OPERATION AND MAINTENANCE FOR BIORETENTION

PRINCE GEORGE'S COUNTY, MARYLAND

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INDEX

OPERATION AND MAINTENANCE

The proper functioning of bioretention areas depends on their long-term maintenance. While maintenance is relatively minimal and similar to regular landscaped areas, extra care must be taken to maintain the bioretention area's pollutant removal and infiltration capacity. This is accomplished by maintaining soil structure, caring for soil invertebrates, mulching as needed, and periodic removal of debris. A Maintenance Schedule (see Insert A) has been included to provide guidance on the timing of maintenance activities for the bioretention areas.

In general, maintenance strategies should reflect a commitment to environmentally sensitive methods. Such methods typically favor physical labor over chemical applications; the use of low-toxicity, low-residue compounds; and strategies such as Integrated Pest Management.

1.0 Plant Care

1.1 Trimming, Pruning, and Thinning

Trimming and pruning of excess vegetation will occasionally be necessary. Dead, dying, diseased, or hazardous branches should be trimmed and removed as they occur. Trees and shrubs may also be pruned for shape or to maximize fruit production. Trees, shrubs, and flowers may be pinched, pruned, thinned or dead-headed during the growing season to encourage more flowering, a bushier plant, or a fresh set of leaves. Pruning of trees should occur before bud-break (usually by mid-March). Pruning of flowering shrubs should be performed immediately after the plants have finished blooming. For specific pruning instructions for particular species consult the Maryland Cooperative Extension's Home and Garden Information Center at 800-342-2507 or www.hgic.umd.edu.

1.2 Mowing

Mowing is recommended for grassed areas (e.g., dry swales) where turf grass is the only plant-type. Minimal grass height should not be shorter than 4" for turf grasses and 8" for native grasses. Mowing should be scheduled so as to maintain a neat, trim appearance. High-use areas should be mowed at a frequency of once a week during the peak growing season (late spring and early fall). However, these areas should be mowed less frequently during early spring, mid-summer and late fall when blade growth is much slower. Low-use areas should be mowed less frequently, perhaps as infrequently as once a year, as dictated by on-site needs and landowner preference. Mowing of bioretention areas is not necessary or recommended. By design, plants in bioretention areas are meant to flourish throughout the growing season, leaving dry standing stalks during the dormant months. When mowing near bioretention areas, either use a mulching blade, or point the mower away from the bioretention area. Fresh

grass clippings are high in nitrogen and should not be applied to bioretention areas, as they will compromise the facility's pollutant reduction effectiveness.

1.3 Weeding

Weeding should be limited to invasive and exotic species, which can overwhelm the desired plant community. However, native non-invasive volunteer species are often desirable, as they add to the diversity of the plant community. Weeding should occur once a week during the summer and at least once a month during the remainder of the growing season. Non-chemical methods (hand pulling and hoeing) are preferable. Chemical herbicides should be avoided. A list of invasive species is included in Insert B. For updated information on invasive species consult the Maryland Invasive Species Council at http://www.mdinvasivesp.org.

1.4 Watering

Watering is most critical during the first few weeks after planting, and less critical yet important, during the first three years after planting. During the first three years, plants should be watered whenever the soil is dry at a minimum depth of 4". After the first three years, once plants are established, watering should only be necessary during drought conditions. During drought conditions, plants should be watered a minimum of every seven to ten days.

To conserve water, reduce the potential for immediate evaporation, disease and fungal infestation, and improve the potential for infiltration, watering should be performed from sunset to sunrise, roughly from 8:00pm to 8:00am.
A general rule of thumb when monitoring plant success is: if plants wilt during the day but recover in the evening, watering is not necessary. If plants do not recover in the evening, then watering is likely to be necessary. Another rule of thumb is to stick a pencil or screwdriver about 4" into the soil. If the soil is moist at that depth, watering is not needed.

In addition, although plantings have been selected for their ability to withstand both dry and wet conditions, care should be taken to not over-water. Signs of stress associated with over-watering include: wilting of leaves or petals, yellowing of leaves, ringed spots on leaves, and soft or rotting plant base.

1.5 Fertilizing

By design, bioretention facilities are located in areas where nutrients, (especially nitrogen), are typically elevated above natural levels. Therefore, it is unlikely that soil fertilization will be necessary. Excess fertilization compromises the facility's pollutant reduction effectiveness, leads to weak plant growth, promotes disease and pest outbreaks, and inhibits soil life. If soil fertility is in doubt, call the Maryland Cooperative Extension Home and Garden Information Center at 800-342-2507 or access the their

website at www.hgic.umd.edu for information on soil testing. If fertilization is necessary, only organic fertilizers should be used. For more information, consult one of the following organic fertilizer suppliers (or a similar manufacturer): Home Harvest, tel. 800-348-4769, http://homeharvest.com (Maryland).

1.6 Pest Management

Trees and shrubs should be monitored for the appearance of, or damage to plants by pests and disease. Monitoring should occur once a week during the growing season. For identification of specific pests and diseases, and for treatment recommendations, consult the Maryland Cooperative Extension's Home and Garden Information Center at 800-342-2507 or http://www.hgic.umd.edu.

It is important to keep in mind that insects and soil microorganisms perform a vital role in maintaining soil structure. Therefore, the use of pesticides should be avoided so as not to harm beneficial organisms. An alternative to pesticide use is to adopt an Integrated Pest Management (IPM) approach. This involves reducing pests to acceptable levels using a combination of biological, physical, mechanical, cultural, and chemical controls. For more information, consult University of Maryland's IPM website at http://www.agnr.umd.edu/users/nrsl/entm/.

1.7 Plant Replacement

In the even that plant mortality occurs, dead plants should be removed and replaced with healthy new plants. When replacing a plant, place the new plant in the same location as the old plant, or as near as possible to the old location. The exception to this recommendation is if plant mortality is due to initial improper placement of the plant (i.e. in an area that is too wet or too dry) or if diseased/infected plant material was used and there is risk of persistence of the disease or fungus in the soil.
The best time to plant is in early to mid-fall or early to mid-spring. Trees can be planted as long as the soil temperature remains above 32 degrees Fahrenheit at a depth of 6". Plants should be planted as soon as possible after purchase to ensure the best chance of survival. If possible, new plants should be approximately the same size as those that are being replaced. If surrounding plants have already become well established, care may need to be given to the new plants to ensure successful growth. Use native species where possible, and avoid exotic or invasive species. See the planting list provided in Insert C for suggested species.

2.0 Infiltration Maintenance

2.1 Ponding and Drainage Problems

Bioretention facilities are designed to have water standing for up to 6 hours at a time. If this water period is routinely exceeded, the facility may not be functioning properly.

Excessive pooling of water is usually a result of clogging or blockage of the filtration

layer (in some cases, the pea gravel layer). If clogging of the pea gravel layer has occurred, use lengths of small reinforcing bar (2'-3' #4 rebar) to puncture the layer with holes every 1' on center. Another maintenance alternative is to remove the mulch layer and rake the sediment on top of the pea gravel. This will loosen some of the fine-grained sediments that may be filling the pore spaces. After raking has been conducted, the mulch layer should be returned. Care should be given to not disturb the existing, well-established plants.
In a worst -case scenario, the entire facility may need to be re-installed. If this is the case, contact the programs and Planning Division, Department of Environmental Resources for an evaluation of the facility and recommendations on how to correct the situation.

2.2 Trash and Debris Removal

Runoff flowing into bioretention facilities may carry trash and debris. Trash and debris should be removed weekly to ensure that inlets do not become blocked and to keep the area from becoming unsightly. Inspect bioretention areas after rainstorms to ensure drainage paths are free from blockages. Curb cuts in parking areas will need to periodically be cleared of accumulated sediment and debris

2.3 Composting

Plant waste (e.g., fallen branches and leaves) should be collected from paved surfaces and lawn areas and composted on site. Composted material can be used to amend the soil in mown grass areas and in tree and shrub beds, saving the cost of both waste disposal and soil amendments. Composting should be established in a location with limited public access, yet close enough for easy access by maintenance staff. Invasive plant species, weeds with ripe seed heads, diseased plants, or unshredded woody debris larger than ¼" diameter should not be composted.
Note that composted material should NOT be applied to bioretention areas.

2.4 Mulching

Mulch has many benefits: it reduces competition by grass roots with tree and plant roots; controls weeds; prevents and reduces soil compaction; preserves soil moisture; and discourages potentially injurious practices like mowing and string trimming near tree trunks or woody stems. Bioretention areas should receive a protective layer of mulch over root areas, similar to that provided by leaf litter in a natural forest. Mulch layers should not exceed 3" in depth around trees and shrubs, and should be limited to 1-2" in depth around perennials. Avoid blocking inflow entrance points with mounded mulch or raised plantings. To avoid bark rot and subsequent infestation by pests, mulch should

not be mounded around the base of woody plants. Mulch material should be re-applied once every 6 months during the first three growing seasons. The use of aged mulch is

recommended and should consist of the shredded type rather than the chip type, to minimize floating. The mulch materials placed in the facility will decompose and blend with the soil medium over time. Once a full groundcover is established, mulching may not be necessary.

The following materials may be used as mulch in bioretention areas:

- Shredded bark mulch
- Decayed grass clippings
- Buckwheat
- Pine needles
- Cocoa shells
- Shredded leaf mold
- Compost

The following materials should NOT be used as mulch in bioretention areas:

- Fresh grass clippings
- Animal waste

2.5 Pet Waste Removal

Pet waste should not be left to decay in bioretention facilities because of the danger of disease-causing organisms.

2.6 Snow Removal

Plowed or shoveled snow piles should not block inlet structures or be placed in bioretention areas.
Note that snow removal is NOT recommended in bioretention areas.

2.7 De-icing

When de-icing compounds are necessary for roads and walkways, the least harmful chemicals should be used. Chemicals should be evaluated for their potential to damage vegetation (evidenced by foliage burn on grass at the edge of pavements, stunted perennial growth, and deformed buds on trees and shrubs); metals (corrosion and accelerated rusting of railings, furniture, grates, and drains); and hardscapes (scaling or flaking of surface layers of concrete). Environmentally friendly ice control agents are available that has been shown to have fewer adverse effects on pavement, infrastructure, vehicles, and plants. For example, calcium magnesium acetate (CMA) can be used as an alternative to salt in environmentally sensitive areas. Although CMA is environmentally friendly, it is effective only to 21 degrees Fahrenheit (-6 degrees Celsius) and has a higher cost than conventional chemicals. Other anti-icing agents that prevent the formation of ice are also available. Ice Ban,

(http://www.cerf.org/about/press/10_27_99.htm) for example, is made from agricultural

residues and is considered to be environmentally friendly.
Abrasives such as sand and gravel are frequently used alone or in conjunction with salt to provide traction on slippery surfaces. Use of large amounts of sand and gravel should be avoided, however, since they may obstruct waterway conveyance systems. Ice removal is NOT recommended in bioretention areas.

3.0 Other Sources of Bioretention Maintenance

For additional sources on bioretention maintenance and operation issues, see Chapter 5, Environmental Outreach and Appendix A, Bioretention Guidelines.

4.0 References

1. How Does Your Garden Grow? - A Reference Guide to Enhancing Your Rain Garden, Prince George's County Department of Environmental Resources
2. Bioretention Yahoo! Discussion Group - http://groups.yahoo.com/group/bioretention/

INSERT A

Maintenance Schedule for Bioretention Areas

1.0 Plant Care		Spring			Summer			Fall			Winter		
1.1	Trimming, Pruning, & Thinning												
1.2	Mowing												
1.3	Weeding												
1.4	Watering (estab. & drought)												
1.5	Fertilizing												
1.6	Pest Management												
1.7	Plant Replacement												
2.0 Infiltration Maintenance		**Spring**			**Summer**			**Fall**			**Winter**		
2.1	Ponding and Drainage												
2.2	Trash and Debris Removal												
2.3	Composting												
2.4	Mulching												
2.5	Pet Waste Removal												
2.6	Snow Removal												
2.7	De-Icing												

	Required
	Required at low frequency
	Required as necessary

INSERT B

INVASIVE PLANT SPECIES OF CONCERN IN PRINCE GEORGE'S COUNTY, MD

TAXON	COMMON NAME	DESCRIPTION
Acer platanoides	Norway Maple	Tree that escapes from cultivation, invades open fields, meadows and woods where it forms thickets, very prolific seeder
Ailanthus altissima	Tree of Heaven	Tree that spreads clonally over large areas, will freely seed, very difficult to control
Alliaria petiolata	Garlic Mustard	Herbaceous biennial that overtakes floodplain flora and mesic uplands, very adaptable to shady forests
Allium vineale	Wild Garlic	Perennial bulb that invades lawns, fields, and meadows, subject to state quarantines
Ampelopsis brevipedunculata	Porcelain Berry	Woody vine, well established in a variety of habitats, introduced as a cultivated plant, berries spread by birds and other wildlife
Artemisia vulgaris	Mugwort	Herbaceous perennial that escapes from fields, roadsides and waste places into native habitats
Berberis thunbergii	Japanese Barberry	Shrub, well established in woodlands and forests, introduced as a cultivated plant, seeds spread by birds and other wildlife
Carduus acanthoides	Plumeless Thistle	Herbaceous biennial that invades roadsides, pastures, and open native habitats, seeds dispersed by wind and wildlife
Carduus nutans	Musk Thistle	Herbaceous biennial that invades roadsides, pastures and open native habitats, hybridizes with plumeless thistle
Celastrus orbiculatus	Oriental Bittersweet	Woody vine established in woodlands and forests, introduced as a cultivated plant, berries dispersed by birds and other wildlife
Centaurea maculosa	Spotted Knapweed	Herbaceous perennial that escapes from fields and roadsides into native habitats
Cirsium arvense	Canada Thistle	Herbaceous perennial that invades fields and pastures, establishes clonal colonies, seeds distributed by wind and wildlife
Cirsium vulgare	Bull Thistle	Herbaceous biennial that escapes from fields and roadsides into native open habitats, seeds distributed by wildlife
Elaeagnus umbellate	Autumn Olive	Shrub that invades a variety of native habitats from grassland to forest, introduced as a cultivated plant, berries distributed by wildlife
Hedera helix	English Ivy	Woody vine that invades forests and woodlands, introduced as a cultivated plant, berries distributed by birds and other wildlife
Hemerocallis fulva	Daylily	Herbaceous perennial that invades a variety of native habitats, introduced as a cultivated plant
Humulus japonicus	Japanese Hops	Annual vine, introduced as a cultivated plant
Lonicera japonica	Japanese Honeysuckle	Woody vine that invades a variety of habitats, introduced as a cultivated plant
Lonicera maackii	Amur Honeysuckle	Shrub that invades a variety of habitats, introduced as a cultivated plant, fruit is dispersed by birds and other wildlife

INVASIVE PLANT SPECIES OF CONCERN IN PRINCE GEORGE'S COUNTY, MD
Cont.

TAXON	COMMON NAME	DESCRIPTION
Lonicera morrowi	Morrow's Honeysuckle	Shrub that invades a variety of habitats, introduced as a cultivated plant, fruit is dispersed by birds and other wildlife
Lonicera tatarica	Tartarian Honeysuckle	Shrub that invades a variety of habitats, introduced as a cultivated plant, fruit is dispersed by birds and other wildlife
Lythrum salicaria	Purple Loosestrife	Herbaceous perennial that overtakes native wetlands, prolific seeder, biological control organisms available
Microstegium vimineum	Japanese Stiltgrass	Herbaceous annual rapidly expanding into numerous native habitats, shade-tolerant
Miscanthus sinensis	Eulalia Herbaceous	Perennial grass widely grown in nursery trade, early flowering cultivars have viable seed and are spreading to roadsides
Perilla frutescens	Perilla	Herbaceous annual that invades a variety of habitats, introduced as a cultivated plant, used medicinally
Phragmites australis	Phragmites	Herbaceous perennial that overtakes wetland ecosystems, forms large colonies
Polygonum cuspidatum	Japanese Knotweed	Herbaceous perennial that invades a variety of habitats, forms large colonies, introduced as a cultivated plant
Polygonum perfoliatum	Mile-a-minute	Annual thorny vine that rapidly overtakes shrubs and trees, seeds dispersed by water
Pueraria montana var.*lobata*	Kudzu	Woody vine that rapidly overtakes shrubs and trees
Ranunculus ficaria	Lesser Celandine	Herbaceous perennial that overtakes native floodplain flora, difficult to control due to persistent underground tubers
Sorghum bicolor	Shattercane	Annual grass that invades agricultural and natural ecosystems
Sorghum halepense	Johnsongrass	Perennial grass that invades agricultural and natural ecosystems
Rosa multiflora	Multiflora Rose	Shrub that overtakes a variety of open and semi-open habitats, fruits dispersed by birds and other wildlife

Excerpted from "Invasive Species of Concern in Maryland", Maryland Invasive Species Council (http://www.mdinvasivesp.org)

INSERT C

RECOMMENDED PLANT SPECIES FOR PRINCE GEORGE'S COUNTY, MD

Canopy Trees

Acer rubrum	Red Maple
Diospyros virginiana	Persimmon
Fraxinus pennsylvanica	Green Ash
Liquidambar styraciflua	Sweetgum
Nyssa sylvatica	Black gum
Quercus alba	White Oak
Quercus palustris	Pin Oak
Quercus rubra	Northern Red Oak

Understory Trees

Amelanchier canadensis	Serviceberry
Asimina triloba	Paw Paw
Betula nigra	River Birch
Carpinus caroliniana	Hornbeam
Cercis Canadensis	Redbud
Crataegus viridis	Green Hawthorne
Hamamelis virginiana	Witch Hazel

Shrubs

Aronia melanocarpa	Black Chokecherry
Comptonia peregrina	Sweet Fern
Ilex glabra	Inkberry
Leucothoe axillaris	Coastal Leucothoe
Lindera benzoin	Spicebush
Kalmia latifolia	Mountain Laurel
Myrica cerifera	Wax Myrtle
Rhododendron caroliniana	Carolina Rhododendron
Rhododendron roseum	Roseshell Azalea
Vaccinium angustifolium	Low-Bush Blueberry
Vaccinium corymbosum	High-Bush Blueberry
Viburnum acerifolium	Maple-Leaf Viburnum

Ferns

Osmunda claytonia	Interrupted Fern
Polystichum acrostichoides	Christmas Fern
Thelypteris kunthii	Southern Shield Fern

Understory Plug Mix

Aquilegia canadensis	Columbine
Asarum canadense	Wild Ginger
Chrysogonum virginianum var. australe	Southern Green-and-Gold
Elymus hystrix	Bottlebrush Grass
Gaultheria procumbens	Wintergreen
Geranium maculatum	Cranesbill Geranium
Heuchera americana	Alum Root
Phlox divaricata	Blue Woodland Phlox
Polygonatum biflorum	Solomon's Seal
Saxifraga virginiensis	Early Saxifrage
Sedum ternatum	Mountain Stonecrop