Lorson Ranch Metropolitan District Operations and Maintenance Manual Extended Detention Ponds

Extended detention basins have low to moderate maintenance requirements. Routine and non-routine maintenance is necessary to assure performance, enhance aesthetics, and protect structural integrity. The dry basins can result in nuisance complaints if not properly designed or maintained. Bio-degradable pesticides may be required to limit insect problems. Frequent debris removal and grass-mowing can reduce aesthetic complaints. If a shallow wetland or marshy area is included, mosquito breeding and nuisance odors could occur if the water becomes stagnant.

1. Lorson Ranch Ponds maintained by Lorson Ranch Metropolitan District.

There are multiple ponds within Lorson Ranch that the metro district owns and maintains. The following is a list of the ponds, type of pond, and the name of the subdivision within Lorson Ranch that built the pond. Attached to this manual is a location map of all the ponds owned/maintained by the Lorson Ranch Metropolitan District.

a. Pond A1 – Extended Detention Basin with WQCV. Pond A1 was built in 2006 as part of the Fontaine Blvd/Old Glory street improvement project. The final drainage report for Fontaine Blvd/Old Glory covers the drainage calculations for this pond.
b. Pond A2 – Extended Detention Basin (no WQCV). Pond A2 was built in 2006 as part of the Fontaine Blvd/Old Glory street improvement project. The final drainage report for Fontaine Blvd/Old Glory covers the drainage calculations for this pond.
c. Pond A3 – Extended Detention Basin with WQCV. Pond A3 was originally built in 2006 as part of the Fontaine Blvd/Old Glory street improvement project and was expanded in September, 2020 and upgraded to full spectrum design volumes with a full spectrum outlet structure as part of Ponderosa at Lorson Ranch Filing No. 3. The final drainage report for Ponderosa at Lorson Ranch Filing No. 3 covers the drainage calculations for this pond.
d. Pond A4 – Extended Detention Basin (no WQCV). Pond A4 was built in 2010 as part of the Pioneer Landing Filing No. 1 development. The final drainage report for Pioneer Landing Filing No. 1 covers the drainage calculations for this pond.
e. Pond A5 - Extended Detention Basin with WQCV. Pond A5 was built in 2009-2010 as part of the Townhomes at Lorson Ranch Filing 1A development. The final drainage report covers the drainage calculations for this pond.
f. Pond B1 – Extended Detention Basin with WQCV. Pond B1 was built in 2016 as part of the Pioneer Landing Filing No. 2 development. The final drainage report for Pioneer Landing Filing No. 2 covers the drainage calculations for this pond.
g. Pond B2 – Extended Detention Basin with WQCV. Pond B2 was built in 2013 as part of the Meadows at Lorson Ranch Filing No. 3 development. The final

drainage report for Meadows at Lorson Ranch Filing No. 3 covers the drainage calculations for this pond.

h. Pond C1-R – Extended Detention Basin with WQCV. Pond C1 was built in 2011 as part of the Allegiant at Lorson Ranch development. The final drainage report for Allegiant at Lorson Ranch covers the drainage calculations for this pond. The outlet structure and pond calculations for Pond C1-R are updated in 2019 by Creekside at Lorson Ranch Filing 1 to include full spectrum detention and WQ.

i. Pond C3a– Extended Detention Basin with WQCV. Pond C3a was built in 2014 as part of the Meadows at Lorson Ranch Filing No. 4 development. The final drainage report for Meadows 4 at Lorson Ranch covers the drainage calculations for this pond.

j. Pond G1-G2 – Extended Detention Basin with WQCV. Full spectrum Pond G1-G2 was built in 2017 as part of the Carriage Meadows South development. The final drainage report for Carriage Meadows South covers the drainage calculations for this pond.

k. Pond G3 – Extended Detention Basin with WQCV. Full Spectrum Pond G3 was built in 2017 as part of the Carriage Meadows South development. The final drainage report for Carriage Meadows South covers the drainage calculations for this pond.

l. Pond C5 - Extended Detention Basin with WQCV. Full Spectrum Pond C5 was built in 2018 as part of the Lorson Ranch East development. The final drainage report for Lorson Ranch East Filing No. 1 covers the drainage calculations for this pond.

m. Pond D2 - Extended Detention Basin with WQCV. Full Spectrum Pond D2 was built in 2018 as part of the Lorson Ranch East development. The final drainage report for Lorson Ranch East Filing No. 1 covers the drainage calculations for this pond.

n. Pond CMN-1. Extended Detention Basin with WQCV. Full Spectrum Pond CMN-1 was built in 2018 as part of the Carriage Meadows North Filing No. 1 development. The final drainage report for Carriage Meadows North Filing No. 1 covers the drainage calculations for this pond.

o. Pond C3. Extended Detention Basin with WQCV. Pond C3 was built in 2018 as part of the Lorson Ranch East Filing No. 2 development and is expanded in 2020 as part of The Hills at Lorson Ranch Filing No. 1 including WQCV. The final drainage report for The Hills at Lorson Ranch Filing No. 1 covers the drainage calculations for this pond.

p. Pond CR2 - Extended Detention Basin with WQCV. Full Spectrum Pond CR2 will be built in 2019 as part of the Creekside at Lorson Ranch Filing No. 1 development. The final drainage report for Creekside at Lorson Ranch Filing No. 1 covers the drainage calculations for this pond.

q. Pond CR3 – Sand Filter Detention Basin with WQCV. Full Spectrum Pond CR2 will be built in 2019 as part of the Creekside at Lorson Ranch Filing No. 1 development. The final drainage report for Creekside at Lorson Ranch Filing No. 1 covers the drainage calculations for this pond. This pond is a sand filter basin.

r. Pond E1 – Future Extended Detention Basin with WQCV. Future Full Spectrum Pond E1 was excavated in 2019 as part of the Lorson Ranch East Filing No. 4 development. The final drainage report for Lorson Ranch East Filing No. 4 covers

the drainage calculations for this pond. This pond will consist of a pipe outlet until upstream development occurs which will also construct the outlet structure.

s. Pond E2 – Extended Detention Basin with WQCV. Full Spectrum Pond E2 will be built in 2019 as part of the Lorson Ranch East Filing No. 4 development. The final drainage report for Lorson Ranch East Filing No. 4 covers the drainage calculations for this pond.

t. Pond C1 - Extended Detention Basin with WQCV. Full Spectrum Pond C1 will be built in 2020 as part of the The Hills at Lorson Ranch Filing No. 1 development. The final drainage report for The Hills at Lorson Ranch Filing No. 1 covers the drainage calculations for this pond.

u. Pond C2.1 – Extended Detention Basin with WQCV. Pond C2.1 was excavated in 2020 as part of the The Hills at Lorson Ranch development. Pond C2.1 will be an Extended Detention Basin with WQCV. Full Spectrum Pond C2.1 will be completed including an outlet structure in 2022 as part of the The Ridge at Lorson Ranch Filing No. 1 development. The final drainage report for The Ridge at Lorson Ranch Filing No. 1 covers the drainage calculations for this pond.

v. Pond C2.2 - Extended Detention Basin with WQCV. Full Spectrum Pond C2.2 will be built in 2020 as part of the The Hills at Lorson Ranch Filing No. 1 development. The final drainage report for The Hills at Lorson Ranch Filing No. 1 covers the drainage calculations for this pond.

w. Pond C2.3 - Extended Detention Basin with WQCV. Full Spectrum Pond C2.3 will be built in 2020 as part of the The Hills at Lorson Ranch Filing No. 1 development. The final drainage report for The Hills at Lorson Ranch Filing No. 1 covers the drainage calculations for this pond.

x. Pond C4 - Extended Detention Basin with WQCV. Pond C4 was excavated in 2020 as part of the The Hills at Lorson Ranch development. Pond C4 will be an Extended Detention Basin with WQCV. Full Spectrum Pond C4 will be completed including an outlet structure in 2022 as part of the The Ridge at Lorson Ranch Filing No. 1 development. The final drainage report for The Ridge at Lorson Ranch Filing No. 1 covers the drainage calculations for this pond.

y. WQ Pond F – WQCV Pond F is an extended detention basin that is only for treating runoff for water quality and will be built in 2021 as part of the The Ridge at Lorson Ranch Filing No. 1 development. The final dxrainage report for The Ridge at Lorson Ranch Filing No. 1 covers the drainage calculations for this pond.

1.1 Lorson Ranch Grass Buffer for Backyard Water Quality Treatment maintained by Lorson Ranch Metropolitan District.

There are multiple areas that the backyards of houses drain directly to the East Tributary of Jimmy Camp Creek or the main channel of Jimmy Camp Creek. A grass buffer WQ CMP located in a separate tract of land will be used for these areas within Lorson Ranch and the metro district will own and maintain the buffer tracts. The following is a list of the grass buffer BMP's and the name of the subdivision within Lorson Ranch that built the BMP. Attached to this manual is a location map of all the ponds and BMP's owned/maintained by the Lorson Ranch Metropolitan District. See Section 4.0 for maintenance of Grass Buffers.

a.1. Carriage Meadows North at Lorson Ranch Filing No. 1 – Tract C – Grass Buffer BMP

a.2 Lorson Ranch East Filing No. 1 – Tract D – Grass Buffer BMP
a.3 Lorson Ranch East Filing No. 2 – Tract B – Grass Buffer BMP
a.4 Creekside at Lorson Ranch Filing No. 1 – Tract A, C, E, K – Grass Buffer BMP

2. Pond Inspections

Inspection and Frequency

- Annually inspect basins to ensure that the basin continues to function as initially intended. The annual inspection should evaluate the forebay, pond side slopes, inflow storm sewer, the spillway condition, the depth of sediment in the forebay, outlet structure, trash rack, downstream storm sewer, and the condition of the downstream face of the pond. A site survey will be the best indication of excessive sediment buildup and degradation of the spillway. In addition, an inspection of the vegetation on the berm, inside the detention area and the downstream face of the spillway should be conducted. Any bare areas should be noted and repaired using native grasses. Any sloughing or erosion of the embankment should be noted and repaired. Items to record will include any items inspected and the mowing frequency of the vegetation on the facility.
- Just before annual storm seasons (that is, April and May) and following significant rainfall events, inspect for litter and debris that may plug outlets. Of notable importance, the inspections should also include the water quality orifice plate and trash rack to ensure plugging has not occurred.
- A baseline survey should be performed at the time of construction and comparison surveys conducted every ten to twenty years after to monitor overall performance of the pond. Results of inspections should be recorded and kept at a central location for review and recording by the district.

Inspection Personnel

A qualified engineer, surveyor, or certified storm water inspector should conduct inspections of the facility.

3.0 Operations

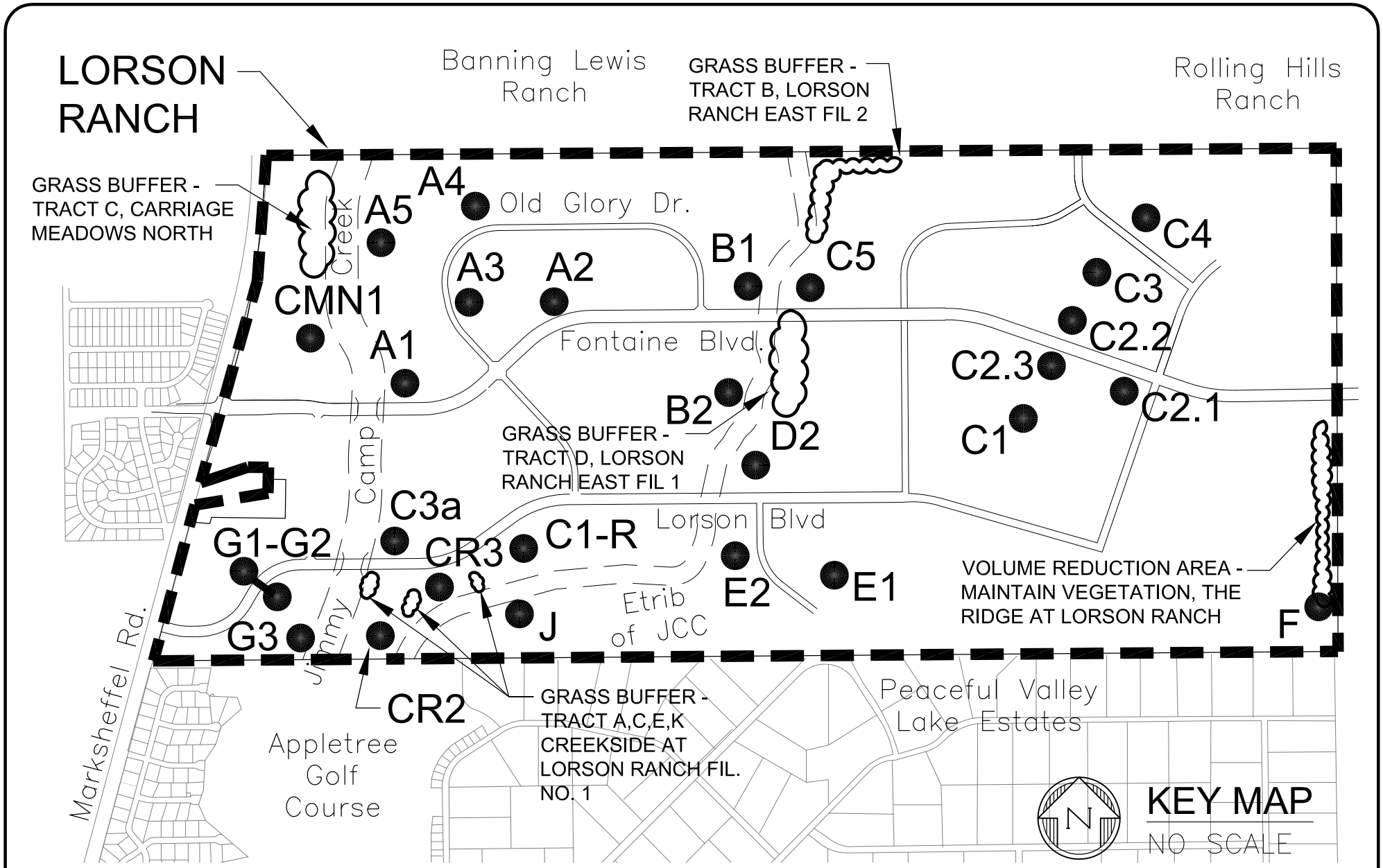
No specific operating instructions are required.

4.0 Maintenance

4.1 Maintenance of the Water Quality Ponds shall be in accordance with the guidelines included in Table EDB-1, attached.

4.2 Maintenance of Grass Buffers shall be in accordance with the guidelines included in the appendix

4.3 Maintenance of the Sand Filter Basins shall be in accordance with the guidelines included in Appendix A, attached.



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LORSON RANCH DETENTION POND and GRASS BUFFER LOCATION MAP

SCALE:	DATE:	FIGURE NO.
NTS	JULY, 2021	--

Appendix A – Maintenance Requirements

6.0 EXTENDED DETENTION BASINS (EDB)

Extended detention basins have low to moderate maintenance requirements. Routine and nonroutine maintenance is necessary to assure performance, enhance aesthetics, and protect structural integrity. The dry basins can result in nuisance complaints if not properly designed or maintained. Bio-degradable pesticides may be required to limit insect problems. Frequent debris removal and grass-mowing can reduce aesthetic complaints. If a shallow wetland or marshy area is included, mosquito breeding and nuisance odors could occur if the water becomes stagnant. Access to critical elements of the pond (inlet, outlet, spillway, and sediment collection areas) must be provided. The basic elements of the maintenance requirements are presented in Table EDB-1.

Table EDB-1—Extended Detention Basin Maintenance Considerations

Required Action	Maintenance Objective	Frequency of Action
Lawn mowing and lawn care	Occasional mowing to limit unwanted vegetation. Maintain irrigated turf grass as 2 to 4 inches tall and nonirrigated native turf grasses at 4 to 6 inches.	Routine – Depending on aesthetic requirements.
Debris and litter removal	Remove debris and litter from the entire pond to minimize outlet clogging and improve aesthetics.	Routine – Including just before annual storm seasons (that is, April and May) and following significant rainfall events.
Erosion and sediment control	Repair and revegetate eroded areas in the basin and channels.	Nonroutine – Periodic and repair as necessary based on inspection.
Structural	Repair pond inlets, outlets, forebays, low flow channel liners, and energy dissipators whenever damage is discovered.	Nonroutine – Repair as needed based on regular inspections.

Required Action	Maintenance Objective	Frequency of Action
Inspections	Inspect basins to insure that the basin continues to function as initially intended. Examine the outlet for clogging, erosion, slumping, excessive sedimentation levels, overgrowth, embankment and spillway integrity, and damage to any structural element.	Routine – Annual inspection of hydraulic and structural facilities. Also check for obvious problems during routine maintenance visits, especially for plugging of outlets.
Nuisance control	Address odor, insects, and overgrowth issues associated with stagnant or standing water in the bottom zone.	Nonroutine – Handle as necessary per inspection or local complaints.
Sediment removal	Remove accumulated sediment from the forebay, micro-pool, and the bottom of the basin.	Nonroutine – Performed when sediment accumulation occupies 20 percent of the WQCV. This may vary considerably, but expect to do this every 10 to 20 years, as necessary per inspection if no construction activities take place in the tributary watershed. More often if they do. The forebay and the micro-pool will require more frequent cleanout than other areas of the basin, say every 1 or 2 years.

root systems are recommended. Plant selection is crucial on roofs with intense wind and light such as roofs of skyscrapers or roofs that receive reflected solar radiation from other structures. Additionally, certain portions of the roof may experience more intense sunlight and or reflected heat, requiring additional care or irrigation system adjustments.

Care of the plants on a green roof will require the most attention during the critical establishment phase. A horticultural professional should work with individuals caring for the new roof to organize schedules and routines for hand weeding, thinning, pruning, fertilizing, irrigation system scheduling and adjustments, and plant replacement. Watering and weeding are particularly important for the first two years of the green roof. For overall health of the green roof, weeds should be identified and removed early and often.

If the growing medium needs to be replaced, it should be replaced in accordance with the original design specifications, unless these specifications have been identified as a cause of poor plant growth or green roof performance. Any substitutions or adjustments to the original green roof media must be balanced carefully to meet loading limits, drainage requirements, and characteristics conducive to healthy plant growth.

When caring for plants or adjusting growing media, care should be taken to avoid use of materials likely to result in nutrient export from the green roof. For example, growing media and compost should have a low phosphorus index (P index). Appropriate plants with low fertilization requirements should be chosen. If used, fertilizer application should be minimized to levels necessary only for plant health.

6.3 Irrigation Scheduling and Maintenance

Green roofs in Colorado should be equipped with irrigation systems, even if the ultimate goal is for the plants to rely primarily on natural precipitation. Irrigation schedules should be based on the evapotranspiration (ET) requirements of the plants, the type of irrigation system used (e.g., drip or spray), and changing ET over the growing season. Irrigation systems equipped with advanced irrigation controllers based on soil moisture can help facilitate watering according to the changing water needs of the plants. If advanced systems are not used, irrigation should be manually adjusted during the growing season to replace water lost through ET. During the first two years of plant establishment, regular irrigation will likely be needed. After plant establishment, it may be possible to reduce supplemental irrigation during non-drought conditions.

Completely drain the irrigation system before the first winter freeze each year. Upon reactivation of the irrigation system in the spring, inspect all components and replace damaged parts, as needed.

7.0 Extended Detention Basins (EDBs)

EDBs have low to moderate maintenance requirements on a routine basis, but may require significant maintenance once every 15 to 25 years. Maintenance frequency depends on the amount of construction activity within the tributary watershed, the erosion control measures implemented, the size of the watershed, and the design of the facility.

7.1 Inspection

Inspect the EDB at least twice annually, observing the amount of sediment in the forebay and checking for debris at the outlet structure.

7.2 Debris and Litter Removal

Remove debris and litter from the detention area as required to minimize clogging of the outlet.

7.3 Mowing and Plant Care

When starting from seed, mow native/drought tolerant grasses only when required to deter weeds during the first three years. Following this period, mowing of native/drought tolerant grass may stop or be reduced to maintain a height of no less than 6 inches (higher mowing heights are associated with deeper roots and greater drought tolerance). In general, mowing should be done as needed to maintain appropriate height and control weeds. Mowing of manicured grasses may vary from as frequently as weekly during the summer, to no mowing during the winter. See Section 4 of this chapter for additional recommendations from the CSU Extension.

7.4 Aeration

For EDBs with manicured grass, aeration will supply the soil and roots with air and increase infiltration. It reduces soil compaction and helps control thatch while helping water move into the root zone. Aeration is done by punching holes in the ground using an aerator with hollow punches that pull the soil cores or "plugs" from the ground. Holes should be at least 2 inches deep and no more than 4 inches apart.

Aeration should be performed at least once per year when the ground is not frozen. Water the turf thoroughly prior to aeration. Mark sprinkler heads and shallow utilities such as irrigation lines and cable TV lines to ensure those lines will not be damaged. Avoid aerating in extremely hot and dry conditions. Heavy traffic areas may require aeration more frequently.

7.5 Mosquito Control

Although the design provided in this manual implements practices specifically developed to deter mosquito breeding, some level of mosquito control may be necessary if the BMP is located in close proximity to outdoor amenities. The most effective mosquito control programs include weekly inspection for signs of mosquito breeding with treatment provided when breeding is found. These inspections can be performed by a mosquito control service and typically start in mid-May and extend to mid-September. Treatment should be targeted toward mosquito larvae. Mosquitoes are more difficult to control when they are adults. This typically requires neighborhood fogging with an insecticide.

The use of larvicidal briquettes or "dunks" may be appropriate. These are typically effective for about one month and perform best when the basin has a hard bottom (e.g., concrete lined micropool).

Facts on Mosquito Breeding

Although mosquitoes prefer shallow, stagnant water, they can breed within the top 6 to 8 inches of deeper pools.

Mosquitoes need nutrients and prefer shelter from direct sunlight.

Mosquitoes can go from egg to adult within 72 hours.

The most common mosquitoes in Colorado include the *Aedes Vexans* and the *Culex Tarsalis*. Both have similar needs for breeding and development.

7.6 Irrigation Scheduling and Maintenance

Adjust irrigation throughout the growing season to provide the proper irrigation application rate to maintain healthy vegetation. Less irrigation is typically needed in early summer and fall, with more irrigation needed during July and August. Native grass and other drought tolerant plantings should not require irrigation after establishment.

Check for broken sprinkler heads and repair them, as needed. Completely drain the irrigation system before the first winter freeze each year. Upon reactivation of the irrigation system in the spring, inspect all components and replace damaged parts, as needed.

7.7 Sediment Removal from the Forebay, Trickle Channel, and Micropool

Remove sediment from the forebay and trickle channel annually. If portions of the watershed are not developed or if roadway or landscaping projects are taking place in the watershed, the required frequency of sediment removal in the forebay may be as often as after each storm event. The forebay should be maintained in such a way that it does not provide a significant source of resuspended sediment in the stormwater runoff.

Sediment removal from the micropool is required about once every one to four years, and should occur when the depth of the pool has been reduced to approximately 18 inches. Small micropools may be vacuumed and larger pools may need to be pumped in order to remove all sediment from the micropool bottom. Removing sediment from the micropool will benefit mosquito control. Ensure that the sediment is disposed of properly and not placed elsewhere in the basin.

7.8 Sediment Removal from the Basin Bottom

Remove sediment from the bottom of the basin when accumulated sediment occupies about 20% of the water quality design volume or when sediment accumulation results in poor drainage within the basin. The required frequency may be every 15 to 25 years or more frequently in basins where construction activities are occurring.

7.9 Erosion and Structural Repairs

Repair basin inlets, outlets, trickle channels, and all other structural components required for the basin to operate as intended. Repair and vegetate eroded areas as needed following inspection.

8.0 Sand Filters

Sand filters have relatively low routine maintenance requirements. Maintenance frequency depends on pollutant loads in runoff, the amount of construction activity within the tributary watershed, the erosion control measures implemented, the size of the watershed, and the design of the facility.

8.1 Inspection

Inspect the detention area once or twice annually following precipitation events to determine if the sand filter is providing acceptable infiltration. Also check for erosion and repair as necessary.

8.2 Debris and Litter Removal

Remove debris and litter from detention area to minimize clogging of the media. Remove debris and litter from the overflow structure.

8.3 Filter Surface Maintenance

Scarify the top 2 inches of sand on the surface of the filter. This may be required once every two to five years depending on observed drain times. After this has been done two or three times, replenish the top few inches of the filter with clean coarse sand (AASHTO C-33 or CDOT Class C filter material) to the original elevation. Maintain a minimum sand depth of 12 inches. Eventually, the entire sand layer may require replacement.

8.4 Erosion and Structural Repairs

Repair basin inlets, outlets, and all other structural components required for the BMP to operate as intended. Repair and vegetate any eroded side slopes as needed following inspection.

9.0 Retention Ponds and Constructed Wetland Ponds

9.1 Inspection

Inspect the pond at least annually. Note the amount of sediment in the forebay and look for debris at the outlet structure.

9.2 Debris and Litter Removal

Remove debris and litter from the pond as needed. This includes floating debris that could clog the outlet or overflow structure.

9.3 Aquatic Plant Harvesting

Harvesting plants will permanently remove nutrients from the system, although removal of vegetation can also resuspend sediment and leave areas susceptible to erosion. Additionally, the plants growing on the safety wetland bench of a retention pond help prevent drowning accidents by demarking the pond boundary and creating a visual barrier. For this reason, UDFCD does not recommend harvesting vegetation completely as routine maintenance. However, aquatic plant harvesting can be performed if desired to maintain volume or eliminate nuisances related to overgrowth of vegetation. When this is the case, perform this activity during the dry season (November to February). This can be performed manually or with specialized machinery.

If a reduction in cattails is desired, harvest them annually, especially in areas of new growth. Cut them at the base of the plant just below the waterline, or slowly pull the shoot out from the base. Cattail removal should be done during late summer to deprive the roots of food and reduce their ability to survive winter.

4.0 Grass Buffers and Swales

Grass buffers and swales require maintenance of the turf cover and repair of rill or gully development. Healthy vegetation can often be maintained without using fertilizers because runoff from lawns and other areas contains the needed nutrients. Periodically inspecting the vegetation over the first few years will help to identify emerging problems and help to plan for long-term restorative maintenance needs. This section presents a summary of specific maintenance requirements and a suggested frequency of action.

Photograph 6-2. A lack of sediment removal in this grass swale has resulted in a grade change due to growth over the deposition and ponding upstream.

4.1 Inspection

Inspect vegetation at least twice annually for uniform cover and traffic impacts. Check for sediment accumulation and rill and gully development.

4.2 Debris and Litter Removal

Remove litter and debris to prevent rill and gully development from preferential flow paths around accumulated debris, enhance aesthetics, and prevent floatables from being washed offsite. This should be done as needed based on inspection, but no less than two times per year.

4.3 Aeration

Aerating manicured grass will supply the soil and roots with air. It reduces soil compaction and helps control thatch while helping water move into the root zone. Aeration is done by punching holes in the ground using an aerator with hollow punches that pull the soil cores or "plugs" from the ground. Holes should be at least 2 inches deep and no more than 4 inches apart.

Aeration should be performed at least once per year when the ground is not frozen. Water the turf thoroughly prior to aeration. Mark sprinkler heads and shallow utilities such as irrigation lines and cable TV lines to ensure those lines will not be damaged. Avoid aerating in extremely hot and dry conditions. Heavy traffic areas may require aeration more frequently.

4.4 Mowing

When starting from seed, mow native/drought-tolerant grasses only when required to deter weeds during the first three years. Following this period, mowing of native/drought tolerant grass may stop or be reduced to maintain a length of no less than six inches. Mowing of manicured grasses may vary from as frequently as weekly during the summer, to no mowing during the winter. See the inset for additional recommendations from the CSU Extension.

4.5 Irrigation Scheduling and Maintenance

Adjust irrigation schedules throughout the growing season to provide the proper irrigation application rate to maintain healthy vegetation. Less irrigation is typically needed in early summer and fall, with more irrigation needed during July and August. Native grass should not require irrigation after establishment, except during prolonged dry periods when supplemental, temporary irrigation may aid in maintaining healthy vegetation cover. Check for broken sprinkler heads and repair them, as needed. Do not overwater. Signs of overwatering and/or broken sprinkler heads may include soggy areas and unevenly distributed areas of lush growth.

Completely drain and blowout the irrigation system before the first winter freeze each year. Upon reactivation of the irrigation system in the spring, inspect all components and replace damaged parts, as needed.

CSU Extension Recommendations for Mowing Manicured Turf (Source: T. Koski and V. Skinner, 2003)

The two most important facets of mowing are mowing height and frequency. The minimum height for any lawn is 2 inches. The preferred mowing height for all Colorado species is 2.5 to 3 inches. Mowing to less than 2 inches can result in decreased drought and heat tolerance and higher incidence of insects, diseases and weeds. Mow the lawn at the same height all year. There is no reason to mow the turf shorter in late fall.

Mow the turf often enough so no more than 1/3 of the grass height is removed at any single mowing. If your mowing height is 2 inches, mow the grass when it is 3 inches tall. You may have to mow a bluegrass or fescue lawn every three to four days during the spring when it is actively growing but only once every seven to 10 days when growth is slowed by heat, drought or cold. Buffalograss lawns may require mowing once every 10 to 20 days, depending on how much they are watered.

If weather or another factor prevents mowing at the proper time, raise the height of the mower temporarily to avoid cutting too much at one time. Cut the grass again a few days later at the normal mowing height.

4.6 Fertilizer, Herbicide, and Pesticide Application

Use the minimum amount of biodegradable nontoxic fertilizers and herbicides needed to establish and maintain dense vegetation cover that is reasonably free of weeds. Fertilizer application may be significantly reduced or eliminated by the use of mulch-mowers, as opposed to bagging and removing clippings. To keep clippings out of receiving waters, maintain a 25-foot buffer adjacent to open water areas where clippings are bagged. Hand-pull the weeds in areas with limited weed problems.

Frequency of fertilizer, herbicide, and pesticide application should be on an as-needed basis only and should decrease following establishment of vegetation. See BMP Fact Sheet S-8 in Chapter 5 for additional information. For additional information on managing vegetation in a manner that conserves water and protects water quality, see the 2008 *GreenCO Best Management Practices Manual* (www.greenco.org) for a series of Colorado-based BMP fact sheets on topics such as irrigation, plant care, and soil amendments.

4.7 Sediment Removal

Remove sediment as needed based on inspection. Frequency depends on site-specific conditions. For planning purposes, it can be estimated that 3 to 10% of the swale length or buffer interface length will require sediment removal on an annual basis.

- **For Grass Buffers**: Using a shovel, remove sediment at the interface between the impervious area and buffer.
- **For Grass Swales**: Remove accumulated sediment near culverts and in channels to maintain flow capacity. Spot replace the grass areas as necessary.

Reseed and/or patch damaged areas in buffer, sideslopes, and/or channel to maintain healthy vegetative cover. This should be conducted as needed based on inspection. Over time, and depending on pollutant loads, a portion of the buffer or swale may need to be rehabilitated due to sediment deposition. Periodic sediment removal will reduce the frequency of revegetation required. Expect turf replacement for the buffer interface area every 10 to 20 years.

5.0 Bioretention (Rain Garden or Porous Landscape Detention)

The primary maintenance objective for bioretention, also known as porous landscape detention, is to keep vegetation healthy, remove sediment and trash, and ensure that the facility is draining properly. The growing medium may need to be replaced eventually to maintain performance. This section summarizes key maintenance considerations for bioretention.

5.1 Inspection

Inspect the infiltrating surface at least twice annually following precipitation events to determine if the bioretention area is providing acceptable infiltration. Bioretention facilities are designed with a maximum depth for the WQCV of one foot and soils that will typically drain the WQCV over approximately 12 hours. If standing water persists for more than 24 hours after runoff has ceased, clogging should be further investigated and remedied. Additionally, check for erosion and repair as necessary.

5.2 Debris and Litter Removal

Remove debris and litter from the infiltrating surface to minimize clogging of the media. Remove debris and litter from the overflow structure.

5.3 Mowing and Plant Care

- **All vegetation**: Maintain healthy, weed-free vegetation. Weeds should be removed before they flower. The frequency of weeding will depend on the planting scheme and cover. When the growing media is covered with mulch or densely vegetated, less frequent weeding will be required.
- **Grasses**: When started from seed, allow time for germination and establishment of grass prior to mowing. If mowing is required during this period for weed control, it should be accomplished with hand-held string trimmers to minimize disturbance to the seedbed. After established, mow as desired or as needed for weed control. Following this period, mowing of native/drought tolerant grasses may stop or be reduced to maintain a length of no less than 6 inches. Mowing of manicured grasses may vary from as frequently as weekly during the summer, to no mowing during the winter. See Section 4.4 for additional guidance on mowing.