

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

for:

Lot 23 Claremont Business Park Filing No. 2

Located at:

7344 Cole View

Prepared for:

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Reference:

**This plan is adapted from various maintenance manuals developed in the
Colorado Front Range**

**Stormwater Best Management Practices
Inspection and Maintenance Plan Procedures/Forms for
Sand Filter Basins (SFBs)**

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Stormwater Best Management Practices Inspection and Maintenance Plan Procedures/Forms for Sand Filter Basins (SFBs)

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.

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 and submittal of the required Inspection and Maintenance Forms shall be provided on an annual basis. The annual reporting form shall be provided 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 El Paso County (EPC).

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 any 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 both a designated access location and the County has the right to enter for the purpose of inspecting and for maintaining BMPs where 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 personal, 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.

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 El Paso County Stormwater 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 EPC Stormwater; however, inspection and maintenance forms shall be completed with the information also being reported on the annual report forms that are submitted to the County.

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 EPC Stormwater, but do require that completed maintenance forms be submitted to EPC Stormwater 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 EPC Stormwater and may require an engineering design with construction plans to be prepared for review and approval by the County. 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 EPC Stormwater and require that completed maintenance forms be submitted to EPC Stormwater 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:

El Paso County Planning & Community Development
2880 International Circle, Suite 110
Colorado Springs, CO 80910

Refer to Section II of this Manual regarding the annual reporting of inspections and maintenance activities performed

Appendix B

Standard Operation Procedures
for
Inspection and Maintenance

Sand Filter Basins (SFBs)

May 2008

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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 dewateres 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 stormwater¹. 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**

	Sediment Removal	Mowing Weed control	Trash/ Debris Removal	Erosion	Overgrown Vegetation Removal	Removal/ Replacement	Structure Repair
Inflow Points/Splitter Box	X		X				X
Sedimentation Chamber	X	X	X	X	X		
Filter Media	X	X	X	X	X	X	
Underdrain System	X					X	
Overflow Outlet Works	X		X				X
Embankment		X	X	X	X		

¹ Design of Stormwater Filtering Systems, Centers for Watershed Protection, December 1996

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 the storm sewer system 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 often conveys the runoff to a regional 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.

SBF-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 40-hours of the filling. If the drain time for the basin is longer than 40-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 EPC Stormwater per the requirements of the Inspection and Maintenance Plan. These inspection forms shall be kept a minimum of 5 years and made available to EPC 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 EPC Stormwater 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 mowings, 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 EPC, however, completed inspection and maintenance forms shall be submitted to EPC Stormwater 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**

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

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 ECP. Completed inspection and maintenance forms shall be submitted to EPC Stormwater 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**

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

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. A SFB should drain completely within 40-hours of a storm event. If drain times exceed the 40-hour drain time then 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

US Standard Sieve Size (Number)	Total Percent Passing (%)
9.5 mm (3/8 inch)	100
4.75 mm (No. 4)	95-100
2.36 mm (No. 8)	80-100
1.18 mm (No. 16)	50-85
600 <input type="checkbox"/> m (No.	25-60
300 <input type="checkbox"/> m (No.	10-30
150 <input type="checkbox"/> m (No	2-10

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 EPC's Engineering staff 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 EPC's Engineering staff.

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 capacity 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 EPC's Engineering staff 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 SFB-4
Summary of Rehabilitation Maintenance Activities**

Maintenance Activity	Minimum Frequency	Look for:	Maintenance Action
Major Sediment/Pollutant Removal	As needed – based upon scheduled inspections	Large quantities of sediment in the sedimentation chamber and/or filter media; reduced infiltration rate /capacity	Remove and dispose of sediment. Repair vegetation as needed
Major Erosion Repair	As needed – based upon scheduled inspections	Severe erosion including gullies, excessive soil displacement, areas of settlement, holes	Repair erosion – find cause of problem and address to avoid future erosion
Structural Repair	As needed – based upon scheduled inspections	Deterioration and/or damage to structural components – broken concrete, damaged pipes & outlet works	Structural repair to restore the structure to its original design
SFB Rebuild	As needed – due to complete failure of SFB	Removal of filter media and underdrain system	Contact EPC Engineering

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 – Repair as needed, based upon inspections.

SFB-3.8.2 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.

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 EPC's Engineering staff 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 EPC's Engineering staff shall take place prior to any rebuild project.

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

APPENDIX C

INSPECTION FORM

APPENDIX D

MAINTENANCE FORM

Appendix D: Maintenance Form

SAND FILTER BASIN (SFB) MAINTENANCE FORM

Subdivision/Business Name: _____ Completion Date: _____

Subdivision/Business Address: _____ Contact Name: _____

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

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
- ___ REVEGETATION
- ___ JET-VAC/CLEARING DRAINS
 - ___ INFLOWS
 - ___ OUTLET WORKS
 - ___ UNDERDRAIN

REHABILITATION WORK

- ___ SEDIMENT REMOVAL (DREDGING)
 - ___ FILTER MEDIA
 - ___ SEDIMENTATION CHAMBER
- ___ EROSION REPAIR
 - ___ INFLOW POINT/SPLITTER BOX
 - ___ OUTLET WORKS
 - ___ EMBANKMENTS
 - ___ SEDIMENTATION CHAMBER
 - ___ EMERGENCY OVERFLOW
 - ___ FILTER MEDIA
- ___ STRUCTURAL REPAIR
 - ___ INFLOW POINT/SPLITTER BOX
 - ___ OUTLET WORKS
 - ___ FILTER MEDIA
 - ___ SEDIMENTATION CHAMBER
 - ___ EMERGENCY OVERFLOW

OTHER _____

ESTIMATED TOTAL MANHOURS: _____

COSTS INCURRED (include description of costs): _____

EQUIPMENT/MATERIAL USED (include hours of equipment usage and quantity of material used):

COMMENTS/ADDITIONAL INFO:

APPENDIX E

ANNUAL INSPECTION AND MAINTENANCE REPORTING FORM

Appendix E: Annual Inspection and Maintenance Submittal Form

Annual Inspection and Maintenance Reporting Form
for
Stormwater BMPs

(This form to be submitted to El Paso County prior to May 31 of each year)

Date: _____

**To: El Paso County Planning & Community Development
2880 International Circle
Colorado Springs, CO 80910**

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

BMP Maintenance Cost Estimates (2007)

Routine maintenance costs can usually be predicted for an annual budget and may range from four percent of original capital construction costs per year for an EDB to nine percent of original capital costs per year for an infiltration BMP.

A general rule of thumb is that annual maintenance costs may run from \$100 per acre for minor maintenance, such as mowing, to \$500 per acre for more intensive maintenance including weed control, debris removal, etc.

Non-routine maintenance costs, however, can be substantial over the long run, especially when considering the possibility of eventual BMP replacement. To lessen the immediate financial impact of non-routine costs, it is advised that a BMP maintenance fund, with annual contributions, be established.

As an example, for EDBs, which need to have sediment removed once every two to ten years, ten to 50 percent of anticipated dredging costs should be collected annually. In addition, the average EDBs has a life expectancy of 20 to 50 years. A separate fund that collects two to five percent a year should be established for replacement. Anticipated interest may be used to offset the effects of inflation.

Type of BMP	Sediment Removal Frequency	Facility Life Span*
Retention Pond	5 to 15 years	20 to 50 years
EDB	2 to 10 years	20 to 50 years
Sand Filter	Every 6 months or as required	20 to 50 years
PLD	5 to 10 years	10 to 25 years
Grass Swale/Grass Buffer	As needed	10 to 25 years
Porous Paving	3 to 4 times per year	25 years

*Assumes the facility is maintained on a regular basis.

Estimating and Planning for Non-routine Costs for BMPs

Costs for non-routine maintenance of BMPs are highly specific and will vary depending upon:

- the type, size, and depth of the facility;
- the volume of the sediment trapped in the BMP;
- the accessibility of the BMP; and
- whether or not on-site disposal of the sediment is possible.

Retention Pond and EDB Sediment Removal

The technique used to remove sediment from a retention pond or EDB is very site-specific. The information below provides an estimate of costs associated with the dredging process.

♦ Mobilization and Demobilization of Machinery

Associated Costs: \$1,000 to \$10,000

Large retention ponds or regional facilities will often require a waterborne operation during which an excavator or a crane must be mounted to a floating barge and moved into position. For smaller ponds, larger ponds that can be drained or dredged from the shore, and extended detention basins, a perimeter or dry operation will usually suffice. In this case, a backhoe, truck equipment, or crane may be used to scoop out the sediment. Additional costs for the construction and restoration of access roads for trucks and heavy equipment may be accrued.

♦ Dredging

Associated Costs: \$10 per cubic yard to \$20 per cubic yard

The cost of dredging a BMP depends on the volume of sediment removed. The cost (expressed by cubic yard) is largely influenced by the depth of the water and the distance between the excavation area and the “staging area” where sediment is transferred to trucks for removal. Another consideration is whether equipment can easily access the BMP bottom. The following equation can be used to estimate the volume of sediment in cubic yards.

Equation to Estimate the Volume of Sediment in a BMP (in cubic yards)

surface area _____ (acres) x depth of sediment _____ (feet) x 43,560 = _____ cubic feet
cubic feet _____ / 27 = _____ **cubic yards**

♦ Disposal

Associated Costs: \$5 per cubic yard - on-site to \$47 per cubic yard - off-site

The primary determinant of disposal costs is whether on-site disposal is an option. If on-site disposal is not available, then locating a landfill or large area to apply the spoils may prove challenging and transportation costs may increase considerably. Dredged materials will require special disposal if found to contain hazardous materials.

Adding the likely costs of the sediment removal components establishes a range in which an owner can expect to pay for sediment/pollutant removal. For a facility with a small surface area (0.25 acres) overall costs can range from \$4,000 to \$10,000+. For a large facility (10 acres) overall costs can range from \$170,000 to \$550,000+.

	Maintenance	Annual Associated Cost
PLD	Removal of sediments and replacement of some level of soil is required periodically. Mulch should be replaced annually, or as needed.	Between \$1,500 and \$2,000, depending upon the size and complexity of the facility.
Grass Swale/ Grass Buffer	Remove sediments, replace check dams (usually made of earth, riprap, or wood), reseed or sod (if grassed) or replace dead plants, every two years.	
Porous Paving	Vacuum sediments from surface, twice a year.	Between \$500 and \$1,000, depending on the size of the facility.
Sand Filter	Remove the top filter cloth and remove/replace the filter gravel, when a semiannual inspection reveals that it is necessary. Remove and replace the filter cloth and gravel every three to five years.	Between \$3,000 to \$10,000, depending on the type and size of the sand filter and the amount of impervious surface draining to it.

If an oil sheen is present in the facility, it should be removed by a qualified oil recycler, which increases costs. Other expenses, such as removal of trash and hydrocarbons from water traps may also be required.

Removing sediment from stormwater facilities can be a considerable expense. Look for opportunities to reduce the amount of sediment entering the pond from the surrounding drainage area.

Reference: Information adapted from “Maintaining Stormwater Systems, A Guidebook for Private Owners and Operators in Northern Virginia”, January 2007, Northern Virginia Regional Commission

APPENDIX H

PE CERTIFICATION

PE Certification Checklist for: Sand Filter Extended Detention Basin (SFB)

Grading

- Grading & slope grades completed per approved plans
- Properly sized perforated underdrain installed per approved plans
- Geotextile filter or impermeable liner installed

Soil Mixes (sand and gravel layers)

- Proper storage of soil mix prior to placement to ensure no cross contamination
- Underdrain Aggregate correct per approved plans
 - Load ticket verified
- Soil mix correct per approved plans
 - Load ticket verified

Forebay

- Built per approved plans
- Forebay volume per approved plans

Outlet Works

- Built per approved plans

Spillway Structure

- Built per approved plans

WQCV and Elevations

- WQCV per approved plans
- All elevations per approved plans

As built

- As built plans for permanent BMP

Recommended Key Phases for Observation

1. Final grading
2. Underdrain installation
3. Installation of soil mixes
4. Installation of forebay
5. Installation of overflow and spillway

Notes:

- 1) This checklist is not meant to be all inclusive and is for informational purposes only.
- 2) Initial all items that pertain to the approved plans.
- 3) Mark all items that do not pertain as N/A for not applicable.