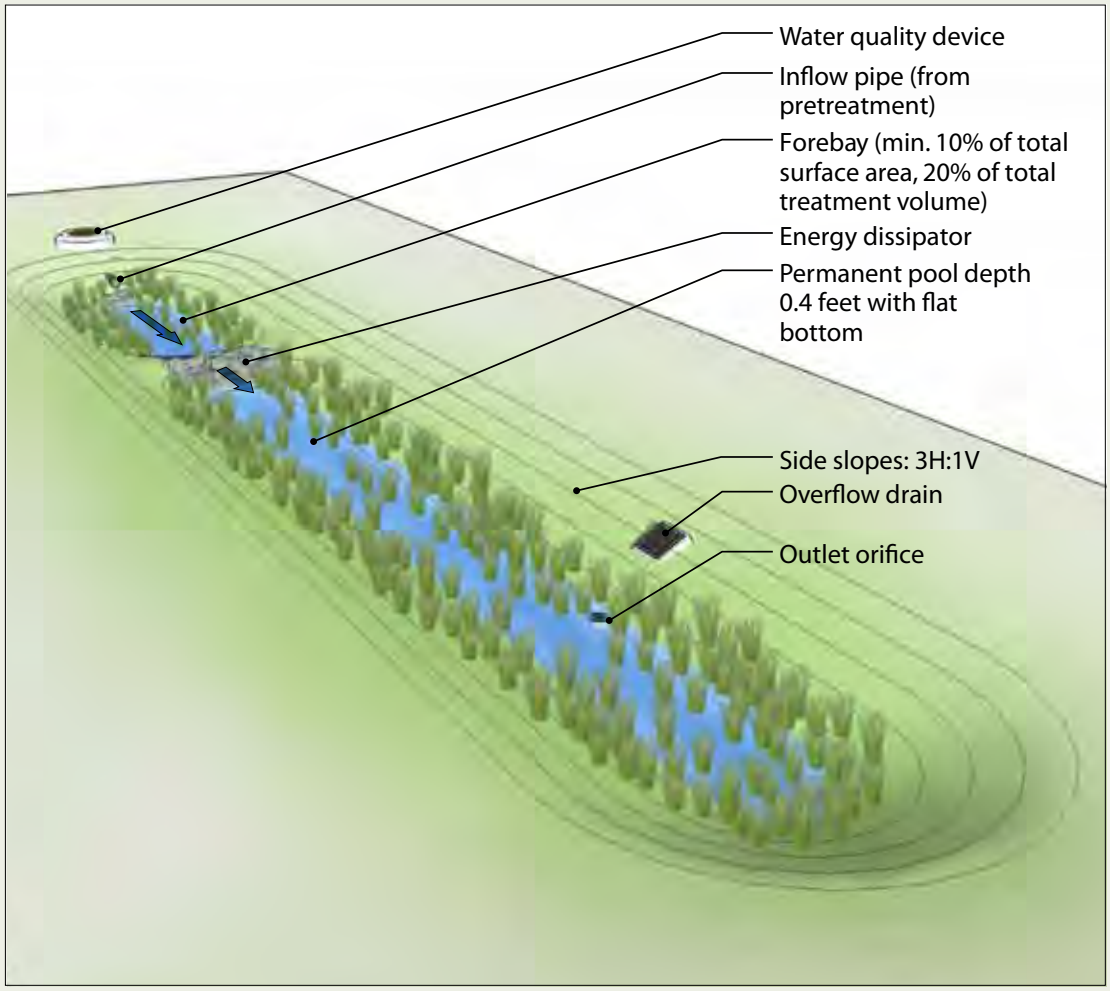
Water Quality Facility Management Program

Maintenance and Inspection Guide

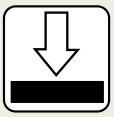
August 2010

Environmental Services Division
Water Resource Section

Water Quality Ponds and Basins



parking areas & impermeable landscape



impermeable soils

permeable soils

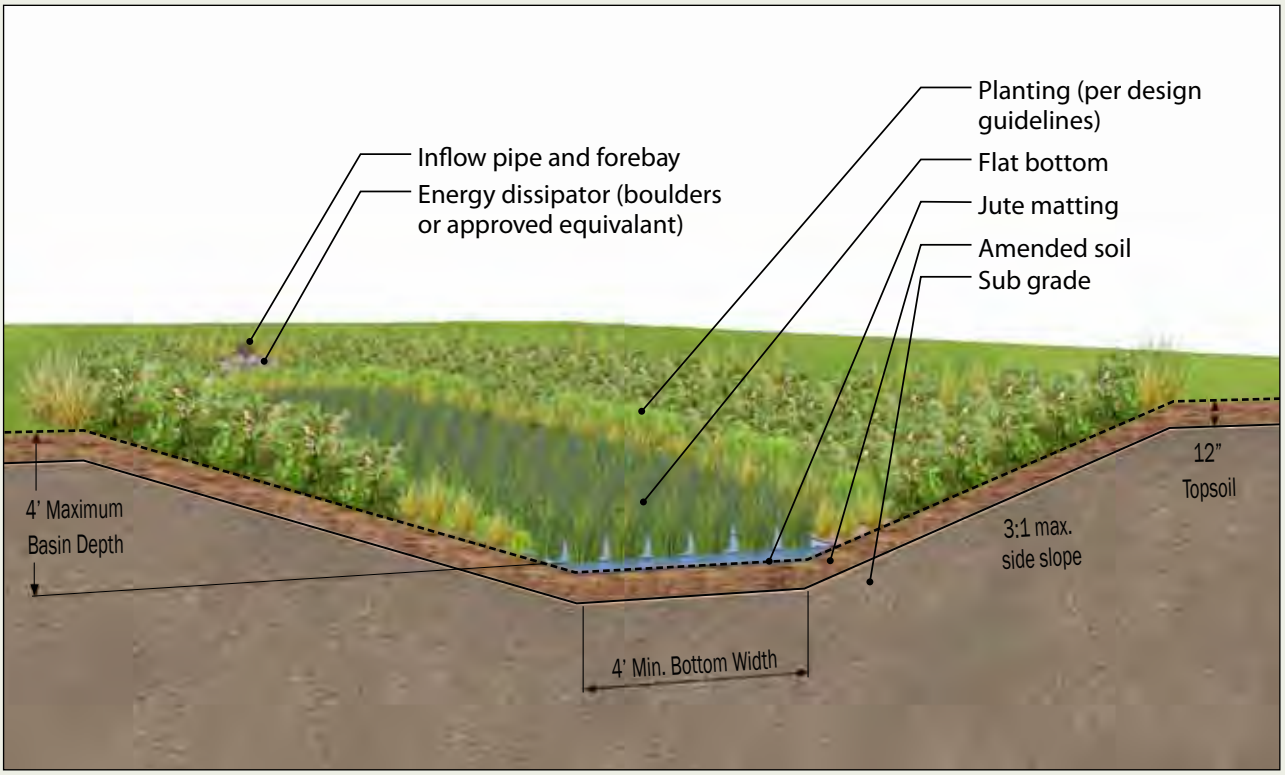
Description

Water quality ponds and basins are shallow landscaped depressions with a flat bottom that collects and holds stormwater runoff, allowing pollutants to settle and filter out as the water infiltrates into the ground or is discharged to an approved stormwater system or location. An extended dry basin has two or more cells (the first cell is the forebay). An inflow pipe conveys stormwater into the basin or pond where it is temporarily stored.

Application & Limitations

Ponds and basins may help fulfill a site's landscaping area requirement. This type of facility is approved to treat stormwater from most types of impervious surfaces, including private property and the public right-of-way, rooftops, parking lots, and streets.

Home Depot, Glenn Widing Drive, North Portland



Design Factors

Sizing

Sizing of the detention basin is determined by the volume of runoff and the detention period required for treatment. At a minimum, the detention basin must accommodate the water quality design storm and be sized for a 48 hour drawdown time.

The minimum water quality detention volume is equal to (1) x the water quality volume (WQV). The outlet orifice size is determined by the following equation:
D = 24 * [(Q/ (C[2gH]0.5) / pi] 0.5
Where:
D (in) = diameter of orifice
Q(cfs) = WQV(cf) /(48*60*60)
C = 0.62
H(ft) = 2/3 x temporary detention height to centerline of orifice.

Geometry/Slopes

An extended dry basin has two or more cells. The first cell, the forebay, is at least 10% of the entire surface area and constitutes 20% of the treatment volume. The minimum width of the bottom of the extended dry basin is 4 feet, and the permanent pool depth is 0.4 feet and covers the entire bottom of the basin. The maximum depth of the water quality pool, not including the permanent pool, is 4 feet unless otherwise limited by the jurisdiction.

The maximum side slopes of the basin treatment area are 3H: 1V (33.33%); the minimum freeboard is 1 foot above the 25-year design water surface elevation.

Piping for Ponds and Basins

Incoming flows are pretreated using an approved water quality device in accordance with Springfield Design Standards. Other pretreatment may include proprietary devices, filter strip, trapped catch basin, or methods approved by the City. An approved outlet structure is provided for all flows.

Setbacks

Check with the local building department to confirm site-specific requirements.

Soil Amendment/Mulch

If required, place ¾" to 2-inch river run rock 2.5 to 3 inches deep where sustained flow is anticipated. River rock (if required), topsoil, and high density jute or coconut matting extend to the top of the treatment area. Topsoil and low density jute matting extend to the edge of the water quality tract or easement area.

in accordance with the Springfield Standards.

Washington County

Vegetation

The entire facility area (side slopes and treatment areas) is planted with vegetation appropriate for the varying planting conditions within the ponds or basins. Planting conditions vary from saturated soil to relatively dry, and several planting zones should be considered. The flat bottom of the pond or basin to the top of the 0.4 foot permanent pool is a saturated zone and will be constantly inundated with water. The saturated zone should be planted with rushes, sedges, and other wetland species (oxygenators) that are well-suited to water-saturated, oxygen-deprived (anaerobic) planting conditions.

The side slopes above the permanent pool depth will vary from wet at the bottom to relatively dry near the top where inundation rarely occurs. This moisture gradient will vary depending upon the designed maximum water depth, basin depth, and side slope steepness. This wet-to-moist transition zone from the top of the permanent pool to the designed high water line or top of freeboard should be planted with sedges, rushes, perennials, ferns and shrubs that can tolerate occasional standing water and wet-to-moist planting conditions. The areas above the designed high water line and immediately adjacent to the extended dry basin will not be regularly inundated. The dry zone should be planted with self-sustaining, low maintenance grasses, perennials, and shrubs suitable for the local climate and site.

The use of native plants is encouraged, but appropriate, beneficial, adapted non-invasive ornamentals are acceptable for added aesthetic and functional value. All vegetation should be densely and evenly planted to ensure proper hydrological function of the pond or basin; consider mature size.

Plant Spacing

A) Ponds and Basins in tracts or easements less than 30 feet wide are planted as follows to achieve the specified per acre densities:
i. Treatment area = 6 plugs per square foot (min. 1-inch diameter by 6-inch tall)
ii. Total number of shrubs per acre = area in square feet x 0.05
iii. Groundcover = plant and seed to achieve 100% coverage

B) Ponds and Basins in tracts or easements 30 feet wide or more are planted as followings to achieve the specified per acre densities:
i. Treatment area = 6 plugs per square foot (min. 1-inch diameter by 6-inch tall)
ii. Total number of trees per acre = area in square feet x 0.01
iii. Total number of shrubs per acre = area in square feet x 0.05
iv. Groundcover = plant and seed to achieve 100% coverage

Water Quality Ponds and Basins

Home Depot, Glenn Widing Drive, North Portland

Washington County

Maintenance

- Water efficient irrigation should be applied for the first two years after construction of the facility, particularly during the dry summer months, while plantings become established. Irrigation of plantings after these two years is at the discretion of the owner.
- If public, the permittee is responsible for the maintenance of the facility for a minimum of two years following construction and acceptance of the facility. All publicly maintained facilities must have a public easement. If private, the property owner is responsible for ongoing maintenance per a recorded maintenance agreement or property deed.
- Remove all trash, debris and sediment regularly to keep outlet structures and trash racks operable during storm events. Proper maintenance also reduces mosquito breeding habitats. Comply with debris and trash disposal regulations.
- Maintain adequate groundcover and shrubs in the basin, but not overgrown to the extent that storage capacity is inhibited.
- Inspect annually at a minimum by qualified personnel during wet weather to verify detention times are met. Look for and repair clogging, rapid release, subsidence, erosion, cracking, unwanted plant growth, accumulation of sediment in the forebay or around outlets, etc. Based on the inspections, determine an appropriate maintenance and repair schedule.
- Remove invasive plants

References

- City of Springfield Design and Construction Standards
- Gardening with Native Plants poster

Water Quality Ponds and Basins Checklist

Annual inspections are required. This checklist describes inspection activities, and notes additional recommended inspections.

CHECK ✓	Recommended, in addition to required annual inspection	System Feature	Problem	Conditions to Check for	Preferred Conditions and Maintenance Practices
	Monthly and after any major storm (1-inch in 24 hours) Annually Required	General	Trash and Debris	Visual evidence of trash, debris or dumping	Trash and debris removed from facility
	Monthly Annually Required	General	Invasive Vegetation	No invasive vegetation is planted or permitted to remain, including but not limited to: Himalayan Blackberry; Reed Canary Grass; Teasel; English Ivy; Nightshade; Clematis; Cattail; Thistle; Scotch Broom	No invasive vegetation; remove excessive weeds. Attempt to control even if complete eradication is not feasible.
	Monthly from November through April Annually Required	General	Vegetation	Vegetation blocking more than 10% of the inlet or outlet pipe opening	No vegetation blocking pipe openings
	Monthly from November through April and after any major storm (1-inch in 24 hours) Annually Required	General	Contaminants and Pollution	Evidence of oil, gasoline, contaminants or pollutants	No contaminants or pollutants present; coordinate removal/ cleanup with local jurisdiction
	Monthly Annually Required	General	Rodents	Evidence of rodents or water piping through facility via rodent holes	No rodents; facility repaired.
	Annually Required	General	Insects	Insects such as wasps and hornets interfere with maintenance activities	Harmful insects removed
	Annually Required		Tree Growth and Hazard Trees	Tree growth interferes with access for maintenance (slope mowing, silt removal, vactoring, or equipment movements). Do not remove trees that are not interfering with access or maintenance.	Trees do not hinder maintenance activities; recycle harvested trees into mulch or beneficial uses (e.g., alders for firewood)
	Annually Required	General	Hazard Trees	Dead, dying or diseased trees	Hazard trees removed; certified Arborist to determine health of tree or removal requirements

Water Quality Ponds and Basins Checklist (continued)

Annual inspections are required. This checklist describes inspection activities, and notes additional recommended inspections.

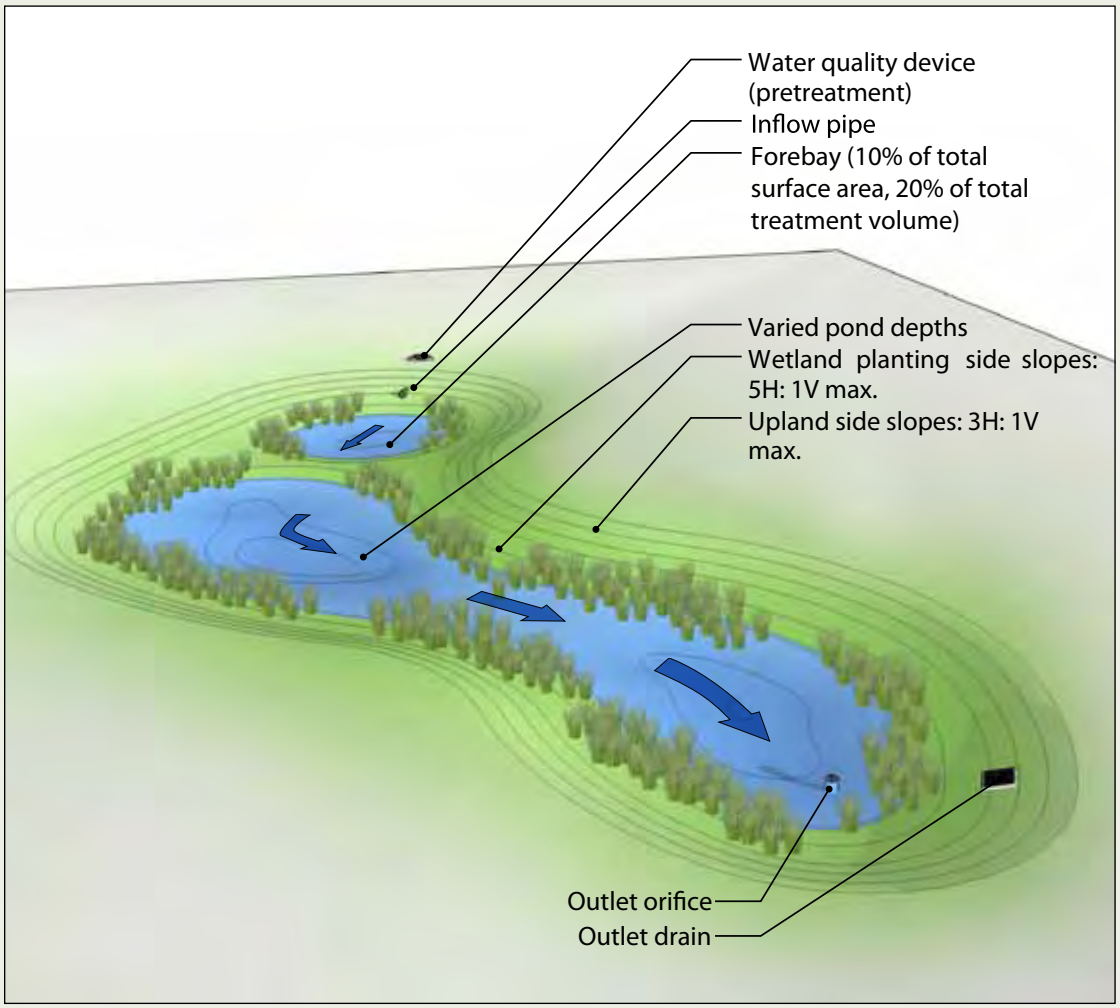
CHECK ✓	Recommended, in addition to required annual inspection	System Feature	Problem	Conditions to Check for	Preferred Conditions and Maintenance Practices
	Monthly and after any major storm (1-inch in 24 hours) Annually Required	General	Obstructed Inlet/ Outlet	Inlet/outlet areas clogged with sediment, vegetation or debris	Unobstructed inlet/outlet; material and blockages removed
	Annually Required	Pond Berms (Dikes)	Erosion	Discernable water flow through pond berm or ongoing and potential erosion; recommend inspection by licensed civil engineer to evaluate condition and recommend repair	Piping eliminated; erosion potential resolved
	Annually Required	Pond Berms (Dikes)	Settlements	Any part of berm has settled 4 inches lower than the design elevation; measure settlement to determine amount. Settling may indicate 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 reconstructed to the design elevation
	Monthly from November through April and after any major storm (1-inch in 24 hours) Annually Required	Compacted Berm Embankment	Erosion	Erosion observed on a compacted berm embankment; a licensed civil engineer should be consulted to resolve the source of erosion.	Erosion resolved
	Annually Required	Emergency Overflow/ Spillway	Blockage of Overflow/ Spillway	Tree growth on emergency spillways creates blockages and may cause the berm to fail due to uncontrolled overtopping. A licensed civil engineer should be consulted for proper berm/spillway restoration.	Trees removed Small root system (base less than 4 inches) may be left in place; otherwise, roots are removed and the berm is restored
	Annually Required	Emergency Overflow/ Spillway	Exposed Soil or Erosion	Native soil is exposed at the spillway, or there is only one layer of rock in areas 5 sqft or larger; rip-rap on inside slopes need not be replaced	Rocks and pad depth are restored to design standards
	After any major storm (use 1-inch in 24 hours as a guideline) Annually Required	Overflow Structure and Orifice Plate	Excessive Standing Water or Water Is Not Detained For Required Time	If water is not detained check to see if the orifice plate is installed; if water does not drain in required time, check to see if overflow structure is plugged	Orifice plate is cleared for proper drainage or re-installed to ensure required detention; overflow structure is unobstructed

Water Quality Ponds and Basins Checklist (continued)

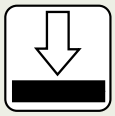
Annual inspections are required. This checklist describes inspection activities, and notes additional recommended inspections.

CHECK ✓	Recommended, in addition to required annual inspection	System Feature	Problem	Conditions to Check for	Preferred Conditions and Maintenance Practices
	Monthly from November through April Annually Required	Pond Bottom	Sediment Accumulation in Pond Bottom	Sediment accumulation in pond bottom exceeds 6 inches or affects facility inlet/ outlet or plant growth in treatment area	Sediment removed to designed pond shape and depth; reseeded as necessary to control erosion; replanted to achieve treatment; stormwater is evenly distributed within treatment area
	Monthly from November through April Annually Required	Liner (If Applicable)	Exposed or Damaged	Liner is visible; more than three 1/4-inch holes in liner	Liner repaired or replaced and fully covered
	Monthly from November through April and after any major storm (1-inch in 24 hours) Annually Required	Side Slopes of Pond	Erosion	Eroded damage more than 2 inches deep if cause of damage is still present or there is potential for continued erosion	Slopes stabilized using appropriate erosion control measures (rock reinforcement, planting of grass, compaction)
	Monthly during growing season Annually Required	General	Vegetation	Specified or approved grass grows so tall that it competes with shrubs or becomes a fire danger.	String trim grass to 4" to 6" and remove clippings; take care not to girdle the bark of trees and shrubs. (Note: except emergent wetland grasses in the treatment area of low maintenance facilities)

Constructed Water Quality Wetland



parking areas & impermeable landscape



impermeable soils

permeable soils

Description

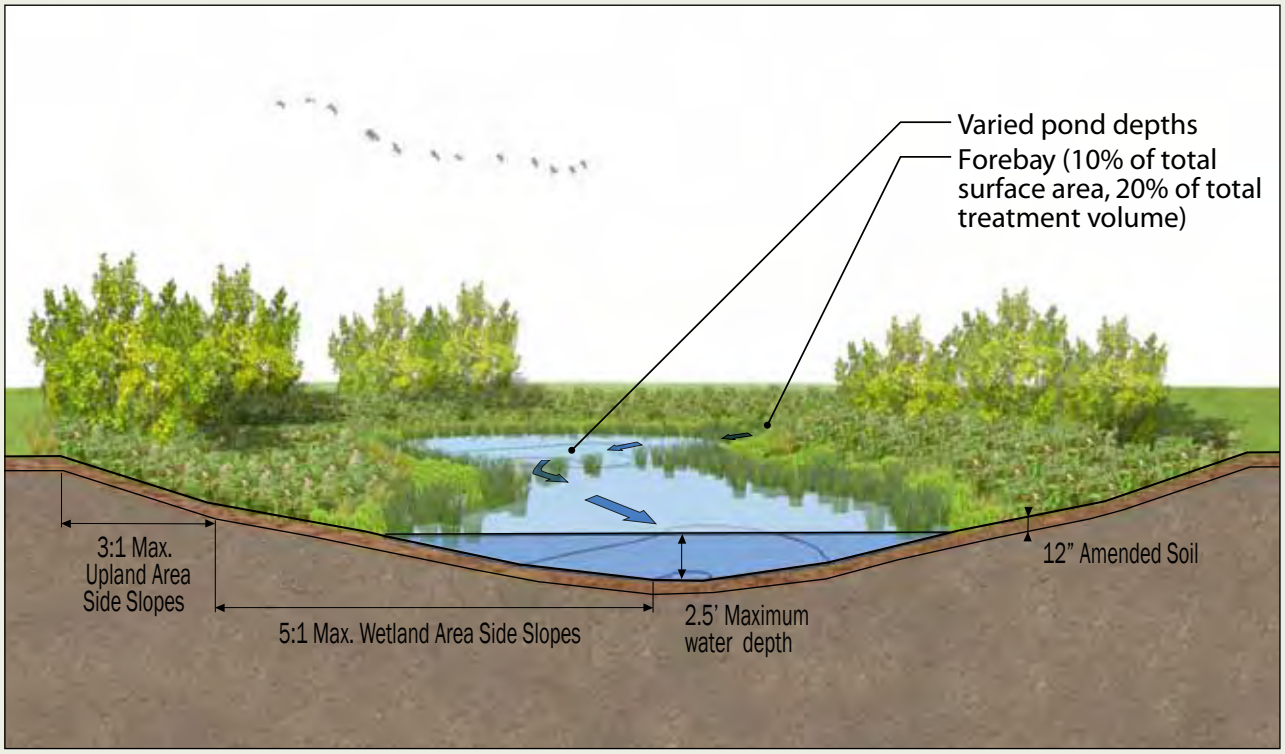
A constructed water quality wetland is a shallow landscaped depression that collects and holds stormwater runoff and allows pollutants to settle and filter out during storm events. Constructed wetlands have a permanent pool of water and also an extended detention area above that fills during storm events and releases water slowly over a number of hours. The permanent pool is sized to reduce pollution by settling and biological processes. The extended detention area is sized to meet flow control requirements.

Application & Limitations

Constructed water quality wetlands may help fulfill a site's landscaping area requirement. Constructed wetlands are approved to treat stormwater from all types of impervious surfaces, including private property and the public right-of way, runoff from rooftops, parking lots, and streets.

Ronler Acres, Hillsboro

Constructed Water Quality Wetland



Design Factors

Sizing

Sizing of the constructed water quality wetland is determined by the volume of runoff and the required detention time for treatment. At a minimum, the detention basin must accommodate the water quality design storm and be sized for a 48 hour drawdown time. The minimum water quality detention volume is equal to (1)x the water quality volume (WQV). The outlet orifice size is determined by the following equation:

D = 24 * [(Q/ (C[2gH]0.5) / Pi] 0.5

Where:

D (in) = diameter of orifice
Q(cfs) = WQV(cf) /(48*60*60)
C = 0.62
H(ft) = 2/3 x temporary detention height to centerline of orifice.

Geometry/Slopes

Constructed water quality wetlands have two or more cells. The first cell, known as the forebay, is at least 10% of the entire surface area and constitutes 20% of the treatment volume. If space is limited, one cell with a forebay at the inlet will settle sediments and distribute flow across the wet pond.

Unlike the flat bottom of an extended dry basin, in a constructed wetland the pool depth varies throughout the pond. Not including the permanent pool, the maximum depth of the water quality pool is 2.5-feet unless otherwise approved by the City.

Side slopes for wetland planting areas should not exceed 5H: 1V (20%) and side slopes for non-wetland planting areas should not exceed 3H: 1V (33.33%). The minimum freeboard height is 1 foot from the 25-year design water surface elevation. A perimeter 10 to 20 feet wide provides inundation during storm events.

Piping for Constructed Water Quality Wetlands

Incoming flows to the water quality wetland facility are pretreated by a water quality device or other approved pretreatment method in accordance with City Design Standards. Other pretreatment methods may include proprietary devices, filter strip, trapped catch basin, or other methods as approved by the City.
An approved outlet structure is provided for all flows.

Setbacks

Check with the local building department to confirm site-specific requirements.

Oleson Woods Apartments, Tigard

Design Factors (continued)

Soil Amendment/Mulch
A minimum of 12" of topsoil should be applied to all treatment areas.

Vegetation
The entire facility area (permanent pool, side slopes and perimeter zone) are planted with vegetation appropriate for the varying planting conditions within the constructed wetland. Planting conditions within the wetland vary from saturated soil to relatively dry, and several planting zones should be considered. The zone between the bottom of the constructed wetland and the top of the permanent pool will be constantly inundated with water and have saturated soils. This wet zone should be planted with rushes, sedges, and other wetland species that are well-suited to water-saturated, oxygen-deprived (anaerobic) planting conditions. The variable depth of the bottom of the wetland will create a series of micro planting conditions. Within this wet zone, areas of open water may be too deep to support significant vegetation.

The side slopes above the permanent pool depth to the outer edges of the perimeter zone will have a moisture gradient that varies from wet near the bottom to relatively dry near the edge of the perimeter area where inundation rarely occurs. This moisture gradient will vary depending upon the maximum designed water depth, constructed wetland depth, and side slope steepness. This moist-to-wet transition zone from the top of the permanent pool to the designed high water line or top of freeboard should be planted with sedges, rushes, perennials, ferns and shrubs that can tolerate occasional standing water and wet-to-moist planting conditions. Areas above the designed high water line and immediately adjacent to the water quality wetland is a dry zone and will not be regularly inundated. The dry zone should be planted with self-sustaining, low maintenance grasses, perennials, and shrubs suitable for the local climate. The planting design should minimize solar exposure of open water areas to reduce heat gain in the water. Lower water temperatures help to maintain healthy oxygen levels and minimize algae blooms. Trees or other appropriate vegetation should be planted at the perimeter of the pond to maximize shading. The use of native plants is encouraged, but adapted, non-invasive ornamentals are acceptable for added aesthetic and functional value.

Plan for a variety of vegetation; avoid planting native invasive plants such as cattails that will create mono-cultures and choke out other native plants.

Constructed Water Quality Wetland

Ronler Acres, Hillsboro

Vegetation (continued)
All vegetation should be densely and evenly planted to ensure proper hydrological function of the water quality wetland. Consider the mature size of the plant.

Plant Spacing

Constructed Water Quality Wetlands in tracts or easements are to be planted as follows to achieve the specified per acre densities:

i. Treatment area = 6 plugs per square foot (min. 1-inch diameter by 6-inch tall)
ii. Total number of trees per acre = area in square feet x 0.01
iii. Total number of shrubs per acre = area in square feet x 0.05
iv. Groundcover = plant and seed to achieve 100% coverage

Maintenance

- Water efficient irrigation or hand watering should be applied for the first two years after construction of the facility, particularly during the dry summer months, while plantings become established. Irrigation of plantings after these two years is at the discretion of the owner.
- If public, the permittee is responsible for the maintenance of the constructed water quality wetland for a minimum of two years following construction and acceptance of the facility. All publicly maintained facilities must have a public easement. If private, the property owner is responsible for ongoing maintenance per a property deed or a recorded maintenance agreement.
- Conduct inspections by qualified personnel at least once a year; evaluate the effectiveness of the regular maintenance schedule and determine the timing of corrective maintenance procedures.
- Remove debris and trash regularly to reduce the chance of outlet structures, trash racks and other components becoming clogged and inoperable during storm events. Dispose of debris and trash in compliance with local, state and federal waste regulations. Use only suitable disposal/recycling sites.
- Investigate any evidence of clogging or rapid release in the wetland. Correct any subsidence, erosion, cracking, unwanted vegetation growth, over-accumulation of sediment around forebays, etc.
- Place inlet structure at the appropriate level to function; not low enough to get buried or "silt in", nor so high that it causes erosion during storm events.
- Replant any bare patches as necessary to achieve adequate coverage.
- See detailed maintenance checklist.

References

- City of Springfield Design and Construction Standards
- Gardening with Native Plants poster

Constructed Water Quality Wetland Checklist

Annual inspections are required. This checklist describes inspection activities, and notes additional recommended inspections.

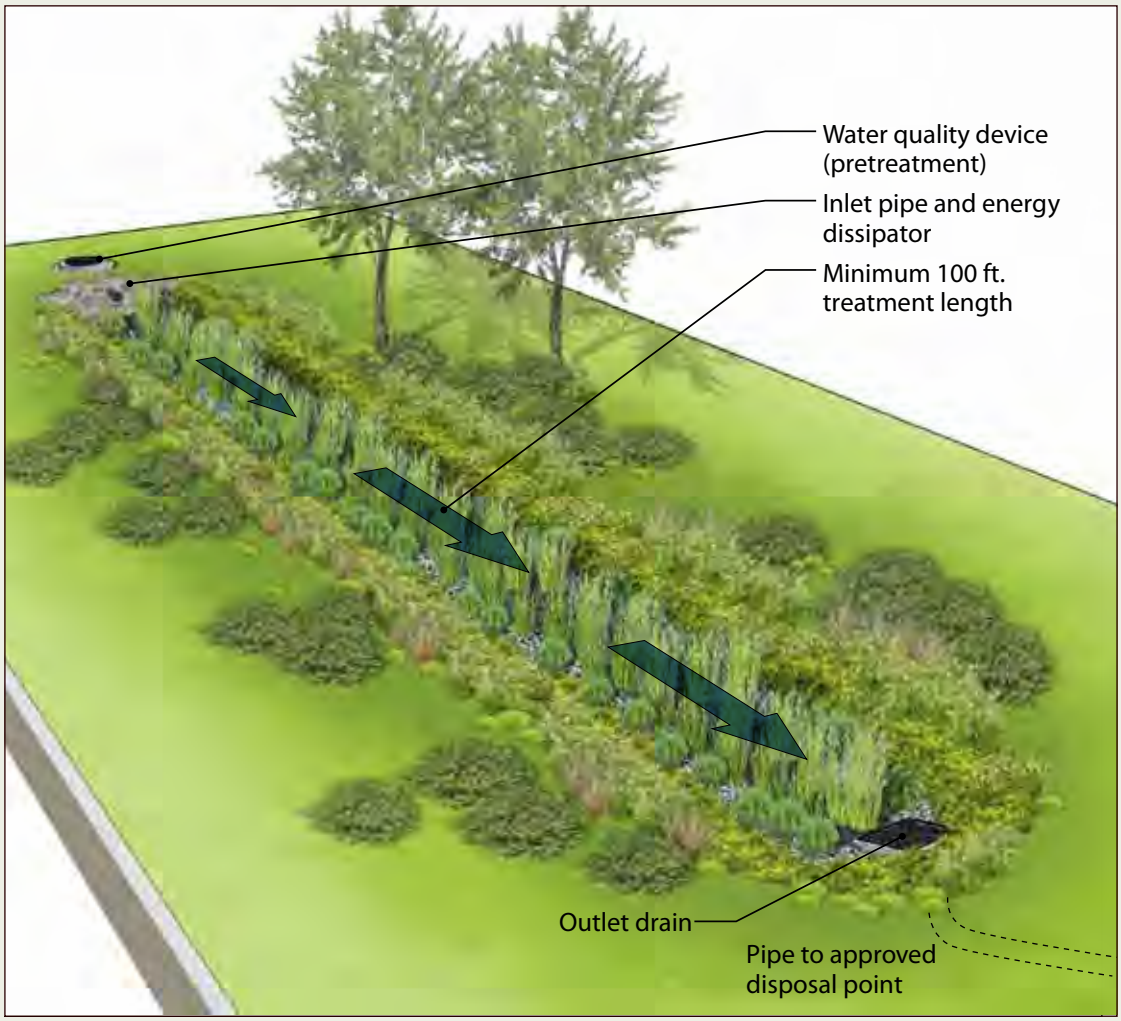
CHECK ✓	Recommended, in addition to required annual inspection	System Feature	Problem	Conditions to Check for	Preferred Conditions and Maintenance Practices
	Monthly and after any major storm (1-inch in 24 hours) Annually Required	General	Trash and Debris	Visual evidence of trash, debris or dumping	Trash and debris removed from facility
	Monthly and after any major storm (1-inch in 24 hours) Annually Required	General	Obstructed Inlet	Inlet/outlet areas clogged with sediment, vegetation or debris	Unobstructed inlet/outlet; material and blockages removed
	Annually Required	General	Erosion	Erosion of pond side slopes; scouring of the pond bottom more than 6 inches, or continued erosion is prevalent	Slopes and pond bottom repaired and stabilized using proper erosion control measures
	Monthly Annually Required	General	Invasive Vegetation	No invasive vegetation is planted or permitted to remain, including but not limited to: Himalayan Blackberry; Reed Canary Grass; Teasel; English Ivy; Nightshade; Clematis; Cattail; Thistle; Scotch Broom	No invasive vegetation; remove excessive weeds. Attempt to control even if complete eradication is not feasible.
	Monthly from November through April Annually Required	General	Vegetation	Vegetation blocking more than 10% of the inlet pipe opening	No vegetation blocking inlet pipe opening
	Monthly Annually Required	General	Rodents	Evidence of rodents or water piping through facility via rodent holes	No rodents; facility repaired.
	Annually Required	General	Insects	Insects such as wasps and hornets interfere with maintenance activities	Harmful insects removed
	Monthly from November through April Annually Required	Inlet/Outlet Pipe	Inlet/Outlet Pipe Blocked	Inlet/outlet pipe clogged with sediment or debris	Inlet and outlet piping cleared

Constructed Water Quality Wetland Checklist (continued)

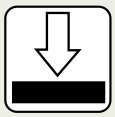
Annual inspections are required. This checklist describes inspection activities, and notes additional recommended inspections.

CHECK ✓	Recommended, in addition to required annual inspection	System Feature	Problem	Conditions to Check for	Preferred Conditions and Maintenance Practices
	Annually Required	Emergency Overflow/ Spillway	Exposed Soil or Erosion	Native soil is exposed at the spillway, or only one layer of rock in areas 5 sqft or larger; rip-rap on inside slopes need not be replaced	Rocks and pad depth are restored to design standards
	Monthly from November through April Annually Required	Pond	Oil Sheen on Water	Prevalent and visible oil sheen	Oil removed using oil-absorbent pads or vactor truck; source of oil located and corrected. If low levels of oil persist, plant wetland plants that can uptake small concentrations of oil such as *Juncus effusus* (soft rush)
	Monthly from November through April Annually Required	Pond Bottom Dike/Berm Internal Berm	Sediment Accumulation in Pond Bottom	Sediment depth in wetland bottom exceeds 6 inches or affects inlet/outlet functions or plant growth in treatment area	Sediment removed to designed wetland shape and depth; reseed if necessary to control erosion, or replant to achieve treatment
	Annually Required	Dike/Berm	Settlement of Pond Dike/Berm	Any part has settled 4 inches or lower than the design elevation; inspector determines dike/berm is unsound	Dike/berm is repaired to specifications
	Annually Required	Internal Berm	Erosion	Berm dividing cells should be level so water flows evenly over entire length of berm	Berm surface is leveled
	Monthly during growing season Annually Required	General	Vegetation	Specified or approved grass grows so tall that it competes with shrubs or becomes a fire danger	String trim grass to 4” to 6” and remove clippings; take care not to girdle the bark of trees and shrubs. (Note: except emergent wetland grasses in the treatment area of low maintenance facilities)

Vegetated Swale



parking areas & impermeable landscape



impermeable soils

permeable soils

Description

A vegetated swale is a gently sloping landscaped depression that collects and conveys stormwater runoff, and is narrow. The long densely planted swale filters stormwater as it flows the length of the swale and allows infiltration of water into the ground. The vegetated swale may discharge to a storm sewer or other approved discharge point where soils do not drain well.

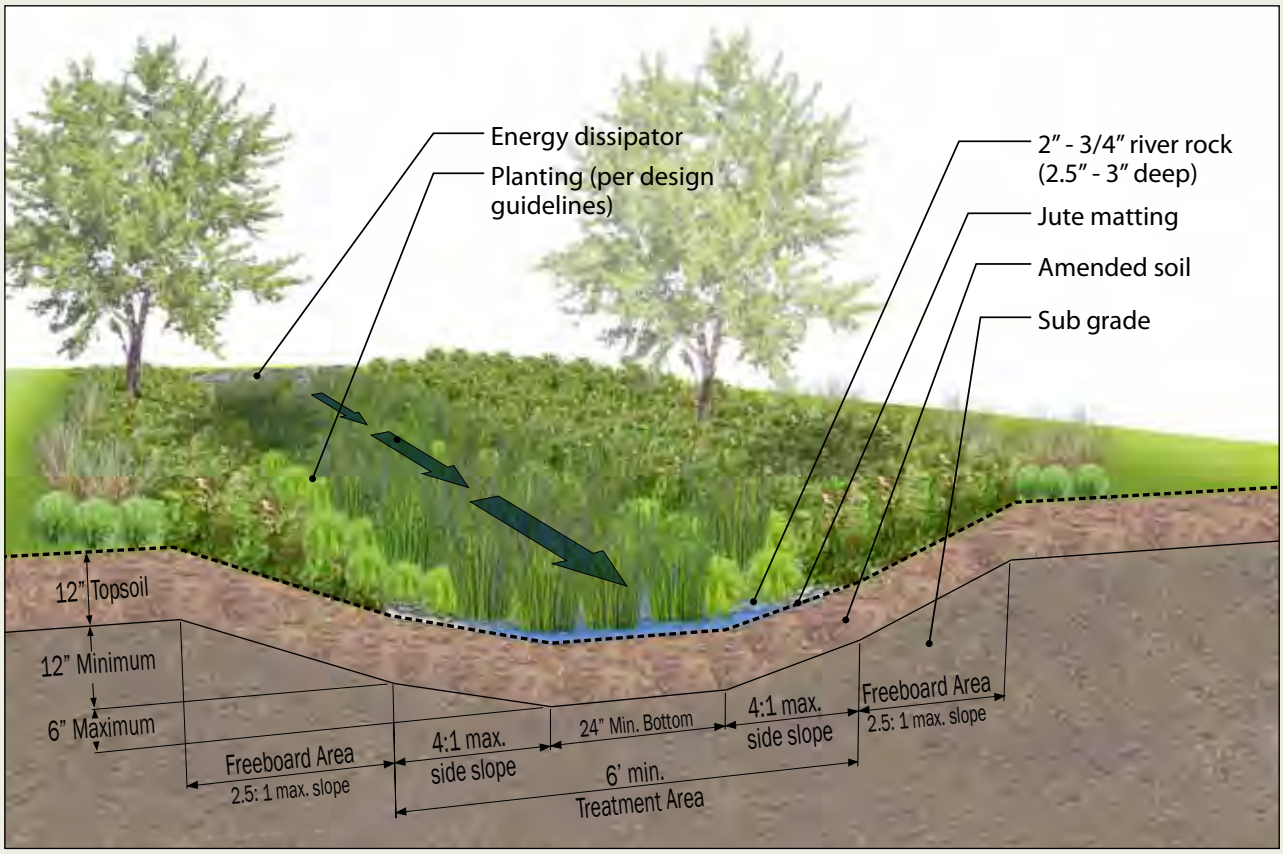
Vegetated swales have a required minimum length, width and stormwater residence time. See Springfield's Engineering Design and Construction Standards Details.

Application & Limitations

Vegetated swales may help fulfill a site's landscaping area requirement. Vegetated swales are approved to treat stormwater from all types of impervious surfaces including private property and the public right-of-way, rooftops, parking lots, and streets.

Westhaven Subdivision, Washington County, Oregon

Vegetated Swale



Design Factors

Sizing

A vegetated swale is long in length and needs to detain stormwater for at least nine minutes for treatment as specified in Springfield's Design and Construction Standards.

Geometry/Slopes

A vegetated swale's slope end to end is at least 0.5% and the maximum velocity for a 25 year storm flow is 2 feet per second. Side slopes within the treatment area are 25% (4 horizontal: 1 vertical) or less; side slopes of the freeboard area above the treatment zone are 40% (2.5 horizontal: 1 vertical) or less. While the bottom of the swale is at least 2 feet wide, the treatment area is at least 6 feet wide and no more than ½ foot in depth. The freeboard area has at least one foot of vertical height. All swales have an energy dissipater such as boulders at the entrance to reduce velocities and spread the flow across the treatment area.

Piping for Vegetated Swales

Flows coming into the vegetated swale facility are pretreated by a water quality device in accordance with the Design and Construction Standards. Other pretreatment may include an approved proprietary treatment device, filter strip, trapped catch basin, or other method approved by the City. An approved outlet structure must be provided for all flows. If location would make access for maintenance difficult, the swale may be a flow-through facility with unsumped structures.

Arbor Oaks Subdivision, Washington County, Oregon

Tanasbourne Office Building, Washington County

Aloha Huber Park Elementary School, Washington County

Design Factors (continued)

Setbacks
Check with the local building department to confirm site-specific requirements.

Soil Amendment/Mulch
The treatment area has ¾" to 2-inch river run rock placed 2.5 to 3 inches deep on high density jute or coconut matting over 12 inches of native topsoil. The river rock, topsoil and high density jute or coconut matting extends to the top of the treatment area, topsoil and low density jute matting extends to the edge of the water quality tract or easement area.

Vegetation
The entire facility including freeboard and treatment areas is vegetated according to the Standards with vegetation appropriate for the soil conditions. Planting conditions vary from wet to relatively dry within the swale. The flat bottom will be inundated frequently and should be planted with species such as rushes, sedges, perennials, and ferns, as well as shrubs that are well-suited to wet-to-moist soil conditions. The side slope moisture gradient varies from wet at the bottom to relatively dry near the top where inundation rarely occurs. The moisture gradient will vary depending upon the designed water depth, swale depth, and side slope steepness. The transition zone from the bottom of the swale to the designed high water line or top of freeboard should be planted with sedges, rushes, perennials, and ferns, as well as shrubs that can tolerate occasional standing water, and wet-to-moist planting conditions. The areas above the designed high water line and immediately adjacent to the vegetated swale will not be regularly inundated and should be planted with self-sustaining, low maintenance grasses, perennials, and shrubs suitable for the local climate and site. Avoid planting invasive plants such as catails that create mono cultures and choke out other native plants.

Plant Spacing
A) Vegetated swales in tracts or easements less than 30 feet wide are planted as follows to achieve the specified per acre densities:
i. Treatment area = 6 plugs per square foot (min. 1-inch diameter by 6-inch tall)
ii. Total number of shrubs per acre = area in square feet x 0.05
iii. Groundcover = plant and seed to achieve 100% coverage

B) Vegetated swales in tracts or easements 30 feet wide or more are planted as follows to achieve the specified per acre densities:
i. Treatment area = 6 plugs per square foot (min. 1-inch diameter by 6-inch tall)
ii. Total number of trees per acre = area in square feet x 0.01
iii. Total number of shrubs per acre = area in square feet x 0.05
iv. Groundcover = plant and seed to achieve 100% coverage

Vegetated Swale

Broadview, Seattle

PCC Rock Creek Campus, Beaverton

Sandy Boulevard, Portland

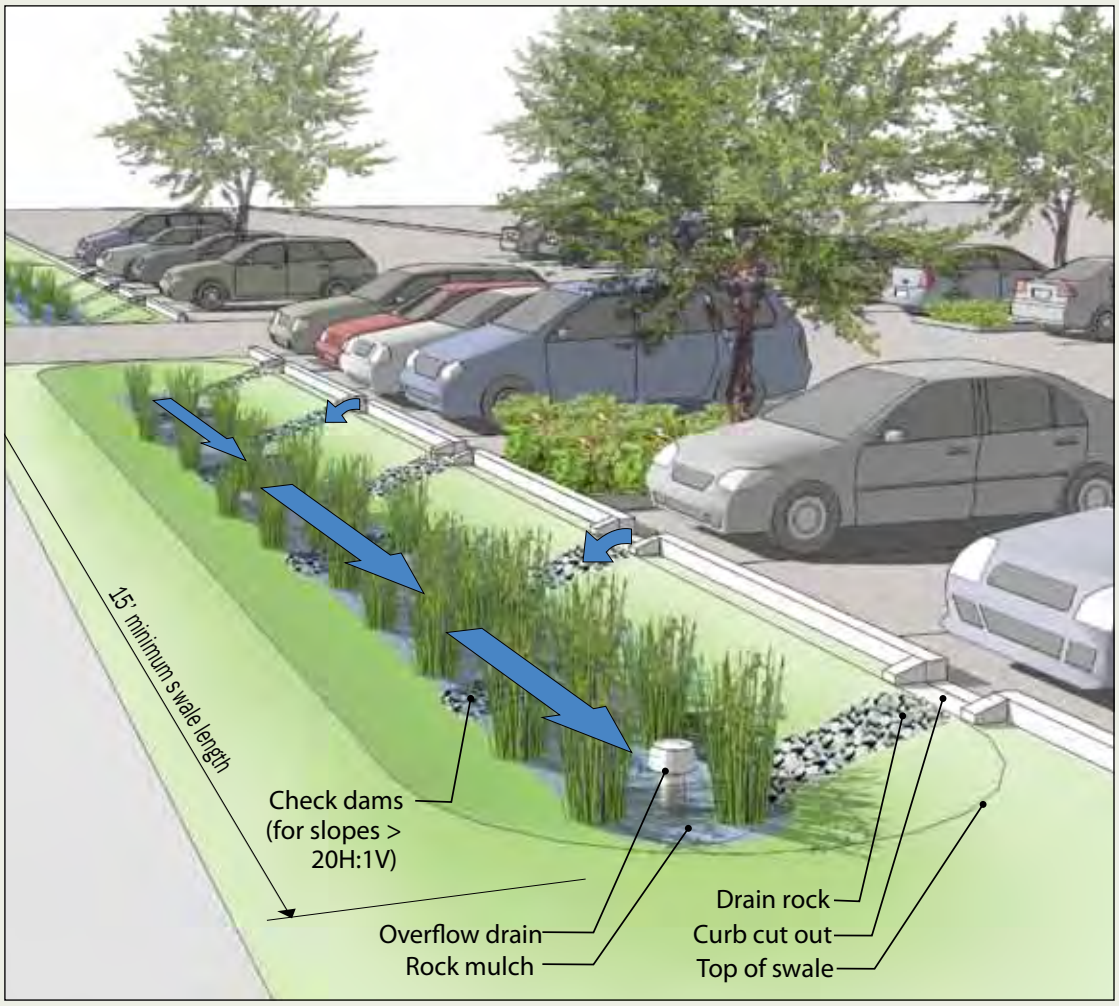
Maintenance

- Provide maintenance access as required by Springfield's Design and Construction Standards.
- Water efficient irrigation should be applied for the first two years after construction of the facility, particularly during the dry summer months, while plantings become established. Irrigation of plantings after these two years is at the discretion of the owner.
- If public, the permittee is responsible for the maintenance of the vegetated swale for a minimum of two years following construction and acceptance of the facility. All publicly maintained facilities must have a public easement. If private, the property owner is responsible for ongoing maintenance per a maintenance agreement.
- The facility should be inspected in spring and fall, at a minimum.
- Evaluate and replant landscaping to achieve a survival rate of 80% or better with 90% facility coverage. Remove invasive plants.
- Remove all trash and debris that might impede water flow and clog the system.
- Check inlet pipes and outlet structure for damage or missing pieces; remove obstructions and heavy vegetation.
- Make sure stormwater is traveling the length of the treatment area. If stormwater is "short circuiting" the treatment area, repair the swale to achieve full treatment.
- See the detailed maintenance checklist for maintenance.

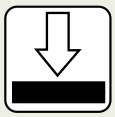
References

- City of Springfield Design and Construction Standards.
- Gardening with Native Plants poster.

Parking Strip Swale



parking areas & impermeable landscape



impermeable soils

permeable soils

Description

A parking strip swale is a narrow, gently sloping landscaped depression that collects and conveys stormwater runoff. The densely planted swale filters stormwater as it flows the length of the swale and allows infiltration of water into the ground. The swale discharges to a storm sewer or other approved discharge point.

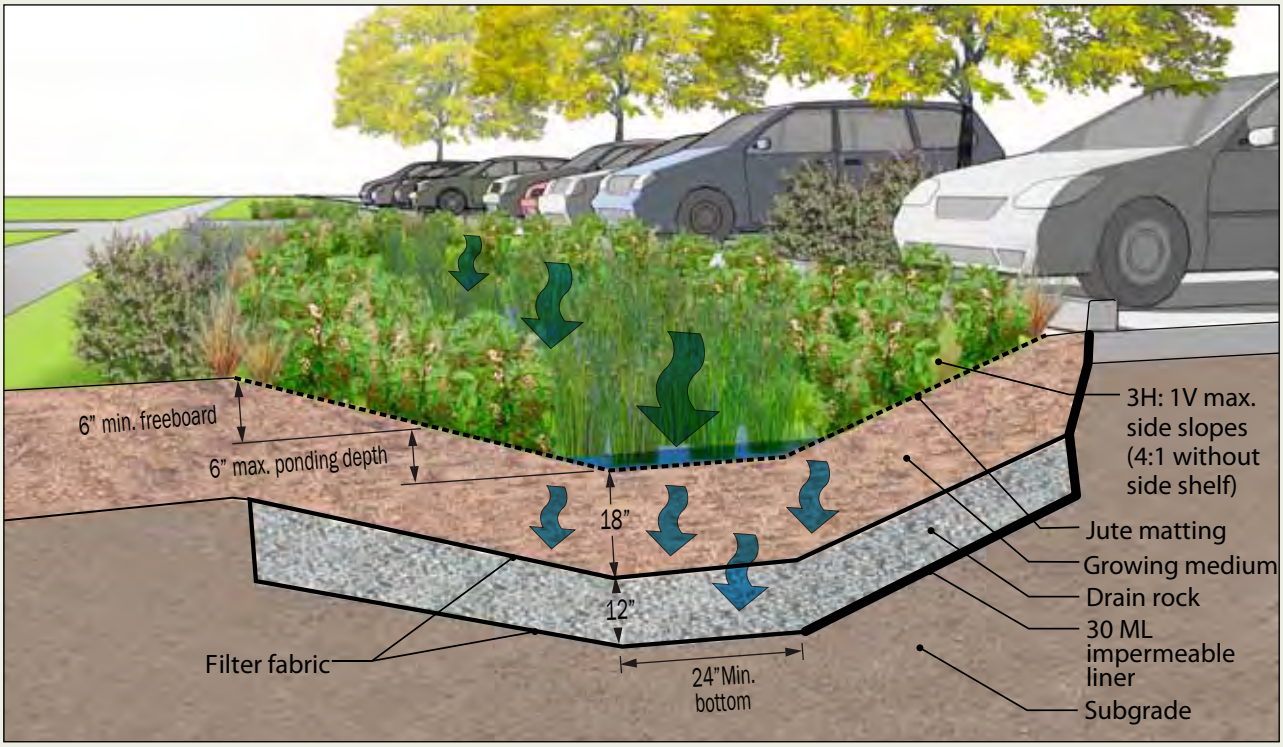
Compared to vegetated swales, parking strip swales may be shorter and narrower, but require deeper levels of amended soil and a subsurface drain rock layer to compensate for the smaller size and to function effectively.

Application & Limitations

A parking strip swale may help fulfill a site's landscaping area requirement. Swales are approved to treat stormwater flowing from all types of impervious surfaces including private property and the public right-of-way, rooftops, parking lots, and streets.

Boeckman Road, Wilsonville

Parking Strip Swale



Design Factors

Sizing

The size of the parking strip swale will depend upon the infiltration rate of existing soils. A sizing factor of 0.06 assumes the site infiltration rate is less than 2 in/hr.

For example, the size of a swale managing 1,500 square feet of total impervious area would be 90 square feet (1,500 x 0.06).

Size may be decreased if:

- Demonstrated infiltration rate is greater than 2 in/hr using ASTM D3395-09 method; or
- Amended soil depth is increased

Geometry/Slopes

A swale's slope end to end is at least 0.5% and no more than 6%. For sites with steeper slopes, check dams may be incorporated into the design. Side slopes from the bottom to the top of the swale must be 3:1 or less. The minimum bottom width is 2 feet, and the minimum depth is 1 foot.

Piping for parking strip Swales

If needed, stormwater may be directed from impervious surfaces to swales by piping per plumbing code requirements, or may flow directly into the swale via curb openings. A swale has no underdrain. An overflow drain allows no more 6 inches of water depth to collect in the swale. On private property, the overflow drain and piping must meet plumbing code requirements and direct excess stormwater to an approved disposal point. Check with the local jurisdiction or use Springfield's Design and Construction Standards for additional information on piping material for use in the public right-of-way.

Setbacks

- Check with the local building department to confirm site-specific requirements.

Peoples Food Cooperative, SE Portland

Ecotrust building, Portland

New Seasons, SE Division St, Portland

Design Factors (continued)

Soil Amendment/Mulch

Amended soils with appropriate compost serve numerous benefits: infiltration; detention; retention; better plant establishment and growth; reduced summer irrigation needs; reduced fertilizer need; increased physical/chemical/microbial pollution reduction; and reduced erosion potential. Primary treatment will occur in the top 18 inches of the Swale. Amended soil in the treatment area is composed of imported soil, mix of one part organic compost, one part gravelly sand, and one part top soil. Compost is weed-free, decomposed, non-woody plant material; animal waste is not allowed. Reduce water velocities and potential erosion by providing energy dissipaters such as river rock at entrances to the swale.

To avoid erosion, use approved erosion control BMPs.

Vegetation

The entire facility area including side slopes and treatment areas are planted with vegetation appropriate for the soil conditions. Planting conditions vary from wet to relatively dry within the swale. The flat bottom will be inundated frequently and should be planted with species such as rushes, sedges, perennials, ferns, and shrubs well-suited to wet-to-moist soil conditions. The side slope moisture gradient varies from wet at the bottom to relatively dry near the top where inundation rarely occurs. The moisture gradient will vary depending upon the designed water depth, the swale depth, and side slope steepness. The transition zone from the bottom of the swale to the designed high water line or top of freeboard should be planted with sedges, rushes, perennials, ferns, and shrubs that can tolerate occasional standing water and wet-to-moist planting conditions. The areas above the designed high water line and immediately adjacent to the swale will not be regularly inundated and should be planted with self-sustaining, low maintenance grasses, perennials, and shrubs suitable for the local climate and site.

Native plants are encouraged, but appropriate, non-invasive ornamentals are acceptable for aesthetic and functional value. All vegetation should be densely and evenly planted to ensure proper hydrological function of the swale.

Quantities:

Bottom of swale (wet-to-moist zone, per 100 sf)

- 115 herbaceous plants, 1' on center spacing, ½-gal container size; or
- 100 herbaceous plants, 1' on center, and 4 shrubs, 1-gal container size, 2' on center

Side slopes and top of swale (wet-to-moist transition zone and dry zone)

- 1 tree per 300 sq. ft, minimum 2-gal container size by 2 ft-tall and
- 10 shrubs (1-gal) and 70 groundcovers (½-gal) per 100 sf

Trees are allowed in swales, and may be required. Trees should be selected by adaptability to wet-to-moist conditions and size at maturity. An area twice the width of the tree rootball and the depth of the rootball plus 12" (or total depth of 30", whichever is greater) should be backfilled with amended soil for optimal growth, with no sub-surface rock layer. Place trees along the side slopes rather than the bottom of the swale.

Parking Strip Swale

Tualatin Hills Park, Portland Community College

NE Siskiyou Street, Portland

Maintenance

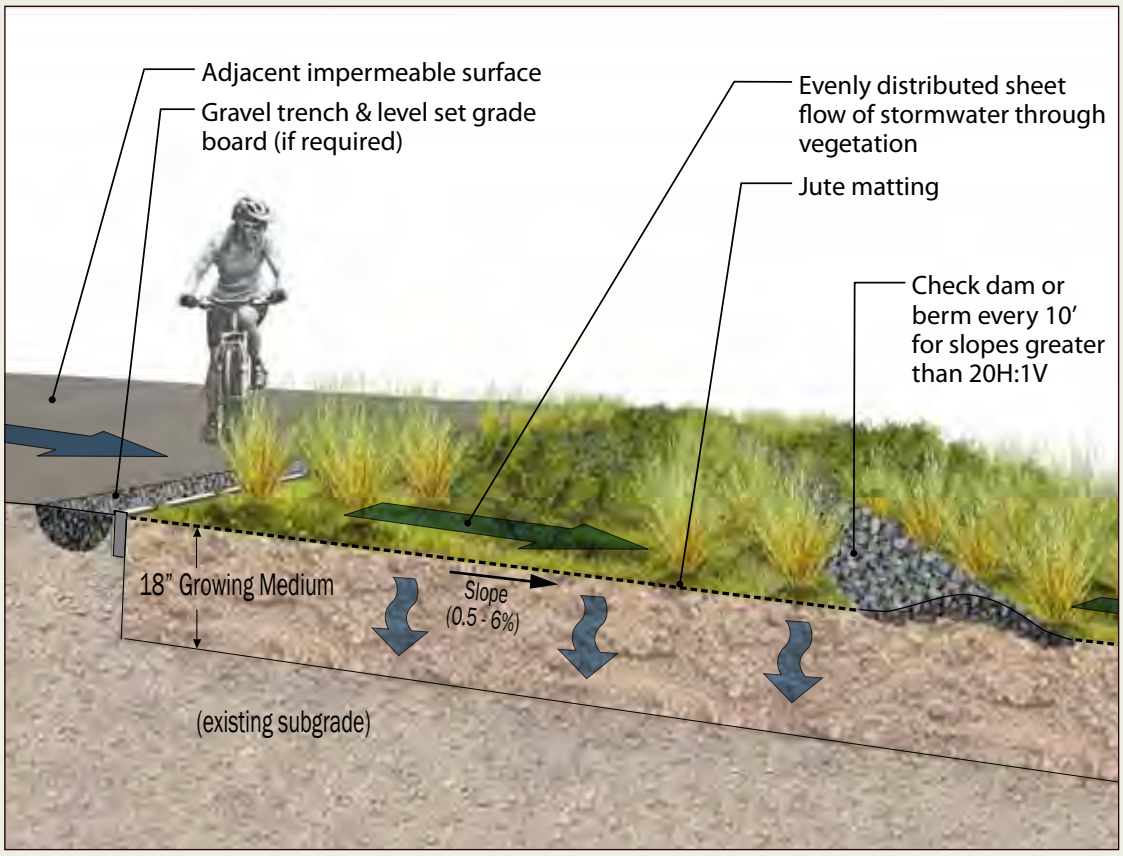
- Water efficient irrigation should be applied for the first two years after construction of the facility, particularly during the dry summer months, while plantings become established. Irrigation after two years is at the discretion of the owner.
- If public, the permittee is responsible for the maintenance of the swale for a minimum of two years following construction and acceptance of the facility. All publicly maintained facilities not located in the public right-of-way must have a public easement. If private, the property owner is responsible for ongoing maintenance per a property deed or a recorded maintenance agreement.
- Inspect the facility at least twice annually, in spring and fall.
- Evaluate landscaping and replant as necessary to ensure a minimum of 80% survival rate of the required vegetation and 90% facility coverage. Remove non-native, invasive plant species when found in the facility.
- Remove garbage, landscaping debris and other material that may impede water flow and clog the system.
- Check inlet pipes and outlet structure for damage or missing pieces. Inlet pipes and outlet structures should be free of obstructions and heavy vegetation.
- Design swales so that they do not require mowing.
- See the detailed maintenance checklist for maintenance.

References

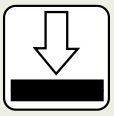
- Springfield Design and Construction Standards
- Gardening with Native Plants Poster

115th & Hart, Beaverton

Vegetated Filter Strip



parking areas & impermeable landscape



impermeable soils

permeable soils

Description

Vegetated filter strips are gently sloped areas designed to receive sheet flows from adjacent impervious surfaces. Filter strips are vegetated with grasses and groundcovers that filter and reduce the velocity of stormwater. Peak stormwater flows are attenuated as stormwater travels across the filter strip and infiltrates or is stored temporarily in the soils below.

For residential driveways, center filter strips typically are 3 feet wide between two 3-foot wide paved sections. The strip treats and infiltrates stormwater only from the impervious area of the drive aisles which slope toward the center filter strip. The driveway center filter strip must be maintained to the design requirements for vegetated filter strips.

Application & Limitations

Vegetated filter strips should be integrated into the overall site design and may help fulfill a site's landscaping area requirement. Vegetated filter strips can be used to manage stormwater runoff from a variety of impervious surfaces such as walkways and driveways on private property and within the public right-of-way.

Oregon Zoo parking lot, Portland

Vegetated Filter Strip

Oregon Zoo parking lot

Design Factors

Sizing

Vegetated filter strips are appropriate for all soil types and have 18" depth of growing medium. The size of the filter strip will depend upon the infiltration rate of existing soils. A sizing factor of 0.06 assumes that the site has an infiltration rate less than 2 in/hr.

For example, a facility managing 1,500 square-feet of total impervious area would require a 90 sq ft filter strip (1,500 x 0.06).

Size may be decreased if:

- Demonstrated infiltration rate is greater than 2 in/hr using ASTM D3395-09 method; or
- Amended soil depth is increased

Geometry/Slopes

The minimum width of a vegetated filter strip is 5 feet measured in the direction of stormwater flow. The slope is between 0.5 and 6%, and the slope of the impervious area draining to the strip is less than 6%.

Check dams may be required to maintain shallow slopes if the existing site slopes exceed 5%. Typically, check dams are 3 to 5 inches high and are placed every 10 feet where slopes exceed 5%.

If a level spreader such as a grade board or sand/gravel trench is required to disperse runoff evenly across the filter strip, the top must be horizontal and at an appropriate height to direct sheet flow to the soil without scour. Grade boards may be any material that withstands weather and solar degradation but should not be old railroad ties, used utility poles, or other pollutant source.

Piping for Vegetated Filter Strips

Non-infiltrated flows/overflows from the vegetated filter strip are collected and conveyed to an approved system or outlet structure.

Setbacks

Check with local building department to confirm site-specific requirements.

Arata Creek School, Troutdale

Design Factors (continued)

Soil Amendment/Mulch

Amended soils with appropriate compost serve numerous benefits: infiltration; detention; retention; better plant establishment and growth; reduced summer irrigation needs; reduced fertilizer need; increased physical/chemical/microbial pollution reduction; and reduced erosion potential. Primary treatment will occur in the top 18 inches of the vegetated filter strip. Amended soil in the treatment area is composed of equal parts of organic compost, gravelly sand and topsoil. Compost is weed-free, decomposed, non-woody plant material; animal waste is not allowed.

To avoid erosion, use approved erosion control BMP.

Vegetation

Herbs, shrubs and grasses can provide the vegetation needed to remove sediment and pollutants. The vegetated filter strip is planted or seeded with a mix of grasses, wildflowers, and groundcovers well-suited to moist-to-dry soil conditions. All vegetation should be self-sustaining and drought tolerant. Native plants are encouraged but adapted, non-invasive ornamentals are acceptable for added aesthetic and functional value.

Trees are not required for vegetated filter strips, but are encouraged where applicable. Tree species should be selected by their adaptability to moist-to-dry conditions and full size at maturity.

The filter strip conveys evenly-distributed sheet flows of water through vegetation for treatment. Because unplanted areas may decrease stormwater treatment, the entire filter strip must have 100% vegetation coverage to ensure proper hydrologic function.

If check dams are required, plants suited to wet-to-moist planting conditions may be supplemented on the upslope side of the check dam where occasional inundation and pooling of water may occur.

Maintenance

- Water-efficient irrigation should be applied for the first two years after construction of the facility, particularly during the dry summer months, while plantings become established. Irrigation after two years is at the discretion of the owner.
- If public, the permittee is responsible for the maintenance of the vegetated filter strip for a minimum of two years following construction and acceptance of the facility. All publicly maintained facilities not located in the public right-of-way must have a public easement. If private, the property owner is responsible for ongoing maintenance per a recorded maintenance agreement.
- The facility should be inspected monthly during the rainy season (November - April).
- Evaluate landscaping and replant as necessary to ensure 100% facility coverage. Remove non-native, invasive plant species when found in the facility.
- Remove garbage, landscaping debris and other material that may impede uniform sheet water flow.
- See the detailed maintenance checklist for maintenance.

References

- Springfield Design and Construction Standards
- Gardening with Native Plants poster.

Vegetated Swale Checklist

Annual inspections are required. This checklist describes inspection activities, and notes additional recommended inspections.

CHECK ✓	Recommended, in addition to required annual inspection	System Feature	Problem	Conditions to Check for	Preferred Conditions and Maintenance Practices
	Monthly and after any major storm (1-inch in 24 hours) Annually Required	General	Obstructed Inlet/ Outlet	Inlet/outlet areas clogged with sediment, vegetation or debris	Unobstructed inlet/outlet; material and blockages removed
	Monthly from November through April Annually Required	General	Flow not distributed evenly	Flows unevenly distributed through swale due to uneven or clogged flow spreader	Level the spreader and clean so that flows spread evenly over entire swale width
	Annually Required	General	Structure Damage to Frame or Top Slab	Frame not sitting flush on top slab (more than 3/4 inch between frame and top slab); frame not securely attached	Frame is firmly attached and sits flush on the riser rings or top slab
	Annually Required	General	Fractures or Cracks in Basin Walls or Bottom	Maintenance person determines the structure is unsound	Basin replaced or repaired to design standards
	Annually Required	General	Fractures or Cracks in Basin Walls or Bottom	Grout fillet is separated or cracked wider than 1/2 inch and longer than 1 foot at the joint of any inlet/outlet pipe, or evidence of soil entering through cracks	Pipe is regrouted and secure at basin wall
	Annually Required	General	Settlement / Misalignment	Failure of basin has created a safety, function, or design problem	Basin replaced or repaired to design standards
	Monthly from November through April Annually Required	General	Constant Baseflow	Small, continual flow of water through the swale even after weeks without rain; swale bottom has an eroded, muddy channel	Add a low-flow pea gravel drain the length of the swale or bypass the baseflow around the swale
	Monthly from November through April Annually Required	General	Sediment Accumulation in Treatment Area	Sediment depth exceeds 3 inches	Remove sediment deposits on grass treatment area of the bio-swale; swale is level from side to side and drains freely toward outlet; no standing water once inflow has ceased

Vegetated Swale Checklist (continued)

Annual inspections are required. This checklist describes inspection activities, and notes additional recommended inspections.

CHECK ✓	Recommended, in addition to required annual inspection	System Feature	Problem	Conditions to Check for	Preferred Conditions and Maintenance Practices
	Monthly from November through April Annually Required	General	Erosion Scouring	Eroded or scoured planter bottom due to flow channelization, or higher flows	Repair ruts or bare areas by filling with topsoil during dry season; regrade and replant large bare areas
	Monthly Annually Required	General	Poor Vegetation Coverage	Grass or other vegetation is sparse or bare in more than 10% of the swale bottom	Determine cause of poor growth and correct the condition; replant with plugs or containerized plants as needed to meet current density standards during next appropriate planting season.
	Monthly Annually Required	General	Invasive Vegetation	Nuisance weeds or other invasive vegetation is taking over	No invasive vegetation; remove excessive weeds. Attempt to control even if complete eradication is not feasible.
	Monthly Annually Required	General	Vegetation	Vegetation blocking more than 10% of the basin opening	No vegetation blocking opening to basin
	Monthly from November through April Annually Required	General	Vegetation	Vegetation growing in inlet/outlet pipe joints that is more than 6 inches tall and less than 6 inches apart	No vegetation or root growth present
	Monthly from November through April Annually Required	General	Vegetation	Vegetation blocking more than 10% of the inlet or outlet pipe opening	No vegetation blocking inlet or outlet pipe opening
	Monthly from November through April Annually Required	General	Excessive Shading	Vegetation growth is poor because sunlight does not reach swale	Trim over-hanging limbs, if possible; remove brushy vegetation as needed

Vegetated Swale Checklist (continued)

Annual inspections are required. This checklist describes inspection activities, and notes additional recommended inspections.

CHECK ✓	Recommended, in addition to required annual inspection	System Feature	Problem	Conditions to Check for	Preferred Conditions and Maintenance Practices
	Monthly and after any major storm (1-inch in 24 hours) Annually Required	General	Trash and Debris	Visual evidence of trash, debris or dumping	Trash and debris removed from facility
	Monthly from November through April Annually Required	General	Standing Water	Standing water in the swale between storms that does not drain freely	Remove sediment or trash blockages; improve grade from end to end of swale; no standing water 24 hours after any major storm (1-inch in 24 hours)
	Monthly from November through April Annually Required	General	Rodents	Evidence of rodents or water piping through facility via rodent holes	No rodents; facility repaired.
	Annually Required	General	Insects	Insects such as wasps and hornets interfere with maintenance activities	Harmful insects removed
	Monthly from November through April Annually Required	General	Contamination and Pollution	Any evidence of oil, gasoline, contaminants, or other pollutants	No contaminants or pollutants present; coordinate removal/ cleanup with local water quality response agency
	Monthly from November through April and after any major storm (1-inch in 24 hours) Annually Required	Grates	Trash and Debris	Visual evidence of trash, debris or dumping	Trash and debris removed from grate
	Annually Required	Grates	Damaged or Missing Grate Not in Place	Grate missing or broken grate members Grate is missing or only partially in place	Grate is in place and meets design standards Any open structure needs maintenance; replace grate if missing
	Annually Required	Outlet Structure and Orifice Plate	Excessive Standing Water or Water Is Not Detained For Required Time	If water is not detained check to see if the orifice plate is installed; if water does not drain in required time, check to see if overflow structure is plugged	Orifice plate is cleared for proper drainage or re-installed to ensure required detention; overflow structure is unobstructed
	Monthly during growing season Annually Required	General	Vegetation	Specified or approved grass grows so tall that it competes with shrubs or becomes a fire danger. (Note: except emergent wetland grasses in the treatment area of low maintenance facilities)	String trim grass to 4" to 6" and remove clippings; take care not to girdle the bark of trees and shrubs

Vegetated Filter Strip Checklist

Annual inspections are required. This checklist describes inspection activities, and notes additional recommended inspections.

CHECK ✓	Recommended, in addition to required annual inspection	System Feature	Problem	Conditions to Check for	Preferred Conditions and Maintenance Practices
	Monthly from November through April Annually Required	General	Flow not distributed evenly	Flows unevenly distributed through filter strip due to uneven or clogged flow spreader	Level the spreader and clean so that flows spread evenly over entire filter strip width
	Monthly Annually Required	General	Invasive Vegetation	No invasive vegetation is planted or permitted to remain, including but not limited to the following: Himalayan Blackberry; Reed Canary Grass; Teasel; English Ivy; Nightshade; Clematis; Cattail; Thistle; Scotch Broom	No invasive vegetation; remove excessive weeds. Attempt to control even if complete eradication is not feasible.
	Monthly from November through April Annually Required	General	Vegetation	Grass more than 10 inches tall; weeds and other vegetation taking take over	Mow grass to a height of 3 to 4 inches; control nuisance vegetation such that flow is not impeded
	Monthly from November through April Annually Required	General	Erosion	Eroded or scoured filter bottom due to flow channelization, or higher flows	Repair ruts or bare areas by filling with topsoil during dry season; regrade and replant large bare areas
	Monthly from November through April Annually Required	General	Scouring Sediment Accumulation	Sediment depth exceeds 2 inches	Remove sediment deposits; re-level so slope is even and flows pass evenly through strip
	Monthly and after any major storm (use 1-inch in 24 hours as a guideline) Annually Required	General	Trash and Debris	Visual evidence of trash, debris or dumping	Trash and debris removed from facility
	Monthly Annually Required	General	Rodents	Evidence of rodents or water piping through facility via rodent holes	No rodents; facility repaired.
	Annually Required	General	Insects	Insects such as wasps and hornets interfere with maintenance activities	Harmful insects removed
	Monthly during growing season Annually Required	General	Vegetation	Specified or approved grass grows so tall that it competes with shrubs or becomes a fire danger	String trim grass to 4” to 6” and remove clippings; take care not to girdle the bark of trees and shrubs

Water Quality Devices

Interior and exterior images of standard water quality devices

Description

Water quality manholes (hydrodynamic separators) and catchbasins provide pretreatment to a series of Best Management Practices (BMPs). These water quality (WQ) devices remove coarse solids and floatable trash and garbage that may rapidly clog a downstream system, such as a swale. This helps in reducing maintenance. The WQ structure may provide required pretreatment for a vegetated swale, an extended dry basin, or a constructed water quality wetland. Two types of WQ manholes and one type of catchbasin are approved:

1) Standard WQ manhole with snout or mechanical tee assembly
2) Proprietary hydrodynamic separators
3) Duel Chamber Catchbasin with elbow assembly or trap

Contech's CDS® is an approved proprietary hydrodynamic separator. It is a flow-through structure with a settling or separation unit to remove sediment and other pollutants .

Application & Limitations

Water quality pre-treatment devices manage stormwater flow from all types of impervious surfaces including private property and the public right-of-way, treating runoff from rooftops, parking lots, and streets. Generally, these facilities are allowed in ultra high density development with high pollutant load potentials, such as commercial parking lots. Consult Springfield's Design and Construction Standards for allowed uses.

Diagrams and construction photographs of hydrodynamic separators

Design Factors

Designers should reference Springfield's Design and Construction Standards to size standard WQ manholes and catchbasins.

WQ devices are sized by treatment objectives, including desired level of pollutant removal, flow to be treated and target particle size. Designers should contact the manufacturer's representative for design and sizing guidance. The pollutant removal rates differ by product and should be evaluated before a system is selected for a site. Because performance is affected by hydraulic loading rate, excess flow should not be routed through the device.

Inspection & Maintenance Guidelines

Contact the manufacturer for specific maintenance procedures. At a minimum, the following procedures that use common equipment and existing maintenance protocols are required:

1. Inspection: Monthly monitoring is recommended during the first year of a new installation after the site has been stabilized.

2. Maintenance: Clean the structure when the sump is half full (e.g., 2 feet of material collects in a 4-foot sump), or if there is a spill or other incident. Use a vacuum truck for best results. Material will need to be disposed of properly, check with your local waste transfer facility (dump) before disposal.

Snout/elbow/trap:

Annual inspection of the anti-siphon vent/elbow/trap and the access hatch is recommended. Open and close the access hatch. Flush the vent or clean with a flexible wire.

Access:

Vacuum trucks which are typically used for maintenance must have unobstructed access for pollutant removal.

References:

Springfield's Design & Construction Standards

Water Quality Pretreatment Devices Checklist

Annual inspections are required. This checklist describes inspection activities, and notes additional recommended inspections.

CHECK ✓	Recommended, in addition to required annual inspection	System Feature	Problem	Conditions to Check for	Preferred Conditions and Maintenance Practices
	Monthly from November through April Annually Required	General	Trash, Debris and Sediment	Material exceeds 50% of sump depth or one foot below the tee, elbow, trap or snout	Tee, elbow, trap or snout is not blocked; trash, debris and sediment removed.
	Annually Required	General	Structural Damage	Tee or Snout is not securely attached to the structure's wall	Tee or Snout securely attached to wall and outlet pipe
	Monthly from November through April Annually Required	General	Contamination and Pollution	Evidence of oil, gasoline, or other pollutants	No contaminants present, coordinate removal and cleanup with pretreatment device cleaning company and/or hazardous waste cleanup company, depending on degree of material
	Monthly Annually Required	General	Vermin and Odors	Dead animals or vegetation that could generate odors or dangerous gases (e.g. methane) and could cause complaints	No dead animals or vegetation in the structure
	Annually Required	General	Structural Damage	Connections to in/out pipes are not watertight	Connections to in/out pipe are watertight; structure repaired or replaced and works as designed
	Annually Required	Structural Components	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
	Annually Required	Structural Components	Cover or Grate Not in Place	Cover or grate is missing or only partially in place	Access hole is closed Grate and/or cover is in place and meets design standards
	Annually Required	Structural Components	Cover Difficult to Remove	One maintenance person cannot remove lid using normal lifting pressure; cover makes access for maintenance difficult	Cover can be removed by one maintenance person
	Annually Required	Structural Components	Ladder Rungs Unsafe	Maintenance person determines ladder is unsafe (missing rungs, misalignment, rust, cracks); ladder must be repaired or secured immediately	Ladder meets design standards and allows safe access for maintenance. No person shall enter the structure without the proper training.
	Monthly from November through April Annually Required	Media filter vault	Sediment accumulation on top of filter	Sediment accumulation exceeds 0.5 inches over media	No sediment deposits on top of media; sediment likely indicates that the media is plugged and in need of required replacement

Water Quality Pretreatment Devices Checklist

Annual inspections are required. This checklist describes inspection activities, and notes additional recommended inspections.

CHECK ✓	Recommended, in addition to required annual inspection	System Feature	Problem	Conditions to Check for	Preferred Conditions and Maintenance Practices
	Monthly from November through April Annually Required	Media filter vault	Sediment accumulation in vault	Sediment accumulation in vault exceeds 4 inches	Sediment in vault removed
	Monthly from November through April Annually Required	Media filter vault	Trash and floatable debris accumulation	Trash and floatable debris accumulation in vault	No trash or other floatable debris in filter vault
	Annually and after any major storm (1-inch in 24 hours) Annually Required	Media filter vault	Filter media submerged	Filter vault does not drain within 24 hours following storm; look for evidence of submergence due to back water or excessive hydrocarbon loading	Replace filter media If filters have not been changed changed in 2 years, replace immediately
	Monthly from November through April Annually Required	Media filter vault	Vault is in bypass	Filter vault remains in bypass condition (water over the internal outlet baffle wall during an average rain fall event	Clean out vault and/or basket - unplug clogged pipes - replace media if damaged or plugged
	Annually and after any major storm (1-inch in 24 hours) Annually Required	Grates	Trash and Debris	Trash and debris blocking more than 20% of grate surface inletting capacity	Grate free of trash and debris
	Annually Required	Walls and bottom	Fractures or Cracks	Maintenance person determines the structurre is unsound. Cracks wider than 1/2 inch and longer than 1 foot, evidence of soil entering through cracks	Structure replaced or repaired to design standards
	Monthly from November through April Annually Required	Inlet/Outlet	Blockage of Inlet / Outlet	Trash or debris in any inlet or outlet pipe blocking more than 1/3 of its capacity or over basket	Inlet and outlet pipes free of trash and debris

Catch Basin Checklist

Annual inspections are required. This checklist describes inspection activities, and notes additional recommended inspections.

CHECK ✓	Recommended, in addition to required annual inspection	System Feature	Problem	Conditions to Check for	Preferred Conditions and Maintenance Practices
	Monthly and after any major storm (1-inch in 24 hours) Annually Required	General	Trash and Debris	Visual evidence of trash, debris or dumping	Trash and debris removed from catch basin
	Monthly Annually Required	General	Vermin and Odors	Dead animals or vegetation that could generate odors or dangerous gases (e.g., methane) and could cause complaints	No dead animals or vegetation in the catch basin
	Monthly from November through April Annually Required	General	Contamination and Pollution	Evidence of oil, gasoline, contaminants, or other pollutants	No contaminants or pollutants present; coordinate removal/ cleanup with local catchbasin cleaning agency and/or local hazardous wastes clean up agency; depending on the degree, amount and material.
	Annually Required	General	Settlement or Misalignment	Failure of basin has created a safety, function, or design problem	Basin replaced or repaired to design standards
	Monthly Annually Required	General	Vegetation	Vegetation blocking more than 10% of the basin opening	No vegetation blocking basin opening
	Monthly Annually Required	General	Vegetation	Vegetation in inlet/outlet pipe joints that is more than 6 inches tall and less than 6 inches apart	No vegetation or root growth present
	Monthly and after any major storm (1-inch in 24 hours) Annually Required	Grates	Trash and Debris	Trash and debris blocking more than 20% of grate surface inletting capacity	Grate free of trash and debris
	Annually Required	Grates	Damaged or Missing	Missing grate; missing or broken grate members	Grate is in place and meets design standards
	Annually Required	Catch Basin Cover	Cover Not in Place	Cover is missing or only partially in place	Closed catch basin cover; any open catch basin requires maintenance
	Annually Required	Catch Basin Cover	Cover Difficult to Remove	One maintenance person cannot remove lid using normal lifting pressure; difficult to access for maintenance	Cover can be removed by one maintenance person

Catch Basin Checklist (continued)

Annual inspections are required. This checklist describes inspection activities, and notes additional recommended inspections.

CHECK ✓	Recommended, in addition to required annual inspection	System Feature	Problem	Conditions to Check for	Preferred Conditions and Maintenance Practices
	Annually Required	Frame and Top Slab	Structure Damage to Frame or Top Slab	Holes in top slab larger than 2 square inches or cracks wider than 1/4 inch; intent is to ensure no material is running into basin	Top slab is free of holes and cracks
	Annually Required	Frame and Top Slab	Structure Damage to Frame or Top Slab	Frame not sitting flush on top slab (more than 3/4 inch between frame and top slab); frame not securely attached	Frame is firmly attached and sits flush on the riser rings or top slab
	Annually Required	Ladder	Ladder Rungs Unsafe	Ladder is unsafe (missing rungs, not securely attached, misalignment, rust, cracks, sharp edges, etc.)	Ladder meets design standards and allows safe access for maintenance person. No person shall enter the basin without proper training.
	Annually Required	Basin Walls and Bottom	Fractures or Cracks	Maintenance person determines the structure is unsound	Basin replaced or repaired to design standards
	Annually Required	Basin Walls and Bottom	Fractures or Cracks	Grout is separated or cracked wider than 1/2 inch and longer than 1 foot at the joint of any inlet/outlet pipe; evidence of soil entering through cracks	Pipe is re-grouted and secure at basin wall
	Monthly and after any major storm (1-inch in 24 hours) Annually Required	Sump	Trash & Debris	Trash or debris in the basin exceeds 50% of the sump depth from the bottom of basin to flowline of the lowest pipe into or out of the basin; less than 6 inches clearance from the debris surface to the flowline of the lowest pipe	No trash or debris in the catch basin; in no case less than 6 inches clearance from the debris surface to the flowline of the lowest pipe
	Monthly Annually Required	Sump	Sediment	Sediment in the basin exceeds 50% of the sump depth from the bottom of basin to flowline of the lowest pipe into or out of the basin; in no case less than 6 inches of clearance from the sediment surface to the flowline of the lowest pipe	No sediment in the catch basin
	Monthly from November through April Annually Required	Inlet/Outlet	Blockage of Inlet/ Outlet	Trash or debris in any inlet or outlet pipe blocking more than 1/3 of its capacity	Inlet and outlet pipes free of trash or debris