

# Inspection and Maintenance Requirements for Bioretention Facilities



## Maintenance Checklist

Maintenance Component	Conditions When Maintenance is Needed	Action Needed	Satisfactory	Unsatisfactory	Comments
<b>Facility Footprint</b>					
Earthen side slopes and berms	<ul style="list-style-type: none"> <li>Erosion (gullies/ rills) greater than 2 inches deep around inlets, outlet, and alongside slopes</li> </ul>	<ul style="list-style-type: none"> <li>Eliminate cause of erosion and stabilize damaged area (regrade, rock, vegetation, erosion control matting)</li> <li>For deep channels or cuts (over 3 inches in ponding depth), temporary erosion control measures should be put in place until permanent repairs can be made.</li> <li>Properly designed, constructed and established facilities with appropriate flow velocities should not have erosion problems except perhaps in extreme events. If erosion problems persist, the following should be reassessed:                             <ol style="list-style-type: none"> <li>flow volumes from contributing areas and bioretention facility sizing;</li> <li>flow velocities and gradients within the facility; and</li> <li>flow dissipation and erosion protection strategies at the facility inlet.</li> </ol> </li> </ul>			
	<ul style="list-style-type: none"> <li>Erosion of sides causes slope to become a hazard</li> </ul>	<ul style="list-style-type: none"> <li>Take actions to eliminate the hazard and stabilize slopes</li> </ul>			
	<ul style="list-style-type: none"> <li>Settlement greater than 3 inches (relative to undisturbed sections of berm)</li> </ul>	<ul style="list-style-type: none"> <li>Restore to design height</li> </ul>			
	<ul style="list-style-type: none"> <li>Downstream face of berm wet, seeps or leaks evident</li> </ul>	<ul style="list-style-type: none"> <li>Plug any holes and compact berm (may require consultation with engineer, particularly for larger berms)</li> </ul>			

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<b>Facility Footprint (cont.)</b>					
Earthen side slopes and berms (cont.)	<ul style="list-style-type: none"> <li>Any evidence of rodent holes or water piping in berm</li> </ul>	<ul style="list-style-type: none"> <li>Eradicate rodents (see "Pest control")</li> <li>Fill holes and compact (may require consultation with engineer, particularly for larger berms)</li> </ul>			
Concrete sidewalls	<ul style="list-style-type: none"> <li>Cracks or failure of concrete sidewalls</li> </ul>	<ul style="list-style-type: none"> <li>Repair/ seal cracks</li> <li>Replace if repair is insufficient</li> </ul>			
Rockery sidewalls	<ul style="list-style-type: none"> <li>Rockery side walls are insecure</li> </ul>	<ul style="list-style-type: none"> <li>Stabilize rockery sidewalls (may require consultation with engineer, particularly for walls 4 feet or greater in height)</li> </ul>			
Facility area	<ul style="list-style-type: none"> <li>Trash and debris present</li> </ul>	<ul style="list-style-type: none"> <li>Clean out trash and debris</li> </ul>			
Facility bottom area	<ul style="list-style-type: none"> <li>Accumulated sediment to extent that infiltration rate is reduced (see "Ponded water") or surface storage capacity significantly impacted</li> </ul>	<ul style="list-style-type: none"> <li>Remove excess sediment</li> <li>Replace any vegetation damaged or destroyed by sediment accumulation and removal</li> <li>Mulch newly planted vegetation</li> <li>Identify and control the sediment source (if feasible)</li> <li>If accumulated sediment is recurrent, consider adding pre-settlement or installing berms to create a forebay at the inlet</li> </ul>			
	<ul style="list-style-type: none"> <li>Accumulated leaves in facility</li> </ul>	<ul style="list-style-type: none"> <li>Remove leaves if there is a risk to clogging outlet structure or water flow is impeded</li> </ul>			

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<b>Facility Footprint (cont.)</b>					
Low permeability check dams and weirs	<ul style="list-style-type: none"> <li>Sediment, vegetation, or debris accumulated at or blocking (or having the potential to block) check dam, flow control weir or orifice</li> </ul>	<ul style="list-style-type: none"> <li>Clear the blockage</li> </ul>			
	<ul style="list-style-type: none"> <li>Erosion and/or undercutting present</li> </ul>	<ul style="list-style-type: none"> <li>Repair and take preventative measures to prevent future erosion and/or undercutting</li> </ul>			
	<ul style="list-style-type: none"> <li>Grade board or top of weir damaged or not level</li> </ul>	<ul style="list-style-type: none"> <li>Restore to level position</li> </ul>			
Bioretention soil media	<ul style="list-style-type: none"> <li>Bioretention soil media protection is needed when performing maintenance requiring entrance into the facility footprint</li> </ul>	<ul style="list-style-type: none"> <li>Minimize all loading in the facility footprint (foot traffic and other loads) to the degree feasible in order to prevent compaction of bioretention soils.</li> <li>Never drive equipment or apply heavy loads in facility footprint.</li> <li>Because the risk of compaction is higher during saturated soil conditions, any type of loading in the cell (including foot traffic) should be minimized during wet conditions.</li> <li>Consider measures to distribute loading if heavy foot traffic is required or equipment must be placed in facility. As an example, boards may be placed across soil to distribute loads and minimize compaction.</li> <li>If compaction occurs, soil must be loosened or otherwise rehabilitated to original design state.</li> </ul>			

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<b>Facility Footprint</b>					
Ponded water	<ul style="list-style-type: none"> <li>Excessive ponding water: Water overflows during storms smaller than the design event or ponded water remains in the basin 48 hours or longer after the end of a storm.</li> </ul>	<p>Determine cause and resolve in the following order:</p> <ol style="list-style-type: none"> <li>Confirm leaf or debris buildup in the bottom of the facility is not impeding infiltration. If necessary, remove leaf litter/debris.</li> <li>Ensure that underdrain (if present) is not clogged. If necessary, clear underdrain.</li> <li>Check for other water inputs (e.g., groundwater, illicit connections).</li> <li>Verify that the facility is sized appropriately for the contributing area. Confirm that the contributing area has not increased. If steps #1-4 do not solve the problem, the bioretention soil is likely clogged by sediment accumulation at the surface or has become overly compacted. Dig a small hole to observe soil profile and identify compaction depth or clogging front to help determine the soil depth to be removed or otherwise rehabilitated (e.g., tilled). Consultation with an engineer is recommended.</li> </ol>			

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Maintenance Component	Conditions When Maintenance is Needed	Action Needed	Satisfactory	Unsatisfactory	Comments
<b>Inlets/Outlets/Pipes</b>					
Splash block inlet	<ul style="list-style-type: none"> <li>Water is not being directed properly to the facility and away from the inlet structure</li> </ul>	<ul style="list-style-type: none"> <li>Reconfigure/repair blocks to direct water to facility and away from structure</li> </ul>			
Curb cut inlet/outlet	<ul style="list-style-type: none"> <li>Accumulated leaves at curb cuts</li> </ul>	<ul style="list-style-type: none"> <li>Clear leaves (particularly important for key inlets and low points along long, linear facilities)</li> </ul>			
Pipe inlet/outlet	<ul style="list-style-type: none"> <li>Pipe is damaged</li> </ul>	<ul style="list-style-type: none"> <li>Repair/ replace</li> </ul>			
	<ul style="list-style-type: none"> <li>Pipe is clogged</li> </ul>	<ul style="list-style-type: none"> <li>Plug any holes and compact berm (may require consultation with engineer, particularly for larger berms)</li> </ul>			
	<ul style="list-style-type: none"> <li>Sediment, debris, trash, or mulch reducing capacity of inlet/outlet</li> </ul>	<ul style="list-style-type: none"> <li>Clear the blockage</li> <li>Identify the source of the blockage and take actions to prevent future blockages</li> </ul>			
	<ul style="list-style-type: none"> <li>Accumulated leaves at inlets/ outlets</li> </ul>	<ul style="list-style-type: none"> <li>Clear leaves (particularly important for key inlets and low points along long, linear facilities)</li> </ul>			
	<ul style="list-style-type: none"> <li>Maintain access for inspections</li> </ul>	<ul style="list-style-type: none"> <li>Clear vegetation (transplant vegetation when possible) within 1 foot of inlets and outlets, maintain access pathways</li> <li>Consultation with a landscape architect is recommended for removal, transplant, or substitution of plants</li> </ul>			

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Maintenance Component	Conditions When Maintenance is Needed	Action Needed	Satisfactory	Unsatisfactory	Comments
<b>Inlets/Outlets/Pipes (cont.)</b>					
Erosion control at inlet	<ul style="list-style-type: none"> <li>Concentrated flows are causing erosion</li> </ul>	<ul style="list-style-type: none"> <li>Maintain a cover of rock or cobbles or other erosion protection measure (e.g., matting) to protect the ground where concentrated water enters the facility (e.g., a pipe, curb cut or swale)</li> </ul>			
Trash rack	<ul style="list-style-type: none"> <li>Trash or other debris present on trash rack</li> </ul>	<ul style="list-style-type: none"> <li>Maintain a cover of rock or cobbles or other erosion protection measure (e.g., matting) to protect the ground where concentrated water enters the facility (e.g., a pipe, curb cut or swale)</li> </ul>			
	<ul style="list-style-type: none"> <li>Pipe is damaged</li> </ul>	<ul style="list-style-type: none"> <li>Remove/dispose</li> </ul>			
Overflow	<ul style="list-style-type: none"> <li>Capacity reduced by sediment or debris</li> </ul>	<ul style="list-style-type: none"> <li>Remove sediment or debris/dispose</li> </ul>			
Underdrain pipe	<ul style="list-style-type: none"> <li>Plant roots, sediment or debris reducing capacity of underdrain</li> <li>Prolonged surface ponding (see "Ponded water")</li> </ul>	<ul style="list-style-type: none"> <li>Jet clean or rotary cut debris/roots from underdrain(s)</li> <li>If underdrains are equipped with a flow restrictor (e.g., orifice) to attenuate flows, the orifice must be cleaned regularly.</li> </ul>			

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<b>Vegetation</b>					
Facility bottom area and upland slope vegetation	<ul style="list-style-type: none"> <li>Vegetation survival rate falls below 75% within first two years of establishment (unless project O&amp;M manual or record drawing stipulates more or less than 75% survival rate).</li> </ul>	<ul style="list-style-type: none"> <li>Determine cause of poor vegetation growth and correct condition</li> <li>Replant as necessary to obtain 75% survival rate or greater. Refer to original planting plan, or approved jurisdictional species list for appropriate plant replacements (See <i>Appendix 3 - Bioretention Plant List, in the LID Technical Guidance Manual for Puget Sound</i>).</li> <li>Confirm that plant selection is appropriate for site growing conditions</li> <li>Consultation with a landscape architect is recommended for removal, transplant, or substitution of plants</li> </ul>			
Vegetation (general)	<ul style="list-style-type: none"> <li>Presence of diseased plants and plant material</li> </ul>	<ul style="list-style-type: none"> <li>Remove any diseased plants or plant parts and dispose of in an approved location (e.g., commercial landfill) to avoid risk of spreading the disease to other plants</li> <li>Disinfect gardening tools after pruning to prevent the spread of disease</li> <li>See <i>Pacific Northwest Plant Disease Management Handbook</i> for information on disease recognition and for additional resources</li> <li>Replant as necessary according to recommendations provided for "facility bottom area and upland slope vegetation".</li> </ul>			

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## Maintenance Checklist

Maintenance Component	Conditions When Maintenance is Needed	Action Needed	Satisfactory	Unsatisfactory	Comments
<b>Vegetation (cont.)</b>					
Trees and shrubs	<ul style="list-style-type: none"> <li>Pruning as needed</li> </ul>	<ul style="list-style-type: none"> <li>Prune trees and shrubs in a manner appropriate for each species. Pruning should be performed by landscape professionals familiar with proper pruning techniques</li> <li>All pruning of mature trees should be performed by or under the direct guidance of an ISA certified arborist</li> </ul>			
	<ul style="list-style-type: none"> <li>Large trees and shrubs interfere with operation of the facility or access for maintenance</li> </ul>	<ul style="list-style-type: none"> <li>Prune trees and shrubs using most current ANSI A300 standards and ISA BMPs.</li> <li>Remove trees and shrubs, if necessary.</li> </ul>			
	<ul style="list-style-type: none"> <li>Standing dead vegetation is present</li> </ul>	<ul style="list-style-type: none"> <li>Remove standing dead vegetation</li> <li>Replace dead vegetation within 30 days of reported dead and dying plants (as practical depending on weather/planting season)</li> <li>If vegetation replacement is not feasible within 30 days, and absence of vegetation may result in erosion problems, temporary erosion control measures should be put in place immediately.</li> <li>Determine cause of dead vegetation and address issue, if possible</li> <li>If specific plants have a high mortality rate, assess the cause and replace with appropriate species. Consultation with a landscape architect is recommended.</li> </ul>			

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Maintenance Component	Conditions When Maintenance is Needed	Action Needed	Satisfactory	Unsatisfactory	Comments
<b>Vegetation (cont.)</b>					
Trees and shrubs (cont.)	<ul style="list-style-type: none"> <li>Planting beneath mature trees</li> </ul>	<ul style="list-style-type: none"> <li>When working around and below mature trees, follow the most current ANSI A300 standards and ISA BMPs to the extent practicable (e.g., take care to minimize any damage to tree roots and avoid compaction of soil).</li> <li>Planting of small shrubs or groundcovers beneath mature trees may be desirable in some cases; such plantings should use mainly plants that come as bulbs, bare root or in 4-inch pots; plants should be in no larger than 1-gallon containers.</li> </ul>			
	<ul style="list-style-type: none"> <li>Presence of or need for stakes and guys (tree growth, maturation, and support needs)</li> </ul>	<ul style="list-style-type: none"> <li>Verify location of facility liners and underdrain (if any) prior to stake installation in order to prevent liner puncture or pipe damage</li> <li>Monitor tree support systems: Repair and adjust as needed to provide support and prevent damage to tree.</li> <li>Remove tree supports (stakes, guys, etc.) after one growing season or maximum of 1 year.</li> <li>Backfill stake holes after removal.</li> </ul>			

# Inspection and Maintenance Requirements for Bioretention

## Facilities



### Maintenance Checklist

Maintenance Component	Conditions When Maintenance is Needed	Action Needed	Satisfactory	Unsatisfactory	Comments
<b>Vegetation (cont.)</b>					
Trees and shrubs adjacent to vehicle travel areas (or areas where visibility needs to be maintained)	<ul style="list-style-type: none"> <li>Vegetation causes some visibility (line of sight) or driver safety issues</li> </ul>	<ul style="list-style-type: none"> <li>Maintain appropriate height for sight clearance</li> <li>When continued, regular pruning (more than one time/ growing season) is required to maintain visual sight lines for safety or clearance along a walk or drive, consider relocating the plant to a more appropriate location.</li> <li>Remove or transplant if continual safety hazard</li> <li>Consultation with a landscape architect is recommended for removal, transplant, or substitution of plants</li> </ul>			
Flowering plants	<ul style="list-style-type: none"> <li>Dead or spent flowers present</li> </ul>	<ul style="list-style-type: none"> <li>Remove spent flowers (deadhead)</li> </ul>			
Perennials	<ul style="list-style-type: none"> <li>Spent plants</li> </ul>	<ul style="list-style-type: none"> <li>Cut back dying or dead and fallen foliage and stems</li> </ul>			
Emergent vegetation	<ul style="list-style-type: none"> <li>Vegetation compromises conveyance</li> </ul>	<ul style="list-style-type: none"> <li>Hand rake sedges and rushes with a small rake or fingers to remove dead foliage before new growth emerges in spring or earlier only if the foliage is blocking water flow (sedges and rushes do not respond well to pruning)</li> </ul>			
Ornamental grasses (perennial)	<ul style="list-style-type: none"> <li>Dead material from previous year's growing cycle or dead collapsed foliage</li> </ul>	<ul style="list-style-type: none"> <li>Leave dry foliage for winter interest</li> <li>Hand rake with a small rake or fingers to remove dead foliage back to within several inches from the soil before new growth emerges in spring or earlier if the foliage collapses and is blocking water flow</li> </ul>			

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Maintenance Component	Conditions When Maintenance is Needed	Action Needed	Satisfactory	Unsatisfactory	Comments
<b>Vegetation (cont.)</b>					
Ornamental grasses (evergreen)	<ul style="list-style-type: none"> <li>Dead growth present in spring</li> </ul>	<ul style="list-style-type: none"> <li>Hand rake with a small rake or fingers to remove dead growth before new growth emerges in spring</li> <li>Clean, rake, and comb grasses when they become too tall</li> <li>Cut back to ground or thin every 2-3 years as needed</li> </ul>			
Noxious weeds	<ul style="list-style-type: none"> <li>Listed noxious vegetation is present (refer to current county noxious weed list)</li> </ul>	<ul style="list-style-type: none"> <li>By law, class A &amp; B noxious weeds must be removed, bagged and disposed as garbage immediately</li> <li>Reasonable attempts must be made to remove and dispose of class C noxious weeds</li> <li>It is strongly encouraged that herbicides and pesticides not be used in order to protect water quality; use of herbicides and pesticides may be prohibited in some jurisdictions</li> <li>Apply mulch after weed removal (see "Mulch")</li> </ul>			
Weeds	<ul style="list-style-type: none"> <li>Weeds are present</li> </ul>	<ul style="list-style-type: none"> <li>Remove weeds with their roots manually with pincer-type weeding tools, flame weeders, or hot water weeders as appropriate</li> <li>Follow IPM protocols for weed management</li> </ul>			

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Maintenance Component	Conditions When Maintenance is Needed	Action Needed	Satisfactory	Unsatisfactory	Comments
<b>Vegetation (cont.)</b>					
Excessive vegetation	<ul style="list-style-type: none"> <li>Low-lying vegetation growing beyond facility edge onto sidewalks, paths, or street edge poses pedestrian safety hazard or may clog adjacent permeable pavement surfaces due to associated leaf litter, mulch, and soil</li> </ul>	<ul style="list-style-type: none"> <li>Edge or trim groundcovers and shrubs at facility edge</li> <li>Avoid mechanical blade-type edger and do not use edger or trimmer within 2 feet of tree trunks</li> <li>While some clippings can be left in the facility to replenish organic material in the soil, excessive leaf litter can cause surface soil clogging</li> </ul>			
	<ul style="list-style-type: none"> <li>Excessive vegetation density inhibits stormwater flow beyond design ponding or becomes a hazard for pedestrian and vehicular circulation and safety</li> </ul>	<ul style="list-style-type: none"> <li>Determine whether pruning or other routine maintenance is adequate to maintain proper plant density and aesthetics</li> <li>Determine if planting type should be replaced to avoid ongoing maintenance issues (an aggressive grower under perfect growing conditions should be transplanted to a location where it will not impact flow)</li> <li>Remove plants that are weak, broken or not true to form; replace in-kind</li> <li>Thin grass or plants impacting facility function without leaving visual holes or bare soil areas</li> <li>Consultation with a landscape architect is recommended for removal, transplant, or substitution of plants</li> </ul>			
	<ul style="list-style-type: none"> <li>Vegetation blocking curb cuts, causing excessive sediment buildup and flow bypass</li> </ul>	<ul style="list-style-type: none"> <li>Remove vegetation and sediment buildup</li> </ul>			

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<b>Mulch</b>					
Mulch	<ul style="list-style-type: none"> <li>Bare spots (without mulch cover) are present or mulch depth less than 2 inches</li> </ul>	<ul style="list-style-type: none"> <li>Supplement mulch with hand tools to a depth of 2 to 3 inches</li> <li>Replenish mulch per O&amp;M manual. Often coarse compost is used in the bottom of the facility and arborist wood chips are used on side slopes and rim (above typical water levels)</li> <li>Keep all mulch away from woody stems</li> </ul>			
<b>Watering</b>					
Irrigation system (if any)	Irrigation system present	Follow manufacturer's instructions for O&M			
	Sprinklers or drip irrigation not directed/located to properly water plants	Redirect sprinklers or move drip irrigation to desired areas			

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Maintenance Component	Conditions When Maintenance is Needed	Action Needed	Satisfactory	Unsatisfactory	Comments
<b>Watering (cont.)</b>					
Summer watering (first year)	<ul style="list-style-type: none"> <li>• Trees, shrubs and groundcovers in first year of establishment period</li> </ul>	<ul style="list-style-type: none"> <li>• 10 to 15 gallons per tree</li> <li>• 3 to 5 gallons per shrub</li> <li>• 2 gallons water per square foot for groundcover areas</li> <li>• Water deeply, but infrequently, so that the top 6 to 12 inches of the root zone is moist</li> <li>• Use soaker hoses or spot water with a shower type wand when irrigation system is not present                             <ul style="list-style-type: none"> <li>◇ Pulse water to enhance soil absorption, when feasible</li> <li>◇ Pre-moisten soil to break surface tension of dry or hydrophobic soils/mulch, followed by several more passes. With this method , each pass increases soil absorption and allows more water to infiltrate prior to runoff</li> </ul> </li> <li>• Add a tree bag or slow-release watering device (e.g., bucket with a perforated bottom) for watering newly installed trees when irrigation system is not present</li> </ul>			

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Maintenance Component	Conditions When Maintenance is Needed	Action Needed	Satisfactory	Unsatisfactory	Comments
<b>Watering (cont.)</b>					
Summer watering (second and third years)	<ul style="list-style-type: none"> <li>Trees, shrubs and groundcovers in second or third year of establishment period</li> </ul>	<ul style="list-style-type: none"> <li>10 to 15 gallons per tree</li> <li>3 to 5 gallons per shrub</li> <li>2 gallons water per square foot for groundcover areas</li> <li>Water deeply, but infrequently, so that the top 6 to 12 inches of the root zone is moist</li> <li>Use soaker hoses or spot water with a shower type wand when irrigation system is not present                             <ul style="list-style-type: none"> <li>◇ Pulse water to enhance soil absorption, when feasible</li> <li>◇ Pre-moisten soil to break surface tension of dry or hydrophobic soils/mulch, followed by several more passes. With this method , each pass increases soil absorption and allows more water to infiltrate prior to runoff</li> </ul> </li> </ul>			
Summer watering (after establishment)	<ul style="list-style-type: none"> <li>Established vegetation (after 3 years)</li> </ul>	<ul style="list-style-type: none"> <li>Plants are typically selected to be drought tolerant and not require regular watering after establishment; however, trees may take up to 5 years of watering to become fully established</li> <li>Identify trigger mechanisms for drought-stress (e.g., leaf wilt, leaf senescence, etc.) of different species and water immediately after initial signs of stress appear</li> <li>Water during drought conditions or more often if necessary to maintain plant cover</li> </ul>			

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<b>Pest Control</b>					
Mosquitoes	<ul style="list-style-type: none"> <li>Standing water remains for more than 3 days after the end of a storm</li> </ul>	<ul style="list-style-type: none"> <li>Identify the cause of the standing water and take appropriate actions to address the problem (see "Ponded water")</li> <li>To facilitate maintenance, manually remove standing water and direct to the storm drainage system (if runoff is from non pollution-generating surfaces) or sanitary sewer system (if runoff is from pollution-generating surfaces) after getting approval from sanitary sewer authority.</li> <li>Use of pesticides or <i>Bacillus thuringiensis israelensis</i> (Bti) may be considered only as a temporary measure while addressing the standing water cause. If overflow to a surface water will occur within 2 weeks after pesticide use, apply for coverage under the Aquatic Mosquito Control NPDES General Permit.</li> </ul>			

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<b>Pest Control (cont.)</b>					
Nuisance animals	<ul style="list-style-type: none"> <li>Nuisance animals causing erosion, damaging plants, or depositing large volumes of feces</li> </ul>	<ul style="list-style-type: none"> <li>Reduce site conditions that attract nuisance species where possible (e.g., plant shrubs and tall grasses to reduce open areas for geese, etc.)</li> <li>Place predator decoys</li> <li>Follow IPM protocols for specific nuisance animal issues (see "Additional Maintenance Resources" section for more information on IPM protocols)</li> <li>Remove pet waste regularly</li> <li>For public and right-of-way sites consider adding garbage cans with dog bags for picking up pet waste.</li> </ul>			
Insect pests	<ul style="list-style-type: none"> <li>Signs of pests, such as wilting leaves, chewed leaves and bark, spotting or other indicators</li> </ul>	<ul style="list-style-type: none"> <li>Reduce hiding places for pests by removing diseased and dead plants</li> <li>For infestations, follow IPM protocols</li> </ul>			