

SPRING 2026

WMATA Bioswale Planting



COURSE

PLSC452: Environmental Agriculture

PALS

An initiative of the National Center for Smart Growth

Kathryn Howell, NCSG Executive Director

Michelle Kokolis, PALS Director



Partnership for
Action Learning
in Sustainability



AUTHORS

Ian Bartlett, Abigail Butina, Jason Hipp, Leyu Kalkidan, Nick Mobbille, Hess Morgan, Corinne Quaerna

UNDER THE SUPERVISION OF

Dr. Diana Cochran

ACKNOWLEDGMENTS

Emily Judson, RA, Senior Program Coordinator

ABOUT PALS

The Partnership for Action Learning in Sustainability (PALS) is administered by the National Center for Smart Growth at the University of Maryland, College Park (UMD). It is a campus-wide initiative that harnesses the expertise of UMD faculty and the energy and ingenuity of UMD students to help Maryland communities become more environmentally, economically, and socially sustainable. PALS is designed to provide innovative, low-cost assistance to local governments while creating real-world problem-solving experiences for University of Maryland graduate and undergraduate students.

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EXECUTIVE SUMMARY

We partnered with the Washington Metropolitan Area Transport Authority (WMATA) to design and implement two plantings for stormwater management in their bioretention ponds at the Landover Bus Division. The previously built bioretention ponds needed to be refreshed with new plantings. To address this, the class divided into two groups, each focusing on one pond, and submitted initial designs and plant lists for feedback. After two revision rounds, final designs that prioritized accessibility, biodiversity, and aesthetic appeal were selected and installed. Additionally, a maintenance guide was developed, including essential information, recommended maintenance schedules, and plant health tips, to assist WMATA in caring for these plantings and to support future projects.

ICON KEY

Scientific name		Common name			Picture Holder
Zones:	↑ H	← W →	N		
 		  	 R		
   	 Bloom Time		 R		
	Level (low, medium)	Type of Maintenance	Maintenance Time		
Comments:					



Tree



Evergreen Shrub



Deciduous Shrub



Perennial Grass



Herbaceous Perennials

N- Native

NN- Nonnative



Full Sun



Partial Sun



Shade



Can be planted on slope/ or used for erosion control

NR- Not recommended to be planted on slope



Tolerates full inundation



Tolerates occasional inundation



Tolerates moist soil with no inundation



Fall color: R= red, Y= yellow, G= Green, P= Purple, T= Tan, O= orange



Bee attractant



Bird attractant



Butterfly attractant



Other Insect Attractant



Flowering Time



Flower Color: R= red, Y= yellow G= green, P= purple Pi= pink, W= white, B= blue, O= orange



Maintenance Information: Low, Medium, High

Low: Maintenance once a year

Medium: Twice a year

High: Three or more times a year



Height



Width

Comments: additional information as needed (pests issues, environmental tolerance, soil requirements, etc.)

PLANT SELECTION

DECIDUOUS TREES

<i>Acer rubrum</i>		Red maple		
Zones: 3-9	 40-70'	 30-50' 	N 	
 		  	 R	
 		 March- April		 R
	Low	Branch pruning	Winter	
Comments: Needs acidic soil				

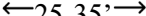


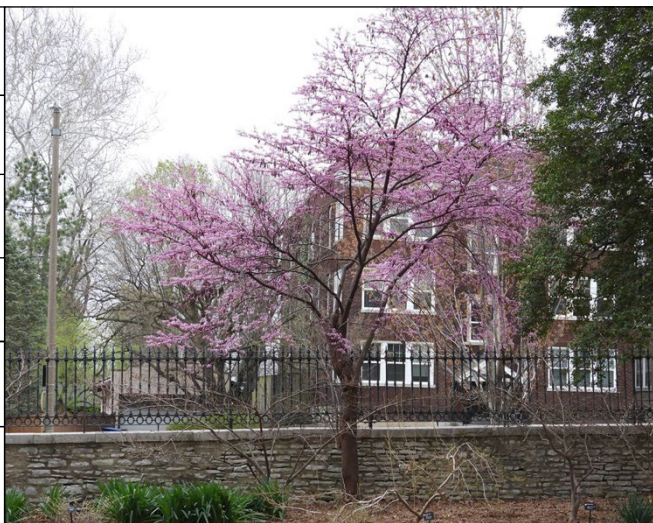
Amelanchier canadensis		serviceberry		
Zones: 4-8	 25-30'	←15-20'→	N	
 		 	 O	
   		 April- May		 W
	Low	Prune suckers and dead		Late winter
Comments: One inch of water per week during establishment year.				



<i>Celtis occidentalis</i>		hackberry		
Zones: 2-9	 40-60'	 40-60' 		N
 		 		 Y
 		 April-May		 G
	Low	Structural pruning	Late Winter	
Comments: Hackberry nipple gall, powdery mildew, scale, and lacebugs can be a problem.				



<i>Cercis canadensis</i>		Eastern redbud		
Zones: 4-8	 20-30'	 25-35' →	N	
 			 Y	
		 April		 P
 Low	Branch Pruning		Winter - early-spring	
Comments: Canker can be a serious disease. Deer tolerant.				



<i>Chionanthus virginicus</i>		fringe tree		
Zones: 3-9	 12-20'	 12-20' →	N	
 			 Y	
		 May-June		 W
 Low	Water during establishment		First 1-2 years or droughts	
Comments: Dioecious with male flowers being showier than female. Acidic soils.				



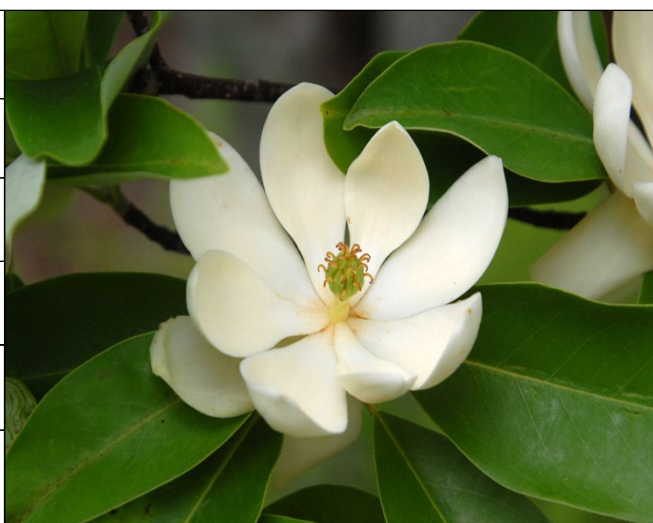
<i>Gordonia lasianthus</i>		Loblolly bay		
Zones: 7-9	↑ 35-70'	←12-24'→	N	
 			 G	
 		 July- September		 W
 Low	Sanitation pruning		As needed	
Comments: Acidic soils. Can be hard to find commercially. Not drought tolerant.				



<i>Ilex opaca</i>		American holly		
Zones: 5-9	 15-30'	 10-20' 	N	
 			 G	
  		 May		 W
	Low	Deadwooding	Late winter-early spring	
Comments: Needs acidic soil. Holly leaf miner, spider mites, whitefly, scale, and leaf spot				



<i>Magnolia virginiana</i>		Sweetbay magnolia		
Zones: 5-10	 10-35'	 10-35' 	N	
 		 	 G	
		 May-June		 W
	Low	Light pruning	After flowering	
Comments: Need acidic soil. Needs water during establishment and dry periods.				



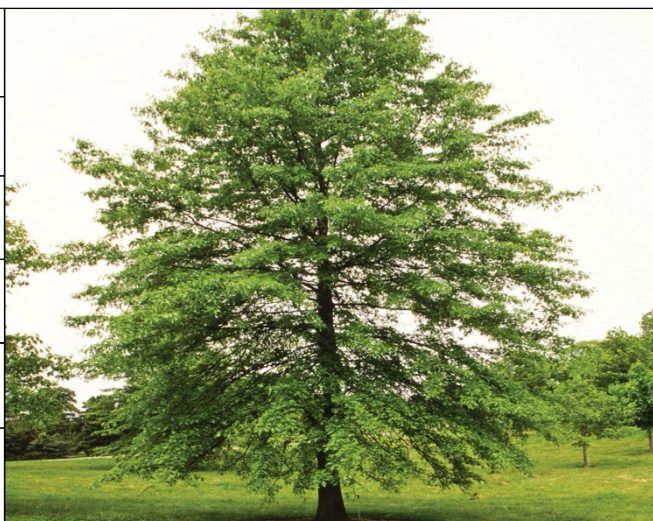
<i>Nyssa sylvatica</i>		black gum		
Zones: 3-9	 30-50'	 20-30' 	N	
		 	 O	
 		 May-June		 G
	Low	Branch Pruning	Winter	
Comments: Acidic soils.				



<i>Quercus bicolor</i>		Swamp white oak		
Zones: 3-8	↑ 50-50'	←50-60'→	N	
	NR		 Y	
		 April		 G
	Low	Branch Pruning	Late Winter	
Comments: Needs acidic soil; highly susceptible to oak wilt; deer resistant; salt tolerant.				



<i>Quercus palustris</i>		pin oak		
Zones: 4-8	↑ 50-70'	←40-60'→	N	
	NR		 R	
 		 April		 G
	Medium	Branch Pruning	Winter	
Comments: Chlorotic in acidic soils; potential for oak diseases, but not extremely susceptible.				



<i>Rhus glabra</i>		Smooth sumac		
Zones: 3-9	↑ 9-15'		←9-15'→	N
 				 R
 		 May- July		 W
	Medium	Remove suckers		Periodically
Comments: Can be weedy; moderately deer resistant; can renewal prune.				



Taxodium distichum		bald cypress		
Zones: 4-9	↑ 50-70'	←20-45'→	N	
			 O	
N/A		 N/A	N/A	
	Low	Prune dead branches	Winter/ early spring	
Comments: Will grow “knobs” around base, can be problematic for mowing. Needs acidic soil.				





Thuja occidentalis		Eastern arborvitae		
Zones: 2-7	↑ 20-40'	←10-15'→	N	
 			 G	
N/A		 N/A Conifer		N/A
	Low	Aesthetic pruning	Late winter-early spring	
Comments: Prefers neutral to alkaline soils.				





EVERGREEN SHRUBS

<i>Buxus sempervirens</i>		Common boxwood		
Zones: 5a-8b	↑ 5-10'	←5-15'→	NN	
 			N/A	
 		 March- April		 YR
	Low	Branch pruning	Late spring	
Comments: Deer resistant; shallow root system				



<i>Camellia sasanqua</i>		Sasanqua camellia		
Zones: 7a- 9b	 6-14'	←5-7'→	NN	
 			N/A	
   		 Sept.- Dec.		 P
	Medium	Sanitation pruning	Late Winter	
Comments: Neutral to acidic soils; prone to fungal diseases; salt tolerant; deer resistant.				



Ilex glabra		Inkberry holly		
Zones: 4a-11b	↑ 5-10'	← 5-8' →	NN	
 			N/A	
  		April- June		 W
	Low	Branch pruning	Late winter-early spring	
Comments: Deer resistant; Leaves may brown in extreme cold, berries are not guaranteed				



Ilex vomitoria		Yaupon holly		
Zones:7a-10b	 15-20'	 8-12'→	N	
 			N/A	
   		 April-May	 W	
	Low	Branch pruning	Late winter-early spring	
Comments: Highly salt tolerant; deer resistant; susceptible to powdery mildew; dwarf cv. available				

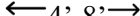


<i>Juniperus communis</i>		Common juniper		
Zones: 6a-10b	↑ 5-15'	←8-12'→	N	
 			N/A	
 		N/A Conifer		N/A
	Low	Water for establishment	First 1-2 years or drought	
Comments: Only prune tips of new growth, it does not grow back from old wood				



<i>Juniperus virginiana</i> 'Grey Owl'		Grey Owl juniper		
Zones: 4a-9b	↑ 2'-3'	←4'-6'→	N	
 			N/A	
 		N/A Conifer		N/A
	Low	Water for establishment	First 1-2 years or drought	
Comments: Only prune tips of new growth, it does not grow back from old wood				



<i>Kalmia latifolia</i>		Mountain laurel		
Zones: 4a-9b	 4-15'	 4'-8'→	N	
 			N/A	
   	 May- June		 W	
	Low	Branch pruning	Late fall- Early summer	
Comments: Poisonous if ingested ; prune after flowers fade; deer resistant				



<i>Leucothoe fontanesiana</i>		Doghobble bush		
Zones: 4a- 6b	↑ 2- 6'	← 4- 8' →	NN	
 			N/A	
 		 April- May		 W
	Low	Prune suckers and dead wood	Late spring after flowering	
Comments: Poisonous if ingested ; sensitive to heat; no major pest problem				



Myrica cerifera		Wax myrtle		
Zones: 7a-11b	↑ 10- 15'	←8- 10'→	N	
 			N/A	
   		 April- May		 Y
	Low	Branch Pruning	Late Winter	
Comments: Fast growing; salt tolerant; tolerates poor soil conditions				



<i>Myrica pensylvanica</i>		Northern bayberry		
Zones: 3a- 7a	↑ 6- 8'	←5- 10'→	N	
 			N/A	
  		 April- May		 W
	Low	Branch pruning	Late winter; early spring	
Comments: Fragrant leaves; salt tolerant; needs one male per planting				



DECIDUOUS SHRUBS

<i>Cephalanthus occidentalis</i>		Buttonbush		
Zones: 5-9	↑ 5'-12'	←4'-8'→	N	
 	Do not plant on slopes		 	 Y
  		 June-July		 W
	Low	Shaping, dead wood		Winter
Comments: Flowers are fragrant and in winter the flower heads turn into hard fruit-like structures				



<i>Cornus amomum</i>		Dogwood		
Zones: 5-8	↑ 6'-12'	← 6'-12' →	N	
 	 	 	 P	
   	 May-June		 W	
	Medium	Reduction, shaping	Late winter – early spring	
Comments: Flowers turn into attractive berry-like drupes that change from white to blue as they ripen in late summer				

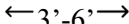


Clethra alnifolia		Sweet pepperbush		
Zones: 3-9	 3'-8'	←4'-6'→	N	
 		 	 Y	
   		 July-August		 W
	Low	Deadwood, Shape	Late winter- early spring	
Comments: Fragrant flowers, flowers turn into brown seed capsules in winter.				



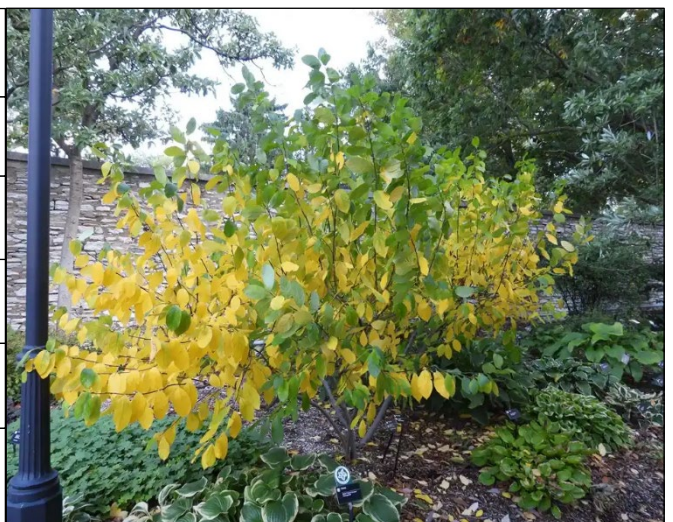
Gaylussacia frondosa		Dangleberry		
Zones: 5-9	↑ 2'-6'	← 2'-6' →	N	
 			 P	
   		 March- April		 w
	Low	Deadwood, Shape		As needed
Comments: Acidic soils				



Itea virginica		Virginia sweetspire		
Zones: 5-9	 3'-5'	 3'-6'→	N	
 			 R	
   		 May-July		 W
	Low	Shaping	After bloom	
Comments: Deer resistant				



Lindera benzoin		Spice bush		
Zones: 4-9	↑ 6'-12'	←6'-12'→	N	
 			 Y	
   		 March- April		 Y
	Low	Shaping	After flower, early spring	
Comments: Moderate to fast grower				



Physocarpus opulifolius		Ninebark		
Zones: 2-8	↑ 5'-8'	← 4'-6' →	N	
 			 Y	
   		 May-June		 W
	Medium	Deadwood, shaping	After bloom	
Comments: Exfoliating bark; grows well in a variety of soil types/conditions.				





<i>Rosa Palustris</i>		Swamp rose		
Zones: 3-9		↑ 3'-6'	← 3'-6' →	N
 				 R
   		 May-July		 P
	Low	Deadwood, Shaping	Late winter-early spring	
Comments: Flowers are highly fragrant; very thick thorny shrub.				





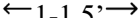
HERBACEOUS PERENNIALS

<i>Aquilegia canadensis</i>		Eastern columbine		
Zones: 3a-8b	 1-3'	 1-1.5' →	N	
 			 G	
   		 March- May		 R
	Medium	Aesthetics	June January-March	
Comments: Deer resistant; to rejuvenate the plant, mow the entire plant to the ground				



<i>Asclepias incarnata</i>		Swamp milkweed		
Zones: 3a-9b	↑ 3-5'	← 2-3' →	N	
 			 Y	
 		 July-September		 Pi
	Low	Mow/prune stems	January-March	
Comments: Deer and rabbit resistant; toxic if ingested ; prone to aphids				



<i>Asclepias tuberosa</i>		Butterflyweed		
Zones: 3a-9b	 1-2'	 1-1.5' →		N
 			 Y	
   		 May-August		 O
	Low	Mow/Prune stems		January-March
Additional Comments: Salt, deer, and rabbit tolerant; susceptible to rust and leaf spot; toxic if ingested				



<i>Chelone glabra</i>		White turtlehead		
Zones: 3a-8b	 1-3'	 1-2'	N	
 			 G	
   		 July-October		 W
	Low	Mow/Prune stems	January-March	
Comments:				



<i>Conoclinium coelestinum</i>		Blue mistflower		
Zones: 5a-10b	 1.5-3’	 1.5-3’ 		N
 				 G
  		 March- April		 B
	Medium	Mow/prune stems	April-June January-March	
Comments: Deer resistant; susceptible to powdery mildew; can become weedy; spreads easily.				



<i>Eutrochium purpureum</i>		Joe Pye weed		
Zones: 4a-9b	↑ 5-7'	← 2-4' →	N	
 			 Y	
   		 July-September		 P
	Level Low	Mow/prune stems	January-March	
Comments: Deer resistant				



<i>Helianthus angustifolius</i>		Swamp sunflower		
Zones: 5a-9b	↑ 5-8'	←2.5-4'→	N	
 			 G	
   		 July-November		 Y
	Medium	Mow/prune stems	April-June January-March	
Comments: Deer and salt resistant; susceptible to rust, fungal spots, and powdery mildew; can be weedy				

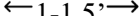


<i>Liatris spicata</i>		Blazing star		
Zones: 3a-8b	↑ 3-6'	←.25-1.5'→	N	
			 Y	
   		 July-September		 P
	Low	Mow/prune stems	January-March	
Additional Comments: Tall stalks may fall over if not staked, ‘Kobold’ is more compact				



<i>Lobelia cardinalis</i>		Cardinal flower		
Zones: 3a-9b	↑ 4-5'	← 1-2' →	N	
 			 G	
  		 July-October		 R
	Low	Mow/prune stems	January-March	
Comments: Toxic if ingested				



<i>Lobelia siphilitica</i>		Great blue lobelia		
Zones:	 1.5-4'	 1-1.5'	N	
 			 F	
  		 July-October		 B
	Low	Mow/prune stems		January-March
Comments: Deer resistant; toxic if ingested				



<i>Mertensia virginica</i>		Virginia bluebells		
Zones: 3a-9b	↑ 1.5-2'	← 1-1.5' →	N	
			N/A	
  		 March-May		 B
	Low	Dormant pruning	June	
Additional Comments: Rabbit resistant				



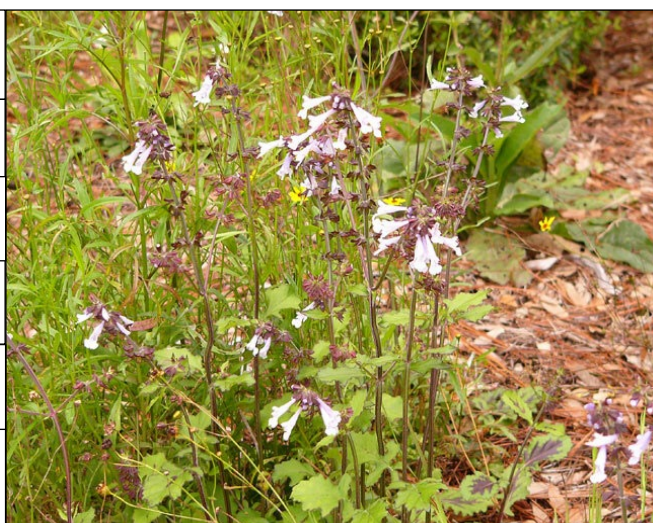
<i>Penstemon digitalis</i>		Foxglove beardtongue		
Zones: 3-8	 3-5'	 1.5-2' →	N	
			N/A	
  		 April-June		 W
	Low	Mow	End of winter or early spring	
Comments: Deer and drought resistant.				



<i>Rudbeckia hirta</i>		Black-eyed susan		
Zones: 3-7	↑ 3-7'	←1-2→	N	
			 G	
		 June-September		 Y
	Low	Mow	End of winter	
Comments: Deer resistant; susceptible to powdery mildew; self-seeding.				



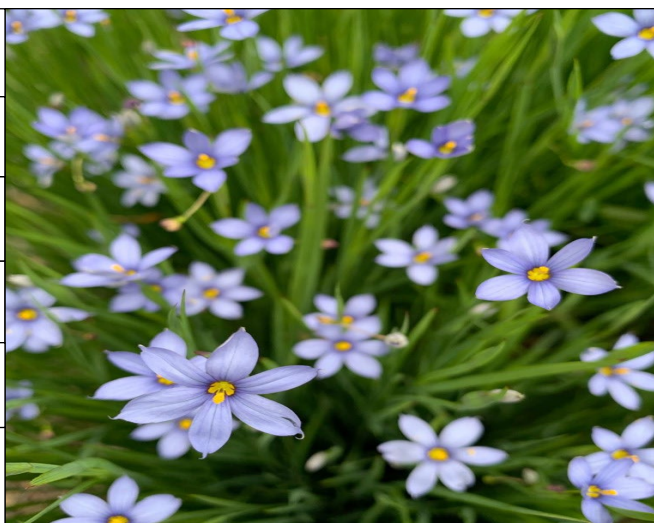
Salvia lyrata		Lyre-leaf sage		
Zones: 5-8	 1-2'	 0.75-1' →	N	
			 R	
  		 April - June		 P
	Low	Mow	After bloom/ fall	
Comments: No serious disease or insect problems				

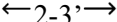


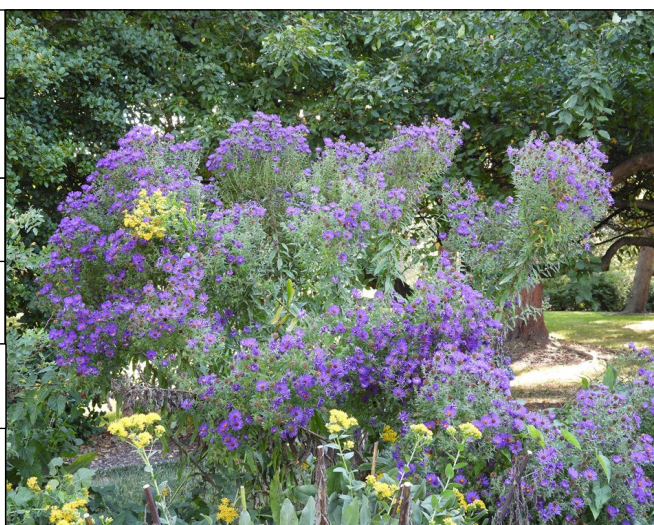
<i>Solidago drummondii</i>		Goldenrod		
Zones: 5-8	↑ 1.5-3'	←1.5→	N	
			 Y	
 		 Aug.- Sept.		 Y
	Low	Deadhead	Fall	
Comments: Clump forming; tolerates deer; rust can be an infrequent problem.				



<i>Sisyrinchium angustifolium</i>		Blue-eyed grass		
Zones: 4-9	 1.5-2’	 0.5-1’	N	
 			 G	
  		 May-June		 P
	Low	Mow to 1-2”	Fall	
Comments: No serious disease or insect issues.				



<i>Symphyotrichum novae-angliae</i>		New England Aster		
Zones: 4-8	 3-6'	 2-3'	N	
			 Y	
		 Aug.-Sept.		 P
	Low	Mow	End of winter	
Comments: Some susceptibility to powdery mildew; aster wilt can also be an occasional problem.				



Tradescantia virginiana		Spider lily		
Zones: 4-9	 1.5'-3'		N	
			 G	
  		 May-June		 P
	Low	Deadhead	Late summer/fall	
Comments: Young shoots are susceptible to snail damage.				



<i>Vernonia noveboracensis</i>		New York Ironweed		
Zones: 5-9	 4-6'	 3-4	N	
			 G	
   		 August-September		 P
	Low	Mow	End of winter	
Comments: Can self-seed; plant height may be reduced by cutting back stems in late spring.				



Viola sororia		Common blue violet		
Zones: 3-7	 0.5-0.75'	 0.5-0.75 		N
 				 G
 		 April-August		 P
	Low	Deadhead	Fall	
Comments: Self-seeding; susceptible to slugs.				



Zizia aurea		Golden Alexander		
Zones: 3-8	 1.5-3'	 1.5-2' 		N
 				 G
 		 May-June		 W
	Low	Mow	End of winter or early spring	
Comments: Under ideal conditions can aggressively self-seed.				



GRASSES AND SEDGES

<i>Andropogon gerardii</i>		big bluestem			
Zones: 5-8	↑ 5-8’	← 2 - 3’ →	N		
 			 Y		
 		 March – April	 Pi		
	Low	Mow – 4-6”	Jan - Feb		
Comments: Salt tolerant; deer resistant; Diseases: aphids, rust.					

Andropogon virginicus		broomsedge			
Zones: 5-8	↑ 2-3'	← 1 - 2' →	N		
 			 O		
 		 Sept, Oct, Nov		 W	
	Low	Mow – 4-6"	Jan - Feb		
Comments: We know this plant survived and tolerated the retention ponds at Landover Bus Division.					

<i>Carex vulpinoidea</i>		fox sedge			
Zones: 4-9	↑ 1-3'	← 1 - 3' →	N		
 			 Y		
  		 May-July		 G	
	Low	Mow – 4-6”	Jan - Feb		
Comments: Ideal for stormwater retention ponds; foliage turns yellow after frost; deer resistant.					

<i>Chasmanthium latifolium</i>		inland sea oats		
Zones: 5-9	 2-5'	 1 - 3' 	N	
 			 Y	
 		 May *		 Y
	Low	Mow – 4-6"	Jan - Feb	
Comments: Salt tolerant; self-seeder				



<i>Eragrostis spectabilis</i>		purple lovegrass		
Zones: 5-9	 8-18"	 2 - 3' 	N	
			 T	
 		 July-Aug		 P
	Low	Mow – 4-6"	Jan - Feb	
Comments: salt tolerant; good for erosion control; no serious pest problems.				



<i>Muhlenbergia capillaris</i>		pink muhlygrass		
Zones: 3-9	 2-5'	 2 - 3' 	N	
			 T	
 		 July-Aug		 Pi
	Low	Mow – 3-6"	Jan - Feb	
Comments: Good for urban environment; salt tolerant; No serious pest problems.				



<i>Panicum virgatum</i>		switchgrass		
Zones: 5-9	↑ 2-7'	← 2 - 3' →	N	
			 G	
		 July-Oct		 G
 Low	Mow – 3-6"		Jan - Feb	
Comments: Tolerates some salt; highly flammable; resistant to air pollution; deer resistant.				



Schizachyrium scoparium		little bluestem		
Zones: 3-9	 2-5'	 2 - 3' 		N
				 O
		 Sept-Oct		 P
 Low	Mow – 3-6"		Jan - Feb	
Comments: Heat & humidity tolerant; urban conditions; may flop over if soil is too rich; highly resistant to deer graze.				



<i>Sorghastrum nutans</i>		indiangrass		
Zones: 3-9	↑ 2-5'	← 2 - 3' →	N	
			 G	
		📅 Sept-Oct		 O
	Low	Mow – 4-6”		Jan - Feb
Additional Comments: Highly resistant to deer browse. No serious pests.				



<i>Spartina bakeri</i>		sand cord grass		
Zones: 6-11	↑ 3-5'	← 2 - 3' →	N	
			 G	
		 April-Oct		 O
	Low	Mow – 3-6"	Jan - Feb	
Comments: salt tolerant; highly resistant to deer. No known pests.				



<i>Sporobolus heterolepis</i>		prairie dropseed		
Zones: 3-9	 2-5'	 2 - 3' 		N
 		  		 O
  		 Sept-Oct		 Y
	Low	Mow – 4-6"	Jan - Feb	
Comments: Flowers have unique scent like buttered popcorn or hot wax; remains standing in winter; renewal prune.				



GROUNDCOVERS

<i>Asarum shuttleworthii</i>		Wild Ginger		
Zones: 6-9	↑ 0.5-0.75’	← 0.50-1’ →	NN	
			 G	
		📅 April- May		 B
	Low	Sanitation prune	February-March	
Comments: Deer-resistant and heavy shade tolerant, evergreen.				



Carex Socialis		Social Sedge		
Zones: 5-9	 0.7-1’	← 1-2’ →	NN	
			 G	
Provides habitat for pollinators		 April- May		 G
	Low	Once a year cut back	Mid- February-early March	
Comments:				



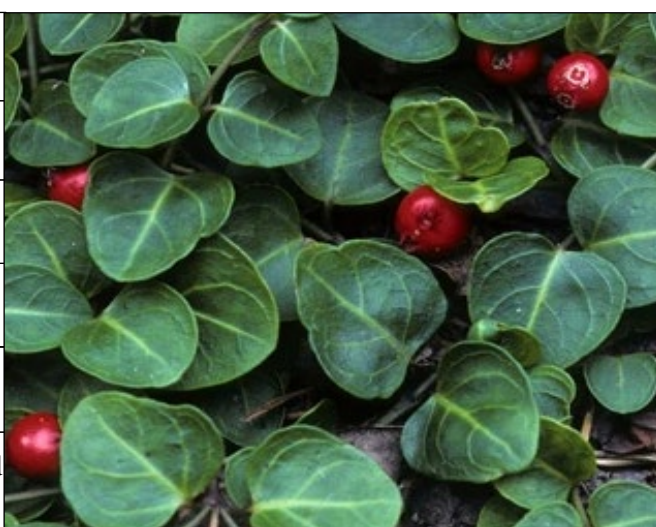
<i>Chrysogonum virginianum</i>		Golden Knee		
Zones: 5-9	 0.5-1'	 0.75-1.5'		N
				 G
   		 May- October		 Y
	Low	Cut back stems	Early March- mid April	
Comments: Pruning spent flowers and cutting back stems is optional.				



Galium odoratum		Sweet-scented Bedstraw		
Zones: 4-8	↑ 0.5-1'	← 0.75-1.5' →	NN	
			 G	
  		 April- May		 W
 Low	Mow to control growth		May-June	
Comments: Tolerates heavy shade, can spread aggressively				



<i>Mitchella repens</i>		Patridge Berry		
Zones: 3-8	 0-0.25'	 0.50-1' 	N	
			 G	
		 May- July		 W
	Low	Can prune	After May-July March-May	
Comments: produces showy red berries, evergreen and provides winter interest, does not spread quickly				



<i>Phlox stolonifera</i>		Creeping Phlox		
Zones: 5-9	↑ 0.5-1’	← 0.75-1.5’ →	NN	
 				G
   	 July- September			P
	Low	Light prune for aesthetics	Late May- mid-June	
Comments: Avoid problems with powdery mildew by cutting back stems after flowering. Foliage has skunky smell when crushed.				



<i>Phlox subulata</i>		Moss Phlox		
Zones: 3-9	 0.25-0.5'	 ← 1-2' →		N
				 G
   		 March- May		 P
	Medium	Cut back half of stems		After flowering
Comments: deer and drought-resistant, erosion control, urban conditions; several flower colors.				



<i>Sedum ternatum</i>		Three-leaved Stonecrop		
Zones: 4-8	↑ 0.25-0.5'	← 0.5-0.75' →	N	
 			 G	
  		 April- May		 W
	Low	Optional cut back	Late February-early March	
Comments: Deer, rabbit, and drought resistant; tolerant of urban conditions.				



<i>Thymus serpyllum</i>		Mother of Thyme		
Zones: 4-8	↑ 0.25'	← 0.25-1' →	NN	
			 G	
   		 June- July		 P
	Low	Cut back stems	March-April (early spring)	
Comments: Deer and drought-resistant, dislikes wet soils (rotting can occur); prune to control spread.				



Waldsteinia fragarioides		Barren Strawberry		
Zones: 4-7	↑ 0.25-0.5'	← 0.50-1' →	N	
 			 G	
 		 April- May		 Y
	Level Low	Remove old foliage	Early March- mid April	
Comments: Deer-resistant; tolerates heavy, clay soils.				





PLANT HEALTH AND CARE APPENDIX

Introduction

This document provides a simple, practical guide for maintaining the health of plants installed in the bioretention areas at the Washington Metropolitan Area Transportation Authority (WMATA) through Integrated Pest Management (IPM) strategies.

A bioretention swale is a landscaped area designed to capture and filter stormwater runoff. The plants that were selected for this project are native to the Maryland area and will help to absorb water, reduce erosion and sedimentation, improve water quality, and support beneficial insects and wildlife.

Integrated Pest Management (IPM)

Integrated Pest Management (IPM) is a sustainable approach to managing pests by combining biological, cultural, physical, and chemical tools in a way that minimizes economic, health, and environmental risks. IPM can be adapted to site-specific conditions. Many pest related issues that may affect plants within the bioretention swale areas can be effectively addressed by implementing IPM strategies.

The five primary components of IPM are:

1. Monitoring
 - a. Pest Identification
 - b. Establishing tolerance levels
2. Cultural: how plants are grown and maintained
 - a. Promoting plant health
 - b. Maintaining a clean landscape
3. Mechanical: physical activities to remove pests
 - a. Hand picking
 - b. Pruning/thinning
 - c. Spraying with water
 - d. Mulching
4. Biological: use of living organisms to manage pests
 - a. Beneficial insects
 - b. Conservation of natural predators
5. Chemical: using pesticides to control pests
 - a. Biorational pesticides
 - b. Inorganic insecticides and fungicides
 - c. Synthetic pesticides

CHART OF COMMON PESTS AND DISEASES OF SELECT PLANTS

This chart describes the common pests and diseases that the selected bioretention swale plants are susceptible to.

Common Name	Scientific Name	Type	Common Pests	Common Diseases
Fox Sedge	<i>Carex vulpinoidea</i>	Grass	Aphids, Plant bugs, Leafhoppers	Crown rot, Rust, Leaf spot
Swamp Sunflower	<i>Helianthus angustifolius</i>	Perennial	Aphids, Spider mites, Whiteflies, Scale, Sunflower moth	Rust, Powdery Mildew, Leaf spot
Wax Myrtle	<i>Myrica cerifera</i>	Shrub	Spider mites, Whiteflies, Scale, Thrips	Leaf spot, Stem canker
Woodland Stonecrop	<i>Sedum ternatum</i>	Groundcover	Aphids, slugs/snails, Spider mites, Mealybugs	Root rot, Botrytis Blight
Blue Mistflower	<i>Conoclinium coelestinum</i>	Perennial	Leafminers, Aphids	Powdery Mildew
Eastern Columbine	<i>Aquilegia canadensis</i>	Perennial	Sawflies, Leafminer, Aphids	Crown rot, Powdery Mildew
Cardinal Flower	<i>Lobelia cardinalis</i>	Perennial	Slugs/Snails, Leafhoppers, Aphids, Spider mites	Leaf spot, Rust, Botrytis Blight, Bacterial Blight, Root rot
Blue-eyed grass	<i>Sisyrinchium augustifolium</i>	Perennial	Aphids, Spider mites, Thrips, Scale	Crown rot, Rust, Powdery Mildew, Leaf spot
Switchgrass	<i>Panicum virgatum</i>	Grass	Aphids, Whiteflies, Leafhoppers, Spider mites, Japanese beetles	Rust, Leaf spot, Root/Crown rot
Inkberry Holly	<i>Ilex glabra</i> ‘Shamrock’	Shrub	Leafminers, Scale, Spider mites, Aphids, Whiteflies	Black root rot, Leaf spot, Botryosphaeria canker
Virginia Sweetspire	<i>Itea virginica</i>	Shrub	Aphids, Scale, Spider mites	Leaf spot, Blight, Canker, Root rot
Pink Muhly Grass	<i>Muhlenbergia capillaris</i>	Grass	Aphids, Mealybugs, Scale, Spider mites	Root rot, Rust
Black-eyed Susan	<i>Rudbeckia fulgida</i>	Perennial	Aphids, Leafhoppers, Spider mites, Whiteflies, Four-lined Plant bugs	Leaf spot, Downy Mildew, Powdery Mildew
Butterfly Weed	<i>Asclepias tuberosa</i>	Perennial	Aphids, Milkweed bugs/beetles	Crown/Root rot, Leaf spot, Rust

DETAILED PROFILES OF COMMON PESTS AND DISEASES

The following provides a more in-depth description of the common pests and diseases that affect the plants and shrubs that were planted in the bioretention swales.

APHIDS

Description: Adults are 1/16" – 1/8", pear-shaped and soft bodied. Their color ranges from green to brown, red and black. There are multiple generations in a year.

Damage: Adults feed on the plant sugars (Phloem) and excrete a sugary liquid called honeydew. The honeydew drips onto plant foliage and provides a suitable habitat for a black fungus called Sooty Mold to grow.



Figure 1. Close-up of a leaf infested with yellow aphids clustered along the central vein. The image highlights the extent of pest infestation, indicating potential damage to plant health. Photo by ArgoMagen.



Figure 2. Close-up of numerous small black aphids clustered on a green plant stem. The image highlights the infestation pattern and density of aphids on the plant surface. Photo by learningwithexperts.com

MEALYBUGS

Description: Adults are 1/8" long and are covered with white wax filaments (hairs). They have up to three generations a year.

Damage: Adults feed on the plant sugars (Phloem) and excrete a sugary liquid called honeydew. The honeydew drips onto plant foliage and provides a suitable habitat for a black fungus called sooty mold to grow. Terminal leaves can turn yellow and become distorted. Plant vigor is affected by high population density.



Figure 3. Muhly grass infested with mealybugs. Photo by Merle Shepard, HGIC@Clemson.edu.



Figure 4. Closeup of a muhly grass mealybug (*Stemmatomerinx acircula*) on a leaf blade. Photo by Merle Shepard, HGIC@Clemson.edu

WHITEFLIES

Description: Adults have pure white wings that are held roof-like over the abdomen. The immature stages are translucent and pale in color.

Damage: Heavy infestations will cause decline in plant vigor, yellow foliage, premature leaf drop, and stunting of growth. Adults feed on the plant sugars (Phloem) and excrete a sugary liquid called honeydew.



Figure 5. Close-up of a leaf heavily infested with whiteflies. Photo by Bugs for Growers.



Figure 6. Close-up of a whitefly. Photo by Horticulture Westland.

SOFT SCALE

Description: Adult female scale develops a waxy coating that can be white or light brown in color, oval and appear flattened in shape. They are found on the underside of leaves or along stems. The soft covers enlarge with eggs and will hatch over a period. The young scale is called crawlers. The crawlers will eventually develop a waxy coating after settling on a place to feed on the plant.

Damage: Adults feed on the plant sugars (Phloem) and excrete a sugary liquid called honeydew. The honeydew drips onto plant foliage and provides a suitable habitat for a black fungus called sooty mold to grow. Heavy infestations will cause premature leaf drop, wilting, and dieback.



Figure 7. Close-up of brown soft scale, small flattened oval shaped insects. Photo by Lesley Ingram, Bugwood.org.



Figure 8. Photograph showing a close-up of a plant stem infested with white, cotton-like scale insects clustered along its length. Photo by Wisconsin Horticulture.

JAPANESE BEETLES

Description: Adult beetles are 3/8" long with an oval metallic green body and brown wing covers. Grubs (Larval stage) are white with a brown head. Grubs live in the ground. There is one generation a year.

Damage: Beetles feed on the leaf tissue between veins leaving an outline of the network of leaf veins. This type of damage is called leaf skeletonization.



Figure 9. A close-up photograph of a green leaf heavily damaged by several small beetles, showing a lace-like pattern where the leaf tissue has been eaten away. Photo by Fairway Green, Inc.



Figure 10. Photograph of a metallic green and copper-colored beetle resting on a green leaf blade. The beetle's iridescent shell and detailed legs are clearly visible, highlighting its natural texture and coloration. Photo by North Arizona University.

SPIDER MITES

Description: Spider mites are closely related to spiders. They have eight legs, no antennae and an oval body. They are very tiny (0.4mm) long and will require hand lens to see.

Damage: Spider mite damage is called stippling. Their mouth parts pierce leaves and plant cells to remove the contents. The damage left is tiny yellow or white specks, resembling tiny pin pricks on the tops of the foliage. Heavy infestations will leave plants distorted, stunted, or killed.



(Photo by
Mlgardner)
(Photo by
Gardening

Figure 12. Close-up photo of a leaf showing signs of spider mite damage characterized by stippling (tiny yellow-white dots). Photo by Mlgardner.



SG)

Figure 11. Close-up picture of adult spider mites. Photo by Gardening SG.

LEAF MINERS

Description: Adults are 1/8" long with a dark colored hairy body and clear wings. The larva is the damaging stage of this pest. The maggots are 2mm long, legless, with a pale-yellow body. There is one generation a year.

Damage: Larvae mine the inside of the leaves in a serpentine fashion. This activity may cause leaves to yellow and prematurely drop leaves.



Figure 13. Close-up of larvae inside the leaf cavity. Photo by Missouri Botanical Garden.



Figure 14. Classic symptom of leaf minors. Serpentine trails or tunnels created by the larvae as they feed. Photo by UW-Milwaukee.

LEAFHOPPERS

Description: Adults are 1/8" – 3/16" long with a wedge-shaped elongate body. The eggs are laid just under the leaf surface along the leaf veins and twigs. Adults are winged and "hop" from plant to plant as they feed.

Damage: Adults feed on the plant sugars (Phloem) and excrete a sugary liquid called honeydew. This damage is not as significant as its distant relative, the Aphid. Heavy infestations may injure the vascular system of the plant causing "hopperburn". Leafhoppers may also transmit plant pathogens that cause diseases.



Figure 15. Close-up of Rhododendron leafhopper (*Graphocephala fennahi*) feeding on a leaf. Photo by MGK.



Figure 16. A macro capture of two adult leafhoppers on the surface of a Hibiscus leaf. Photo by J.A. Davidson, UMD.

THRIPS

Description: Adults are 1-2mm long slender body with narrow wings. The wings are held flat on their back and have fringes of hair. They can be white, yellow, black, or brown in color. There are multiple generations a year.

Damage: Some species of thrips feed only on plant pollen and do not cause plant damage. Others cause stippling damage from feeding on plant cells. Damage is primarily on blossoms and flowers and will appear as a white streak.



(Photo by UMD Extension)

(Photo by UMD Extension)

SNAILS/SLUGS

Description: Snails and slugs are nocturnal animals, only feeding at night. They are soft bodied animals without a skeletal system. They will avoid sunny, dry environments and conditions.

Damage: Snails and slugs have fine teeth that “chew” on the foliage causing irregular holes with smooth edges. Their activity can be seen by the slime trail that they leave behind. Most damage occurs during spring and fall when temperatures are cooler.



Figure 17. Hosta foliage displaying slug and snail feeding damage. Photo by Missouri Botanical Garden.

Figure 18. Close-up of slug feeding on a hosta leaf. Photo by Oregon State University.

FOUR-LINED PLANT BUGS

Description: Adults are 3/16" long, yellow body with four black stripes down the back. The nymphs look the same only smaller. There is one generation a year. Eggs overwinter in the plant shoots.

Damage: Plant damage occurs mainly in mid to late spring. The adults feed on the plant juices, leaving brown necrotic spots on the foliage. Heavy infestations can cause the entire leaf to turn brown.



Figure 19. Adult four-lined plant bug and associated foliar feeding lesions. Photo by North American Insects and Spiders.



Figure 20. Macro view of an adult four-lined plant bug. Photo by UMD Extension.

MILKWEED BUGS/BETTERLES

Description: Adults are orange and black in color with three distinct black patches surrounded by orange. A diamond-shaped patch directly behind the head, one on the forewings, and a wide black band in the middle of the body. Nymphs are dark red orange in color with black wing buds. Adults and nymphs can be found feeding on the plant in clusters.

Damage: Milkweed bugs are more of a nuisance than a threat to milkweed plants. They feed on the seeds in mid to late summer.



Figure 21. Macro presentation of *Oncopeltus fasciatus*, showing characteristic orange and black hemipteran wing patterning and prominent antennae. Photo by Monarch Guide.



Figure 22. A cluster of immature large milkweed bugs (*Oncopeltus fasciatus*) feeding on a milkweed seed pod. Photo by Focus on Natives.

CROWN ROT/ROOT ROT

Description: Both root and crown rot are soil borne diseases that kill trees and plants from the roots up through the root crown and lower trunk. Root and crown rots develop in areas where the soil is consistently wet for extended periods of time. The pathogens kill the inner bark and cause browning of the sapwood. In herbaceous perennials, the pathogens grow into the stem and collapse the stem causing the entire plant to die.

Damage: Both root and crown rot appear drought stressed. The leaves may turn a dull green or yellow color. Leaves may droop and create a “shepherd’s hook” appearance. Symptoms begin on one branch or stem and then spread to the rest of the plant. The plant decline may be in one growing season or over a period of years.



Figure 23. Exposed root system exhibiting chronic root rot and tissue necrosis. Photo by Gardener's Path.



Figure 24. Severe systemic wilting and structural collapse of foliage resulting from advanced root and crown rot. Photo by UMD Extension.

LEAF SPOT

Description: Leaf spots are caused by fungi. They develop during wet weather conditions and on susceptible plants. Leaf spots are found on leaves and can vary in size and color; however, most spots are generally brown or black, in concentric ring formation. Active leaf spots will appear to be purple in color or have a yellow-purple halo around the spot.

Damage: Leaf spot can cause leaves to yellow and premature leaf drop. Most healthy plants can withstand complete defoliation late in the season but will not be able to withstand it year after year.



Figure 25. Fungal leaf spot symptoms on the foliage of coneflower. Photo by Missouri Botanical Garden.



Figure 26. Visual documentation of epidermal blistering and tissue senescence on a cherry tree. Photo by Missouri Botanical Garden.

DOWNY MILDEW

Description: Downy Mildew is a fungal disease that affects the foliage of a plant. This pathogen is active during cool wet weather and can only grow on plant tissue inside the plant. The fungi develop into a soft, gray or brown sporulation on the underside of the leaves.

Damage: Plant foliage will be mottled yellow with angular leaf spots. Leaves may be distorted, downward cupped, stunted growth, and premature defoliation. In severe cases, this disease will kill the entire plant.



Figure 27. Cucumber foliage displaying severe angular leaf lesions indicative of a cucurbit downy mildew. Photo by WVU Extension.



Figure 28. Pronounced downy mildew sporulation visible on the underside of infected leaf tissue. Photo by IPM-UConn.

POWDERY MILDEW

Description: Spores overwinter on leaves, buds and along bark crevices. Infection begins as small fuzzy pale spots on the foliage. Prefers warm days and cool nights.

Damage: White powdery fungus grows on foliage; entire leaf may be covered. Infected foliage may be twisted and stunted.



Figure 29. Severe infection on pot marigold, illustrating the classic powder-like coating on the upper leaf surface. Photo by Swallow Tail Seeds.



Figure 30. Black-eyed Susan foliage demonstrating severe symptoms of powdery mildew infection. Photo by Univ. of Minnesota.

RUST

Description: Rusts are fungal pathogens that affect the foliage of plants. Their spores develop inside the leaf and the fungal fruiting bodies develop on the undersides of the leaf. Leaf spots first appear yellow to red orange (rust color) on the top of the leaves. Plants near infected plants will develop rust disease on its leaves.

Damage: Leaf spots may enlarge causing the leaves to shrivel and turn brown. Premature defoliation is likely on heavily affected plants.



Figure 31. Visual symptoms of rust pathogen proliferation. Photo by UMD Extension.



Figure 32. Pear tree foliage exhibiting severe symptoms of pear trellis rust. Photo by Cropaia.

BLIGHTS

Description: Blights are caused by fungal, bacterial, or virus pathogens. Blight occurs during hot and humid or cool and moist weather conditions. Blights damage the plant's ability to photosynthesize correctly, hindering growth and development.

Damage: Blights affect the plant by causing leaf spots, discoloration, distortion, wilting, and premature leaf drop. They may also damage the stems and flowers of the plant.



Figure 33. Close-up view of an advanced necrotrophic fungal infection, highlighting lesion coalescence and subsequent shot-hole epidermal tearing. Photo by Clemson University – USDA Cooperative Extension Slides Series, Bugwood.org.



Figure 34. Macro view of a stem demonstrating a severe brown lesion characteristic of late blight. Photo by The Daily Garden.

CANKERS

Description: Canker diseases can be caused either by fungal or bacterial pathogens. The pathogen enters the plant through an injury or open wound. The pathogen then spreads throughout the plant through the vascular tissue.

Damage: The pathogen will kill the vascular plant tissue causing sunken, discolored lesions on the stems. The pathogen will clog the vascular system causing disruption in nutrient flow. This will lead to plant wilting, dieback, and eventually death of the plant.



Figure 35. Close-up view of a woody stem canker, demonstrating localized cambial death. Photo by VCE Publications-Virginia Tech.



Figure 36. Pittosporum sp. foliage exhibiting severe branch wilting and desiccation. Photo by Gardenia.net.

PLANT CARE BASICS

Plants installed in bioretention areas need a baseline of care and maintenance for maximal success, establishment, and long-term health. This section outlines basic care routines that are considered best management practices for plant care.

PLANT HEALTH

Plants that are healthy and properly maintained are more resilient to environmental stress, pests, and diseases. Nutrient or water deficiencies can result in poor plant vigor and reduced flowering.

Annual soil analysis is recommended to monitor nutrient levels and make appropriate amendments. Fertilizers should be applied directly to the soil and not on top of mulch to ensure proper absorption into the root zone. Occasionally, adding organic matter as a top dressing can improve soil structure, enhance water retention, and support beneficial soil organisms. These soil organisms help break down nutrients so that they are readily available for plants.

Seasonal Expectations:

- Spring/Summer: Growth and flowering
- Fall: Color change
- Winter: Dormancy

PRUNING

Pruning plants offers numerous benefits, including promoting healthy growth, improving plant structure, and increasing flowering and fruit production. It helps remove dead, damaged, or diseased branches, reducing the risk of pests and disease. Additionally, pruning can enhance the plant's overall appearance and shape, making it more aesthetically pleasing. Regular pruning also encourages new growth and can extend the life of the plant.

Pruning Terms:

- Cane prune: remove canes after flowering to encourage growth
- Deadheading: remove spent or faded flowers from a plant to encourage continued blooming, improve appearance, and prevent seed formation
- Deadwooding: removing only dead, dying or decayed branches
- Maintenance pruning: maintain the desired shape and form of the plant
- Renewal pruning: remove one-third of the oldest canes/trunks/stems annually
- Sanitation pruning: removing only dead, diseased, or broken branches; minimal pruning requirements
- Sucker removal: remove unwanted shoots that grow from the base or roots of a plant

WATERING

Watering plants is essential for their health and growth. It helps deliver nutrients, maintain cellular functions, and support photosynthesis. Proper watering prevents wilting, encourages strong root development, and boosts overall plant vitality. Consistent and adequate watering also helps plants resist pests and diseases, ensuring they remain healthy and thriving.

Watering Recommendations:

- Water during establishment (first growing season); 1 inch of water per week
- After establishment, rely on rainfall unless there are extended periods of drought
- Avoid overwatering

ENVIRONMENTAL BENEFITS

Bioretention swales are multifunctional systems that filter stormwater runoff, removing pollutants before they reach our local waterways. By slowing and absorbing water, they help stabilize soils and reduce erosion. The diversity in the selected plants and shrubs creates habitats essential for pollinators while improving the site's aesthetics and supporting increased biodiversity.

CONCLUSION

The long-term success of the WMATA bioretention landscapes depends on a balanced approach that integrates plant health care, routine monitoring, and sustainable management practices. The plants and shrubs selected for the installation are tailored to the site's unique environmental conditions and challenges, including periodic flooding, drought stress, and urban pressures. The chosen plants and shrubs will provide both functional and ecological benefits.

By implementing the principles of Integrated Pest Management (IPM), maintenance efforts will remain proactive rather than reactive. Regularly monitoring plants for pests and diseases, and identifying them accurately, enables better decisions about health care while minimizing unnecessary treatments. Prioritizing cultural, mechanical, and biological controls before chemicals keeps management practices sustainable and proactive for beneficial organisms and ecosystem health. Proper cultural care including watering during establishment, soil management, and annual soil analysis will ensure the landscape is healthy and able to resist environmental and urban pressures.

The WMATA Bioretention landscape plays an important role in stormwater management, erosion control, and improved water quality. The plants and shrubs provide biodiversity and habitat for pollinators, beneficial insects, and enhance the visual character of the WMATA site. This document serves as a resource to support the long-term health, function, and value of the bioretention landscape.

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