains/Jet-Vac**

An EDB contains many structures, openings, and pipes that can be frequently clogged with debris. These blockages can result in a decrease of hydraulic capabilities and create standing water in areas outside of the micro-pool. Many times the blockage to this infrastructure can be difficult to access and/or clean. Specialized equipment (jet-vac machines) may be necessary to clear debris from these difficult areas.

*Frequency* – Nonroutine – As necessary based upon inspections.

**EDB-3.8 Rehabilitation Maintenance Activities**

This work consists of larger maintenance/operational problems and failures within the stormwater management facilities. All of this work requires consultation with Monument Director of Development Services to ensure the proper maintenance is performed. This work requires that the engineering staff review the original design and construction drawings to access the situation and assign the necessary maintenance. This work may also require more specialized maintenance equipment, design/details, surveying, or assistance through private contractors and consultants. Any proper permits required for this activity must be obtained.

**Table – EDB-4 Summary of Rehabilitation Maintenance Activities**

<table>
<thead>
<tr>
<th>Maintenance Activity</th>
<th>Minimum Frequency</th>
<th>Look for:</th>
<th>Maintenance Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major Sediment Removal</td>
<td>As needed – based upon scheduled inspections</td>
<td>Large quantities of sediment; reduced pond capacity</td>
<td>Remove and dispose of sediment. Repair vegetation as needed</td>
</tr>
<tr>
<td>Major Erosion Repair</td>
<td>As needed – based upon scheduled inspections</td>
<td>Severe erosion including gullies, excessive soil displacement, areas of settlement, holes</td>
<td>Repair erosion – find cause of problem and address to avoid future erosion</td>
</tr>
<tr>
<td>Structural Repair</td>
<td>As needed – based upon scheduled inspections</td>
<td>Deterioration and/or damage to structural components – broken concrete, damaged pipes, outlet works</td>
<td>Structural repair to restore the structure to its original design</td>
</tr>
</tbody>
</table>
EDB-3.8.1 Major Sediment Removal

Major sediment removal consists of removal of large quantities of sediment or removal of sediment from vegetated areas. Care shall be given when removing large quantities of sediment and sediment deposited in vegetated areas. Large quantities of sediment need to be carefully removed, transported and disposed of. Vegetated areas need special care to ensure design volumes and grades are preserved.

Frequency – Nonroutine – Repair as needed based upon inspections.

EDB-3.8.2 Major Erosion Repair

Major erosion repair consist of filling and revegetating areas of severe erosion. Determining the cause of the erosion as well as correcting the condition that caused the erosion should also be part of the erosion repair. Care should be given to ensure design grades and volumes are preserved.

Frequency – Nonroutine – Repair as needed based upon inspections.

EDB-3.8.3 Structural Repair

An EDB includes a variety of structures that can deteriorate or be damaged during the course of routine maintenance. These structures are constructed of steel and concrete that can degrade or be damaged and may need to be repaired or re-constructed from time to time. These structures include items like outlet works, trickle channels, forebays, inflows and other features. In-house operations staff can perform some of the minor structural repairs. Major repairs to structures may require input from a structural engineer and specialized contractors. Consultation with Monument Director of Development Services should take place prior to all structural repairs.

Frequency – Nonroutine – Repair as needed based upon inspections.

Reference:
This Manual is adapted from SEMSWA (2007) and from the City of Parker, Colorado (2004), STORMWATER PERMANENT BEST MANAGEMENT PRACTICES (PBMP) LONG-TERM OPERATION AND MAINTENANCE MANUAL.
APPENDIX C

INSPECTION FORM
GRASS BUFFER-GRASS SWALE INSPECTION FORM

Date: ________________________
Inspector: ____________________
Subdivision/Business Name: ________________________
Subdivision/Business Address: ________________________
Weather: ________________________
Date of Last Rainfall: ________________________ Amount: ________________________ Inches

Property Classification: Residential Multi Family Commercial Other: ________________________

(Circle One)
Reason for Inspection: Routine Complaint After Significant Rainfall Event

(Circle One)

INSPECTION SCORING - For each facility inspection item, insert one of the following scores:
0 = No deficiencies identified  2 = Routine maintenance required
1 = Monitor (potential for future problem)  3 = Immediate repair necessary
N/A = Not applicable

FEATURES

1.) Grass Swale Bottom & Side Slopes
   _____Sediment/Debris Accumulation
   _____Vegetation Cover
   _____Erosion Present
   _____Standing Water/Boggy Areas

2.) Grass Buffer
   _____Sediment/Debris Accumulation
   _____Vegetation Cover
   _____Erosion Present
   _____Standing Water/Boggy Areas

3.) Inflow Points
   _____Rip Rap Displaced/Rundown or Pipe Damage
   _____Erosion Present/Outfall Undercut
   _____Sediment Accumulation

4.) Underdrain System
   _____Standing water/Not draining
   _____Evidence of clogged system

5.) Grade Control
   _____Erosion Present
   _____Structural Damage

6.) Level Spreader
   _____Erosion Present
   _____Structural Damage
   _____Uneven/Uneven Distribution of flow

7.) Irrigation
   _____General Grass Condition
   _____Bare Spots
   _____Broken sprinkler heads

8.) Miscellaneous
   _____Encroachment In Easement Area
   _____Public Hazards
   _____Burrowing Animals/Pests
   _____Other

Inspection Summary / Additional Comments: _____________________________________________

OVERALL FACILITY RATING (Circle One)
0 = No Deficiencies Identified  2 = Routine Maintenance Required
1 = Monitor (potential for future problem exists)  3 = Immediate Repair Necessary
# Porous Landscape Detention (PLD) Inspection Form

**Date:**

**Subdivision/Business Name:**

**Subdivision/Business Address:**

**Weather:**

**Date of Last Rainfall:**

**Amount:**

**Inches**

**Property Classification:** Residential  Multi Family  Commercial  Other:

**Reason for Inspection:**

Routine  Complaint  After Significant Rainfall Event

**INSPCTION SCORING -** For each facility inspection item, insert one of the following scores:

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No deficiencies identified</td>
</tr>
<tr>
<td>1</td>
<td>Monitor (potential for future problem)</td>
</tr>
<tr>
<td>2</td>
<td>Routine maintenance required</td>
</tr>
<tr>
<td>3</td>
<td>Immediate repair necessary</td>
</tr>
<tr>
<td>N/A</td>
<td>Not applicable</td>
</tr>
</tbody>
</table>

**FEATURES**

1. **Inflow Points**
   - Rip Rap Displaced/Rundown or Pipe Damage
   - Erosion Present/Outfall Undercut
   - Sediment Accumulation
   - Structural Damage

2. **Filter Media**
   - Infiltration Rate Check
   - Sediment Removal
   - Filter Replacement

3. **Landscaping**
   - Woody Growth/Weeds Present
   - General Landscape Care

4. **Underdrain System**
   - Evidence of dogged system
   - Jet-vac cleaning required

5. **Embankments**
   - Vegetation Sparse
   - Erosion Present

6. **Overflow Outlet Works**
   - Structural Damage
   - Woody Growth/Weeds Present
   - Trash/Debris

7. **Miscellaneous**
   - Encroachment in Easement Area
   - Graffiti/Vandalism
   - Public Hazards
   - Other

**Inspection Summary / Additional Comments:**

---

**OVERALL FACILITY RATING (Circle One)**

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No Deficiencies Identified</td>
</tr>
<tr>
<td>1</td>
<td>Monitor (potential for future problem exists)</td>
</tr>
<tr>
<td>2</td>
<td>Routine Maintenance Required</td>
</tr>
<tr>
<td>3</td>
<td>Immediate Repair Necessary</td>
</tr>
</tbody>
</table>

This inspection form has been adopted from the City of Colorado Springs, Post-Construction Maintenance Program, for use by Town of Monument.
# SAND FILTER BASIN (SFB) INSPECTION FORM

**Date:**

**Subdivision/Business Name:**

**Inspector:**

**Subdivision/Business Address:**

**Weather:**

**Date of Last Rainfall:**

**Amount:**

**Inches**

<table>
<thead>
<tr>
<th>Property Classification:</th>
<th>Residential</th>
<th>Multi Family</th>
<th>Commercial</th>
<th>Other:</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Circle One)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Reason for Inspection:</th>
<th>Routine</th>
<th>Complaint</th>
<th>After Significant Rainfall Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Circle One)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**INSPECTION SCORING**

- 0 = No deficiencies identified
- 2 = Routine maintenance required
- 1 = Monitor (potential for future problem)
- 3 = Immediate repair necessary
- N/A = Not applicable

## FEATURES

1. Inflow Points/Splitter Box
   - Riprap Displaced
   - Sediment Accumulation
   - Structural Damage (pipe, end-section, etc.)
   - Trash/Debris

2. Sedimentation Chamber
   - Mowing /weed/woody growth control
   - Erosion Present
   - Trash/Debris
   - Sediment Accumulation

3. Filter Media
   - Mowing /weed/woody growth control
   - Sediment/Pollutant Removal
   - Filter Replacement
   - Infiltration Rate Check

4. Underdrain System
   - Evidence of clogged system (jet-vac cleaning required)

5. Outlet Works
   - Structural Damage (concrete, steel, subgrade)
   - Mowing /weed/woody growth control

6. Embankments
   - Vegetation Sparse
   - Erosion Present
   - Trash/Debris
   - Mowing /weed/woody growth control

7. Emergency Overflow
   - Riprap Displaced
   - Erosion Present
   - Woody Growth/Weeds Present
   - Obstruction/Debris

8. Miscellaneous
   - Encroachment in Easement Area
   - Graffiti/Vandalism
   - Public Hazards
   - Other

**Inspection Summary / Additional Comments:**

---

**OVERALL FACILITY RATING (Circle One)**

- 0 = No Deficiencies Identified
- 2 = Routine Maintenance Required
- 1 = Monitor (potential for future problem exists)
- 3 = Immediate Repair Necessary

This inspection form has been adopted from the City of Colorado Springs, Post-Construction Maintenance Program, for use by Town of Monument.
**EXTENDED DETENTION BASIN (EDB) INSPECTION FORM**

**Date:**

**Subdivision/Business Name:**

**Inspector:**

**Subdivision/Business Address:**

**Weather:**

**Date of Last Rainfall:** ___________ **Amount:** ___________ **Inches**

**Property Classification:** Residential Multi Family Commercial Other: ___________

(Circle One)

**Reason for Inspection:** Routine Complaint After Significant Rainfall Event

(Circle One)

---

**INSPECTION SCORING** - For each facility inspection item, insert one of the following scores:

- **0:** No deficiencies identified
- **1:** Monitor (potential for future problem)
- **2:** Routine maintenance required
- **3:** Immediate repair necessary
- **N/A:** Not applicable

---

**FEATURES**

1.) Inflow Points
   - Ripped Displaced
   - Erosion Present/Outfall Undercut
   - Sediment Accumulation
   - Structural Damage (pipe, end-section, etc.)
   - Woody Growth/Weeds Present

2.) Forebay
   - Sediment/Debris Accumulation
   - Concrete Cracking/Falling
   - Drain Valve/Water Grogged (not draining)
   - Water/Drain Pipe Damage

3.) Trickle Channel (Low-flow)
   - Sediment/Debris Accumulation
   - Concrete/Riprap Damage
   - Woody Growth/Weeds Present
   - Erosion Outside Channel

4.) Bottom Stage (Micro-Pool)
   - Sediment/Debris Accumulation
   - Woody Growth/Weeds Present
   - Bank Erosion
   - Mosquitoes/Algae Treatment
   - Petroleum/Chemical Sheen

5.) Outlet Works
   - Trash Rack/Water Screen Clogged
   - Structural Damage (concrete, steel, subgrade)
   - Office Plate(s) Missing/Not Secure
   - Manhole Access (cover, steps, etc.)
   - Woody Growth/Weeds Present

6.) Emergency Spillway
   - Riprap Displaced
   - Erosion Present
   - Woody Growth/Weeds Present
   - Obstruction/Debris

7.) Upper Stage (Dry Storage)
   - Vegetation Sparse
   - Woody Growth/Undesirable Vegetation
   - Standing Water/Boggy Areas
   - Sediment Accumulation
   - Erosion (banks and bottom)
   - Trash/Debris
   - Maintenance Access

8.) Miscellaneous
   - Encroachment In Easement Area
   - Graffiti/Vandalism
   - Public Hazards
   - Burrowing Animals/Pests
   - Other

**Inspection Summary / Additional Comments:**

---

**OVERALL FACILITY RATING (Circle One)**

- **0:** No deficiencies Identified
- **1:** Monitor (potential for future problem exists)
- **2:** Routine Maintenance Required
- **3:** Immediate Repair Necessary

This inspection form has been adopted from the City of Colorado Springs, Post-Construction Maintenance Program, for use by Town of Monument.
APPENDIX D

MAINTENANCE FORM
### GRASS BUFFERS AND GRASS SWALES (GB-GS) MAINTENANCE FORM

**Subdivision/Business Name:** __________________________ **Completion Date:** __________________________

**Subdivision/Business Address:** __________________________ **Contact Name:** __________________________

#### Maintenance Category:
(Circle all that apply)
- Routine
- Restoration
- Rehabilitation

#### MAINTENANCE ACTIVITIES PERFORMED

**Routine Work**
- [ ] Mowing
- [ ] Trash/Debris Removal
- [ ] Outlet Works Cleaning (Trash Rack/Well Screen)
- [ ] Weed Control (Herbicide Application)

**Restoration Work**
- [ ] Sediment Removal
  - [ ] Inflow Point
  - [ ] Swale Bottom
  - [ ] Side Slope
  - [ ] Buffer Strip
- [ ] Erosion Repair
  - [ ] Inflow Point
  - [ ] Swale Bottom
  - [ ] Side Slope
  - [ ] Buffer Strip
- [ ] Grade Control/Level Spreader
- [ ] Revegetation
  - [ ] Swale Bottom
  - [ ] Side Slope
  - [ ] Buffer Strip

**Rehabilitation Work**
- [ ] Sediment Removal (Dredging)
  - [ ] Swale Bottom
  - [ ] Inflow Point
- [ ] Erosion Repair
  - [ ] Inflow Point
  - [ ] Swale Bottom
  - [ ] Side Slope
  - [ ] Buffer Strip
- [ ] Structural Repair
  - [ ] Inflow
  - [ ] Underdrain
  - [ ] Level Spreader

**Other:**
- [ ]
- [ ]
- [ ]

#### COMMENTS/ADDITIONAL INFO:

_________________________________

_________________________________

_________________________________

This Maintenance Activity Form has been adopted from the City of Colorado Springs, Post-Construction Maintenance Program, for use by Town of Monument.
POROUS LANDSCAPE DETENTION (PLD) 
MAINTENANCE FORM

Subdivision/Business Name: ___________________________ Completion Date: ________________

Subdivision/Business Address: _________________________ Contact Name: __________________

<table>
<thead>
<tr>
<th>Maintenance Category:</th>
<th>Routine</th>
<th>Restoration</th>
<th>Rehabilitation</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Circle all that apply)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

MAINTENANCE ACTIVITIES PERFORMED

**ROUTINE WORK**

- [ ] MOWING
- [ ] TRASH/DEBRIS REMOVAL
- [ ] OUTLET WORKS CLEANING (TRASH RACK/WELL SCREEN)
- [ ] WEED CONTROL (HERBICIDE APPLICATION)

**RESTORATION WORK**

- [ ] SEDIMENT REMOVAL
- [ ] INFLOW POINT
- [ ] OUTLET WORKS
- [ ] FILTER MEDIA
- [ ] EROSION REPAIR
- [ ] INFLOW POINT
- [ ] EMBANKMENTS
- [ ] OUTLET WORKS
- [ ] REVEGETATION
- [ ] EMBANKMENTS
- [ ] JET-VAC/CLEARING DRAINS
- [ ] OUTLET WORKS
- [ ] INFLOWS
- [ ] UNDERDRAIN SYSTEM

**REHABILITATION WORK**

- [ ] SEDIMENT REMOVAL (DREDGING)
- [ ] FILTER MEDIA
- [ ] INFLOW POINT
- [ ] EROSION REPAIR
- [ ] OUTLET WORKS
- [ ] EMBANKMENTS
- [ ] BOTTOM STAGE
- [ ] STRUCTURAL REPAIR
- [ ] INFLOW
- [ ] OUTLET WORKS
- [ ] FILTER MEDIA

OTHER

- [ ] ____________________________
- [ ] ____________________________
- [ ] ____________________________
- [ ] ____________________________

COMMENTS/ADDITIONAL INFO:

- [ ] ____________________________
- [ ] ____________________________
- [ ] ____________________________

This Maintenance Activity Form has been adopted from the City of Colorado Springs, Post-Construction Maintenance Program, for use by Town of Monument.
# Sand Filter Basin (SFB) Maintenance Form

**Subdivision/Business Name:**

**Completion Date:**

**Subdivision/Business Address:**

**Contact Name:**

<table>
<thead>
<tr>
<th>Maintenance Category</th>
<th>Routine</th>
<th>Restoration</th>
<th>Rehabilitation</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Circle all that apply)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Maintenance Activities Performed

### Routine Work

- **Mowing**
- **Trash/Debris Removal**
- **Outlet Works Cleaning (Trash Rack/Well Screen)**
- **Weed Control (Herbicide Application)**

### Restoration Work

- **Sediment Removal**
  - Inflow Point/Splitter Box
  - Outlet Works
  - Filter Media
  - Sedimentation Chamber
  - Emergency Overflow
- **Erosion Repair**
  - Inflow Point/Splitter Box
  - Outlet Works
  - Embankments
  - Sedimentation Chamber
  - Emergency Overflow
  - Filter Media

### Rehabilitation Work

- **Sediment Removal (Dredging)**
  - Filter Media
  - Sedimentation Chamber
- **Erosion Repair**
  - Filter Media
  - Sedimentation Chamber
  - Emergency Overflow
  - Embankments
  - Structural Repair

### Other

- **Revegetation**
  - Jet-Vac/Clearing Drains
  - Inflows
  - Outlet Works
  - Underdrain

### Comments/Additional Info:

---

This Maintenance Activity Form has been adopted from the City of Colorado Springs, Post-Construction Maintenance Program, for use by Town of Monument.
EXTENDED DETENTION BASIN (EDB) MAINTENANCE FORM

Subdivision/Business Name: ___________________________ Completion Date: ___________________________
Subdivision/Business Address: ___________________________ Contact Name: ___________________________

<table>
<thead>
<tr>
<th>Maintenance Category:</th>
<th>Routine</th>
<th>Restoration</th>
<th>Rehabilitation</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Circle All That Apply)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

MAINTENANCE ACTIVITIES PERFORMED

ROUTINE WORK

___ MOWING
___ TRASH/DEBRIS REMOVAL
___ OUTLET WORKS CLEANING (TRASH RACK/WELL SCREEN)
___ WEED CONTROL (HERBICIDE APPLICATION)
___ MOSQUITO TREATMENT
___ ALGAE TREATMENT

RESTORATION WORK

___ SEDIMENT REMOVAL
   ___ FOREBAY
   ___ TRICKLE CHANNEL
   ___ INFLOW
___ EROSION REPAIR
   ___ INFLOW POINT
   ___ TRICKLE CHANNEL
___ VEGETATION REMOVAL/TREE THINNING
   ___ INFLOW(S)
   ___ TRICKLE CHANNEL
   ___ UPPER STAGE
   ___ BOTTOM STAGE
___ REVEGETATION
___ JET-VAC/CLEARING DRAINS
   ___ FOREBAY
   ___ OUTLET WORKS
   ___ INFLOWS

REHABILITATION WORK

___ SEDIMENT REMOVAL (DREDGING)
   ___ BOTTOM STAGE
   ___ UPPER STAGE
___ EROSION REPAIR
   ___ OUTLET WORKS
   ___ UPPER STAGE
   ___ BOTTOM STAGE
   ___ SPILLWAY
___ STRUCTURAL REPAIR
   ___ INFLOW
   ___ OUTLET WORKS
   ___ FOREBAY
   ___ TRICKLE CHANNEL

COMMENTS/ADDITIONAL INFO:

________________________________________________________________________

This Maintenance Activity Form has been adopted from the City of Colorado Springs, Post-Construction Maintenance Program, for use by Town of Monument.
APPENDIX E

ANNUAL INSPECTION AND MAINTENANCE REPORTING FORM
Annual Inspection and Maintenance Reporting Form
For Permanent
Stormwater BMPs

(This form to be submitted to the Public Works Director prior to May 31 of each year)

Date: __________________________

To: Town of Monument
   Attn: Director of Public Works
   PO Box 325
   645 Beacon Lite Road
   Monument, Co. 80132

Re: Certification of Inspection and Maintenance; Submittal of forms

Property/Subdivision Name: __________________________

Property Address: __________________________

Contact Name: __________________________

Contact Phone #: __________________________

Contact Email Address: __________________________

I verify that the required stormwater facility inspections and required maintenance have been completed in accordance with the Stormwater BMP Maintenance Agreement and the Inspection and Maintenance Manual associated with the above referenced property.

The required Stormwater Facility Inspection and Maintenance forms are attached to this form.

Name of Party Responsible for Inspection & Maintenance

Property Owner

Authorized Signature

Signature
APPENDIX F

EROSION AND STORMWATER QUALITY CONTROL PLAN/AS-BUILTS
APPENDIX G

BMP MAINTENANCE COST ESTIMATES
APPENDIX H

PE CERTIFICATION