POST CONSTRUCTION STORMWTER MANAGEMENT FOR DEVELOPMENT AND REDEVELOPMENT IMPLEMNTATION DOCUMENT

Part One: Revisions to Chapter 14

14.0 Introduction

This chapter addresses requirements and criteria related to incorporating stormwater quality considerations during the overall development planning and site design process and, in particular, the design, construction, and maintenance of permanent post-construction stormwater quality facilities, or control measures (CMs). Refer to SEMSWA's Grading, Erosion, and Sediment Control (GESC) Manual for temporary erosion and sediment control measures during construction and to SEMSWA's illicit discharge, detection and elimination (IDDE) Plan for management of improper discharges. Both documents are available on SEMSWA's website at www.semswa.org.

SEMSWA requires post-construction CMs to prevent or reduce the discharge of pollutants into SEMSWA's storm drain system, specifically SEMSWA's MS4. SEMSWA requires post-construction CMs for all applicable development sites within the Cherry Creek Basin and for sites outside of the Cherry Creek Basin that result in a land disturbance of greater than or equal to one acre or part of a common plan of development or sale, as further described in the SEMSWA Water Quality Treatment Matrix, available at www.semswa.org.

Land disturbance is defined as any activity that results in a change in the existing land surface (both vegetative and non-vegetative). Land disturbance activities include, but are not limited to clearing, grading, excavation, demolition, installation of new or improved haul roads and access roads, staging areas, stockpiling of fill materials, and borrow areas. Compaction that is associated with stabilization of structures and road construction shall also be considered a land disturbing activity.

Common plan of development or sale is defined as a contiguous area where multiple separate and distinct construction activities may be taking place at different times on different schedules but remain related, where contiguous means construction activities located in close proximity to each other (within ¼ mile). Construction activities are considered to be "related" if they share the same development plan, builder or contractor, equipment, storage areas, etc.

Sites are defined as either new development or redevelopment. New development means a land disturbance occurs; structural development, including construction or installation of a building or structure, creation of impervious surface; and land subdivision for a site that does not meet the definition of redevelopment. Redevelopment means a site that is already substantially developed with 35% or more of existing imperviousness; with the creation or addition of impervious area (including removal and/or replacement), to include the expansion of a building footprint or addition or replacement of a structure; structural development including construction, replacement of impervious area that is not part of routine maintenance activity; and land disturbance. Sites that are exempt from post-construction CMs are those sites outside of the Cherry Creek Basin with a land disturbance of less than one acre, or those sites further discussed in Section 14.3.2 and 14.4 and as indicated on the SEMSWA Water

Quality Treatment Matrix.

Stormwater runoff water quality management is a critical component of a land development process and requires an integrated approach to stormwater quality. The design of post-construction CMs must start in the early stages of the land development process and be integrated into the site and the upstream and downstream drainage network. Collaboration with professionals in fields such as site planning, civil engineering, landscape architecture, and geotechnical and structural engineering is recommended to create post-construction CMs that function well, can be maintained for long-term operation, and are aesthetically pleasing.

14.1 Stormwater Quality Design Process: Four Step Process

The four-step approach to water quality planning, outlined in Volume 3 of the Urban Storm Drainage Criteria Manual (USDCM), is the approach that shall be used by every site within the SEMSWA Service Area. The four steps aim for a comprehensive approach to stormwater quality by 1) reducing the amount of site runoff; 2) implementing applicable post-construction CMs; 3) drainageway improvements to create stable, healthy streams; and 4) implementing source controls to prevent pollutants from entering the stormwater system. Specific SEMSWA considerations related to the four-step process are identified below:

1. Step 1: Employ Runoff Reduction Practices (Minimizing Directly Connected Impervious Areas (MDCIA)). Reducing runoff volume is accomplished by reducing the amount of impervious area such as pavement and roof area that is directly connected to inlets and storm sewer, while maximizing the pervious area that receives runoff from the unconnected impervious area. Appropriately designed receiving pervious areas provide stormwater runoff volume reduction by dissipating the energy of the runoff, filtering the runoff through vegetation, and infiltrating stormwater runoff into the soil. Design engineers are responsible for justifying that MDCIA techniques have been maximized for the proposed site, with the justification discussed in the Drainage Report or Letter and in accordance with Chapter 4.

   SEMSWA has a hierarchy for runoff reduction and the implementation of MDCIA for site areas that should be followed to obtain the maximum benefit for the reduction in runoff volume in terms of stormwater quality, as follows:

   (a) Parking lot(s) and driveway(s) or other paved surfaces subject to routine vehicular use and/or deicing activities
   (b) Other paved areas (not parking lot or driveways)
   (c) Roof areas or sidewalks
   (d) Other areas identified with potential pollutants.

   Design engineers should justify, in the Drainage Report or Letter, that this hierarchy has been followed to reduce runoff to the maximum extent practicable. For example, a site's first priority for disconnecting impervious areas should be parking lots and driveways. If this opportunity is not

available, and is justified by the design engineer, they should next look to disconnect other paved areas, continuing through the hierarchy. It is not acceptable to disconnect only roof drains, for example, when disconnecting parking lots flows is possible. Sites that utilize a regional facility to provide their Water Quality Capture Volume (WQCV) requirements are also required to provide runoff reduction. This is described further in Section 14.2.4.

Volume 3 of the USDCM can be used to estimate an effective imperviousness value based on reducing DCIA. This reduced imperviousness can result in a smaller WQCV, Excess Urban Runoff Volume (EURV), and 100-year volume as described in Chapter 13. Reduced imperviousness can also result in smaller Rational Method peak flows for the 5-year and smaller storms.

2. Step 2: Implement Control Measures with WQCV with Slow Release. After reducing runoff volume, the remaining runoff is to be controlled through post-construction CMs that have the necessary WQCV (or equivalent discussed in Section 14.2 and 14.3.1.2) and flood detention volume. Appropriate reductions in required detention volumes may be applied for any reduction in runoff volume from Step 1, as discussed in Chapter 13.

3. Step 3: Stabilize Streams. The stream channel stabilization techniques described in Chapter 12, shall be applied to any drainageway that exists on or adjacent to the site or is constructed as part of the site development. In some cases, as determined by SEMSWA, some stabilization may be required in offsite drainageways that receive runoff from the site.

   Where regional or sub-regional detention is implemented, drainageways shall be stabilized based on approved flow rates. In general, drainageways upstream of the facilities shall be stabilized based on the increased, undetained runoff that will flow in the channels. Drainageways downstream of the facility shall be stabilized based on the fully developed design flow rates for the channel. If a site utilizes a regional facility, the channel between the site and regional facility must be stabilized prior to discharging developed flows from the site. Stabilization, for the purposes of this section, can be defined as a channel that has adjusted its channel slope, depth, and width to accommodate the basin geology, hydrology (discharge of water and sediment), dimensions (slope, width, depth), and vegetation, or a stream that is in dynamic equilibrium (Charlton, 2007), as determined by SEMSWA.

4. Step 4: Implement Site-specific and Other Source Controls. Section 14.8 addresses requirements for source controls to reduce the potential for illicit discharges. If a site has the potential for chemicals, oils, fertilizers, or other pollutants to enter the stormwater system, additional source controls should be provided that will mitigate such potential discharge of pollutants. These measures may include covering of storage/operation/handling areas, spill containment and control, and other best available technologies.

14.2 Water Quality Control Measure Selection Requirements

SEMSWA allows use of the following post-construction CMs to meet water quality requirements. See Section 14.3.1.2 for a discussion of Water Quality Control Measure Selection Requirements for sites within the Cherry Creek Basin for disturbances less than one acre that are not part of a larger common plan or development or sale. Selecting the type of water quality post-construction CM for a project depends on a number of factors. See Table 14-1 for additional requirements and considerations when selecting a post-construction CM based on various site constraints.

1. Water Quality Capture Volume (WQCV). This standard can be achieved through the treatment and/or infiltration of the WQCV, typically through post-construction CMs such as Extended Detention Basins, Sand Filters, or Bioretention (also known as Rain Gardens). When utilizing the WQCV standard, sites must provide treatment for the entire new development or redevelopment, even in the case of a redevelopment where the total site imperviousness is proposed to be less than previously existed. However, SEMSWA may allow areas to be excluded from treatment when it can be justified that a portion of the site cannot practically drain to a post-construction CM, such as driveway access, perimeter sidewalks, or tree lawns. In such cases, the design engineer must justify in the Drainage Report or Letter that these areas cannot practically drain to a CM, and such cases must be approved by SEMSWA staff as acceptable. In addition, these excluded areas may not be more than 20% of the site, not to exceed one acre.

2. Pollutant Removal or Underground Water Quality. This standard can be achieved through treating stormwater runoff in a manner expected to reduce the event mean concentration of total suspended solids (TSS) to a median value of 30 mg/L or less for the 80th percentile storm. Use of underground water quality facilities must be approved through the variance process in Chapter 1 and in accordance with Section 14.6, in addition to meeting the following conditions:

    (a) The post-construction CM provides treatment for a public, linear project where other post-construction CMs are not practical; or

    (b) The post-construction CM serves a redevelopment with greater than 90% site imperviousness where other post-construction CMs are not practical. In such cases, additional funds for long-term operations and maintenance of the post-construction CM may be included in the site Public Improvement Agreement (PIA), or additional conditions may be required to ensure that the facility can be accessed and inspected by SEMSWA for long-term operation.

3. Runoff Reduction. This standard can be achieved through the infiltration,

evaporation, or evapotranspiration of 60% of the site's WQCV, with the WQCV calculation assuming all of the impervious area for the site discharges without infiltration. This treatment uses or mimics natural process that rely on vegetation and soils, such as Grass Swales, or Grass Buffers. Refer to USDCM Fact Sheet T-0 for additional information. Use of the Runoff Reduction CM Standard must meet the following conditions:

(a) When utilizing this standard as the only means for meeting the water quality requirements (not in collaboration with the WQCV standard to meet pretreatment requirements), additional soils analysis and recommendations from a geotechnical engineer are required to demonstrate that site geology and other factors allow appropriate infiltration to occur, with justification provided in the Drainage Report or Letter in accordance with Chapter 4. Underdrains are not allowed for facilities meeting this standard and full infiltration is required, unless approved by SEMSWA.

(b) The design engineer must take into account all of the site's WQCV, even though the standard only requires treatment of 60% of the WQCV. That is, if additional flows are routed through the Runoff Reduction CM, the CM must be sized to handle these additional flows.

For sites that utilize Runoff Reduction to meet the Regional WQCV pretreatment 20/10 requirements discussed in 14.2.4 the reduction in treatment to 60% of the site's WQCV shall not apply.

4. Regional WQCV. Regionalization of water quality facilities is an effective means of addressing Step 2 (WQCV) for sites that are tributary to and can take advantage of a regional facility to provide the required WQCV for the site. However, the water quality of the major drainageway between the site and the regional pond cannot be ignored. Therefore, additional steps must be taken to address potential water quality impacts onsite, prior to conveyance into the system. The following are required for sites that utilize a regional WQCV facility:

   (a) Pretreatment or the 20/10 Rule. For each site utilizing a regional WQCV facility, at least 20% of the upstream imperviousness must be disconnected and drain through a receiving pervious area comprising at least 10% of the upstream disconnected impervious area. The receiving pervious area must consist of some combination of Grass Buffers and Grass Swales designed in accordance with Section 14.5. SEMSWA has prepared a Pretreatment Calculator to assist in calculating the 20/10 for sites, which can be found at www.semswa.org. Meeting the 20/10 Rule is also a means of runoff reduction (Step 1). As such, the hierarchy discussed in Section 14.1.1 should be adhered to when designing pretreatment post-construction CMs.

(b) Stream Stabilization. Stream Stabilization requirements addressed in Section 14.1.3 must be adhered to when utilizing a regional WQCV facility.

(c) Status of the Regional Facility. In order to utilize a regional WQCV facility, the facility must:

- Be implemented, functional, and maintained following good engineering, hydrologic, and pollution control practices;
- Be designed and maintained for 100% WQCV for the entire tributary area;
- Have capacity to accommodate the drainage from the site; and
- Be designed and implemented with flood control or water quality as the primary use. Waterbodies listed by name in surface water quality classifications and standards regulations (5 CCR 1002-38) may not be considered regional WQCV facilities.

5. Constrained Redevelopment Site. When using this standard, the following conditions must be met:

(a) The redevelopment is greater than 75% impervious; and

(b) SEMSWA has approved through a variance process that it is not practical to meet the other post-construction CM requirements listed in Section 14.2.

Constrained Redevelopment Site post-construction CMs must be designed to meet one of the following.

(a) Provide WQCV for at least 50% of the impervious area of the site and otherwise meet the requirements in Section 14.2.1; or

(b) Provide treatment for the 80th percentile stormwater event, where the post-construction CM is designed to treat stormwater runoff in a manner expected to reduce the event mean concentration of TSS to a median value or 30 mg/L or less. A minimum of 50% of the site, including 50% or more of the impervious area of the site, shall drain to the post-construction CM, and otherwise meet the requirements in Section 14.2.2. Use of this standard does not require 100% of the site to be directed to the post-construction CM as long as the overall removal goal is met or exceeded; or

(c) Provide Runoff Reduction through infiltration, evaporation, or evapotranspiration, for a quantity of water equal to 30% of what the calculated WQCV would be if all impervious area for the site discharged without infiltration, and otherwise meets the requirements in Section 14.2.3.

14.3 Cherry Creek Basin Considerations

The MS4 Permit requires that the more stringent of Reg 61 and CR 72 requirements be used in the Cherry Creek Basin. The following discussion specifies those instances where land disturbance within the Cherry Creek Basin will have a different approach to post-construction CMs than sites outside of the Cherry Creek Basin. In general, those instances are specific to sites with Land Disturbances less than one acre and that are not part of a larger common plan of development of sale.

14.3.1 Cherry Creek Basin Control Measure Selection Requirements

1. Land Disturbance Thresholds in the Cherry Creek Basin. The CR 72 post-construction CM requirements are based on these tiers of land disturbance and associated imperviousness:

   (a) Tier 1 - land disturbances resulting in less than or equal to 500 sf of imperviousness for new development, or less than or equal to 500 sf of added imperviousness for redevelopment, are not required to provide post-construction CMs.

   (b) Tier 2 - land disturbances resulting in greater than 500 sf and less than or equal to 5000 sf of imperviousness for new development, or greater than 500 sf and less than or equal to 5000 sf of additional imperviousness for redevelopment, are required to provide non-WQCV post-construction CMs in accordance with Section 14.3.2.

   (c) Tier 3 - land disturbances resulting in greater than 5000 sf of imperviousness for new development, or greater than 5000 sf of additional imperviousness for redevelopment, or disturbances greater than one acre regardless of imperviousness, are required to provide post-construction CMs in accordance with Section 14.3.2.

2. CM Selection in the Cherry Creek Basin. Once the land disturbance tier has been determined, the required post-construction CM can be determined based on the following:

   (a) For all Tier 1 new development and redevelopment, no post-construction CMs are required.

   (b) For all Tier 2 new development and redevelopment, CMs are required to meet one of the following, also referred to as water quality enhancements:
      - WQCV storm event assumed to not leave site.
      - Runoff discharged as sheet flow across a Grass Buffer.
      - Runoff is discharged from the site through a Grass Swale in combination with implementation of MDCIA practices.
      - Runoff is discharged across undisturbed and vegetated land a minimum distance of 50 feet or three times the distance criteria

for Grass Buffers, whichever is greater, with a slope not exceeding 4% over that distance.

- Allowed discharge of a storm event that adequately protects water quality, as demonstrated by analysis, and approved by SEMSWA through the variance process.
- Alternative CMs may be used if they are shown to have comparable or better nutrient removal characteristics for the given use, in comparison to the above listed CMs. These alternative CMs must be demonstrated by analysis and approved by SEMSWA through the variance process.

(c) For all Tier 3 new development or redevelopment, refer to Section 14.2. For Tier 3 new development or redevelopment that does NOT result in one acre or more of disturbances, the following may apply in addition to the post-construction CM Selection guidance in Section 14.2:

SEMSWA may allow alternative post-construction CMs that do not use the WQCV approach if they are shown to have comparable or better nutrient concentration reduction characteristics. These alternative CMs must be demonstrated by analysis and approved by SEMSWA through the variance process.

(d) The Stream Preservation Areas within the Cherry Creek Basin have additional CM requirements to supplement those discussed in Section 14.3.1.2 in this critical resource area location. Stream Preservation Areas are defined by land disturbance within the Cherry Creek Reservoir, all of the Cherry Creek State Park (Park), drainage and discharges to the Park within 100 feet of the Park boundary, lands within the Cherry Creek 100-year floodplain, and lands within the 100-year floodplain of any tributaries to Cherry Creek. When a land disturbance within the Stream Preservation Area occurs for Tier 2 and Tier 3 new development and redevelopment, in addition to meeting the post-construction CM requirements addressed above, additional CMs shall be provided that promote filtration or infiltration, where appropriate, to treat the WQCV for all runoff from the developed areas within the Stream Preservation Area. Additional post-construction CM requirements for Stream Preservation Areas may be excluded if the following occurs:

- The disturbance in the Stream Preservation Area is the result of implementing an approved CM.
- Construction of a roadway, highway, and/or underground utility crossing provided the applicable post-construction CM required by Tier 2 and Tier 3 new development and redevelopment are implemented.
- Exclusion conditions for post-construction CM requirements in Section 14.3.2 are met.

14.3.2 Exclusions to Control Measure Requirements in the Cherry Creek Basin.

In addition to those exclusions from the Reg 61 MS4 Permit listed as applicable

to the Cherry Creek Basin in Section 14.4, the following exclusions are allowed within the Cherry Creek Basin for land disturbances less than one acre that are not part of a common plan of development or sale:

1. Pavement Management Sites, also referred to as Excluded Roadway Projects. Excluded Roadway Projects can be defined as activities associated with the maintenance, repair, preservation, and associated minor modification to roadways and associated appurtenant features that do not permanently expand the original footprint of the roadway and do not increase the impervious area.

2. Routine Maintenance of Facilities. Routine Maintenance is maintenance that is performed to maintain the original line and grade, hydraulic capacity, or original purpose of a facility.

3. Underground Utility Construction. Underground Utility Construction is defined as utility construction, provided that stormwater runoff and erosion from soil and material stockpiles are confined and will not enter the drainage system.

4. Individual Home Construction. Individual Home Construction is development for a single home, not including roads or road improvements, where the owner of the single home holds a permit for the construction of only one dwelling unit.

5. Construction of a Sidewalk or Driveway. Sidewalks or driveways, not including improvements associated with roadway construction.

6. Agricultural Activities. Agricultural Activities can be defined as agricultural and silvicultural activities generating non-point source discharges, including runoff from orchards, cultivated crops, pastures, range lands, and forest lands, but does not include construction of facilities or other activities generating stormwater runoff associated with industrial construction activity.

7. Trails. Trails can be defined as permanent access areas constructed primarily for the purpose of recreation but also provide access for operations and maintenance. This includes trails that consist, for at least some portion of the trail, of sidewalks adjacent to roadways.

14.3.3 Source Controls in the Cherry Creek Basin

Additional post-construction CMs are required in the Cherry Creek Basin to prevent or reduce pollutants generated and/or released from land disturbances associated with new development or redevelopment. Where potential pollutants have been identified within the Cherry Creek Basin such as commercial and industrial land uses with outdoor fertilizer operations or deicing operations, and as further discussed in Section 14.8, the following shall occur as additional post-construction CMs:

- For outdoor activities with potential for pollutant transport offsite, the

activity shall be enclosed or covered.

- When fueling, lubricants, or other chemicals are proposed outdoors, secondary containment shall be provided to collect leaks and spills.
- When outdoor pollutant generating activities are proposed, stormwater shall be diverted away from or around the pollutant generating activity.
- If vehicle or equipment is proposed to be washed outdoors, the direct discharge into the storm system shall be prohibited. Flow shall be recycled, treated by a post-construction CM, or otherwise rerouted.

14.4 Exclusions from Post-construction Control Measure Requirements

The following sections provide a discussion on the allowed exclusions from post-construction CMs as provided for in the MS4 Permit. Refer to the Water Quality Treatment Matrix available at www.semswa.org for a comprehensive list of allowable exclusions.

As further discussed in Section 14.0, SEMSWA requires post-construction CMs to prevent or reduce the discharge of pollutants into SEMSWA's storm system. SEMSWA requires post-construction CMs for all sites within the Cherry Creek Basin, as defined in Section 14.3, and for sites outside of the Cherry Creek Basin that result in a land disturbance of greater than or equal to one acre, or less than one acre and part of a larger common plan of development or sale. Activities that may be excluded from post-construction CM requirements are outlined below.

1. Pavement Management Sites (outside of the Cherry Creek Basin). Pavement Management Sites can be defined as the rehabilitation, maintenance and reconstruction of existing roadway pavement where no new impervious area is added, including roadway resurfacing, mill and overlay, white topping, black topping, curb & gutter replacement, concrete panel replacement, and pothole repair. The purpose of pavement management is to provide additional years of service and optimize safety and service. The site must be limited to the repair and replacement or pavement in a manner that does not result in an increased impervious area and the infrastructure must not substantially change. Sites covered under this exclusion are day-to-day maintenance activities, rehabilitation, and reconstruction of pavement. Roadways include roads and bridges that are improved, designed, or ordinarily used for vehicular travel and contiguous areas improved, designed, or ordinarily used for pedestrian or bicycle traffic, drainage for the roadway, and/or parking along the roadway. Areas primarily used for parking or access to parking are not roadways.

2. Excluded Roadway Redevelopment (outside the Cherry Creek Basin). Excluded Roadway Redevelopment is defined as the addition of not more than 8.25 feet of paved width at any location to the existing roadway or the addition of less than one acre of paved area per mile of roadway to existing roadway.

3. Existing Roadway Areas (outside and within the Cherry Creek Basin). For

redevelopment sites that are existing roadways, only the area of the existing roadway is excluded when the site does not increase the width by two times or more, on average, of the original roadway area. The added impervious area still requires treatment and is not considered part of the exclusion.

4. Above Ground and Underground Utilities (outside the Cherry Creek Basin). Above Ground and Underground Utilities can be defined as activities for the installation and maintenance of utilities or infrastructure that does not permanently alter the terrain, ground cover, or drainage patterns from those existing prior to the construction activity, such as installing, replacing, or maintaining utilities under roadways or other paved areas that return the surface to the same condition.

5. Large Lot Single Family Sites (outside and within the Cherry Creek Basin). Large Lot Single Family Sites can be defined as a single-family residential lot, or agricultural zoned lands, greater than or equal to 2.5 acres in size per dwelling unit and having a total lot imperviousness of less than 10% outside of the Cherry Creek Basin, and less than 20% within the Cherry Creek Basin. A total imperviousness greater than 10%, but not more than 20% for those areas outside of the Cherry Creek Basin may be allowed through an approved variance when a study specific to the watershed and/or MS4 shows the expected soil and vegetation conditions are suitable for infiltration/filtration of the WQCV for a typical site. SEMSWA may also prepare a study to address these conditions for the SEMSWA service area outside of the Cherry Creek Basin.

6. Non-Residential and Non-Commercial Infiltration Conditions (outside of the Cherry Creek Basin). Non-Residential and Non-Commercial Infiltration Conditions can be defined as sites which post-development surface conditions do not result in concentrated stormwater flow during the 80th percentile stormwater runoff event. In addition, post-development surface conditions must not be projected to result in surface water discharges from the 80th percentile stormwater runoff events. Therefore, the 80th percentile event must be infiltrated and not discharged as concentrated flow. The design engineer must prepare and have approved by SEMSWA a study to show rainfall and soil conditions present at the site, allowable slopes, surface conditions, and ratios of impervious area to pervious area. SEMSWA may also prepare a study to address Non-Residential and Non-Commercial Infiltration Conditions for the SEMSWA service area to include those areas both within and outside of the Cherry Creek Basin.

7. Land Disturbance to Undeveloped Land that Will Remain Undeveloped (outside and within the Cherry Creek Basin). Land Disturbances to Undeveloped Land that Will Remain Undeveloped can be defined as sites with land disturbance to undeveloped land (land with no human-made structures such as buildings or pavement) that will remain undeveloped after the site development. Within the Cherry Creek Basin, this includes floodplain and channel stabilization sites.

8. Stream Stabilization Projects (outside of the Cherry Creek Basin). This can be defined as an exclusion for the land disturbance and associated increase in imperviousness associated with improvements constructed for the purposes of stabilization.

9. Trails (outside and within the Cherry Creek Basin). Trails can be defined as bike and pedestrian trails and do not include bike lanes for roadways. In the Cherry Creek Basin, Trails can further be defined as permanent access constructed primarily for recreation but also providing access for operations and maintenance.

10. Oil and Gas Exploration (outside of the Cherry Creek Basin). Oil and Gas Exploration may be defined as facilities associated with oil and gas exploration, production, processing, or treatment operations, or transmission facilities, including activities necessary to prepare sites for drilling and for the movement and placement or drilling equipment, whether or not such activities or operations may be considered to be an applicable construction activity.

No exemptions to these Criteria will be allowed that would result in a non-compliance with the SEMSWA Reg 61 MS4 Permit and CR 72.

14.5 Design Criteria for SEMSWA Standard Post-construction Control Measures

SEMSWA has adopted these five standard post-construction CMs: Extended Detention Basins, Sand Filters, Bioretention (Rain Gardens), Grass Buffers, and Grass Swales. Each of these standard post-construction CMs can be used to meet the water quality requirements outlined in Sections 14.2 and 14.3.1.2, as applicable. The following sections provide brief summaries of the standard post-construction CM design components and identify any SEMSWA requirements that vary from the USDCM Volumes 1, 2, and 3. If a component or requirement is not discussed, refer to the USDCM. The design engineer should utilize SEMSWA Standard Post-construction CM Details, available at www.semswa.og. The Details include additional design information and material specifications and should be consulted concurrent with the text in this section.

14.5.1 Extended Detention Basins and Modified Extended Detention Basins

1. Description. An Extended Detention Basin (EDB) is a sedimentation basin designed to extend the release rate of frequent runoff events to facilitate pollutant removal. Unless otherwise stated in the following sections or shown on the EDB Detail (available at www.semswa.org), all proposed EDBs shall be designed using guidelines in Volume 3 of the USDCM with specific attention to Fact Sheet T-5, Extended Detention Basin. The following sections provide brief summaries of the EDB design components and identify any SEMSWA requirements for EDBs that vary from the USDCM.

2. Site Selection. A Modified EDB (MEDB) shall be used for sites with a tributary impervious area greater than 1 acre and less than or equal to 5 acres, whereas a standard EDB must be used for sites greater than 5 acres. Sites with less than 1 acre of tributary impervious area shall not utilize an MEDB for treatment and should evaluate the use of a more appropriate post-construction CM such as Bioretention. Unless otherwise noted, general criteria for EDBs also apply to MEDBs.

   EDB configurations may be implemented as onsite, subregional or regional facilities. EDBs can be designed to provide water quality volume only, or the WQCV can be nested within the Excess Urban Runoff Volume (EURV) for full spectrum detention facilities that provide both water quality and flood control. EDBs can be utilized to meet the WQCV or Regional WQCV Standard discussed in Section 14.2.

   EDBs and MEDBs shall comply with the selection criteria shown in Table 14-1.

3. Designing for Maintenance. An Operations and Maintenance Site Plan and Maintenance Agreement are required for EDBs. See Section 14.7 for additional requirements. The EDB Detail contains additional design and maintenance considerations.

4. Design Procedure and Criteria. The following sections summarize SEMSWA requirements for EDBs that vary from the USDCM. Refer to the EDB Detail for additional criteria and considerations.
   (a) Basin Storage Volume. An EDB can be designed to 1) provide a design volume equal to the WQCV or 2) combine the WQCV with the Excess Urban Runoff Volume (EURV) and 100-year detention in full spectrum detention facilities. Criteria for EURV and 100-year detention are described in Chapter 13 Storage. The USDCM also provides detailed guidance for combining WQCV treatment with full spectrum detention.

   (b) Retaining Walls. The use of retaining walls within detention basins is discouraged due to the potential increase in long-term maintenance costs and concerns regarding the safety of the general public and maintenance personnel. If retaining walls are proposed, the following design criteria must be followed:
      - The bottom elevation of all footings shall be located above the EURV.
      - Wall heights shall not exceed 30 inches, measured from the top of the wall to the bottom of the footing.
      - Retaining walls should be concrete cantilever walls. Dry-stack retaining walls and Mechanically Stabilized Earth (MSE) walls are not permitted.
      - Walls shall not be used on more than 50% of the basin circumference.
      - For terraced retaining walls, a separation of at least 5 feet shall be provided between walls. Additional width may be required to address the wall design and maintenance requirements. The engineering analysis shall include a discussion and the necessary calculations to determine the appropriate “bench” width.
      - The maximum ground slope between adjacent walls shall be 4%.

- The horizontal distance from any retaining wall footing to any maintenance access drive not used as a sidewalk or roadway shall be at least 4 feet.
- Foundation walls of buildings shall not be used as EDB retaining walls.
- Perimeter fencing (to limit access), safety railing, or guardrails may be required depending upon the location of the wall relative to roadways, parking areas and pedestrian use areas.
- Retaining walls shall not be used within the limits of any impermeable lining for an EDB.
- Confer with the Building Department to determine if additional design considerations are required, and if a building permit is necessary. Coordination and design approval are the applicant's responsibility.

A Professional Engineer licensed in the State of Colorado shall perform a structural analysis and design the retaining wall for the various loading conditions the wall may encounter, including the hydrostatic pressure differential between the front and the back of the wall and live loading conditions, as applicable. A drain system should be considered behind the wall to ensure that hydrostatic pressures are equalized as the water level changes in the pond. Retaining walls may not be used where live loading or additional surcharge from maintenance equipment or vehicle traffic could occur unless the wall is designed to accommodate the live loading condition. The wall design and calculations shall be stamped by the Professional Engineer, with approval from the Building Department, as applicable.

(c) Forebay Design. See the EDB Details for sediment forebay concepts that are integrated into the downstream outfall of storm sewer systems.

(d) Trickle Channel. Concrete trickle channels designed in accordance with the EDB Detail are required for EDBs with greater than 5 acres of impervious tributary area (standard EDB) and for those with less than 5 acres with an unstable tributary area. A stable tributary is defined as pavement, concrete, rock mulch, rooftop, irrigated sod and established native turf-forming grass.

EDBs with less than or equal to 5 impervious acres of tributary area (MEDBs) that have a stable tributary area are permitted to use a vegetated or soft low-flow channel with 1.5-foot depth, designed in accordance with Volume 3 of the USDCM.

Vegetated low-flow channels increase the long-term maintenance and overall maintenance costs and may result in additional permitting when maintenance occurs.

(e) Micropool and Outlet Structure. Micropools are an essential part of EDB function, designed in conjunction with the trashrack protecting the control orifices to reduce the potential for trashrack and orifice plugging. Micropools shall be contained within the outlet structure (integral) or, if approved by SEMSWA, extend upstream of the outlet structure (external), while maintaining a connection to the trashrack.

EDBs shall be designed to outlet into a storm sewer, drainageway, or other designated drainage system, typically a public drainage system. EDBs should not have an outlet pipe terminating into a gutter, street chase, or other impervious surfaces because of hazards such as icing and water quality impacts. If a system is not available, construction of the system will be a requirement of the developing site. The storm system must adequately convey the EDB flows.

See the USDCM Chapter 12 for guidance on the design of the outlet structure and outlet pipe hydraulics.

(f) Trash Rack (and Orifice Plate). Trash racks and orifice plates shall be designed in accordance to Volume 3 of the USDCM.

The following shall be considered when designing trash racks and orifice plates:

- Standard fabricated bar grating (with nominal openings of 1 by 4 inches) may be used as a debris grate instead of wellscreen when control orifices are 2.5 inches or greater in diameter or 2 inches square. This larger grate may reduce the potential for clogging with debris as compared to wellscreen. In addition, when approved by SEMSWA, the number of orifices may be decreased to as few as two or even one orifice to enable larger orifices and larger trash rack openings.
- Bar grating may be used on parallel sloping wingwalls, either as the primary debris grate (if orifices are at least 2.5 inches in diameter) or as a coarse screen and safety grate in lieu of handrail.
- Sloping bar grating shall have a lockable hinged section measuring at least 2 feet by 2 feet to allow access to the orifice plate or wellscreen.
- The bearing bars for steel bar grating shall be designed to withstand a uniform loading of at least 100 pounds per square foot, but generally not designed for larger loads (like vehicular loads) so that the panels are not excessively heavy.
- Panels of bar grating shall be no more than 3-feet wide and all parts of the grating and support frames shall be hot-dipped galvanized. Bar grating shall be fastened down to the outlet structure.

(g) Overflow Embankment. The embankment shall be protected from catastrophic failure due to overtopping. Overtopping can occur when the basin outlets become obstructed or when a storm larger than the design event occurs. Erosion protection for the embankment may be provided in the form of a buried riprap layer on the entire downstream face of the embankment or a separate emergency spillway constructed of buried riprap or concrete. In either case, the emergency protection shall be constructed to convey the 100-year developed flow from the upstream watershed without accounting for any flow reduction within the detention basin. See Chapter 12 of the USDCM for additional guidance on design of an emergency spillway including crest elevation, required freeboard and spillway channel section.

The emergency spillway is also needed to control the release point and

direction of the overflow. The emergency spillway and the path of the emergency overflow downstream of the spillway and embankment shall be clearly depicted on the drainage plan. The spillway flows should be conveyed to a stormwater system. If the spillway is proposed offsite and is not into a public drainage system, a drainage easement is required. Structures shall not be permitted in the path of the emergency spillway or overflow. The emergency overflow water surface shall be shown on the Construction Drawings in accordance with Chapter 4.

(h) Vegetation. SEMSWA encourages the integration of CMs (and detention) with site landscaping requirements. The type and quantity of landscaping materials should be considered to ensure that the capacity of the EDB is maintained and that future maintenance activities can be performed with minimal disruption of vegetated areas.

Successful establishment of vegetation within an EDB is critical to its long-term success and can often result in reduced long-term maintenance cost. Several key factors contribute to the success of vegetation, including placement of topsoil following the guidelines of the USDCM Topsoil Guidance, selection of seed mixes that are suitable for the hydrologic conditions, and irrigation for initial establishment and sustainability over time. In an effort to establish facilities with high quality vegetation, several specific requirements for vegetation in EDBs are required by SEMSWA:

- Permanent irrigation is required for onsite and sub-regional MEDBs to establish vegetation post-construction and to support long-term maintenance. Temporary irrigation is required for standard EDBs until vegetation has been established in accordance with the GESC Manual.
- Irrigation heads shall be placed to assure complete coverage of EDB facility. Where possible, place irrigation heads above the EURV to reduce the likelihood of the irrigation head being buried by sediment.
- Trees shall be planted above the EURV water surface in EDBs. Trees such as cottonwood, willow, and aspen shall not be planted within the 100-year water surface of an EDB to avoid nuisance spreading of root systems within the facility.
- No trees shall be planted in a MEDB below the 100-year water surface.
- Shrubs may be planted above the EURV water surface for EDBs and MEDBs.
- Rock and mulch are not permitted in EDBs due to long-term maintenance concerns and the potential for clogging of debris grates.
- Standard seed mixes shown in SEMSWA's Standard Materials Specification Detail (available at www.semswa.org) shall be used in all EDBs. If alternate seed mixes are used, prior approval from SEMSWA is required.

(i) Access. To accommodate maintenance access and activities, a formalized maintenance access is required to all structural elements of the EDB, including the outlet structure, forebay(s), and low-flow channel, in accordance with the EDB Detail.

For a MEDB, a hard surface maintenance access is required to the outlet structure in accordance with EDB Detail to accommodate maintenance access and activities. Maintenance access can include parking lots, trails, or other similar surfaces (at least 6 feet in width) adjacent to the MEDB that provide adequate access to the outlet structure.

The working bench and access drive shall be constructed in accordance with the specifications and materials described in the EDB Detail.

Any retaining walls shall be laid out in a manner that does not restrict access. Likewise, any handrails or fence, shall permit vehicular access. The entrance to an access drive from a roadway or parking lot shall be located so that traffic safety is not compromised.

(j) Signage. Appropriate warning signage shall be provided for each EDB facility and in accordance with EDB Detail.

5. Design Drawings and Checklist. Construction drawings for EDBs shall include design drawings and detailed information, as required on the CM design checklist available at www.semswa.org.

14.5.2 Sand Filter

1. Description. A Sand Filter (SF) collects runoff during storm events and gradually infiltrates the stormwater into the underlying sand bed. Unless otherwise stated in the following sections or shown on the SF Detail (available at www.semswa.org), all proposed SFs shall be designed using guidelines in Volume 3 of the USDCM, with specific attention to Fact Sheet T-6, Sand Filter. The following sections provide brief summaries of the SF design components and identify any SEMSWA requirements for SFs that differ from the USDCM.

   SEMSWA does not allow the construction of SFs underground or within a vault due to extremely high maintenance and replacement costs, along with inspection difficulties.

2. Site Selection. SFs may only be used as an onsite water quality facility (cannot be used as a regional or sub-regional facility). SFs may be constructed on stable sites with an impervious tributary area of 20 acres or less. A stable tributary area is defined as pavement, concrete, rock mulch, rooftop, irrigated sod and established native turf-forming grass. If the tributary area has newly seeded native turf-forming grass (“unstable” tributary area), the newly seeded native grass areas must be blanketed with a coir mat or approved equivalent after seeding to be considered stable. This will protect the SF while grass is established. Runoff and sediment from unstable watersheds will clog the filter media and create significant long-term maintenance issues for the facility. In conditions where a SF is proposed in potentially unstable conditions, SEMSWA will require an alternate post-construction CM or pretreatment of runoff upstream of the SF, as discussed in Section 14.5.2.4.f.

   In order to minimize the impact to the filter media, SF media should be one of the last

features installed on a site. Temporary control measures must be implemented onsite during construction until the SF has been completed, and in accordance with the approved GESC plan.

SFs may be designed to treat a volume equal to the WQCV or combined with the EURV and 100-year detention for full spectrum detention facilities. SFs can be utilized to meet the WQCV Standard discussed in Section 14.2.

SFs shall comply with the selection criteria shown in Table 14-1.

3. Designing for Maintenance. An Operations and Maintenance Site Plan and Maintenance Agreement are required for a SF. See Section 14.7 for additional requirements. The SF Detail contains additional design and maintenance considerations.

4. Design Procedure and Criteria. The following sections summarize any SEMSWA requirements for SFs that differ from the USDCM. Refer to the SF Details for additional criteria and considerations.

   (a) Basin Storage Volume. A SF can be designed to provide a design volume equal to the WQCV or combined with EURV and 100-year detention storage and outlet structures for full spectrum detention facilities. Criteria for EURV and 100-year detention are described in Chapter 13 Storage. The USDCM also provides detailed guidance for combining WQCV treatment with full spectrum detention in SF facilities.

   For SFs providing WQCV only, the WQCV depth shall be less than or equal to 2 feet, with the exception of SFs located adjacent to paved areas where the WQCV depth shall be limited to 18 inches. For SFs providing EURV and 100-year detention storage, the EURV depth shall be less than or equal to 2 feet, with the exception of SFs located adjacent to paved areas where the EURV depth shall be limited to 18 inches. The bottom of the basin shall be flat for the entire area of the filter media. If the EURV and 100-year volumes are included, the surface area of the filter media stays the same and the overflow drop-inlet is designed to control the EURV and 100-year outflows as shown in the SF Detail.

   (b) Retaining Walls. SEMSWA prohibits the use of retaining walls within a SF. Perimeter walls (walls used to separate the filter media from the adjacent native soils) are shown in the SF Detail.

   (c) Subsurface Soils Analysis. The appropriate type of infiltration section to use for a SF depends on several factors including underlying soils, proximity of adjacent structures, anticipated land use and presence of expansive or contaminated soils. As part of the geotechnical investigation required for structure foundations and groundwater evaluations on a site, the designer must consider the proposed location(s) of SFs and conduct soil investigations in these locations. The type of infiltration section selected for the SF must be based on the recommendations of a geotechnical engineer.

A soils investigation, with a corresponding recommendation by the geotechnical engineer, are necessary when utilizing the SF. A soils investigation must be completed prior to submission of the site development plan and again during construction of the SF. A soils investigation must be included with the site development plan submittal and meet the following requirements:

- The soils analysis should be used to determine whether the soils located underneath the filter (sand) media are suitable for infiltration. Prior to soils testing, it is important to determine whether the proposed SF will be constructed in a cut or fill portion of the site. The soils analysis must include testing of the material that represents the final subgrade of the proposed SF.
- A recommendation for a full infiltration, partial infiltration, or no infiltration section design, based on the requirements in Volume 3 of the USDCM, should accompany the soils investigation.

At the time of SF construction, an additional soil analysis will be required to verify conformance with the initial soil investigation and recommendation. If the onsite soils have been modified during construction such that compliance cannot be achieved, the design engineer should be consulted.

A soil investigation is not required if the design engineer elects to utilize a no infiltration section, in accordance with the SF Detail and the Materials Specification Detail.

(d) Underdrain System. Underdrains are not required for full infiltration SFs with a tributary area less than one acre. Underdrains are required for all partial and no infiltration SFs, regardless of tributary basin size. For SFs with a tributary area less than one acre and poor/uncertain subsurface soils (Type C/D and B) and full infiltration SFs with a tributary area greater than one acre, SEMSWA shall require the installation of an underdrain as a backup measure. In this case, the underdrain shall be constructed with a valve at the outlet. If it is determined that adequate infiltration is not achieved, the valve can be opened allowing the system to operate with partial infiltration.

Cleanouts shall be installed at the upstream end of the underdrain and upstream of any bends 22 ½ degrees or greater in the underdrain for inspection and maintenance of the underdrain pipe. Maximum spacing between cleanouts along an underdrain is 150 feet. The top of cleanouts should not extend above final grade and should be cut and capped. Refer to the SF Detail for additional information.

(e) Impermeable Geomembrane Liner and Perimeter Walls. As summarized in Section 14.5.2.4.c (Subsurface Soils Analysis), consultation with a geotechnical engineer prior to submission of the site development plan is required for all SFs to determine both suitability of onsite soils for infiltration and to obtain a recommendation for a full infiltration, partial infiltration or no infiltration section for the SF. An impermeable liner may be required when the SF basin is adjacent to a structure or

pavement, where expansive soils are a concern or where there is a potential for hazardous chemicals or excessive petroleum runoff from the tributary catchment. SEMSWA requires a recommendation from a geotechnical engineer to mitigate impacts for all of these conditions if anticipated.

If a SF basin is constructed within 10 feet of a paved area or within 50 feet of a building, a no infiltration section is required that includes a perimeter wall and impermeable liner. The perimeter wall must be constructed from the top of the filter media to the bottom of the drainage media. Perimeter walls should be constructed of concrete or another material approved by SEMSWA. Perimeter walls shall be designed by a professional engineer and detailed on the construction plans in accordance with the SF Detail.

(f) Inlet Control and Outlet Control. A forebay provides a location for debris and coarse sediment to drop out of stormwater, extending the functionality of a SF. Forebays are required for the following:

- Upstream basins that do not meet the stable tributary requirements described in Section 14.5.2.2 (Site Selection); or
- All inflow points into the SF with a stable tributary area greater than 4 acres.

Flows can be routed in the SF via pipe, concrete rundown, void-filled riprap rundown, or riprap. When a forebay is not required, energy dissipation meeting the SF Detail shall be provided at each inflow point to the SF.

SFs shall be designed to outlet into a storm sewer, drainageway, or other designated drainage system, typically a public drainage system. SFs should not have an outlet pipe terminating into a gutter, street chase, or other impervious surfaces because of hazards such as icing and water quality impacts. If a system is not available, construction of the system will be a requirement of the developing site. The storm system must adequately convey the SF discharge.

(g) Overflow Embankment. A SF can be designed and constructed to treat the WQCV only or provide full spectrum detention. Regardless, an overflow embankment/emergency spillway shall be provided for all SFs to protect the facility from catastrophic failure due to overtopping. Overtopping can occur when the outlet becomes obstructed or when a storm larger than the design event occurs. Erosion protection for the embankment may be provided in the form of a buried riprap layer on the entire downstream face of the embankment or a separate emergency spillway constructed of buried riprap or concrete. In either case, the emergency protection shall be constructed to convey the 100-year developed flow from the upstream watershed without accounting for any flow reduction within the upstream facility. See the USDCM for additional guidance on design of an emergency spillway including crest elevation, required freeboard and spillway channel section.

The emergency spillway is also needed to control the release point and direction of the overflow. The spillway should be conveyed to a public drainage system. If the spillway is proposed offsite and is not into a public drainage system, a drainage

easement is required. Structures shall not be permitted in the path of the emergency spillway or overflow. The emergency overflow water surface, path of the emergency overflow downstream of the spillway, and embankment shall be clearly depicted on the Construction Drawings in accordance with Chapter 4.

(h) Vegetation. SEMSWA encourages the integration of SFs with site landscaping requirements. A SF can become an integral part of a site's landscape by establishing high quality vegetation along the slopes of the SF.

Successful establishment of vegetation associated with a SF is critical to its long-term success and can often result in reduced long-term maintenance cost. Several key factors contribute to the success of vegetation, including placement of topsoil following the guidelines of the USDCM Topsoil Guidance, selection of seed mixes that are suitable for the particular hydrologic conditions, and irrigation for initial establishment and sustainability. In order to maintain the integrity and long-term function of a SF, several specific requirements for vegetation in SFs are required by SEMSWA:

- No vegetation or mulch shall be installed in the filter media of a SF.
- Permanent irrigation is required along the side slopes of all SFs to establish vegetation post-construction and for long-term maintenance.
- Irrigation heads shall be placed to assure complete coverage of all SF side slopes. Where possible, place irrigation heads above the SF design event (WQCV or EURV) water surface to reduce the likelihood of the irrigation head being impacted by sediment.
- Shrubs shall be planted above the design event (WQCV or EURV) water surface.
- Trees planted adjacent to a SF shall be isolated from the basin using concrete or sheet pile barriers to ensure that the root structure does not impact the filter media or underdrain system. The barriers shall be placed adjacent to the basin, outside the WQCV water surface, if a geomembrane liner is required. Cottonwood, willow, and aspen are not allowed to avoid nuisance spreading of root systems within the facility.
- Rock and mulch are not permitted in SFs due to long-term maintenance concerns and the potential for clogging of outlet structures.
- SEMSWA standard seed mixes shown on the Material Specification Detail shall be used on all side slopes of SFs. If alternate seed mixes are used, prior approval from SEMSWA is required.
- The layout of landscaping on the side slopes of a SF shall allow for necessary maintenance access.

Access. In order to accommodate maintenance access and activities, a hard surface maintenance access is required to the outlet structure in accordance with the Sand Filter Detail. Hard surface maintenance access to the outlet structure can include parking lots, trails, or other similar surfaces (at least 6 feet in width) adjacent to the SF. Any handrails or fences shall permit vehicular access. The entrance to an access drive from a roadway or parking lot shall be located so that traffic safety is not compromised.

(i) Signage. Appropriate warning signage shall be provided for each SF facility and in accordance with the SF Detail.

5. Design Drawings and Checklist. Construction Drawings for SFs shall include design drawings and detailed information, consistent with the CM design checklist available at www.semswa.org.

14.5.3 Bioretention (Rain Garden)

1. Description. A Rain Garden (RG) is a depressed landscape area that collects and treats runoff during storm events through filtration, infiltration, and plant uptake. The treatment process is referred to as bioretention and the CM is referred to as a rain garden or porous landscape detention. Unless otherwise stated in the following sections or shown on the RG Detail (available at www.semswa.org), all proposed RGs shall be designed using guidelines in Volume 3 of the USDCM, with specific attention to Fact Sheet T-3, Bioretention. The following sections provide brief summaries of the RG design components and identify any SEMSWA requirements for RGs that differ from the USDCM.

2. Site Selection. RGs may only be used as an onsite water quality facility. RGs must be constructed on stable sites. A stable tributary area is defined as pavement, concrete, rock mulch, rooftop, irrigated sod and established native turf-forming grass. If the tributary area has newly seeded native turf-forming grass (“unstable” tributary area), the newly seeded native grass areas must be blanketed with a coir mat or approved equivalent after seeding to be considered stable. This will protect the RG while grass is established. Runoff and sediment from unstable watersheds will clog the infiltration media and create significant long-term maintenance issues for the facility. In conditions where an RG is proposed in potentially unstable conditions, SEMSWA will require an alternate post-construction CM or pretreatment of runoff upstream of the RG. The maximum tributary area for an RG is limited only by the space or surface area available to meet the maximum depth requirements in the RG.

   In order to minimize the impact to the infiltration media, RG media should be one of the last features installed on a site. Temporary control measures must be implemented onsite during construction until the RG has been completed, and in accordance with the approved GESC plan.

   RGs may be used to provide a design volume equal to the WQCV or combined with the EURV and 100-year detention in a full spectrum detention facility. RGs can be utilized to meet the WQCV Standard discussed in Section 14.2.

   RGs shall comply with the selection criteria shown in Table 14-1.

3. Designing for Maintenance. An Operations and Maintenance Site Plan and Maintenance Agreement are required for an RG. See Section 14.7 for additional requirements. The RG Details contain additional design and maintenance considerations.

4. Design Procedure and Criteria. The following sections summarize any SEMSWA requirements for RGs that differ from the USDCM. Refer to the RG Detail for additional criteria and considerations.

   (a) Basin Storage Volume. An RG can be designed to provide a volume equal to the WQCV or combined with the EURV and 100-year detention storage and outlet structures for full spectrum detention facilities. Criteria for EURV and 100-year detention are described in Chapter 13 Storage. The USDCM also provides detailed guidance for combining WQCV treatment with full spectrum detention in RG facilities.

   For all RGs, the WQCV depth shall be less than or equal to 12 inches. The EURV depth shall be less than or equal to 2 feet extending vertically from the filter media surface, with the exception of RGs located adjacent to paved areas where the EURV depth shall be limited to 18 inches. The bottom of the basin shall be flat for the entire area of the filter media. If the EURV and 100-year volumes are included, the surface area of the filter media stays the same and the overflow drop-inlet is designed to control the EURV and 100-year outflows as shown in the RG Detail.

   (b) Retaining Walls. The maximum WQCV ponding depth and filter area required for an RG shall be in accordance with Volume 3 of the USDCM.

   SEMSWA prohibits the use of retaining walls within an RG. Perimeter walls (walls used to separate the filter media from the adjacent native soils) are shown on the RG Detail.

   (c) Subsurface Soils Analysis. The appropriate type of infiltration section to use for an RG depends on several factors including underlying soils, proximity of adjacent structures, anticipated land use and presence of expansive or contaminated soils. As part of the geotechnical investigation required for structure foundations and groundwater evaluations on a site, the designer must consider the proposed location(s) of RGs and conduct soil investigations in these locations. The type of infiltration section shall be based on the guidance of a geotechnical engineer.

   Concurrent with the land use plan submittal:

   - A soils analysis to determine the suitability of the onsite soils for infiltration. Specifically, the analysis should recommend the use of onsite soils as the growing media (with amendments, as necessary) or the import of suitable materials. All growing media, including amended or import media, must comply with the Materials Specification Details. In addition, the soils analysis must determine whether the soils located underneath the filter (growing) media are suitable for infiltration. Prior to soils testing, it is important to determine whether the proposed RG will be constructed in a cut or fill portion of the site. The soils analysis must include testing of the material that represents the final subgrade of the proposed RG.
   - A recommendation for a full infiltration, partial infiltration, or no infiltration section, based on the requirements noted in Volume 3 of the USDCM, should accompany the soil investigation.

At the time of RG construction, an additional soil analysis will be required to verify conformance with the initial soil investigation and recommendation. If the onsite soils have been modified during construction such that compliance cannot be achieved, the design engineer should be consulted.

A soil investigation is not required if the design engineer elects to utilize a no infiltration section with imported media in accordance with the RG Detail and Materials Specifications Detail.

(d) Underdrain System. Underdrains are not required for full infiltration RGs with a tributary area less than one acre. Underdrains are required for all partial and no infiltration RGs, regardless of tributary basin size. For RGs with a tributary area less than one acre and poor/uncertain subsurface soils (Type C/D and B) and full infiltration RGs with a tributary area greater than one acre, SEMSWA shall require the installation of an underdrain as a backup measure. In this case, the underdrain shall be constructed with a valve at the outlet. If it is determined that adequate infiltration is not achieved, the valve can be opened allowing the system to operate with partial infiltration.

Cleanouts shall be installed at the upstream end of the underdrain and upstream of any bends 22 ½ degree or greater in the underdrain for inspection and maintenance of the underdrain pipe. Maximum spacing between cleanouts along an underdrain is 150 feet. The top of cleanouts should not extend above final grade but should be cut and capped. Refer to the RG Detail for additional information.

(e) Impermeable Geomembrane Liner and Perimeter Walls. As summarized in Section 14.5.3.4.c (Subsurface Soils Analysis) consultation with a geotechnical engineer prior to submission of the site development plan is required for all RGs to determine suitability of onsite soils for infiltration and must include a recommendation for a full infiltration, partial infiltration or no infiltration section for the RG. An impermeable liner may be required when the RG is adjacent to a structure or pavement, where expansive soils are a concern or where there is a potential for chemicals or petroleum runoff from the tributary catchment. SEMSWA requires a recommendation from a geotechnical engineer to mitigate impacts for all of these conditions if anticipated.

If an RG is constructed within 10 feet of a paved area or within 50 feet of a building, a no infiltration section is required that includes a perimeter wall and impermeable liner. The perimeter wall must be constructed from the top of the growing media to the bottom of the drainage media. Perimeter walls should be constructed of concrete or another material approved by SEMSWA. Perimeter walls shall be designed by a Professional Engineer and detailed on the construction plans and prepared in accordance with the RG Detail.

(f) Inlet Control and Outlet Control. RGs shall have a stable tributary area. A stable tributary area is defined by land cover that includes pavement, concrete, rock mulch, rooftop, irrigated sod and established native turf-forming grass. If the

tributary area has newly seeded native turf-forming grass ("unstable" tributary area), the newly seeded native grass areas must be blanketed with a coir mat or approved equivalent after seeding to be considered stable. This will protect the RG while grass is established.

A forebay provides a location for debris and coarse sediment to drop out of stormwater, extending the functionality of an RG. Forebays are required for the following:

- Upstream basins that do not meet the stable tributary requirements described in Section 14.5.3.2; or
- All inflow points into the RG with a stable tributary area greater than 4 acres.

Flows can be routed into an RG via pipe, concrete rundown, void-filled riprap rundown, or vegetated soil riprap. When a forebay is not required, energy dissipation meeting the RG Detail shall be provided at each inflow point to the RG.

RGs should not have an outlet pipe terminating into a gutter, street chase, or other impervious surfaces because of hazards such as icing and water quality impacts. Therefore, RGs shall be designed to outlet into a storm sewer, drainageway, or other designated drainage system, typically a public drainage system. If a system is not available, construction of the system will be a requirement of the developing site. The storm system must adequately convey the RG flows.

(g) Overflow Embankment. An RG can be designed and constructed to treat the water quality event and may also incorporate full spectrum detention. Regardless of the event that the RG is designed for, an overflow embankment/emergency spillway shall be provided for all RGs to protect from catastrophic failure due to overtopping. Overtopping can occur when the outlet becomes obstructed or when a storm larger than the design event occurs. Erosion protection for the embankment may be provided in the form of a buried riprap layer on the entire downstream face of the embankment or a separate emergency spillway constructed of buried riprap or concrete. In either case, the emergency protection shall be constructed to convey the 100-year developed flow from the upstream watershed without accounting for any flow reduction within the upstream facility. See the USDCM for additional guidance on design of an emergency spillway including crest elevation, required freeboard, spillway channel section and erosion protection.

The emergency spillway is also needed to control the release point and direction of the overflow. The spillway should be conveyed to a public drainage system. If the spillway is proposed offsite and is not into a public drainage system, a drainage easement is required. Structures shall not be permitted in the path of the emergency spillway or overflow. The emergency overflow water surface, path of the emergency overflow downstream of the spillway, and embankment shall be clearly depicted on the Construction Drawings.

(h) Vegetation and Irrigation. SEMSWA encourages the integration of CMs (and detention) with site landscaping requirements. An RG can become an integral part of a site's landscape by establishing plant species appropriate for the conditions.

Successful establishment of vegetation within an RG is critical to its long-term success and can often result in reduced long-term maintenance cost. Several key factors contribute to the success of vegetation including appropriate growing medium, topsoil placement, selection of seed mixes that are suitable for the particular hydrologic conditions, and irrigation for initial establishment and sustainability. In order to maintain the integrity and long-term function of an RG, several specific requirements for vegetation in RGs are required by SEMSWA:

- Vegetation in the filter area of an RG shall consist of native turf-forming grasses established via seed. Alternatively, irrigated turf-grass sod can be used in the filter area but must be sand-grown and is not permitted in areas where a sediment load is anticipated.
- Trees planted adjacent to an RG shall be isolated from the basin using a root barrier to ensure that the root structure does not impact the growing medium or underdrain system. The barriers shall be placed adjacent to the basin, outside the WQCV water surface, if a geomembrane liner is required. Cottonwood, willow, and aspen are not allowed to avoid nuisance spreading of root systems within the facility and are not allowed below the 100-yr water surface.
- Shrubs are not permitted within the RG, unless the shrubs are planted with rock around the base of the shrub, with the rock not covering more than 15% of the RG surface area (see below).
- Small quantities of rock, 2-inch diameter and larger, can be used as an accent or barrier in RGs. Rock shall not cover more than 15% of the RG surface area.
- Wood mulch is not permitted in RGs due to long-term maintenance concerns and the potential for clogging of outlet structures.
- SEMSWA standard seed mixes shall be used in the filter area and side slopes as shown on the Materials Specification Detail. If alternate seed mixes are used, prior approval from SEMSWA is required.
- The layout of landscaping on the side slopes of an RG shall take into consideration access for maintenance.
- Permanent irrigation is required for all RGs to establish vegetation post-construction and for long-term maintenance. Irrigation heads shall be placed to assure complete coverage of the RG filter area and side slopes. Place irrigation heads above the RG filter area and when possible, above the design event (WQCV or EURV) water surface to reduce the likelihood of the irrigation heads getting impacted by sediment. Irrigation rates and schedules shall be determined by the landscape designer and adjusted as necessary to maintain overall functionality of the control measure.

(j) Access. In order accommodate maintenance access and activities, a hard surface maintenance access is required to the outlet structure in accordance with the RG Detail. Hard surface maintenance access can include parking lots, trails, or other similar surfaces (at least 6 feet in width) adjacent to the RG that provide appropriate access to the outlet structure.

Any handrails or fences shall permit vehicular access. The entrance to an access drive from a roadway or parking lot shall be located so that traffic safety is not compromised.

(i) Signage. Appropriate warning signage shall be provided for each RG facility and in accordance with the RG Detail.

5. Design Drawings and Checklist. Construction drawings for RGs shall include design drawings and detailed information as required on the CM design checklist available at www.semswa.org.

14.5.4 Grass Buffer

1. Description. A Grass Buffer (GB) is a pervious area with suitable soil and dense grass type, wither Bluegrass sod or native turf-forming grass, receiving runoff from pavement or roof surfaces. GBs provide filtration of sediment and promotes stormwater infiltration by slowing runoff applied to it via sheet flow. Unless otherwise stated in the following sections or shown on the GB Detail (available at www.semswa.org), all proposed GBs shall be designed using guidelines in Volume 3 of the USDCM, with specific attention to Fact Sheet T-1, Grass Buffers. The following sections provide brief summaries of the GB design components and identify any SEMSWA requirements for GBs that differ from the USDCM.

2. Site Selection. GBs shall be used for sites with an impervious tributary area of 10 acres or less. Site selection for a GB must include consideration of the existing onsite soils. UDFCD's Topsoil Guidance provides guidance on assessing onsite soils, selecting the most favorable soils for a GB, and amending marginal soils for use in a GB. It is imperative that design plans clearly show the location of suitable soils and coordination with the contractor occurs in the early stages of construction to ensure that desirable soils are stockpiled (as appropriate) for use in the GB.

   GBs can be utilized to meet the Runoff Reduction Standard or pretreatment associated with the Regional WQCV Standard discussed in Section 14.2.

   GBs shall comply with the selection criteria shown in Table 14-1.

3. Designing for Maintenance. An Operations and Maintenance Site Plan and Maintenance Agreement are required in association with a GB. See Section 14.7 for additional requirements. The GB Detail contains additional design and maintenance considerations.

   GBs should be constructed with a 4- to 6-inch drop from the edge of pavement to the top of the buffer. This drop provides room for vegetation growth and accumulation of sediment without obstructing runoff entering the GB. In locations where vehicular traffic is anticipated, a slotted curb or thickened edge with parking blocks is required to avoid rutting and minimize traffic safety concerns.

4. Design Procedure and Criteria. The following sections summarize any SEMSWA requirements for GBs that differ from the USDCM. Refer to GB Detail for additional criteria and considerations.

   (a) Buffer Slope. SEMSWA allows a maximum GB design slope of 25% for irrigated Bluegrass sod and 10% for irrigated native turf-forming grass. The minimum slope for all GBs is 2%.

   (b) Underdrain. An underdrain must be installed when recommended by a geotechnical engineer. When underdrains are required, cleanouts should be installed at the upstream end of the underdrain and upstream of any bends 22 ½ degrees or greater for inspection and maintenance of the underdrain pipe. Maximum spacing between cleanouts along an underdrain is 150 feet. The top of cleanouts should not extend above final grade but should be cut and capped. Refer to the GB Detail for additional information.

   (c) Tributary area characteristics. A stable tributary area is required for GBs, defined as pavement, concrete, rock mulch, rooftop, irrigated sod and established native turf-forming grass. If the tributary area has newly seeded native turf-forming grass ("unstable" tributary area), the newly seeded native grass areas must be blanketed with a coir mat or approved equivalent after seeding to be considered stable. This will protect the GB while grass is established. Runoff and sediment from unstable watersheds will clog the filter media and create significant long-term maintenance issues for the facility. In conditions where a GB is proposed in potentially unstable conditions, SEMSWA will require an alternate post-construction CM.

   When utilizing a GB to meet 20/10 pretreatment requirements, the tributary area may include gravel, provided the gravel is generally clean imported material intended to stabilize underlying subgrade soils.

   (d) Flow Distribution. Concentrated flows cannot discharge into a GB; therefore, if concentrated flows exist, a level spreader is required. Refer to the GB Detail, in addition to the example level spreaders shown in Volume 3 of the USDCM.

   (e) Soil Preparation. Soil sampling and testing must be completed for soils proposed for use in all GBs prior to construction. As mentioned, the USDCM Topsoil Guidance provides guidance on assessing onsite soils, selecting the most favorable soils for a GB and amending marginal soils to for use in a GB. Refer to the Materials Specification Detail for guidance on growing media and filter media requirements for GBs.

   (f) Vegetation. SEMSWA encourages the integration of GBs with site landscaping requirements. A GB can become an integral part of a site's landscape by establishing high quality vegetation. Vegetative cover is one of the most important elements of a GB, as filtration and infiltration are the primary methods of stormwater quality treatment. In order to maintain the integrity and long-term function of a GB, several specific requirements for vegetation in GBs are required by SEMSWA:

- All GBs be must be densely vegetated with sod or turf-forming native grasses.
- No mulch, cobble, or other landscaping cover shall be placed within the GB.
- Trees and shrubs are not permitted within the GB.

(g) Irrigation. All GBs must be constructed with permanent irrigation. A permanent irrigation system will be critical in establishing high quality vegetation that provides optimum filtration and infiltration opportunities and provides a means to keep the vegetation healthy during drought conditions. Irrigation rates and schedules shall be determined by the landscape designer and adjusted as necessary to maintain overall functionality of the GB.

(h) Outflow Collection and Major Storm Conveyance. In the event that flow greater than the required water quality event is routed to a GB, it must be clearly shown how the major storm event will be conveyed and managed as it passes through and downstream of the GB.

5. Construction Considerations. In order to establish a GB with high quality vegetation, there are several items that must be taken into consideration during the construction of a GB. In addition to those suggestions listed in Volume 3 of the USDCM, the following must also be considered.

   (a) Perform soil placement, fine grading and seeding/sod only after all tributary areas have been fully stabilized and any necessary utility work that crosses the GB has been completed. In the event that the CM is installed prior to full stabilization of the tributary area, SEMSWA may determine that the GB function has been compromised and require a full reconstruction of the GB. Appropriate temporary construction control measures must be put in place to protect post-construction GBs.

   (b) Subgrade must be scarified 6 to12 inches below the growing media. In cases where existing soils meet the growing media requirements (with or without amendments), then the existing soil shall be scarified 12 inches prior to placement of sod or seeding operations.

   (c) It is recommended that a roller be used over newly placed sod to reduce air pockets between the sod and soil.

6. Application of the “20/10” Rule Requirements. GBs (and Grass Swales) are the post-construction CMs that can be utilized to meet requirements of the “20/10” rule. The 20/10 rule provides pretreatment of stormwater for developments that rely on a regional facility to meet the WQCV requirements. See Section 14.2.4.

7. Design Drawings and Checklist. Construction drawings for GBs shall include design drawings and detailed information as required on the CM design checklist available at www.semswa.org.

14.5.5 Grass Swale

1. Description. A Grass Swale (GS) is a densely vegetated channel with suitable soil that conveys runoff slowly, therefore providing stormwater quality treatment through filtration of sediment and promoting stormwater infiltration. Unless otherwise stated in the following sections or shown on the GS Detail (available at www.semswa.org), all proposed GSs shall be designed using guidelines in Volume 3 of the USDCM, with specific attention to Fact Sheet T-2, Grass Swale. The following sections provide brief summaries of the GS design components and identify any SEMSWA requirements for GSs that differ from the USDCM.

2. Site Selection. GSs shall be used for sites with an impervious tributary area of 20 acres or less. Site selection for a GS must include consideration of the existing onsite soils. The USDCM Topsoil Guidance provides guidance on assessing onsite soils, selecting the most favorable soils for a GS, and amending marginal soils for use in a GS. It is imperative that design plans clearly show the location of suitable soils and that coordination with the contractor occurs in the early stages of construction to ensure that desirable soils are stockpiled (as appropriate) for use in the GS.

   GSs can be utilized to meet the Runoff Reduction Standard or pretreatment associated with the Regional WQCV Standard discussed in Section 14.2.

   GSs shall comply with the selection criteria shown in Table 14-1.

3. Designing for Maintenance. An Operations and Maintenance Site Plan and Maintenance Agreement are required for a GS. See Section 14.7 for additional requirements. The GS Detail contains additional design and maintenance considerations**.**

4. Design Procedure and Criteria. The following sections summarize any SEMSWA requirements for GSs that differ from the USDCM. Refer to the GS Detail for additional criteria and considerations.

   (a) Longitudinal Slope. SEMSWA requires a minimum longitudinal slope for all GSs of 0.50%. In addition, the maximum longitudinal slope for irrigated Bluegrass sod is 4.0% and the maximum slope for irrigated native turf-forming grass is 2.5%.

   (b) Swale Geometry. SEMSWA requires all GSs to have a trapezoidal geometry with the intent of encouraging flows to spread uniformly across the bottom of the swale, with a maximum side slope of 4:1. When calculating runoff reduction using the USDCM Fact Sheet T-0, the wetted area is based on the bottom width of the swale. V-channels are not appropriate for GSs.

   (c) Vegetation. SEMSWA encourages the integration of GSs with site landscaping requirements. A GS can become an integral part of a site's landscape by establishing high quality vegetation, as filtration and infiltration are the primary methods of stormwater quality treatment. In order to maintain the integrity and

long-term function of a GS, several specific requirements for vegetation in GSs are required by SEMSWA:

- All GSs must be vegetated with sod or turf-forming native grasses.
- No mulch, cobble, or other landscaping cover shall be placed within the GS.
- If vegetating with seed to establish turf-forming native grasses, SEMSWA standard seed mixes shown on the Materials Specification Detail shall be used. If alternate seed mixes are used, prior approval from SEMSWA is required.
- Trees and shrubs are allowed above the 2-year water surface.

(d) Tributary area characteristics. A stable tributary area is required for GSs, defined as pavement, concrete, rock mulch, rooftop, irrigated sod and established native turf-forming grass. If the tributary area has newly seeded native turf-forming grass ("unstable" tributary area), the newly seeded native grass areas must be blanketed with a coir mat or approved equivalent after seeding to be considered stable. This will protect the GS while grass is established. Runoff and sediment from unstable watersheds will clog the filter media and create significant long-term maintenance issues for the facility. In conditions where a GS is proposed in potentially unstable conditions, SEMSWA will require an alternate post-construction CM. When utilizing a GS to meet 20/10 pretreatment requirements, the tributary area may include gravel, provided the gravel is generally clean imported material intended to stabilize underlying subgrade soils.

(e) Design Velocity. The maximum permissible velocity for the 2-year storm event for fully established vegetation in a GS shall be as follows:

- Irrigated Bluegrass Sod = 4.0 feet per second
- Irrigated Native Turf Grass = 3.0 feet per second

In addition, the anticipated major storm event velocity should be evaluated for reasonableness and the design adjusted to provide stable conditions.

(f) Underdrain. Underdrains are required in GSs with longitudinal slopes less than 2%. Cleanouts shall be installed at the upstream end of the underdrain and upstream of any bends 22 ½ degrees or greater for inspection and maintenance of the underdrain pipe. Maximum spacing between cleanouts along an underdrain is 150 feet. The top of cleanouts should not extend above final grade but should be cut and capped. Refer to the GS Detail for additional information.

(g) Soil Preparation. Soil sampling and testing must be completed for soils proposed for use in all GSs prior to construction. As mentioned, the USDCM Topsoil Guidance provides guidance on assessing onsite soils, selecting the most favorable soils for a GS and amending marginal soils for use in a GS. Refer to the Material Specification Details for guidance on growing media and filter media requirements for GSs.

(h) Irrigation. All GSs must be constructed with permanent irrigation. A permanent irrigation system will be critical in establishing high quality vegetation and provide a means to keep the vegetation healthy during drought conditions. Irrigation rates

and schedules shall be determined by the landscape designer and adjusted as necessary to maintain overall functionality of the control measure. Irrigation heads shall be installed above the 2-year water surface.

(i) Major Storm Conveyance. It must be clearly shown how the major storm event will be conveyed and managed as it passes through and downstream of the GS. The GS shall be designed to accommodate the major storm event. The swale must be evaluated under a major storm event by calculating the hydraulic parameters, including depth and velocity, to ensure that the GS is stable under the major storm event.

5. Construction Considerations. In order to establish a GS with high-quality vegetation, there are several items that must be taken into consideration during the construction of a GS. In addition to those suggestions listed in Volume 3 of the USDCM, the following must also be considered.

(d) Perform soil placement, fine grading and seeding only after all tributary areas have been fully stabilized and any necessary utility work that crosses the GS has been completed. In the event that the GS is installed prior to full stabilization of the tributary area, SEMSWA may determine that the GS function has been compromised and require a full reconstruction of the GS. Appropriate temporary construction control measures must be put in place to protect postconstruction GSs.

(e) Subgrade should be scarified 6 to 12 inches below the growing media. In cases where existing soils meet the growing media requirements (with or without amendments), then the existing soil shall be scarified 12 inches prior to placement of sod or seeding.

(f) It is recommended that a roller be used over newly placed sod to reduce air pockets between the sod and soil.

6. Application of the “20/10” Rule Requirements. GSs (and GBs) are the post-construction CMs that can be utilized to meet requirements of the 20/10 rule. The 20/10 rule provides pretreatment of stormwater for developments utilizing a regional facility to meet the WQCV requirements. See section 14.2.4.

7. Design Drawings and Checklist. Construction drawings for GSs shall include design drawings and detailed information as required on the CM design checklist available at www.semswa.org.

14.6 Design Criteria for SEMSWA Non-Standard Post-construction Control Measures

SEMSWA has adopted the use of five Standard Post-construction CMs, as discussed in Section 14.5. Additional post-construction CMs are available for use, which will be referred to as Non-Standard Post Constriction CMs. These measures include Underground Post-construction CMs (including proprietary devices), Constructed Wetland Ponds, Constructed

Wetland Channels, Green Roofs, and Permeable Pavements (including Permeable Interlocking Concrete Pavement, Concrete Grid Pavement, Porous Gravel Pavement, and Reinforced Grass Pavement). The following sections identify SEMSWA requirements for Non-Standard Post-construction CMs that differ from the USDCM. Refer to Section 1.8 for the variance process required to utilize Non-Standard Post-construction CMs.

14.6.1 Additional Requirements for Non-Standard Post-construction Control Measures

1. Underground Water Quality. In order to utilize underground proprietary water quality devices, development sites must be linear (such as a roadway or utility project) or be a redevelopment project with a site imperviousness greater than 90% or otherwise considered ultra-urban infill development or redevelopment.

2. Constructed Wetland Ponds or Constructed Wetland Channels. In order to utilize Constructed Wetland Ponds or Channels, justification shall be provided showing adequate water rights are or will be in place, and that there will be no obstacles to long-term maintenance because of the ability to obtain necessary environmental permitting.

3. Green Roof. In order to utilize a Green Roof, the design team shall include a landscape architect and/or ecologist, and structural engineer. The landscape architect and/or ecologist shall make a recommendation on the plant species and irrigation requirements for the roof. In additional, a structural engineer shall be responsible for the structural components associated with the Green Roof. Coordination with the Building Department may be necessary.

4. Permeable Pavement. In order to utilize any type of Permeable Pavement, an enhanced Maintenance Agreement must have enough specific data to provide the owner with information on the additional maintenance needs and cost associated with this Non-standard Post-construction CM.

5. Other Non-Standard CMs. Should an applicant propose to utilize a Non-standard Post-construction CM not listed in Section 14.6, a detailed analysis shall be provided to SEMSWA showing how the proposed CM meets or exceeds the water quality treatment as compared to the Standard Post-construction CMs.

14.6.2 Additional Submittal Requirements for Non-Standard Post-construction Control Measures

If SEMSWA approves the use of a Non-Standard Post-construction CM through the variance process, it is the applicant's responsibility to prepare details, the O&M Site Plan and associated standard operating procedures (SOPs) for the Non-Standard Post-construction CM, along with any other necessary submittal documents that may not be available from SEMSWA for Non-Standard Post-construction CMs.

14.7 Design for Long Term Operations and Maintenance of Post-construction Control Measures

Operations and Maintenance documents shall be required for all post-construction CMs. The purpose of the Operations and Maintenance documents is to provide information and guidance for entities responsible for the long-term inspection and maintenance of the facility. SEMSWA is not responsible for the long-term operations and maintenance of post-construction CMs associated with new development and redevelopment, unless the post-construction CMs are regional improvements shown in a Master Plan, and the maintenance responsibility has been accepted by SEMSWA.

To facilitate SEMSWA's ability to perform inspections, all post-construction CMs must be placed in a drainage easement with a legal means of access to the drainage easement and the CM (easement, right-of-way, or similar).

14.7.1 Operations and Maintenance Requirements

Operations and Maintenance documents consist of three parts, as further outlined below:

1. Standard Operating Procedures (SOPs) specific to SEMSWA's Standard Post-construction CMs. Each Standard Post-construction CM has an SOP discussing specific operations and maintenance procedures, which can be found at www.semswa.org and include the frequencies for routine inspections and maintenance activities. If Standard Post-construction CMs are utilized with no variances, no changes to these SOPs are required. Should a Non-Standard Post-construction CM be utilized, it is the design engineer's responsibility to create an SOP for the CM used, and such SOPs must be reviewed and approved by SEMSWA. The SOP must be drafted to discuss maintenance needs based on the approved variance. SOPs that have been modified from the standard SOP format must be recorded against the property with the Arapahoe County Clerk and Recorder, with fees paid in accordance with SEMSWA's adopted Fee Schedule, available at www.semswa.org.

2. Maintenance Agreement. A Standard Maintenance Agreement must be executed concurrent with or prior to approval of the Construction Drawings (CDs) associated with proposed post-construction CMs. One Agreement is adequate for each site, and an agreement is not necessary for each CM installed at the site. Substantive modifications to the Agreement are not permitted without approval from the SEMSWA Board of Directors. The Maintenance Agreement requires maintenance of the post-construction CMs to ensure functionality in accordance with the approved CDs and in accordance with the associated SOPs. The Maintenance Agreement outlines enforcement procedures in the event appropriate maintenance does not occur. SEMSWA will, at a minimum, inspect all post-construction CMs at a frequency determined as appropriate for the post-construction CM, and at a minimum as defined by the Reg 61 MS4 Permit.

3. Post-construction Control Measure Operations and Maintenance Site Plan.

The design engineer is responsible for the preparation of a CM Operations and Maintenance Site Plan. A detailed submittal checklist for the Operations and Maintenance Site Plan can be found at www.semswa.org, and should be included with the Operations and Maintenance Site Plan submittal to SEMSWA. It is anticipated that the stormwater design sheet and/or landscaping plan sheet from the CDs can be utilized as a base for preparing the Operations and Maintenance Site Plan.

The Maintenance Agreement and Operations and Maintenance Site Plan will be recorded against the property, concurrent with or prior to approval of the CDs associated with the proposed post-construction CM, at the Arapahoe County Clerk and Recorder's office, with fees paid in accordance with SEMSWA's adopted Fee Schedule, available at www.semswa.org.

14.8 Source Controls

14.8.1 General

SEMSWA allows only stormwater to enter the storm drain system, with some exceptions including foundation drains, footing drains, and stormwater runoff with incidental pollutants. A comprehensive list and discussion of approved discharges into the storm system can be found in the SEMSWA Illicit Discharge and Detection Plan (IDDE Plan), available at www.semswa.org.

14.8.2 Direct Connections

Direct connections into the public storm sewer system are prohibited, except for those storm sewer systems connections that are reviewed and approved by SEMSWA as a part of the Site Development's Drainage Report or Letter. SEMSWA may approve other flows that are acceptable (see section 14.6.1) to discharge to the storm drainage system. All cases shall be approved by a variance request, with adequate analysis and justification. A Direct Connection License Agreement, which addresses the terms and conditions for the connection, is required for non-stormwater direct connections approved as part of the Site Development review process.

14.8.3 Indirect Connections

Sites with a higher potential to discharge pollutants into stormwater are required to provide source controls with the purpose of reducing or preventing the likelihood of those pollutants from entering the storm system. Example activities include:

- Outside material storage
- Vehicle washing
- Vehicle maintenance
- Outside manufacturing
- Painting operations
- Above ground storage tanks
- Loading and unloading areas

- Fueling
- Power washing
- Pet day camps

SEMSWA may determine additional activities that pose a higher potential for pollutants to be discharged and transported offsite during the Site Development review process.

Sites that propose outdoor uses and activities which are deemed by SEMSWA to have the potential to discharge pollutants into the storm system shall be required to provide appropriate source controls. These measures are above and beyond the Post-construction CMs discussed in Section 14.5 and 14.6.

14.8.4 Structural Source Controls

Projects that propose outdoor uses and activities which are deemed by SEMSWA to have the potential to create illicit discharges shall be required to provide special source controls. The source controls shall be designed to prevent the contamination of stormwater runoff from the site.

Source controls can include, but are not limited to:

- Permanent covering of outdoor storage areas
- Spill containment and control (secondary containment, curbing, diking, etc.)
- Proper sanitary sewer connections (directing non-stormwater flows to the sanitary sewer, with approval from sanitary sewer provider).
- Provision of designated storage and material handling areas
- Provision of proper waste management facilities

Table 14-1, Selection and Applicability of Standard Control Measures

Standard Control Measure	Regional, Sub-Regional or Onsite	Tributary Drainage Area	Treatment Standard	Upstream land cover	Construction Requirements	Other Design Considerations
Extended Detention Basin (EDB)	Regional, Sub-Regional or Onsite	Impervious area of 5 acres to 640 acres.	• WQCV	• Native non-irrigated grasses • Irrigated grasses • Pavement/Concrete • Rooftops • Stable drainageways	• If used as a temporary sediment basin during construction, all sediment must be removed (including inlet/outlet structures), final grades and vegetation established at the end of construction, prior to Probationary Acceptance of the Site. • If a sediment basin is used as temporary WQCV until a regional improvement is available, the design for the sediment basin must meet WQCV sizing requirements.	• Can be designed for WQCV or combined with EURV and 100-year detention. • Temporary irrigation is required to establish vegetation, at a minimum. • Formal maintenance access required to all structural elements (outlet structure, forebay, trickle channel). • Sites with a high potential for pollutant discharges will be required to reduce or prevent contaminants from entering the EDB by implementing source controls (see Section 14.8).
Modified Extended Detention Basin (MEDB)	Sub-Regional or Onsite	Impervious area greater than 1 acre and less than 5 acres.	• WQCV	• Native non-irrigated grasses • Irrigated grasses • Pavement/Concrete • Rooftops	• If used as a temporary sediment basin during construction, all sediment must be removed (including inlet/outlet structures), final grades and vegetation established at the end of construction, prior to Probationary Acceptance of the Site.	• Can be designed for WQCV or combined with EURV and 100-year detention. • Permanent irrigation is required to establish vegetation, at a minimum Formal maintenance access required to outlet structure. • Sites with a high potential for pollutant discharges will be required to reduce or prevent contaminants from entering the MEDB by implementing source controls (see Section 14.8).
Bioretention/ Rain Garden (RG)	Onsite	Must adhere to maximum depth criteria for RG. Tributary area only limited by surface area required to meet this requirement.	• WQCV	• Pavement/Concrete • Rock Mulch • Rooftops • Irrigated sod • Established native turf-forming grass	• The area tributary to the RG must be stabilized (including pavement) prior to allowing flows to enter the RG. This requirement reduces the impacts of sedimentation and compaction (from construction equipment) to the facility.	• Can be designed for WQCV or combined with EURV and 100-year detention. • Soils investigation required prior to or concurrently with the submission of the site development plan and during construction. • Permanent irrigation is required along RG side slopes. • Formal maintenance access required to outlet structure. • If RG is proposed in potentially unstable conditions, pretreatment of runoff required upstream of the RG. • Sites with a high potential for pollutant discharges will be required to reduce or prevent contaminants from entering the RG by implementing source controls (see Section 14.8).
Sand Filter (SF)	Onsite	Impervious area of 20 acres or less.	• WQCV	• Pavement/Concrete • Rock Mulch • Rooftops • Irrigated sod • Established native turf-forming grass	• The area tributary to the SF must be stabilized (including pavement) prior to allowing flows to enter the SF. This requirement reduces the impacts of sedimentation to the facility.	• Can be designed for WQCV or combined with EURV and 100-year detention. • Soils investigation required prior to or concurrently with the submission of the site development plan and during construction. • Permanent irrigation is required along SF side slopes. • Formal maintenance access required to outlet structure. • If SF is proposed in potentially unstable conditions, pretreatment of runoff required upstream of the SF. • Sites with a high potential for pollutant discharges will be required to reduce or prevent contaminants from entering the SF by implementing source controls (see Section 14.8).
Grass Buffer (GB)	Onsite	Impervious area of 10 acres or less.	• Runoff Reduction • Regional “20/10” pretreatment	• Pavement/Concrete • Rock Mulch • Rooftops • Irrigated sod • Established native turf-forming grass	• The area tributary to the GB must be stabilized (including pavement), and no construction traffic anticipated over the GB, prior to allowing flows to enter the GB.	• Favorable soil and vegetative cover required for success of GB. • Permanent irrigation is required. • No mulch, cobble, trees, or shrubs shall be placed within the GB.
Grass Swale (GS)	Onsite	Impervious area of 20 acres or less.	• Runoff Reduction • Regional “20/10” pretreatment	• Pavement/Concrete • Rock Mulch • Rooftops • Irrigated sod • Established native turf-forming grass	• The area tributary to the GS must be stabilized (including pavement), and no construction traffic anticipated over the GS, prior to allowing flows to enter the GS.	• Favorable soil and vegetative cover required for success of GS. • Permanent irrigation is required, irrigation heads shall be placed above the WQCV water surface elevation. • No mulch, cobble, or other landscape cover shall be placed within the GS. Trees or shrubs can be placed above the WQCV elevation.