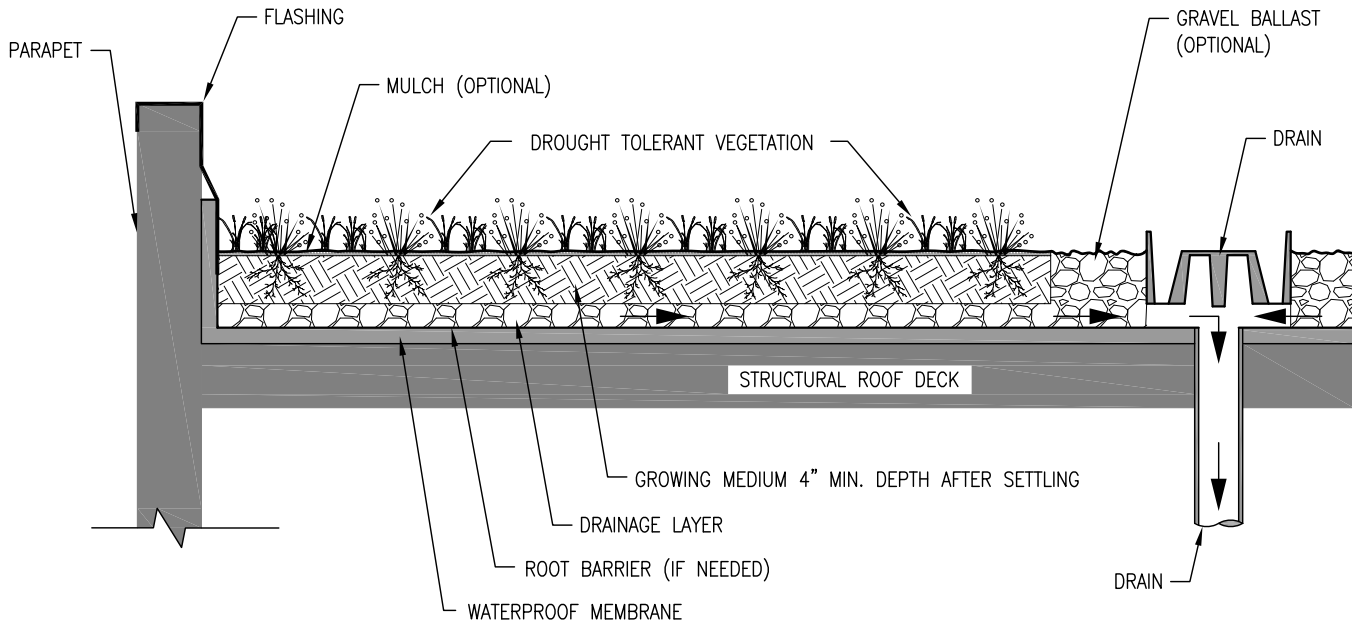


ECOROOF WITH DRAINAGE LAYER



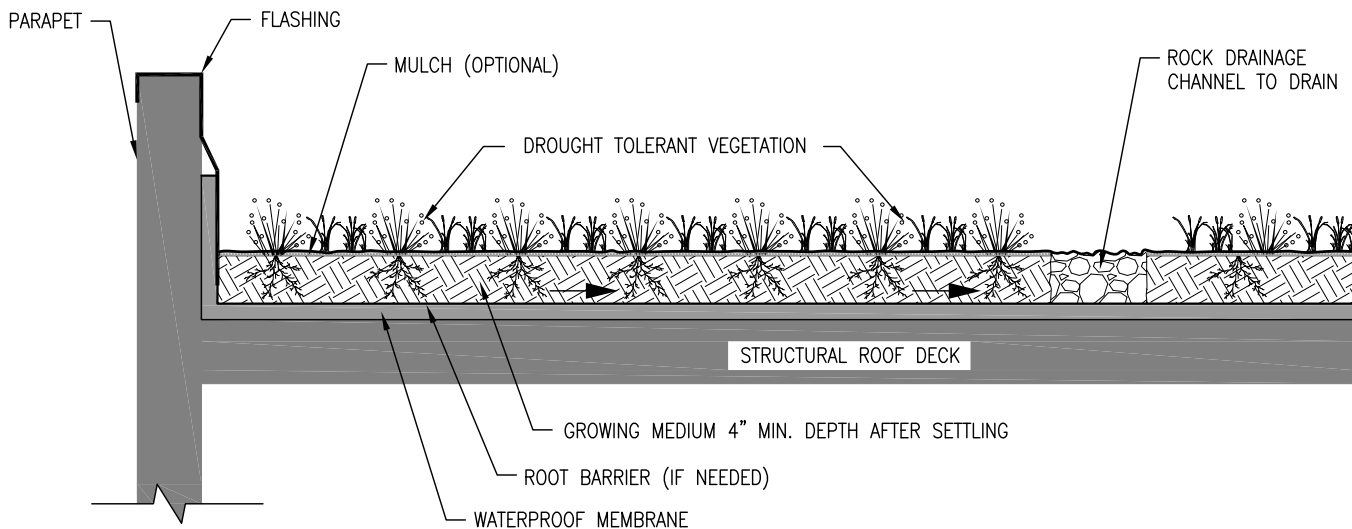
NOTE: Building elements such as glass and lighting placed near ecoroofs have the potential to exacerbate bird-srike mortality. Glass treatments may be required. See City code 33.510.223 and the Resource Guide for Bird-Friendly Building Design:
<http://www.portlandoregon.gov/bps/article/446308>

1. Inspections: Call BDS IVR inspection line, (503) 823-7000. Request 487.3 inspections required.

CONSTRUCTION REQUIREMENTS

Follow the manufacturer's requirements for installation of the membrane. Install enough medium to achieve the design depth, allowing for initial settling. Minimize compaction of the growing media after placement - limit foot traffic to pathways designated for that use.

ECOROOF WITH DRAINAGE CHANNELS



- DRAWINGS NOT TO SCALE -



Bureau of Environmental Services



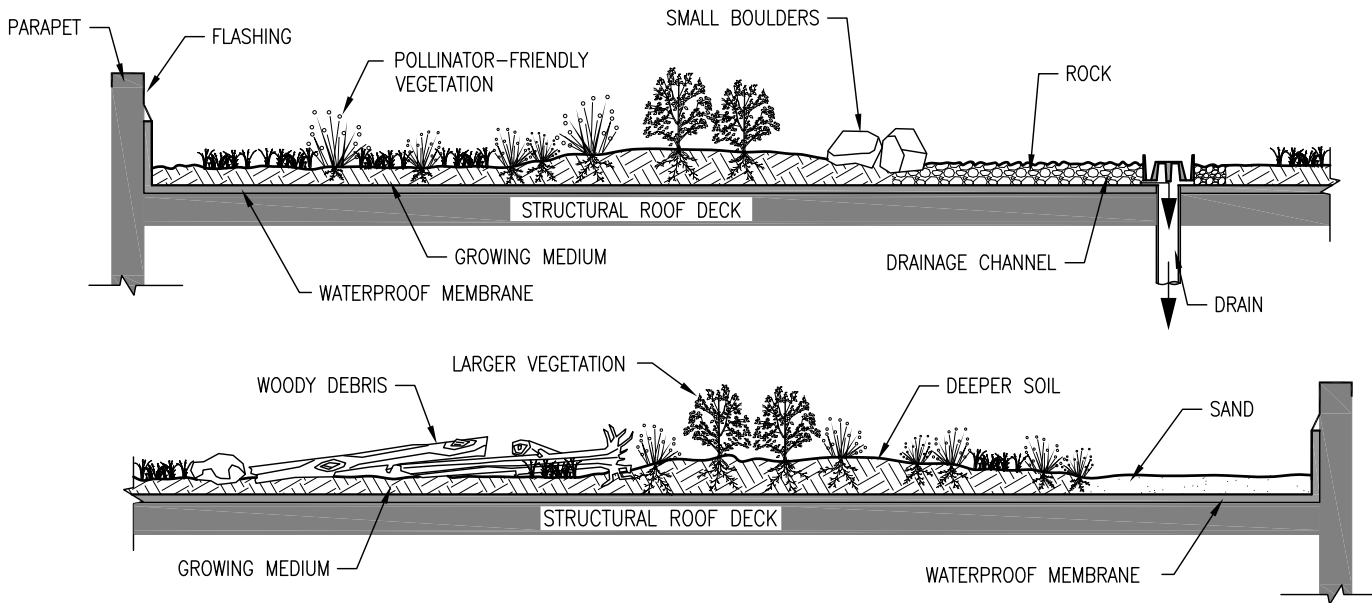
STORMWATER MANAGEMENT
TYPICAL DETAILS FOR
PRIVATE PROPERTY

ECOROOF

SW-100

HABITAT ECOROOF EXAMPLE SECTIONS

- DRAWINGS NOT TO SCALE -



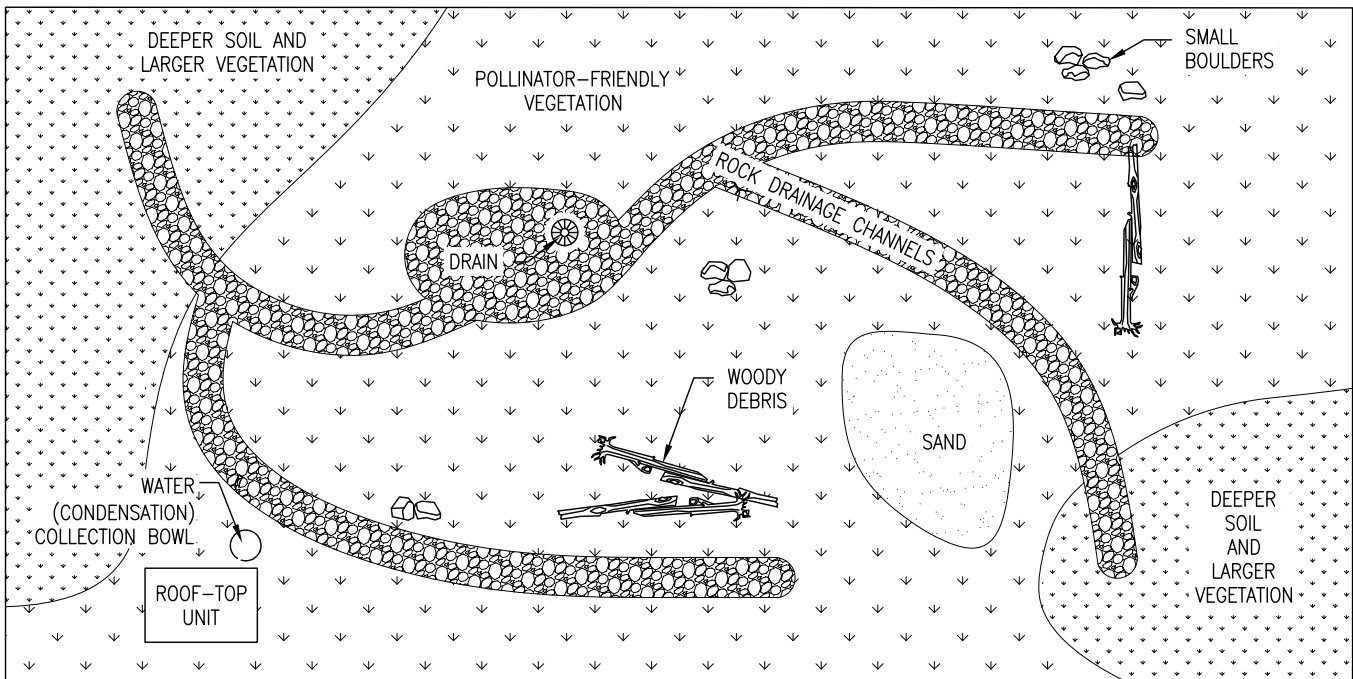
NOTE: Building elements such as glass and lighting placed near ecoroofs have the potential to increase bird-srike mortality. Glass treatments may be required. See City code 33.510.223 and the Resource Guide for Bird-Friendly Building Design: <http://www.portlandoregon.gov/bps/article/446308>

CONSTRUCTION REQUIREMENTS

Follow the manufacturer's requirements for installation of the membrane. Install enough medium to achieve the design depth, allowing for initial settling. Minimize compaction of the growing media after placement - limit foot traffic to pathways designed for that use.

1. Inspections: Call BDS IVR inspection line, (503) 823-7000. Request 487.3 inspections required.

HABITAT ECOROOF WITH DRAINAGE CHANNELS - EXAMPLE PLAN



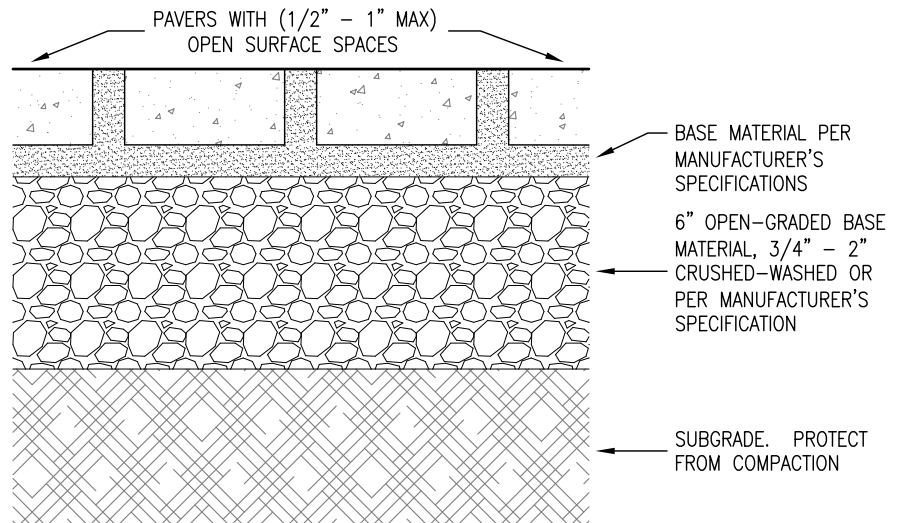
Bureau of Environmental Services



STORMWATER MANAGEMENT
TYPICAL DETAILS FOR
PRIVATE PROPERTY

HABITAT ECOROOF SW-101

SIM approach is applicable only for residential driveways and pedestrian-only areas.



PERMEABLE CONCRETE PAVER SYSTEMS

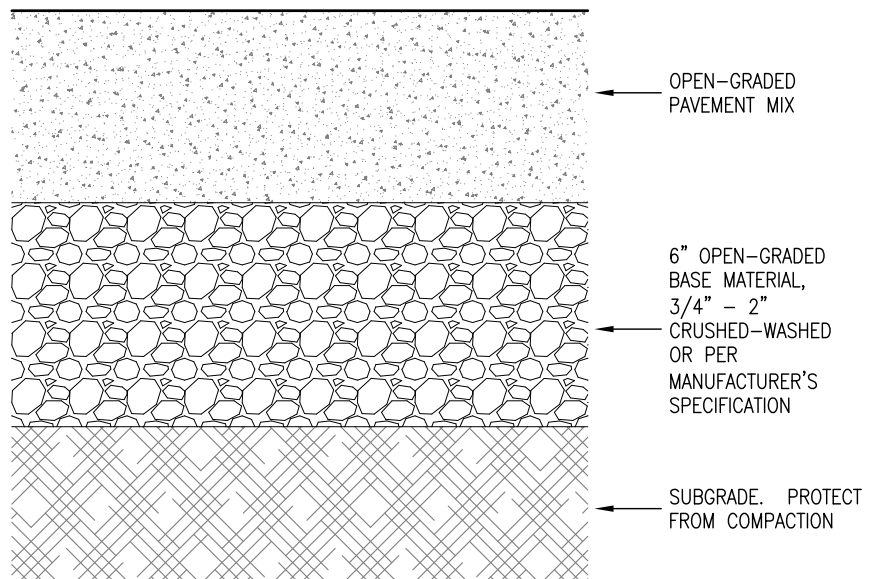
	RESIDENTIAL DRIVEWAY OR PEDESTRIAN ONLY
CONCRETE	4"
ASPHALT	2 1/2"
PAVERS	Varies
COMPACTION REQ'D	NO

CONSTRUCTION REQUIREMENTS

Protect subgrade from over-compaction during construction; do not construct or compact the subgrade in wet conditions. Sequence the work to avoid traffic on the subgrade and protect the finished pavement from construction traffic and sediment accumulation. A permeable pavement protection plan may be required.

REQUIRED TOP LIFT DEPTH

1. Inspections: Call BDS IVR inspection line, (503) 823-7000. Request 487.3 inspections required.



PERVIOUS CONCRETE AND POROUS ASPHALT SYSTEMS

– DRAWINGS NOT TO SCALE –



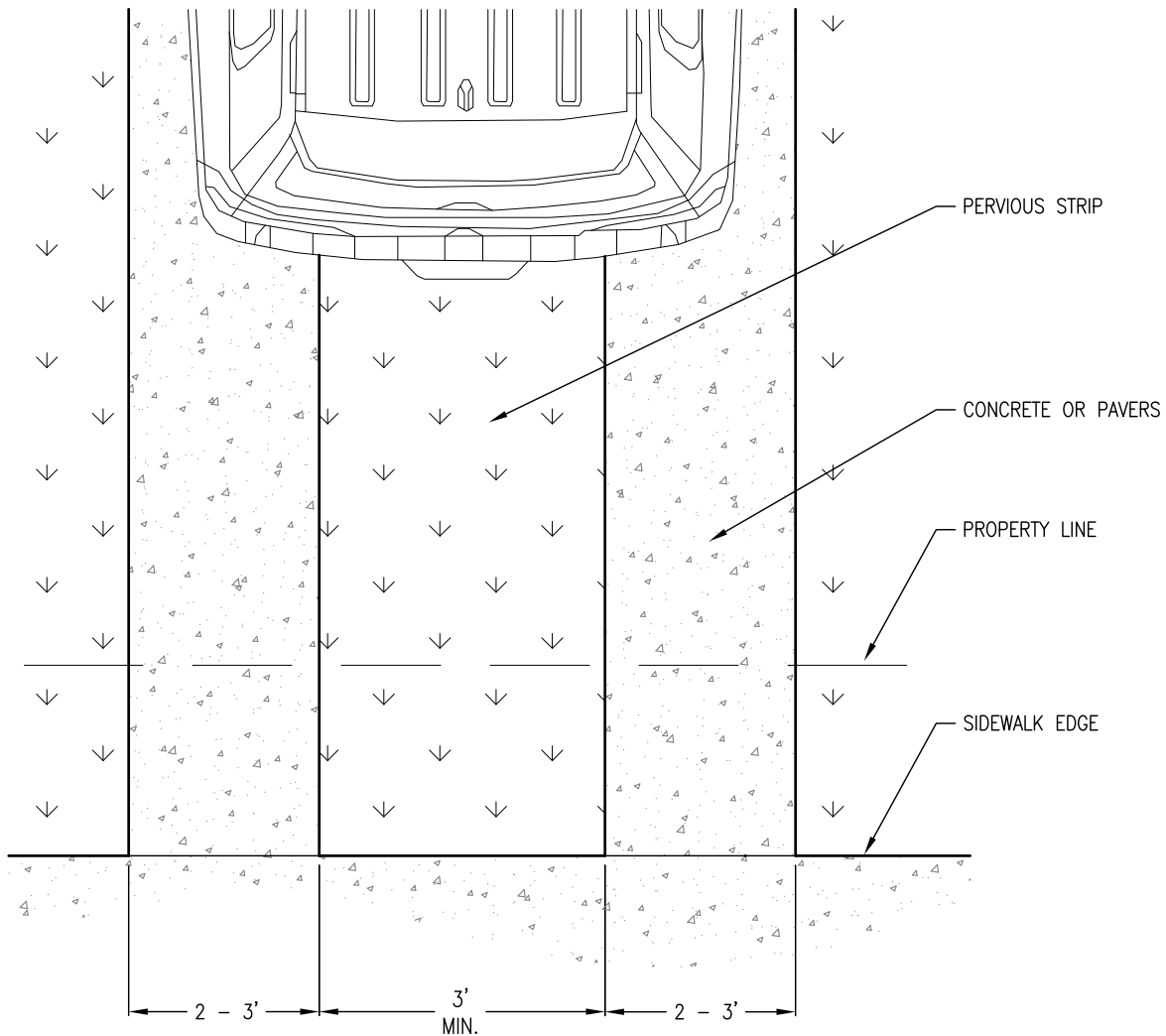
Bureau of Environmental Services



STORMWATER MANAGEMENT
TYPICAL DETAILS FOR
PRIVATE PROPERTY

PERMEABLE
PAVEMENT

SW-110



1. Wheel tracks can be concrete, permeable concrete, pavers or concrete grids.
2. The pervious strip must be: 1) turf grass, native grass or groundcovers, or 2) at least 4" of clean, angular gravel no smaller than $\frac{3}{4}$ ". Bare earth is not allowed.
3. Center strip must be at least 1" lower than adjacent wheel tracks.
4. Add directional grooves or scoring to wheel tracks to direct water to center strip.
5. Driveway center strips are prohibited where the longitudinal slope > 15%, and the length is limited to 50' where the longitudinal slope is 10–15%.

6. Inspections: Call BDS IVR inspection line, (503) 823-7000. Request 487.3 inspections required.

CONSTRUCTION REQUIREMENTS

Protect the center strip from compaction during construction. Do not drive heavy equipment across the area or allow storage of waste or construction materials.

- DRAWING NOT TO SCALE -



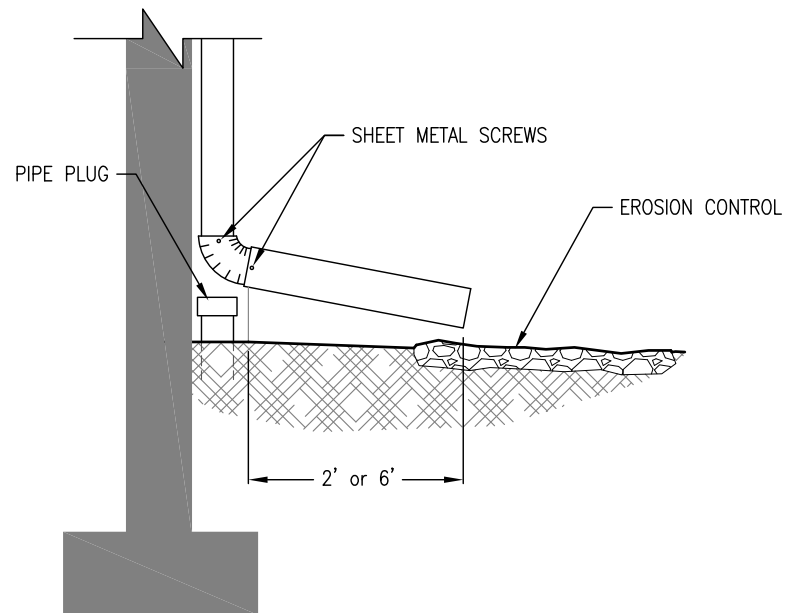
Bureau of Environmental Services



STORMWATER MANAGEMENT
TYPICAL DETAILS FOR
PRIVATE PROPERTY

DRIVEWAY
CENTER STRIP

SW-111



1. Applicability: Limited to retrofits of existing areas, only with BES approval.
2. Site Suitability: Suitable for sites with infiltration rates $>2''$ per hour and have an overall slope of 10% or less.
3. Sizing: The footprint of the landscape area where the downspout discharges must be at least 10% of the contributing roof area.
4. Setbacks: The end of the extension must be at least 6 feet from basement walls and at least 2 feet from crawl spaces and concrete slabs, and must be at least 5 feet from the property line (possibly more if the landscape slopes toward the neighbor's property).
5. Do not discharge onto driveways, hardscape or other impervious areas including public sidewalks and streets.
6. Extension materials: Gutter-grade extension materials are required. Flexible hose is prohibited.
7. Entrance Erosion Control: Install river rock, flagstone, or similar materials to dissipate the energy of water discharged by the downspout. No erosion control is required if discharging to lawn. Plastic splash blocks are not allowed.

CONSTRUCTION REQUIREMENTS

Extensions must discharge to areas that can accommodate stormwater flows; they can't cross walkways or drain onto driveways, patios, or other impervious surfaces. Runoff must drain safely away from building foundations and property lines. Downspouts can be field-fit to meet the standards based on site conditions. Hinged downspout extensions or "flipper" extensions are useful for ease of landscape maintenance.

- DRAWING NOT TO SCALE -



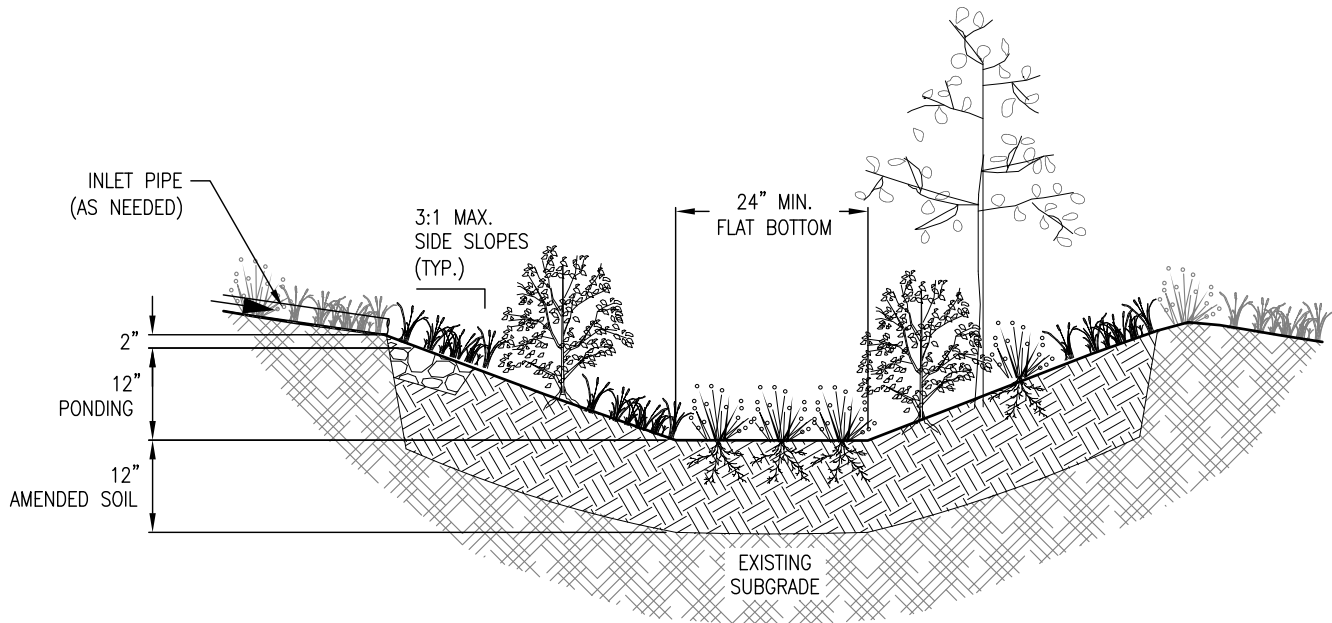
Bureau of Environmental Services



STORMWATER MANAGEMENT
TYPICAL DETAILS FOR
PRIVATE PROPERTY

**DOWNSPOUT
EXTENSION**
ONLY FOR RETROFITS TO
EXISTING DEVELOPMENT

SW-120



1. Setbacks: 2' from any onsite building without a basement; 6' from any onsite building with a basement; the deepest point must be 10' from all structures; 5' from property lines except next to the right-of-way; 5' from base of retaining walls > 3' high; 10' from top of retaining walls > 3' high.
2. Overflow: A rain garden must include an overflow route that safely directs runoff to a disposal point in heavy rainfall. Overflow routes must drain away from building foundations and adjacent properties. Overflow routes must be planted or covered with rock to limit erosion.
3. Piping: Must conform with the requirements of the Oregon Specialty Plumbing Code.
4. Amended Soil: Amend native soil with 3" of yard debris compost, blend to a depth of 12".
5. Vegetation: Refer to plant list in SWMM Section 3.5. Minimum container size is 1 gal. Number of plantings per 100sf of facility area: 80 herbaceous plants OR 72 herbaceous plants and 4 small shrubs.
6. Entrance Erosion Control: Install river rock, flagstone, or similar to dissipate the energy of incoming water at entrances and ends of downspout extensions.
7. Mulch: The surface can be mulched with 2" of dark (aged) medium hemlock mulch.
8. Inspections: Call BDS IVR Inspection Line, (503) 823-7000, request 487. 3 inspections required.

CONSTRUCTION REQUIREMENTS

Mark the location of future facilities, and fence or cover facility locations after excavation. Do not allow vehicular traffic, foot traffic, material storage, or heavy equipment within 10 feet of the infiltration area except as needed to excavate, grade, and construct the facility. Do not allow entry of runoff or sediment during construction.

- DRAWING NOT TO SCALE -



Bureau of Environmental Services

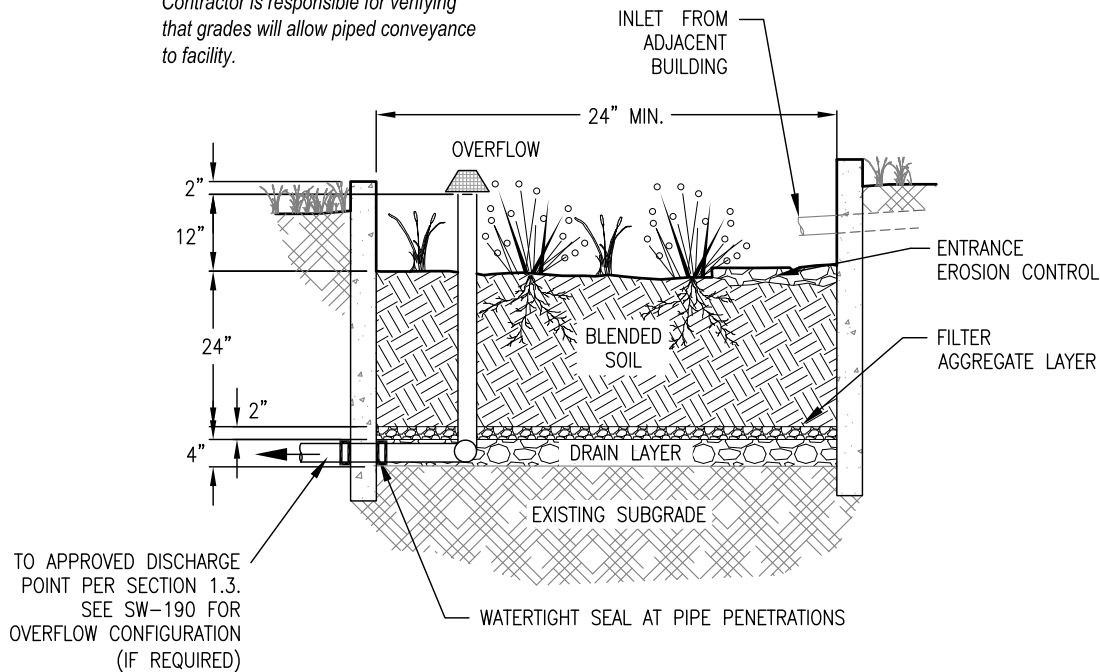


STORMWATER MANAGEMENT
TYPICAL DETAILS FOR
PRIVATE PROPERTY

RAIN GARDEN

SW-121

Contractor is responsible for verifying that grades will allow piped conveyance to facility.



1. Setbacks: 10' from building foundations; 5' along property lines except next to right-of-way. Walls can't exceed 30" height above grade if within 5' of property line including right-of-way.
2. Facility Slope (planted floor): Maximum of 0.5% in all directions.
3. Piping: Conform with Oregon Plumbing Specialty Code (OPSC) requirements.
4. Drain Layer: 4" of $\frac{3}{4}$ "-1 $\frac{1}{2}$ " washed drain rock. Filter aggregate layer: 2-3" of $\frac{1}{4}$ "-No.10 washed angular aggregate.
5. Overflow: Overflow elevation must allow for 2" of freeboard, minimum. Protect from debris and sediment with strainer or grate.
6. Blended Soil: Use BES' standard soil blend for stormwater facilities (SWMM Section 6.3) unless otherwise approved. Install minimum of 24" of blended soil.
7. Vegetation: Refer to plant list in SWMM Section 3.5. Minimum container size is 1 gal. Number of plantings per 100sf of facility area: 80 herbaceous plants OR 72 herbaceous plants and 4 small shrubs.
8. Entrance Erosion Control: Install river rock, flagstone, or similar to dissipate the energy of incoming water at entrances and ends of downspout extensions.
9. Inspections: Call BDS IVR Inspection Line, (503) 823-7000, request 487. 3 inspections required.

CONSTRUCTION REQUIREMENTS

Mark the location of future facilities, and fence or cover facility locations after excavation. Do not allow vehicular traffic, foot traffic, material storage, or heavy equipment within 10 feet of the infiltration area except as needed to excavate, grade, and construct the facility. Do not allow entry of runoff or sediment during construction.

- DRAWING NOT TO SCALE -



Bureau of Environmental Services

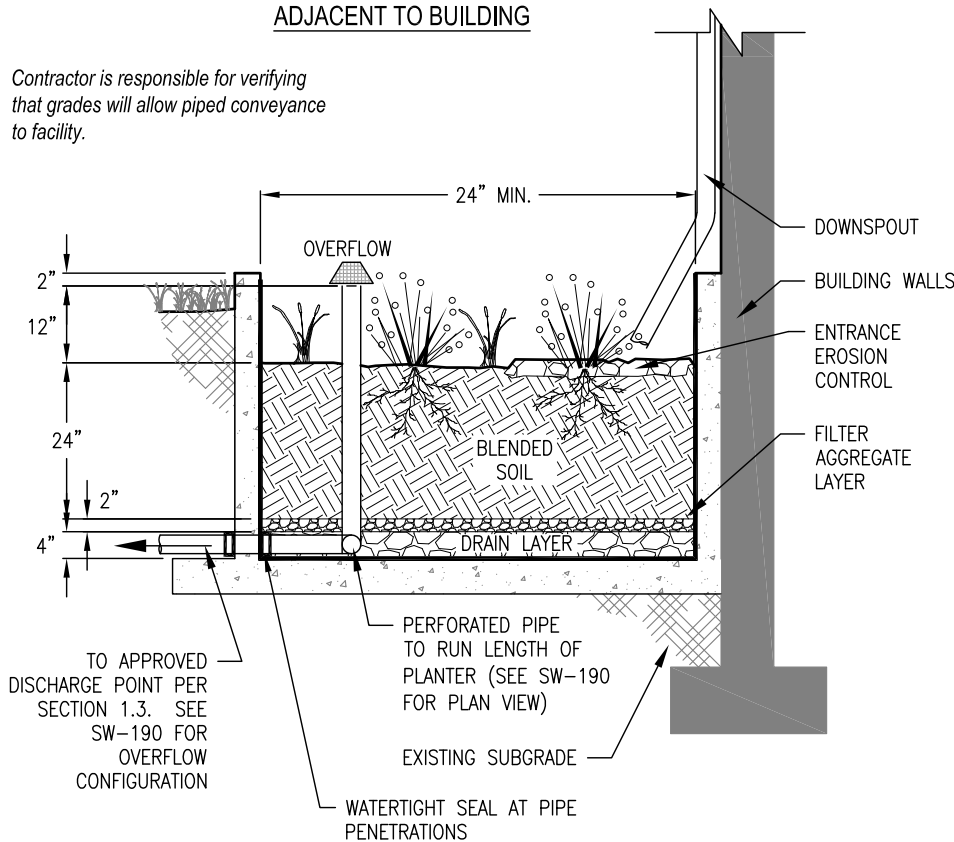


STORMWATER MANAGEMENT
TYPICAL DETAILS FOR
PRIVATE PROPERTY

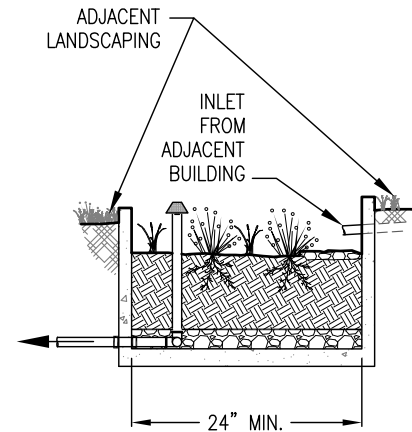
UNLINED PLANTER SW-140

ADJACENT TO BUILDING

Contractor is responsible for verifying that grades will allow piped conveyance to facility.



FREESTANDING PLANTER



1. Setbacks: No setback is required for lined planters. Walls can't exceed 30" height above grade if within 5' of property line including right-of-way.
2. Facility Slope (planted floor): Maximum of 0.5% in all directions.
3. Planter Structure: A single-pour monolithic concrete shell, without cold joints, is required to avoid the requirement for liner. Include walls on foundation plans. Check state structural standards for foundations.
4. Waterproofing: No additional waterproofing is needed if structure is monolithically poured.
5. Piping: Conform with Oregon Plumbing Specialty Code (OPSC) requirements.
6. Drain Layer: 4" of $\frac{3}{4}$ "-1 $\frac{1}{2}$ " washed drain rock. Filter aggregate layer: 2-3" of $\frac{1}{4}$ "-No.10 washed angular aggregate.
7. Overflow: Overflow elevation must allow for 2" of freeboard, minimum. Protect from debris and sediment with strainer or grate.
8. Blended Soil: Use BES' standard soil blend for stormwater facilities (SWMM Section 6.3) unless otherwise approved. Install minimum of 24" of blended soil.
9. Vegetation: Refer to plant list in SWMM Section 3.5. Minimum container size is 1 gal. Number of plantings per 100sf of facility area: 80 herbaceous plants OR 72 herbaceous plants and 4 small shrubs.
10. Entrance Erosion Control: Install river rock, flagstone, or similar to dissipate the energy of incoming water at entrances and ends of downspout extensions.
11. Inspections: Call BDS IVR Inspection Line, (503) 823-7000, request 487. 3 inspections required.

CONSTRUCTION REQUIREMENTS

Do not allow temporary storage of construction waste or materials in the facilities. Do not allow entry of runoff or sediment during construction.

- DRAWINGS NOT TO SCALE -



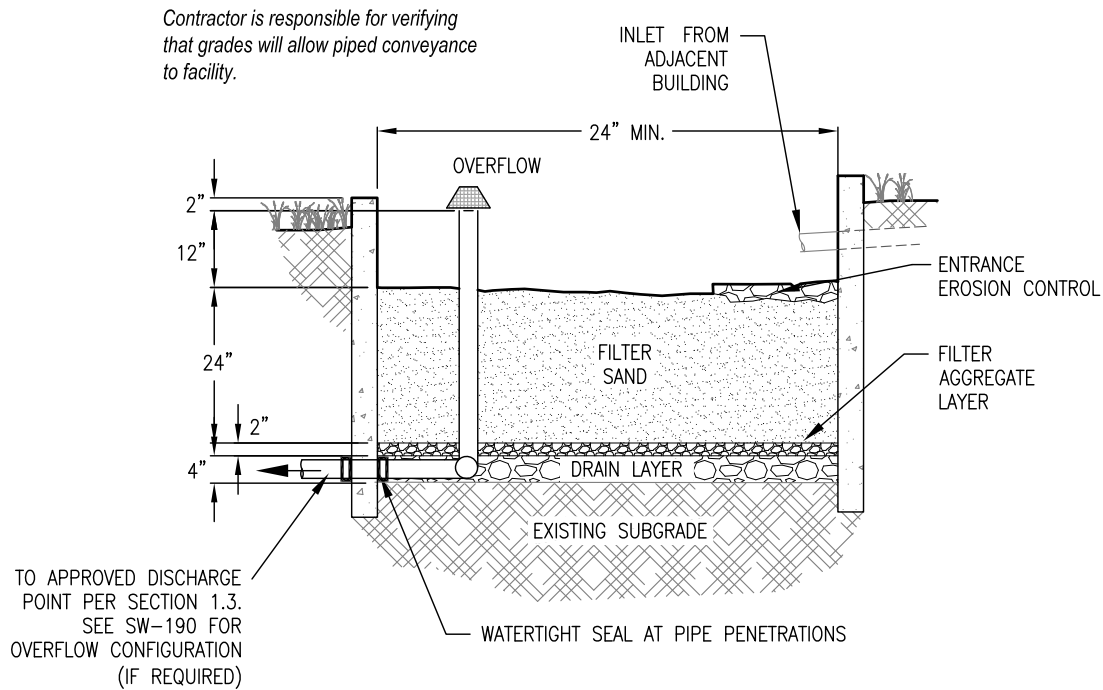
Bureau of Environmental Services



STORMWATER MANAGEMENT
TYPICAL DETAILS FOR
PRIVATE PROPERTY

LINED PLANTER

SW-141



1. Setbacks: 10' from building foundations; 5' along property lines except next to right-of-way. Walls can't exceed 30" height above grade if within 5' of property line including right-of-way.
2. Facility Slope (sand surface): Maximum of 0.5% in all directions.
3. Piping: Conform with Oregon Plumbing Specialty Code (OPSC) requirements.
4. Drain Layer: 4" of $\frac{3}{4}$ "-1 $\frac{1}{2}$ " washed drain rock. Filter aggregate layer: 2-3" of $\frac{1}{4}$ "-No.10 washed angular aggregate.
5. Overflow: Overflow elevation must allow for 2" of freeboard, minimum. Protect from debris and sediment with strainer or grate.
6. Filter Sand: Install 24" of filter sand. See sand spec. in SWMM section 3.2.5.4.
7. Entrance Erosion Control: Install river rock, flagstone, or similar to dissipate the energy of incoming water at entrances and ends of downspout extensions.
8. Inspections: Call BDS IVR Inspection Line, (503) 823-7000, request 487. 3 inspections required.

CONSTRUCTION REQUIREMENTS

Mark the location of future facilities, and fence or cover facility locations after excavation. Do not allow vehicular traffic, foot traffic, material storage, or heavy equipment within 10 feet of the infiltration area except as needed to excavate, grade, and construct the facility. Do not allow entry of runoff or sediment during construction.

- DRAWINGS NOT TO SCALE -



Bureau of Environmental Services



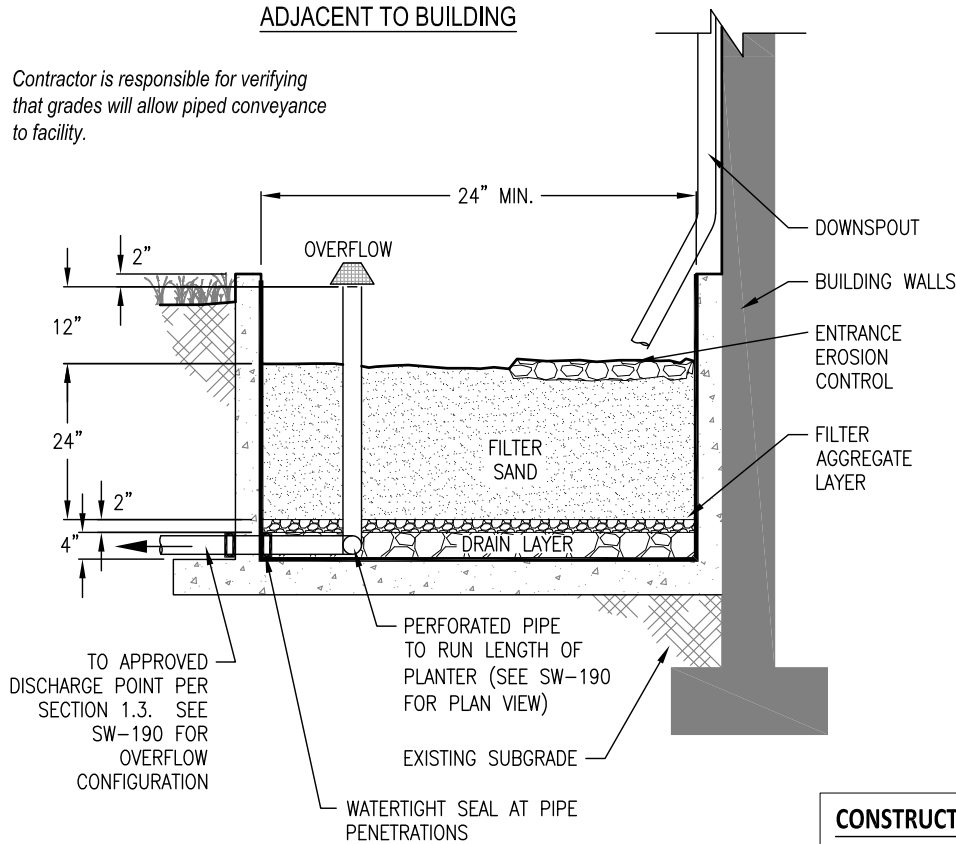
STORMWATER MANAGEMENT
TYPICAL DETAILS FOR
PRIVATE PROPERTY

UNLINED
SAND FILTER

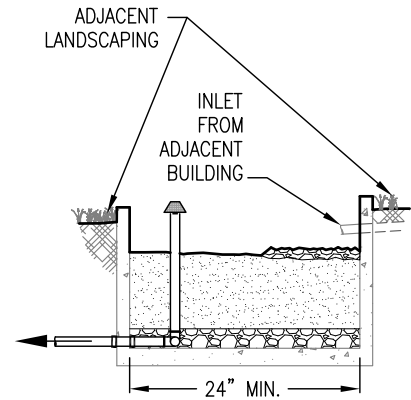
SW-142

ADJACENT TO BUILDING

Contractor is responsible for verifying that grades will allow piped conveyance to facility.



FREESTANDING



CONSTRUCTION REQUIREMENTS

Do not allow temporary storage of construction waste or materials in the facilities. Do not allow entry of runoff or sediment during construction.

1. Setbacks: No setback is required for lined sand filters. Wall height must be less than 30" above finished grade if within 5' of property line.
2. Facility Slope (sand surface): Maximum of 0.5% in all directions.
3. Overflow: Overflow elevation must allow for 2" of freeboard, minimum. Protect from debris and sediment with strainer or grate.
4. Piping: Conform with Oregon Plumbing Specialty Code (OPSC) requirements.
5. Drain Layer: 4" of $\frac{3}{4}$ "-1 $\frac{1}{2}$ " washed drain rock. Filter aggregate layer: 2-3" of $\frac{1}{4}$ "-No.10 washed angular aggregate.
6. Filter Sand: Install 24" of filter sand. See filter sand spec. in SWMM Section 3.2.5.4.
7. Planter Structure: A single-pour monolithic concrete shell, without cold joints, is required to avoid the requirement for a liner.
8. Waterproofing: No additional waterproofing is needed if structure is monolithically poured.
9. Entrance Erosion Control: Install river rock, flagstone, or similar to dissipate the energy of incoming water at entrances and ends of downspout extensions.
10. Inspections: Call BDS IVR Inspection Line, (503) 823-7000. Request 487.3 inspections required.

- DRAWINGS NOT TO SCALE -



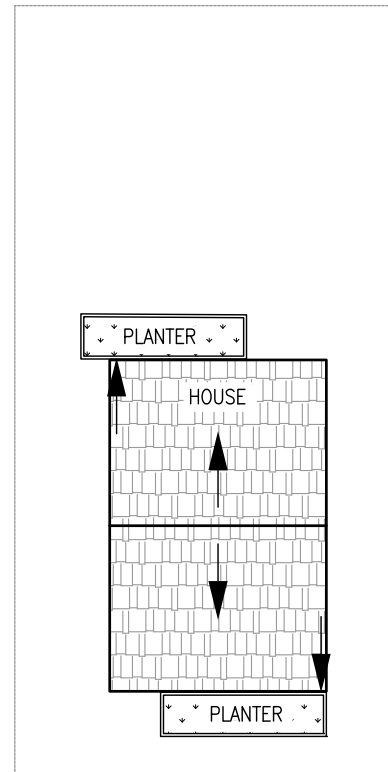
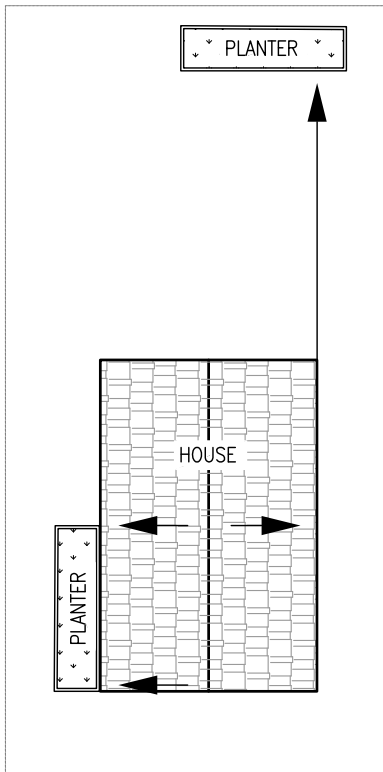
Bureau of Environmental Services



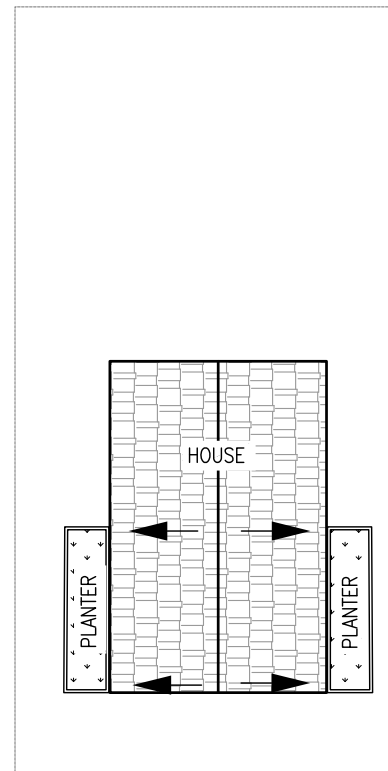
STORMWATER MANAGEMENT
TYPICAL DETAILS FOR
PRIVATE PROPERTY

LINED
SAND FILTER

SW-143



1. Drainage areas and corresponding facilities can be divided to accommodate site and building configurations. Configurations are shown as examples.
2. Design professional is responsible for verifying that grades will allow piped conveyance to facility.



- DRAWINGS NOT TO SCALE -



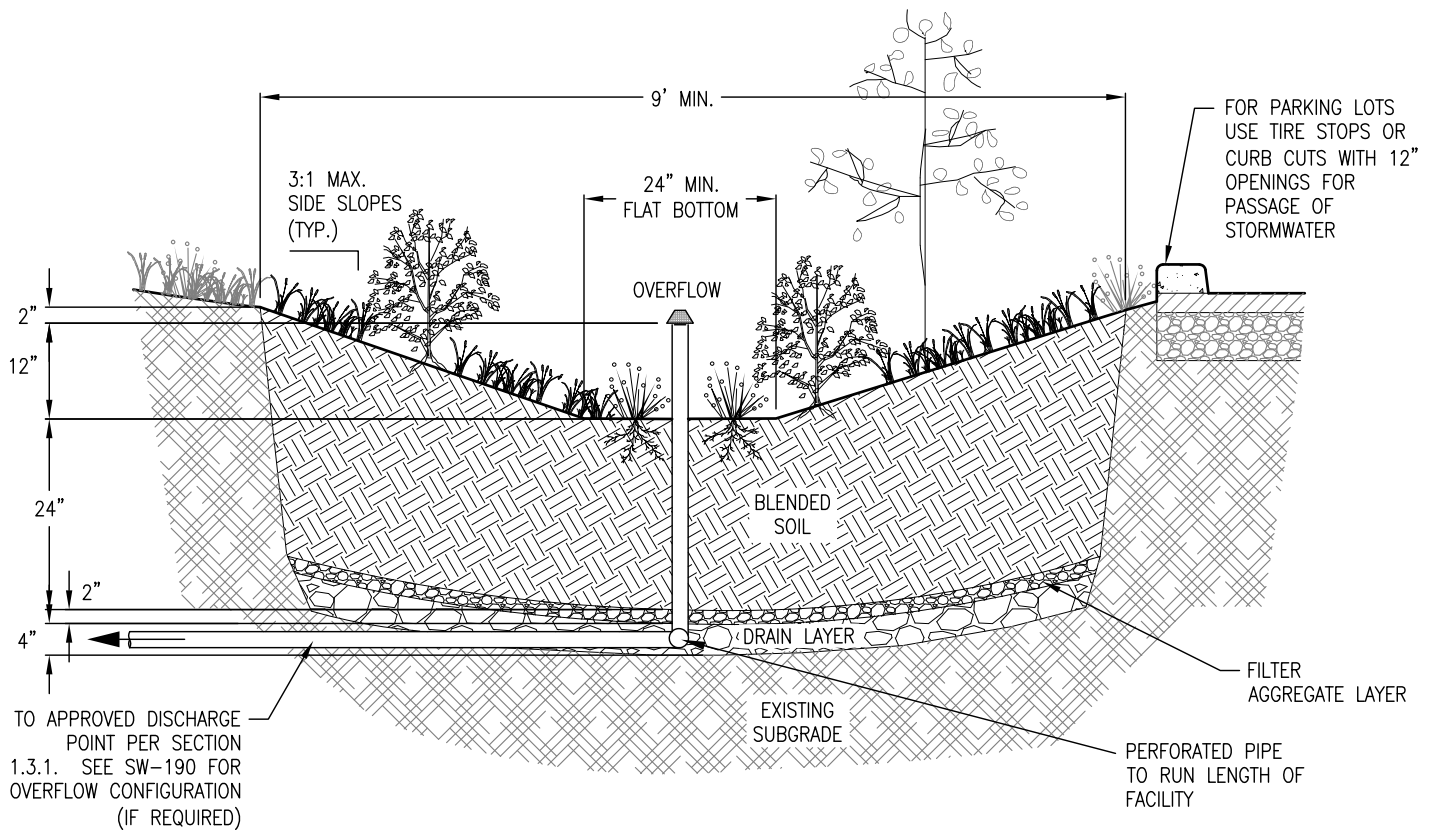
Bureau of Environmental Services



STORMWATER MANAGEMENT
TYPICAL DETAILS FOR
PRIVATE PROPERTY

LINED PLANTER AND
SAND FILTER
SITE CONFIGURATIONS

SW-144



1. Setbacks: 5' along property lines except next to right-of-way; 10' from building foundations.
2. Slope: Maximum slope of 6% (facility bottom).
3. Overflow: Overflow elevation must allow for 2" of freeboard, minimum. Protect from debris and sediment with strainer or grate.
4. Piping: Conform with Oregon Plumbing Specialty Code (OPSC) requirements.
5. Drain Layer: 4" of $\frac{3}{4}$ "-1 $\frac{1}{2}$ " washed drain rock. Filter aggregate layer: 2-3" of $\frac{1}{4}$ "-No.10 washed angular aggregate.
6. Blended Soil: Use BES' standard soil blend for stormwater facilities (SWMM Section 6.3) unless otherwise approved. Install minimum of 24" of blended soil.
7. Vegetation: Refer to plant list in SWMM Section 3.5. Minimum container size is 1 gal. Number of plantings per 100sf of facility area:
 - Zone A (wet): 80 herbaceous plants OR 72 herbaceous plants and small shrubs.
 - Zone B (moderate to dry): 7 large to small shrubs AND 70 groundcover plants.
 The delineation between zone A and B shall be either at the outlet elevation or the check dam elevation, whichever is lowest.
8. Entrance Erosion Control: Install river rock, flagstone, or similar to dissipate the energy of incoming water at entrances and ends of downspout extensions.
9. Check Dams: Place check dams every 10' where slope exceeds 4%. Check dam ends must be keyed into the native soil a minimum of 12" (see SW-152).
10. Inspections: Call BDS IVR Inspection Line, (503) 823-7000, request 487. 3 inspections required.

CONSTRUCTION REQUIREMENTS

Mark the location of future facilities, and fence or cover facility locations after excavation. Do not allow vehicular traffic, foot traffic, material storage, or heavy equipment within 10 feet of the infiltration area except as needed to excavate, grade, and construct the facility. Do not allow entry of runoff or sediment during construction.

- DRAWING NOT TO SCALE -



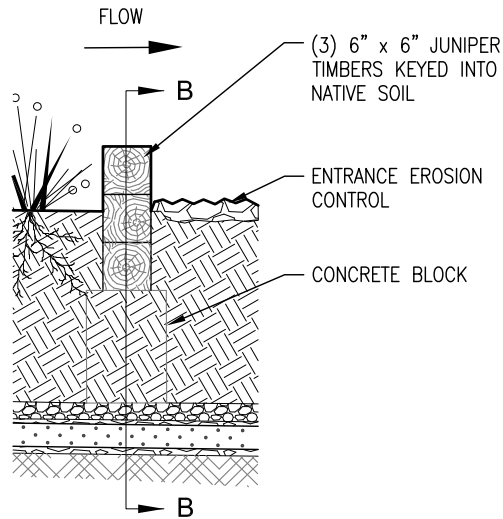
Bureau of Environmental Services



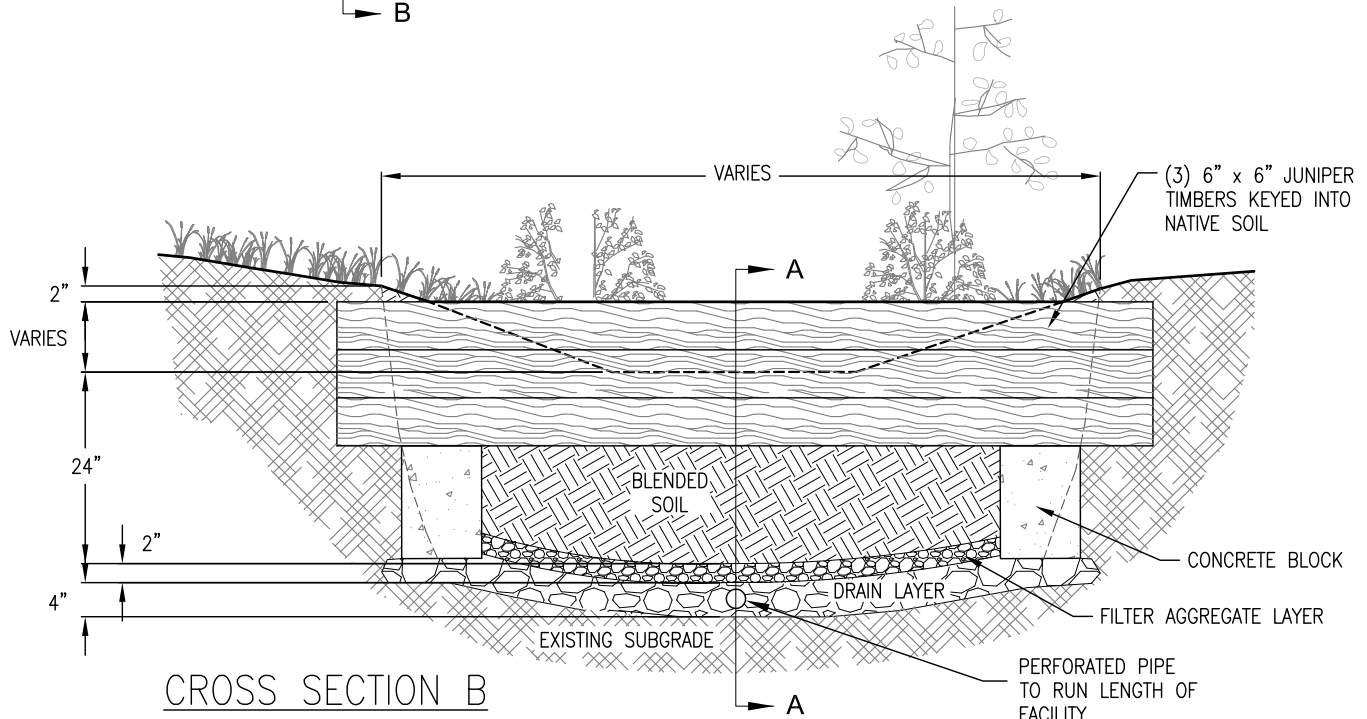
STORMWATER MANAGEMENT
TYPICAL DETAILS FOR
PRIVATE PROPERTY

UNLINED BASIN

SW-150



CROSS SECTION A



CROSS SECTION B

1. Check Dam Overflow: Overflow elevation must meet required ponding depth and allow for 2" of freeboard, minimum.
2. Spacing: Place check dams every 10' where slope exceeds 4%. Ends to be keyed into native soil a minimum of 12".
3. Materials: Check dams can be constructed of other rot resistant materials such as cedar and concrete. Treated lumber is not acceptable.

- DRAWINGS NOT TO SCALE -



Bureau of Environmental Services



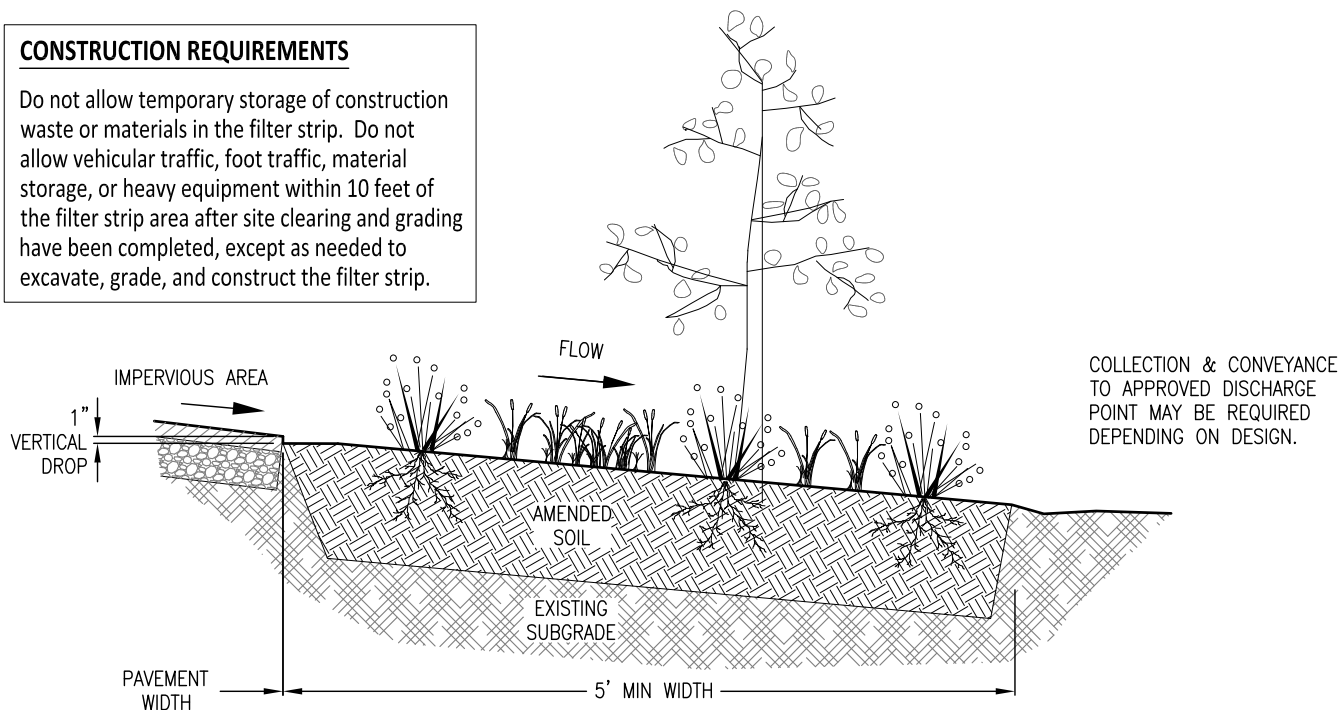
STORMWATER MANAGEMENT
TYPICAL DETAILS FOR
PRIVATE PROPERTY

BASIN
CHECK DAM

SW-152

CONSTRUCTION REQUIREMENTS

Do not allow temporary storage of construction waste or materials in the filter strip. Do not allow vehicular traffic, foot traffic, material storage, or heavy equipment within 10 feet of the filter strip area after site clearing and grading have been completed, except as needed to excavate, grade, and construct the filter strip.



1. Provide protection from all vehicle traffic, equipment staging, as well as foot traffic for proposed infiltration areas prior to and during construction.
2. Dimensions and Limits: See sizing table below. Minimum flow line length is 5'
3. Impervious Area Limits: The maximum width that can be managed with a filter strip is 12', and the maximum slope of the impervious area is 10%.
4. Setbacks: 2' from any onsite building without a basement; 6' from any onsite building with a basement; 5' from property lines, except next to the right-of-way.
5. Amended Soil: If area isn't already vegetated, amend native soil by adding 3 inches of yard-debris compost and blending to a depth of 12 inches.
6. Vegetation: The filter strip must have at least 90% coverage by native vegetation, grass or tree canopy.
7. Inspections: Call BDS IVR Inspection Line, (503) 823-7000. Request 487.3 inspections required.

Filter Strip Sizing for the Simplified Approach

Slope	Infiltration Rate	Sizing Ratio*
<10%	≥2"/hr	2/3
	<2"/hr	3

*Ratio of the width of the filter strip to the width of the surface draining to it.

- DRAWING NOT TO SCALE -



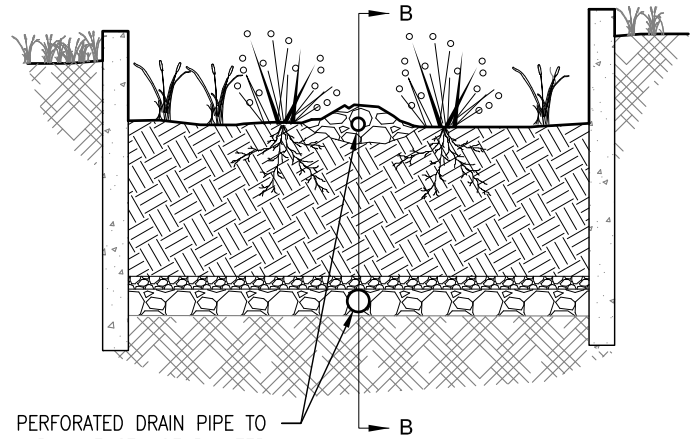
Bureau of Environmental Services



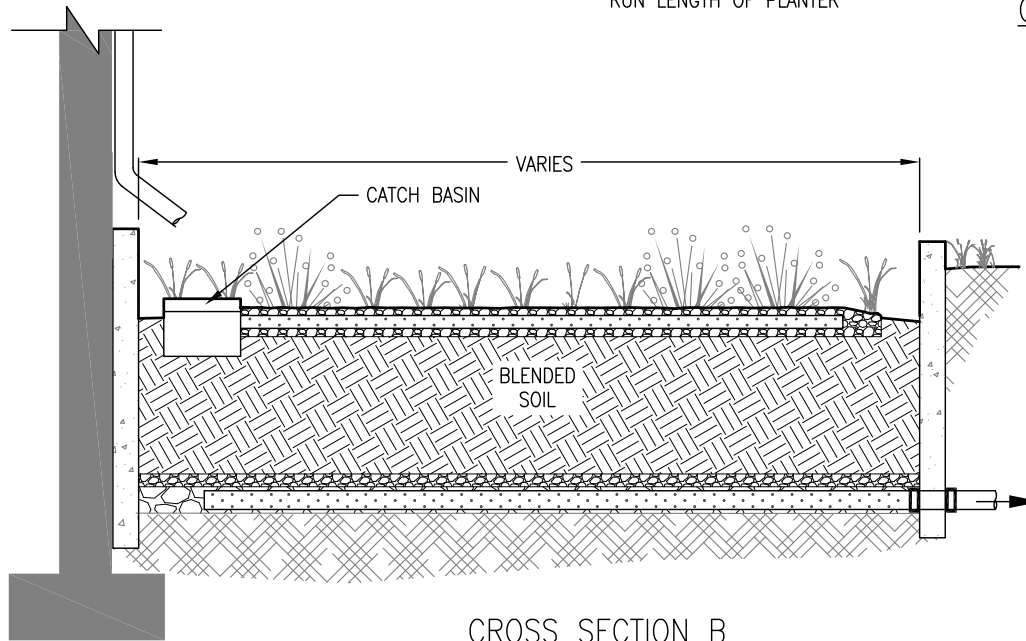
STORMWATER MANAGEMENT
TYPICAL DETAILS FOR
PRIVATE PROPERTY

FILTER STRIP

SW-160



CROSS SECTION A



CROSS SECTION B

1. Catch Basin: Install NDS Spee-D Basin or equal beneath downspout to collect debris or sediment.
2. Perforated drain pipe must be embedded in coarse, free-draining aggregate.
3. Perforated drain pipe must be level.

- DRAWINGS NOT TO SCALE -

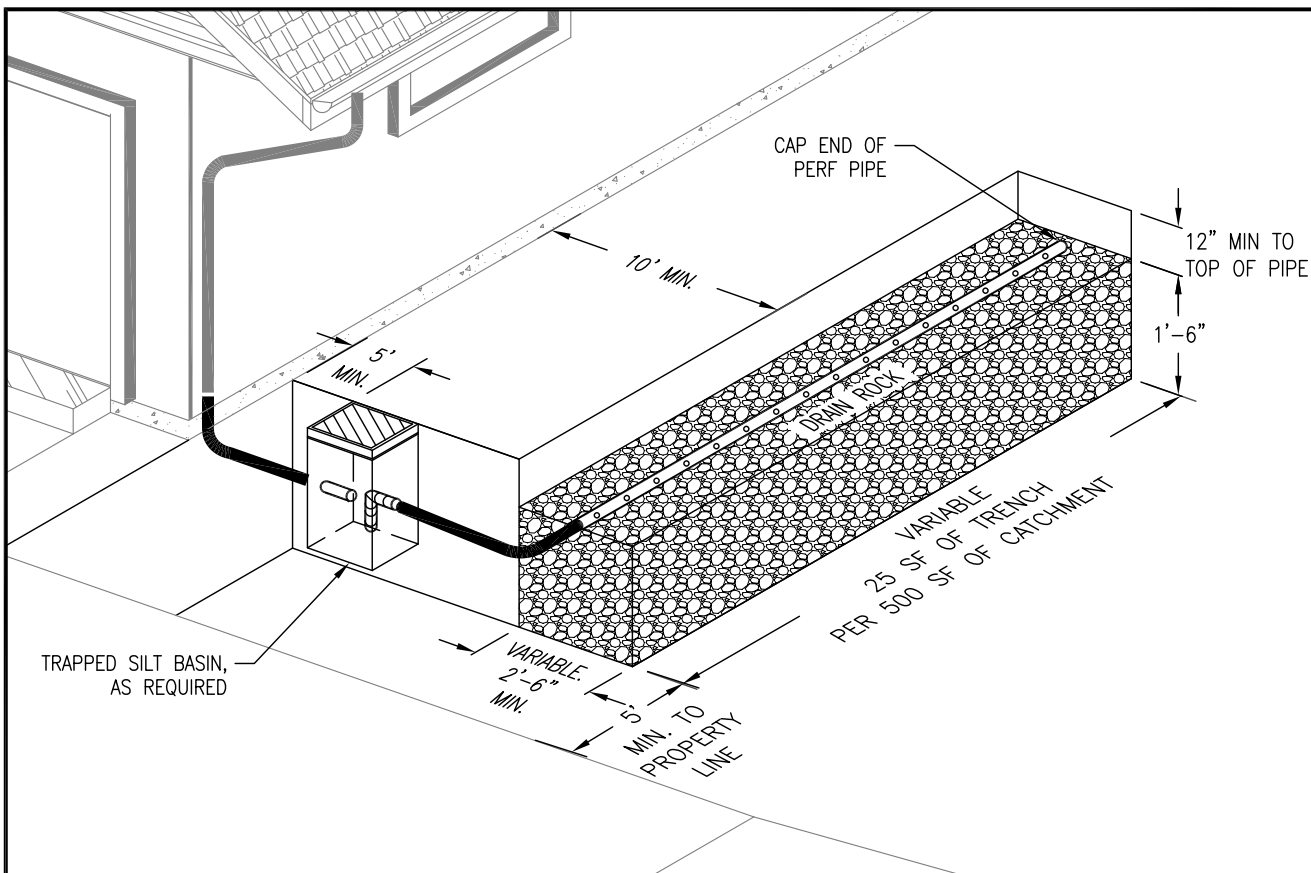


Bureau of Environmental Services



STORMWATER MANAGEMENT
TYPICAL DETAILS FOR
PRIVATE PROPERTY

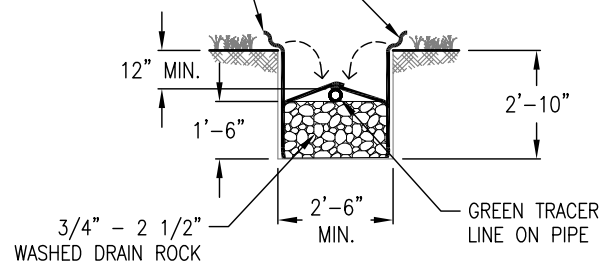
FLOW DISSIPATOR SW-161



1. Siting Criteria: The base of the soakage trench must be at least 5' above seasonal high groundwater.
2. Sizing: 1'-6" tall, 2'-6" wide minimum. 25 square feet of trench per 500 square feet of catchment area.
3. Setbacks: Measured from the edge, the soakage trench must be 10' from foundations and 5' from property lines, except next to the right-of-way.
4. Pre-Treatment: A trapped silt basin such as a sumped catch basin is required except for soakage trenches managing roof runoff and runoff from pedestrian-only areas.
5. Piping: Conform with Oregon Plumbing Specialty Code (OPSC) requirements.
6. The top of the soakage trench must be lower than foundations, including basements within 10 feet of the soakage trench.
7. Inspections: Call BDS IVR inspection line, (503) 823-7000. Request 487.3 inspections required.

SECTION

FILTER FABRIC TO BE PLACED ON SIDES AND ENDS. FOLD OVER AND COVER PERF PIPE AND DRAIN ROCK.



CONSTRUCTION REQUIREMENTS

The outline of the facility must be clearly marked before site work begins to avoid soil disturbance. Use of heavy equipment should be minimized within 10 feet of soakage trench areas. The bottom of the soakage trench and the perforated pipe must be level. Clay check dams may be used to prevent water from collecting near the downstream end. Smearing the soil surface during excavation can potentially limit infiltration rates; if smooth excavation tools are used, roughen the sides and bottom of the excavation with a sharp pointed tool. Remove loose material from the bottom of the excavation.

LINE TRENCH SIDES WITH PERMEABLE FILTER FABRIC AS SHOWN, ADD 18" OF DRAIN ROCK. PLACE PERF. PIPE AND COVER ALL.

- DRAWINGS NOT TO SCALE -



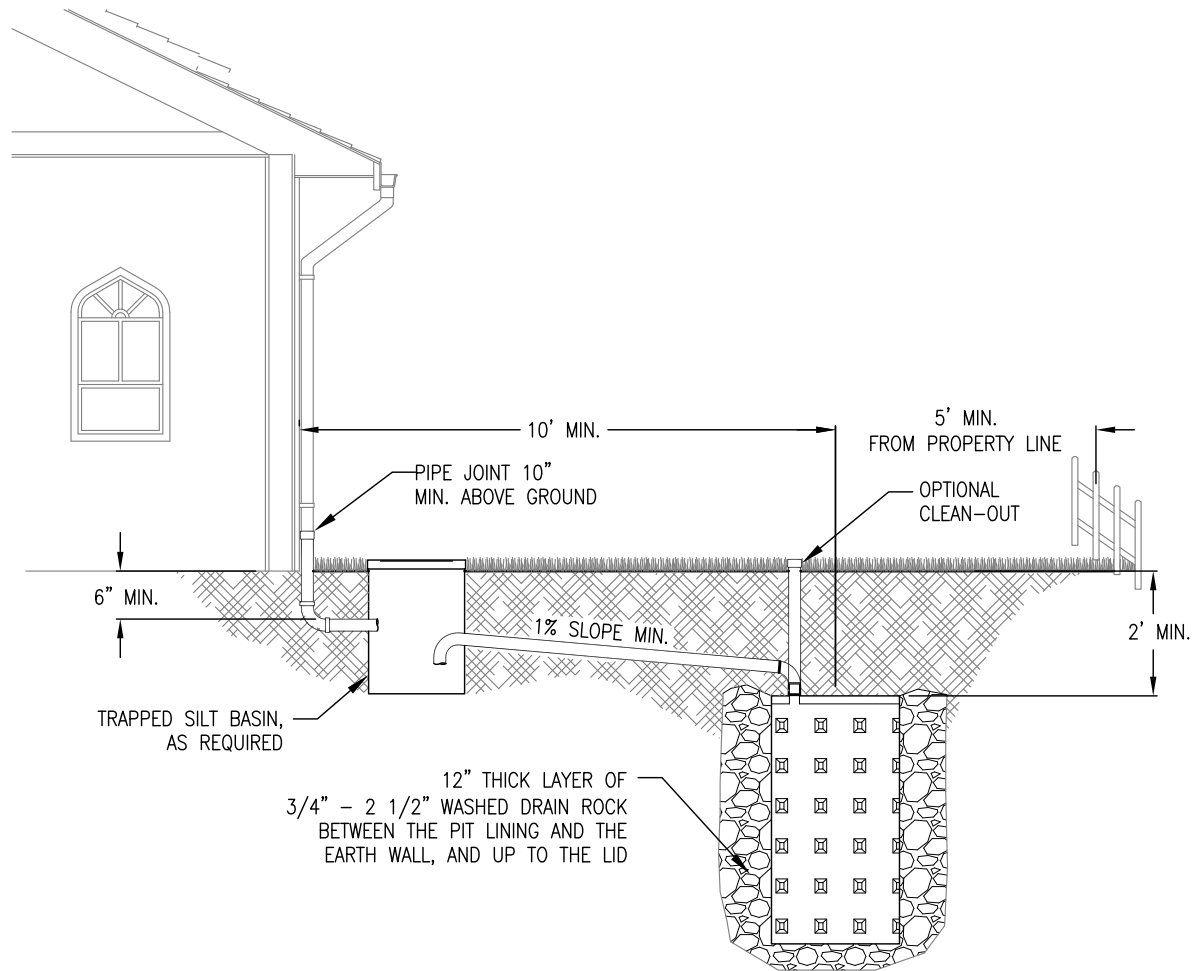
Bureau of Environmental Services



STORMWATER MANAGEMENT
TYPICAL DETAILS FOR
PRIVATE PROPERTY

SOAKAGE TRENCH

SW-170



1. Sizing: See adjacent table to size the drywell(s) based on impervious area.
2. Siting Criteria: The base of the drywell must be at least 5' above seasonal high groundwater.
3. Setbacks: Measured from the center, the drywell must be 10' from foundations and 5' from property lines except next to the right-of-way where no setback is required between the edge of the drywell drain rock and the property line. The foundation setback is 8" for plastic mini-drywells.
4. Piping: Conform with Oregon Plumbing Specialty Code (OPSC) requirements.
5. Access: In residential settings, an access cleanout is optional but highly recommended.
6. Pre-Treatment: A trapped silt basin such as a sumped catch basin is required except for drywells managing roof runoff and runoff from pedestrian-only areas.
7. The top of the perforated drywell sections must be lower than neighboring foundations.
8. Inspections: Call BDS IVR inspection line, (503) 823-7000. Request 487.3 inspections required.

Drywell Depth	Maximum Catchment Area Managed by One Drywell	
	28" diameter	48" diameter
5'	1000 sf	2500 sf
10'	2500 sf	4500 sf
15'	3500 sf	5000 sf
2x2 plastic mini-drywell (maximum of 2 drywells per catchment)	500 sf	

CONSTRUCTION REQUIREMENTS

Smearing the soil surface during excavation can limit infiltration rates. If smooth excavation tools are used, roughen the sides and bottom of the excavation with a sharp pointed tool. Remove loose material from the bottom of the excavation.

- DRAWING NOT TO SCALE -



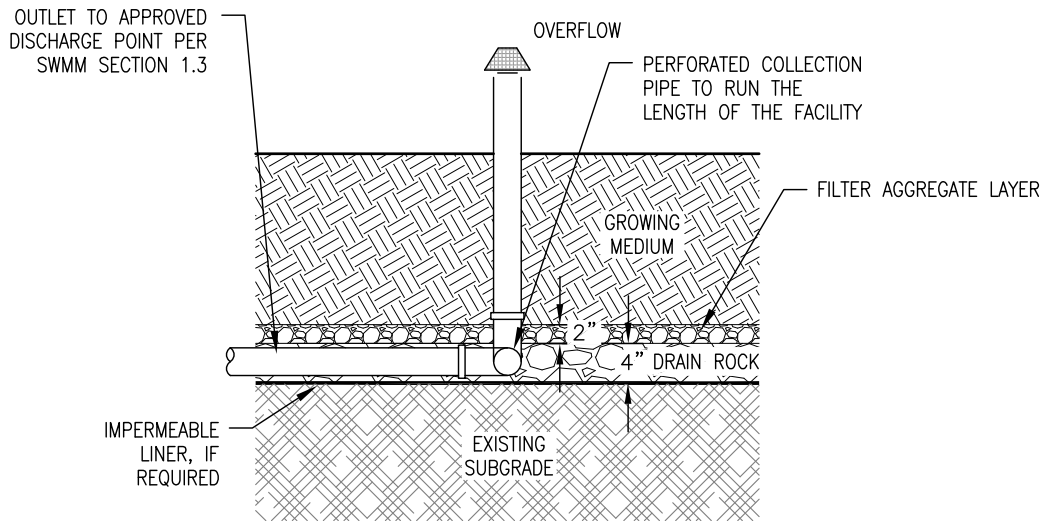
Bureau of Environmental Services



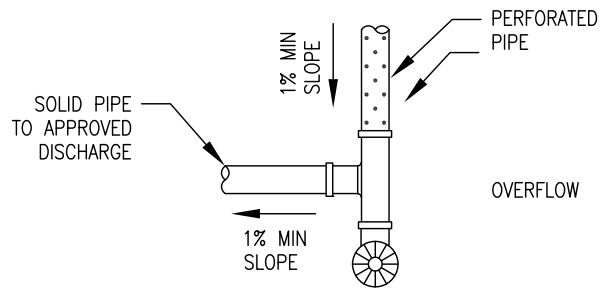
STORMWATER MANAGEMENT
TYPICAL DETAILS FOR
PRIVATE PROPERTY

DRYWELL

SW-180



SECTION



PLAN

PIPE W/ UNDERDRAIN & DISCHARGE POINT

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STORMWATER MANAGEMENT
TYPICAL DETAILS FOR
PRIVATE PROPERTY

**UNDERDRAIN
AND OVERFLOW
CONFIGURATIONS**

SW-190