Stormwater Operations and Maintenance Guide

Bioretention (Rain Gardens and Sand Filters)

Introduction

Bioretention features are landscaped or sandy areas designed to capture stormwater runoff and reduce pollutants using natural filtration, typically over a 12-hour period. Rain Gardens contain growing media and are established with a variety of native and perennial plants, grasses and flowers, having the added benefit of adding color to the landscape. Sand Filters do not contain biomedia, instead having only sand for filtration. Bioretention features also are designed with drainage control elements to double their function for flood mitigation and public safety.

Bioretention Components

Bioretention features have several components that each serve a special function and have different inspection and maintenance needs. Bioretention components include:

Inflow point (inlets)

The inflow point is where runoff enters the system through a storm sewer pipe roof downspout, surface channel, curb-cut or as "distributed" surface overflow. Inflow points should have a vertical drop to allow positive drainage into the feature.

Forebays/ Energy Dissipation

The forebay is located below the inflow point and is designed to remove large particles, trash and other debris as well as provide energy dissipation. Some features do not include a Forebay and instead have only energy dissipation features such as rip rap, curb cuts, etc.

Filter Media

Filter media is generally 18 to 36 inches deep and removes pollutants as runoff flows downward through it. For sand filters, the filter media is a specified type of sand. For rain gardens, the filter media is a specified mix of sand, silt/clay, shredded mulch, or other materials and is intended to have vegetation growing on it.

Underdrain

Underdrains are used in areas where infiltration of runoff into groundwater beneath the BMP is low or not allowed. Underdrains are designed to completely drain the feature within 12 to 24 hours and discharge into the outlet structure. Note: Not all features will have underdrains.

Outlet Structure

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

Spillway (Weir/Overflow)

Often the Outlet Structure serves as the emergency overflow but sometimes bioretention features may include a traditional overflow spillway with a concrete weir.

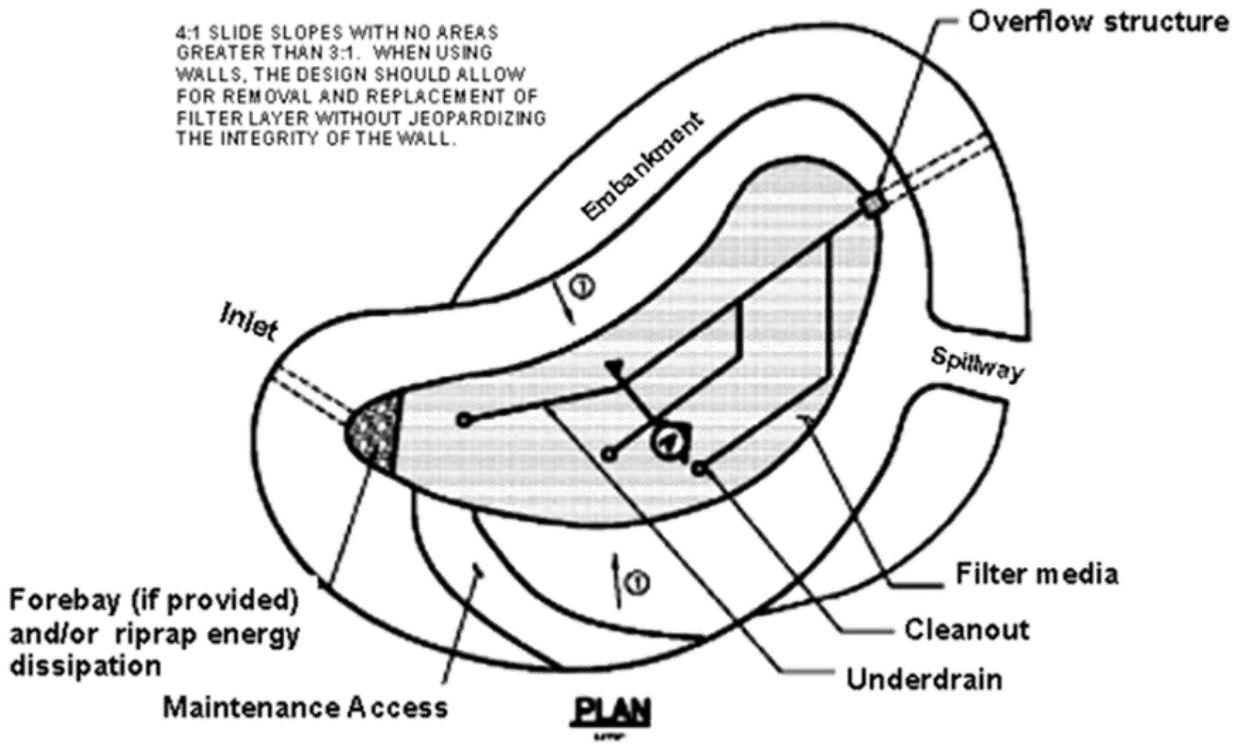
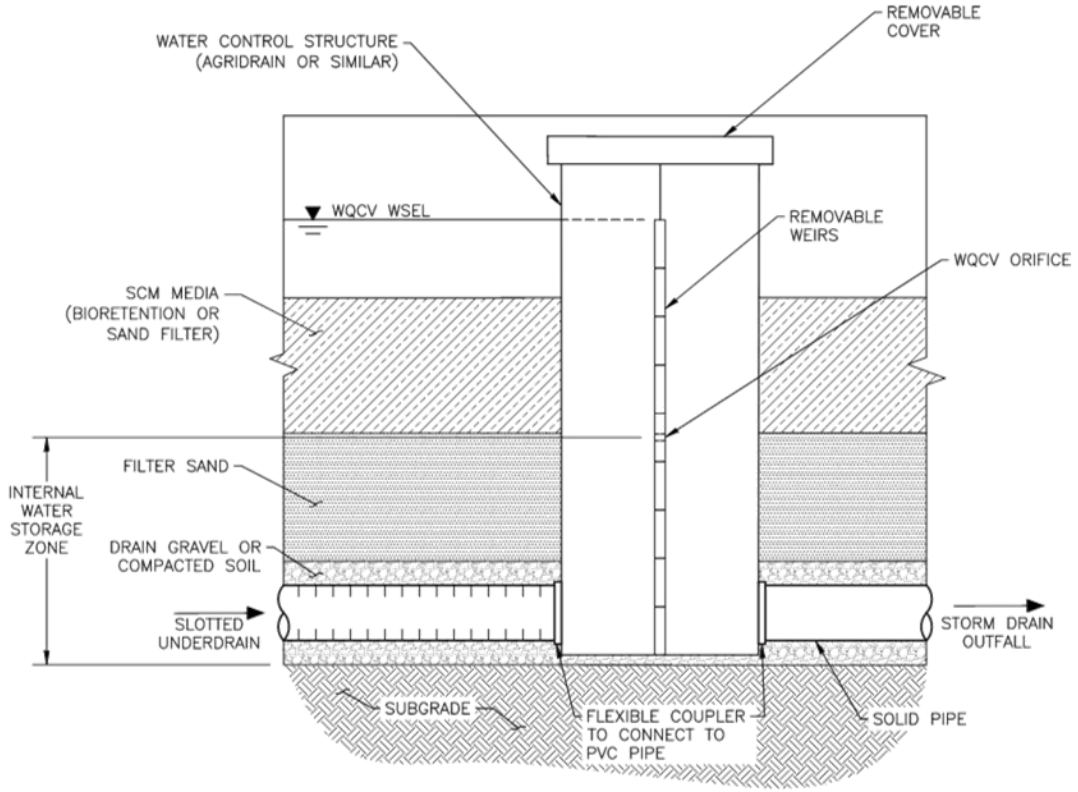


Figure Plan view diagram of typical bioretention/sand filter



NOTES:

1. PARTIAL INFILTRATION SECTION SHOWN. SEE FIGURE 4–2 FOR MORE INFORMATION.

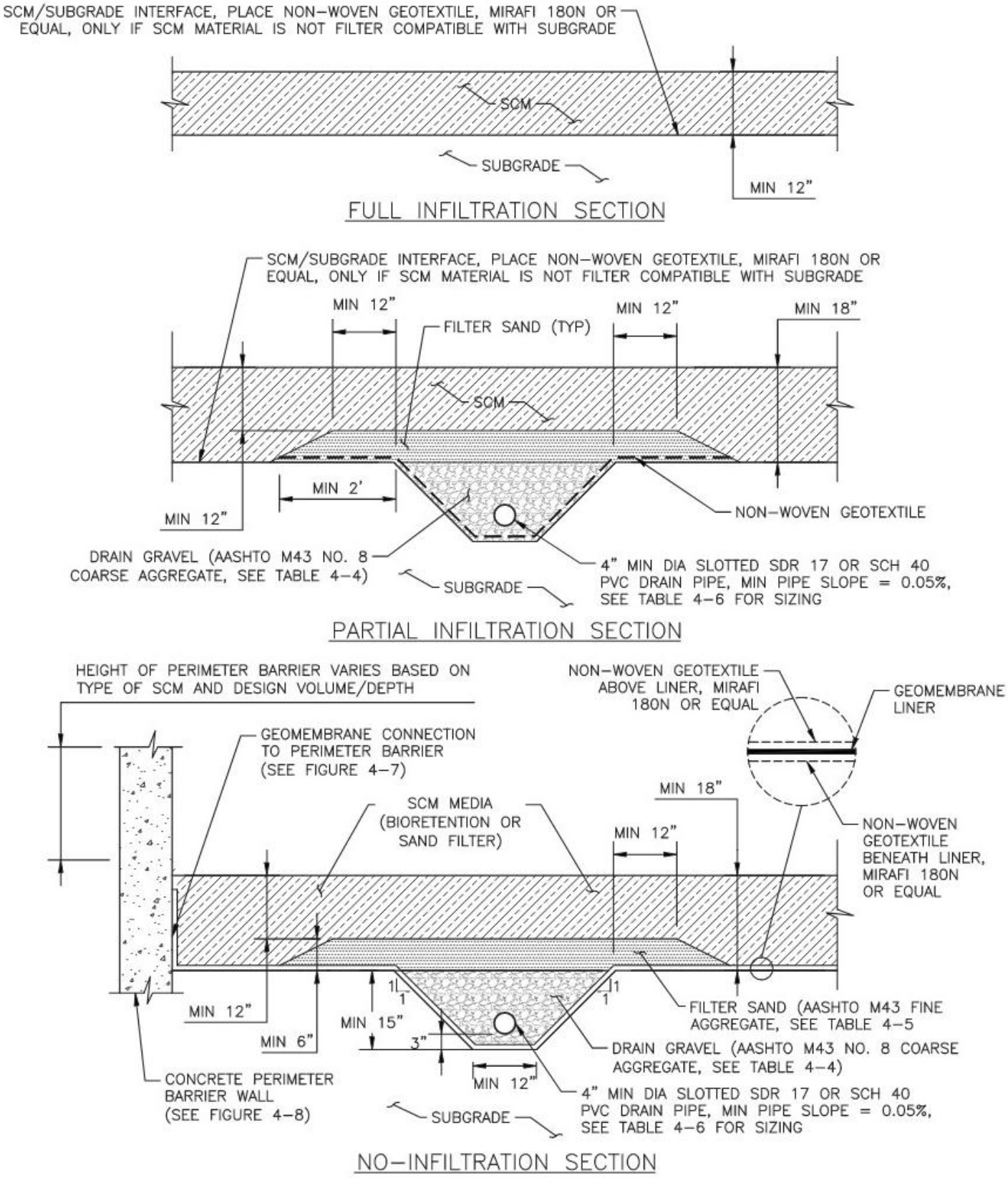
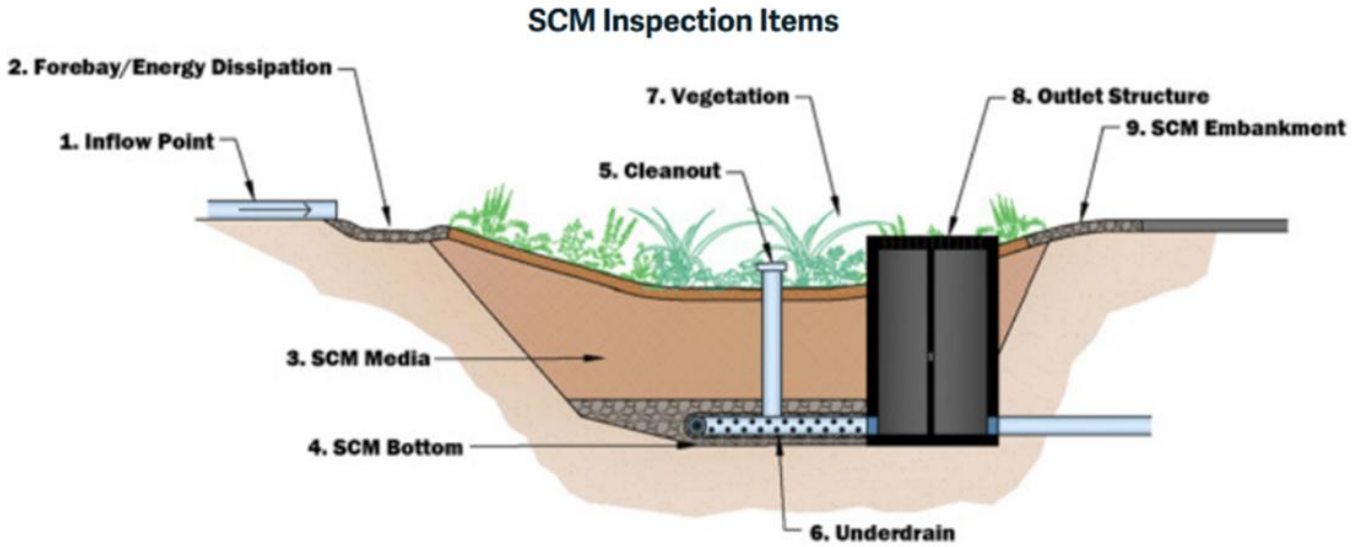


Figure 4-2 Conceptual cross sections for full, partial, and no infiltration systems section view (not to scale)



This is an example illustration of a bioretention SCM. Layout can vary between facilities.

Keeping a close eye on the key parts of any SCM is very important to make sure it is working properly. Frequent, informal inspections performed during landscaping activities and after strong storms and snows will help you catch and repair minor issues before they become major problems. Major problems can result in costly repairs, property damage, stream pollution, and legal issues with property owners affected by failure of your SCM.

Bioretention SCM Inspection Items

1. The inflow point lets the stormwater flow into the bioretention area
2. The forebay/energy dissipation area slows stormwater down before it enters the bioretention SCM media, which helps to prevent scouring and erosion as stormwater rushes in.
3. SCM media is typically 18” thick and acts as the main treatment area where stormwater is collected and allowed to soak into the media (e.g. engineered soil).
4. SCM bottom is typically constructed 2 ft below ground surface and is where the stone/underdrain are placed.
5. The cleanout is used to access the underdrain, which may need to be periodically cleaned out if it becomes clogged with sediment or debris
6. The underdrain discharges water that isn’t absorbed by the bioretention SCM media into the stormwater system at a controlled rate.
7. Vegetation is planted to help treat stormwater runoff through evapotranspiration, which is when water is absorbed into the leaves of the plants and sent back into the atmosphere. The roots of the plants also filter the polluted stormwater runoff before it makes its way to the underdrain. Vegetation also helps to keep the soil porous so it can continue to infiltrate.
8. The outlet structure and pipe lets water exit the bioretention SCM and is connected to the stormwater system.
9. An SCM embankment is a bank of earth or vertical wall that is intended to help prevent stormwater from overflowing into the bioretention area to other parts of the property.

Inspections

Inspect the bioretention feature (Rain Garden/Sand Filter) at least twice annually, observing the amount of sediment in the forebay and checking for clogging in the filter media.

Sediment/Trash/Debris Removal

Inflow Points/Forebays

Ensure the Inflow Points (Inlets) are kept clear of sediment and debris and remove excess vegetation which will inhibit flows entering the pond. Also remove any larger bushes or trees growing directly on or next to Inlets as they will cause damage over time. For features with Forebays attached to the Inflow Points, remove collected sediment and trash at least biannually

Acceptable: Bioretention forebay that has been properly cleaned

Not acceptable: Bioretention forebay that needs sediment and debris removed

Acceptable: Bioretention with curb-cut inlet showing 3 inches of “fall” into BMP

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

Not acceptable: Sand filter with rip-rap energy dissipater. Sediment that has accumulated near the riprap should be removed periodically. If maintenance of riprap is difficult, the owner may consider installing a forebay for easier maintenance.

Filter Media

Filter Media should be kept clean and not clogged with debris. The simplest method to determine clogging is if the feature takes longer than 24 hours to drain out after a 0.5-inch storm event. Other key indicators are vegetated areas which have died off or areas covered in sediment rather than sand. Bio Media and Sand may have to be replaced in the top few inches as needed with contaminated material removed entirely. Snow should not be piled on Bioretention features as sediment and salts in the snow will damage the feature over time.

Not acceptable: Bioretention with uneven filter media grading. Maintenance is required to re-grade so that filter media is flat.

Not acceptable: Sand filter with obvious "cake layer" of sediment built up over time. This sand filter needs to be maintained by removing 1-2 inches of filter media and sediment throughout the entire BMP.

Acceptable: Typical bioretention with ponded runoff during rain event

Acceptable: Typical sand filter

Not acceptable: Snow should not be stored on bioretention/sand filter BMPs

Underdrain

Underdrains should be inspected for clogging through inspection ports and the Outlet Structure at least biannually.

Acceptable: water flowing freely from the underdrain discharge point within the outlet structure.

Outlet Structure

The Outlet Structure should be inspected for clogging from high flows at least biannually. Inspection should include verification the underdrain orifice plate or cap is still in place and not clogged.

Not acceptable: sand filter overflow elevation equal to elevation of the filter media. This BMP will not store water on top of the filter media. Original design showed distance of 9 inches between filter media and overflow elevation.

Mowing and Plant Care

In Rain gardens only, maintain healthy, weed-free vegetation. Weeds should be removed before they flower but overall mowing should be very infrequent, perhaps only once per year to promote slow growing native grasses. Sand Filters should not have any vegetative cover with any present removed at least once per year.

Acceptable: bioretention with healthy and well-dispersed vegetation

Not acceptable: bioretention with dead vegetation. At this site, the wrong filter media was installed which led to rapid clogging.

Summary of maintenance activities

Bioretention

Activity	Frequency	What to look for	Action
Drain cleaning/ jet vac	As needed based upon inspection	Sediment build-up/ non-draining system	Clean drains/ jet vac areas if needed
Erosion repair	As needed based upon inspection	Rills/gullies forming on side slopes, trickle channel, and other areas	Repair eroded areas, revegetate and address source of erosion
Forebay/ trickle channel/ micropool/ outlet structure cleaning	As needed after significant rain events; minimum of twice annually	Clogged features; ponding water	Remove and dispose of debris/trash/sediment to allow outlet to function properly
Major sediment removal	As needed based upon inspection	Large quantities of sediment/ reduced pond capacity	Remove and dispose of sediment and repair vegetation or replace sand as needed
Mowing	Twice annually	Excessive grass height/ aesthetics	No less than 6-inch grass height
Structural repair	As needed based upon inspection	Deterioration and/or damage to structural components such as broken concrete, damaged pipes, outlet structure	Structural repair to restore the structure to its original design
Trash/ debris removal	Twice annually	Trash and debris in EDB	Remove and dispose of trash and debris
Weed control	Twice annually	Noxious weeds; unwanted vegetation	Treat with herbicide or hand-pull (consult local weed specialist)

Stormwater Quality Feature Inspection Checklist

Feature: _____ Date: _____

Inspected by: _____

Type of Inspection: ☐ Routine ☐ Storm Event _____ (# of days since event)

General Observations:

- Is water flowing?
- Standing water (more than 48 hours after the last storm event)?
    - Depth:
- Any evidence of obstructions or erosion in vicinity of the feature that could affect performance?

General Conditions:

- Do the feature sides/slopes/bottom show signs of settling, cracking, sloughing or other problems?
- Do the embankments, emergency spillway (if applicable), or side slopes show any erosion or instability?
- Is there any evidence of animal burrowing or other activity that could contribute to instability or increased erosion?
- Is there evidence of encroachment into or improper use of the feature?
- Do vegetated areas need mowing or thinning i.e. grass, cattails, willows, trees etc.?
- Are there areas that need to be re-vegetated?
- Is there general accumulation of trash, debris and/or litter to be removed around the feature?
- Any signs of vandalism or other activity that could affect performance of the feature?
- Unusual Algae blooms? (May signal too many nutrients in runoff; identify dog activity and clippings management)

Structural Conditions:

- Are the pipes/inlets going into or out of the feature clogged or obstructed?
- If applicable are concrete trickle channels in the feature clogged, undercut or damaged? (Detention Ponds)
- If applicable is the filter media evenly distributed and unclogged? (Rain Gardens, Sand Filters, etc.)
- If applicable is the underdrain clear of sediment or debris; as viewed through inspection port? (Rain Gardens, Sand Filters, Underground features)
- If applicable is there debris or other obstructions directly in front of or inside the Outlet Structure/Overflow?
- If applicable is the orifice and/or trash rack obstructed? (Detention Ponds)
- Is there any structural damage to the outlet structure?
- Do any safety features, such as fences, gates or locks need repair or replacement?
- If applicable, do the Stormwater Educational Signage features need cleaning or repair?

Overall Feature Condition

☐ Feature has numerous or severe issues which could impact water quality or public safety and needs immediate repair.
☐ Feature has minor issues and needs maintenance.
☐ Feature has no issues of note.

Notes: