




City of Bellevue
Utilities Department

Storm and Surface Water Maintenance Standards

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CHAPTER M1 - GENERAL

M1-01 PURPOSE

These Maintenance Standards set forth the minimum standards for the maintenance of public and private storm and surface water systems. These facility specific maintenance standards are intended to be conditions for determining if maintenance actions are required as identified through inspection. They are not intended to be measures of the facility's required condition at all times between inspections. In other words, exceedance of these conditions at any time between inspections and/or maintenance does not automatically constitute a violation of these standards. However, based upon inspection observations, the inspection and maintenance schedules shall be adjusted to minimize the length of time that a facility is in a condition that requires a maintenance action.

The bases for these maintenance standards are:

- The Storm and Surface Water Utility Code, Chapter 24.06 of the Bellevue City Code, adopted by Ordinance 5905 on October 5, 2009;
- Chapter 4.6 Maintenance Standards for Drainage Facilities from Volume V – Runoff Treatment BMPs and Volume IV - Source Control BMPs of the Stormwater Management Manual for Western Washington (revised 2005), Washington State Department of Ecology
<http://www.ecy.wa.gov/programs/wq/stormwater/manual.html>;
- Natural Drainage Practices Maintenance Guidelines, May 1, 2009; Prepared by SvR Design Company for the City of Bellevue Utilities Department;
- National Pollutant Discharge Elimination System (NPDES) Western Washington Phase II Municipal Stormwater Permit issued by the Washington State Department of Ecology on January 17, 2007.

In addition to these Maintenance Standards, private drainage systems are required to have an Operations and Maintenance Manual for all flow control and treatment facilities, including on-site stormwater management facilities and constructed source controls, per the January 2010 Utilities Engineering Standards Chapter D2-09 (or as subsequently updated). Appendix M-1 contains a copy of Chapter D2-09.

M1-02 MAINTANANCE AND REPLACEMENT OF FACILITIES

All parts of the drainage system shall be maintained or replaced as required when the facility becomes or may become inoperative or as directed by the Utility Director. Responsibility for maintenance or replacement is with the Utility for Utility facilities, with the owners for private property, and with the appropriate agency and/or owner for other public properties.

M1-03 RECORDKEEPING

Private property owners shall retain records of maintenance activities for their storm and surface water system for a minimum of 5 years. These records shall be made available to the Utility upon request. The Storm and Surface Water Utility shall retain records of maintenance activities for the public storm and surface water utility system and of inspections conducted as part of the Private Drainage Inspection Program for a minimum of 5 years.

M1-04 MAINTENANCE STANDARDS ROAD MAP

Chapter M1 contains general requirements, information, and definitions. Chapter M2 contains maintenance standards for drainage facilities covered by the Ecology 2005 Stormwater Management Manual for Western Washington. Chapter M3 contains definitions and maintenance standards for natural drainage practices (NDP) which are small-scale, distributed best management practices (BMPs) that control the volume, peak flow rate, and amount of pollutants in stormwater runoff from development. These NDP best management practices include rain gardens and stormwater planters (bioretention), porous (aka pervious) pavement, vegetated roofs, rain recycling, and amended soils. Chapter M4 contains source control or preventative best management practices which apply to all storm and surface water systems. These BMPs include both operational and structural source controls which protect system function, minimize maintenance and replacement of drainage facilities and NDPs, and improve the water quality of system discharges. Following Chapter M-4 are References and Appendix M-1.

M1-05 DEFINITIONS

The following terms as used in this document are defined in accordance with the 2005 Ecology Stormwater Manual and/or the Storm and Surface Water Utility Code, Chapter 24.06, Bellevue City Code.

"Best Management Practice"

“Best Management Practice: (BMP) means those physical, structural, and/or managerial practices that, when used individually or in combination, prevent or reduce pollution of water.

"Catch Basin"

A chamber or well built for the admission of surface water to a storm drain, having at its base a sediment sump designed to retain grit and detritus below the point of overflow.

"Channel"

A feature that conveys surface water and is open to the air.

"Channel, constructed"

Channels or ditches constructed (or reconstructed natural channels) to convey surface water.

"Channel, natural"

Streams, creeks, or swales that convey surface or ground water and have existed long enough to establish a stable route and/or biological community.

"Conveyance"

A mechanism for transporting water from one point to another, including pipes, ditches, and channels.

"Flow Control Facility" or "Runoff Control BMPs" or "Detention Facility"

A drainage facility or runoff control BMPs designed to mitigate the impacts of increased surface and stormwater runoff flow rates generated by development. A few examples of flow control facilities are detention ponds, vaults, control structures, and combination wetpool facilities.

"Forebay"

An easily maintained, extra storage area provided near an inlet of a BMP to trap incoming sediments before they accumulate in a pond or wetland BMP.

"Industrial Activities"

Material handling, transportation, or storage; manufacturing; maintenance; treatment; or disposal. Areas with industrial activities include plant yards, access roads and rail lines used by carriers of raw materials, manufactured products, waste material, or by-products; material handling sites; refuse sites; sites used for the application or disposal of process waste waters; sites used for the storage and maintenance of material handling equipment; sites used for residual treatment, storage, or disposal; shipping and receiving areas; manufacturing buildings; storage areas for raw materials, and intermediate and finished products; and areas where industrial activity has taken place in the past and significant materials remain and are exposed to stormwater.

“Leachate”

Liquid that has percolated through solid waste and contains contaminants in solution or suspension.

"Maintenance"

Maintenance includes repair and maintenance activities conducted on currently serviceable structures, facilities, and equipment that involves no expansion or use beyond that previously existing and resulting in no significant adverse hydrologic impact. It includes those usual activities taken to prevent a decline, lapse, or cessation in the use of structures and systems and includes replacement of disfunctioning facilities, including cases where environmental permits require replacing an existing structure with a different type structure, as long as the functioning characteristics of the original structure are not changed. For example, removing sediments and roots from catch basins and pipes in order to restore sediment removal capability and flow capacity or replacement of a collapsed, fish-blocking round culvert with a new box culvert under the same span, or width, of roadway.

"Noxious Weed"

Opportunistic species of inferior biological value that tend to out-compete more desirable forms and become dominant; applied to non-native species in these standards. The noxious weed list established by the Noxious Weed Control Board can be found at: www.wa.gov/agr/weedboard/weed_list/weed_listhome.html.

"Native Vegetation"

Vegetation comprised of plant species, other than noxious weeds, that are indigenous to the coastal region of the Pacific Northwest and which reasonably could have been expected to naturally occur on the site. Examples include trees such as Douglas fir, Western Hemlock, Western Red Cedar, Alder, Big-leaf Maple, and Vine Maple; shrubs such as willow, elderberry, salmonberry, and salal; and herbaceous plants such as sword fern, foam flower, and fireweed.

“Ordinary High Water Line”

The mark on the shores of all waters that will be found by examining the bed and banks and ascertaining where the presence and action of waters are so common and usual and so long continued in ordinary years, as to mark upon the soil or vegetation a character distinct from that of the abutting upland. Any area where the ordinary high water line cannot be found, the ordinary high water line shall be the elevation of the mean annual flood.

"Operational Source Control BMPs"

Operational BMPs are a type of source control BMP that include schedules of activities, prohibition of practices, and other managerial practices to prevent or reduce pollutants from entering stormwater.

"Private Storm and Surface Water System" or "Private Drainage Facility"

Private system or private drainage facility means any element of the storm and surface water system which is not a part of the public drainage system as defined in Chapter 24.06, Bellevue City Code.

"Public Storm and Surface Water System" or "Public Drainage System"

Public storm and surface water system or public drainage system means those elements of the storm and surface water system maintained and operated by the utility, which includes elements located on property owned by the utility or in public right-of-way except to the extent that private ownership is indicated as a matter of record or by law and elements located on property on which the city has an easement, license, or other right of use for utility purposes.

"Sediment"

Fragmented material that originates from weathering and erosion of rocks or unconsolidated deposits, and is transported by, suspended in, or deposited by water.

"Stream"

Stream means any aquatic area where surface water produces a channel, not including a wholly artificial channel, unless the artificial channel is: (1) used by salmonids; or (2) used to convey a stream that occurred naturally before construction of the artificial channel. The definition of stream and designation thereof is set forth in Chapter 20.25, Bellevue Land Use Code.

"Storm and Surface Water System"

Storm and surface water system, also referred to as the drainage system, means the entire system within the city, both public and private, naturally existing and manmade, for the drainage, conveyance, detention, treatment or storage of storm and surface waters. However, facilities directly associated with buildings or structures such as foundation drains, rockery/retaining wall drains, gutters and downspouts or groundwater under-drains are not considered parts of the storm and surface water system.

"Structural Source Control BMPs"

Physical, structural, or mechanical devices or facilities that are intended to prevent pollutants from entering stormwater. Structural source control BMPs typically include:

Enclosing and/or covering the pollutant source (building or other enclosure, a roof over storage and working areas, temporary tarp, etc.)

Segregating the pollutant source to prevent run-on of stormwater, and to direct only contaminated stormwater to appropriate treatment BMPs.

Directing polluted water (i.e., car wash water, restaurant grease, and dumpster leachate) to sanitary sewer.

“Waters of the State” or “Receiving Waters”

Receiving Waters are waters of the state which includes lakes, rivers, ponds, streams, inland water and water courses within the jurisdiction of the State of Washington to which runoff is discharged via a point source or sheet flow.

“Water Quality Treatment Facility” or “Runoff Treatment BMPs”

A stormwater facility or BMPs intended to remove sediments and other pollutants from storm water runoff. A few examples of water quality treatment facilities are wetponds, sand filters, oil/water separators, biofiltration swales, and constructed wetlands.

CHAPTER M2 – Ecology Facility Standards

The maintenance standards in this chapter are from the Washington State Department of Ecology's 2005 Stormwater Management Manual for Western Washington (Chapter 4.6 of Volume V – Runoff Treatment BMPs).

M2-01 – Detention Ponds

Maintenance Component	Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
General	Trash & Debris	Any trash and debris which exceed 5 cubic feet per 1,000 square feet (this is about equal to the amount of trash it would take to fill up one standard size garbage can). In general, there should be no visual evidence of dumping. If less than threshold all trash and debris will be removed as part of next scheduled maintenance.	Trash and debris cleared from site.
	Poisonous Vegetation and noxious weeds	Any poisonous or nuisance vegetation which may constitute a hazard to maintenance personnel or the public. Any evidence of noxious weeds as defined by State or local regulations. (Apply requirements of adopted IPM policies for the use of herbicides).	No danger of poisonous vegetation where maintenance personnel or the public might normally be. (Coordinate with local health department) Complete eradication of noxious weeds may not be possible. Compliance with State or local eradication policies required
	Contaminants and Pollution	Any evidence of oil, gasoline contaminants or other pollutants (Coordinate removal/cleanup with local water quality response agency).	No contaminants or pollutant present.
	Rodent Holes	Any evidence of rodent holes if facility is acting as a dam or berm, or any evidence of water piping through dam or berm via rodent holes.	Rodents destroyed and dam or berm repaired. (Coordinate with local health department; coordinate with Ecology Dam Safety Office if pond exceeds 10acre-feet.)

M2-01 – Detention Ponds

Maintenance Component	Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
	Beaver Dams	Dam results in change or function of the facility.	Facility is returned to design function. (Coordinate trapping of beavers and removal of dams with appropriate permitting agencies)
	Insects	When insects such as wasps and hornets interfere with maintenance activities.	Insects destroyed or removed from site. Apply insecticides in compliance with adopted IPM policies
	Tree Growth and Hazard Trees	Tree growth does not allow maintenance access or interferes with maintenance activity (i.e., slope mowing, silt removal, vactoring, or equipment movements). If trees are not interfering with access or maintenance, do not remove. If dead, diseased, or dying trees are identified (Use a certified Arborist to determine health of tree or removal requirements)	Trees do not hinder maintenance activities. Harvested trees should be recycled into mulch or other beneficial uses (e.g., alders for firewood). Remove hazard Trees
Side Slopes of Pond	Erosion	Eroded damage over 2 inches deep where cause of damage is still present or where there is potential for continued erosion. Any erosion observed on a compacted berm embankment.	Slopes should be stabilized using appropriate erosion control measure(s); e.g., rock reinforcement, planting of grass, compaction. If erosion is occurring on compacted berms a licensed civil engineer should be consulted to resolve source of erosion.
Storage Area	Sediment	Accumulated sediment that exceeds 10% of the designed pond depth unless otherwise specified or affects inletting or outletting condition of the facility.	Sediment cleaned out to designed pond shape and depth; pond reseeded if necessary to control erosion.
	Liner (If Applicable)	Liner is visible and has more than three 1/4-inch holes in it.	Liner repaired or replaced. Liner is fully covered.

M2-01 – Detention Ponds

Maintenance Component	Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
Pond Berms (Dikes)	Settlements	Any part of berm which has settled 4 inches lower than the design elevation. If settlement is apparent, measure berm to determine amount of settlement. Settling can be an indication of more severe problems with the berm or outlet works. A licensed civil engineer should be consulted to determine the source of the settlement.	Dike is built back to the design elevation.
	Piping	Discernable water flow through pond berm. Ongoing erosion with potential for erosion to continue. (Recommend a Geotechnical engineer be called in to inspect and evaluate condition and recommend repair of condition.	Piping eliminated. Erosion potential resolved.
Emergency Overflow/ Spillway and Berms over 4 feet in height.	Tree Growth	Tree growth on emergency spillways creates blockage problems and may cause failure of the berm due to uncontrolled overtopping. Tree growth on berms over 4 feet in height may lead to piping through the berm which could lead to failure of the berm.	Trees should be removed. If root system is small (base less than 4 inches) the root system may be left in place. Otherwise the roots should be removed and the berm restored. A licensed civil engineer should be consulted for proper berm/spillway restoration.
	Piping	Discernable water flow through pond berm. Ongoing erosion with potential for erosion to continue. (Recommend a Geotechnical engineer be called in to inspect and evaluate condition and recommend repair of condition.	Piping eliminated. Erosion potential resolved.
Emergency Overflow/ Spillway	Emergency Overflow/ Spillway	Only one layer of rock exists above native soil in area five square feet or larger, or any exposure of native soil at the top of out flow path of spillway. (Rip-rap on inside slopes need not be replaced.)	Rocks and pad depth are restored to design standards.
	Erosion	See "Side Slopes of Pond"	

M2-02 - Infiltration

Maintenance Component	Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
General	Trash & Debris	See "Detention Ponds" (No. 1).	See "Detention Ponds" (No. 1).
	Poisonous/Noxious Vegetation	See "Detention Ponds" (No. 1).	See "Detention Ponds" (No. 1).
	Contaminants and Pollution	See "Detention Ponds" (No. 1).	See "Detention Ponds" (No. 1).
	Rodent Holes	See "Detention Ponds" (No. 1).	See "Detention Ponds" (No. 1).
Storage Area	Sediment	Water ponding in infiltration pond after rainfall ceases and appropriate time allowed for infiltration. (A percolation test pit or test of facility indicates facility is only working at 90% of its designed capabilities. If two inches or more sediment is present, remove).	Sediment is removed and/or facility is cleaned so that infiltration system works according to design.
Filter Bags (if applicable)	Filled with Sediment and Debris	Sediment and debris fill bag more than 1/2 full.	Filter bag is replaced or system is redesigned.
Rock Filters	Sediment and Debris	By visual inspection, little or no water flows through filter during heavy rain storms.	Gravel in rock filter is replaced.
Side Slopes of Pond	Erosion	See "Detention Ponds" (No. 1).	See "Detention Ponds" (No. 1).
Emergency Overflow Spillway and Berms over 4 feet in height.	Tree Growth	See "Detention Ponds" (No. 1).	See "Detention Ponds" (No. 1).
	Piping	See "Detention Ponds" (No. 1).	See "Detention Ponds" (No. 1).
Emergency Overflow Spillway	Rock Missing	See "Detention Ponds" (No. 1).	See "Detention Ponds" (No. 1).
	Erosion	See "Detention Ponds" (No. 1).	See "Detention Ponds" (No. 1).
Pre-settling Ponds and Vaults	Facility or sump filled with Sediment and/or debris	6" or designed sediment trap depth of sediment.	Sediment is removed.

M2-03 – Closed Detention Systems (Tanks/Vaults)

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
Storage Area	Plugged Air Vents	One-half of the cross section of a vent is blocked at any point or the vent is damaged.	Vents open and functioning.
	Debris and Sediment	Accumulated sediment depth exceeds 10% of the diameter of the storage area for 1/2 length of storage vault or any point depth exceeds 15% of diameter. (Example: 72-inch storage tank would require cleaning when sediment reaches depth of 7 inches for more than 1/2 length of tank.)	All sediment and debris removed from storage area.
	Joints Between Tank/Pipe Section	Any openings or voids allowing material to be transported into facility. (Will require engineering analysis to determine structural stability).	All joint between tank/pipe sections are sealed.
	Tank Pipe Bent Out of Shape	Any part of tank/pipe is bent out of shape more than 10% of its design shape. (Review required by engineer to determine structural stability).	Tank/pipe repaired or replaced to design.
	Vault Structure Includes Cracks in Wall, Bottom, Damage to Frame and/or Top Slab	Cracks wider than 1/2-inch and any evidence of soil particles entering the structure through the cracks, or maintenance/inspection personnel determines that the vault is not structurally sound. Cracks wider than 1/2-inch at the joint of any inlet/outlet pipe or any evidence of soil particles entering the vault through the walls.	Vault replaced or repaired to design specifications and is structurally sound. No cracks more than 1/4-inch wide at the joint of the inlet/outlet pipe.
Manhole	Cover Not in Place	Cover is missing or only partially in place. Any open manhole requires maintenance.	Manhole is closed.
	Locking Mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than 1/2 inch of thread(may not apply to self-locking lids).	Mechanism opens with proper tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure. Intent is to keep cover from sealing off access to maintenance.	Cover can be removed and reinstalled by one maintenance person.
	Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, misalignment, not securely attached to structure wall, rust, or cracks.	Ladder meets design standards. Allows maintenance person safe access.
Catch Basins	See "Catch Basins" (No. 5)	See "Catch Basins" (No. 5).	See "Catch Basins" (No. 5).

M2-04 - Control Structure/Flow Restrictor

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Trash and Debris (Includes Sediment)	Material exceeds 25% of sump depth or 1 foot below orifice plate.	Control structure orifice is not blocked. All trash and debris removed.
	Structural Damage	Structure is not securely attached to manhole wall.	Structure securely attached to wall and outlet pipe.
		Structure is not in upright position (allow up to 10% from plumb).	Structure in correct position.
		Connections to outlet pipe are not watertight and show signs of rust.	Connections to outlet pipe are water tight; structure repaired or replaced and works as designed.
		Any holes--other than designed holes--in the structure.	Structure has no holes other than designed holes.
Cleanout Gate	Damaged or Missing	Cleanout gate is not watertight or is missing.	Gate is watertight and works as designed.
		Gate cannot be moved up and down by one maintenance person.	Gate moves up and down easily and is watertight.
		Chain/rod leading to gate is missing or damaged.	Chain is in place and works as designed.
		Gate is rusted over 50% of its surface area.	Gate is repaired or replaced to meet design standards.
Orifice Plate	Damaged or Missing	Control device is not working properly due to missing, out of place, or bent orifice plate.	Plate is in place and works as designed.
	Obstructions	Any trash, debris, sediment, or vegetation blocking the plate.	Plate is free of all obstructions and works as designed.
Overflow Pipe	Obstructions	Any trash or debris blocking (or having the potential of blocking) the overflow pipe.	Pipe is free of all obstructions and works as designed.
Manhole	See "Closed Detention Systems" (No. 3).	See "Closed Detention Systems" (No. 3).	See "Closed Detention Systems" (No. 3).
Catch Basin	See "Catch Basins" (No. 5).	See "Catch Basins" (No. 5).	See "Catch Basins" (No. 5).

M2-05 – Catch Basins

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is performed
General	Trash & Debris	Trash or debris which is located immediately in front of the catch basin opening or is blocking inletting capacity of the basin by more than 10%.	No Trash or debris located immediately in front of catch basin or on grate opening.
		Trash or debris (in the basin) that exceeds 60percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of six inches clearance from the debris surface to the invert of the lowest pipe.	No trash or debris in the catch basin.
		Trash or debris in any inlet or outlet pipe blocking more than 1/3 of its height.	Inlet and outlet pipes free of trash or debris.
		Dead animals or vegetation that could generate odors that could cause complaints or dangerous gases (e.g., methane).	No dead animals or vegetation present within the catch basin.
	Sediment	Sediment (in the basin) that exceeds 60percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of 6 inches clearance from the sediment surface to the invert of the lowest pipe.	No sediment in the catch basin
	Structure Damage to Frame and/or Top Slab	Top slab has holes larger than 2 square inches or cracks wider than 1/4 inch (Intent is to make sure no material is running into basin).	Top slab is free of holes and cracks.
		Frame not sitting flush on top slab, i.e., separation of more than 3/4 inch of the frame from the top slab. Frame not securely attached	Frame is sitting flush on the riser rings or top slab and firmly attached.
	Fractures or Cracks in Basin Walls/Bottom	Maintenance person judges that structure is unsound.	Basin replaced or repaired to design standards.
		Grout fillet has separated or cracked wider than 1/2 inch and longer than 1 foot at the joint of any inlet/outlet pipe or any evidence of soil particles entering catch basin through cracks.	Pipe is regouted and secure at basin wall.
	Settlement/Mis alignment	If failure of basin has created a safety, function, or design problem.	Basin replaced or repaired to design standards.
	Vegetation	Vegetation growing across and blocking more than 10% of the basin opening.	No vegetation blocking opening to basin.
		Vegetation growing in inlet/outlet pipe joints that is more than six inches tall and less than six inches apart.	No vegetation or root growth present.

M2-05 – Catch Basins

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is performed
	Contamination and Pollution	See "Detention Ponds" (No. 1).	No pollution present.
Catch Basin Cover	Cover Not in Place	Cover is missing or only partially in place. Any open catch basin requires maintenance.	Catch basin cover is closed
	Locking Mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than 1/2 inch of thread.	Mechanism opens with proper tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure. (Intent is keep cover from sealing off access to maintenance.)	Cover can be removed by one maintenance person.
Ladder	Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, not securely attached to basin wall, misalignment, rust, cracks, or sharp edges.	Ladder meets design standards and allows maintenance person safe access.
Metal Grates (If Applicable)	Grate opening Unsafe	Grate with opening wider than 7/8 inch.	Grate opening meets design standards.
	Trash and Debris	Trash and debris that is blocking more than 20% of grate surface inletting capacity.	Grate free of trash and debris.
	Damaged or Missing.	Grate missing or broken member(s) of the grate.	Grate is in place and meets design standards.

M2-06 – Debris Barriers (e.g., Trash Racks)

Maintenance Components	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Trash and Debris	Trash or debris that is plugging more than 20% of the openings in the barrier.	Barrier cleared to design flow capacity.
Metal	Damaged/ Missing Bars.	Bars are bent out of shape more than 3 inches.	Bars in place with no bends more than 3/4 inch.
		Bars are missing or entire barrier missing.	Bars in place according to design.
		Bars are loose and rust is causing 50% deterioration to any part of barrier.	Barrier replaced or repaired to design standards.
	Inlet/Outlet Pipe	Debris barrier missing or not attached to pipe	Barrier firmly attached to pipe

M2-07 – Energy Dissipaters

Maintenance Components	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
External:			
Rock Pad	Missing or Moved Rock	Only one layer of rock exists above native soil in area five square feet or larger, or any exposure of native soil.	Rock pad replaced to design standards.
	Erosion	Soil erosion in or adjacent to rock pad.	Rock pad replaced to design standards.
Dispersion Trench	Pipe Plugged with Sediment	Accumulated sediment that exceeds 20% of the design depth.	Pipe cleaned/flushed so that it matches design.
	Not Discharging Water Properly	Visual evidence of water discharging at concentrated points along trench (normal condition is a "sheet flow" of water along trench). Intent is to prevent erosion damage.	Trench redesigned or rebuilt to standards.
	Perforations Plugged.	Over 1/2 of perforations in pipe are plugged with debris and sediment.	Perforated pipe cleaned or replaced.
	Water Flows Out Top of "Distributor" Catch Basin.	Maintenance person observes or receives credible report of water flowing out during any storm less than the design storm or its causing or appears likely to cause damage.	Facility rebuilt or redesigned to standards.
	Receiving Area Over-Saturated	Water in receiving area is causing or has potential of causing landslide problems.	No danger of landslides.
Internal:			
Manhole/Chamber	Worn or Damaged Post, Baffles, Side of Chamber	Structure dissipating flow deteriorates to 1/2 of original size or any concentrated worn spot exceeding one square foot which would make structure unsound.	Structure replaced to design standards.
	Other Defects	See "Catch Basins" (No. 5).	See "Catch Basins" (No. 5).

M2-08 – Typical Biofiltration Swale

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Recommended Maintenance to Correct Problem
General	Sediment Accumulation on Grass	Sediment depth exceeds 2 inches.	Remove sediment deposits on grass treatment area of the bio-swale. When finished, swale should be level from side to side and drain freely toward outlet. There should be no areas of standing water once inflow has ceased.
	Standing Water	When water stands in the swale between storms and does not drain freely.	Any of the following may apply: remove sediment or trash blockages, improve grade from head to foot of swale, remove clogged check dams, add under drains or convert to a wet biofiltration swale.
	Flow spreader	Flow spreader uneven or clogged so that flows are not uniformly distributed through entire swale width.	Level the spreader and clean so that flows are spread evenly over entire swale width.
	Constant Baseflow	When small quantities of water continually flow through the swale, even when it has been dry for weeks, and an eroded, muddy channel has formed in the swale bottom.	Add a low-flow pea-gravel drain the length of the swale or by-pass the baseflow around the swale.
	Poor Vegetation Coverage	When grass is sparse or bare or eroded patches occur in more than 10% of the swale bottom.	Determine why grass growth is poor and correct that condition. Re-plant with plugs of grass from the upper slope: plant in the swale bottom at 8-inch intervals. Or re-seed into loosened, fertile soil.
	Vegetation	When the grass becomes excessively tall (greater than 10-inches); when nuisance weeds and other vegetation starts to take over.	Mow vegetation or remove nuisance vegetation so that flow not impeded. Grass should be mowed to a height of 3 to 4 inches. Remove grass clippings.
	Excessive Shading	Grass growth is poor because sunlight does not reach swale.	If possible, trim back over-hanging limbs and remove brushy vegetation on adjacent slopes.
	Inlet/Outlet	Inlet/outlet areas clogged with sediment and/or debris.	Remove material so that there is no clogging or blockage in the inlet and outlet area.
	Trash and Debris Accumulation	Trash and debris accumulated in the bio-swale.	Remove trash and debris from bioswale.
	Erosion/Scouring	Eroded or scoured swale bottom due to flow channelization, or higher flows.	For ruts or bare areas less than 12 inches wide, repair the damaged area by filling with crushed gravel. If bare areas are large, generally greater than 12 inches wide, the swale should be re-graded and re-seeded. For smaller bare areas, overseed when bare spots are evident, or take plugs of grass from the upper slope and plant in the swale bottom at 8-inch intervals.

M2-09 – Wet Biofiltration Swale

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Recommended Maintenance to Correct Problem
General	Sediment Accumulation	Sediment depth exceeds 2-inches in 10% of the swale treatment area.	Remove sediment deposits in treatment area.
	Water Depth	Water not retained to a depth of about 4 inches during the wet season.	Build up or repair outlet berm so that water is retained in the wet swale.
	Wetland Vegetation	Vegetation becomes sparse and does not provide adequate filtration, OR vegetation is crowded out by very dense clumps of cattail, which do not allow water to flow through the clumps.	Determine cause of lack of vigor of vegetation and correct. Replant as needed. For excessive cattail growth, cut cattail shoots back and compost off-site. Note: normally wetland vegetation does not need to be harvested unless die-back is causing oxygen depletion in downstream waters.
	Inlet/Outlet	Inlet/outlet area clogged with sediment and/or debris.	Remove clogging or blockage in the inlet and outlet areas.
	Trash and Debris Accumulation	See "Detention Ponds" (No. 1).	Remove trash and debris from wet swale.
	Erosion/Scouring	Swale has eroded or scoured due to flow channelization, or higher flows.	Check design flows to assure swale is large enough to handle flows. By-pass excess flows or enlarge swale. Replant eroded areas with fibrous-rooted plants such as <i>Juncus effusus</i> (soft rush) in wet areas or snowberry (<i>Symphoricarpos albus</i>) in dryer areas.

M2-10 – Filter Strips

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Recommended Maintenance to Correct Problem
General	Sediment Accumulation on Grass	Sediment depth exceeds 2 inches.	Remove sediment deposits, re-level so slope is even and flows pass evenly through strip.
	Vegetation	When the grass becomes excessively tall (greater than 10-inches); when nuisance weeds and other vegetation starts to take over.	Mow grass, control nuisance vegetation, such that flow not impeded. Grass should be mowed to a height between 3-4 inches.
	Trash and Debris Accumulation	Trash and debris accumulated on the filter strip.	Remove trash and Debris from filter.
	Erosion/Scouring	Eroded or scoured areas due to flow channelization, or higher flows.	For ruts or bare areas less than 12 inches wide, repair the damaged area by filling with crushed gravel. The grass will creep in over the rock in time. If bare areas are large, generally greater than 12 inches wide, the filter strip should be re-graded and re-seeded. For smaller bare areas, overseed when bare spots are evident.
	Flow spreader	Flow spreader uneven or clogged so that flows are not uniformly distributed through entire filter width.	Level the spreader and clean so that flows are spread evenly over entire filter width.

M2-11 – Wet Ponds

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Water level	First cell is empty, doesn't hold water.	Line the first cell to maintain at least 4 feet of water. Although the second cell may drain, the first cell must remain full to control turbulence of the incoming flow and reduce sediment resuspension.
	Trash and Debris	Accumulation that exceeds 1 CF per 1000-SF of pond area.	Trash and debris removed from pond.
	Inlet/Outlet Pipe	Inlet/Outlet pipe clogged with sediment and/or debris material.	No clogging or blockage in the inlet and outlet piping.
	Sediment Accumulation in Pond Bottom	Sediment accumulations in pond bottom that exceeds the depth of sediment zone plus 6-inches, usually in the first cell.	Sediment removed from pond bottom.
	Oil Sheen on Water	Prevalent and visible oil sheen.	Oil removed from water using oil-absorbent pads or vactor truck. Source of oil located and corrected. If chronic low levels of oil persist, plant wetland plants such as <i>Juncus effusus</i> (soft rush) which can uptake small concentrations of oil.
	Erosion	Erosion of the pond's sideslopes and/or scouring of the pond bottom, that exceeds 6inches, or where continued erosion is prevalent.	Slopes stabilized using proper erosion control measures and repair methods.
	Settlement of Pond Dike/Berm	Any part of these components that has settled 4-inches or lower than the design elevation, or inspector determines dike/berm is unsound.	Dike/berm is repaired to specifications.
	Internal Berm	Berm dividing cells should belevel.	Berm surface is leveled so that water flows evenly over entire length of berm.
Overflow Spillway	Rock is missing and soil is exposed at top of spillway or outside slope.	Rocks replaced to specifications.	

M2-12 – Wet Vaults

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Trash/Debris Accumulation	Trash and debris accumulated in vault, pipe or inlet/outlet (includes floatables and non-floatables).	Remove trash and debris from vault.
	Sediment Accumulation in Vault	Sediment accumulation in vault bottom exceeds the depth of the sediment zone plus 6-inches.	Remove sediment from vault.
	Damaged Pipes	Inlet/outlet piping damaged or broken and in need of repair.	Pipe repaired and/or replaced.
	Access Cover Damaged/Not Working	Cover cannot be opened or removed, especially by one person.	Pipe repaired or replaced to proper working specifications.
	Ventilation	Ventilation area blocked or plugged.	Blocking material removed or cleared from ventilation area. A specified % of the vault surface area must provide ventilation to the vault interior (see design specifications).
	Vault Structure Damage -Includes Cracks in Walls Bottom, Damage to Frame and/or Top Slab	Maintenance/inspection personnel determine that the vault is not structurally sound.	Vault replaced or repairs made so that vault meets design specifications and is structurally sound.
		Cracks wider than 1/2-inch at the joint of any inlet/outlet pipe or evidence of soil particles entering through the cracks.	Vault repaired so that no cracks exist wider than 1/4-inch at the joint of the inlet/outlet pipe.
	Baffles	Baffles corroding, cracking, warping and/or showing signs of failure as determined by maintenance/inspection staff.	Baffles repaired or replaced to specifications.
Access Ladder Damage	Ladder is corroded or deteriorated, not functioning properly, not attached to structure wall, missing rungs, has cracks and/or misaligned. Confined space warning sign missing.	Ladder replaced or repaired to specifications, and is safe to use as determined by inspection personnel. Replace sign warning of confined space entry requirements. Ladder and entry notification complies with OSHA standards.	

M2-13 – Sand Filters (Above Ground/Open)

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Above Ground (open sand filter)	Sediment Accumulation on top layer	Sediment depth exceeds 1/2-inch.	No sediment deposit on grass layer of sand filter that would impede permeability of the filter section.
	Trash and Debris Accumulations	Trash and debris accumulated on sand filter bed.	Trash and debris removed from sand filter bed.
	Sediment/ Debris in Clean-Outs	When the clean-outs become full or partially plugged with sediment and/or debris.	Sediment removed from clean-outs.
	Sand Filter Media	Drawdown of water through the sand filter media takes longer than 24-hours, and/or flow through the overflow pipes occurs frequently.	Top several inches of sand are scraped. May require replacement of entire sand filter depth depending on extent of plugging (a sieve analysis is helpful to determine if the lower sand has too high a proportion of fine material).
	Prolonged Flows	Sand is saturated for prolonged periods of time (several weeks) and does not dry out between storms due to continuous base flow or prolonged flows from detention facilities.	Low, continuous flows are limited to a small portion of the facility by using a low wooden divider or slightly depressed sand surface.
	Short Circuiting	When flows become concentrated over one section of the sand filter rather than dispersed.	Flow and percolation of water through sand filter is uniform and dispersed across the entire filter area.
	Erosion Damage to Slopes	Erosion over 2-inches deep where cause of damage is prevalent or potential for continued erosion is evident.	Slopes stabilized using proper erosion control measures.
	Rock Pad Missing or Out of Place	Soil beneath the rock is visible.	Rock pad replaced or rebuilt to design specifications.
	Flow Spreader	Flow spreader uneven or clogged so that flows are not uniformly distributed across sand filter.	Spreader leveled and cleaned so that flows are spread evenly over sand filter.
	Damaged Pipes	Any part of the piping that is crushed or deformed more than 20% or any other failure to the piping.	Pipe repaired or replaced.

M2-14 – Sand Filters (Below Ground/Enclosed)

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Below Ground Vault.	Sediment Accumulation on Sand Media Section	Sediment depth exceeds 1/2-inch.	No sediment deposits on sand filter section that which would impede permeability of the filter section.
	Sediment Accumulation in Pre-Settling Portion of Vault	Sediment accumulation in vault bottom exceeds the depth of the sediment zone plus 6-inches.	No sediment deposits in first chamber of vault.
	Trash/Debris Accumulation	Trash and debris accumulated in vault, or pipe inlet/outlet, floatables and non-floatables.	Trash and debris removed from vault and inlet/outlet piping.
	Sediment in Drain Pipes/Cleanouts	When drain pipes, cleanouts become full with sediment and/or debris.	Sediment and debris removed.
	Short Circuiting	When seepage/flow occurs along the vault walls and corners. Sand eroding near inflow area.	Sand filter media section re-laid and compacted along perimeter of vault to form a semi-seal. Erosion protection added to dissipate force of incoming flow and curtail erosion.
	Damaged Pipes	Inlet or outlet piping damaged or broken and in need of repair.	Pipe repaired and/or replaced.
	Access Cover Damaged/Not Working	Cover cannot be opened, corrosion/deformation of cover. Maintenance person cannot remove cover using normal lifting pressure.	Cover repaired to proper working specifications or replaced.
	Ventilation	Ventilation area blocked or plugged	Blocking material removed or cleared from ventilation area. A specified % of the vault surface area must provide ventilation to the vault interior (see design specifications).
	Vault Structure Damaged; Includes Cracks in Walls, Bottom, Damage to Frame and/or Top Slab.	Cracks wider than 1/2-inch or evidence of soil particles entering the structure through the cracks, or maintenance/inspection personnel determine that the vault is not structurally sound.	Vault replaced or repairs made so that vault meets design specifications and is structurally sound.
		Cracks wider than 1/2-inch at the joint of any inlet/outlet pipe or evidence of soil particles entering through the cracks.	Vault repaired so that no cracks exist wider than 1/4-inch at the joint of the inlet/outlet pipe.
Baffles/Internal walls	Baffles or walls corroding, cracking, warping and/or showing signs of failure as determined by maintenance/inspection person.	Baffles repaired or replaced to specifications.	

M2-14 – Sand Filters (Below Ground/Enclosed)

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
	Access Ladder Damaged	Ladder is corroded or deteriorated, not functioning properly, not securely attached to structure wall, missing rungs, cracks, and misaligned.	Ladder replaced or repaired to specifications, and is safe to use as determined by inspection personnel.

M2-15 - Stormfilter™ (Leaf Compost Filter)

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Below Ground Vault	Sediment Accumulation on Media.	Sediment depth exceeds 0.25-inches.	No sediment deposits which would impede permeability of the compost media.
	Sediment Accumulation in Vault	Sediment depth exceeds 6-inches in first chamber.	No sediment deposits in vault bottom of first chamber.
	Trash/Debris Accumulation	Trash and debris accumulated on compost filter bed.	Trash and debris removed from the compost filter bed.
	Sediment in Drain Pipes/Clean-Outs	When drain pipes, clean-outs, become full with sediment and/or debris.	Sediment and debris removed.
	Damaged Pipes	Any part of the pipes that are crushed or damaged due to corrosion and/or settlement.	Pipe repaired and/or replaced.
	Access Cover Damaged/Not Working	Cover cannot be opened; one person cannot open the cover using normal lifting pressure, corrosion/deformation of cover.	Cover repaired to proper working specifications or replaced.
	Vault Structure Includes Cracks in Wall, Bottom, Damage to Frame and/or Top Slab	Cracks wider than 1/2-inch or evidence of soil particles entering the structure through the cracks, or maintenance/inspection personnel determine that the vault is not structurally sound.	Vault replaced or repairs made so that vault meets design specifications and is structurally sound.
		Cracks wider than 1/2-inch at the joint of any inlet/outlet pipe or evidence of soil particles entering through the cracks.	Vault repaired so that no cracks exist wider than 1/4-inch at the joint of the inlet/outlet pipe.
	Baffles	Baffles corroding, cracking warping, and/or showing signs of failure as determined by maintenance/inspection person.	Baffles repaired or replaced to specifications.
	Access Ladder Damaged	Ladder is corroded or deteriorated, not functioning properly, not securely attached to structure wall, missing rungs, cracks, and misaligned.	Ladder replaced or repaired and meets specifications, and is safe to use as determined by inspection personnel.
Below Ground Cartridge Type	Compost Media	Drawdown of water through the media takes longer than 1 hour, and/or overflow occurs frequently.	Media cartridges replaced.
	Short Circuiting	Flows do not properly enter filter cartridges.	Filter cartridges replaced.

M2-16 – Baffle Oil/Water Separators (API Type)

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed	
General	Monitoring	Inspection of discharge water for obvious signs of poor water quality.	Effluent discharge from vault should be clear with out thick visible sheen.	
	Sediment Accumulation	Sediment depth in bottom of vault exceeds 6-inches in depth.	No sediment deposits on vault bottom that would impede flow through the vault and reduce separation efficiency.	
	Trash and Debris Accumulation	Trash and debris accumulation in vault, or pipe inlet/outlet, floatables and non-floatables.	Trash and debris removed from vault, and inlet/outlet piping.	
	Oil Accumulation	Oil accumulations that exceed 1-inch, at the surface of the water.	Extract oil from vault by vactoring. Disposal in accordance with state and local rules and regulations.	
	Damaged Pipes	Inlet or outlet piping damaged or broken and in need of repair.	Pipe repaired or replaced.	
	Access Cover Damaged/Not Working	Cover cannot be opened, corrosion/deformation of cover.	Cover repaired to proper working specifications or replaced.	
	Vault Structure Damage - Includes Cracks in Walls Bottom, Damage to Frame and/or Top Slab	See "Catch Basins" (No. 5)		Vault replaced or repairs made so that vault meets design specifications and is structurally sound.
		Cracks wider than 1/2-inch at the joint of any inlet/outlet pipe or evidence of soil particles entering through the cracks.		Vault repaired so that no cracks exist wider than 1/4-inch at the joint of the inlet/outlet pipe.
	Baffles	Baffles corroding, cracking, warping and/or showing signs of failure as determined by maintenance/inspection person.	Baffles repaired or replaced to specifications.	
Access Ladder Damaged	Ladder is corroded or deteriorated, not functioning properly, not securely attached to structure wall, missing rungs, cracks, and misaligned.	Ladder replaced or repaired and meets specifications, and is safe to use as determined by inspection personnel.		

M2-17 – Coalescing Plate Oil/Water Separators

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed	
General	Monitoring	Inspection of discharge water for obvious signs of poor water quality.	Effluent discharge from vault should be clear with no thick visible sheen.	
	Sediment Accumulation	Sediment depth in bottom of vault exceeds 6-inches in depth and/or visible signs of sediment on plates.	No sediment deposits on vault bottom and plate media, which would impede flow through the vault and reduce separation efficiency.	
	Trash and Debris Accumulation	Trash and debris accumulated in vault, or pipe inlet/outlet, floatables and non-floatables.	Trash and debris removed from vault, and inlet/outlet piping.	
	Oil Accumulation	Oil accumulation that exceeds 1-inch at the water surface.	Oil is extracted from vault using vactoring methods. Coalescing plates are cleaned by thoroughly rinsing and flushing. Should be no visible oil depth on water.	
	Damaged Coalescing Plates	Plate media broken, deformed, cracked and/or showing signs of failure.	A portion of the media pack or the entire plate pack is replaced depending on severity of failure.	
	Damaged Pipes	Inlet or outlet piping damaged or broken and in need of repair.	Pipe repaired and or replaced.	
	Baffles	Baffles corroding, cracking, warping and/or showing signs of failure as determined by maintenance/inspection person.	Baffles repaired or replaced to specifications.	
	Vault Structure Damage -Includes Cracks in Walls, Bottom, Damage to Frame and/or Top Slab		Cracks wider than 1/2-inch or evidence of soil particles entering the structure through the cracks, or maintenance/inspection personnel determine that the vault is not structurally sound.	Vault replaced or repairs made so that vault meets design specifications and is structurally sound.
			Cracks wider than 1/2-inch at the joint of any inlet/outlet pipe or evidence of soil particles entering through the cracks.	Vault repaired so that no cracks exist wider than 1/4-inch at the joint of the inlet/outlet pipe.
	Access Ladder Damaged	Ladder is corroded or deteriorated, not functioning properly, not securely attached to structure wall, missing rungs, cracks, and misaligned.	Ladder replaced or repaired and meets specifications, and is safe to use as determined by inspection personnel.	

M2-18 – Catchbasin Inserts

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Sediment Accumulation	When sediment forms a cap over the insert media of the insert and/or unit.	No sediment cap on the insert media and its unit.
	Trash and Debris Accumulation	Trash and debris accumulates on insert unit creating a blockage/restriction.	Trash and debris removed from insert unit. Runoff freely flows into catch basin.
	Media Insert Not Removing Oil	Effluent water from media insert has a visible sheen.	Effluent water from media insert is free of oils and has no visible sheen.
	Media Insert Water Saturated	Catch basin insert is saturated with water and no longer has the capacity to absorb.	Remove and replace media insert
	Media Insert-Oil Saturated	Media oil saturated due to petroleum spill that drains into catch basin.	Remove and replace media insert.
	Media Insert Use Beyond Normal Product Life	Media has been used beyond the typical average life of media insert product.	Remove and replace media at regular intervals, depending on insert product.

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Chapter M3 – Natural Drainage Practices (NDP) Standards

M3-01 INTRODUCTION AND DEFINITIONS

"Low impact development (LID) is a stormwater management strategy that emphasizes conservation and use of existing natural site features integrated with distributed, small-scale stormwater controls to more closely mimic natural hydrologic patterns in residential, commercial, and industrial settings."

*Puget Sound Action Team 2005. Low Impact Development
Technical Guidance Manual for Puget Sound,
Washington State University Pierce County Extension*

Stormwater management can have substantial effects on the surrounding habitats and ecosystems. Bellevue's Natural Drainage Practices employs LID stormwater management controls that are dispersed throughout a site in order to manage, reduce, and treat stormwater. The goal is to reduce stormwater impact on Bellevue's environment and more closely mimic natural hydrologic processes.

Rain gardens, bioretention areas, amended soils, vegetated roofs, cisterns, porous pavement and pavers are all stormwater treatment systems that require regular maintenance to sustain their designed performances. These devices can reduce the area of impervious surfaces, the volume of stormwater runoff, sediment levels, and pollutants. They can also reduce the rate of runoff, contributing to a cleaner stormwater system, and further downstream, a healthier ecosystem.

Consistent maintenance is essential to ensure that the systems are efficient, long-lasting, and the prescribed performance levels (desired outcomes) are being achieved. In addition, regular inspection and maintenance regimes can assist in decreasing the chance of site flooding and ground water pollution. Regular maintenance, as with most things, is critical and is a smart and cost-saving practice over time.



DEFINITIONS



<u>NDP Term</u>	<u>Definition</u>
Bioretention	“Shallow landscaped depressions with a designed soil mix and plants adapted to local climate and soil moisture conditions that receives storm water from a small contributing area.” (LID Technical Guidance Manual for Puget Sound by PSAT and WSU Pierce County Extension, Jan 2005)
Cleanout	A vertical pipe with a cap at the surface. Vertical pipe is connected to a horizontal pipe with a slope. Cleanouts are access points for cleaning pipes.
Filtration	Water flowing through amended soils, vegetation, and other media.
Gullies	A ditch/channel is created as a result of running water (such as during a heavy downpour) eroding and wearing away the soil and vegetation. Gullies may be either shallow or deep in depth.
Infiltration	Water seeps into native soils.
Natural Drainage Practices (NDP)	Small-scale storm water controls that incorporate vegetation, infiltration, and evapotranspiration to mimic the hydrologic performance of natural land surfaces.
Natural Drainage System (NDS)	A drainage system that uses a combination of grass-lined and vegetated swales, pervious/porous paving, downspout disconnects, rainwater gardens, tree preservation and bioretention to manage stormwater runoff. Emphasis is on decentralizing stormwater collection and dispersal to many areas to maximize infiltration of water back into the soil.
Observation Port	A vertical pipe buried in the ground used to determine the water level beneath the surface. The pipe will have a cap/lid at the surface (similar to a cleanout) for observation access. Small slots are cut along the length of the pipe. The bottom of the pipe is not capped and is set in the undisturbed soil. See City of Bellevue’s standard details of an Observation Port for further information and the Storm As-Built Plan or Operations and Maintenance Agreement Form for location of the Observation port(s).

<u>NDP Term</u>	<u>Definition</u>
Porous, Permeable, Pervious Pavements	Terms are used interchangeably. Pavement that allows water to filter through the pavement section via voids in the pavement materials and clean crushed gravel subbase.
Stormwater	The rainfall runoff from rooftops, streets, parking lots and other impervious surfaces that flows to waterways.
Structure	A precast structure used to collect rain water such as area drain, catch basin, cleanout, grate, inlet, culvert pipe.
Swale	An open and gently sloping vegetated channel designed for treating and conveying stormwater runoff.
Underdrain	A pipe with holes or slots along the length of the pipe to allow water to flow into pipe and be conveyed away. The pipe is set in rock at the bottom of an infiltrating NDP such as a rain garden or porous pavement.
Water Quality	The chemical and physical characterization of water, the primary bases of which are parameters relating to potability, safety of human contact and health of ecosystems.



M3-02 RAIN GARDENS AND STORMWATER PLANTERS


REGULAR MAINTENANCE

REGULAR / ROUTINE MAINTENANCE		
Recommended Frequency	References and Images	Notes
M3-02-R1 Observation Ports		
<ul style="list-style-type: none"> Visually check observation ports at least two times per year. Check observation ports after 1-inch of rainfall in 24-hour period and record water level. 		<ul style="list-style-type: none"> Remove cap of observation port. Measure depth between observed water level and top of lid for port. Replace cap securely when done. Keep a record of measurements (including date) in maintenance log. Check O&M Manual for minimum distance between top of observation port and water surface level during dry and wet weather. During rainy weather, ponding will occur in the rain garden and the water level will rise. After the rain event is over, the water level at the observation port should drop as the water drains out. If water does not drain out of the observation port after 72 hours after the rain event has ceased, or ponding at surface does not dry out in 48 hours, then the rain garden system requires remediation. See "Ponding" in section on <i>Triggered Maintenance for rain gardens</i>.
M3-02-R2 Inspect Inflow and Outflow Points for Clogging		
<ul style="list-style-type: none"> Monthly and as needed during wet season. 		<ul style="list-style-type: none"> If observed, remove sediment at surface, in pre-settling areas and at storm structure outfalls. Remove any accumulated debris from inflow/outflow points (curb cuts, pipes, trench drains, storm structures, etc.). Remove any vegetation that has grown around/blocking grate of storm structure or curb cut.



M3-02 RAIN GARDENS AND STORMWATER PLANTERS

REGULAR MAINTENANCE

REGULAR / ROUTINE MAINTENANCE		
Recommended Frequency	References and Images	Notes
M3-02-R3 Cleanouts and Underdrains (if used)		
<ul style="list-style-type: none"> Visually check cleanouts and discharge points of underdrains pipes annually to determine if cleaning is necessary. 		<ul style="list-style-type: none"> Jet clean or rotary cut debris/roots from underdrains so that standing water is not present in pipes during dry weather.
M3-02-R4 Watering During First and Second Growing Seasons		
<ul style="list-style-type: none"> In the first 6 weeks, plantings will require approximately 1 - inch of water twice per week to establish deep roots. After watering, confirm the soil is moist 3 to 6 inches below surface. Reduce watering frequency to once a week until the end of the first growing season (May-Sept). The second growing season will require approximately 1 inch of water once per week. 	<p>See WSU Pierce County Extension Rain Garden Handbook for Western Washington Homeowners for watering tips and schedule: http://www.pierce.wsu.edu/Water_Quality/LID/Raingarden_handbook.pdf</p> <p>See Watering to Establish your new Plant: http://www.ci.mercer-island.wa.us/Files/Watering%20Your%20New%20Plants.pdf</p>	<ul style="list-style-type: none"> Intent of watering is to keep plant material sustained through establishment. Monitor rainfall to determine irrigation/watering schedule. Water regularly during the first two growing seasons. Dry periods will need additional watering for establishing plants due to warmer temperatures and increased sunlight both of which can stress vegetation. Wilted leaves and drooping stems are all indications of stress caused by dry soils and hot temperatures. Optimal watering time is early in the morning or late in the evening to reduce evaporation. A preferred watering approach is to have repeated short cycles of watering and soaking into the ground. Follow manufacturer's guidelines for operations and maintenance of irrigation system and its components.




M3-02 RAIN GARDENS AND STORMWATER PLANTERS

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Recommended Frequency	References and Images	Notes
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M3-02-R5 Dry Period Watering for Established Rain Gardens

<ul style="list-style-type: none"> Water infrequently but thoroughly: 1/2-inch to 1-inch every 2 weeks or when plants appear stressed. Monitor rainfall and check weather updates and adjust watering accordingly. 	<p>See Natural Lawn and Garden Handbook, Healthy Landscapes for a Healthy Environment - Smart Watering: http://www.ci.bellevue.wa.us/pdf/Utilities/Smart_Watering.pdf</p> <p>See The Plant List - A Companion to the Choosing the Right Plants Natural Lawn & Garden Guide: http://www.savingwater.org/docs/plantlist.pdf</p> <div style="text-align: center;">  </div>	<ul style="list-style-type: none"> Established (over 2 years) drought tolerant plants may need water during prolonged dry periods (possibly late July to mid-September). Inspect plantings during dry periods and look for signs of stress. Verify if any watering restrictions are in effect in the City for watering during dry periods/water shortages. If no restrictions, then note the following: Optimal watering time is early in the morning or late in the evening to reduce evaporation. Monitor rainfall to determine an irrigation schedule. Do not apply water faster than the soil can absorb it. Deeper and less frequent watering will encourage plants to develop a deep root system. If present, inspect irrigation system components for breaks and blockages and repair as necessary.
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Recommended Frequency	References and Images	Notes
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M3-02-R6 Leaf, Branch, and Organic Matter Removal

<ul style="list-style-type: none"> Inspect weekly for organic matter or debris that is blocking inflow points or structures and causing ponding of water. Schedule weekly leaf removal in fall. Bi-weekly mowing will be required from spring through mid July for turf raingardens. Monthly mowing will be required July through mid November for turf raingardens. 	<p>See Ecologically Sound Lawn Care for the Pacific Northwest - Integrated Pest Management: Preventive Health Care for Lawns (pages: 42-49): http://www.seattle.gov/util/stellent/groups/public/@spu/@csb/documents/webcontent/ecological_200312021255394.pdf</p> <div style="display: flex; justify-content: space-around; align-items: center;">   </div> <p style="text-align: center; font-size: small;">Raingarden study SPU On-Call 04006</p>	<ul style="list-style-type: none"> To prevent clogging, larger pieces of biodegradable landscape debris should be mulched or collected for composting, green waste pick up, or disposal to a recycling facility. Maintaining a minimum height of 4 - inches for turf grass within rain gardens (turf) will reduce weed invasion and encourage deep root growth which strengthens drought resistance. Mow with a mulch mower. Sharpen mower blades frequently to reduce ragged cutting. A thick layer of leaves, branches, and trash can prevent water and light from getting to lawn and other landscaped areas. <u>Excessive</u> leaf litter around plantings can provide cover for pests and allow mildew growth. Mulching organic matter (leaves) is recommended to facilitate decomposition for both turf and vegetated raingardens.
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M3-02-R7 Trash and Debris Removal

<ul style="list-style-type: none"> Remove trash and debris. Inspect after large storm events (~over 1-inch of rainfall in 24 hours or heavy downpour). 		<ul style="list-style-type: none"> Collect and properly dispose of trash/litter. Pet waste is a serious concern and should not be left within a rain garden as it contains disease-causing organisms and flushes bacteria into the stormwater.
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M3-02 RAIN GARDENS AND STORMWATER PLANTERS

REGULAR MAINTENANCE

REGULAR / ROUTINE MAINTENANCE		
Recommended Frequency	References and Images	Notes
M3-02-R8 Pruning and Removal of Dead Material		
<ul style="list-style-type: none"> In Spring, remove dead or old plant material from previous season. Mid summer and fall, inspect and cut back any plant material that blocks sidewalks and utilities. In fall, prune to maintain plant appearance. 	<div style="display: flex; justify-content: space-around;">   </div> <p>See Plant Amnesty Pruning Guide: http://www.plantamnesty.org/pruning_guides/pg_northwest_pacific_maritime.htm</p>	<ul style="list-style-type: none"> Trim and thin vegetation from prior season's growth, leaving 6 to 8 -inches. Allow dormant vegetation and old flower stalks to remain in winter to provide food and cover for birds. For early blooming shrubs/trees, prune in spring following bloom. Plants may require pruning, pinching, and dead heading during the growing season to promote reflowering, direct growth, etc. Native and/or ornamental grasses may appear dead but generally these plants are dormant during the winter months. Do not remove, prune dry material in spring as new material emerges. If appear dead in mid-summer, remove and replace. Keep water inlets and outlets clear. Reduce shading of under-story plants if they require sun.
M3-02-R9 Weed Control of Invasive Vegetation/ Weeds		
<ul style="list-style-type: none"> Remove as soon as observed. During three year establishment period, inspect at least once per month in growing season. Inspect at least three times per year once plants are established. 	<div style="display: flex; align-items: center;">  <div style="margin-left: 10px;"> <p>Invasive vegetation negatively impacts the health of landscaped areas by competing for sunlight, water, and nutrients, and should be kept under control.</p> <p>See WSU and King County Noxious Weeds Information at: http://gardening.wsu.edu/text/weed.htm http://www.kingcounty.gov/environment/animalsAndPlants/noxious-weeds.aspx</p> </div> </div>	<ul style="list-style-type: none"> Pay special attention to nuisance and invasive vegetation before it establishes a foothold. Particular threats to wet areas are reed canary grass and Japanese knot weed. Other threats include clover, scotch broom, horsetail, morning glory, alder seedlings, English ivy, and blackberry. Watch for any signs of these plants and remove them, including root system. See following section "Weed Control of Non-Invasive Vegetation and Weeds" for additional information. Persistent and invasive vegetation that is located in a mass can be killed by covering the area with black plastic for several weeks during summer.




M3-02 RAIN GARDENS AND STORMWATER PLANTERS REGULAR MAINTENANCE

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Recommended Frequency	References and Images	Notes
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M3-02-R10 Weed Control of Non-Invasive Vegetation/ Weeds

- Inspect the full bed and remove weeds February, June and September.
- Minor weeding monthly.
- See mulch section of this manual for more information to reduce weed establishment.




Weeds negatively impact the health of landscaped areas by competing for sunlight, water, and nutrients, and should be kept under control.



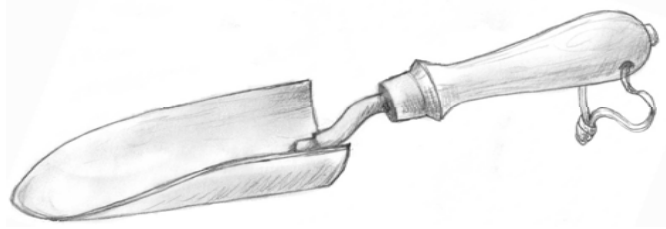
Photos from City of Seattle

See the Natural Lawn & Garden Natural Pest, Weed and Disease Control for more information:
http://www.seattle.gov/util/stellent/groups/public/@spu/@csb/documents/webcontent/naturalpe_200311261701589.pdf

Please refer to the King County Hazardous Waste - Natural Lawn care and IPM:
<http://www.govlink.org/hazwaste/house/yard/lawn/chemicals.html>

See Washington State University - Hortsense for additional information: <http://pep.wsu.edu/hortsense/weedmanage.html>

- Remove weeds manually before they go to seed by using pincer-type weeding tools, hoes, flame weeders, or hot water weeders. Remove the roots for best results.
- Weeds should be pulled when first observed and especially before they go to seed.
- Weeds need to be pulled in early spring so that the desired plants can thrive.
- Mulch immediately (no more than five days) following weeding to improve weed control.
- When dealing with invasive plant material/weeds, attempt all other physical methods to remove before considering a more aggressive method.
- It is important to note that chemicals can harm or kill beneficial or desirable plants, and also add pollutants to stormwater that can negatively impact water quality.






M3-02 RAIN GARDENS AND STORMWATER PLANTERS

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REGULAR / ROUTINE MAINTENANCE

Recommended Frequency	References and Images	Notes
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M3-02-R11 Bare Spots and Vegetation Removal and Replacement

<ul style="list-style-type: none"> Inspect for bare spots and areas of disturbed vegetation every 6 months. 	<div style="text-align: center;">  </div> <p style="text-align: center; margin-top: 10px;"> See Saving Water Partnership Plant List at: http://www.savingwater.org/docs/PlantList.pdf See King County Native Plant Resources at: http://www.kingcounty.gov/environment/stewardship/nw-yard-and-garden/native-plant-resources-nw.aspx </p>	<ul style="list-style-type: none"> Plants may die due to unsuitable conditions or microclimates, disease, pests, or other unforeseen issues. These plants must be removed/replaced to avoid the establishment of weeds in bare areas, the spread of disease, and the reduction in functionality. Reseed or replant bare areas and replace poor performing plants. Vegetation should cover 90% of rain garden. Replace vegetation with in-kind planting material or replace plants with high mortality rate with appropriate plants. Maintain 1- foot zone clear of vegetation around all inlets and outlets. Plants may be dormant during winter. Apply mulch to bare spots during winter and wait until spring to determine if plants need to be replaced.
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M3-02-R12 Mulch

<ul style="list-style-type: none"> Add wood chip mulch in fall and/or spring. Replace or add wood chip mulch as needed to maintain 2 to 3 -inches depth. 	<div style="text-align: center;">  </div> <p style="text-align: center; margin-top: 10px;">Photo from City of Seattle</p>	<ul style="list-style-type: none"> 1 cubic yard of mulch will cover 100 square feet at a depth of 3 -inches. 1 cubic yard = 27 cubic feet. Commercial mulch products generally are available in 2 cubic foot bags. 13.5 bags = 1 cubic yard. Wood chip mulch helps to control weeds, conserve soil moisture, improve filtration, regulate soil temperatures and adds nutrients to the soil as it decomposes.
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M3-02 RAIN GARDENS AND STORMWATER PLANTERS



REGULAR MAINTENANCE

REGULAR / ROUTINE MAINTENANCE		
Recommended Frequency	References and Images	Notes
M3-02-R13 Sediment Removal		
<ul style="list-style-type: none"> Late fall and late spring. After heavy downpour and rain events of 1-inch or more precipitation in 24-hour period. 	 <p style="margin-left: 20px;">Sediment will impact the ability of the water to be absorbed into the soil and can lead to standing water and/or slow draining rain garden/ stormwater planter. Remove sediment to maintain absorption and filtration into the underlying soils.</p>	<ul style="list-style-type: none"> If over 2-inch accumulation, remove sediment preferably when the rain garden/ stormwater planter is dry. Remove sediment manually, using shovels or rakes. Dispose of sediment in accordance with local requirements. Replace damaged or destroyed vegetation with in-kind plant material. Immediately try to determine source of sediment, regrade as necessary and stabilize area with vegetative cover. Place cobbles at inflow points, if necessary.
M3-03-R14 Fertilizers		
<ul style="list-style-type: none"> Fertilizers should not be applied to a rain garden or stormwater planter. 	 <p style="margin-left: 20px;">See The Natural Lawn and Garden Growing Healthy Soil for more information: http://www.ci.bellevue.wa.us/pdf/Utilities/Healthy_Soil.pdf</p>	<ul style="list-style-type: none"> Fertilizers wash off and pollute groundwater, streams, and other bodies of water. If additional nutrients are necessary, blend compost into soil to increase nutrients. Excessive fertilizing can produce weak plants that can lead to pest outbreaks and higher rates of disease. Rain garden soil mixes are rich in nutrients and when used with native plants or plants adapted to this region, fertilizers are not needed. Soil testing will indicate if soil is nutrient deficient. Additionally, the mulch layer contributes organic matter to the soil. Document fertilizer use in maintenance log.



M3-02 RAIN GARDENS AND STORMWATER PLANTERS


REGULAR MAINTENANCE

REGULAR / ROUTINE MAINTENANCE		
Recommended Frequency	References and Images	Notes
M3-02-R15 Pesticides		
<ul style="list-style-type: none"> See references. 	<p>See King County Native Plant Resources at: http://www.kingcounty.gov/environment/stewardship/nw-yard-and-garden/native-plant-resources-nw.aspx</p> <p>Refer to Chapter 2 in the City of Bellevue Parks and Community Services Department's Best Management Practices Manual: http://bellevuewa.gov/pdf/Document%20Library/2006_EBMP_DS_Manual.pdf</p> <div style="display: flex; justify-content: space-around; align-items: center;">   </div> <p style="text-align: center; margin-top: 10px;">Photos from City of Seattle</p>	<ul style="list-style-type: none"> Prevention is the first step when dealing with garden pests. Identify pests before proceeding with any treatment. Creating healthy soils with mulch and compost, choosing drought and pest resistant plants, pulling weeds, and removing diseased/dead plant material all will help in preventing pest infestations. All non-chemical pest control options (physical, mechanical, and cultural) should be employed to keep pest populations low. Consider removing a plant that continues to require pest management tactics to avoid using pesticides. Replanting the area with native plant selections that are resistant or tolerant to common pests and diseases will reduce future pest maintenance requirements. Pesticides should only be used as a last resort and must be applied by a certified applicator. Limit area of treatment to areas infested with pests rather than treating the entire facility. Document pesticide use in maintenance log.



M3-02 RAIN GARDENS AND STORMWATER PLANTERS



REGULAR MAINTENANCE

REGULAR / ROUTINE MAINTENANCE		
Recommended Frequency	References and Images	Notes
M3-02-R16 Herbicides		
<ul style="list-style-type: none"> See references. 	<div style="text-align: center;">  </div> <p>See the Natural Lawn & Garden Natural Pest, Weed and Disease Control for more information: http://www.seattle.gov/util/stellent/groups/public/@spu/@csb/documents/webcontent/naturalpe_200311261701589.pdf</p> <p>See Washington State University - Hortsense for additional information: http://pep.wsu.edu/hortsense/weedmanage.html</p>	<ul style="list-style-type: none"> It is not recommended to apply conventional herbicides to weeds within rain gardens and landscape natural drainage practices systems. Herbicides should be used only as the last resort when dealing with invasive weeds and after all practical methods are tried. Herbicides can harm or kill beneficial plants and add pollutants to stormwater that can negatively impact water quality. Herbicide use requires a certified applicator. There are preventative measures and physical controls that should be used instead of resorting to herbicide use. Combining regular maintenance, manual weeding, and mulching (2 to 3-inch depth of wood chip mulch) should keep weed growth to a minimum. Dig up roots if infested. Refer to "weed control" within this document for physical solutions. All practical preventative measures and physical controls shall be tried before herbicides are used. Document herbicide use in maintenance log.
M3-02-R17 Maintenance Log		
<ul style="list-style-type: none"> As needed to document all maintenance activities. 		<ul style="list-style-type: none"> Maintain a log documenting all inspections dates, observations and activities. The maintenance log shall be available upon request by the City.








M3-02 RAIN GARDENS AND STORMWATER PLANTERS

TRIGGERED MAINTENANCE

TRIGGERED MAINTENANCE		
Condition Observed	References and Images	Instructions
M3-02-T1 Ponding Water		
<ul style="list-style-type: none"> Water is standing/ponding in rain garden and not draining within 48 hours after the rain event has stopped. The facility is not functioning properly due to blockage of sediment and/or debris in the soil strata, underdrain or outlet structures. 		<ul style="list-style-type: none"> Check observation port to determine if underdrain pipe is blocked. Remove debris. Check surface overflow, outlet pipe or structure to determine if blocked. Remove debris. May need suction vacuum. The soil may also be blocked by fine sediments. Rake mulch layer aside and remove sediment from top surface layer, aerate soil, and respread mulch.
M3-02-T2 Erosion of Soils and Sediment Loading		
<ul style="list-style-type: none"> Two inch (or greater in depth) gullies/rills are present, washing out soils and mulch. Sediment washed downstream is clogging outlets and/or rock around outlet structures. 		<ul style="list-style-type: none"> Remove and store any desirable vegetation (to be used for replanting) from rain garden. Rake and remove fine sediments from surface. Add additional soil if necessary and regrade to direct water towards low point of rain garden, or level out bottom surface. Replant and/or replace vegetation and reapply mulch. If slopes have been compromised, remove vegetation (reserve for replanting), re-grade, and re-contour area by hand tools where practical. Replant vegetation and install 2 to 3 - inches of mulch. Clear away rocks, sediment and reinstall rock protection at structure inlets/outlets and add more rocks if needed. To avoid soil erosion, inspect system prior to the wet season and immediately after a large rain event. Fixing gullies will help discourage erosion and additional clogging and ponding.





M3-02 RAIN GARDENS AND STORMWATER PLANTERS TRIGGERED MAINTENANCE

TRIGGERED MAINTENANCE		
Condition Observed	References and Images	Instructions
M3-02-T3 Stormwater Planter- Cracked/ Damaged Liner or Wall		
<ul style="list-style-type: none"> Water seeping out through wall or cracks. Planter appears unusually dry or one of the planters in a series appears dry. 		<ul style="list-style-type: none"> Repair/ seal waterproof liner in accordance with liner manufacturer's requirements. If planter wall is structurally damaged (cracks in wall or breakage of concrete), consult a professional Engineer, Utility Engineer and/or Division Water Resource Engineer to determine whether structure is compromised and to plan for repairs. Replace rain garden/stormwater planter soils, replant and remulch, if necessary.
M3-02-T4 Soil Settlement		
<ul style="list-style-type: none"> Soil has settled two or more inches below paving surface. 		<ul style="list-style-type: none"> Rake mulch aside for later use. Apply prepared rain garden soil mix (use soil mix design per original plans if possible or see reference below for information) to bring soil height within 1 to 2-inches of top of pavement. Add 1 to 2-inches of mulch to bring top of mulch flush with adjacent paving/surface. Replant if necessary to provide vegetative cover over exposed soil. See Rain Garden Handbook for Western Washington Homeowners for further information: http://www.pierce.wsu.edu/Water_Quality/LID/Raingarden_handbook.pdf
M3-02-T5 Pest Control		
<ul style="list-style-type: none"> Pests have been reported to cause extensive plant damage or death and have/could become a nuisance or public health concern. Mosquitoes can breed in shallow stagnant ponding water. 	<div style="display: flex; justify-content: space-around;">   </div> <p>Above photos from: http://en.wikipedia.org</p> <div style="text-align: center;">  </div> <p>See References for resources for pest control.</p>	<ul style="list-style-type: none"> Remove all trash, fruit, and nuts that have fallen to the ground to avoid attracting rodents. Mosquito larvae look like "wiggling sticks" typically floating perpendicular to water's surface. Mosquitoes take 5-7 days to mature. Rain gardens are designed to drain out within 24-48 hours after the rain event has ceased. If stagnant ponding and larvae are observed, then remove ponding (see paragraph on "ponding"). See also Department of Ecology's website for more information on mosquito prevention: www.ecy.wa.gov/news/2003news/2003-046.html Where rodent holes are present, fill with soil and lightly compact soil around the holes.



M3-03 POROUS PAVEMENT REGULAR MAINTENANCE

(Includes Porous Cement, Porous Asphalt, Permeable Pavers, and Rigid/Flexible Open-Celled Paver Systems)

REGULAR / ROUTINE MAINTENANCE		
Recommended Frequency	References and Notes	Instructions
M3-03-R1 Inspect Observation Ports		
<ul style="list-style-type: none"> Visually check observation ports at least two times annually. 		<ul style="list-style-type: none"> Remove cap of observation port. Measure depth between observed water level and top of lid for port. Replace cap securely when done. Keep a record of measurements (including date) in maintenance log. Check O&M Manual for minimum distance between top of observation port and water surface level during dry and wet weather. During rainy weather, the water level will rise within the observation port. However, after the rain event has ceased, the water level at the observation port will drop as the water drains out of the pavement section. If water does not drain out of the observation port after 72 hours after rain has ceased, then the pavement base materials may be clogged or the groundwater table is high.
M3-03-R2 Inspect System for Clogging		
<ul style="list-style-type: none"> Inspect for ponding water (clogging) after heavy rain events (over 1-inch of rainfall in 24 hours). Inspect pavement in early fall. 		<ul style="list-style-type: none"> Check for clogging and reduced permeability. If clogged, clean pavement as described below. If inspecting during dry weather, spray water (e.g. use garden hose) onto areas that appear clogged. If water runs off and does not filter into the pavement, pavement may be clogged. Implement cleaning measures to remove sediment such as using dry broom, pavement vacuum sweepers, or other tools. Remove finer debris with vacuum equipment. Follow manufacturer guidelines for when vacuuming is most effective (e.g. when pavement is dry). With open-celled paver systems, remove debris as described above and replace gravel.




M3-03 POROUS PAVEMENT REGULAR MAINTENANCE

(Includes Porous Cement, Porous Asphalt, Permeable Pavers, and Rigid/Flexible Open-Celled Paver Systems)




REGULAR / ROUTINE MAINTENANCE

Recommended Frequency	References and Notes	Instructions
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M3-03-R3 Manually Sweep Large Debris and Leaves - Porous Cement, Porous Asphalt, Permeable Pavers

<ul style="list-style-type: none"> Once per year in fall or as needed. 		<ul style="list-style-type: none"> Sweep porous pavement manually to maintain appearance and remove large debris such as leaves from pavement. Sweep and rake leaves as soon as leaves drop, preferably when surface and debris is dry. Remove sediment with dry broom, vacuum system or using other equipment.
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M3-03-R4 Vacuum Sweep - Porous Cement, Porous Asphalt, Permeable Pavers

<ul style="list-style-type: none"> Vacuum sweep twice per year. 	  <p>Photos from City of Olympia</p>  <p>Photos from City Bellevue</p>	<ul style="list-style-type: none"> Keep porous pavement surfaces clean to decrease sediment clogging. Vacuum sweep porous pavement to maintain appearance, remove sediment and provide positive infiltration through pavement. Sweep porous pavement to maintain appearance and remove leaves and other debris as required to maintain positive infiltration rate.
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M3-03 POROUS PAVEMENT REGULAR MAINTENANCE




(Includes Porous Cement, Porous Asphalt, Permeable Pavers, and Rigid/Flexible Open-Celled Paver Systems)

REGULAR / ROUTINE MAINTENANCE		
Recommended Frequency	References and Notes	Instructions
M3-03-R5 Mow - Vegetative Paver System		
<ul style="list-style-type: none"> As needed to maintain a height of 3 - inches (usually 1 time per week during summer). 		<ul style="list-style-type: none"> Mow with a mulching mower. Clippings can be left in place.
M3-03-R6 Moss Removal - Porous Cement, Porous Asphalt, Permeable Pavers		
<ul style="list-style-type: none"> As needed if water is unable to infiltrate through the moss covering. 	 <p>Scrubber for cleaning Photos from City of Olympia</p>	<ul style="list-style-type: none"> Moss is a common occurrence in the Pacific Northwest. Some moss will not affect the overall performance of porous pavement; however, if it grows thick and covers a large area, it can possibly reduce infiltration rates. Test infiltration and removal techniques on a small area before proceeding. Use any of the following options: scrubber washing, weed burner, sweeping, vacuum sweeping or a combination of all.
M3-03-R7 Weed - Vegetated Open-Celled Paver System		
<ul style="list-style-type: none"> Bimonthly from March through October. 	 <p>See the Natural Lawn and Garden Natural Pest, Weed and Disease Control for more information: http://www.seattle.gov/util/stellent/groups/public/@spu/@csb/documents/webcontent/natural_pe_200311261701589.pdf</p>	<ul style="list-style-type: none"> Remove weeds with their roots manually using pincer-type weeding tools, or hot water weeders. Reseed bare spots resulting from weeding in lawn areas.



M3-03 POROUS PAVEMENT REGULAR MAINTENANCE




(Includes Porous Cement, Porous Asphalt, Permeable Pavers, and Rigid/Flexible Open-Celled Paver Systems)

REGULAR / ROUTINE MAINTENANCE		
Recommended Frequency	References and Notes	Instructions
M3-03-R8 Weed - Permeable Pavers and Open-Celled Gravel Filled Paver Systems		
<ul style="list-style-type: none"> Bimonthly from March through October. 	 <p>See the Natural Lawn and Garden Natural Pest, Weed and Disease Control for more information: http://www.seattle.gov/util/stellent/groups/public/@spu/@csb/documents/webcontent/naturalpe_200311261701589.pdf</p>	<ul style="list-style-type: none"> Remove weeds manually by their roots with pincer-type weeding tools, or hot water weeders.
M3-03-R9 Trim Ground Covers along Porous Pavement Edge		
<ul style="list-style-type: none"> Bimonthly (minimum) from March through September. 	 <p>Where fast-spreading ground covers are planted adjacent to porous pavement, the ground cover may spread too aggressively and root in the pavement. Ground cover could reduce the pavement's infiltration function.</p>	<ul style="list-style-type: none"> Regularly trim plants along porous pavement edge. Time trimming as needed to keep plants from rooting in adjacent porous pavement. Replace invasive ground covers with non-invasives and re-establish plantings.
M3-03-R10 Sweep Gravel - Permeable Pavers and Gravel Filled Open-Celled Paver System		
<ul style="list-style-type: none"> Once per month or as needed. 		<ul style="list-style-type: none"> Remove and dispose of litter/debris and sweep clean gravel back into gravel pavers areas.



M3-03 POROUS PAVEMENT REGULAR MAINTENANCE

(Includes Porous Cement, Porous Asphalt, Permeable Pavers, and Rigid/Flexible Open-Celled Paver Systems)

REGULAR / ROUTINE MAINTENANCE		
Recommended Frequency	References and Notes	Instructions
M3-03-R11 Topdress Gravel - Gravel Filled Open-Celled Paver System		
<ul style="list-style-type: none"> As needed when gravel has worn away exposing grid cells of gravel pavers. Once per year (minimum). 		<ul style="list-style-type: none"> Refill cells with clean gravel per original designs to top of or slightly above geogrid surface. Follow manufacturer's guidelines for repair of structural components of pavement system grid.
M3-03-R12 Refill Gravel - Permeable Pavers		
<ul style="list-style-type: none"> As needed when gravel has worn away exposing more than paver face. Once per year minimum. 		<ul style="list-style-type: none"> Refill paver voids with the clean gravel from the original design. Follow manufacturer's guidelines.
M3-03-R13 Check for Cracking, Settlement, or Structure Damage for Open Celled and Paver Systems		
<ul style="list-style-type: none"> Inspect once per year or as needed. 		<ul style="list-style-type: none"> Replace the confinement cells if they are damaged. Follow manufacturer guidelines for replacing sections of cells. As necessary, replace clean crushed gravel for gravel filled sections or reseed for vegetative covered sections.
M3-03-R14 Porous Pavement Restoration		
<ul style="list-style-type: none"> Five to thirty years. 	<p>Do not seal coat or black/white top, or overlay porous asphalt and porous cement concrete, since this will seal off permeable</p>	<ul style="list-style-type: none"> If wearing course needs to be replaced, remove wearing course and reinstall porous pavement section. Review with geotechnical engineer if original subbase can be reused for the pavement section or repair/replace as needed.



M3-03 POROUS PAVEMENT REGULAR MAINTENANCE




(Includes Porous Cement, Porous Asphalt, Permeable Pavers, and Rigid/Flexible Open-Celled Paver Systems)

REGULAR / ROUTINE MAINTENANCE		
Recommended Frequency	References and Notes	Instructions
M3-03-R15 Maintenance Log		
<ul style="list-style-type: none"> As needed to document all maintenance activities. 		<ul style="list-style-type: none"> Maintain a log documenting all inspections dates, observations and activities. The maintenance log shall be available upon request by the City.



M3-03 POROUS PAVEMENT TRIGGERED MAINTENANCE




(Includes Porous Cement Concrete, Porous Asphalt, Permeable Pavers, and Rigid/Flexible Open-Cell Paver and Paver Systems)

TRIGGERED MAINTENANCE		
Condition Observed	References and Images	Instructions
M3-03-T1 Stockpiling Landscape Material on Porous Pavement		
<ul style="list-style-type: none"> Materials should not be stockpiled directly on porous surfaces as it will result in clogged pavement. 		<ul style="list-style-type: none"> Remove materials from porous surface and vacuum sweep area. To reduce additional clogging, ensure any potential runoff does not come into contact with porous pavement. Cover pavement with impermeable material (tarp or plastic) and place stockpile on tarp. Cover stockpiled material to prevent erosion, if not used immediately. Alternatively, stockpile material away from (not on) porous pavement.
M3-03-T2 Exposed soils upslope of porous pavement		
		<ul style="list-style-type: none"> Permanently stabilize exposed soils that may erode onto porous pavement. Till, plant/seed and mulch area immediately to avoid sediment overflow onto pavement caused by erosion. Remove accumulated sediment from the surface with dry broom, vacuum system or other tools.
M3-03-T3 Sediment Washouts		
<ul style="list-style-type: none"> Watch for washouts from planted areas where soil, mulch, or sediment is deposited on porous pavement. 		<ul style="list-style-type: none"> Clear soil/sediment/mulch immediately and vacuum sweep area. Stabilize adjacent landscape areas from erosion by maintaining full vegetative cover (plants/turf). Monitor washout occurrences to identify problem areas.



M3-03 POROUS PAVEMENT TRIGGERED MAINTENANCE



(Includes Porous Cement Concrete, Porous Asphalt, Permeable Pavers, and Rigid/Flexible Open-Celled Paver and Paver Systems)

TRIGGERED MAINTENANCE		
Condition Observed	References and Images	Instructions
M3-03-T4 Repairs/ Patching		
<ul style="list-style-type: none"> Damaged porous asphalt/ cement, or when utility cut needed. 		<ul style="list-style-type: none"> Implement measures to protect porous pavement to remain (such as covering adjacent landscaping areas with tarp, avoid stockpiling material on porous pavement, and vacuum to collect saw cut slurry during removal operations). Patch with same porous material including clean subbase material per original design. When needed, use temporary patch until full panel can be replaced. Determine source of breakage, (e.g. using pavement not as intended such as vehicles driving over sidewalk) and implement preventative measures to avoid future occurrences.
M3-03-T5 Damaged Permeable Pavers, and Open-Celled Paver System		
		<ul style="list-style-type: none"> Replace sections of confinement cells if they are damaged or uplifted. See manufacturer's repair recommendations. Restore with same porous pavement section as original design. Replace gravel (when 10% loss occurs) for gravel-filled sections or reseed for vegetative cover sections.
M3-03-T6 Cracked Porous Cement Concrete and Porous Asphalt		
		<ul style="list-style-type: none"> Determine source of breakage, (e.g., using pavement not as intended such as vehicles driving over sidewalk) and implement preventative measures to avoid future occurrences. Replace full panel, joint to joint, for substantial cracks. Provide protective cover for undamaged pavement section to remain. Patch with porous section per original design.





M3-03 POROUS PAVEMENT TRIGGERED MAINTENANCE

(Includes Porous Cement Concrete, Porous Asphalt, Permeable Pavers, and Rigid/Flexible Open-Celled Paver and Paver Systems)

TRIGGERED MAINTENANCE		
Condition Observed	References and Images	Instructions
M3-03-T7 Snow Removal - Porous Asphalt, Porous Cement Concrete or Permeable Pavers		
		<ul style="list-style-type: none"> Do not apply sand on porous pavement. Sand can clog pavement. In the case of an emergency and sanding is required for safety measures, remove sand/sediment via vacuum sweeping or other measures as soon as road is dry. If using snow plow, test small area first and then adjust plow height as needed to minimize scarring of pavement. If possible, use a snow plow with skids or rollers to keep the blade slightly above the pavement surface. Restore or readjust pavers displaced by snow removal. During snow melt, if water is not draining through pavement then remove debris and sediment that is clogging pores via vacuum sweeping or other measures.
M3-03-T8 Washout of Fresh Concrete or Other Materials Spilling onto Pavement		
<ul style="list-style-type: none"> (e.g. Fresh concrete from a mixer truck is washed onto porous pavement.) 		<ul style="list-style-type: none"> Let material harden, then remove, and replace sections affected and reinstall with full pavement section per original design. Implement notification measures to workers in the area of location of permeable pavement prior to construction beginning. Porous pavements should not be used in areas with hazardous materials (e.g. fueling stations etc.). However, if oil or gas spills onto porous pavement, remove full section to depth of spill and dispose of contaminated material. Replace section in its entirety.



M3-04 VEGETATED ROOF REGULAR MAINTENANCE

REGULAR / ROUTINE MAINTENANCE		
Recommended Frequency	References and Notes	Instructions
M3-04-R1 Observation Ports		
<ul style="list-style-type: none"> Visually check observation ports at a minimum twice per year in fall and spring. 		<ul style="list-style-type: none"> Inspect for ponding water. Check and clean out debris from drains and overflow systems. During rainy weather, ponding may occur on the vegetated roof. After the rain event, the water level in the Observation Port should go down if the system is functioning properly.
M3-04-R2 Weed Control		
<ul style="list-style-type: none"> New (less than 3 years) vegetated roofs require intensive monitoring and inspection. Inspect for weeds every two weeks. To control weeds within an established vegetated roof, inspect and remove weeds at least four times per year (March, May, July, and September). 	 <p>See the Natural Lawn and Garden Natural Pest, Weed and Disease Control for more information: http://www.seattle.gov/util/stellent/groups/public/@spu/@csb/documents/webcontent/naturalpe_200311261701589.pdf See Washington State University - Hortsense for additional information: http://pep.wsu.edu/hortsense/weedmanage.html Please refer to the King County Hazardous Waste - Natural Lawn care and IPM: http://www.govlink.org/hazwaste/house/yard/lawn/chemicals.html</p>	<ul style="list-style-type: none"> Prune and manually weed to maintain appearance. Remove all plant waste. The inspector may adjust inspection frequency in accord with seasonal variations in weed growth, but at no time should the interval be long enough to allow for any weed to flower and set seed. Weeds need to be pulled as early in spring as possible so that the desired plants can thrive. When dealing with invasive plants material/weeds, attempt all other physical methods to remove before considering a more aggressive method. It is important to note that chemicals can harm or kill beneficial or desirable plants, and also add pollutants to stormwater that can negatively impact water quality. The need for herbicides is a sign of weeding too infrequently.




M3-04 VEGETATED ROOF REGULAR MAINTENANCE

REGULAR / ROUTINE MAINTENANCE

Recommended Frequency	References and Notes	Instructions
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M3-04-R3 *Inspect and Replace Diseased/Dead Vegetation*

<ul style="list-style-type: none"> Inspect vegetated roof for missing plants or thin areas twice per year. 	 <p>Exposed areas (missing vegetation) will increase evaporation rates and potentially allow weeds to establish.</p>	<ul style="list-style-type: none"> Vegetation should cover the vegetated roof as per original design. If planting is thinning, replant per original design.
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M3-04-R4 *Inspect Vegetated Roof for water damage*


<ul style="list-style-type: none"> Inspect roof ceiling for water damage which will be an indication of leakage. Inspect structural components per design / manufacturer's guidelines. 	 <p>Please refer to the Low Impact Development Center's "Quality Assurance for Nonpoint Source Best Management Practices": http://www.lowimpactdevelopment.org/qapp/greenroofs_maintain.htm</p>	<ul style="list-style-type: none"> Contact manufacturer or installation company for repair of torn waterproof membrane. Follow manufacturer's guidelines for review of roof. Roofs can leak from drainage backups or root puncture or if the correct waterproofing membrane system, root barrier, and/or drainage layer were not selected or installed. Most roofing companies, including those that install green roofs, will provide a warranty for the waterproofing integrity of the roof membrane(s) that they have installed, including green roof membranes.
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M3-04-R5 *Inspect Growing Medium for Ponding or Excessive Moisture*

<ul style="list-style-type: none"> Inspect monthly from October through March. Inspect midsummer. 		<ul style="list-style-type: none"> Check that water infiltrates within time specified per original design. If it doesn't infiltrate, clear blocked drains (pipes and structures) and till soils as needed. Check conditions of irrigation system for leaks in the irrigation network.
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M3-04 VEGETATED ROOF REGULAR MAINTENANCE

REGULAR / ROUTINE MAINTENANCE		
Recommended Frequency	References and Notes	Instructions
M3--4-R6 <i>Inspect Growing Medium for Erosion (water and/or wind scour)</i>		
<ul style="list-style-type: none"> Inspect monthly from October through March. Inspect once in July. 	<ul style="list-style-type: none"> If continuous, consult with professional installer to determine cause of erosion and remedy. 	<ul style="list-style-type: none"> Check for erosion and fill any gullies/rills that are more than 2 - inches deep with specified roof soil medium. Restore soil section and plantings per original design.
M3-04-R7 <i>Inspect Growing Medium for Crusting, Dry or Shrinking Medium</i>		
<ul style="list-style-type: none"> Inspect growing medium early summer and early fall. 		<ul style="list-style-type: none"> Amend soils and rake as needed to restore texture and filtration capabilities. If condition persists, consult professional installer for additional information.
M3-04-R8 <i>Clear Drains and Overflow System</i>		
<ul style="list-style-type: none"> Inspect and clean drains, downspouts and/or scuppers, of debris and/or sediment monthly during the rainy season. Inspect drains and overflows in fall after deciduous leaves have fallen, or as needed. 		<ul style="list-style-type: none"> Clear out all debris and sediment to maintain free drainage.



M3-04 VEGETATED ROOF REGULAR MAINTENANCE






REGULAR / ROUTINE MAINTENANCE

Recommended Frequency	References and Notes	Instructions
M3-04-R9 Watering		
<ul style="list-style-type: none"> • During the plant establishment period (first three months) the vegetation will require watering. Consult manufacturer's guidelines for frequency. • Generally, new vegetated roofs may require watering (season dependent) 2 to 3 times per week to achieve approximately 1-inch of water per week. Consult manufacturer's guidelines for frequency. • Once vegetation is established, irrigation requirements are reduced. Consult manufacturer's guidelines for frequency. 	 <p>See Watering to Establish Your New Plant: http://www.ci.mercer-island.wa.us/Files/Watering%20Your%20New%20Plants.pdf</p>	<ul style="list-style-type: none"> • Intent of watering is to keep plant material sustained through establishment. • Monitor rainfall to determine irrigation/watering schedule. • Dry periods will require additional watering (especially during plant establishment) due to warmer temperatures and increased sunlight, both of which can stress vegetation. Wilted leaves and drooping stems are all indications of stress caused by dry soils and hot temperatures. • Optimal watering time is early in the morning or late in the evening to reduce evaporation. • For vegetated roofs with automatic irrigation systems - follow irrigation system manufacturer's guidelines for specific system's operations and maintenance.
M3-04-R10 Maintenance Log		
<ul style="list-style-type: none"> • As needed to document all maintenance activities. 		<ul style="list-style-type: none"> • Maintain a log documenting all inspection dates, observations, and activities. List repairs and contractors. • The maintenance log shall be available upon request by the City.

Note: Vegetated roof structural components shall be operated and maintained per manufacturer's instructions.




M3-05 RAIN RECYCLING REGULAR MAINTENANCE

REGULAR / ROUTINE MAINTENANCE		
Recommended Frequency	References and Images	Instructions
M3-05-R1 Sediment Removal		
<ul style="list-style-type: none"> Inspect early fall and late spring and clean out as necessary. 	 	<ul style="list-style-type: none"> Inspect cistern or rain barrel and remove any accumulated sediment in the bottom.
M3-05-R2 Inspect Gutters and Downspouts, Downspout Screens, Rain Barrel Screens		
<ul style="list-style-type: none"> Inspect and remove debris in late spring and early fall. Check screen weekly in late summer for insects and mosquito larvae. Inspect connections in early spring and late fall. 		<ul style="list-style-type: none"> Downspouts which supply water to rain barrels must be kept clear and clean of debris. Inspect for any leaks, debris, and blockages. Screens should be maintained in good condition. Mosquito larvae look like "wiggling sticks" floating perpendicular to water's surface. Inspect and ensure overflow is clear and in working order.
M3-05-R3 Close the Outlet Pipe Valve		
<ul style="list-style-type: none"> Mid-spring but begin to monitor overflow weekly. 		<ul style="list-style-type: none"> Close the valve on the outlet pipe midspring to harness rainwater for irrigation during dry summer months.
M3-05-R4 Open the Outlet Pipe Valve		
<ul style="list-style-type: none"> Mid-fall. 		<ul style="list-style-type: none"> Open the valve on the outlet pipe to slowly release stored rain and disperse it over the landscape area. Keep valve open during winter to avoid water back up.



M3-06 AMENDED SOILS REGULAR MAINTENANCE

REGULAR / ROUTINE MAINTENANCE		
Recommended Frequency	References and Images	Instructions
M3-06-R1 Protect from Compaction and Erosion		
<ul style="list-style-type: none"> Ongoing monitoring. Aerate lawns yearly. Turn over landscape areas in late spring and early fall. 		<ul style="list-style-type: none"> Protect amended areas and landscaped areas from vehicle access, maintenance equipment, and excessive foot traffic to prevent compaction. Boulders, shrubs, ground covers, and fencing can be used to limit traffic in the amended area. Install stepping stones if foot traffic is not preventable.
M3-06-R2 Maintain Landscape Areas and Pervious Footprint for Site		
<ul style="list-style-type: none"> Inspect yearly. 		<ul style="list-style-type: none"> Avoid converting landscape areas and permeable pavements to impervious areas. Landscaped areas with amended soils can restore soil water infiltration and storage capacities, as well as decrease surface water runoff and erosion.
M3-06-R3 Add Compost Mulch and Allow Plant Debris to Remain on Soil		
<ul style="list-style-type: none"> Spring and Fall. 	<p>Compost helps to control weeds, conserves soil moisture, improves filtration, regulates soil temperatures, and adds nutrients.</p> <p>See The Natural Lawn and Garden- Growing Healthy Soils: http://www.ci.bellevue.wa.us/pdf/Utilities/Healthy_Soil.pdf</p> <p>See Building Soil-Guidelines and Resources for Implementing Soil Quality and Depth: http://www.soilsforsalmon.org/pdf/Soil_BMP_Manual.pdf</p>	<ul style="list-style-type: none"> In vegetative areas, apply 2 to 3-inches of compost layer carefully to avoid smothering and damaging plants. Allow plant debris to remain on soil to replenish organic matter. For areas in rain gardens, see maintenance section on <i>Rain Gardens and Stormwater Planter</i>. In turf areas, consider aerating then applying 1/2 to 1-inch of fine screen compost and over seed.



M3-07 EQUIPMENT AND MATERIALS

M3-07 EQUIPMENT AND MATERIALS

The following equipment is recommended for use (purchase or rental) by maintenance personnel to ensure efficient and proper maintenance.

M3-07 Power Equipment*

- Riding Mulch Mower - to be used for lawn areas where feasible.
- Walk-behind Power Mulch Mower - to be used for lawn areas where a riding mower is not practical or accessible (small areas, steeper slopes).
- Power Trimmer - to be used for cutting grass where a mower cannot reach.
- Power Edger - for redefining lawn edge along walks, driveways and planted areas.
- Power Core Aerator - to be used for aeration of lawn areas.
- Power Lawn Vacuum - for vacuuming up aeration plugs in lawn areas. It may be possible to locate a multi-purpose vacuum for both hard surface and lawn applications.
- Power Overseeder - for applying lawn seed following aeration.
- Power Thatcher - for thatch removal of lawn areas.
- Chipper – For breaking down woody material to be composted on-site or hauled away as green waste.
- Golf Cart - for moving crews and equipment between areas.
- Vacuum Sweeper - for vacuuming debris and sediment from porous paving areas. Equipment can be rented or the tasks contracted to an outside maintenance provider.

* It is recommended to use equipment that minimizes pollution generation. When available, consider using equipment that meets stricter clean air and noise requirements equivalent to State of California.



M3-07 EQUIPMENT AND MATERIALS

M3-07 EQUIPMENT AND MATERIALS

The following equipment is recommended for use (purchase or rental) by maintenance personnel to ensure efficient and proper maintenance.

M3-07 Manual Equipment

- Blade Sharpeners.
- Bypass Pruner - for shrub and perennial pruning and deadheading. Look for $\frac{3}{4}$ - inch to 1 - inch curved blades.
- Cultivator/fork - for turning material at on-site compost facility.
- Gloves - leather and cloth.
- Hand Tamper – for compacting NDS soils in drainage swales.
- Long-reach Pruners - for areas not easily accessible. Choose pruners with a 4 to 5 - foot long handle and cut and hold feature.
- Loppers - for pruning shrubs and smaller tree branches. Look for 24 to 36 - inch handles and 2 - inch curved blades.
- Manual Edger – for redefining lawn edge where power edger is not possible.
- Manual Seed Broadcaster - for applying lawn seed following aeration, in place of power overseeder.
- Pincer-type Weeders – long-handled weeder for pulling weeds with their roots.
- Short handled pick or Japanese sickle tool.
- Pruner Grease or Lubricant.
- Push Broom.
- Rakes - metal construction, seeding rakes and lawn rakes, including narrow width for raking in planted areas.
- Shovels - flat, spade, transplanting spade. Various widths and lengths.
- T-handle Soil Core Sampler or Soil Augur – for collecting samples in lawn areas for monitoring soil texture, color, compaction and running pH tests.
- Tree Pruner - for trimming branches. Choose pruners with a 10 to 14 - foot long handle, and saw blade and lopper combo.
- Wheelbarrow – for transporting soil, mulch, plants and other landscape materials as needed.

M3-07 Other Equipment/ Specialty Items

- Flame Weeders - a set of propane flames that are used to burn weeds. They are best used over paved or larger weedy areas and are not appropriate for planted areas where they can potentially cause damage to plants. Small, single-flame weeders may be appropriate for use in lawn and planted areas.
- Hot water weeders - for hand weeding of lawn and bed areas.
- Small on-site composting bins – these are bins similar to those used at local P-patches. They are larger than residential bins, but small enough that they do not require large yard spaces, anything more than manual turning or regulation.

CHAPTER M4 - SOURCE CONTROL

M4-01 GENERAL

Source Control is the prevention of the release of pollutants associated with site activities to the storm and surface water system. Source control is a much more effective method of protecting surface water quality than water quality treatment, which acts after the contamination has occurred. Source control BMPs include both operational and structural BMPs. Operational source control BMPs includes operational good housekeeping practices and preventative actions. Structural source control BMPs may be required through either the new development/redevelopment permitting process or through the application of these maintenance standards or in response to illicit discharges.

M4-02 OPERATIONAL SOURCE CONTROL BMPS

M4-02.1 Good Housekeeping

1. Promptly contain and clean up solid and liquid pollutant leaks and spills such as oils, solvents, fuels, dust from manufacturing operations, garbage and leachate from dumpsters on any exposed soil, vegetation, or paved area.
2. Clean up pollutant liquid leaks and spills in impervious uncovered containment areas at the end of each working day.
3. Sweep paved material handling and storage areas regularly as needed, for the collection and disposal of dust and debris that could contaminate stormwater. Do not hose down pollutants from any area to the ground, storm drain, conveyance ditch, or receiving water unless approved by the Utility.
4. Repair or replace all substantially cracked or otherwise damaged paved secondary containment, high-intensity parking and any other drainage areas which are subjected to pollutant material leaks or spills.
5. Promptly repair or replace all leaking connections, tanks, pipes, hoses, and valves which can contaminate stormwater.
6. Use solid absorbents for cleanup of liquid spills/leaks, where practicable.
7. Recycle materials such as oils, solvents, and wood waste to the maximum extent practicable.

M4-02.2 Preventative Maintenance

1. Prevent the discharge of unpermitted liquid or solid wastes, process wastewater, and sewage to ground water, surface water, storm drains, or to the ground.
2. Do not connect floor drains to storm drains, surface water, or to the ground.

3. Conduct all oily parts cleaning, steam cleaning, or pressure washing of equipment or containers inside a building or on an impervious contained area such as a concrete pad. Direct contaminated stormwater from such an area to a sanitary sewer where allowed by the Utility, or to other approved treatment.
4. Do not pave over contaminated soil unless it has been determined that ground water has not been and will not be contaminated by the soil. Call the Washington State Department of Ecology for assistance.
5. Construct impervious areas using compatible materials with the materials handled. Portland cement concrete, asphalt, or equivalent material may be considered.
6. Use drip pans to collect leaks and spills from industrial/commercial equipment which are stored outside.
7. Drain oil and fuel filters before disposal. Discard empty oil and fuel filters, oily rags and other oily solid waste into appropriately closed and properly labeled containers, and in compliance with the Uniform Fire Code.
8. Store liquids in containers, such as steel and plastic drums, that are rigid and durable, corrosion resistant to the weather and fluid content, non-absorbent, water tight, rodent-proof, and equipped with a close fitting cover.
9. Keep solid wastes contaminated with liquids or other potential pollutant materials in containers which are durable, corrosion resistant, non-absorbent, non-leaking, and equipped with either a solid cover or screen cover to prevent littering. If covered with a screen, the container must be stored under a lean-to or equivalent structure.
10. Where exposed to stormwater, use containers, piping, tubing, pumps, fittings, and valves that are appropriate for their intended use and for the contained liquid.
11. Where feasible, store potential stormwater pollutant materials inside a building or under a cover and/or containment.
12. Minimize the use of toxic cleaning solvents, such as chlorinated solvents, and other toxic chemicals.
13. Substitute environmentally safer raw materials, products, and additives where feasible.
14. Recycle waste materials such as solvents, coolants, oils, degreasers, and batteries to the maximum extent feasible.
15. Empty drip pans immediately after a spill or leak is collected.
16. Stencil warning signs at stormwater catch basins and drains, e.g., "Dump no waste."

M4-02.3 Spill Prevention and Cleanup

1. Immediately upon discovery, stop, contain, and clean up all spills.
2. If pollutant materials are stored on-site, have spill containment and cleanup kits readily accessible.
3. If the spill has reached or may reach a sanitary or a storm sewer, ground water, or surface water notify the Utility immediately. Notification must comply with all state and federal spill reporting requirements. Spills into the storm and surface water system are a violation of Bellevue City Code 24.06.125.
4. Do not flush absorbent materials or other spill cleanup materials to a storm drain. Collect the contaminated absorbent material as a solid and place in appropriate disposal containers.
5. Place and maintain emergency spill containment and cleanup kit(s) at outside areas where there is a potential for fluid spills. These kits should be appropriate for the materials being handled and the size of the potential spill.

It is recommended that the kit(s) include salvage drums or containers, such as high density polyethylene, polypropylene or polyethylene sheet-lined steel; polyethylene or equivalent disposal bags; an emergency response guidebook; safety gloves/clothes/equipment; shovels or other soil removal equipment; and oil containment booms and absorbent pads; all stored in an impervious container.

M4-02.4 Employee Training

Train all employees that work in pollutant source areas in identifying pollutant sources and in understanding pollutant control measures, spill response procedures, and environmentally acceptable material handling practices - particularly those related to vehicle/equipment liquids such as fuels, and vehicle/equipment cleaning. Use the Washington Department of Ecology's "Stormwater Pollution Prevention Planning for Industrial Facilities" (WQ-R-93-015, 9/93) as a training reference. Provide ongoing refresher training for existing employees as well as training for new employees.

M4-03 **STRUCTURAL SOURCE CONTROL BMPS**

Structural source control BMPs shall be designed and implemented in compliance with the City of Bellevue Utilities Department Surface Water Engineering Standards and Volume IV of the Washington Department of Ecology's Stormwater Management Manual for Western Washington (2005 or as subsequently revised).

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REFERENCES

Bellevue. 2010. Utilities Surface Water Engineering Standards, City of Bellevue Utilities Department. http://www.bellevuewa.gov/doc_library.htm

Ecology. 2005. Stormwater Management Manual for Western Washington, 99-11 through 99-15. Washington Department of Ecology, Olympia, WA. <http://www.ecy.wa.gov/programs/wq/stormwater/manual.html>

Building Soil: Guidelines and Resources for Implementing Soil Quality and Depth BMP T5.13 in WDOE Stormwater Management Manual for Western Washington 2007 Edition http://www.soilsforsalmon.org/pdf/Soil_BMP_Manual.pdf

City of Bellevue Utilities Natural Drainage Practices Pilot Project Training Materials Dec. 2006

City of Bellevue Parks and Community Services Department's Best Management Practices Manual (See Chapter 2)
http://bellevuewa.gov/pdf/Document%20Library/2006_EBMP_DS_Manual.pdf

City of Portland 2008 Stormwater Management Manual
<http://www.portlandonline.com/bes/index.cfm?c=47952&>

High Point Community Right of Way and Open Space Landscape Maintenance Guidelines Dec. 2006 by SvR Design Company
<http://www.svrdesign.com/docs/High%20Point%20ROW%20and%20Landscape%20Maintenance%20Guidelines%20-%202012-21-06.pdf>

Low Impact Development: Technical Guidance Manual for Puget Sound Jan. 2005 by Puget Sound Action Team and WS U Pierce County Extension
http://www.psparchives.com/publications/our_work/stormwater/lid/LID_manual2005.pdf

Maintenance of Low Impact Development Facilities Revised Jan. 2007 by WSU Pierce County Extension and AHBL for Puget Sound Action League
http://www.psparchives.com/publications/our_work/stormwater/lid/D_RevisedMaintenanceofLIDFacilities.pdf

The Natural Lawn and Garden- Growing Healthy Soil
http://www.ci.bellevue.wa.us/pdf/Utilities/Healthy_Soil.pdf

The Natural Lawn and Garden- Natural Pest, Weed & Disease Control
http://www.seattle.gov/util/stellent/groups/public/@spu/@csb/documents/webcontent/naturalpe_200311261701589.pdf

The Natural Lawn and Garden- *Choosing the Right Plants for a Trouble-Free Garden*

http://www.seattle.gov/util/stellent/groups/public/@spu/@csb/documents/webcontent/ch_oosingt_200311261701525.pdf

***Rain Garden Handbook for Western Washington Homeowners* by WSU Pierce County Extension**

http://www.pierce.wsu.edu/Water_Quality/LID/Raingarden_handbook.pdf

***Quality Assurance for Nonpoint Source Best Management Practices* by The Low Impact Development Center**

http://www.lowimpactdevelopment.org/gapp/greenroofs_maintain.htm

ADDITIONAL RESOURCES

King County Resources

King County Solid Waste Division - Composting and Soils

<http://www.metrokc.gov/soils>

King County Public Health Rodent Control

<http://www.kingcounty.gov/healthservices/health>

King County Northwest Yard and Garden

<http://www.kingcounty.gov/environment/stewardship/nw-yard-and-garden.aspx>

King County Noxious Weeds

<http://www.kingcounty.gov/environment/animalsAndPlants/noxious-weeds.aspx>

Integrated Pest Management in King County

<http://www.govlink.org/hazwaste/interagency/ipm/index.cfm>

Water Saving in the Garden. Some basic facts about cisterns and rainbarrels.

<http://dnr.metrokc.gov/wlr/pi/pdf/cistern-water-saving.pdf>

King County Hazardous Waste - Natural Lawn care and IPM

<http://www.govlink.org/hazwaste/house/yard/lawn/chemicals.html>

King County Native Plant Resources

<http://www.kingcounty.gov/environment/stewardship/nw-yard-and-garden/native-plant-resources-nw.aspx>

Washington State University Resources

WSU Extension Master Gardener Program

<http://gardening.wsu.edu/>

WSU Cooperative Extension - Stewardship Gardening
<http://gardening.wsu.edu/stewardship>

WSU Extension – Weeds
<http://gardening.wsu.edu/text/weed.htm>

WSU King County Extension Watering and Mulching Fact Sheet
<http://king.wsu.edu/gardening/documents/11WateringandMulching.pdf>

WSU Extension - Native Plants: Identifying, Propagating and Landscaping
<http://gardening.wsu.edu/nwnative/>

WSU - Hortsense:
<http://pep.wsu.edu/hortsense/weedmanage.html>

Plant Resources

Washington Native Plant Society
<http://www.wnps.org>

Native Plant Nurseries in Washington
http://www.plantnative.org/nd_wa.htm

Plant Amnesty Pruning Guide
http://www.plantamnesty.org/pruning_guides/pg_northwest_pacific_maritime.htm

Native Plant Salvage Foundation
<http://nativeplantsalvage.org>

The Plant List - A Companion to the Choosing the Right Plants Natural Lawn and Garden Guide:
<http://www.savingwater.org/docs/plantlist.pdf>

Water Conservation and Water-wise Landscaping

Saving Water Partnership
<http://www.savingwater.org>

Watering to Establish your New Plants (Saving Water Partnership)
<http://www.ci.mercer-island.wa.us/Files/Watering%20Your%20New%20Plants.pdf>

Natural Lawn and Garden Handbook, Healthy Landscapes for a Healthy Environment - Smart Watering
http://www.ci.bellevue.wa.us/pdf/Utilities/Smart_Watering.pdf

Natural Yard Care

Natural Yard Care: Five steps to make your piece of the planet a healthier place to live.
http://www.ci.bellevue.wa.us/pdf/Utilities/Five_easy_steps.pdf

El cuidado natural del jardín: Cinco pasos para hacer su pedazo del planeta un lugar más sano para vivir.
http://www.seattle.gov/util/stellent/groups/public/@spu/@csb/documents/webcontent/spu01_002254.pdf

Ecologically Sound Lawn Care for the Pacific Northwest - Integrated Pest Management: Preventive Health Care for Lawns (pages: 42-49)
http://www.seattle.gov/util/stellent/groups/public/@spu/@csb/documents/webcontent/ecological_200312021255394.pdf

Department of Ecology: Mosquito Prevention. "Preparing for West Nile Virus Needn't Harm the Environment." www.ecy.wa.gov/news/2003news/2003-046.html

Porous Pavement

City of Olympia Maintenance reports for Porous Pavement
www.olympiawa.gov/cityutilities/stormwater/scienceandinnovations/porouspavement.htm

National Ready Mixed Concrete Association & Pervious Concrete web page
www.nrmca.org

City of Portland 2008 Stormwater Management Manual, Chapter 3: "Simplified Operations and Maintenance Specifications Pervious Pavement"
<http://www.portlandonline.com/bes/index.cfm?c=47952&>

See also manufacturers' guidelines for proprietary paver and open-celled porous pavement systems for O&M recommendations

APPENDIX M-1

D2-09 OPERATION AND MAINTENANCE MANUAL

An operation and maintenance manual (O & M Manual), shall be provided for all flow control and treatment facilities that will not be City owned and operated, including on-site stormwater management facilities, and constructed source controls. As a minimum, the manual will include:

- The name of the party (or parties) responsible for maintenance and operation of the system, such as a Home Owners association, management company or the legal property owner.
- Property legal description, address, and project name, if applicable.
- Agreement to maintain facilities in accordance with City of Bellevue and the Washington State Department of Ecology's Maintenance standards.
- A log of maintenance activities that indicates what actions have been taken, when and by whom. Log shall be kept available for inspection by City of Bellevue at any time. See Figure 2.4 below for recommended activity log format.
- Prominently note the manual and log sheets location on site.
- Maintenance instructions for any components not covered by the maintenance standards referenced above.
- The engineers narrative description of the storm drainage system and how it is intended to function.
- Site diagram of the constructed (As- Built) storm drainage system indentifying it's components, with profiles as needed.
- As-Built details of components, particularly flow control and treatment facilities, as needed for maintenance

A draft must be submitted to the Utilities Department during the plan review process. The final Operation and Maintenance Manual must be approved by the Utilities prior to Utility Extension acceptance, where applicable, or prior to occupancy. The O & M Manual must conform to King County's recording format requirements and be recorded against the property, as a covenant running with the land.

A copy of the manual shall be retained onsite or within reasonable access to the site, and shall be transferred with the property to the new owner. The manual and log sheets must be available for inspection by the City of Bellevue upon request.

The O&M Manual shall be adjusted or revised at the end of the one (1) year warranty period, if needed, as a result of inspection findings and recommendations by the City. The revised O & M Manual shall be recorded against the property.

List regularly scheduled maintenance on a separate checklist based on the facility's Operations and Maintenance Manual and keep the checklist with the maintenance activity log.

A sample "Maintenance Activity Log" is shown in Figure 2.4.

Figure 2.4 - Sample Stormwater Facility Maintenance Activity Log

To be completed by maintenance staff and provided to the City of Bellevue upon request.

Property Name/Owner:	Site Address:
Property Manager/Contact:	Phone:
Facility Type:	Location on Property:
Requirement met by Facility (circle all that apply):	
On-site Stormwater Management Treatment/Water Quality Flow Control	

Date	Reason for Inspection/Action (circle one)	Condition Observed	Action Taken	Initials
	Complaint or Problem Regular Maintenance			
	Complaint or Problem Regular Maintenance			
	Complaint or Problem Regular Maintenance			
	Complaint or Problem Regular Maintenance			
	Complaint or Problem Regular Maintenance			
	Complaint or Problem Regular Maintenance			
	Complaint or Problem Regular Maintenance			
	Complaint or Problem Regular Maintenance			