Appendix 1-I

Stormwater Site Plan Short Form

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Stormwater Site Plan Short Form

The Stormwater Site Plan Short Form is a form designed to fulfil Minimum Requirements #1 - #5 of the *Clark County Stormwater Manual*. This form may be revised by the Responsible Official.

Table of Contents

The Stormwater Site Plan Short Form (Site Plan Short Form) may be used for projects that trigger only Minimum Requirements #1-#5, which may be residential, agricultural, or commercial projects. See the *Clark County Stormwater Manual* (CCSM) Section 1.7 to determine eligibility to use this form.

The guidelines in this form help apply the requirements of Clark County Code 40.386 and the CCSM to small project sites. If conflicts arise, Clark County Code and the CCSM supersede the requirements, processes, and guidelines described herein.

Section 1 — Submittal Requirements

The following submittals are required:

- Project Overview (Section 2)
- Existing Conditions Summary (Section 3)
- Soils Assessment (see Section 4)
- Minimum Requirements Narrative (Section 5)

- Erosion and Sediment Control Plan (Section 6)
- Maps, Plans and Drawings (see Section 7)
- LID Feasibility Checklist, if required (Section 8)

Section 2 — Project Overview

County Permit

Building Permit Number(s): _____

Associated Clark County Permit Number(s) (e.g. land use permits, critical areas permits):

_____

Applicant Info

Name: _____

Address: _____

Phone Number: _____ E-mail: _____

Property Owner Info

Name: _____

Address: _____

Phone Number: _____ E-mail: _____

Property Info

Project Address: _____

Parcel Number _____ Size of Parcel (ac. or sq. ft.): _____

Other Permits

Identify other agency permits required or associated with the subject parcel (e.g. hydraulic permits, Army Corps 404 permits). Provide Permit numbers if available: _____

Project Description

Describe current and future site conditions below, or attach a separate sheet.

Current site condition and use: _____

Proposed site condition and use: _____

Project Impacts

Fill in the following table to summarize the site disturbance and new or replaced surfaced planned for the site. Definitions are found on the next page.

If the site includes more than one Threshold Discharge Area (defined on the following pages), copy this sheet, fill out the table below for each TDA, and submit one sheet for each TDA.

Definitions of terms are shown on the following page.

Threshold Discharge Area ID_____	**Square Feet**
New hard surfaces	
• Roof	
• Driveway and parking area	
• Paved patio and other paved areas	
Replaced hard surfaces	
• Roof	
• Driveway and parking area	
• Paved patio and other paved areas	
Total New + Replaced Hard Surfaces	
~~New and replaced pollution generating hard surfaces (PGHS)~~	
~~Vegetation (including pasture) converted to lawn/landscape~~	
~~Native vegetation converted to pasture~~	
~~Total land disturbing activity~~	

Definitions

Hard Surface – An impervious surface, a permeable pavement, or a vegetated roof.

Impervious Surface – A non-vegetated surface which either prevents or retards the entry of water into the soil below, causing water to run off the surface in greater quantities or at an increased rate compared to natural conditions prior to development. Common impervious surfaces include roofs, walkways, patios, driveways, parking lots, storage areas, gravel roads, and packed earthen materials.

Replaced Hard Surface – For structures, the removal and replacement of hard surfaces down to the foundation. For other hard surfaces, the removal down to bare soil or base course and replacement.

Pollution-generating Hard Surface (PGHS) – Hard surfaces that are significant source of pollutants in stormwater runoff, such as those subject to vehicular traffic and industrial activities. Surfaces include

roads, driveways, parking areas, most metal roofs, and areas that receive direct rainfall or run-on and which are used to store erodible stockpiles, wastes, or chemicals.

Converted Vegetation (areas) – Surfaces on a project site where native vegetation, pasture, scrub/shrub, or unmaintained non-native vegetation (e.g., Himalayan blackberry, scotch broom) are converted to lawn or landscaped areas, or where native vegetation is converted to pasture.

Land Disturbing Activity – Any activity that results in a change in the existing soil cover (both vegetative and non-vegetative) and/or the existing soil topography. Land disturbing activities include grading, filling, and excavation. Compaction associated with stabilization of structures and road construction shall also be considered a land disturbing activity. Landscape maintenance and gardening are not included.

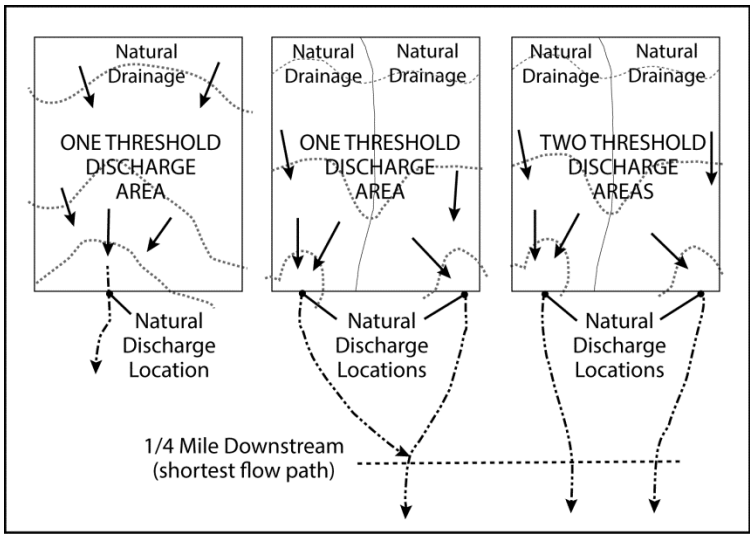


Figure 1: Threshold Discharge Area

Native Vegetation – Plants that are indigenous to the coastal Pacific Northwest and which naturally could have occurred on the site. Examples include Douglas Fir, Western Hemlock, Western Red Cedar, Alder, Big-leaf Maple, and Vine Maple; shrubs such as willow, elderberry, salmonberry and salal; and plants such as sword fern, foam flower, and fireweed.

Threshold Discharge Area – An on-site area draining to a single natural discharge location or multiple natural discharge locations that combine within one-quarter mile downstream (as determined by the shortest flow path), as shown in the illustration above.

Section 3 — Existing Conditions Summary

Describe the existing site conditions. If there are multiple choices, check all that apply. The  icon means that information may be found on Clark County Maps Online.

1. Describe the existing site conditions.

☐ Forest ☐ Prairie ☐ Pasture ☐ Pavement

☐ Landscaping ☐ Brush ☐ Trees ☐ Other _____

2. Describe how surface water (stormwater) drainage flows across/from the site.

☐ Overland ☐ Gutter ☐ Catch Basin ☐ Ditch/Swale

☐ Storm Sewer Pipe ☐ Stream ☐ Other _____

3. Describe, discuss and identify the following for the project site:

- Topography — is the site: ☐ Flat ☐ Rolling ☐ Steep
- Natural and man-made drainage patterns (which direction does stormwater flow and how):

  _____

  _____

  _____

- Are there any known historical drainage problems such as flooding, erosion, etc.)?

  _____

  _____

  _____

-  Are sensitive and/or critical areas present on the site (check all that apply)?

☐ Streams[1] ☐ Lakes/Ponds ☐ Wetlands[1] ☐ Steep Slopes/Geohazard[1]

☐ Floodplain ☐ Springs ☐ Habitat[1] ☐ Critical Aquifer Recharge Area

[1] If the site is on a critical area, Clark County may require additional information, engineering, or other permits.

- Existing utilities

  ☐ Storm ☐ Water ☐ Sewer ☐ Other

- Are fuel tanks present on the site?

  ☐ Yes ☐ No

- Are groundwater wells present on the site and/or within 100 feet of the site?

  ☐ Yes ☐ No

- Are septic systems present on the site and/or within 100 feet of the site?

  ☐ Yes ☐ No

- Are there existing public and/or private easements on the project site?

  ☐ Yes ☐ No

  If Yes, Provide Recording Number(s): _____

Adjacent Areas

Describe adjacent properties and roads. Attach a separate sheet, if necessary.

1. Check any adjacent areas that may be affected by site disturbance and describe below (check all that apply):

☐ Streams[2] ☐ Lakes ☐ Wetlands[2] ☐ Steep Slopes/Geohazards[2]

☐ Residential Areas ☐ Roads ☐ Ditches, pipes, culverts

☐ Other _____

_____

_____

_____

_____

[2] If the site is adjacent to a critical area, Clark County may require additional information, engineering, or other permits.

2. Describe how and where surface water enters the site from upstream properties:

_____

_____

_____

_____

_____

3. Describe how and where surface water exits the site and the downstream drainage, including flooding problems, if known:

_____

_____

_____

_____

_____

Section 4 — Soils Assessment

For all sites, the Soils Assessment must include a soils description, which may be completed by consulting published soil mapping in Clark County MapsOnline (item 1, below). Some sites also require infiltration rate testing (item 2, below) and a groundwater assessment (item 3, below).

If needed to design an LID BMP, obtain a Soils Assessment of the site performed by a qualified professional. Ask the qualified professional to fill out items 1 – 3, below, and attach a written report to this form. ~~The professional will need to consult CCSM Book 1, Section 2.3.~~

Qualified professionals include certified septic system designer, soil scientist, professional engineer, geologist, hydrogeologist or engineering geologist registered in the State of Washington or suitably trained persons working under the supervision of the above professionals. A licensed on-site sewage designer can be used to complete the soil description (item 1) and to conduct infiltration tests (item 2) but may not be used to complete the groundwater assessment (item 3), if required.

1. Soil Description

A soil description is required for all sites.

☐ Soils on the site are described by a qualified professional in accordance with CCSM Book 1, Section 2.3.1.2, Soil Description.

☐ A Soils Report is attached.

☐ The project does not require depth to groundwater or infiltration rate testing to verifiy LID BMP feasibility.

Describe the soils on the site based on published mapping in Clark County MapsOnline:

_____

_____

_____

_____

2. Infiltration Rate Testing

If no LID infeasibilty criteria exist on site, infiltration rate testing is required to determine if ~~for sites that are proposing to use~~ rain gardens or permeable pavement are required to fulfill Minimum Requirement #5 (see Section 5).

Grain size analysis may be substituted for infiltration tests on sites with unconsolidated soil.

☐ Infiltration rate testing N/A

☐ Infiltration rate testing conducted by a qualified professional in accordance with CCSM Book 1, Section 2.3.1.4, Infiltration Rate.

☐ Infiltration testing method, logs, results, and rates are attached or described in the Soils Report.

List the infiltration rate(s) found on the site:

_____

_____

_____

3. Groundwater Depth Assessment

A groundwater depth assessment is required if permeable pavement, downspout full infiltration, or a rain garden are ~~proposed~~ required to meet Minimum Requirement #5 and the seasonal high groundwater elevation in the area is known to be less than five feet below the proposed permeable pavement or rain garden base ~~surface~~.

☐ Ground depth water assessment N/A

☐ Groundwater depth assessment conducted by a qualified professional in accordance with CCSM Book 1, Section 2.3.1.5, Groundwater Assessment.

☐ Groundwater depth assessment attached or included with the Soils Report.

Section 5 — Minimum Requirements Discussion and Narrative

The applicant must demonstrate how five Minimum Requirements will be met. Minimum Requirements describe the minimum stormwater controls and technical specifications for the site.

Generally, small projects must:

- Control erosion and sedimentation during construction (Minimum Requirement #2).
- Prevent stormwater from coming into contact with pollutants (Minimum Requirement #3).
- Preserve the natural drainage patterns on the site (Minimum Requirement #4).
- Capture and control runoff from the site's new and replaced hard surfaces using practices such as rain gardens, dispersion, or infiltration trenches and drywells where feasible (Minimum Requirement #5).
- Demonstrate how the Minimum Requirements will be met using the Stormwater Site Plan Short Form (this form) and other required submittals (Minimum Requirement #1).

Minimum Requirements are discussed below.

Instructions

1. Read each Minimum Requirement.
2. Follow any instructions given in the description.
3. Fill out the "Documentation" section for each Minimum Requirement.

Minimum Requirement #1 — Preparation of a Stormwater Site Plan

Minimum Requirement

All projects shall prepare and submit a Stormwater Site Plan (site plan) for review. The site plan will demonstrate how the project will comply with Clark County Code 40.386 and the *Clark County Stormwater Manual* for control of stormwater. The site plan will be reviewed for compliance and to ensure that stormwater best management practices (BMPs) are correct. A Stormwater Site Plans shall display site-appropriate development principles to retain native vegetation and minimize impervious surfaces to the extent feasible.

Documentation

☐ Stormwater Site Plan Short Form (this form)

Attachments (when required)

☐ Soils Assessment (see Section 4); ☐ N/A

Groundwater Assessment: ☐ Attached ☐ N/A

☐ Erosion and Sediment Control Plan (see Section 6)

☐ LID Infeasibility Checklist, if required (see Section 8)

Drawings (see Section 7)

☐ Vicinity Map

☐ Existing Site Map

☐ Site Plan

☐ BMP Drawings

☐ Erosion and Sediment Control Site Plan

Minimum Requirement #2 — Erosion and Sediment Control during Construction

Minimum Requirement

All construction projects are responsible for preventing discharge of sediment and other pollutants from the site during construction. Instructions for documenting and complying with erosion and sediment control requirements are given in Section 6.

Documentation

☐ Erosion and Sediment Control Plan (Section 6 of this form) completed

☐ Erosion and Sediment Control Site Plan included with required drawings (see Section 7)

Minimum Requirement #3 — Source Control of Pollution

Minimum Requirement

Development and redevelopment projects must use source control BMPs to prevent contamination of stormwater. Source control BMPs must be selected and designed in accordance with Book 3 of the CCSM. Pollutions source controls are normally not required for new home construction.

Description

Non-residential sites that will include any activities in the Commercial Site Activities list, below, must consult CCSM Book 3, and determine the structural and operational source control BMPs that are required for the site. Show any required structural source control BMPs on the site plan, and list any required operational source control BMPs in the "Documentation" section below.

Commercial Site Activities

Check any activity that will take place on the site after construction.

☐ Manufacturing

☐ Transportation and Communication Business

☐ Retail and Wholesale Business

☐ Service Business

☐ Public Agency

Documentation

☐ Consult CCSM Book 3 and list all required BMPs to be installed to provide source control for activities checked above, or check ☐ N/A if no activities above are selected:

_____

_____

_____

_____

☐ Show any required structural source control BMPs on the site plan.

Minimum Requirement #4 — Preserve Natural Drainage Systems and Outfalls

Minimum Requirement

Maintain natural and existing drainage patterns through the site and onto adjacent property as much as possible. **No new development, redevelopment, or drainage project is allowed to materially increase or concentrate stormwater runoff onto an adjacent property or block existing drainage from adjacent lots.**

Documentation

☐ The natural drainage patterns have been maintained to the maximum extent feasible.

Minimum Requirement #5 — On-site Stormwater Management

Minimum Requirement

Projects must use On-site Stormwater Management BMPs to disperse, infiltrate, and retain stormwater runoff from the site's roofs, driveways, parking areas, patios, and landscaped areas to the extent feasible without causing flooding or erosion impacts.

There are lists of site characteristics such as septic system setbacks and critical areas setbacks that remove the requirement for specific LID BMPs.

Description

Stormwater generated from hard surfaces (roofs and pavement) on the site must be infiltrated into the ground or dispersed into vegetation on the using BMPs such as rain gardens, infiltration trenches and drywells, and dispersion.

Documentation

Go through the selection process described below to fill in the check boxes in this section. For each surface to be constructed as part of the project, fill in the first BMP that is feasible using the selection processes.

Results of the Selection Process:

☐ Lawn and Landscape Area will be installed or re-graded.

☐ BMP T5.13 Post Construction Soil Quality and Depth will be used.

☐ Roofs will be constructed.

BMP Selected for Roofs: _____

☐ Other Hard Surfaces will be constructed (e.g. driveway, parking, patio, etc.).

BMP Selected for Other Hard Surfaces: _____

Selection

Project sites usually construct or create ~~up to~~ three types of surfaces that generate stormwater runoff – lawn and landscaped areas, roofs, and other hard surfaces (driveways, patios, parking, etc.).

Use the LID Feasibility Checklists in Section 8 to determine if there are required LID BMPs for the project site.

For each surface constructed or created as part of the project, select a BMP from a prioritized list of required BMPs below. Select the first BMP in the list that is not infeasible (see below for establishing infeasibility). Only one BMP for each surface is required.

Lawn and Landscaped Areas

1. Post Construction Soil Quality and Depth BMP T5.13 is required for all lawn and landscaped areas created or re-graded as part of the project.

Roofs

Select the first BMP in the list that is not infeasible for each new roof on the site:

1. Full Dispersion BMP T5.30A and BMP T5.30B or Downspout Full Infiltration BMP T5.10A and BMP T5.10B.
2. Rain Garden BMP T5.14A.

3. Downspout Dispersion BMP T5.10C.
4. Perforated Stub-out Connection BMP T5.10D

Other Hard Surfaces Such as Driveways, Parking Areas and Patios

Select the first BMP in the list that is not infeasible for each new or replaced hard surface on the site:

1. Full Dispersion BMP T5.30A and BMP T5.30B.
2. Either Rain Garden BMP T5.14A or Permeable Pavement BMP T5.15.
3. Either Sheet Flow Dispersion BMP T5.12 or Concentrated Flow Dispersion BMP T5.11.

Flow charts on the following pages illustrate the selection process.

Establishing Low Impact BMP Feasibility (BMP required for the site) or Infeasibility (BMP not required for the site)

BMPs that are infeasible due to site conditions are not required. The feasibility or infeasibility of using a BMP is established by comparing specific site conditions and requirements with a list of infeasibility criteria given for the BMP in Section 9. Infeasibility must be ascertained using measured or mapped site-specific information, not by general knowledge. Some infeasibility criteria require evaluation by a qualified professional.

Infeasibility must be documented in writing using the LID Feasibility Checklist in Section 8.

Figure 2: BMP Selection Process for Roofs

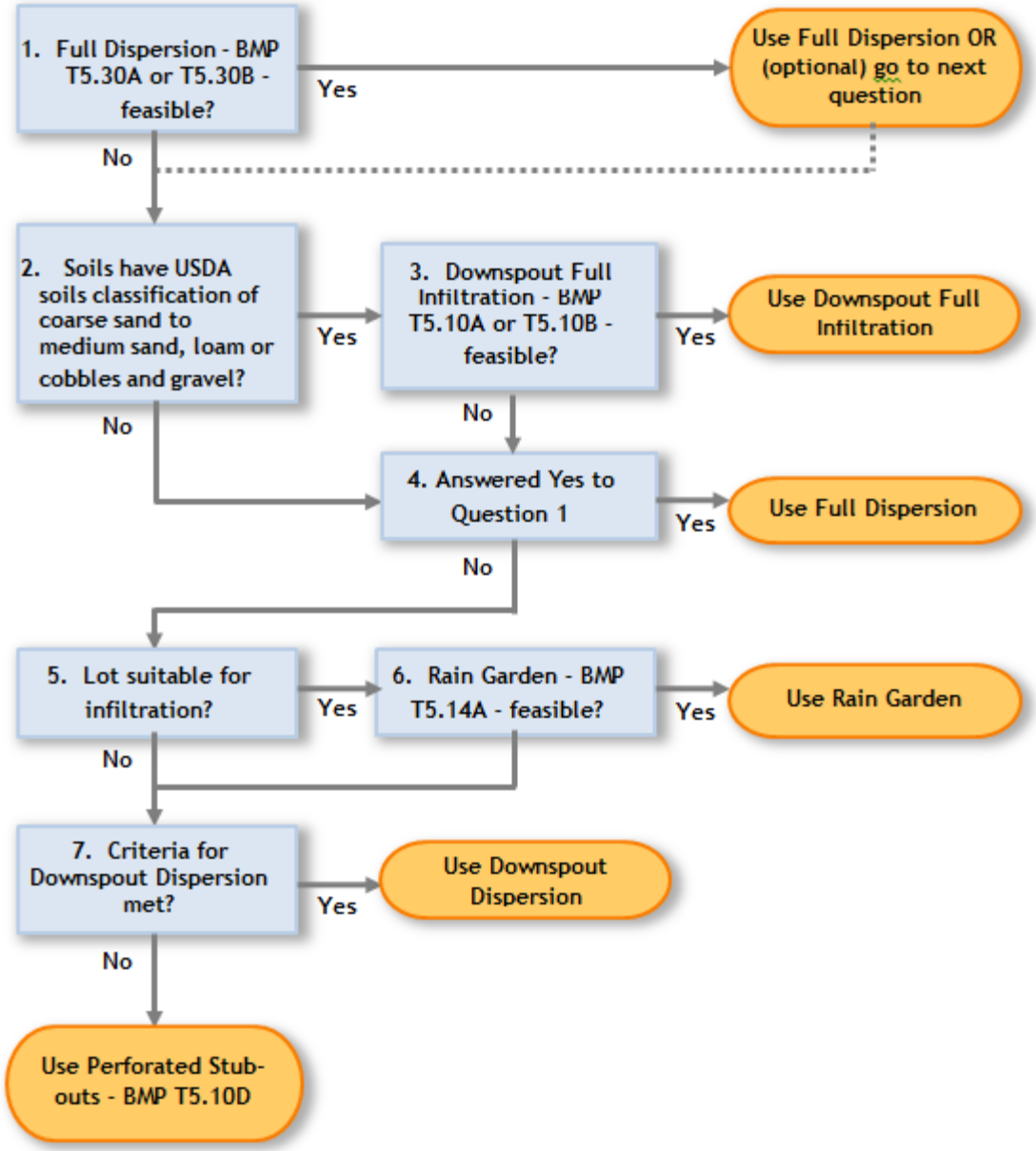
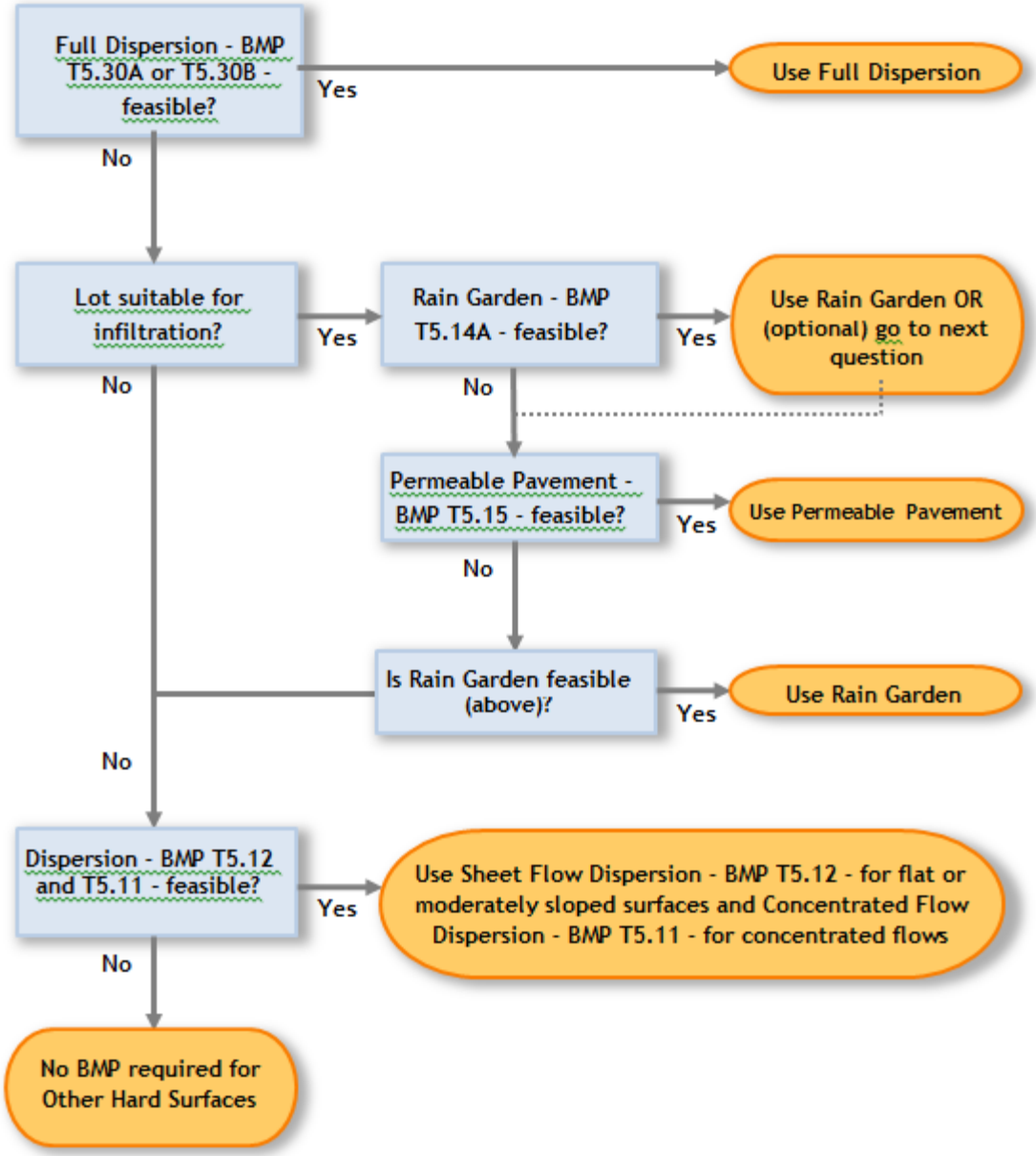


Figure 3: BMP Selection Process for Other Hard Surfaces



Section 6 — Erosion and Sediment Control During Construction

In accordance with Minimum Requirement #2, all construction projects are responsible for preventing discharge of sediment and polluted stormwater from the site during construction.

State law requires Clark County to verify that each of the 13 elements of an erosion control plan are addressed, evein if they are not applicable. If not applicable, check the box for Not Applicable.

The best methods of preventing sediment and polluted stormwater from leaving the site are:

- Remove as little vegetation as possible.
- Limit cutting, filling, and grading to the least amount needed for the project.
- Keep bare soils and stockpiles covered and protected from rain and flows as much as possible.
- Stabilize proposed landscaped and lawn areas as soon as possible after construction using BMP T5.13 (see Section 9).

Instructions

Fill out the Erosion and Sediment Control Narrative in this section and select appropriate erosion and sediment control (ESC) BMPs from the lists provided. Then draw and submit an erosion and sediment control site plan as described in Section 7.

The narrative must address each of the 13 elements listed below. For each element, select at least one BMP to use on the site, unless the BMP is not applicable to the site. If the BMP is not applicable, check "N/A" and describe why.

See Section 10 for a description of each ESC BMP which states the minimum requirements for using the BMP on a small site.

Erosion and Sediment Control Narrative

Element #1 – Preserve Vegetation and Mark Clearing Limits

Retain topsoil and natural vegetation in an undisturbed state to the maximum extent practicable. Mark all clearing limits, sensitive areas and their buffers, and any trees that will be preserved. Limits shall be marked in such a way that any trees or vegetation to remain will not be harmed.

The BMP(s) being proposed to meet this element are:

☐ C101 Preserving Native Vegetation
☐ C102 Buffer Zones
☐ C103 High Visibility Plastic Fence
☐ C233 Silt Fence
OR ☐ Element is N/A: _____

Element #2 – Establish Construction Access

Prevent vehicles from tracking soil from the site onto streets or neighboring properties by stabilizing the entrance with a rock pad. If possible, place the entrance where a future driveway will be located, as it may be possible to use the rock as a driveway base material.

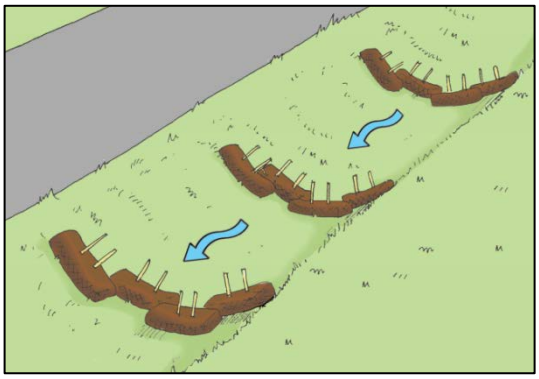
If sediment is tracked offsite, sweep or shovel it from the paved surface immediately.

The BMP being proposed to meet this element is:

☐ C105 Stabilized Construction Entrance

OR ☐ Element is N/A: _____

Element #3 – Control Flow Rates

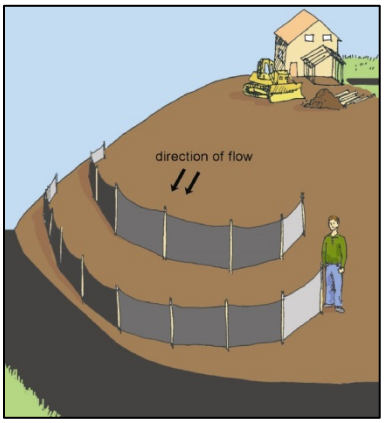


Protect properties and waterways downstream of the construction site from erosion by slowing down stormwater runoff from the site as much as possible.

The BMP(s) being proposed to meet this element are:

☐ C207 Check Dams
☐ C235 Wattles
OR ☐ Element is N/A: _____

Element #4 – Install Sediment Controls



Runoff from disturbed areas must pass through a sediment removal device. Sediment barriers are typically used to slow sheet flow of stormwater and allow the sediment to settle out behind the barrier.

The BMP(s) being proposed to meet this element are:

☐ C231 Brush Barrier
☐ C233 Silt Fence
☐ C234 Vegetated Strip
☐ C235 Wattles
☐ C233-A Bio-Filter Bags Sediment Barrier (for use only with Single Family Residential)
OR ☐ Element is N/A: _____

Element #5 – Stabilize Soils

Protect exposed soils and stockpiles from rain, flowing water, and wind by covering them or planting grass.

During the wet season from October 1 through April 30, no soils or stockpiles shall remain exposed or unworked for more than 2 days. From May 1 to September 30, no soils or stockpiles shall remain exposed and unworked for more than 7 days.

The BMP(s) being proposed to meet this element are:

☐ C121 Mulching
☐ C123 Plastic Covering
☐ C125 Compost
OR ☐ Element is N/A: _____

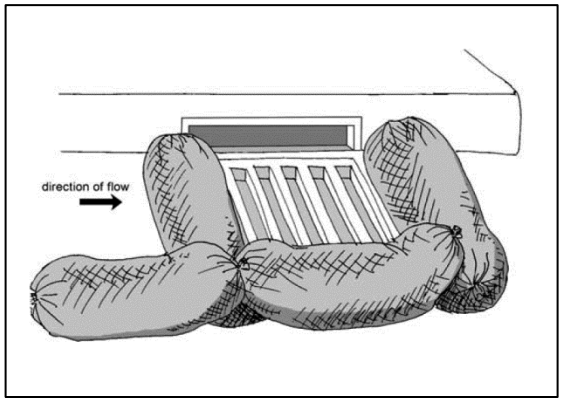
Element #6 – Protect Slopes

Protect slopes by diverting water away from the top of the slope and establishing vegetation on slopes.

The BMP(s) being proposed to meet this element are:

☐ C203 Water Bars
☐ C207 Check Dams
☐ C208 Triangular Silt Dike
OR ☐ Element is N/A: _____

Element #7 – Protect Drain Inlets



Protect all storm drain inlets during construction so that site runoff does not enter the inlets without first being filtered to remove sediment.

Install catch basin protection on all catch basins within 500 feet downstream of the project. Once the site is fully stabilized, catch basin protection must be removed.

The BMP(s) being proposed to meet this element are:

☐ C220 Storm Drain Inlet Protection

OR ☐ Element is N/A: _____

Element #8 – Stabilize Channels and Outlets

Stabilize all temporary and permanent conveyance channels and their outlets.

The BMP(s) being proposed to meet this element are:

☐ C207 Check Dams
☐ C209 Outlet Protection
OR ☐ Element is N/A: _____

Element #9 – Control Pollutants

Handle and dispose of all pollutants, such as chemicals, paint, petroleum products, and concrete (wet and dry) to keep them out of rain and stormwater. Provide cover and containment for liquid materials and handle all concrete and concrete waste appropriately

The BMP(s) being proposed to meet this element are:

☐ C150 Materials on Hand
☐ C151 Concrete Handling
OR ☐ Element is N/A: _____

Element #10 – Control Dewatering

If dewatering is needed, assess the condition of the pumped water. Clean, non-turbid dewatering water, such as groundwater, can be discharged to the stormwater system as long as it does not cause

downstream erosion or flooding. Dirty or contaminated dewatering water must be filtered or may be discharged to the local sanitary sewer, if permitted.

The BMP(s) being proposed to meet this element are:

☐ C203 Water Bars
OR ☐ Element is N/A: _____

Element #11 – Maintain BMPs

Maintain and repair erosion and sediment control BMPs as needed. Inspect all BMPs at least weekly and after every storm event. Keep an erosion control inspection log on site and available for review by the County inspector at all times. The inspection log may be downloaded from https://www.clark.wa.gov/community-development/erosion-control.

Remove all temporary erosion and sediment control BMPs within 30 days after final site stabilization or if the BMP is no longer needed. Any trapped sediment should be removed or stabilized onsite. No sediment shall be discharged into the storm drainage system or natural conveyance systems.

The BMP(s) being proposed to meet this element are:

☐ C150 Materials on Hand
☐ C160 Certified Erosion and Sediment Control Lead
OR ☐ Element is N/A: _____

Element #12 – Manage the Project

Coordinate all work before initial construction with subcontractors and other utilities to ensure no areas are prematurely worked.

Designate an erosion control inspector for the construction site. If land disturbing activity is undertaken by a licensed contractor, then the erosion control inspector must possess a valid CESCL certification. The erosion control inspector must be on the site or on-call 24 hours a day.

The BMP(s) being proposed to meet this element are:

☐ C160 Certified Erosion and Sediment Control Lead
OR ☐ Element is N/A: _____

Element #13 – Protect Low Impact Development BMPs

Protect LID BMPs from compaction, erosion, and sedimentation.

Bioretention and Rain Gardens

Prevent compaction of areas planned for bioretention and rain gardens by excluding construction equipment. Avoid unnecessary foot traffic, and allow necessary foot traffic only when soils are not wet.

Install erosion and sediment control BMPs to protect bioretention and rain gardens from sediment and runoff. If they accumulate sediment during construction, remove sediment and any fouled bioretention/rain garden soils, and replace with soils meeting the design specification.

Permeable Pavement

Do not allow muddy vehicles onto the base material or pavement. Do not allow sediment or muddy runoff to fall or flow onto permeable pavements. Permeable pavements fouled with sediments or no longer passing an initial infiltration text must be cleaned.

Other LID BMPs

Keep all heavy equipment off areas where LID facilities will be located. Protect completed lawn and landscaped areas from compaction by construction equipment and vehicles.

The BMP(s) being proposed to meet this element are:

☐ C102 Buffer Zone
☐ C103 High Visibility Plastic Fence
☐ C207 Check Dams

☐ C208 Triangular Silt Dike
☐ C231 Brush Barrier
(list continues on following page)
☐ C233 Silt Fence
☐ C234 Vegetated Strip
OR ☐ Element is N/A: _____

Section 7 — Maps, Plans, and Drawings

Submit maps, plans, and drawings on 8½ x11 or 11x17 paper as directed below. The  icon means that information may be found or a map may be produced using Clark County Maps Online.

Maps and plans may be drawn by hand on graph paper or may be drafted electronically. See page 30 for blank graph paper. Examples of each required drawing begin on page 25.

1.  **Vicinity Map** — Mark the site on a vicinity map showing the nearest cross-streets; include a North arrow. See Figure 4 for an example.
2. **Existing Site Map** — See Figure 5 for an example. Show the following items:
   -  Address, parcel number, and street names
   - North arrow
   - Parcel boundaries with dimensions or scale
   -  Elevation contours
   - Existing site drainage patterns
     - Include natural and constructed drainages
     - Identify the primary discharge point or points from the site
     - Identify any storm drainage systems receiving site runoff (e.g. roadside ditch)
   - Boundaries of water bodies
   -  Boundaries of Critical Areas, if any, including:
     - Critical Aquifer Recharge Areas (CCC 40.410)
     - Flood Hazard Areas (CCC 40.420)
     - Geologic Hazard Areas (CCC 40.430)

  - Habitat Conservation Areas (CCC 40.440)
  - Wetland Protection Areas (CCC 40.450)
  - Shoreline Master Program Areas (CCC 40.460)
- Boundaries of existing vegetation (e.g. trees, grassy areas, pastures, native vegetation)
- Locations of water wells and septic system drain fields on the parcel or within 100 feet of the parcel boundary
- Locations and dimensions of all existing improvements, including underground utilities

3. **Site Plan** — See Figure 6 for an example. Show proposed improvements and how stormwater will be handled after construction. Show the following items:

-  Address, Parcel Number, and Street Names
- North Arrow
- Parcel boundaries with dimensions or scale
- Proposed elevation contours (10' interval)
- Proposed site drainage patterns
  - Include natural and constructed drainages
  - Identify the primary discharge point or points from the site
  - Identify any storm drainage systems receiving site runoff (e.g. roadside ditch)
- Proposed site drainage pattern
- Boundaries of water bodies
-  Boundaries of Critical Areas, if any, including:
  - Critical Aquifer Recharge Areas (CCC 40.410)
  - Flood Hazard Areas (CCC 40.420)
  - Geologic Hazard Areas (CCC 40.430)
  - Habitat Conservation Areas (CCC 40.440)
  - Wetland Protection Areas (CCC 40.450)
  - Shoreline Master Program Areas (CCC 40.460)
- Identify existing vegetation to be protected
- Location and dimensions of all existing and proposed improvements, including:
  - Buildings and outbuildings
  - Hard and impervious surfaces

  - Stormwater BMPs
    - Include pipe types for all proposed stormwater pipes
    - If dispersion is proposed, show the location of the flowpath
    - If rain garden is proposed, show the overflow path
- Location of proposed easements for on-site stormwater management BMPs

4. **BMP Drawings** — See Figure 7 for an example. If Downspout Drywell, Downspout Infiltration Trench, Rain Garden, or Permeable Pavement are proposed, submit a drawing for each BMP showing a plan view (bird's-eye view) and a profile view (cross-section) of the facility. Include the following details:

- Plan View (Bird's-eye)
  - North arrow
  - Horizontal dimensions (length and width)
  - Notation showing types or sizes of filter fabric, rock, or other required components with a minimum specification in the BMP Design Criteria (Section 8)
- Profile View (cross-section)
  - Depth of entire facility
  - Depth of any component that has a minimum or maximum depth dimension specified in the BMP Design Criteria (Section 8) – e.g. depth of aggregate base for Permeable Pavement, depth of topsoil/amended soil for Rain Garden
  - Slopes (e.g. side slopes of a berm, slope of Permeable Pavement surface)

5. **Erosion and Sediment Control Site Plan** — See Figure 8 for an example. Show the location of improvements, grading, filling, and construction ESC BMPs. Show the following items on the site plan:

-  Address, Parcel Number, and Street names
- North Arrow
- Boundaries of existing vegetation (e.g. trees, pasture, fields, etc.)
- Critical areas and associated buffers (e.g. wetlands, steep slopes, streams, etc.).
- Delineate areas that are to be cleared and graded.
- Cut and fill slopes, indicating top and bottom of slope catch lines.
- Locations where upstream run-on enters the site and where runoff leaves the site.
- Existing surface water flow direction(s).

- Final grade contours and proposed surface water flow direction and surface water conveyance systems (e.g. pipes, catch basins, ditches, etc.).
- Show grades, dimensions, and direction of flow in all (existing and proposed) ditches, swales, culverts, and pipes.
- Identify and locate all ESC BMPs to be used during and after construction.

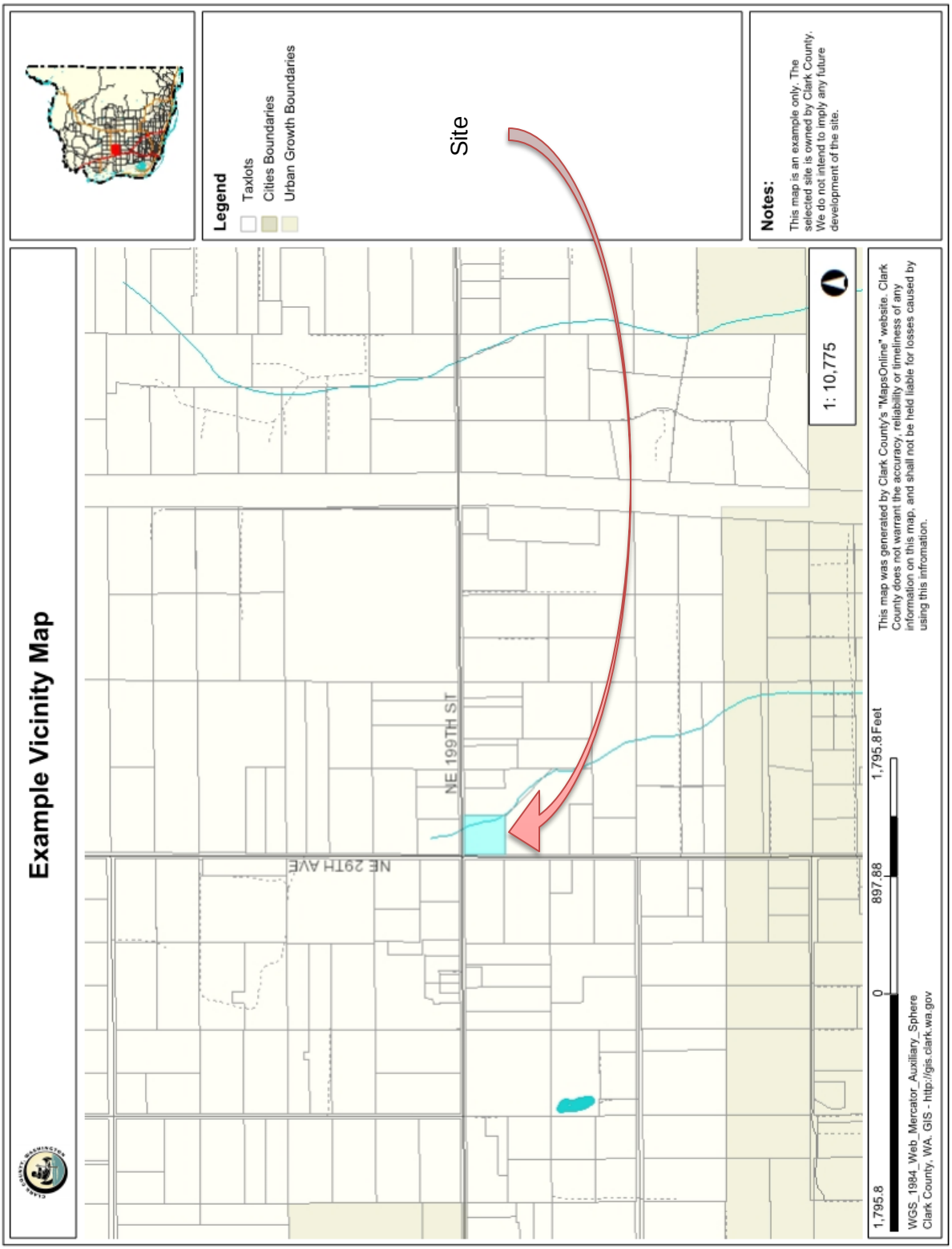


Figure 2: Example Vicinity Map

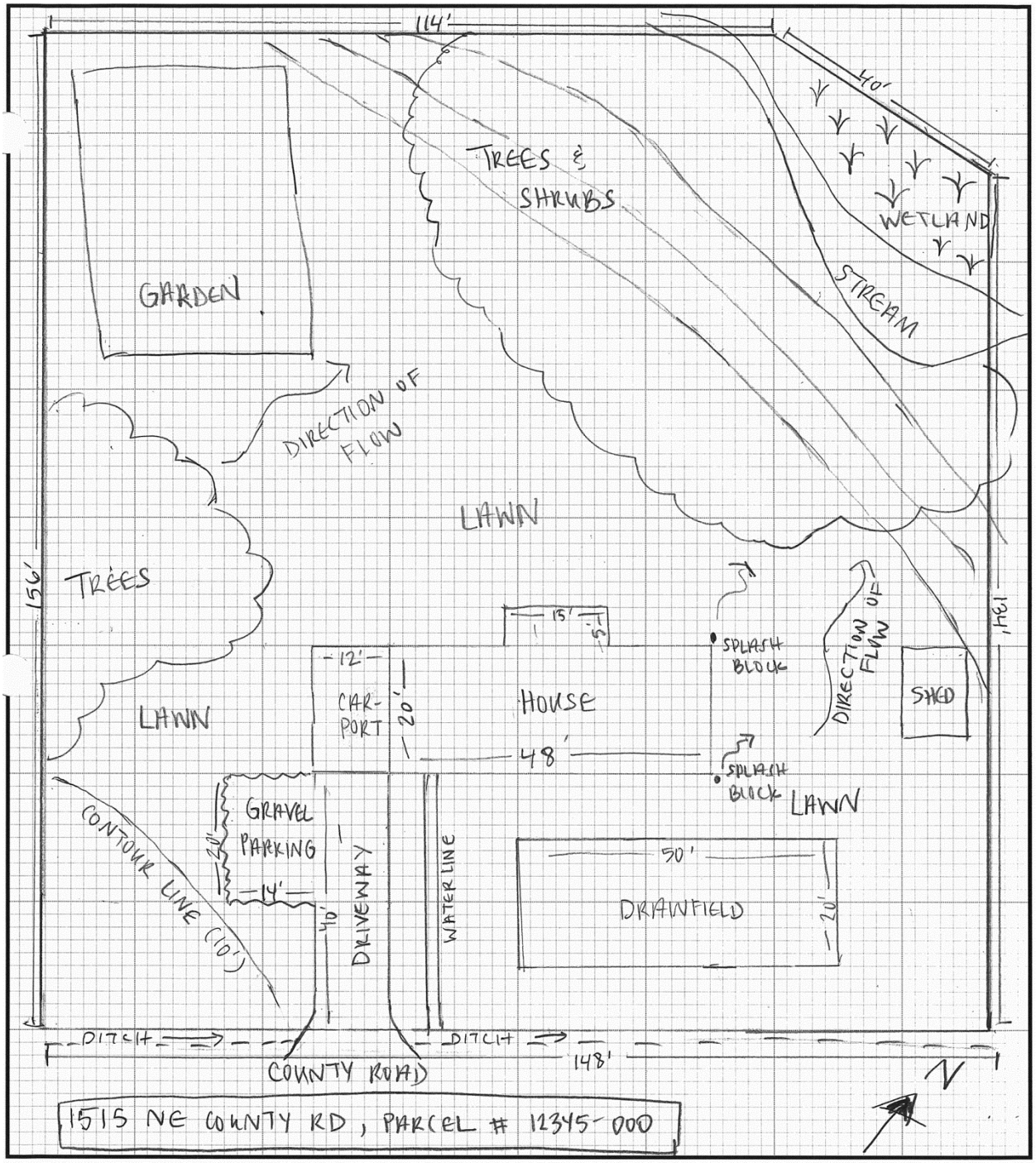


Figure 3: Example Existing Site Map

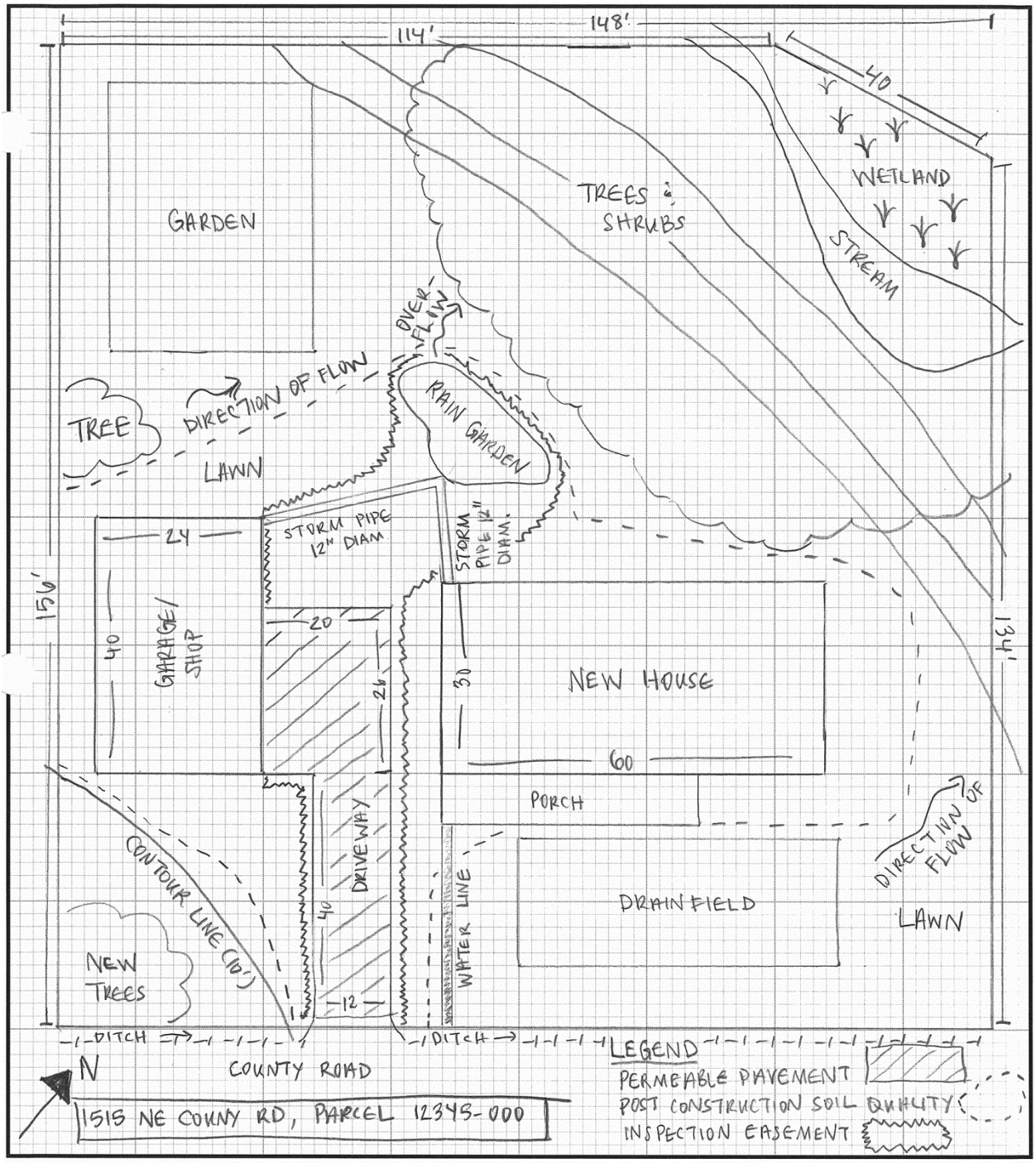


Figure 4: Example Site Plan

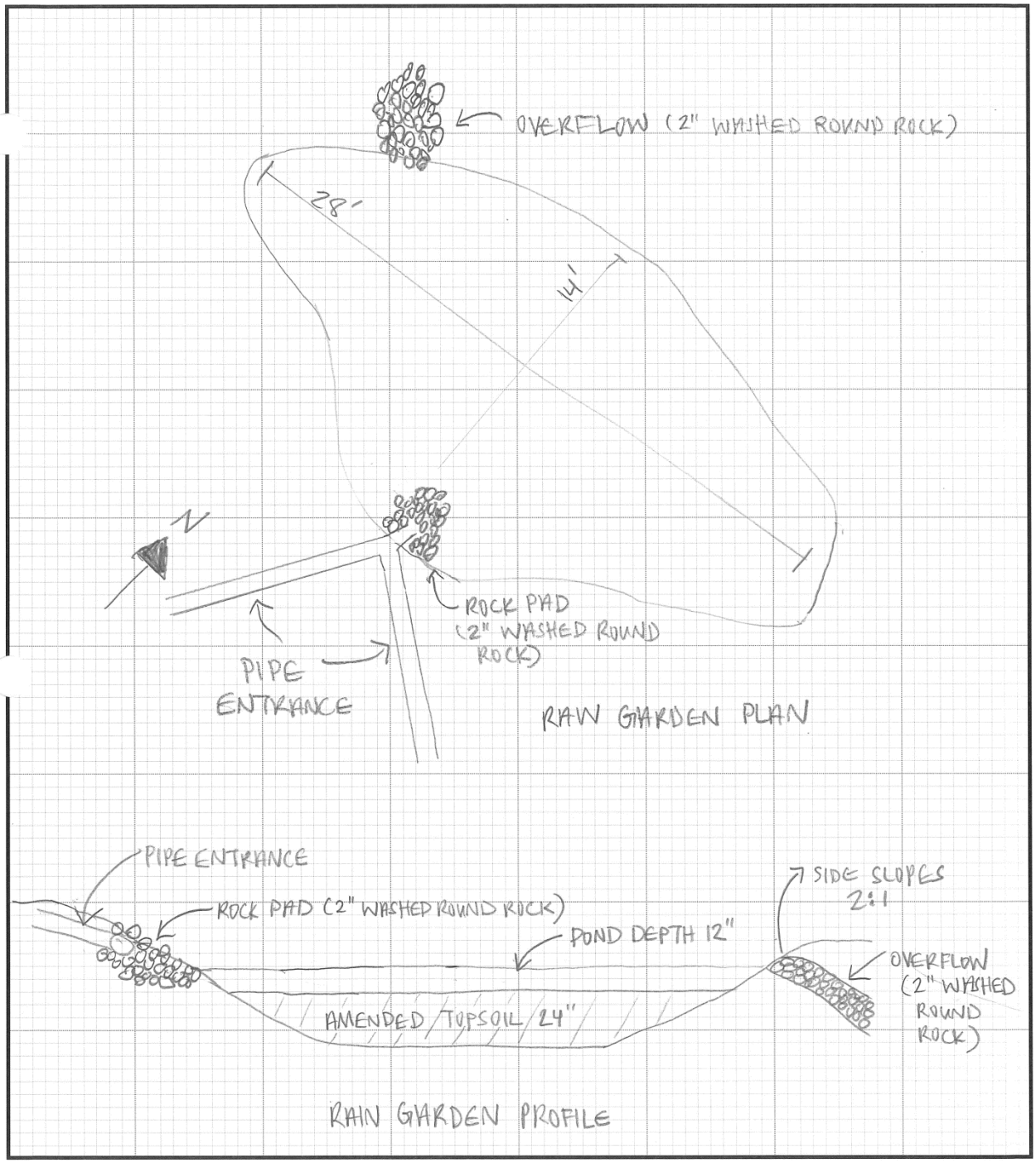


Figure 5: Example BMP Plan and Profile Drawing

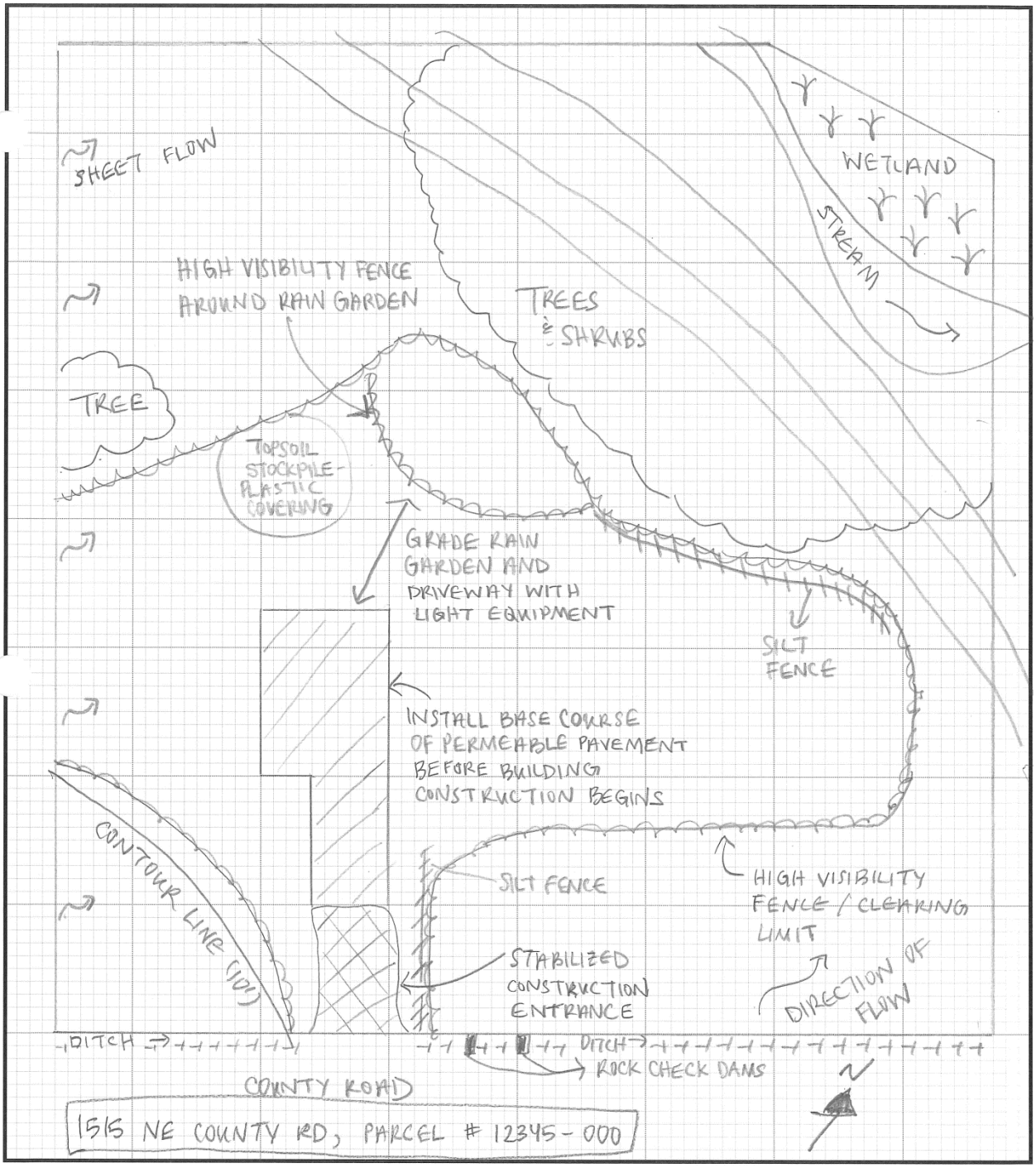
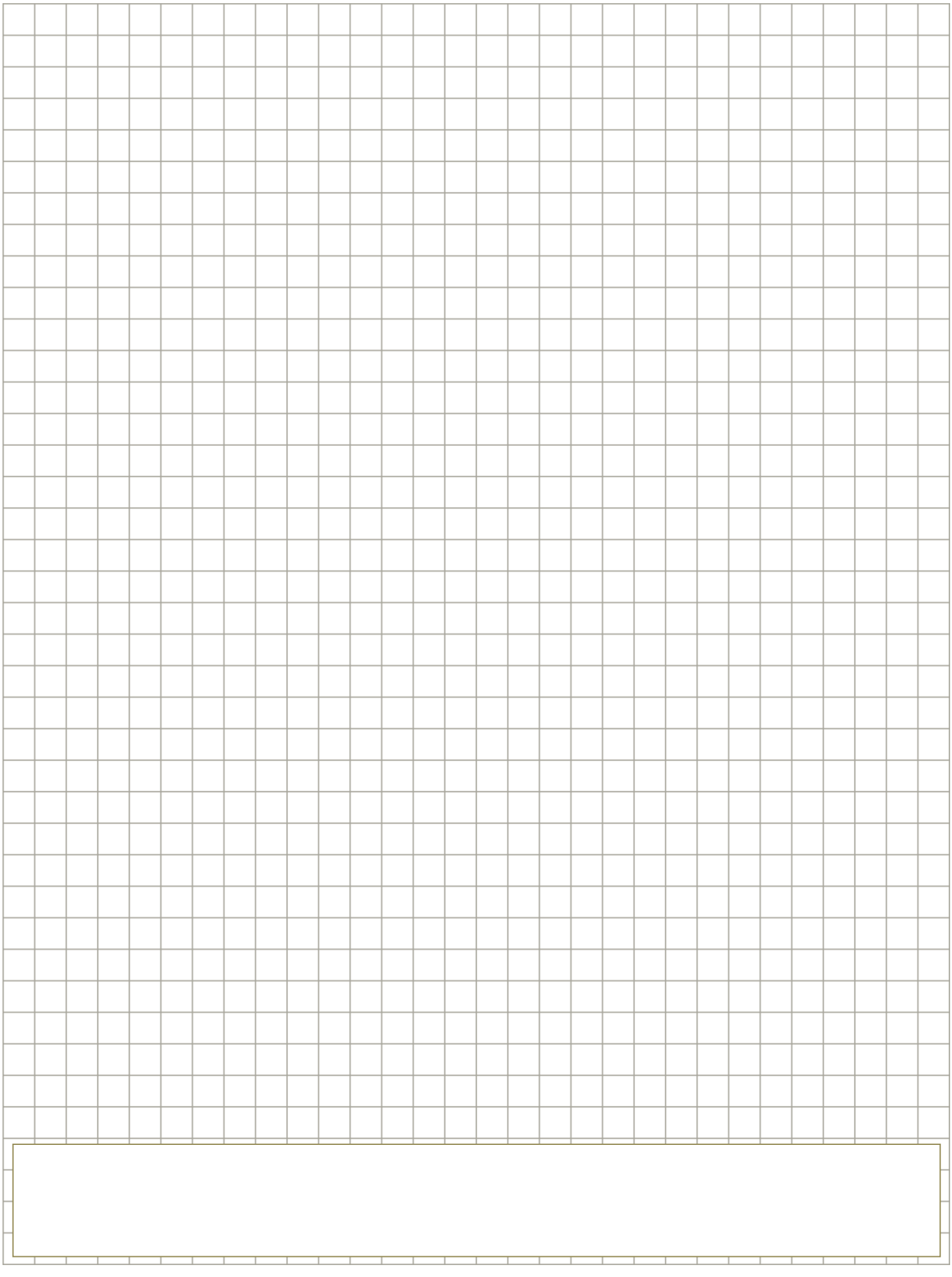


Figure 6: Example Sediment and Erosion Control Site Plan



Section 8 — LID Feasibility Checklist

Preface

Minimum Requirement #5 requires the use of the first feasible On-Site Stormwater Management BMP selected from a prioritized list. In order to select a lower priority BMP from the list, the applicant must first establish the infeasibility of using the higher-priority BMP(s).

As an alternative to the prioritized list, applicants can aalso meet MR #5 by demonstrating the site plan will meet the LID Performance Standard using an approved continuous flow model (WWHM). This requires an engineer.

Infeasibility is established by comparing specific site conditions and requirements with a list of infeasibility criteria given for the BMP in Section 9, below. Infeasibility must be ascertained using site-specific information and may not be established by generalized knowledge. Some infeasibility criteria require evaluation by a qualified professional as described in the criterion.

In some situations, a BMP may be infeasible if it competes with other federal, state, and local priorities, as discussed below.

LID Infeasibility due to Competing Needs

The use of On-site Stormwater Management BMPs to meet Minimum Requirement #5 can be superseded or reduced where they are in conflict with:

- Requirements of the following federal or state laws, rules, and standards:
    - Historic Preservation Laws and Archaeology Laws as listed at http://www.dahp.wa.gov/learn-and-research/preservation-laws.
    - Federal Superfund (general information at: http://www.epa.gov/superfund/about.htm) or Washington State Model Toxics Control Act (RCW Chapter 70.105D and WAC 173-340).
    - Federal Aviation Administration requirements for airports. See WSDOT's *Airport Stormwater Design Manual*.
    - Americans with Disabilities Act. See the 2010 ADA Standards for Accessible Design.
- Where an LID requirement has been found to be in conflict with special zoning district design criteria adopted and being implemented pursuant to a community planning process, the existing local codes may supersede or reduce the LID requirement.
- Public health and safety standards.
- Transportation regulations to maintain the option for future expansion or multi-modal use of public rights-of-way.

Document the use of Competing Needs criteria to supersede or reduce use of On-site Stormwater Management BMPs in the LID Feasibility Checklist.

LID Feasibility Checklist

Project Title and Case Number:

_____

Applicant:

_____

Date: _____

TDA #: _____

***Instructions**: Fill out a LID Feasibility Checklist for each TDA on the project. Submit the completed checklist with the Site Plan Short Form.*

Step 1: Indicate which type(s) of surfaces will be present within the TDA in Section 1.

Step 2: Consider feasibility criteria and setbacks in Section 2.

Consider feasibility of BMPs below in the order indicated in the required list or table for each surface in the TDA.

Section 1: Surfaces

___ Roof ____ Other Hard Surfaces (driveway, parking area, patio, etc.)

Consider feasibility of BMPs below for each surface type in the TDA.

Section 2: Feasibility Criteria

For each type of surface selected in Section1, above, consider BMPs in the order indicated in the Minimum Requirement #5 section of the Stormwater Site Plan Short Form.

For each question, place a mark in either the Yes or No column. For each No answer, move on to the subsequent question within the BMP. ***If a Yes answer is given for any question, ~~then~~ the BMP is not feasible in the TDA and is not required in accordance with Minimum Requirement #5. If No answers are given to all questions, then the BMP is feasible in the TDA and must be implemented in accordance with Minimum Requirement #5.*** *When feasibility of the BMP has been determined, then select the appropriate box in the Determination section.*

For each surface type, stop at the first BMP that is feasible.

Answers to questions must consider site-specific information, and some may require professional written evaluation as justification.

FULL DISPERSION BMP T5.30A		**Roof**		**Other Hard Surfaces**	
	Feasibility Criteria and Setbacks	**YES**	**NO**	**YES**	**NO**
	Will the project protect and maintain less than 65% of the ~~TDA~~ site in a forested native condition?				
	Is the only location available for the discharge less than 100 feet upgradient of a septic system?				
	Is the only area available to place the dispersion device or required flowpath less than 10 feet from any structure, property line, or sensitive area?				
	Is the only area available for the required length of the BMP's flowpath on a slope greater than 20%				
	Is the only area available for the required length of the BMP's flowpath above an erosion hazard or toward a landslide hazard area?				
	Is the only area available to place the dispersion device (not the flowpath) located in a critical area or critical area buffer?				
	Is the only area available to place the dispersion device (not the flowpath) located on a slope greater than 20% or within 50 feet of a geohazard as defined in CCC 40.430?				
	Does a professional geotechnical evaluation recommend dispersion not be used due to reasonable concerns about erosion, slope failure or down gradient flooding?				
	Are there Competing Needs (see Section 8 Preface)? If so, attach a narrative justifying the use of Competing Needs criteria.				
Determination: Is this BMP feasible? **……**					

DISPERSION TO PASTURE OR CROPLAND BMP T5.30B	Roof		Other Hard Surfaces	
Applicability and Setbacks	**YES**	**NO**	**YES**	**NO**
Is the project site 22,000 square feet or less?				
Will the project protect and maintain less than 75% of the site or TDA as pasture or cropland or be covered in more than 15% impervious surfaces?				
Does use of the pasture or cropland for purposes other than plant growth (e.g. unpaved roads, equipment storage, animal pens, haystacks, wheel lines, campsites, trails, etc.) take up more than 10% of the area to be used for dispersion?				
Does the site prohibit a minimum dispersion flow path through pasture or cropland of 300 feet?				
Is the only area available for the required length of the BMP's flowpath on a slope greater than 5%?				
Is the only area available to place the dispersion device or required flowpath less than 10 feet from any structure, property line, or sensitive area?				
Is the only location available for the discharge less than 100 feet upgradient of a septic system?				
Is the only area available for the required length of the BMP's flowpath above an erosion hazard or toward a landslide hazard area?				
Is the only area available to place the dispersion device (not the flowpath) located in a critical area or critical area buffer?				
Is the only area available to place the dispersion device (not the flowpath) located on a slope greater than 20% or within 50 feet of a geohazard as defined in CCC 40.430?				
Are crops other than grass, grain, row crops (including berries, nursery stock, and orchards) grown in the proposed flowpath?				
Is the pasture/cropland under different ownership than the project site?				
If the crop or pasture land is predominantly covered in soils with an infiltration rate greater than 4 inches per hour, was the pasture or cropland cleared after November 2009?				
Is there less than 3 feet between the surface elevation along the dispersion flowpath and the average annual maximum groundwater elevation?				
Does a professional geotechnical evaluation recommend dispersion not be used due to reasonable concerns about				

	erosion, slope failure or down gradient flooding?				
	Are there Competing Needs (see Section 8 Preface)? If so, attach a narrative justifying the use of Competing Needs criteria.				
Determination: Is this BMP feasible? **……**					

ROOF DOWNSPOUT FULL INFILTRATION BMPs T5.10A and T5.10B		**Roof**			
	Feasibility Criteria and Setbacks	**YES**	**NO**		
Note: this BMP is not applicable to other hard surfaces.	Is the proposed location on a slope of 25% (4:1) or greater and cannot reasonably be located elsewhere?				
	Is the proposed location less than 10 feet from any small on-site sewage disposal drainfield, including reserve areas and grey water reuse systems, and cannot reasonably be located elsewhere?				
	Is the proposed location less than 100 feet upgradient of a septic system unless topography clearly prohibits subsurface flows from intersecting the drainfield and cannot reasonably be located elsewhere?				
	Is the proposed location less than 10 feet from any structure, property line, or sensitive area and cannot reasonably be located elsewhere?				
	Has a qualified professional determined that soils in the infiltration zone at the location of the roof downspout infiltration BMP do not fall within USDA textural classes of coarse sands to medium sands, loam, or cobbles and gravels?				
	Is there less than 3 feet of permeable soil from the proposed finished ground elevation at the drywell or trench location to the seasonal high groundwater table?				
	Is there less than 1 foot of soil from the proposed bottom elevation of the roof downspout control to the groundwater elevation?				

	Is the proposed location less than 50 feet from the top of any slope greater than 40% and cannot reasonably be located elsewhere? [Note: at the applicant's request, the Responsible Official may reduce this setback to 15 feet based on a geotechnical evaluation. If requested, submit a geotechnical report with this checklist for County review.]				
	Is the proposed location less than 10 feet from an underground storage tank and its connecting pipes that is used to store petroleum products, chemicals, or liquid hazardous wastes in which 10% or more of the storage volume of the tank and connecting pipes is beneath the ground and cannot reasonably be located elsewhere?				
	Is the proposed location less than 100 feet from a closed or active landfill and cannot reasonably be located elsewhere?				
	Are there Competing Needs (see Section 8 Preface)? If so, attach a narrative justifying the use of Competing Needs criteria.				
Determination: Is this BMP feasible? **……**					

RAIN GARDEN BMP T5.14A		**Roof**		**Other Hard Surfaces**	
	Infeasibility Criteria and Setbacks	**YES**	**NO**	**YES**	**NO**
	Can the site not reasonably be designed to locate the BMP on slopes less than 8%?				
	Is the land for the BMP within an area designated as an erosion hazard or landslide hazard by the geotechnical report or county critical areas mapping?				
	Is the BMP less than 50 feet from the top of slopes greater than 20% and with more than 10 feet of vertical relief and cannot reasonably be located elsewhere?				

Questions continue on following page	~~On properties with known soil or groundwater contamination (typically federal Superfund sites or state cleanup sites under the Model Toxics Control Act (MTCA)) and any of the following criteria:~~				
	~~o Is the proposed BMP within 100 feet of an area known to have deep soil contamination?~~				
	~~o Is the site is in an area where groundwater modeling indicates infiltration will likely increase or change the direction of the migration of pollutants in groundwater?~~				
	~~o Is the proposed BMP located in an area where surface soils have been found to be contaminated, and contaminated soils are still in place within 10 horizontal feet of the infiltration area?~~				
	~~o Is the BMP within any area where it would be prohibited by an approved cleanup plan under the state Model Toxics Control Act or Federal Superfund Law, or an environmental covenant under Chapter 64.70 RCW?~~				
	[End soil / groundwater contamination sub-list.]				
	Is the BMP less than 100 feet from a landfill (active or closed) and cannot reasonably be located elsewhere?				
	Is the BMP less than 100 feet from a drinking water well or a spring used for drinking water and cannot reasonably be located elsewhere?				
	Is the BMP less than 10 feet from any small on-site sewage disposal drain field, including reserve areas, and grey water reuse systems and cannot reasonably be located elsewhere? For setbacks from a "large on-site sewage disposal system," see Chapter 246-272B WAC.				
	Is the BMP less than 10 feet from an underground storage tank and its connecting pipes that is used to store petroleum products, chemicals, or liquid hazardous wastes in which 10% or more of the storage volume of the tank and connecting pipes is beneath the ground and when the capacity of the tank and pipe system is less than 1100 gallons and cannot reasonably be located elsewhere?				
	Does field testing indicate that soils have a measured (a.k.a. initial) native soil coefficient of permeability less than 0.3 inches per hour?				
	Is the minimum vertical separation of one foot to seasonal high water table, bedrock or other impervious layer unable to be achieved below the rain garden?				
	Is the BMP less than 100 feet from an underground storage tank and its connecting pipes that is used to store petroleum products, chemicals, or liquid hazardous wastes in which 10% or more of the storage volume of the tank and connecting pipes is underground and when the capacity of the tank and pipe system is greater than 1100				

	gallons and cannot reasonably be located elsewhere?				
	Are there Competing Needs (see Section 8 Preface)? If so, attach a narrative justifying the use of Competing Needs criteria.				
	The following require professional technical evaluation.				
	Does a professional geotechnical evaluation recommend infiltration not be used due to reasonable concerns about erosion, slope failure or down gradient flooding?				
	Does the site have groundwater that drains into an erosion hazard or landslide hazard area?				
	Is the only area available for siting the BMP threatening the safety or reliability of pre-existing underground utilities, pre-existing underground storage tanks, pre-existing structures and basements, or pre-existing road or parking lot surfaces?				
	Would infiltrating water threaten existing below grade basements?				
Questions continue on following page	Would infiltrating water threaten shoreline structures such as bulkheads?				
	Is the only area available for siting the BMP one that does not allow for a safe overflow pathway to a natural drainageway, the municipal separate storm sewer system or to a private storm sewer system?				
	~~Is the site a redevelopment project that lacks usable space?~~				
Determination: Is this BMP feasible? ……					

DOWNSPOUT DISPERSION BMP T5.10C		**Roof**			
	Setbacks	**YES**	**NO**		
Note: this BMP is not applicable to other hard surfaces.	Is the proposed location less than 10 feet from any sewage disposal drainfield, including reserve areas and grey water reuse systems, and cannot reasonably be located elsewhere?				
	Is the proposed discharge location less than 100 feet upgradient of a septic system drainfield, unless site topography clearly prohibits subsurface flows from intersecting the drainfield and cannot reasonably be located elsewhere?				
	Is the proposed discharge point less than 10 feet from any structure or property line and cannot reasonably be located elsewhere?				
	Is the proposed discharge point less than 50 feet from the top of any slope greater than 15% and cannot reasonably be located elsewhere? [Note: at the applicant's request, the Responsible Official may reduce this setback to 15 feet based on a geotechnical evaluation. If requested, submit a geotechnical report with this checklist for County review.]				
	Are there Competing Needs (see Section 8 Preface)? If so, attach a narrative justifying the use of Competing Needs criteria.				
Determination: Is this BMP feasible? **……**					

SHEET FLOW DISPERSION BMP T5.12 and CONCENTRATED FLOW DISPERSION BMP T5.11		**Roof**		**Other Hard Surfaces**	
	Feasibility Criteria	**YES**	**NO**	**YES**	**NO**
	Is the only area available for the BMP less than 10 feet from any structure, property line, or sensitive area?				
	Is the only area available to place the dispersion device (not the flowpath) located on a slope greater than 20% or within 50 feet of a geohazard as defined by CCC 40.430?				
	Is the only area available for the required length of the BMP's flowpath on a slope greater than 20%				
	Is the only location available for the discharge location less than 100 feet upgradient of a septic system drainfield on the site?				
	Is the only area available to place the dispersion device (not the flowpath) located in a critical area or critical area buffer?				

	Is the only area available for the required length of the BMP's flowpath above an erosion hazard or toward a landslide hazard area?				
	Does a professional geotechnical evaluation recommend dispersion not be used due to reasonable concerns about erosion, slope failure or down gradient flooding?				
	Are there Competing Needs (see Section 8 Preface)? If so, attach a narrative justifying the use of Competing Needs criteria.				
Determination: Is this BMP feasible? **……**					

PERMEABLE PAVEMENT BMP T5.15		**Roof**		**Other Hard Surfaces**	
	Feasibility Criteria and Setbacks	**YES**	**NO**	**YES**	**NO**
	~~Is the surface to be paved a roadway with a projected average daily traffic volume of more than 400 vehicles?~~				
	~~Is the surface to be paved a roadway that will be subject to through truck traffic (not including such traffic as weekly garbage and recycling pick-up, daily school bus use, or frequent use by mail/parcel delivery trucks and maintenance vehicles)?~~				
	~~Is the surface to be paved a multi-level parking garage, a bridge, or roadway over a culvert?~~				
	Is the area for permeable pavement likely to have long-term excessive sediment deposition after construction (e.g. construction and landscaping material yards)?				
	Is the area for permeable pavement designated as an erosion hazard or landslide hazard?				
	~~On properties with known soil or groundwater contamination (typically federal Superfund sites or state cleanup sites under the Model Toxics Control Act (MTCA)) and any of the following criteria:~~				
	~~o Is the proposed BMP within 100 feet of an area known to have deep soil contamination?~~				
	~~o Is the site in an area where groundwater modeling indicates infiltration will likely increase or change the direction of the migration of pollutants in groundwater?~~				
	~~o Is the proposed BMP located in an area where surface soils have been found to be contaminated, and contaminated soils are still in place within 10 horizontal feet of the infiltration area?~~				

	~~o Is the BMP within any area where it would be prohibited by an approved cleanup plan under the state Model Toxics Control Act or Federal Superfund Law, or an environmental covenant under Chapter 64.70 RCW?~~				
	~~*[End soil / groundwater contamination sub-list.]*~~				
Questions continue on following page.	Can the site not reasonably be designed to have a porous asphalt surface at less than 5% slope, or a pervious concrete surface at less than 10% slope, or a permeable interlocking concrete pavement surface (where appropriate) at less than 12% slope, or a grid system at less than the manufacturer's recommended maximum slope limit (generally between 6% to 12%)?				
	~~Do the native soils below a pollution-generating permeable pavement not meet the soil suitability requirement for providing treatment as follows (must meet all criteria to be feasible for treatment)?~~ ~~- One foot depth of soil with the following characteristics:~~ ~~- Cation exchange capacity >5%~~ ~~- Organic content >1%~~ ~~- Measured coefficient of permeability < 12 in./hr.~~				
	Would seasonal high groundwater or an underlying impermeable/low permeable layer create saturated conditions within 1 foot of the bottom of the lowest gravel base course?				
	~~Are underlying soils unsuitable for supporting traffic loads when saturated? (Soils meeting a California Bearing Ratio of 5% are considered suitable for residential access roads.)~~				
	Is measured coefficient of permeability in the area for permeable pavement less than 0.3 inches per hour?				
	~~Is the road type classified as arterial or collector? [Note: do not use this infeasibility criterion for sidewalks and other non-traffic bearing surfaces, even if associated with a collector or arterial road. Use "N/A" in the boxes to the right for sidewalks and other non-traffic bearing surfaces.]~~				
	~~Is the project replacing existing impervious surface, unless the existing surface is a non-pollution generating surface over an outwash soil with a saturated hydraulic conductivity of four inches per hour or greater?~~				
	~~Is the site defined as a high-use site in Appendix 1-A?~~				
	~~Is the area for permeable pavement used for an "industrial activity" as identified in 40 CFR 122.26(b)(14)?~~				
	~~Is the risk of concentrated pollutant spills more likely such as gas stations, truck stops, and industrial chemical storage sites?~~				

	If the area for permeable pavement would be a pollution-generating hard surface (e.g. roads, driveways, parking lots) does the soil underneath the proposed location fail to meet all of the following criteria:
	- At least one foot depth of soil with the following characteristics:
	  - Cation Exchange Capacity > 5%
	  - Organic Content > 1%
	  - Measured coefficient of permeability < 12 inches/hour				

	Is the area for permeable pavement less than 50 feet from the top of a slope greater than 20% with more than 10 feet of vertical relief?				
	Is the area for permeable pavement less than 100 feet from an active or closed landfill?				
	Is the area for permeable pavement less than 100 feet from a drinking water well or a spring used for drinking water?				
	Is the area for permeable pavement less than 10 feet from on-site sewage drainage?				
Questions continue on following page.	Is the area to be paved less than 10 feet from an underground storage tank and its connecting pipes that is used to store petroleum products, chemicals, or liquid hazardous wastes in which 10% or more of the storage volume of the tank and connecting pipes is beneath the ground?				
	Are there Competing Needs (see Section 8 Preface)? If so, attach a narrative justifying the use of Competing Needs criteria.				
	The following require professional technical evaluation.				
	Does a professional geotechnical evaluation recommend infiltration not be used due to reasonable concerns about erosion, slope failure or down gradient flooding?				
	Does the site have groundwater that drains into an erosion hazard or landslide hazard area?				
	Would infiltrating and ponded water below new permeable pavement area compromise adjacent impervious pavement?				
	Is the only area available for siting the BMP threatening the safety or reliability of pre-existing underground utilities, pre-existing underground storage tanks, pre-existing structures and basements, or pre-existing road or parking lot surfaces?				
	Would infiltrating water threaten existing below grade basements?				
	Would infiltrating water threaten shoreline structures such				

	as bulkheads?				
	Is the area for permeable pavement downslope of steep, erosion prone areas that are likely to deliver sediment?				
	Is the area for permeable pavement over fill soils that can become unstable when saturated?				
	~~Is the area for permeable pavement on excessively steep slopes and would the water within the aggregate base layer or at the sub-grade surface be uncontrollable by detention structures and therefore may cause erosion and structural failure, or would surface runoff velocities preclude adequate infiltration at the pavement surface?~~				
	~~Is the area for permeable pavement in an area needed to support heavy loads exceeding the strength of the permeable pavement (such as at a port)?~~				
	~~Would installation of permeable pavement threaten the safety or reliability of pre-existing underground utilities, pre-existing underground storage tanks, or pre-existing road sub-grades?~~				
Determination: Is this BMP feasible? **……**					

Section 9 — On-Site BMP Design Criteria and Drawings

This section describes the applicability, infeasibility criteria, and design criteria for each On-site Stormwater Management BMP required in Minimum Requirement #5 (see Section #5). Each BMP description includes a list of infeasibility criteria; these criteria must be used in the selection process for Minimum Requirement #5. After selection, use the design criteria and illustrations to plan and design the BMPs selected for use on the site.

BMP T5.13: Post-Construction Soil Quality and Depth

Purpose and Description

Naturally occurring (undisturbed) soil and vegetation provide important stormwater functions including: water infiltration; nutrient, sediment, and pollutant adsorption; sediment and pollutant biofiltration; water interflow storage and transmission; and pollutant decomposition. These functions are largely lost when development strips away native soil and vegetation and replaces it with minimal topsoil and sod. Not only are these important stormwater functions lost, but such landscapes themselves begin to generate pollution due to increased use of pesticides, fertilizers and other landscaping and household/industrial chemicals, the concentration of pet wastes, and pollutants that accompany roadside litter.

Establishing soil quality and depth regains greater stormwater functions in the post development landscape, provides increased treatment of pollutants and sediments that result from development and habitation, and minimizes the need for some landscaping chemicals, thus reducing pollution through prevention.

Applications, Limitations and Setbacks

Establishing a minimum soil quality and depth is not the same as preservation of naturally occurring soil and vegetation. However, establishing a minimum soil quality and depth will provide improved onsite management of stormwater flow and water quality. Soil organic matter can be attained through addition of numerous materials such as compost, composted woody material, biosolids, and forest product residuals. It is important that the materials used to meet the soil quality and depth BMP be appropriate and beneficial to the plant cover to be established. Likewise, it is important that imported topsoils improve soil conditions and do not have an excessive percent of clay fines. This BMP can be considered infeasible on till soil slopes greater than 33 percent.

Soil and vegetation provide significant benefits, including:

- Water infiltration.
- Absorption of nutrients, sediments and pollutants.
- Biofiltration of sediment and pollutants.
- Water interflow storage and transmission.
- Pollutant decomposition.

This BMP is mandatory for all projects using this form.

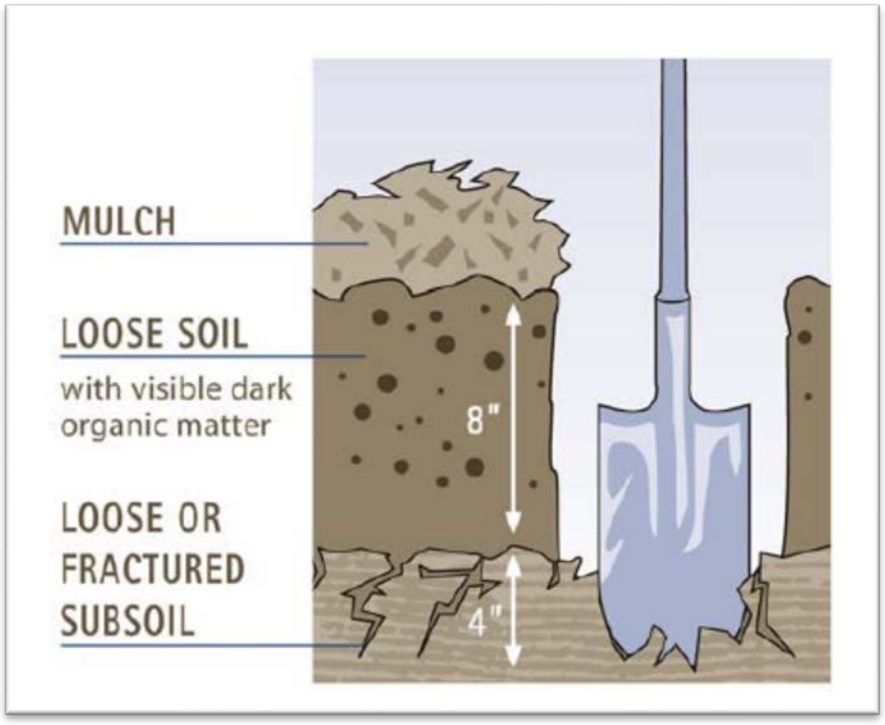


Figure 7: Typical Planting Bed Cross-section

(Source: Washington Organic Recycling Council graphic in SMMWW)

Design Criteria

- Retain, in an undisturbed state, the duff layer and native topsoil to the maximum extent practicable. In any areas requiring grading remove and stockpile the duff layer and topsoil on site in a designated, controlled area, not adjacent to public resources and critical areas, to be reapplied to other portions of the site where feasible.
- Areas subject to clearing and grading that have not been covered by hard surfaces, used for a drainage facility, or where the soils have been engineered as structural fill or slope, shall demonstrate the following after completion of the project:
    - A topsoil layer with:
        - A minimum organic matter content of 10% dry weight in planting beds.
        - 5% organic matter content in turf areas.
        - A pH from 6.0 to 8.0 or matching the pH of the undisturbed soil.
        - A minimum topsoil layer depth of 8 inches except where tree roots do not allow this.
    - Subsoils below the topsoil layer should be scarified at least 4 inches with some incorporation of the upper material to avoid stratified layers, where feasible.

- Mulch planting beds with 2 inches of organic material.
- Use compost and other materials that meet the following specifications:
  - The organic content for pre-approved amendment rates can be met only using compost meeting the following compost specification:
    - Shall meet definition of "composted materials" in WAC 173-350-100, available online at http://www.ecy.wa.gov/programs/swfa/organics/soil.html.
    - Shall be produced at a composting facility permitted by the WA Department of Ecology.
    - Shall originate at least 65% by volume from recycled plant waste as defined as "Type I" in WAC 173-350-220. A current list of permitted facilities is available at http://www.ecy.wa.gov/programs/swfa/compost/
    - Type II and Type IV feedstocks shall not be used in bioretention.
    - No visible free water or dust shall be produced when handling material.
    - Shall be tested in accordance with the US Composting Council "Testing Methods for the Examination of Compost and Composting" (TMECC).
    - Shall have a pH between 6.0 and 8.5.
    - Shall have a manufactured inert content less than 1%.
    - Shall have an organic matter content of 40% to 65%.
    - Shall have a soluble salt content less than 4.0 mmhos per centimeter.
    - Shall have a maturity greater than 80% (TMECC 05.05-A "Germination and Vigor").
    - Shall have stability of 7 or below (TMECC 05.08-B "Carbon Dioxide Evolution Rate").
    - Shall have a Carbon to Nitrogen ratio less than 25:1. May be up to 35:1 if planting composed entirely of Puget Sound Lowland native species or up to 40:1 for coarse compost used as a surface mulch (not in a soil mix).
    - May contain up to 35% biosolids or manure.
  - Calculated amendment rates may be met through use of composted material meeting the above specifications or may be met using other organic materials

amended to meet the carbon to nitrogen ratio requirements, and not exceeding the contaminant limits identified in Table 220-B, Testing Parameters, in WAC 173-350-220.

- The resulting soil should be conducive to the type of vegetation to be established.

- Only one of these methods can be used to meet the above criteria for a specific area on the site:
  - Native vegetation and soil should remain undisturbed and protected from compaction during construction.
  - Amend existing topsoil or subsoil either at default "pre-approved" rates, or at custom calculated rates based on soil tests of the soil and amendments.
  - Stockpile existing topsoil during grading and replace it over disturbed areas prior to planting. Stockpiled topsoil must also be amended if needed to meet the organic matter or depth requirements, either at a default "pre-approved" rate or at a custom calculated rate.
  - Import topsoil mix of sufficient organic content and depth to meet the requirements.
  - More than one method may be used on different portions of the same site. Soil that already meets the depth and organic matter quality standards need not be amended.
  - Scarification of subsoils can be accomplished using mechanical methods such as a rototiller

Maintenance

- Establish soil quality and depth toward the end of construction and, once established, protect from compaction, such as from large machinery use, and from erosion.
- Plant vegetation and mulch the amended soil area after installation.
- Leave plant debris or its equivalent on the soil surface to replenish organic matter.
- Reduce and adjust, where possible, the use of irrigation, fertilizers, herbicides and pesticides, rather than continuing to implement formerly established practices.

BMP T5.30A: Full Dispersion

Dispersion BMPs spread runoff over the land and prevent runoff from concentrating over the length of the designated flowpath. Full dispersion uses standard dispersion techniques over a longer flowpath on a tract of land preserved in native vegetation.

Purpose and Definition

This BMP allows for "fully dispersing" runoff from impervious surfaces and cleared areas of development sites that protect at least 65% of the site (or a threshold discharge area on the site) in a forest or native condition and that limit effective impervious surface on the site to 10% maximum.

Figure 8: Native Vegetation in Clark County

Applications, Limitations and Setbacks

BMP T5.30A Full Dispersion is used in the following situations:

- Rural single family residential developments should use these dispersion BMPs wherever possible to minimize effective impervious surface to less than 10% of the development site.
- Other types of development that retain 65% of the site (or a threshold discharge area on the site) in a forested or native condition may also use these BMPs to avoid triggering the flow control facility requirement.

- The preserved area may be a previously cleared area that has been replanted in accordance with native vegetation landscape specifications described within this BMP.
- The preserved area should be situated to minimize the clearing of existing forest cover, to maximize the preservation of wetlands (though the wetland area and any streams and lakes do not count toward the 65% forest or native condition area), and to buffer stream corridors.
- The preserved area should be placed in a separate tract or protected through recorded easements for individual lots.
- The preserved area should be shown on all property maps and should be clearly marked during clearing and construction on the site.
- All trees within the preserved area at the time of permit application shall be retained, aside from approved timber harvest activities regulated under WAC Title 222, except for Class IV General Forest Practices that are conversions from timberland to other uses, and the removal of dangerous or diseased trees.

Setbacks

Because Full Dispersion relies on the dispersion devices and design criteria for various dispersion BMPs, setbacks for each type(s) of dispersion BMP(s) used to achieve full dispersion shall be observed.

Infeasibility Criteria

The following criteria describe conditions that make full dispersion infeasible to meet Minimum Requirement #5. Citation of any of the infeasibility criteria must be based on an evaluation of site-specific conditions and documented in the LID Feasibility Checklist. Full Dispersion is considered infeasible under the following conditions:

- Where a professional geotechnical evaluation recommends dispersion not be used due to reasonable concerns about erosion, slope failure or down gradient flooding.
- Where the only location available for the discharge location is less than 100 feet up gradient of a septic system.
- Where the only area available for the required length of the BMP's flow path is above an erosion hazard, toward a landslide hazard area, or on a slope greater than 20% unless a professional geotechnical engineer recommends dispersion can be used in these areas.
- Where the only area available to place the dispersion device (not the flow path), if applicable to the BMP, is located in a critical area or critical area buffer.
- Where the only area available to place the dispersion device (not the flow path), if applicable to the BMP, is located on a slope greater than 20% (5% for BMP T5.30B) or within 50 feet of a geohazard (CCC 40.430) area.
- Where the setbacks above cannot be met.

Design Criteria

Developments that preserve 65% of a site (or a threshold discharge area of a site) in a forested or native condition can disperse runoff from the developed portion of the site into the native vegetation area as long as the developed areas draining to the native vegetation do not have impervious areas that exceed 10% of the entire site.

Where a development has less than 65% of a site available to maintain or create into a forested or native condition, that area may still be used for full dispersion of a portion of the developed area. The ratio of the native vegetation area to the impervious area, which is dispersed into the native vegetation, must not be less than 65 to 10. The lawn and landscaping areas associated with the impervious areas may also be dispersed into the native vegetation area. The lawn and landscaped area must comply with BMP T5.13, above. All design requirements listed also must be met.

- The preserved area should be selected in order to limit the clearing of existing forest cover, to maximize preservation of wetlands and to buffer stream corridors.
    - Wetland areas as well as streams and lakes do not count toward the 65% forest or native condition area.
- The preserved area should be placed in a separate tract or protected through recorded easements for individual lots.
- The preserved area should be shown on all property maps and should be clearly marked during clearing and construction on the site.
- All trees within the preserved area at the time of permit application shall be retained, aside from approved timber harvest activities regulated under WAC Title 222, except for Class IV General Forest Practices that are conversions from timberland to other uses, and the removal of dangerous or diseased trees. Dangerous or diseased trees that are removed shall be replanted with a similar species or a native species.
- The portion of the developed area which is not managed through full dispersion can be considered a separate project site provided that, the portion not managed through full dispersion is evaluated against and subject to thresholds in Book 1, Chapter 1 to determine applicable minimum requirements.
- Additional impervious and lawn/landscaped areas are allowed, but should not drain to the native vegetation area, and are subject to the thresholds, treatment and flow control requirements.
- Within the context of this dispersion option, the impervious surfaces that are over and above the 10% maximum can be routed into an appropriately sized drywell or into an infiltration basin that meets the flow control standard and does not overflow into the forested or native vegetation area.
- Runoff shall evenly sheet flow onto dispersion areas naturally, or via a dispersion trench or other structure designed to evenly spread and dissipate concentrated flows.

- Runoff must be dispersed into the native area in accordance with one or more of the dispersion devices, and in accordance with the design criteria and limits for those devices, cited in this BMP. A native vegetation flow path of at least 100 feet in length (25 feet for sheet flow from a non-native pervious surface) must be available along the flow path that runoff would follow upon discharge from a dispersion device cited in this BMP. The native vegetated flow path must meet all of the following criteria:
    - The flow path must be over native vegetated surface.
    - The flow path must be on-site or in an off-site tract or easement area reserved for such dispersion.
    - The slope of the flow path must be no steeper than 15% for any 20-foot reach of the flow path.
    - Slopes up to 33% are allowed where level spreaders are located upstream of the dispersion area and at sites where vegetation can be established.
    - The flow path must be located between the dispersion device and any downstream drainage feature such as a pipe, ditch, stream, river, pond, lake, or wetland.
    - The flow paths for adjacent dispersion devices must be sufficiently spaced to prevent overlap of flows in the flow path areas.
- The preserved area may be used for passive recreation and related facilities, including pedestrian and bicycle trails, nature viewing areas, fishing and camping areas, and other similar activities that do not require permanent structures, provided that cleared areas and areas of compacted soil associated with these areas and facilities do not exceed eight percent of the preserved area.
- The preserved area may contain utilities and utility easements, but not septic systems. Utilities are defined as potable and wastewater underground piping, underground wiring, and power and telephone poles.
- For sites with on-site sewage disposal systems, the discharge of runoff from dispersion devices must be located downslope of the primary and reserve drainfield areas. This requirement may be waived by the Responsible Official if site topography clearly prevents discharged flows from intersecting the drainfield.
- Dispersion devices are not allowed in critical area buffers or on slopes steeper than 20%. Dispersion devices proposed on slopes steeper than 15% or within 50 feet of a geologically hazardous area (Clark County Code 40.430 geologic Hazard Areas) must be approved by a geotechnical engineer or engineering geologist.
- The dispersion of runoff must not create flooding or erosion impacts.

Roof Downspouts

- Roof surfaces are considered to be "fully dispersed" only if they are within a threshold discharge area that is or will be more than 65% forested (or native vegetative cover) and less than 10% impervious AND if they either:
    - Comply with the Downspout Dispersion requirements of BMP T5.10C, but with vegetated flow paths of 100 feet or more through the native vegetation preserved area or,
    - Disperse the roof runoff along with the road runoff in accordance with the roadway dispersion BMP section (below).

Driveway Dispersion

- Driveway surfaces are considered to be "fully dispersed" if they are within a threshold discharge area that is or will be more than 65% forested (or native vegetative cover) and less than 10% impervious AND if they either:
    - Comply with the requirements for Concentrated Flow Dispersion (BMP T5.11) and for Sheet Flow Dispersion (BMP T5.12) and have flow paths of 100 feet or more through native vegetation or,
    - Disperse driveway runoff along with the road runoff in accordance with the roadway dispersion BMP section (below).

Roadway Dispersion

- Roadway surfaces are considered to be "fully dispersed" if they are within a threshold discharge area that is or will be more than 65% forested (or native vegetative cover) and less than 10% impervious AND if they comply with the following requirements:
    - The road section must minimize collection and concentration of roadway runoff. Sheet flow over roadway fill slopes (i.e., where roadway subgrade is above adjacent right-of-way) should be used wherever possible to avoid concentration.
    - When it is necessary to collect and concentrate runoff from the roadway and adjacent upstream areas (such as a ditch on a cut slope), concentrated flows must be incrementally discharged from the ditch through cross culverts or at the ends of cut sections. These incremental discharges are required to be below 0.5 cfs at any discharge point from a ditch for the 100-year runoff event.
        - Where flows at a particular ditch discharge point were already concentrated under existing site conditions (e.g., in a natural channel that crosses the roadway alignment), the 0.5-cfs limit would be in addition to the existing concentrated peak flows.
    - Ditch discharge points with up to 0.2 cfs discharge for the peak 100-year flow must use rock pads or dispersion trenches (criteria defined below) to disperse flows. Ditch

discharge points with 100-year peak flows between 0.2 and 0.5 cfs must use dispersion trenches to disperse flows.

- Dispersion trenches must be designed to accept surface flows (free discharge) from a pipe, culvert, or ditch end. The trenches must be:
    - Aligned perpendicular to the flow path.
    - At least 2 feet by 2 feet in section.
    - At least 50 feet in length.
    - Filled with ¾-inch to 1½-inches washed rock, and provided with a level notched grade board.
- Manifolds may be used to split flows up to 2 cfs discharge for the 100-year peak flow between up to 4 trenches. Dispersion trenches must be spaced at least 50 feet apart (between centerlines).
- Flow paths from adjacent discharge points must not intersect within the 100-foot flow path lengths, and dispersed flow from a discharge point must not be intercepted by another discharge point. To enhance the flow control and water quality effects of dispersion, the flow path shall not exceed 15% slope, and shall be located within designated open space.

Note: Runoff may be conveyed to an area meeting the above-noted flow path criteria.

- Ditch discharge points shall be located a minimum of 100 feet upgradient of steep slopes (slopes steeper than 40%), wetlands, and streams.
- Where the Responsible Official determines there is a potential for significant adverse impacts downstream during plan approval, dispersion of roadway runoff may not be allowed, or other measures may be required.

Cleared Area Dispersion

- The runoff from cleared areas that are comprised of bare soil, non-native landscaping, lawn, and/or pasture of up to 25 feet in flow path length can be considered to be "fully dispersed" if it is dispersed through at least 25 feet of native vegetation following these criteria:
    - The topography of the non-native pervious surface must be such that runoff will not concentrate prior to discharge to the dispersal area.
    - Slopes within the dispersal area must not exceed 15%.
    - If the width of the non-native pervious surface is greater than 25 feet, an extra foot of vegetated flow path is required for each additional 3 feet of non-impervious surface width (up to a maximum of 250 feet).

Native Vegetation Landscape Specifications

These specifications may be used in situations where an applicant wishes to convert a previously developed surface to a native vegetation landscape for purposes of meeting full dispersion requirements. Native vegetation landscape is intended to have the soil, vegetation, and runoff characteristics approaching that of natural forestland.

Conversion of a developed surface to native vegetation landscape requires the removal of impervious surface, de-compaction of soils, and the planting of native trees, shrubs, and ground cover in compost-amended soil according to all of the following specifications:

1. Existing impervious surface and any underlying base course (e.g., crushed rock, gravel) must be completely removed from the conversion area(s).

2. Underlying soils must be broken up to a depth of 18 inches. This can be accomplished by excavation or ripping with either a backhoe equipped with a bucket with teeth, or a ripper towed behind a tractor.

3. At least 4 inches of well-decomposed compost must be tilled into the broken up soil as deeply as possible. The finished surface should be gently undulating and must be only lightly compacted.

4. The area of native vegetated landscape must be planted with native species trees, shrubs, and ground cover. Species must be selected as appropriate for site shade and moisture conditions, and in accordance with the following requirements:

    a. Trees: a minimum of two species of trees must be planted, one of which is a conifer. Conifer and other tree species must cover the entire landscape area at a spacing recommended by a professional landscaper.

    Shrubs**:** a minimum of two species of shrubs should be planted. Space plants to cover the entire landscape area, excluding points where trees are planted.

    b. Groundcover**:** a minimum of two species of ground cover should be planted. Space plants so as to cover the entire landscape area, excluding points where trees or shrubs are planted.

Note: for landscape areas larger than 10,000 square feet, planting a greater variety of species than the minimum suggested above is strongly encouraged. For example, an acre could easily accommodate three tree species, three species of shrubs, and two or three species of groundcover.

5. At least 4 inches of hog fuel or other suitable mulch must be placed between plants as mulch for weed control. It is also possible to mulch the entire area before planting; however, an 18-inch diameter circle must be cleared for each plant when it is planted in the underlying amended soil.

Note: plants and their root systems that come in contact with hog fuel or raw bark have a poor chance of survival.

6. Plantings must be watered consistently once per week during the dry season for the first two years.

7. The plantings must be well established on at least 90% of the converted area. A minimum of 90% plant survival is required after 3 years.

Conversion of an area that was under cultivation to native vegetation landscape requires a different treatment. Elimination of cultivated plants, grasses and weeds is required before planting and will be required on an on-going basis until native plants are well-established. The soil should be tilled to a depth of 18 inches. A minimum of 8 inches of soil having an organic content of 6 to 12 percent is required, or a four inch layer of compost may be placed on the surface before planting, or 4 inches of clean wood chips may be tilled into the soil, as recommended by a landscape architect or forester. After soil preparation is complete, continue with steps 4 through 7 above. Placing 4 inches of compost on the surface may be substituted for the hog fuel or mulch. For large areas where frequent watering is not practical, bare-root stock may be substituted at a variable spacing from 10 to 12 feet o.c. (with an average of 360 trees per acre) to allow for natural groupings and 4 to 6 feet o.c. for shrubs. Allowable bareroot stock types are 1-1, 2-1, P-1 and P-2. Live stakes at 4 feet o.c. may be substituted for willow and red-osier dogwood in wet areas.

BMP T5.30B: Dispersion to Pasture or Cropland

Dispersion BMPs spread runoff over the land and prevent runoff from concentrating over the length of the designated flowpath. Dispersion to Pasture or Cropland uses standard dispersion techniques over a longer flowpath on a tract of land preserved as pasture or cropland.

Description

This LID BMP consists of fully dispersing runoff by directing it onto a pasture or cropland surface where it can be dispersed, infiltrated, evaporated, and consumed by plant uptake.

Figure 9: Cropland in Clark County

Applications, Limitations and Setbacks

On a single-family residential lot or an agriculture parcel or parcels under the same ownership and greater than 22,000 square feet, full dispersion onto pasture and croplands is allowed when in compliance with the following criteria:

- Crop land shall consist of land used to grow grass, grain, or row crops also including berries, nursery stock and orchards.
- The crop or pasture land shall be under the same ownership as the project site.

- For soils with an infiltration rate greater than 4 inches per hour, pasture or cropland shall have been cleared prior to the adoption of this standard (November 2009).
- The total site area shall consist of at least 75 percent cropland, and no more than 15 percent of the site draining to the dispersion area shall be impervious surfaces. Less stringent ratios of sending land and receiving land uses may be submitted, with supporting modeling results showing flow control requirements are satisfied for the site.
- No more than 10 percent of the pasture or cropland used for dispersion shall be used for purposes other than plant growth (for example, but not limited to, unpaved roads, staging areas, equipment storage, animal pens, haystacks, wheel lines, campsites, trails, etc.).
- Runoff from a driveway through the dispersion area shall be dispersed per BMP T5.11 or BMP T5.12 and shall have a flow path exceeding 300 feet.
- Land used for dispersion shall be downslope from building sites and shall not exceed 5% slope.
- There shall be a minimum 3-foot depth to the average annual maximum groundwater elevation.
- The length used for dispersion shall be 300 feet or greater.
- The preserved area is not required to be placed in a separate tract or recorded easement.
- The Applications, Limitations and Setbacks for BMP T5.30A shall also apply to this BMP. Where conflicts between the requirements in BMP T5.30 and the requirements in this BMP occur, the requirements for this BMP shall apply.

Setbacks

- 100 feet upgradient from any septic system unless site topography clearly indicates that subsurface flows will not intersect the drainfield.
- 10 feet from any structure, property line, or sensitive area.
- 50 feet from a geohazard area per CCC 40.430.

Infeasibility Criteria

The following criteria describe conditions that make dispersion to pasture or cropland infeasible to meet Minimum Requirement #5. Citation of any of the infeasibility criteria must be based on an evaluation of site-specific conditions and documented in the LID Feasibility Checklist. Dispersion to pasture or cropland is considered infeasible under the following conditions:

- Where a professional geotechnical evaluation recommends dispersion not be used due to reasonable concerns about erosion, slope failure or down gradient flooding.
- Where the only location available for the discharge location is less than 100 feet up gradient of a septic system.
- Where the only area available for the required length of the BMP's flow path is above an erosion hazard, toward a landslide hazard area, or on a slope greater than 20% unless a professional

geotechnical engineer recommends dispersion can be used in these areas.

- Where the only area available to place the dispersion device (not the flow path), if applicable to the BMP, is located in a critical area or critical area buffer.
- Where the only area available to place the dispersion device (not the flow path), if applicable to the BMP, is located on a slope greater than 20% (5% for BMP T5.30B) or within 50 feet of a geohazard (CCC 40.430) area.
- Where the setbacks above cannot be met.

Design Criteria

Runoff shall evenly sheet flow onto dispersion areas naturally or via a dispersion trench or other structure designed to evenly spread and dissipate concentrated flows into sheet flow.

BMP T5.10A: Downspout Full Infiltration – Drywells

Downspout Full Infiltration Drywells are either pre-manufactured structures or holes in the ground filled with rock that allow roof runoff to infiltrate into the soil below.

Applications, Limitations and Setbacks

Downspout Full Infiltration Drywells are designed to infiltrate runoff from residential roof downspout drains and cannot be used to directly infiltrate runoff from pollutant-generating surfaces (e.g. driveways).

Soil investigation is an important first step to determining the feasibility of using downspout full infiltration. The required soil investigation described in Section 5 includes an initial assessment of the type of site soils, and the infiltration potential.

Setbacks

- 100 feet from closed or active landfills.
- 10 feet from any sewage disposal drainfield, including reserve areas and grey water reuse systems.
- 100 feet upgradient from any septic system unless site topography clearly prohibits subsurface flows from intersecting the drainfield.
- 10 feet from an underground storage tank and its connecting pipes that is used to store petroleum products, chemical, or liquid hazardous wastes in which 10% or more of the storage volume of the tank and connecting pipes is beneath the ground.
- 10 feet from any structure, property line, or sensitive area (except slopes over 40%). However, if the roof downspout infiltration system is a common system shared by two or more adjacent residential lots and contained within an easement for maintenance given to owners of all residential properties draining to the system, then the setback from the property line(s) shared by the adjacent lots may be waived.
- 50 feet from the top of any slope over 40%. This setback may be reduced to 15 feet based on a geotechnical evaluation.

Infeasibility Criteria

The following criteria describe conditions that make Downspout Full Infiltration Drywells infeasible to meet Minimum Requirement #5. Citation of any of the infeasibility criteria must be based on an evaluation of site-specific conditions and documented in the LID Feasibility Checklist. Downspout Full Infiltration Drywells are considered infeasible under the following conditions:

- A qualified professional determines that soils in the infiltration zone at the location of the drywell do not fall within USDA textural classes of coarse sands to medium sands, loam, or cobbles and gravels.

- Less than three feet of permeable soil exists from the proposed finished ground elevation at the drywell location to the seasonal high groundwater table.
- Less than one foot exists between the bottom of the drywell to the seasonal high groundwater table.
- The facility is less than 100 feet from closed or active landfills.
- The facility is less than 10 feet from a sewage disposal drainfield, including reserve areas and grey water reuse systems.
- The facility is less than 100 feet upgradient from any septic system unless site topography clearly prohibits subsurface flows from intersecting the drainfield.
- The facility is less than 10 feet from an underground storage tank and its connecting pipes that is used to store petroleum products, chemical, or liquid hazardous wastes in which 10% or more of the storage volume of the tank and connecting pipes is beneath the ground.
- The facility is less than 10 feet from any structure, property line, or sensitive area (except slopes over 40%). However, if the roof downspout infiltration system is a common system shared by two or more adjacent residential lots and contained within an easement given to owners of all residential properties draining to the system, then the setback from the property line(s) shared by the adjacent lots may be waived.
- The facility is less than 50 feet from the top of any slope over 40%. This setback may be reduced to 15 feet based on a geotechnical evaluation.

Design Criteria

- Drywell bottoms must be a minimum of 1 foot above seasonal high ground water level or impermeable soil layers
- Drywells shall contain a minimum volume of gravel:
    - If located in course sands and cobbles (defined as a particle size of 2mm or greater in accordance with ASTM D422-63 particle size analysis), at least 60 cubic feet of gravel per 1,000 square feet of impervious surface served.
    - If located in medium sands (defined as 0.5 mm to 2 mm in accordance with ASTM D422-63 particle size analysis), at least 90 cubic feet of gravel per 1,000 square feet of impervious surface served.
- Drywells shall be at least 4 feet in diameter and deep enough to contain the gravel amounts specified above for the soil type and impervious surfaced served.
- Choking stone or filter fabric (geotextile) shall be placed on top of the drain rock and filter fabric shall be placed on drywell sides prior to backfilling. Filter fabric shall not be placed on the bottom.
- Spacing between drywells shall be a minimum of 10 feet.

- Downspout infiltration drywells must not be built on slopes greater than 25% (4:1). Drywells may not be placed on or above a landslide hazard area or on slopes greater than 15% without evaluation by a professional engineer with geotechnical expertise or a licensed geologist, hydrogeologist, or engineering geologist, and with approval from the Responsible Official.

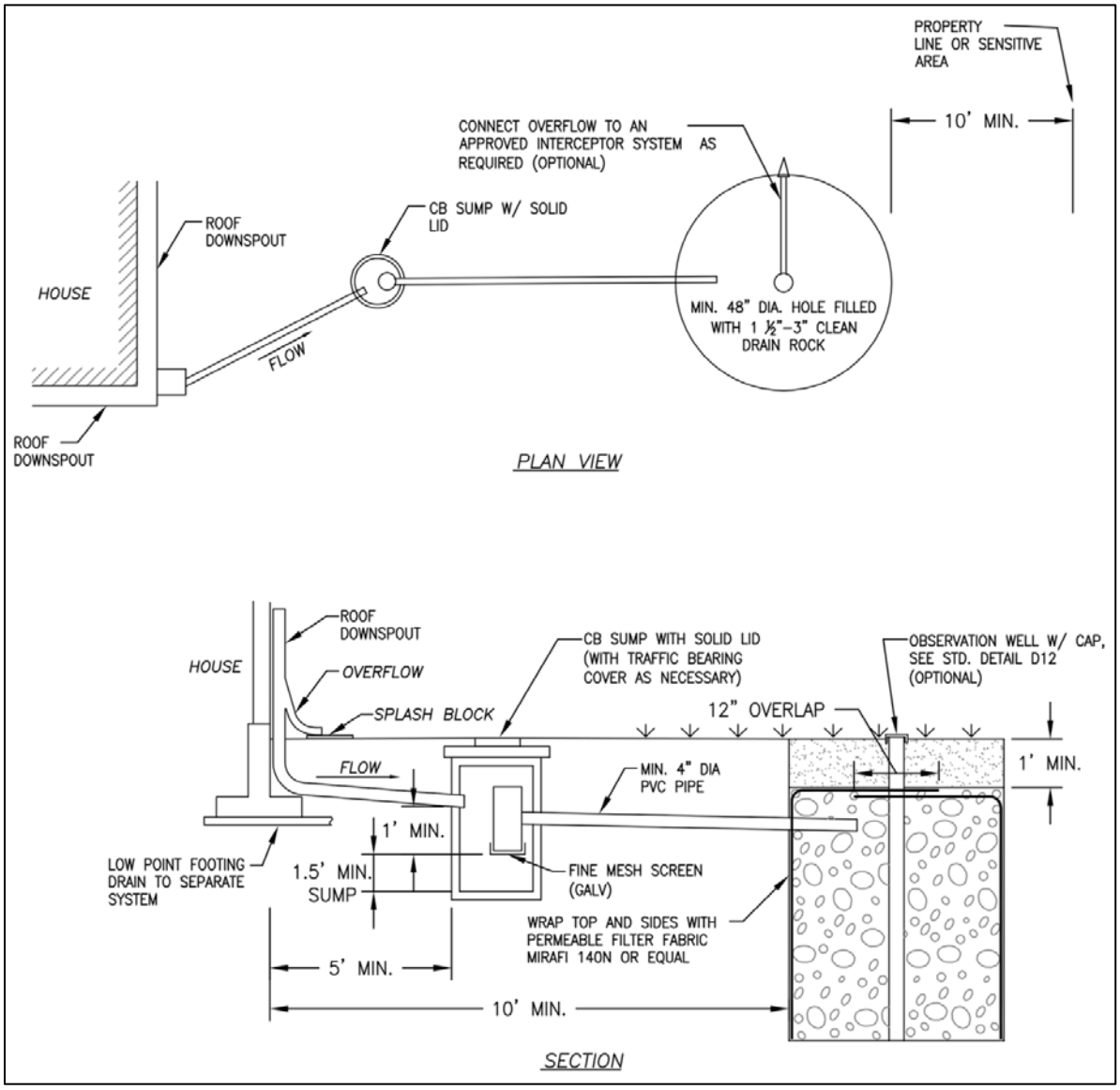


Figure 10: Typical Downspout Infiltration Drywell

(Modified from Clark County standard detail D16.1, January 2015)

BMP T5.10B: Downspout Full Infiltration – Infiltration Trenches

Downspout Full Infiltration Trenches are underground trenches filled with rock and containing perforated pipe that are designed to infiltrate runoff from roof downspout drains into the soil. Alternatives to rock-filled trenches, such as preformed chambers, are acceptable if equivalent storage volume is provided.

Applications, Limitations and Setbacks

Downspout Full Infiltration Trenches are designed to infiltrate runoff from residential roof downspout drains and cannot be used to directly infiltrate runoff from pollutant-generating surfaces (e.g. driveways).

Soil investigation is an important first step to determining the feasibility of using downspout infiltration. The required soil investigation described in Section 5 includes an initial assessment of the type of site soils, and the infiltration potential.

Setbacks

- See BMP T5.10A for setback information.

Infeasibility Criteria

The following criteria describe conditions that make Downspout Full Infiltration Trenches infeasible to meet Minimum Requirement #5. Citation of any of the infeasibility criteria must be based on an evaluation of site-specific conditions and documented in the LID Feasibility Checklist. Downspout Full Infiltration is considered infeasible under the following conditions:

- A qualified professional determines that soils in the infiltration zone at the location of the drywell do not fall within USDA textural classes of coarse sands to medium sands, loam, or cobbles and gravels.
- Less than one foot exists between the bottom of the infiltration trench to the groundwater elevation.
- The facility is less than 100 feet from closed or active landfills.
- The facility is less than 10 feet from a sewage disposal drainfield, including reserve areas and grey water reuse systems.
- The facility is less than 100 feet upgradient from any septic system unless site topography clearly prohibits subsurface flows from intersecting the drainfield.
- The facility is less than 10 feet from an underground storage tank and its connecting pipes that is used to store petroleum products, chemical, or liquid hazardous wastes in which 10% or more of the storage volume of the tank and connecting pipes is beneath the ground.

- The facility is less than 10 feet from any structure, property line, or sensitive area (except slopes over 40%). However, if the roof downspout infiltration system is a common system shared by two or more adjacent residential lots and contained within an easement given to owners of all residential properties draining to the system, then the setback from the property line(s) shared by the adjacent lots may be waived.
- The facility is less than 50 feet from the top of any slope over 40%. This setback may be reduced to 15 feet based on a geotechnical evaluation.

Design Criteria

- The following minimum lengths per 1,000 square feet of roof area based on soil type may be used for sizing downspout infiltration trenches:
    - Coarse sands and cobbles: 20 linear feet
    - Medium Sand: 30 linear feet
    - Fine sand, loamy sand: 75 linear feet.
    - Sandy loam: 125 linear feet
    - Loam: 190 linear feet
- Maximum length of any one trench is 100 feet from the inlet sump. If the minimum required length for the soil type, above, is greater than 100 feet split flow into parallel trenches.
- Minimum spacing between parallel trench centerlines is 6 feet.
- Filter fabric shall be placed over the drain rock prior to backfilling. Filter fabric should not be used where it can impede the flow into the soil.
- Infiltration trenches may be placed in fill material if the fill is placed and compacted under the direct supervision of a geotechnical engineer or professional civil engineer with geotechnical expertise, and if the measured hydraulic conductivity of the compacted fill material is at least 8 inches per hour. Trench length in fill shall be 60 linear feet per 1,000 square feet of roof area.
- Infiltration trenches should not be built on slopes steeper than 25%.
- A geotechnical analysis and report is required on slopes over 15 % or if located within 200 feet of the top of slope steeper than 40%, or in a landslide hazard area.
- Choking stone or filter fabric (geotextile) shall be placed on top of the drain rock and filter fabric shall be placed on trench sides prior to backfilling. Filter fabric shall not be placed on the bottom of the trench.

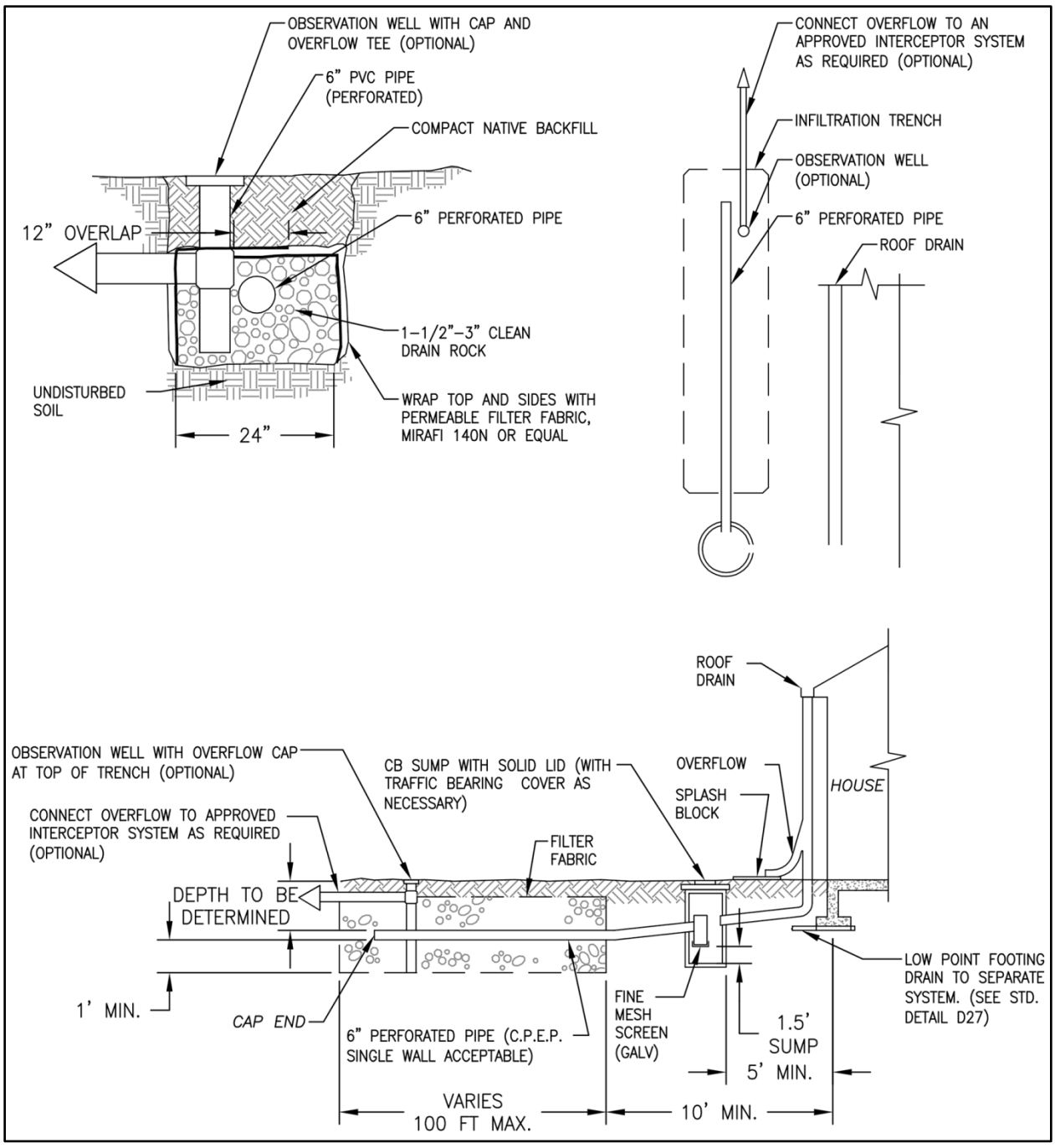


Figure 11: Typical Downspout Infiltration Trench

(Modified from Clark County standard detail D16.0, January 2015)

BMP T5.14A: Rain Gardens

Purpose and Description

Rain gardens are typically small, non-engineered shallow depressions with amended soils and plants adapted to local conditions. Rain gardens remove stormwater that fills the depression via infiltration into the native soil, while excess stormwater overflows into an adjacent drainage system.

Applications, Limitations and Setbacks

Rain Gardens are to be used to the maximum extent feasible for runoff from roofs and other hard surfaces unless a higher priority BMP is feasible.

Rain Gardens are suitable for infiltration if the minimum measured infiltration rate is 0.3 in/hr or greater. See Section 5 for more information on soil assessments and infiltration tests conducted for Rain Gardens.

Setbacks

- 50 feet from the top of slopes greater than 20% or with more than 10 feet of vertical relief.
- 100 feet from a landfill (active or closed).
- 100 feet from a drinking water well or a spring used for drinking water.
- 10 feet from any small on-site sewage disposal drain field, including reserve areas, and grey water reuse systems. For setbacks from a "large on-site sewage disposal system," see Chapter 246-272B WAC.
- From an underground storage tank and its connecting pipes that is used to store petroleum products, chemicals, or liquid hazardous waste in which 10% or more of the storage volume of the tank and connecting pipes is beneath the ground:
    - 10 feet when the system capacity is 1100 gallons or less.
    - 100 feet when the system capacity is greater than 1100 gallons.
- 100 feet from an area with known deep soil contamination.
- 10 feet from any property line or structure unless a qualified professional provides a written document stating that the structure will not be affected by the proposed location.

Because rain gardens can add phosphorus to stormwater from soil amendments and/or plant material:

- Imported compost shall not be used if the site is within 1/4 mile of a phosphorous-sensitive water body.

- An underdrain shall not be used if drainage would be routed to a phosphorous-sensitive waterbody.

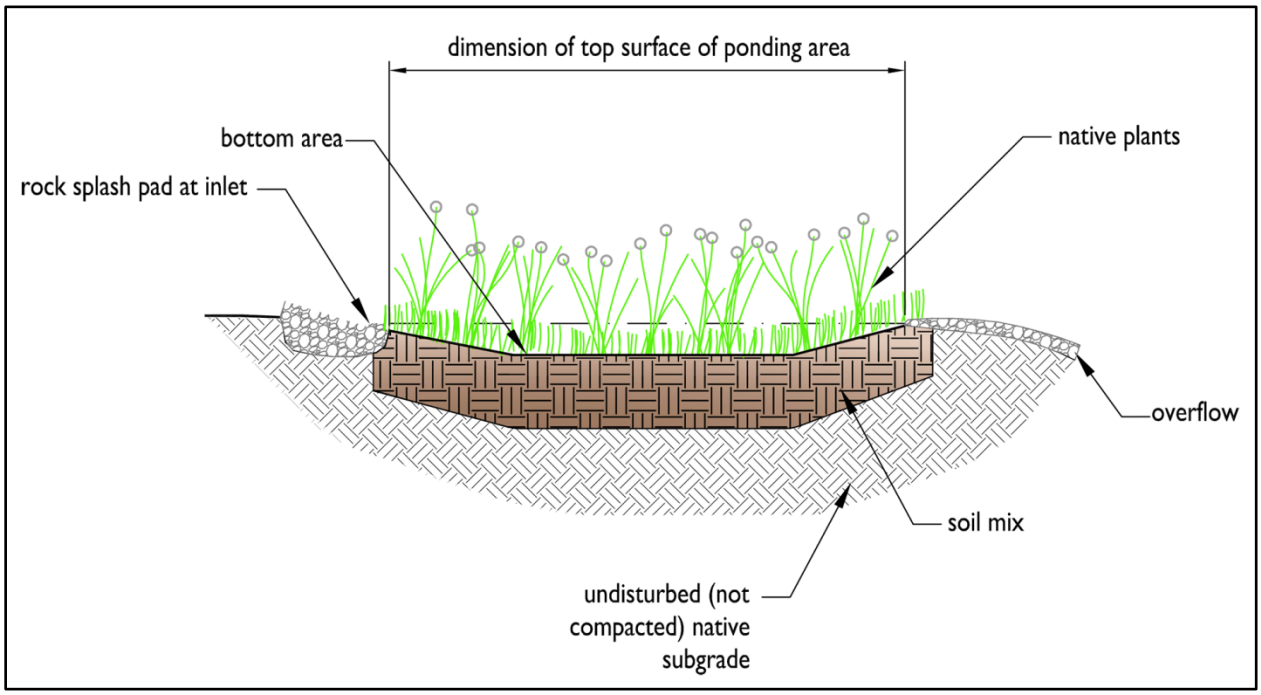


Figure 12: Schematic of Typical Rain Garden

(Source: redrawn from Oregon State University Extension)

Infeasibility

The following criteria describe conditions that make Rain Gardens infeasible to meet Minimum Requirement #5. Citation of any of the infeasibility criteria must be based on an evaluation of site-specific conditions and documented in the LID Feasibility Checklist. Rain Gardens are considered infeasible under the following conditions:

- Where the Responsible Official has determined that the BMP is not compatible with surrounding drainage systems.
- Where the land for the BMP is within an area designated as an erosion hazard or landslide hazard by the geotechnical report or county critical areas mapping.
- Where the site cannot reasonably be designed to locate the BMP on slopes less than 8%.
- On properties with known soil or groundwater contamination (typically federal Superfund sites or state cleanup sites under the Model Toxics Control Act (MTCA)) and any of the following criteria:
    - The proposed BMP is within 100 feet of an area known to have deep soil contamination. [Note: this criterion is also found in Setbacks.]

  - The site is in an area where groundwater modeling indicates infiltration will likely increase or change the direction of the migration of pollutants in groundwater.
  - The proposed BMP is located in an area where surface soils have been found to be contaminated, and contaminated soils are still in place within 10 horizontal feet of the infiltration area.
  - The BMP would be within any area where it would be prohibited by an approved cleanup plan under the state Model Toxics Control Act or Federal Superfund Law, or an environmental covenant under Chapter 64.70 RCW.

- Where the minimum vertical separation of one foot to seasonal high water table, bedrock or other impervious layer cannot be achieved below a Rain Garden.
- Where field testing indicates that soils have a measured (a.k.a. initial) native soil coefficient of permeability less than 0.3 inches per hour. [Note: an LID infiltration BMP may still be feasible with the use of an underdrain to help meet Minimum Requirements #6 or #7, depending on soil and filtration media characteristics.]
- Where the site cannot reasonably be designed to avoid placing the rain garden within setbacks given above.
- Where a professional evaluation demonstrates that any condition below is met:
  - Where a professional geotechnical evaluation recommend infiltration not be used due to reasonable concerns about erosion, slope failure or down gradient flooding.
  - Where the site has groundwater that drains into an erosion hazard or landslide hazard area.
  - Where the only area available for siting the BMP threaten the safety or reliability of pre-existing underground utilities, pre-existing underground storage tanks, pre-existing structures and basements, or pre-existing road or parking lot surfaces.
  - Where infiltrating water would threaten existing below grade basements.
  - Where infiltrating water would threaten shoreline structures such as bulkheads.
  - Where the only area available for siting the BMP is one that does not allow for a safe overflow pathway to the municipal separate storm sewer system or to a private storm sewer system.
  - Where the site is a redevelopment project that lacks usable space.
  - Where the site is a public road project that lacks sufficient space within existing public right-of-way.

Design Criteria

The design criteria and procedures in this section are adapted from the Rain Garden Handbook for Western Washington: A Guide for Design, Installation, and Maintenance (Ecology, 2013). Users may reference the handbook for additional design specifications and construction guidance. If information in the handbook conflicts with information in this manual, the information in this manual shall apply.

Site Considerations

Due to the geologic and topographical conditions in Clark County, not all sites are suitable for rain gardens. A rain garden should not:

1. Be placed over existing utilities. Contact utility locate services in the early design stages.
2. Be located in areas that would require disturbing healthy native soils, trees, and other vegetation—these areas already do a good job of filtering and storing stormwater.
3. Be located where there is high groundwater during the winter. A minimum of one foot of separation is required between the lowest elevation of the rain garden soil or any underlying gravel infiltration layer and the seasonal high groundwater elevation or other impermeable layer.

Pond Area

4. The ponding depth must be 6" minimum and 12" maximum.
5. The pond must have a flat and level bottom.
6. The minimum freeboard measured from the maximum ponding water surface elevation to the top of the facility shall be 2" for drainage areas less than 1,000 square feet and 6" for drainage areas 1,000 square feet or greater.
7. If a berm is used to achieve the minimum top elevation, maximum slope on berm shall be 2H:1V and minimum top width of design berm shall be 1 foot. Berm shall be a material which is water tight. Imported soil may be necessary to ensure berm does not fail. Berm shall be tightly packed during construction.

Sizing Requirement and Procedure

Use this sizing procedure to determine the required area of the top surface of the pond. A rain garden built using this procedure will capture approximately 80% of the water that flows to it.

Size the top surface of the pond by applying a sizing factor determined using the steps below to the total contributing area flowing to the rain garden. If meeting Minimum Requirement #5, in no case shall the sizing factor be less than 5%.

8. Calculate the area of the contributing drainage in square feet.

a. Include all types of surfaces draining to the rain garden including, but not limited to, roofs, driveways, patios, landscaping, and lawn.

9. At the location where the rain garden will be installed, find the infiltration rate of the soil following instructions in Book 1, Section 2.3.1.4. (Note: the *Rain Garden Handbook*, cited above, describes a different procedure for determining soil infiltration rate which is not accepted by Clark County.)

10. Determine the mean annual rainfall at the site (see map at Figure 15).

11. Use Table 1, below, and the information from steps 2 and 3, to determine the sizing factor.

12. Multiply the contributing area and the sizing factor to find the top surface area of the pond (see Figure 14 for an illustration of the top surface of the ponding area).

Table 1: Rain Garden Sizing Factors

Average Annual Precipitation (In.)	**Soil Infiltration Rate**				
	0.10 – 0.24 inches/hour[3]	**0.25 – 0.49 inches/hour[4]**	**0.50 – 0.99 inches/hour**	**1.00 – 2.49 inches/hour**	**2.5 or more inches/hour**
< 30	8%	7%	7%	6%	6%
30 - 40	14%	10%	8%	6%	6%
40 - 50	16%	11%	8%	7%	6%
50 – 70	19%	12%	10%	7%	6%
70 – 90	23%	15%	11%	9%	6%
> 90	28%	18%	13%	10%	7%

[3] At these low drainage rates, the maximum ponding depth is 6 inches. A 12-inch pond will not drain down quickly enough.
[4] If meeting Minimum Requirement #5, a rain garden is not required if the infiltration rate is less than 0.30 inches/hour.

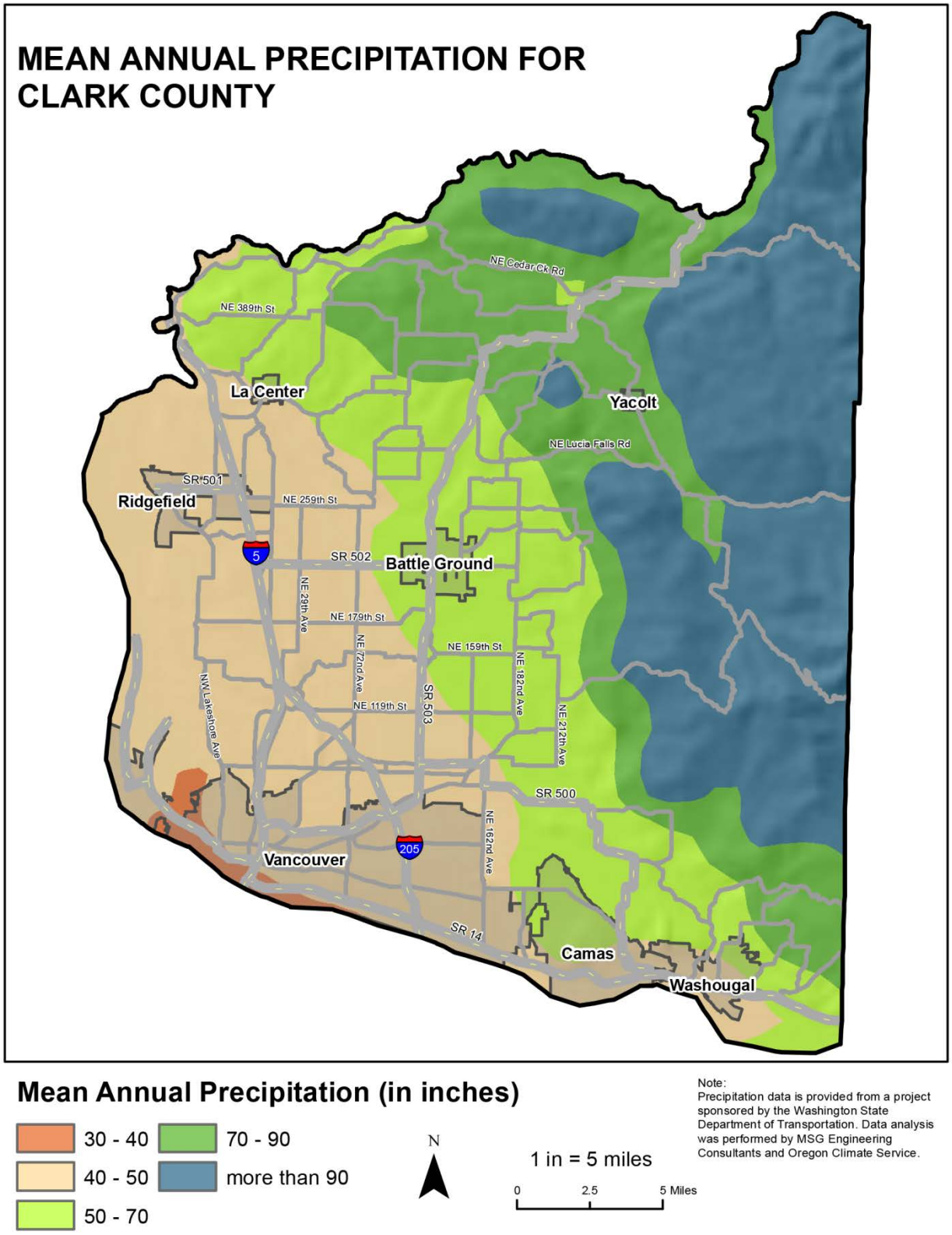


Figure 13: Mean Annual Precipitation in Clark County

Flow Entrances

- Dispersed across a landscaped area. For sheet flow into a rain garden, include at least a 1 inch drop from the edge of the contributing impervious surface. This drop is intended to allow for less frequent maintenance due to sediment/debris buildup.
- Dispersed through an open swale. For slopes greater than 2%, add rock check dams every 5 to 10 feet to slow water flow.
- Pipe flow entrance. Place a rock pad where stormwater enters the rain garden from a swale or pipe. It is recommended to use washed round rock that is a minimum of 2 inches in diameter. Rock pad should be 4" thick and 2 feet wide and extend 2 feet to reduce potential for erosion at the inlet.
- Do not place plants directly in the entrance flow path as they can restrict or concentrate flows.
- Install flow diversion and erosion control measures to protect the rain garden from sedimentation until the upstream area is stabilized.

Overflow

- Provide an overflow pathway lined with a 4" thick washed rock pad. Washed rock shall be a minimum of 2 inches in diameter. Extend overflow 4 feet past rain garden edge.
- Overflow shall not be directed to structures, neighboring properties, or over sidewalks.
- Overflow shall not cause damage to downstream properties or receiving waters.
- The minimum freeboard from the invert of the overflow stand pipe, horizontal drainage pipe or earthen channel shall be 6 inches.

Soil Mix

Rain garden soil mix is the medium that supports plant growth and allows water to infiltrate downward into the undisturbed native subgrade (see Figure 14). Rain garden soil mix is usually a mix of topsoil and compost or sand and compost.

Place rain garden soil mix to a depth of between 12 inches and 24 inches.

There are three methods to achieve a proper rain garden soil mix.

Method 1: Excavate and Replace Soil

Excavate the full depth and replace existing soil with a rain garden soil mix. A rain garden soil mix typically contains about 60% sand and 40% compost by volume.

Use this method if:

- Clay content is greater than 5% (infiltration rate is less than 0.24 inches per hour).

- In gravel soils as plant growth will be inhibited (infiltration rates typically above 2.5 inches per hour).

Method 2: Excavate and Amend Topsoil with Compost

Excavate the rain garden and amend the removed topsoil with compost using 65% excavated soil to 35% compost.

Use this method if soils have a moderate infiltration rate (0.25 to 0.49 inches per hour).

Method 3: Amend Topsoil in Place

Excavate to the ponding depth plus 3 inches. Amend soil in place by spreading 3 inches of compost and tilling to depth of 4 to 5 inches to fully incorporate compost.

Use this option only if the infiltration rate is 1 inch per hour or greater in soil that supports plant growth.

Rain garden soil mixes may be available at local landscape suppliers or nurseries.

Compost

Compost used to amend soils should have the following characteristics:

- Be stable and mature (capable of supporting plant growth) and made from organic waste materials.
- Have an earthy, non-sour smell.
- Be brown to black in color.
- Be a crumbly texture with mixed particle sizes.
- Be a stable temperature. Do not use mushroom compost, un-composted manure, pure bark, biosolids, or sawdust.

Planting

In general, the predominant plant material used in rain gardens are species adapted to stresses associated with wet and dry conditions. Soil moisture conditions will vary within the facility from saturated (bottom of cell) to relatively dry (rim of cell). The minimum requirements associated with the vegetation design include the following:

- The plants must be sited according to sun, soil, wind, and moisture requirements of the plant.
- Plants shall have a maximum mature plant height of 3 feet to minimize the need for extensive pruning that could impact the function of the rain garden in future years.

- Select plants based on suitability for maintenance, including factors such as minimal pruning needs and minimal plant debris (e.g. fruits, bark).
- Minimize plantings around the inlet and outlet to maintain desired water flow.
- At a minimum, provisions must be made for supplemental irrigation during the first two growing seasons following installation.

Table 2: Plant List for Rain Garden*

Moist to Wet Soil Conditions (Facility Bottom to Bottom of Overflow)				
Type	**Botanical Name**	**Common Name**	**O.C. Spacing**	**Allowed ROW****
Herbaceous	*Carex densa*	Dense sedge	12”	Y
~~Herbaceous~~	~~*Carex morrowii*~~	~~Ice Dance~~	~~12”~~	~~Y~~
Herbaceous	*Carex obnupta*	Slough Sedge	12"	N
Herbaceous	*Deschampsia cespitosa*	Tufted Hair Grass	12”	N
Herbaceous	*Juncus patens*	Spreading Rush	12”	Y
Shrub	*Cornus sericea ‘Kelseyii’*	Kelsey Dogwood	24”	Y
Shrub	*Spiraea betulifolia*	Birchleaf Spiraea	24”	N
Shrub	*Spiraea densiflora*	Sub-alpine Spiraea	24”	Y
Shrub	*Spiraea japonica*	Japanese spirea cultivars	24”	Y
Groundcover	*Rubus calcynoides & pentalobus*	Creeping Bramble	12”	N
Accent	*Camassia leichtinii*	Great Camas	12”	N
Accent	*Camassia quamash*	Common Camas	12”	N
~~Tree~~	~~*Acer campestre ‘Evelyn’*~~	~~Elizabeth Hedge Maple~~	~~30’~~	~~Y~~
Tree	*Betula jacquemontii*	Jacquemontii Birch	60’	N
Tree	*Celtis occidentalis*	Hackberry	50’	N
Tree	*Koelreuteria paniculata*	Goldenrain Tree	30’	Y
Tree	*Nyssa sylvatica*	Black tupelo	50’	Y

Tree	*Prunus virginiana 'Canada Red'*	Canada Red Chokecherry	25'	Y
Tree	*Quercus shumardii*	Shumard Oak	70'	Y
Tree	*Rhamnus purshiana*	Cascara	30'	N

Dry Soil Conditions (Overflow and Above)

Type	**Botanical Name**	**Common Name**	**O.C. Spacing**	**Allowed ROW**
Herbaceous	*Deschampsia cespitosa*	Tufted Hair Grass	12"	N
Herbaceous	*Helictotrichon sempervirens*	Blue Oat Grass	12"	Y
Shrub	*Cornus sericea 'Kelseyii'*	Kelsey Dogwood	24"	Y
Shrub	*Euonymous japonicas 'Microphyllus'*	Boxleaf Evergreen	24"	Y
Shrub	*Mahonia aquifolium 'Compacta'*	Oregon Grape	24"	Y
Shrub	*Spiraea betulifolia*	Birchleaf Spiraea	24"	N
Shrub	*Spiraea densiflora*	Sub-alpine Spiraea	24"	Y
Shrub	*Spiraea japonica*	Japanese spirea cultivars	24"	Y
Groundcover	*Arctostapylos uva-ursi*	Kinnickinnick	12"	Y
Groundcover	*Fragaria chiloensis*	Coastal Strawberry	12"	Y
Groundcover	*Mahonia repens*	Creeping Oregon Grape	12"	N
Accent	*Camassia leichtinii*	Great Camas	12"	N
Accent	*Camassia quamash*	Common Camas	12"	N
Tree	*Acer campestre 'Evelyn'*	Elizabeth Hedge Maple	30'	Y
Tree	*Celtis occidentalis*	Hackberry	50'	N
Tree	*Koelreuteria paniculata*	Goldenrain Tree	30'	Y
Tree	*Prunus virginiana 'Canada Red'*	Canada Red Chokecherry	25'	Y
Tree	*Quercus shumardii*	Shumard Oak	70'	Y

Tree	*Rhamnus purshiana*	Cascara	30'	N

Selected plants shall not include any plants from the State of Washington Noxious Weed Board: https://www.nwcb.wa.gov/ and local Clark County Noxious Weed List: https://www.clark.wa.gov/public-works/vegetation-management ~~Refer to www.clark.wa.gov/environmental-services/vegetation-management for a current list of noxious weeds.~~

Also please refer to the State of Washington quarantine list for plants prohibited for sale: https://www.nwcb.wa.gov/noxious-weed-quarantine-list

*Adapted from Portland Bureau of Environmental Services *2014 Stormwater Management Manual*, Appendix F.4., Planting Templates and Plant Lists

** Plant species allowed in Clark County street Rights of Way

Mulch Layer

Rain garden facilities should be designed with a mulch layer. Properly selected mulch material reduces weed establishment, regulates soil temperatures and moisture, and adds organic matter to the soil

- Mulch should be free of weed seeds, soil, roots, and other material that is not trunk or branch wood and bark. Mulch shall not include grass clippings, mineral aggregate, pure bark, or beauty bark. Mulch should be coarse mulch.
- Mulch should be wood chip mulch composed of shredded or chipped hardwood or softwood, depth 2-3 inches. Additional rain garden depth will be needed to ensure appropriate ponding and freeboard.
- A dense groundcover can be used as an alternative to mulch although mulch should be used until the dense groundcover is established.

General Construction Criteria

- Do not install media or excavate rain garden during soil saturation periods.
- Excavation and soil placement should be done from equipment operating adjacent to the facility – no heavy equipment should be operated in the facility to avoid compacting soils
- If equipment must be operated within the facility for excavation, use lightweight, low ground pressure equipment and scarify the base to reduce compaction upon completion. Do not use equipment on top of rain garden soil mix.
- Do not use fully excavated rain garden for erosion and sedimentation control during construction
- Scarify sides and bottom to roughen where equipment may have compacted soil.

- Clogged soil and silt shall be removed during excavation to finished bottom grade prior to installing rain garden soil mix
- Ensure the rain garden is protected from erosion and sedimentation until all contributory areas are fully stabilized.
- If sedimentation occurs within the rain garden, excavate the area a minimum of 12 inches below final grade to remove sediment and replace media, mulch, and plants as necessary.

BMP T5.15: Permeable Pavement

Purpose and Description

Permeable pavements are appropriate in many applications where traditionally impermeable pavements have been used including parking lots, sidewalks, pedestrian and bike trails, driveways, residential access roads, and emergency and facility maintenance roads.

The following are the general categories of permeable paving systems:

- Porous hot or warm-mix asphalt pavement: A flexible pavement similar to standard asphalt, but the fine material is reduced or eliminated, allowing water to infiltrate through voids formed between the aggregate in the pavement surface.
- Pervious Portland cement concrete: A rigid pavement similar to conventional concrete but with the fine aggregate (sand) component reduced or eliminated in the gradation, allowing for infiltration.
- Permeable interlocking concrete pavements (PICP) and aggregate pavers: Solid, precast, manufactured modular units. The solid pavers are (impervious) high-strength Portland cement concrete. Pavements constructed with these units create joints that are filled with permeable aggregates and installed on an open-graded aggregate bedding course. Aggregate pavers (also known as pervious pavers) are distinct from PICPs and include modular precast paving units. The units are made with similar sized aggregates bound together with Portland cement concrete with high-strength epoxy or other adhesives. Like PICP, the joints or openings in the units are filled with open-graded aggregate and placed on an open-graded aggregate bedding course. Aggregate pavers are intended for pedestrian use only.
- Grid systems: Made of concrete or plastic. Both systems can be installed on an open-graded aggregate base as well as a dense-graded aggregate base.

Applications, Limitations and Setbacks

Permeable paving surfaces are an important integrated management practice within the LID approach and can be designed to accommodate pedestrian, bicycle and auto traffic while allowing infiltration, treatment and storage of stormwater.

Limitations

- The Washington State Pollution Control Hearings Board stated in 2014 that permeable pavement is only suitable for "roadways that receive very low traffic volumes and areas of very low truck traffic". This has been interpreted to mean that it's only required to be considered (i.e. review infeasibility criteria) for roadways with an average daily volume of 400 vehicles or less. See infeasibility criteria below.
- No run-on from pervious surfaces is allowed.

- Unless the pavement, base course, and subgrade have been designed to accept runoff from adjacent impervious surfaces, slope impervious runoff away from the permeable pavement to the maximum extent practicable. Sheet flow from up-gradient impervious areas is not recommended, but permissible if the porous surface flow path is greater than the impervious surface flow path.

Setbacks

The following setbacks are required for permeable pavements:

- 50 feet from the top of slopes greater than 20% with more than 10 feet of vertical relief.
- 100 feet from a landfill (active or closed).
- 100 feet from a drinking water well or a spring used for drinking water, if the pavement is a pollution-generating surface.
- 10 feet from on-site sewage drainage.
- 10 feet from an underground storage tank and its connecting pipes that is used to store petroleum products, chemicals, or liquid hazardous waste in which 10% or more of the storage volume of the tank and connecting pipes is beneath the ground.
- 100 feet from an area with known deep soil contamination.

Infeasibility Criteria

The following criteria describe conditions that make Permeable Pavement infeasible to meet Minimum Requirement #5. Citation of any of the infeasibility criteria must be based on an evaluation of site-specific conditions and documented in the LID Feasibility Checklist. Permeable Pavement is considered infeasible under the following conditions:

- Roadways and parking areas where projected average daily traffic volumes are greater than 400 vehicles.
- At multi-level parking garages, and over culverts and bridges.
- Where the site design cannot avoid putting pavement in areas likely to have long-term excessive sediment deposition after construction (e.g., construction and landscaping material yards).
- Within an area designated as an erosion hazard or landslide hazard.
- On properties with known soil or groundwater contamination (typically federal Superfund sites or state cleanup sites under the Model Toxics Control Act (MTCA)) and any of the following criteria:
    - The proposed BMP is within 100 feet of an area known to have deep soil contamination. [Note: this criterion is also a Setback.]
    - The site is in an area where groundwater modeling indicates infiltration will likely

increase or change the direction of the migration of pollutants in groundwater.

- The proposed BMP is located in an area where surface soils have been found to be contaminated, and contaminated soils are still in place within 10 horizontal feet of the infiltration area.
- The BMP would be within any area where it would be prohibited by an approved cleanup plan under the state Model Toxics Control Act or Federal Superfund Law, or an environmental covenant under Chapter 64.70 RCW.

- Where the site cannot be designed to have a porous asphalt surface at less than 5% slope, or a pervious concrete surface at less than 10% slope, or a permeable interlocking concrete pavement surface (where appropriate) at less than 12% slope. Grid systems upper slope limit can range from 6 to 12%; check with manufacturer and local supplier.
- Where the native soils below a pollution-generating permeable pavement (e.g., road or parking lot) do not meet the soil suitability criteria for providing treatment (Book 1, Section 3.1.5.3).
- Where seasonal high groundwater or an underlying impermeable/low permeable layer would create saturated conditions within one foot of the bottom of the lowest gravel base course.
- Where underlying soils are unsuitable for supporting traffic loads when saturated. Soils meeting a California Bearing Ratio of 5% are considered suitable for residential access roads.
- Where measured coefficient of permeability is less than 0.3 inches per hour. In these instances, unless other infeasibility restrictions apply, roads and parking lots may be built with an underdrain, preferably elevated within the base course, if flow control benefits are desired.
- Where replacing existing impervious surfaces, unless the existing surface is a non-pollution generating surface over a soil with a coefficient of permeability of four inches per hour or greater.
- At sites defined as "high-use sites" as defined in Book 1, Appendix 1-A.
- In areas with "industrial activity" as identified in 40 CFR 122.26(b)(14).
- Where the risk of concentrated pollutant spills is more likely such as gas stations, truck stops, and industrial chemical storage sites.
- Where routine, heavy applications of sand occur in frequent snow zones to maintain traction during weeks of snow and ice accumulation. Most lowland western Washington areas do not fit this criterion.
- Where the surface(s) to be paved are within setbacks given in Section 3.9.4.
- Where a professional evaluation demonstrates any condition listed below is met:
  - Where professional geotechnical evaluation recommends infiltration not be used due to reasonable concerns about erosion, slope failure, or down gradient flooding.
  - Where the site has groundwater that drains into an erosion hazard or landslide hazard area.

- Where infiltrating and ponded water below new permeable pavement area would compromise adjacent impervious pavements.
- Where infiltrating water below a new permeable pavement area would threaten existing below grade basements.
- Where infiltrating water would threaten shoreline structures such as bulkheads.
- Downslope of steep, erosion prone areas that are likely to deliver sediment.
- Where fill soils are used that can become unstable when saturated.
- Where there are excessively steep slopes and water within the aggregate base layer or at the sub-grade surface cannot be controlled by detention structures and may cause erosion and structural failure, or where surface runoff velocities may preclude adequate infiltration at the pavement surface.
- Where permeable pavements cannot provide sufficient strength to support heavy loads (such as at ports).
- Where installation of permeable pavement would threaten the safety or reliability of pre-existing underground utilities, pre-existing underground storage tanks, or pre-existing road sub-grades.

Figure 14: Permeable pavement application

(Source: Vancouver McCord's Toyota)

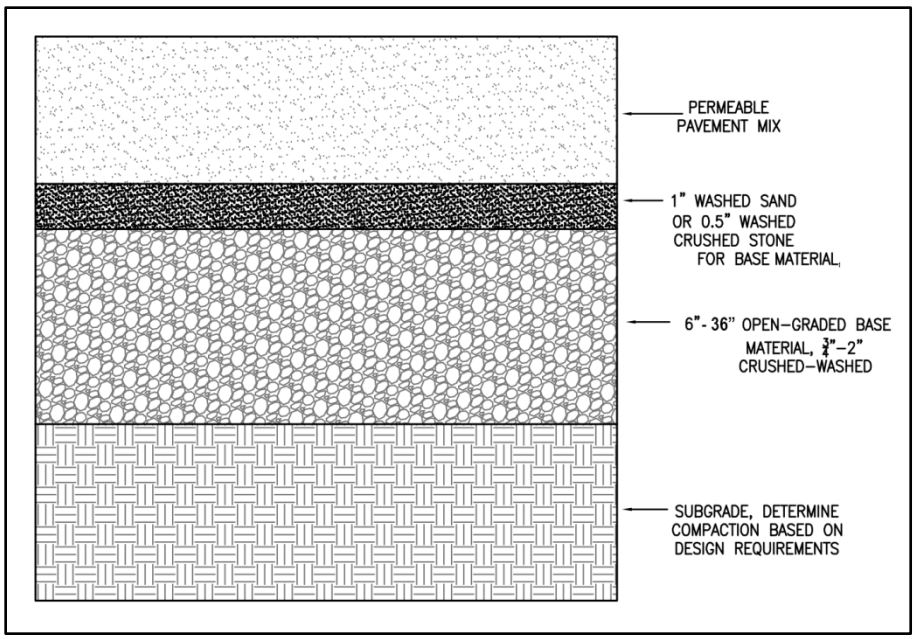


Figure 15: Permeable Pavement typical section

(Source: redrawn from City of Portland)

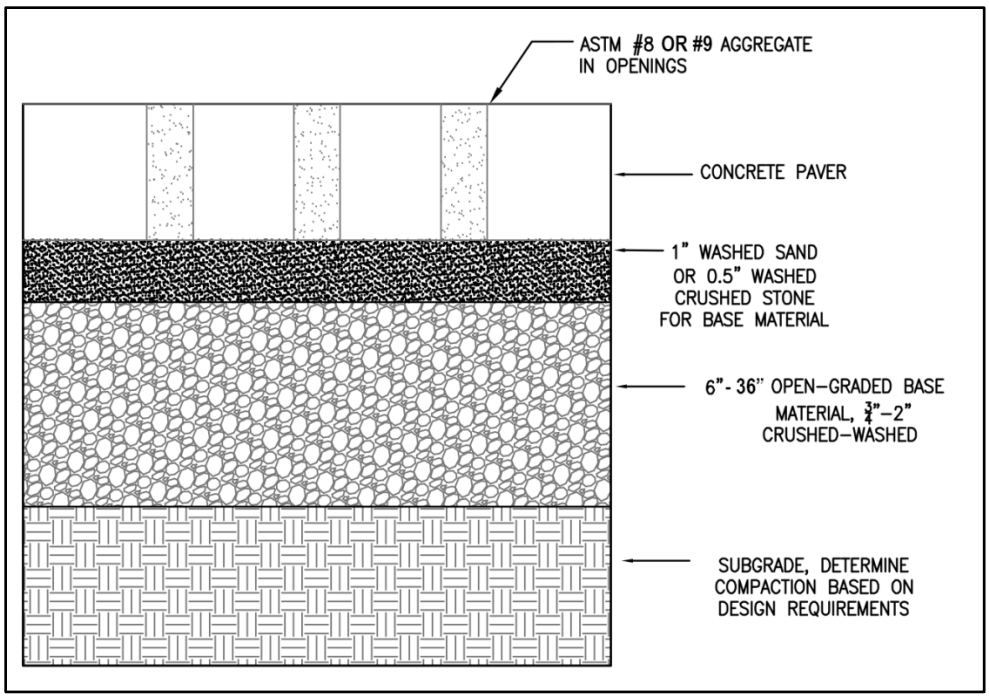


Figure 16: Permeable Pavement typical section of pavers

(Source: redrawn from City of Portland)

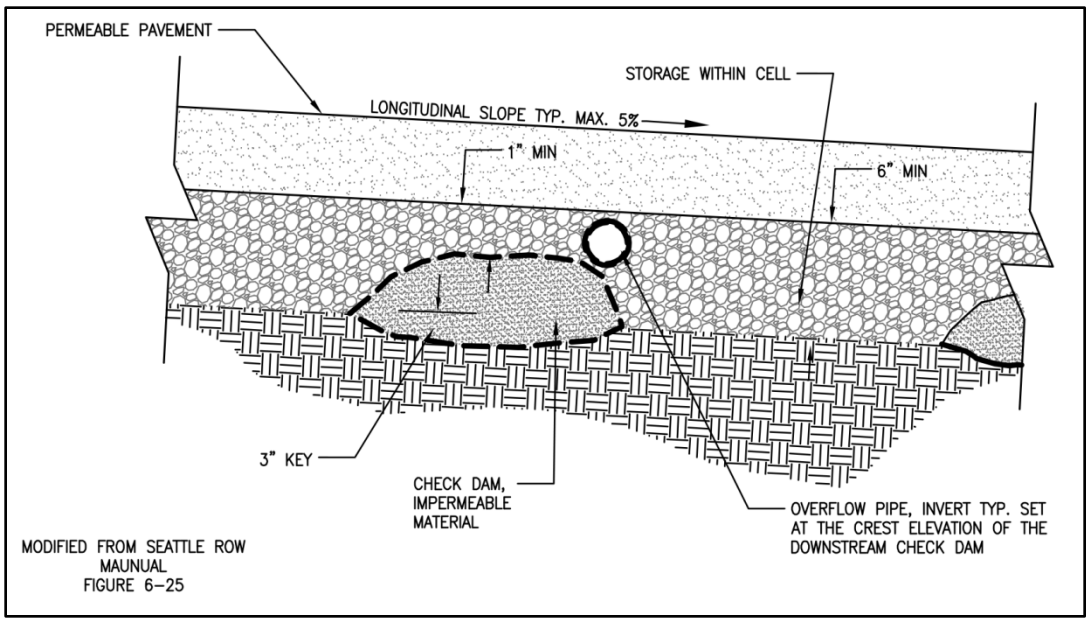


Figure 17: Permeable Pavement check dam for sloped pavement

(Source: modified from SMMWW)

Refer to the LID Technical Guidance Manual (Puget Sound Partnership, 2012) for additional information on permeable pavements. Note that where information in the guidance manual conflicts with information in this manual, the information in this manual must be used.

Design Criteria

Estimation of Long-Term Infiltration Rates

- The infiltration rate shall be determined using the testing procedures described in Book 1, Section 2.3.1.3, with an additional correction factor ranging from 0.9 to 1.0 based on the quality of the aggregate base material.

Contributing Area

- Minimizing the contributing area is preferable since run-on from adjacent surfaces can lead to clogging and reduce long-term performance of permeable pavements. Some stormwater discharge from other surfaces is acceptable if:
    - Sediment is not introduced to the subgrade or pavement surface.
    - The additional flow does not exceed the long-term infiltration capacity of the subgrade or pavement surface.

Subgrade

- The subgrade should be compacted to the minimum extent necessary for structural stability, including the following recommendations:
    - On sites where topsoil is removed and native sub-soil is exposed, no compaction may be required.
    - For areas with heavy truck traffic, some compaction may be necessary for stability.
    - Guidelines used to specify subgrade compaction are "firm and unyielding" (qualitative), and 90- 92% Standard Proctor (quantitative).
- Prevent compaction when installing the aggregate base by:
    - Dumping the aggregate base onto the subgrade from the edge of the installation and then push the aggregate out onto the subgrade.
    - Dumping subsequent loads from on top of the aggregate base as the installation progresses.
- Relative uniformity of subgrade conditions is important to prevent differential settling.

Separation or Bottom Filter Layer (Recommended but Optional)

- A 0.5 inch (or smaller) layer of sand or crushed stone graded allows for infiltration across the surface, stabilization of the base layer and protection of underlying soil from compaction. This layer can also serve as a transition between the base course and the underlying geotextile material.

Wearing Layer

- A minimum initial infiltration rate of 20 inches per hour is necessary. To improve the probability of long-term performance, significantly higher initial infiltration rates are desirable.
- Porous Asphalt: Must have adequate void spaces for infiltration. A void space within the range of 16 – 25% is typical.
- Pervious Concrete: A void space within the range of 15 – 35% is typical
- Grid/lattice systems filled with gravel, sand, or a soil of finer particles with or without grass: The fill material must be at least a minimum of 2 inches of sand, gravel, or soil.
- Permeable Interlocking Concrete Pavement and Aggregate Pavers: Pavement joints should be filled with No. 8 or 9 stone.

Geotextile

- For all permeable pavement systems, geotextile material must line the sides to prevent soil intrusion if concrete curbs or other types of impermeable liners do not extend to the full depth of the base material. The geotextile material should follow the manufacturer's specifications and

recommendations of the project geotechnical engineer for the particular subgrade soil and aggregate base being used.

- Geotextiles are not allowed between the permeable pavement system and subgrade because of their tendency to clog.
- Geogrids can also be used for subgrade reinforcement at the recommendation of a geotechnical engineer.

Membrane Liners and Barriers

- Membrane liners and barriers are recommended to reduce sidewall soil movement and reduction of infiltration capacity, and to protect adjacent, densely-graded subgrade material from migrating onto the aggregate base. 30 mil PVC membranes are generally used.

Storage Reservoir/Aggregate Base

- The aggregate base material should be composed of larger material (1.5-2.5 inches).
- Smaller stone may be used between the larger stones.
- Void space should be 20-40%.
- Aggregate base depth should be 6-36 inches, depending on pavement type, design and storage requirements.

Drainage conveyance

Roads should still be designed with adequate drainage conveyance facilities as if the road surface was impermeable. Roads with base courses that extend below the surrounding grade should have a designed drainage flow path to safely move water away from the road prism and into the roadside drainage facilities. Use of perforated storm drains to collect and transport infiltrated water from under the road surface will result in less effective designs and less flow reduction benefit.

Membrane Liners and Barriers

Membrane liners and barriers are recommended to reduce sidewall soil movement and reduction of infiltration capacity, and to protect adjacent, densely-graded subgrade material from migrating onto the aggregate base. 30 mil PVC membranes are generally used.

Underdrain (Optional)

If an underdrain is needed to protect the pavement wearing course from saturation, then the invert of the underdrain must be elevated at least 6 inches within the aggregate base course.

Permeable interlocking concrete pavements (PICP) Seed Mix

Seed mix within the grids for PCIP shall be as follows:

Table 3: PCIP Seed Mix

Botanical Name	Common Name	% By Weight
Festuca rubra 'Chewings'	Chewings fescue	25.00%
Lolium perenne	perennial rye grass	75.00%
TOTAL		100.00%

Quality Control and Acceptance Testing

- County to inspect subgrade prior to installation of base material
- Driveways can be tested by simply throwing a bucket of water on the surface. If anything other than a scant amount puddles or runs off the surface, additional testing is necessary prior to accepting the construction.
- Roads may be initially tested with the bucket test. In addition, test the initial infiltration with a 6-inch ring, sealed at the base to the road surface, or with a sprinkler infiltrometer. Wet the road surface continuously for 10 minutes. Begin test to determine compliance with 20 inches per hour minimum rate. Use of ASTM C1701 is also recommended.

BMP T5.10C: Downspout Dispersion

Purpose and Description

Downspout dispersion systems are splash blocks or gravel-filled trenches, which serve to spread roof runoff over vegetated pervious areas. These BMPs reduce peak flows and provide some infiltration and water quality benefits. Downspout dispersion may use a dispersion trench or a splashblock.

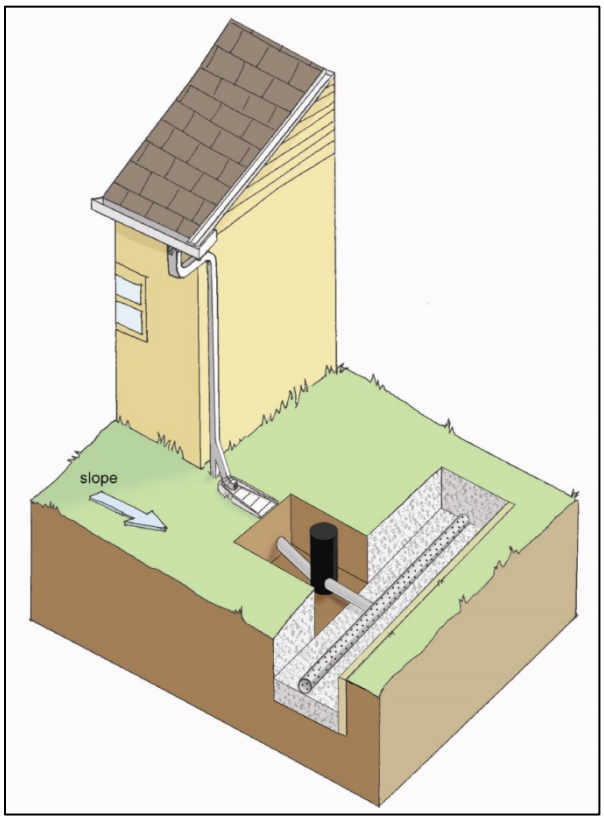


Figure 18: Illustration of Downspout Dispersion Trench

Applications, Limitations and Setbacks

Downspout dispersion where feasible, must be used in lots where downspout full infiltration, full dispersion, and bioretention/rain gardens are not feasible.

Setbacks

- 10 feet from any sewage disposal drainfield, including reserve areas and grey water reuse systems.
- 100 feet upgradient from any septic system unless site topography clearly indicates that subsurface flows will not intersect the drainfield.

- 10 feet from any structure, property line, or sensitive area.
- 50 feet from the top of any slope over 15%. This setback may be reduced to 15 feet based on a geotechnical evaluation.

Infeasibility Criteria

The following criteria describe conditions that make Downspout Dispersion infeasible to meet Minimum Requirement #5. Citation of any of the infeasibility criteria must be based on an evaluation of site-specific conditions and documented in the LID Feasibility Checklist. Downspout Dispersion is considered infeasible under the following circumstances:

- The BMP cannot be designed within the setbacks listed above.

Design Criteria

Dispersion Trenches

- A vegetated flow path of at least 25 feet shall be maintained between the outlet of the trench and any property line, structure, stream, wetland, or impervious surface.
- A vegetated flow path of at least 50 feet in length shall be maintained between the outlet of the trench and any slope steeper than 15%. Sensitive area buffers may count towards flow path lengths.
- Trenches serving up to 700 square feet of roof area shall be at least 10 feet long by 2 feet wide.
- For roof areas larger than 700 square feet, a dispersion trench with notched grade board or alternative material approved by Clark County may be used. The total length of this design shall not exceed 50 feet and shall provide at least 10 feet of trench length per 700 square feet of roof area.
- No erosion or flooding of downstream properties may result.

Splashblocks

- A vegetated flowpath of at least 50 feet shall be maintained between the discharge point and any property line, structure, slope steeper than 15%, stream, wetland, lake, or other impervious surface. Sensitive area buffers may count toward flowpath lengths.
- Each splashblock shall drain a maximum area of 700 square feet.
- For purposes of maintaining adequate separation of flows discharged from adjacent dispersion devices, the vegetated flowpath segment for the splashblock shall not overlap with other flowpath segments, except those associated with sheet flow from a constructed pervious surface.
- A splashblock or a pad of crushed rock (2 feet wide by 3 feet long by 6 inches deep) shall be placed at each downspout discharge point.
- No erosion or flooding of downstream properties shall result.

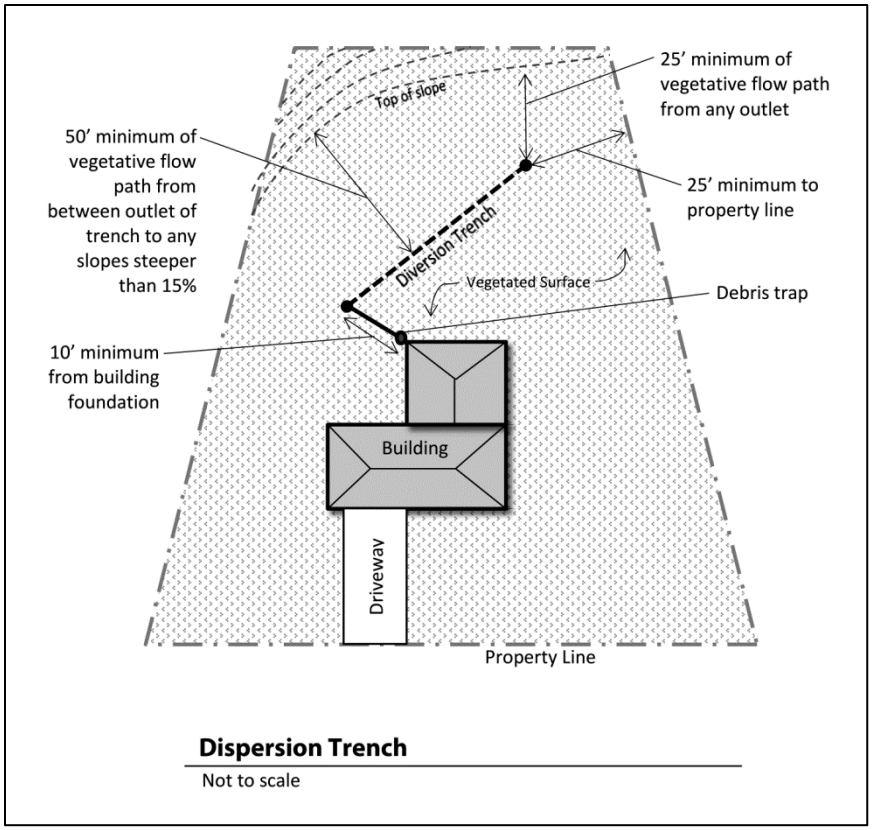


Figure 19: Typical Dispersion Trench Site Plan

(Source: Clark County)

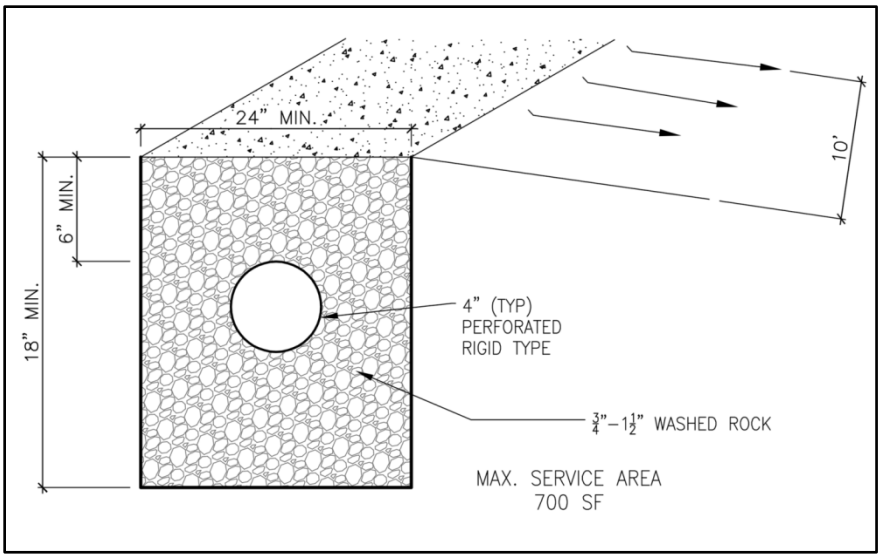


Figure 20: Downspout Dispersion Trench Cross-Section

(Source: modified from Department of Ecology)

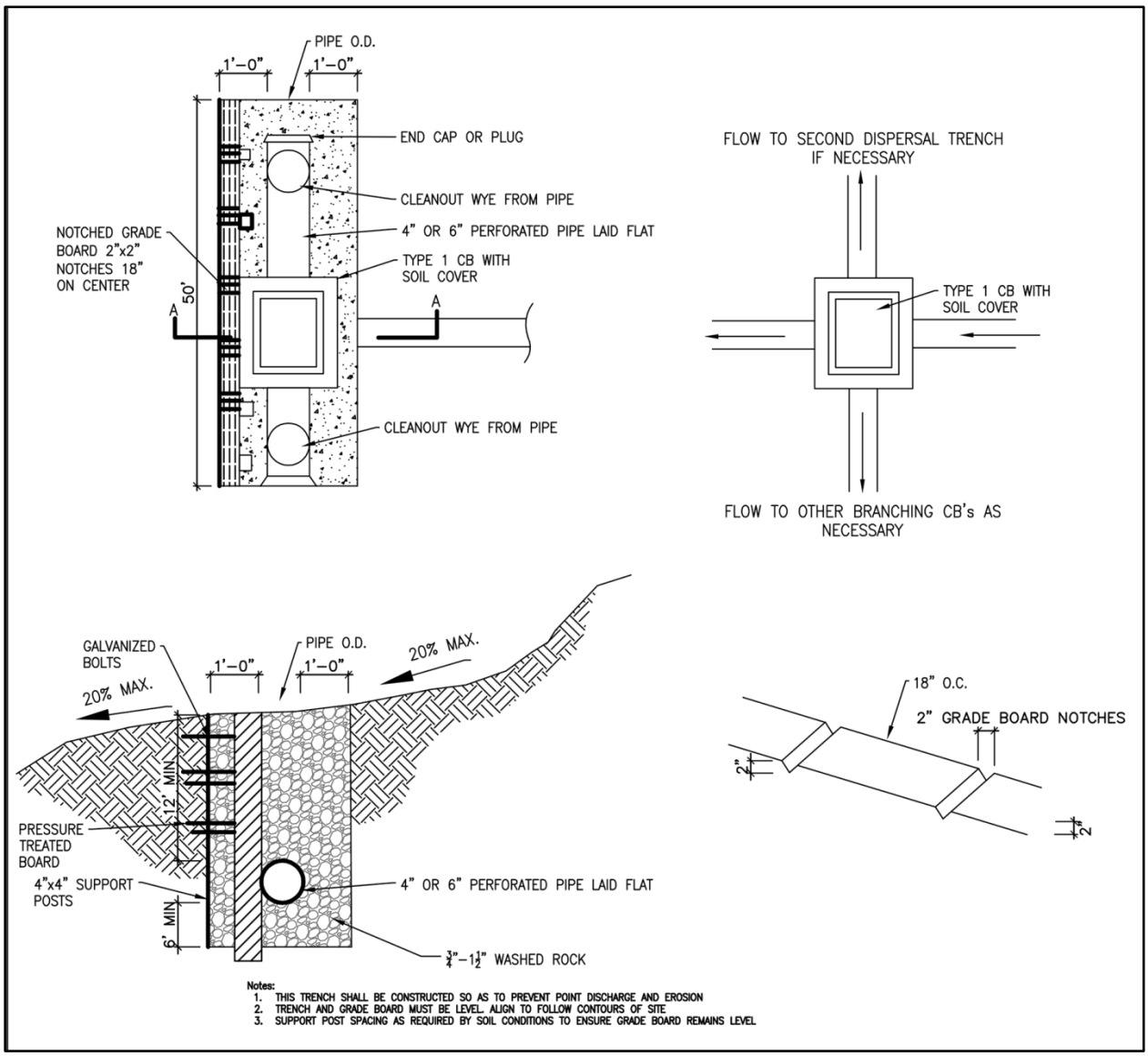


Figure 21: Dispersion Trench with Notched Grade Board

(Source: modified from Department of Ecology)

Splashblocks

- A vegetated flow path of at least 50 feet shall be maintained between the discharge point and any property line, structure, slope steeper than 15%, stream, wetland, lake, or other impervious surface. Sensitive area buffers may count toward flow path lengths.
- Each splashblock shall drain a maximum area of 700 square feet.
- For purposes of maintaining adequate separation of flows discharged from adjacent dispersion devices, the vegetated flow path segment for the splashblock shall not overlap with other flow path segments, except those associated with sheet flow from a constructed pervious surface.

- A splashblock or a pad of crushed rock (2 feet wide by 3 feet long by 6 inches deep) shall be placed at each downspout discharge point.
- No erosion or flooding of downstream properties shall result.

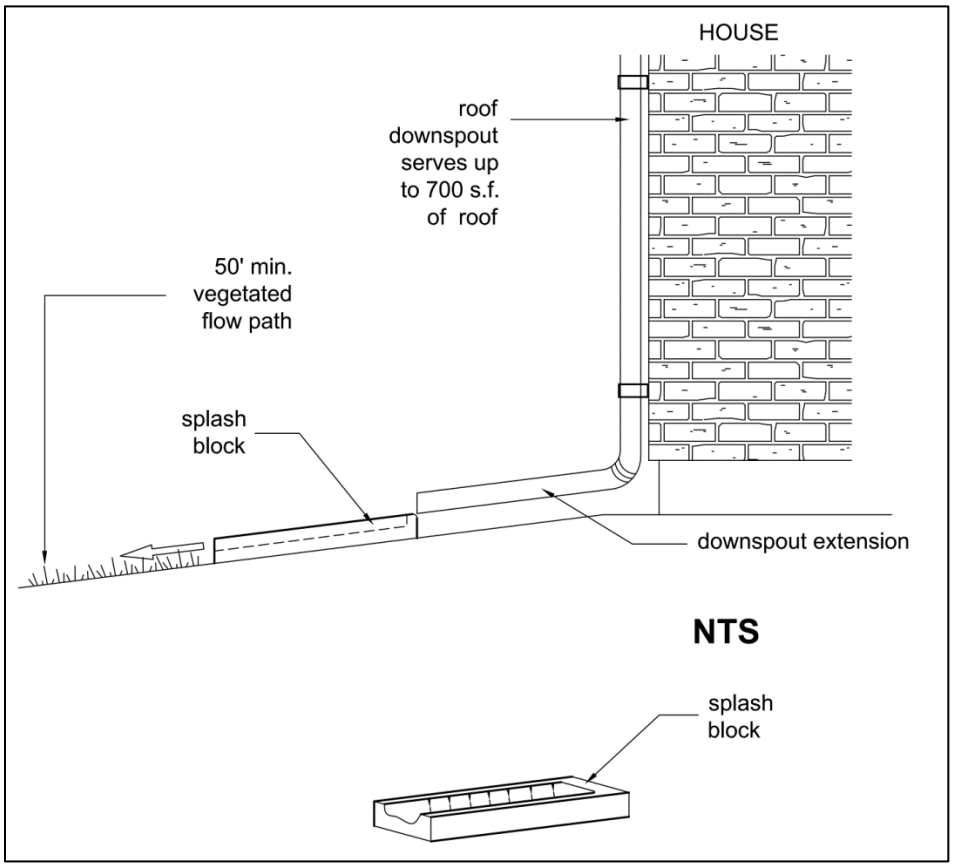


Figure 22: Typical Splashblock

(Source: redrawn from King County Surface Water Design Manual 2009)

BMP T5.12: Sheet Flow Dispersion

Purpose and Description

Sheet flow dispersion is the simplest method of runoff control. This BMP can be used for any impervious or pervious surface that is graded to avoid concentrating flows. Because flows are already dispersed as they leave the surface, they need only to traverse a narrow band of adjacent vegetation for effective attenuation and treatment.

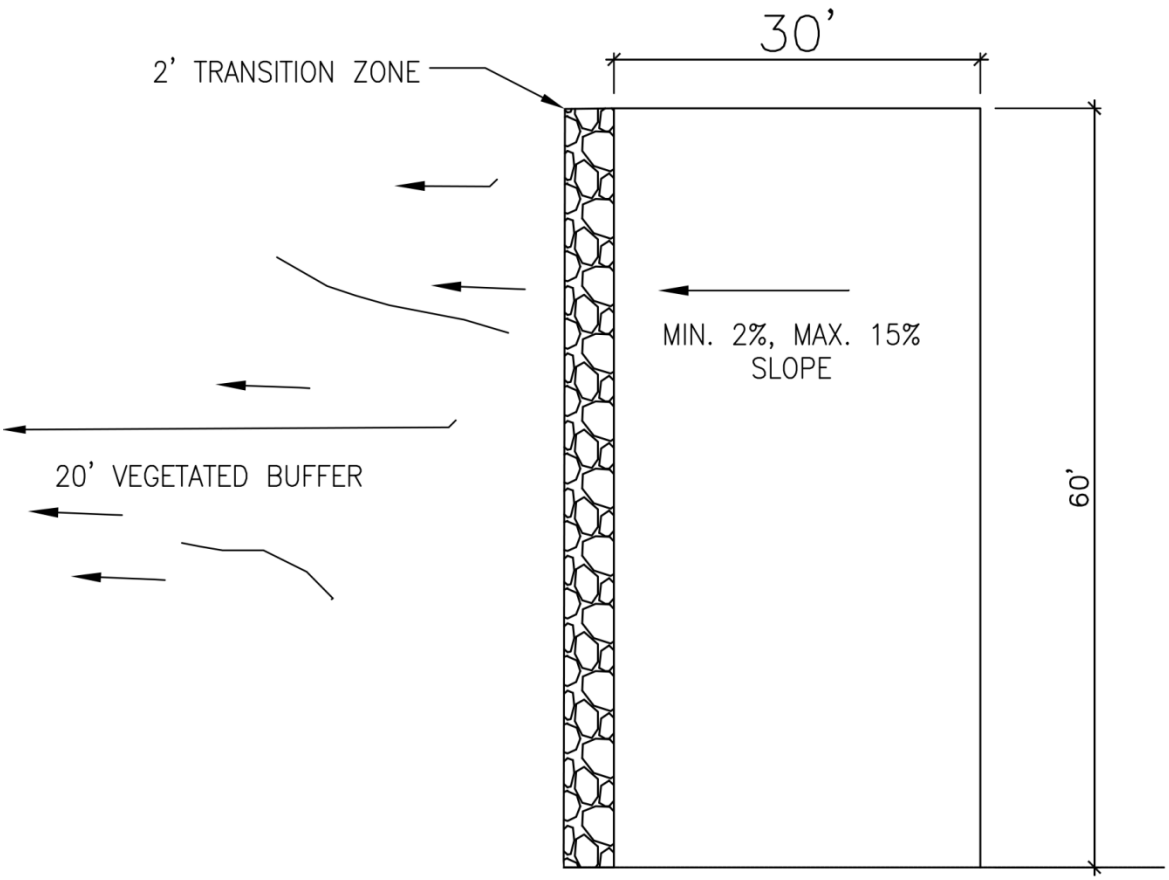


Figure 23: Sheet Flow Dispersion for Flat and Moderate Sloped Surfaces

(Source: Clark County)

Applications, Limitations and Setbacks

Sheet Flow Dispersion is used on flat or moderately sloping (< 15% slope) surfaces such as driveways, sports courts, patios, roofs without gutters, lawns, pastures; or any situation where concentration of flows can be avoided.

Setbacks

- 100 feet upgradient from any septic system unless site topography clearly indicates that subsurface flows will not intersect the drainfield.
- 10 feet from any structure, property line, or sensitive area.
- 50 feet from a geohazard area per CCC 40.430.

Infeasibility

The following criteria describe conditions that make Sheet Flow Dispersion infeasible to meet Minimum Requirement #5. Citation of any of the infeasibility criteria must be based on an evaluation of site-specific conditions and documented in the LID Feasibility Checklist. Sheet Flow Dispersion is considered infeasible under the following conditions:

- Where a professional geotechnical evaluation recommends dispersion not be used due to reasonable concerns about erosion, slope failure or down gradient flooding.
- Where the only location available for the discharge location is up gradient of a septic system.
- Where the only area available for the required length of the BMP's flowpath is above an erosion hazard, toward a landslide hazard area, or on a slope greater than 20% and when a professional geotechnical engineer recommends dispersion not be used in these areas.
- Where the only area available to place the dispersion device (not the flowpath), if applicable to the BMP, is located in a critical area or critical area buffer.
- Where the only area available to place the dispersion device (not the flowpath), if applicable to the BMP, is located on a slope greater than 20% or within 50 feet of a geohazard (CCC 40.430) area.

Design Criteria

- A 2 foot-wide transition zone shall be maintained (to discourage channeling between the edge of the impervious surface and the downslope vegetation). This transition zone may consist of an extension of subgrade material (crushed rock), modular pavement, drain rock, or other material approved by Clark County.
- The sheet flow dispersion area must abut the entire edge of the impervious area being treated by the BMP.

- A 10 foot vegetated flow path must be provided for each 20 feet of impervious surface. For each additional 20 feet of impervious surface or fraction thereof, an additional 10 feet of vegetated flow path must be provided. For example, if a driveway is 30 feet wide and 60 feet long provide a 20-foot wide by 60-foot long vegetated buffer, with a 2-foot by 60-foot transition zone. See Figure 25.
- No erosion or flooding of downstream properties shall result.
- Runoff discharge toward landslide hazard areas must be evaluated by a geotechnical engineer or a qualified geologist.
- Sheet flow dispersion shall not be allowed on or above slopes greater than 20%, or above erosion hazard areas, without evaluation by a geotechnical engineer or qualified geologist and approval by Clark County.
- For sites with septic systems, the discharge area shall be at least 10 feet below the elevation of the drainfield primary and reserve areas. Clark County may waive this requirement during plan approval if site topography clearly prohibits flows from intersecting the drainfield.

BMP T5.11: Concentrated Flow Dispersion

Purpose and Description

Concentrated flow dispersion BMPs disperse concentrated flows from driveways or other pavements through a vegetated, pervious area. These BMPs reduce peak flows by slowing entry of the runoff into the downstream conveyance system, allowing for some infiltration, and providing some water quality benefits.

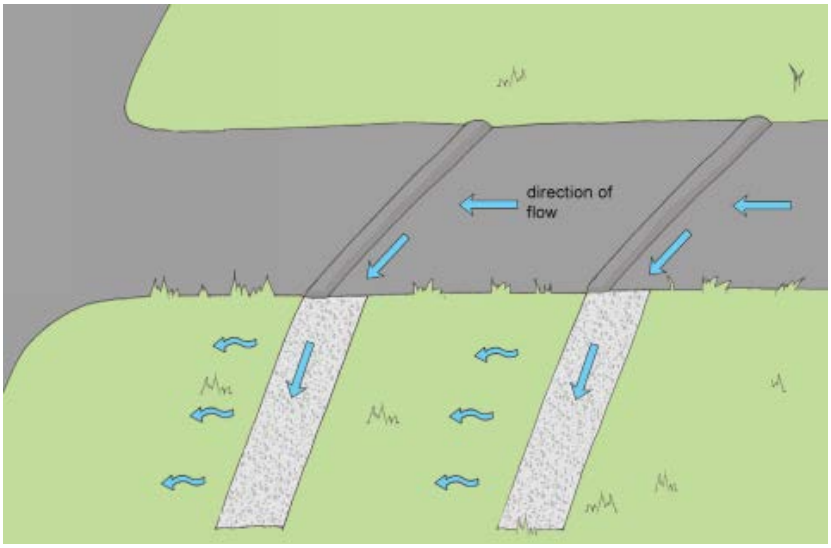


Figure 24: Illustration of Driveway Dispersion Using Berms and Dispersion Trenches

Applications, Limitations and Setbacks

Use this BMP in any situation where concentrated flow can be dispersed through the required length of vegetation.

Setbacks

- 100 feet upgradient from any septic system unless site topography clearly indicates that subsurface flows will not intersect the drainfield.
- 10 feet from any structure, property line, or sensitive area.
- 50 feet from a geohazard area per CCC 40.430.

Infeasibility

The following criteria describe conditions that make concentrated flow dispersion infeasible to meet Minimum Requirement #5. Citation of any of the infeasibility criteria must be based on an evaluation of site-specific conditions and documented in the LID Feasibility Checklist. Dispersion to pasture or cropland is considered infeasible under the following conditions:

Dispersion BMPs listed above are considered infeasible under the following conditions:

- Where a professional geotechnical evaluation recommends dispersion not be used due to reasonable concerns about erosion, slope failure or down gradient flooding.
- Where the only location available for the discharge location is up gradient of a septic system.
- Where the only area available for the required length of the BMP's flowpath is above an erosion hazard, toward a landslide hazard area, or on a slope greater than 20% and when a professional geotechnical engineer recommends dispersion not be used in these areas.
- Where the only area available to place the dispersion device (not the flowpath), if applicable to the BMP, is located in a critical area or critical area buffer.
- Where the only area available to place the dispersion device (not the flowpath), if applicable to the BMP, is located on a slope greater than 20% or within 50 feet of a geohazard (CCC 40.430) area.

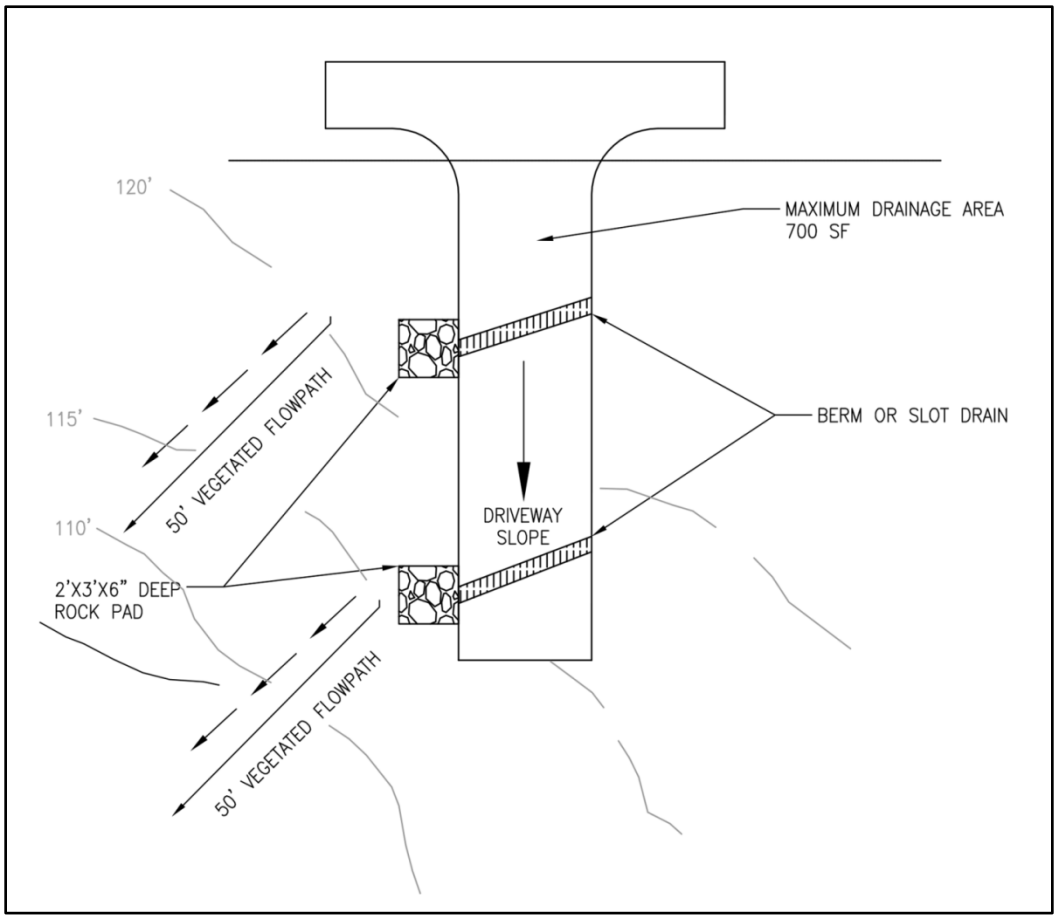


Figure 25: Concentrated Flow Dispersion Using Rock Pad

(Source: Clark County)

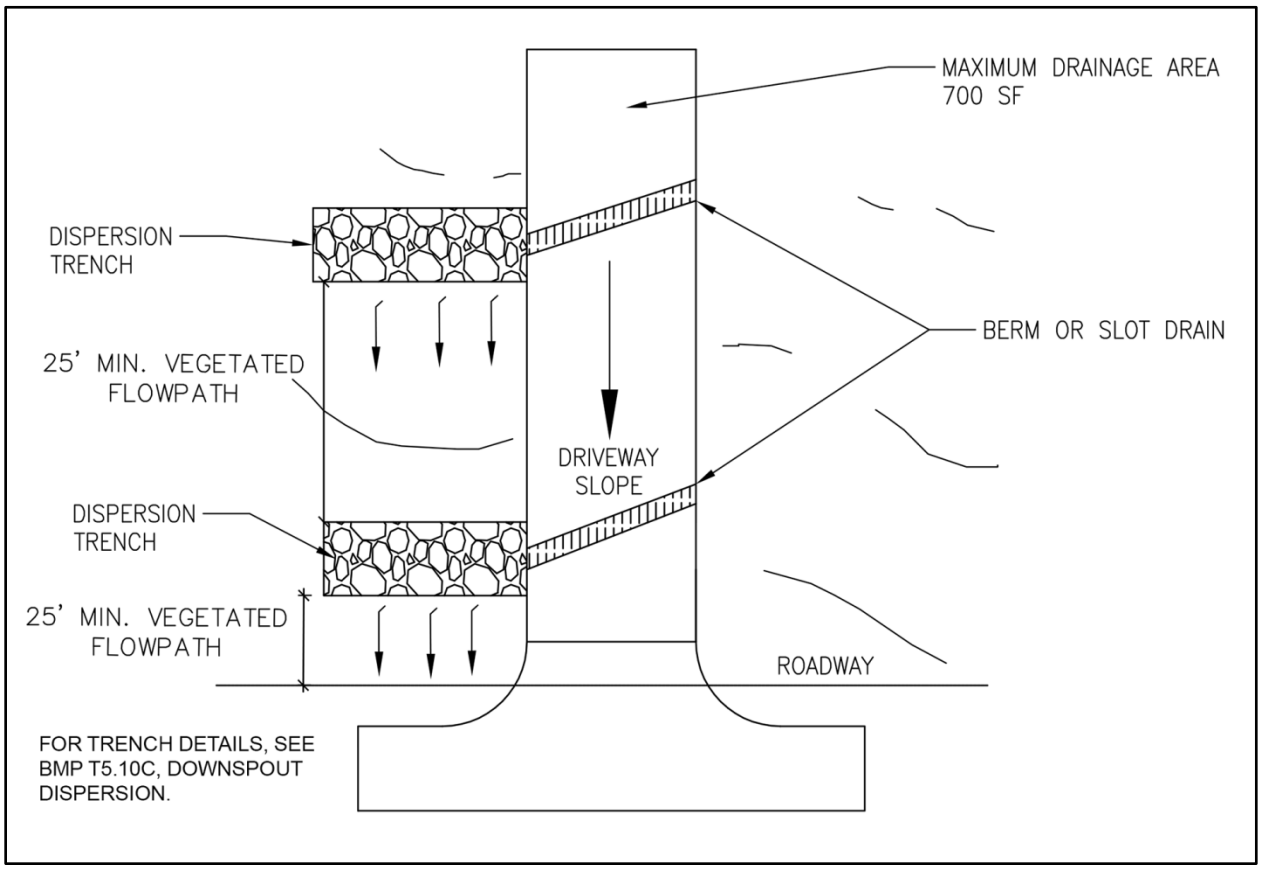


Figure 26: Concentrated Flow Dispersion Using Dispersion Trench

(Source: Clark County)

Design Criteria

- Each Concentrated Flow Dispersion BMP can serve a drainage area up to 700 square feet.
- A vegetated flow path of at least 50 feet shall be maintained between the discharge point and any property line, structure, steep slope (>20%), stream, lake, wetland, lake, or other impervious surface, unless a dispersion trench is used.
- When a dispersion trench per BMP T5.10C is used, the vegetated flow path described above can be reduced to 25 feet. A pad of crushed rock (a minimum of 2 feet wide by 3 feet long by 6 inches deep) shall be placed at each discharge point unless a dispersion trench per BMP T5.10C is being used.
- No erosion or flooding of downstream properties shall result.
- Any runoff discharged towards landslide hazard areas shall be evaluated by a geotechnical engineer or qualified geologist. The discharge point shall not be placed on or above slopes

greater than 20%, or above erosion hazard areas, without evaluation by a geotechnical engineer or qualified geologist and approval by Clark County.

- For sites with septic systems, the discharge point must be at least ten feet below the elevation of the drainfield primary and reserve areas. Clark County may waive this requirement during plan approval if site topography clearly prohibits flows from intersecting the drainfield.

BMP T5.10D: Perforated Stub-out Connections

Purpose and Definition

A perforated stub-out connection is a length of perforated pipe within a gravel-filled trench that is placed between roof downspouts and a stub-out to the local drainage system. These BMPs provide some infiltration during drier months. During the wet winter months, they may provide little or no flow control.

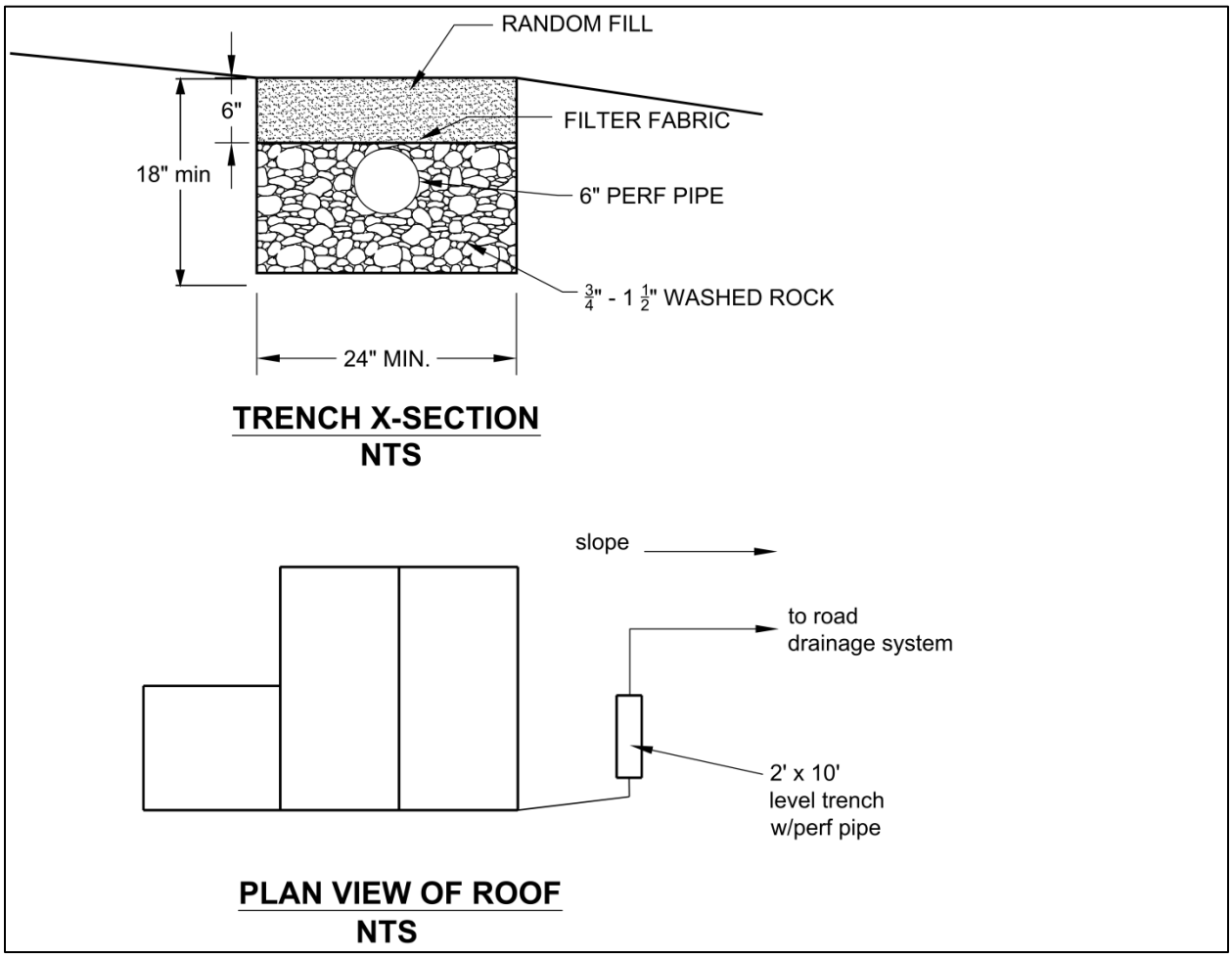


Figure 27: Typical Perforated Stub-out Connection

(Source: King County Surface Water Design Manual 2009)

Applications, Limitations and Setbacks

In projects subject to Minimum Requirement #5 perforated stub-out connections may be used only when all other higher priority on-site stormwater management BMPs are not feasible, per the criteria for each of those BMPs.

Perforated stub-outs cannot be used when the seasonal water table is less than one foot below trench bottom.

A perforated stub-out may also be used where implementation of downspout dispersion might cause erosion or flooding problems, either on site or on adjacent lots.

Select the location of the connection to allow a maximum amount of runoff to infiltrate into the ground (ideally a dry, relatively well drained, location). To facilitate maintenance, do not locate the perforated pipe portion of the system under impervious or heavily compacted (e.g., driveways and parking areas) surfaces.

Have a licensed geologist, hydrogeologist, or engineering geologist evaluate potential runoff discharges towards landslide hazard areas. Do not place the perforated portion of the pipe on or above slopes greater than 20% or above erosion hazard areas without evaluation by a professional engineer with geotechnical expertise or qualified geologist.

For sites with septic systems, the perforated portion of the pipe must be downgradient of the drainfield primary and reserve areas. This requirement can be waived if site topography will clearly prohibit flows from intersecting the drainfield or where site conditions (soil permeability, distance between systems, etc.) indicate that this is unnecessary.

Setbacks

Setbacks shall be the same as for downspout infiltration trenches provided in BMPT5.10A.

Infeasibility

The following criteria describe conditions that make perforated stub-out connections infeasible to meet Minimum Requirement #5. Citation of any of the infeasibility criteria must be based on an evaluation of site-specific conditions and documented in the LID Feasibility Checklist. Perforated stub-out connection is considered infeasible under the following conditions:

- When the seasonal water table is less than one foot below the trench bottom.

Design Criteria

- The BMP must have at least 10 feet of perforated pipe per 5,000 square feet of roof area, laid in a level, 2-foot wide trench backfilled with washed drain rock.
- The drain rock shall be extended to a depth of at least 8 inches below the bottom of the pipe and shall cover the pipe.
- The rock trench shall be covered with filter fabric and 6 inches of fill.

Section 10 — Erosion and Sediment Control BMPs

Use the BMP design criteria and illustrations in this section to select and design BMPs temporary erosion and sediment control.

BMP C101: Preserving Natural Vegetation

Purpose and Description

Preserving trees, brush and ground cover helps reduce erosion generated by a project. Phasing a project to preserve vegetation reduces the need for erosion and sediment controls. In addition, proper preservation of trees and vegetation limit potential for windthrow, preserves the interception of rainfall on the site, and protects root zones that hold the soil in place.

Conditions of Use

Native vegetation must be preserved to the extent feasible on steep slopes, near perennial and intermittent watercourses or swales, and on building sites in wooded areas.

All projects are subject to Clark County Critical Areas Protection requirements under Title 40 of the Clark County Code (CCC).

Design Criteria

- Phase construction to preserve trees, brush, and ground cover on the project site for as long as possible during the construction period.
- Fence or clearly mark areas around native vegetation and existing trees that are designated to be saved.

For Trees to be Preserved

- Identify the critical root zone for trees to be protected (within the drip line). Place a protective fence just outside the dripline, add colored flagging if necessary to increase visibility of fence;
- No construction activities shall take place within a vegetation's critical root zone, including storage of materials, parking of vehicles or placement of utilities;
- Do not alter the soil grade within the critical root zone of the vegetation; placement of mulch in the critical root zone will help protect the vegetation during construction;
- Avoid cuts to roots within the critical root zone. If the utility trenches are necessary, tunnel under the root and then carefully backfill to original grade as soon as possible.
- Do not place fill greater than six inches within the dripline of trees to be saved.
- Cut as few tree roots as possible, and cut cleanly when cutting cannot be avoided. Paint cut root ends with a wood dressing like asphalt base paint if roots will be exposed for more than 24-hours.
- Backfill trench near tree roots as soon as possible.

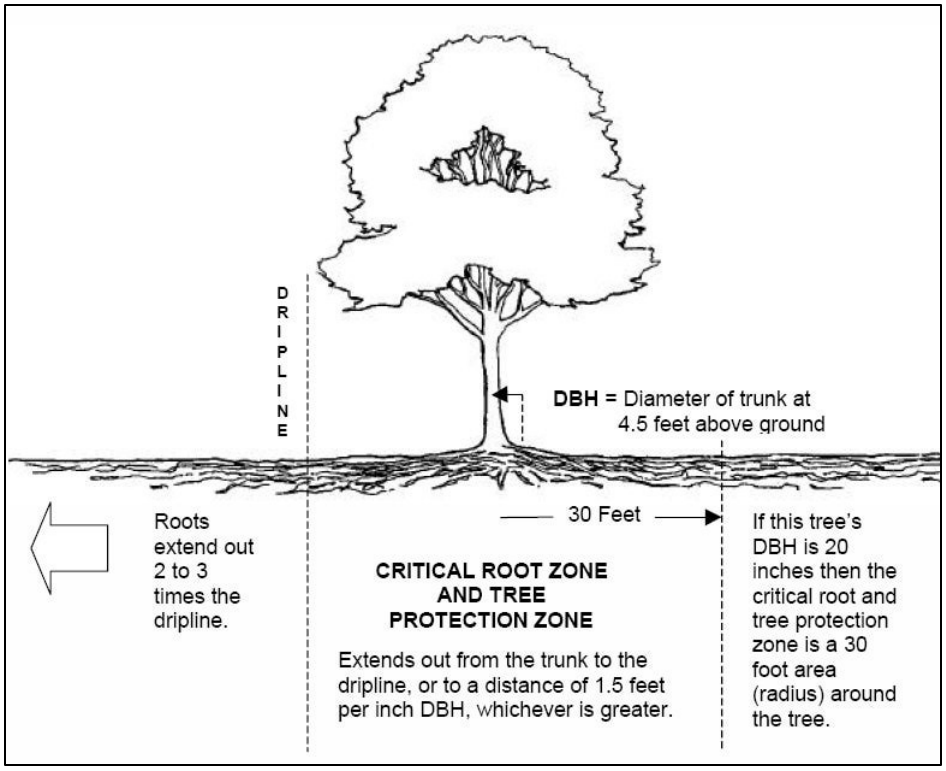


Figure 28: Illustration of Tree's Critical Root Zone

(Source: Athens/Clark County, Georgia)

See Stormwater Management Manual for Western Washington (Ecology, ~~2014~~2019) Volume II, pages Res-4 and Res-5 for more information on protecting specific trees species from injuries.

Maintenance Standards

Inspect flagged and/or fenced areas regularly to make sure flagging or fencing has not been removed or damaged. If the flagging or fencing has been damaged or visibility reduced, repair or replace it immediately and visibility restored.

If tree roots have been exposed or injured, "prune" cleanly with an appropriate pruning saw or loppers directly above the damaged roots and cover with native soils. Treatment of sap flowing trees (fir, hemlock, pine, soft maples) is not advised as sap forms a natural healing barrier.

Inspect protected vegetation at completion of construction. Document and repair any damage to the areas, including the addition of mulch to protect the root zone.

BMP C102: Buffer Zones

Purpose and Description

Reduce soil erosion and runoff velocities by creating an undisturbed area or strip of natural vegetation or establishing a suitable planting.

Conditions of Use

Natural buffer zones are used along streams, wetlands and other bodies of water that need protection from erosion and sedimentation. Vegetative buffer zones not designated as critical areas can be used to protect natural swales and can be incorporated into the natural landscaping of an area.

Critical-areas, including wetland buffer zones as described in Title 40, shall remain completely undisturbed and must not be used as sediment treatment areas.

Design Criteria

- Preserve native vegetation or plantings in clumps, blocks, or strips where feasible.
- Leave all unstable steep slopes along watercourses in existing vegetation.
- Mark clearing limits with high-visibility fence, and keep all equipment and construction debris out of the critical habitat areas, natural areas to be preserved, and wetland buffer zones.
- Keep all excavations outside the dripline of trees and shrubs.
- Do not push debris or extra soil into the buffer zone area.

Maintenance Standards

Inspect the area frequently to make sure fencing remains in place and the area remains undisturbed.

BMP C103: High Visibility Fence

Purpose and Description

Use high-visibility plastic or metal fencing to restrict clearing to approved limits; protect wetlands, streams, and other areas required to be left undisturbed; and limit construction traffic to the designated entrance.

Conditions of Use

Appropriate for all sites.

Design Criteria

High visibility plastic fence shall be composed of a high-density polyethylene material and shall be at least four feet in height. Posts for the fencing shall be steel or wood and placed every 6 feet on center (maximum) or as needed to ensure rigidity. The fencing shall be fastened to the post every six inches with a polyethylene tie. On long continuous lengths of fencing, a tension wire or rope shall be used as a top stringer to prevent sagging between posts. The fence color shall be high visibility orange. The fence tensile strength shall be 360 lbs./ft. using the ASTM D4595 testing method.

If appropriate install fabric silt fence in accordance with BMP C233 to act as high visibility fence. Silt fence shall be at least 3 feet high and must be highly visible to meet the requirements of this BMP.

Metal fences shall be designed and installed according to the manufacturer's specifications. Metal fences shall be at least 3 feet high and must be highly visible.

Fences shall not be wired or stapled to trees.

Maintenance Standards

If the fence has been damaged or visibility reduced, it shall be repaired or replaced immediately and visibility restored.

BMP C105: Stabilized Construction Entrance / Exit

Purpose and Description

Stabilized construction entrances are established to reduce the amount of sediment transported onto paved roads by vehicles or equipment.

Conditions of Use

Use on all construction sites where traffic will be entering or leaving the site if paved roads or other paved areas are within 1,000 feet of the site.

Design Criteria

- Limit vehicle access to the site to one entrance/exit.
- Stabilize access points with a 12-inch thick pad of two-inch diameter gravel, four-inch diameter quarry spalls, or coarse crushed rock.
- Entrance must be wide enough for construction vehicles and the maximum practical length for the site.

Figure 29: Small-scale Construction Entrance

Maintenance Standards

- If the entrance is not preventing sediment from being tracked onto pavement, then replace or clean gravel/quarry spall or increase the dimensions of the entrance.
- Shoveling or street sweeping any sediment that gets tracked onto the adjacent road. Do not hose down the street.
- Immediately remove any quarry spalls or gravel that end up on the roadway.

BMP C121: Mulching

Purpose and Description

Placing mulch over exposed soils provides immediate temporary protection from erosion. Mulch also enhances plant establishment by conserving moisture, holding fertilizer, seed, and topsoil in place, and moderating soil temperatures.

Conditions of Use

As a temporary cover measure, mulch should be used:

- For less than 30 days on disturbed areas that require cover.
- At all times on seeded areas.
- During the wet season on slopes steeper than 3H:1V with more than 10 feet of vertical relief.

Mulch may be applied at any time of the year and must be refreshed periodically.

Design Criteria

Apply mulch to a thickness of 2 inches or sufficient thickness so that the ground is not visible under the mulch layer, whichever is greater. The Responsible Official may require increased thickness on disturbed areas in or near sensitive areas or other areas highly susceptible to erosion.

The following materials are allowed as mulch.

Chipped Site Vegetation

- Apply a minimum thickness of 2" chipped site vegetation
- Do not use on slopes greater than 10%
- Do not use within 200 feet of surface water

Straw

- Apply a minimum thickness of 2-3" or 5 bales per 1,000 sq. ft.
- Straw must be certified weed-free
- If wind may blow straw away, then cover with netting
- Do not apply with the high water mark of a stream, pond, or lake
- May be applied by blowing, if a tackifier is used

Coarse Compost

Where the option of "Compost" is selected, it should be a coarse compost that meets the following size gradations when tested in accordance with the U.S. Composting Council "Test Methods for the Examination of Compost and Composting" (TMECC) Test Method 02.02-B.

- Minimum Percent passing 3" sieve openings 100%
- Minimum Percent passing 1" sieve openings 90%
- Minimum Percent passing ¾" sieve openings 70%
- Minimum Percent passing ¼" sieve openings 40%.

For seeded areas mulch may be made up of 100 percent: cottonseed meal; fibers made of wood, recycled cellulose, hemp, kenaf; compost; or blends of these.

Hog Fuel

- Must be purchased from a supplier with a Solid Waste Handling Permit or one exempt from solid waste regulations
- Apply approximately 800 lbs. per cubic yard

Wood Strand Mulch

- A minimum of 95-percent of the wood strand shall have lengths between 2 and 10-inches, with a width and thickness between 1/16 and ⅜-inches.
- The mulch shall not contain resin, tannin, or other compounds in quantities that would be detrimental to plant life.
- Sawdust or wood shavings shall not be used as mulch

Maintenance Standards

- The thickness of the cover must be maintained.
- Any areas that experience erosion shall be remulched and/or protected with a net or blanket. If the erosion problem is drainage related, then the problem shall be fixed and the eroded area remulched.

BMP C123: Plastic Covering

Purpose and Description

Plastic covering provides immediate, short-term erosion protection to slopes and disturbed areas.

Figure 30: Covering a Stockpile

Conditions of Use

Plastic covering may be used on disturbed areas that require cover measures for less than 30 days, except as stated below.

Plastic is particularly useful for protecting cut and fill slopes and stockpiles. Note: The relatively rapid breakdown of most polyethylene sheeting makes it unsuitable for long-term (greater than six months) applications.

- Due to rapid runoff caused by plastic covering, do not use this method upslope of areas that might be adversely impacted by concentrated runoff. Such areas include steep and/or unstable slopes.
- Plastic sheeting may result in increased runoff volumes and velocities, requiring additional on-site measures to counteract the increases. Creating a trough with wattles or other material can convey clean water away from these areas.
- To prevent undercutting, trench and backfill rolled plastic covering products.
- While plastic is inexpensive to purchase, the added cost of installation, maintenance, removal, and disposal make this an expensive material, up to $1.50-2.00 per square yard.
- Whenever plastic is used to protect slopes install water collection measures at the base of the slope. These measures include plastic-covered berms, channels, and pipes used to covey clean rainwater away from bare soil and disturbed areas. Do not mix clean runoff from a plastic covered slope with dirty runoff from a project.

Design Criteria

Plastic slope cover must be installed as follows:

1. Run plastic up and down slope, not across slope.
2. Plastic may be installed perpendicular to a slope if the slope length is less than 10 feet.
3. Minimum of 8-inch overlap at seams.
4. On long or wide slopes, or slopes subject to wind, tape all seams.
5. Place plastic into a small (12-inch wide by 6-inch deep) slot trench at the top of the slope and backfill with soil to keep water from flowing underneath.
6. Place sand filled burlap or geotextile bags every 3 to 6 feet along seams and tie them together with twine to hold them in place.
7. Inspect plastic for rips, tears, and open seams regularly and repair immediately. This prevents high velocity runoff from contacting bare soil which causes extreme erosion.
8. Sandbags may be lowered into place tied to ropes. However, all sandbags must be staked in place.

- Plastic sheeting shall have a minimum thickness of 0.06 millimeters.
- If erosion at the toe of a slope is likely, a gravel berm, riprap, or other suitable protection shall be installed at the toe of the slope in order to reduce the velocity of runoff.

Maintenance Standards

- Torn sheets must be replaced and open seams repaired.
- Completely remove and replace the plastic if it begins to deteriorate due to ultraviolet radiation.
- Completely remove plastic when no longer needed.

BMP C150: Materials on Hand

Purpose and Description

Keep erosion prevention and sediment control materials on the project site at all times to be used for regular maintenance and emergency situations such as unexpected heavy summer rains.

Conditions of Use

- Construction projects of any size or type can benefit from having materials on hand. If storage space at the project site is at a premium, the contractor could maintain the materials at their office or yard, provided that the office or yard is less than an hour from the project site.
- Materials are stockpiled and readily available before any site clearing, grubbing, or earthwork begins.

Design Criteria

The following is a good minimum list of items that will cover numerous situations includes:

- Clear Plastic, 6mil
- Sandbags, filled
- Straw bales for mulching
- Quarry spalls or washed gravel
- Silt fence material
- Straw wattles or bio-filter bags

Maintenance Standards

- Store materials under cover and out of sun and rain.
- Re-stock materials used as needed.

BMP C151: Concrete Handling

Purpose and Description

Proper handling and disposal of excess concrete, concrete process water, and concrete slurry prevents these materials from entering waters of the state. Discharge of concrete materials to the County storm drainage system and surface water is a violation of County code and state law.

Conditions of Use

Any time concrete is used, utilize these management practices.

Design Criteria

- Assure that washout of concrete trucks, chutes, pumps, and internals is performed at an approved off-site location. Do not wash out concrete trucks onto the ground, or into storm drains, open ditches, streets, or streams.
- Return unused concrete remaining in the truck and pump to the originating batch plant for recycling. Do not dump excess concrete on site.
- Wash off hand tools such as screeds, shovels, rakes, floats, and trowels into a lined portable concrete washout container. Dispose of contained concrete in a manner that does not violate groundwater or surface water quality standards, and dispose of concrete process water as wastewater.
- Always use forms or solid barriers for concrete pours, such as pilings, within 15-feet of surface waters.

Maintenance Standards

Check containers for holes in the liner daily during concrete pours and repair the same day.

BMP C160: Certified Erosion and Sediment Control Lead (CESCL)

Purpose and Description

The project proponent designates at least one person as the responsible representative in charge of erosion and sediment control (ESC), and water quality protection. The designated person shall be the Certified Erosion and Sediment Control Lead (CESCL) who is responsible for ensuring compliance with all local, state, and federal erosion and sediment control and water quality requirements.

Conditions of Use

The CESCL shall:

- Have a current certificate proving attendance in an erosion and sediment control training course that meets the minimum ESC training and certification requirements established by Ecology (see details below). Ecology will maintain a list of ESC training and certification providers at: http://www.ecy.wa.gov/programs/wq/stormwater/cescl.html.

OR

- Be a Certified Professional in Erosion and Sediment Control (CPESC); for additional information go to: www.cpesc.net.

Specifications

- The CESCL shall have authority to act on behalf of the contractor or developer and shall be available, or on-call, 24 hours per day throughout the period of construction.

Duties and responsibilities of the CESCL shall include, but are not limited to the following:

- Maintaining the erosion control plan and the erosion control log on site.
- Directing BMP installation, inspection, maintenance, modification, and removal.
- Keeping daily logs, and inspection reports.

BMP C203: Water Bars

Purpose and Description

A small ditch or ridge of material is constructed diagonally across a road, driveway, or right-of-way to divert stormwater runoff from the road surface, wheel tracks, or a shallow road ditch.

Conditions of Use

Give special consideration to each individual outlet area, as well as to the cumulative effect of added diversions. Use gravel to stabilize the diversion where significant vehicular traffic is anticipated.

Design Criteria

Height: 8-inch minimum measured from the channel bottom to the ridge top.

- Side slope of channel: 2H:1V maximum; 3H:1V or flatter when vehicles will cross.
- Base width of ridge: 6-inch minimum.
- Locate them to use natural drainage systems and to discharge into well-vegetated stable areas.

Guideline for Spacing:

Slope %	**Spacing (ft)**
< 5	125
5 - 10	100
10 - 20	75
20 - 35	50
> 35	Use rock lined ditch

- Grade of water bar and angle: Select angle that results in ditch slope less than 2 percent.
- Install as soon as the clearing and grading is complete. Reconstruct when construction is complete on a section when utilities are being installed.
- Compact the ridge when installed.
- Stabilize, seed and mulch the portions that are not subject to traffic. Gravel the areas crossed by vehicles.

Maintenance Standards

Periodically inspect right-of-way diversions for wear and after every heavy rainfall for erosion damage.

- Immediately remove sediment from the flow area and repair the dike.
- Check outlet areas and make timely repairs as needed.
- When permanent road drainage is established and the area above the temporary right-of-way diversion is permanently stabilized, remove the dikes and fill the channels to blend with the natural ground and appropriately stabilize the disturbed area.

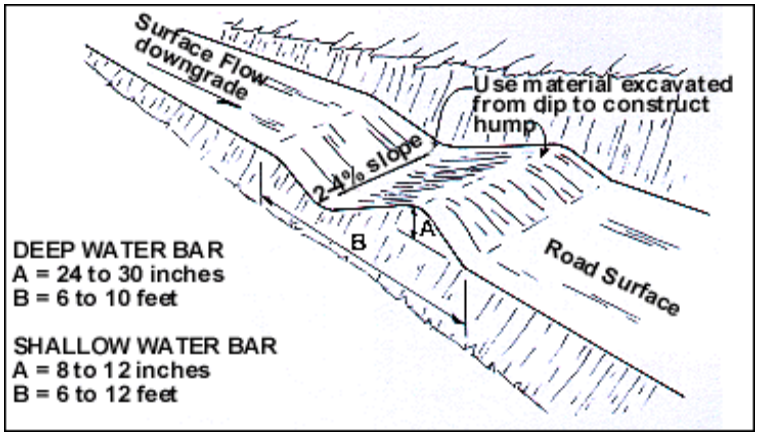


Figure 31: Water Bar

(Source: SMMWW)

BMP C207: Check Dams

Purpose and Description

Small dams across a swale or ditch reduce the velocity of concentrated flow and dissipate energy at the check dam.

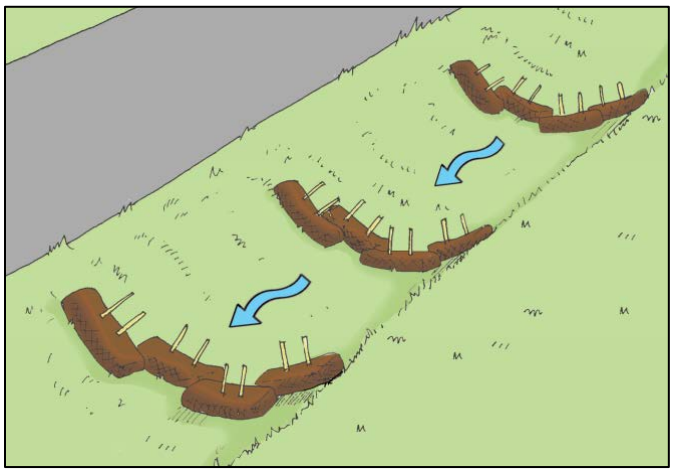


Figure 32: Illustration of Check Dams

Conditions of Use

Where temporary channels or permanent channels are not yet vegetated, channel lining is infeasible, and/or velocity checks are required.

Design Criteria

Materials

- Construct rock check dams from appropriately sized rock. The rock used must be large enough to stay in place when water is flowing through the channel.
- Check dams may also be constructed of bags filled with gravel or bio-filter bags.

Placement

- Do not place check dams below the expected backwater from any salmonid bearing water between October 1 and May 31 to ensure that there is no loss of high flow refuge habitat for overwintering juvenile salmonids and emergent salmonid fry.
- Place check dams perpendicular to the flow of water.
- The maximum spacing between the dams shall be such that the toe of the upstream dam is at the same elevation as the top of the downstream dam.

Shape and Size

- A rock dam should form a triangle when viewed from the side. This prevents undercutting as water flows over the face of the dam rather than falling directly onto the ditch bottom.
- Keep the maximum height at 2 feet at the center of the dam.
- Keep the center of the check dam at least 12 inches lower than the outer edges at natural ground elevation.
- Keep the side slopes of the check dam at 2H:1V or flatter.

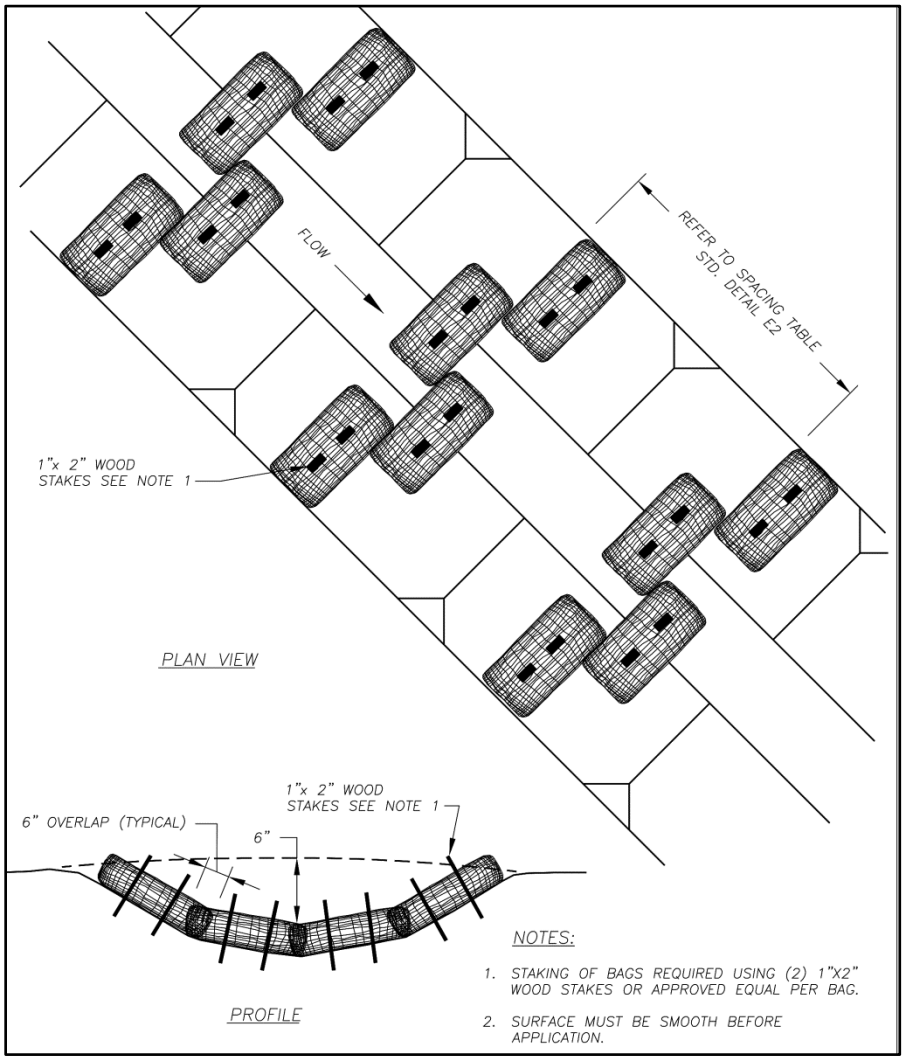


Figure 33: Check Dam using Bio-filter Bags

(Source: Clark County)

Installation

- Before installing check dams impound and bypass upstream water flow away from the work area. Options for bypassing include pumps, siphons, or temporary channels.
- Check dams in association with sumps work more effectively at slowing flow and retaining sediment than just a check dam alone. A deep sump should be provided immediately upstream of the check dam.
- Key the stone into the ditch banks and extend it beyond the abutments a minimum of 18 inches to avoid washouts from overflow around the dam.
- In some cases, if carefully located and designed, check dams can remain as permanent installations with very minor regrading. They may be left as either spillways, in which case accumulated sediment would be graded and seeded, or as check dams to prevent further sediment from leaving the site.
- Use filter fabric foundation under a rock or sand bag check dam. If a blanket ditch liner is used, filter fabric is not necessary. A piece of organic or synthetic blanket cut to fit will also work for this purpose.
- Ensure that channel appurtenances, such as culvert entrances below check dams, are not subject to damage or blockage from displaced stones.

Removal

- In the case of grass-lined ditches and swales, all check dams and accumulated sediment shall be removed when the grass has matured sufficiently to protect the ditch or swale - unless the slope of the swale is greater than 4 percent. The area beneath the check dams shall be seeded and mulched immediately after dam removal.

Maintenance Standards

Check dams shall be monitored for performance and sediment accumulation during and after each runoff producing rainfall. Sediment shall be removed when it reaches one half the sump depth.

- Anticipate submergence and deposition above the check dam and erosion from high flows around the edges of the dam.
- If significant erosion occurs between dams, install a protective riprap liner in that portion of the channel.

BMP C208: Triangular Silt Dike (Geotextile-Encased Check Dam)

Purpose and Description

Triangular silt dikes may be used as check dams, for perimeter protection, for temporary soil stockpile protection, for drop inlet protection, or as a temporary interceptor dike.

Conditions of Use

Triangular silt dikes may be used on soil or on pavement with adhesive or staples.

TSDs have been used to build temporary:

- sediment ponds
- diversion ditches
- concrete wash out facilities
- curbing
- water bars
- level spreaders
- berms

Design Criteria

The triangular silt dike is made of a triangular prism of urethane foam sewn into a woven geosynthetic fabric.

Dimensions

Height	10-14 inches high in the center
Base Width	20-28 inches
Length	7 feet (typical, but may vary)

A 2–foot apron extends beyond both sides of the triangle along its standard section of 7 feet. A sleeve at one end allows attachment of additional sections as needed.

Installation

- Install with ends curved up to prevent water from flowing around the ends.
- The fabric flaps and check dam units are attached to the ground with wire staples. Wire staples should be No. 11 gauge wire and should be 200 mm to 300 mm in length.

- When multiple units are installed, the sleeve of fabric at the end of the unit shall overlap the abutting unit and be stapled.
- When used as check dams, the leading edge must be secured with rocks, sandbags, or a small key slot and staples.

Placement

- Check dams should be located and installed as soon as construction will allow.
- Check dams should be placed perpendicular to the flow of water.

Removal

- In the case of grass-lined ditches and swales, triangular silt dikes functioning as check dams and the accumulated sediment shall be removed when the grass has matured sufficiently to protect the ditch or swale unless the slope of the swale is greater than 4 percent. The area beneath the check dams shall be seeded and mulched immediately after dam removal.

Maintenance Standards

- Triangular silt dams shall be inspected for performance and sediment accumulation during and after each runoff producing rainfall. Sediment shall be removed when it reaches one half the height of the dam.
- Anticipate submergence and deposition above the triangular silt dam and erosion from high flows around the edges of the dam. Immediately repair any damage or any undercutting of the dam.

BMP C209: Outlet Protection

Purpose and Description

Outlet protection prevents scour at conveyance outlets and minimizes the potential for downstream erosion by reducing the velocity of concentrated stormwater flows.

Conditions of Use

Outlet protection is required at the outlets of all ponds, pipes, ditches, or other conveyances, and where runoff is conveyed to a drainage feature such as a stream, wetland, lake, or ditch.

Design Criteria

- The receiving channel at the outlet of a culvert shall be protected from erosion by rock lining a minimum of 6 feet downstream and extending up the channel sides a minimum of 1–foot above the maximum tailwater elevation or 1-foot above the crown, whichever is higher. For pipes greater than 18 inches in diameter, install outlet protection lining in the channel to four times the diameter of the culvert.
- Organic or synthetic erosion blankets, with or without vegetation, are usually more effective than rock, cheaper, and easier to install. Materials can be chosen using manufacturer product specifications. ASTM test results are available for most products and the designer can choose the correct material for the expected flow.
- With low flows, vegetation (including sod) can be effective.
- The following guidelines shall be used for riprap outlet protection:
    - If the discharge velocity at the outlet is less than 5 fps (pipe slope less than 1 percent), use 2-inch to 8-inch riprap. Minimum thickness is 1-foot.
    - For 5 to 10 fps discharge velocity at the outlet (pipe slope less than 3 percent), use 24-inch to 48-inch riprap. Minimum thickness is 2 feet.
    - For outlets at the base of steep slope pipes (pipe slope greater than 10 percent), an engineered energy dissipater shall be used.
    - Filter fabric or erosion control blankets should always be used under riprap to prevent scour and channel erosion.

Maintenance Standards

- Inspect and repair as needed.
- Add rock as needed to maintain the intended function.
- Clean energy dissipater if sediment builds up.

BMP C220: Storm Drain Inlet Protection

Purpose and Description

Storm drain inlet protection prevents coarser sediment from entering drainage systems prior to permanent stabilization of a disturbed area.

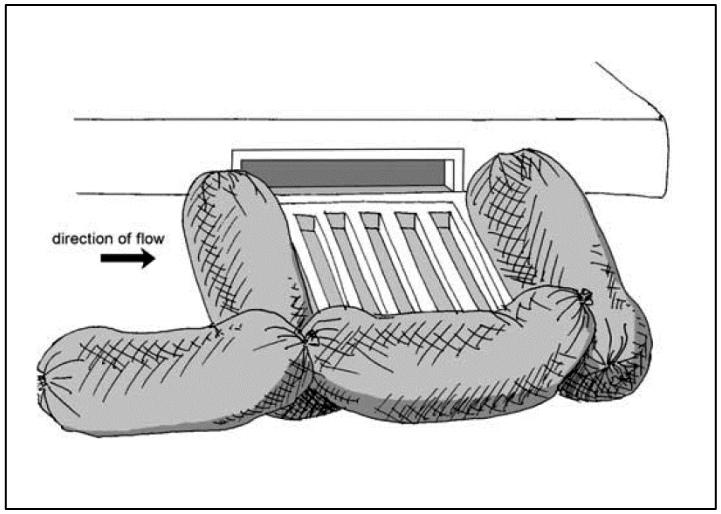


Figure 34: Illustration of Storm Drain Inlet Protection

Conditions of Use

Use storm drain inlet protection at inlets, including lawn and yard drains, that are operational before permanent stabilization of a disturbed drainage area or before gutters and conveyance are completed in new home construction. Provide protection for all storm drain inlets downslope and within 500 feet of a disturbed or construction area, unless conveying runoff entering catch basins to a sediment pond or trap.

Small sites may use bio-filter bag inlet protection or silt sack inlet protection.

Design Criteria

Bio-filter Bag Inlet Protection

- Use Bio-filter bags as shown below around inlets for catch basins, area drains, and dich inlets.
- Stake bags using two 1"x2" wooden stakes

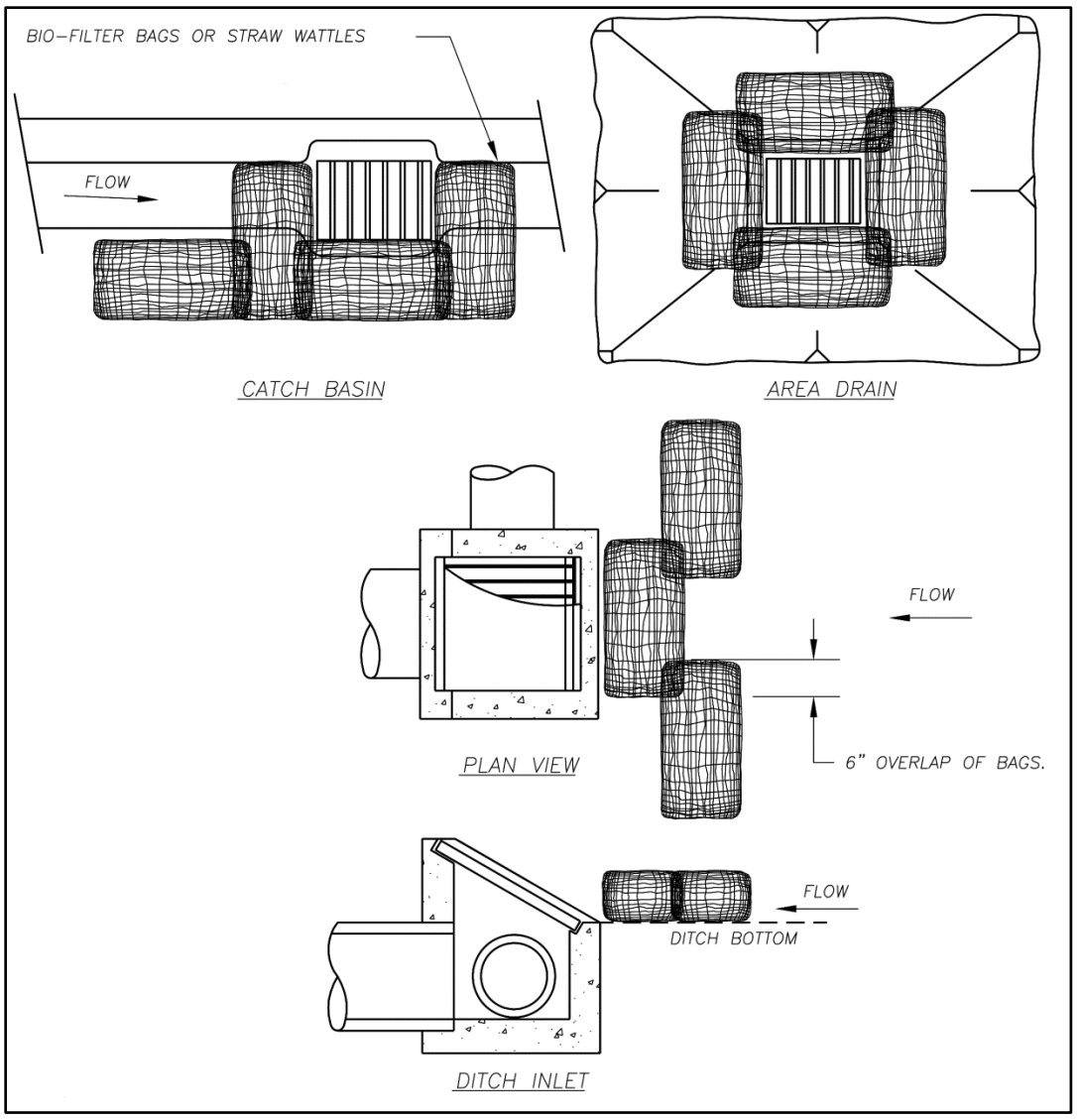


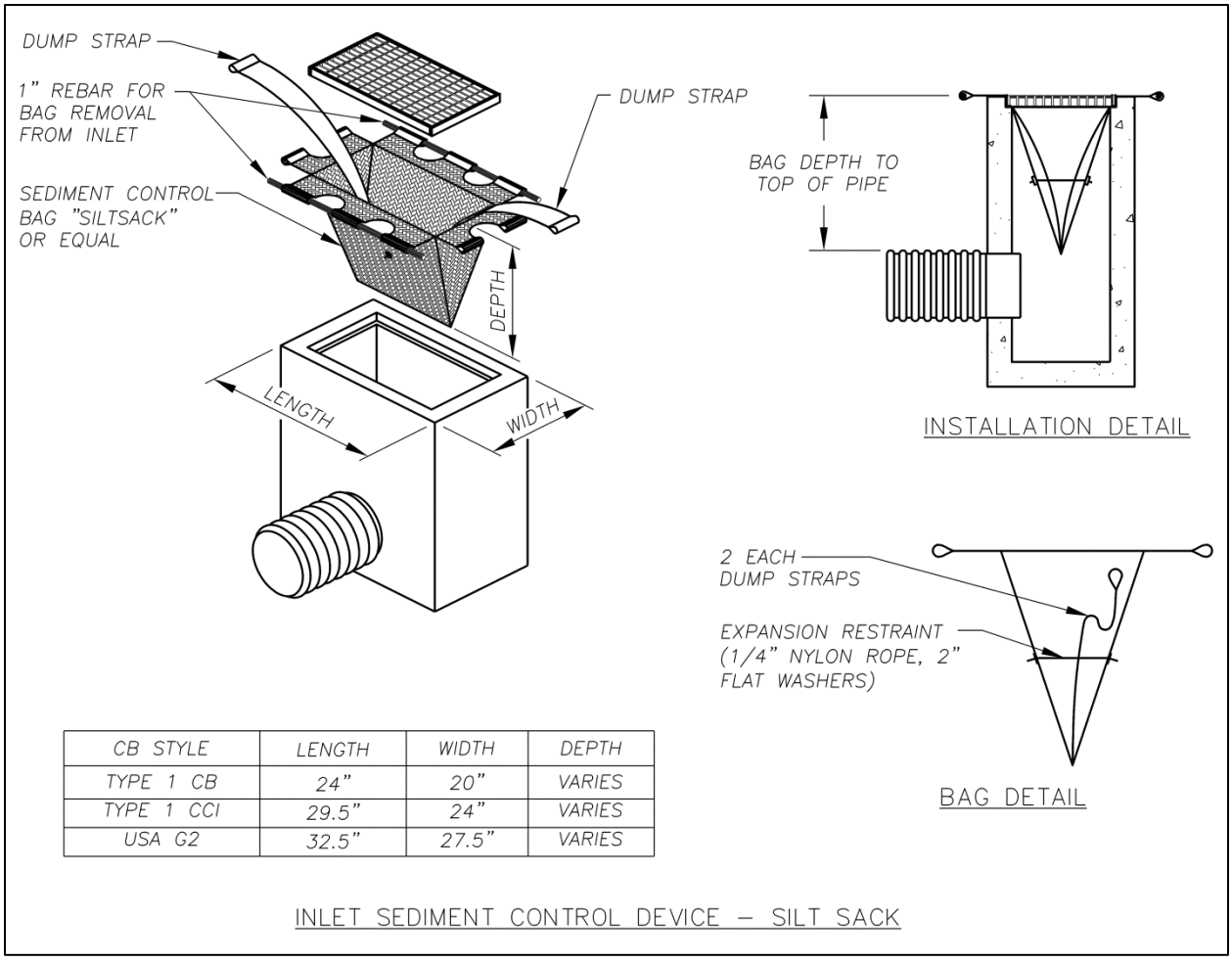
Figure 35: Inlet Protection with Bio-filter Bags

(Source: Clark County)

Catchbasin Filters

Catchbasin filters are designed by manufacturers to be inserted into catch basins for erosion control.

- Provides 5 cubic feet of storage.
- Requires dewatering provisions.
- Provides a high-flow bypass that will not clog under normal use at a construction site.
- Insert the catchbasin filter in the catchbasin just below the grating.



CB STYLE	LENGTH	WIDTH	DEPTH
TYPE 1 CB	24"	20"	VARIES
TYPE 1 CCI	29.5"	24"	VARIES
USA G2	32.5"	27.5"	VARIES

Figure 36: Silt Sack Detail

(Source: Clark County)

BMP C231: Brush Barrier

Purpose and Description

The purpose of brush barriers is to reduce the transport of coarse sediment from a construction site by providing a temporary physical barrier to sediment and reducing the runoff velocities of overland flow.

A brush barrier is a perimeter sediment control constructed of material such as small tree branches, root mats, chipped vegetation, or other debris left over from site clearing and grubbing. Brush barriers can be covered with a filter cloth to stabilize the structure and improve barrier efficiency.

Conditions of Use

- Brush barriers may be used downslope of all disturbed areas of less than one-quarter acre.
- Brush barriers are not intended to treat concentrated flows, nor are they intended to treat substantial amounts of overland flow. Any concentrated flows must be conveyed through the drainage system to a sediment pond. The only circumstance in which overland flow can be treated solely by a brush barrier, rather than by a sediment pond, is when the area draining to the barrier is small.
- Brush barriers should only be installed on contours.

Design Criteria

- Height 2 feet (minimum) to 5 feet (maximum).
- Width 5 feet at base (minimum) to 15 feet (maximum).
- Filter fabric (geotextile) may be anchored over the brush berm to enhance the filtration ability of the barrier. Ten-ounce burlap is an adequate alternative to filter fabric.
- Chipped site vegetation, composted mulch, or wood-based mulch (hog fuel) can be used to construct brush barriers.
- A 100 percent biodegradable installation can be constructed using 10-ounce burlap held in place by wooden stakes.

Maintenance Standards

- There shall be no signs of erosion or concentrated runoff under or around the barrier. If concentrated flows are bypassing the barrier, it must be expanded or augmented by toed-in filter fabric.
- The dimensions of the barrier must be maintained.

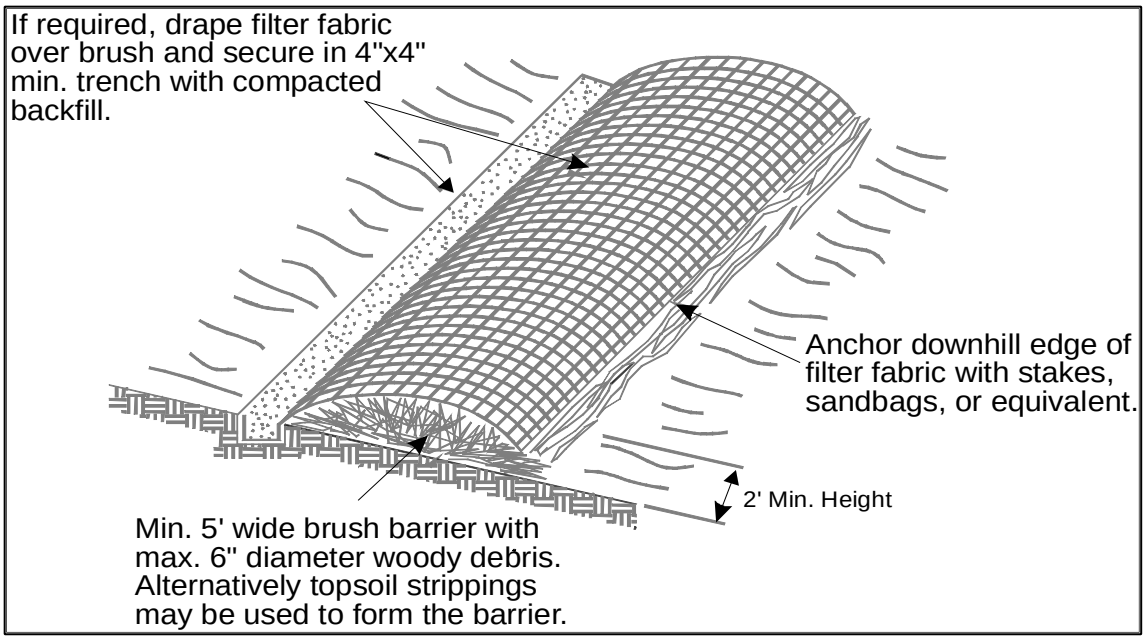


Figure 37: Brush Barrier

(Source: WA State Dept. of Ecology)

BMP C233: Silt Fence

Purpose and Description

A silt fence reduces the transport of coarse sediment from a construction site by providing a temporary physical barrier to sediment and reducing the runoff velocities of overland flow.

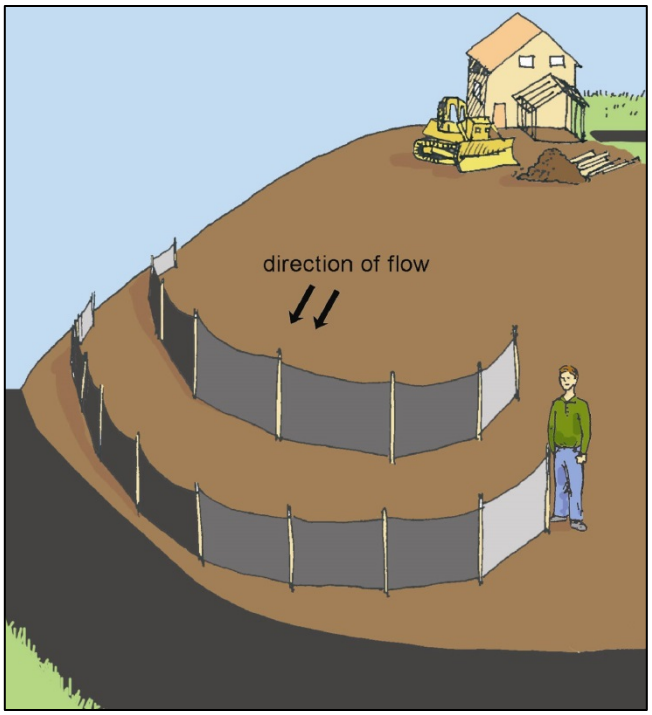


Figure 38: Illustration of Silt Fence

Conditions of Use

Silt fence may be used downslope of all disturbed areas.

- Silt fence shall prevent soil carried by runoff water from going beneath, through, or over the top of the silt fence, but shall allow the water to pass through the fence.
- Silt fence is not intended to treat concentrated flows, nor is it intended to treat substantial amounts of overland flow. Convey any concentrated flows through the drainage system to a sediment pond.
- Do not use silt fences in streams or in V-shaped ditches.

Design Criteria

- Use in combination with sediment basins or other BMPs.
- Maximum slope steepness perpendicular to the fence line shall be 1H:1V.
- Maximum sheet or overland flow path length to the fence shall be 100 feet.
- Maximum flow to the silt fence shall be 0.5 cfs.
- Support standard strength fabrics with wire mesh, chicken wire, 2-inch x 2-inch wire, safety fence, or jute mesh to increase the strength of the fabric. Silt fence materials are available that have synthetic mesh backing attached.
- Filter fabric material shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of six months of expected usable construction life at a temperature range of 0°F. to 120°F.
- The silt fence shall have a 2-feet minimum and a 2½-feet maximum height above the original ground surface.

- The filter fabric shall be sewn together at the point of manufacture to form filter fabric lengths as required. Locate all sewn seams at support posts. Alternatively, two sections of silt fence can be overlapped, provided that the overlap is long enough and that the adjacent fence sections are close enough together to prevent silt laden water from escaping through the fence at the overlap.
- The filter fabric shall be attached on the up-slope side of the posts and secured with staples, wire, or in accordance with the manufacturer's recommendations, in a manner that reduces the potential for tearing.
- Bury the bottom of the filter fabric a minimum of 4 inches below the ground surface. Backfill and tamp soil in place over the buried portion of the filter fabric, so that no flow can pass beneath the fence and scouring cannot occur. When wire or polymeric back-up support mesh is used, the wire or polymeric mesh shall extend into the ground a minimum of 3 inches.
- Place the fence posts into the ground a minimum depth of 18 inches. Fence post depth shall be increased by 6 inches if the fence is located on a slope of 3H:1V or steeper and the slope is perpendicular to the fence. If required post depths cannot be obtained, the posts shall be adequately secured by bracing or guying to prevent overturning of the fence due to sediment loading.
- Use wood, steel or equivalent posts. The spacing of the support posts shall be a maximum of 6 feet. Posts shall consist of either:
    - Wood with dimensions of 2-inches by 2-inches wide min. and a 3-feet min. length. Wood posts shall be free of defects such as knots, splits, or gouges.
    - No. 6 steel rebar or larger.
    - ASTM A 120 steel pipe with a minimum diameter of 1-inch.
    - U, T, L, or C shape steel posts with a minimum weight of 1.35 lbs./ft.
    - Other steel posts having equivalent strength and bending resistance to the post sizes listed above.
- Locate silt fences on contour as much as possible, except at the ends of the fence, where the fence shall be turned uphill such that the silt fence captures the runoff water and prevents water from flowing around the end of the fence.
- If the fence must cross contours, with the exception of the ends of the fence, place gravel check dams perpendicular to the back of the fence to minimize concentrated flow and erosion. The slope of the fence line where contours must be crossed shall not be steeper than 3H:1V.

Maintenance Standards

- Repair any damage immediately.
- Intercept and convey all evident concentrated flows uphill of the silt fence to a sediment pond.

- Check the uphill side of the fence for signs of the fence clogging and acting as a barrier to flow and then causing channelization of flows parallel to the fence. If this occurs, replace the fence or remove the trapped sediment.
- Remove sediment deposits when the deposit reaches approximately one-third the height of the silt fence, or install a second silt fence.
- Replace filter fabric that has deteriorated due to ultraviolet breakdown.

BMP C234: Vegetated Strip

Purpose and Description

Vegetated strips reduce the transport of coarse sediment from a construction site by providing a temporary physical barrier to sediment and reducing the runoff velocities of overland flow.

Conditions of Use

- Vegetated strips may be used downslope of all disturbed areas.
- Vegetated strips are not intended to treat concentrated flows, nor are they intended to treat substantial amounts of overland flow. Any concentrated flows must be conveyed through the drainage system to a sediment pond. The only circumstance in which overland flow can be treated solely by a strip, rather than by a sediment pond, is when the criteria in Table 8.9 are met.

Table 0.1: Contributing Drainage Area for Vegetated Strips

Contributing Drainage Area for Vegetated Strips		
Average Contributing area Slope	**Average Contributing area Percent Slope**	**Max Contributing area Flow path Length**
1.5H:1V or flatter	67% or flatter	100 feet
2H:1V or flatter	50% or flatter	115 feet
4H:1V or flatter	25% or flatter	150 feet
6H:1V or flatter	16.7% or flatter	200 feet
10H:1V or flatter	10% or flatter	250 feet

Design Criteria

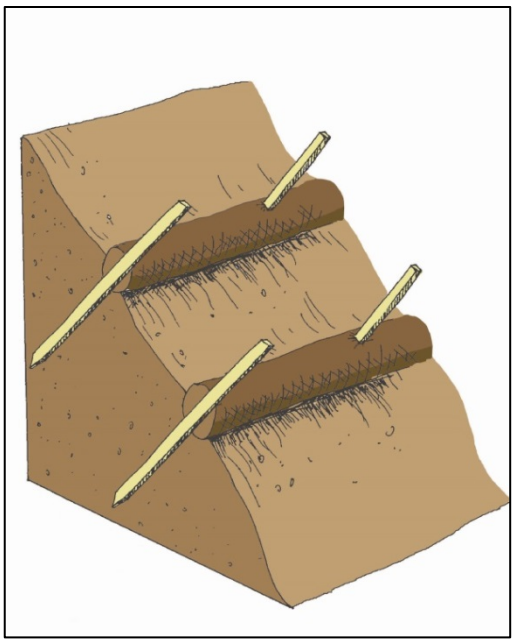
- The vegetated strip shall consist of a minimum of a 25-foot flow path length continuous strip of dense vegetation with topsoil. Grass-covered, landscaped areas are generally not adequate because the volume of sediment overwhelms the grass. Ideally, vegetated strips shall consist of undisturbed native growth with a well-developed soil that allows for infiltration of runoff.
- The slope within the strip shall not exceed 4H:1V.
- The uphill boundary of the vegetated strip shall be delineated with clearing limits.

Maintenance Standards

- Any areas damaged by erosion or construction activity shall be seeded immediately and protected by mulch.
- If more than 5 feet of the original vegetated strip width has had vegetation removed or is being eroded, sod must be installed.
- If there are indications that concentrated flows are traveling across the buffer, surface water controls must be installed to reduce the flows entering the buffer, or additional perimeter protection must be installed.

BMP C235: Wattles

Purpose and Description



Wattles are temporary erosion and sediment control barriers consisting of straw, compost, or other material that is wrapped in biodegradable tubular plastic or similar encasing material.

They reduce the velocity and can spread the flow of rill and sheet runoff, and can capture and retain sediment.

Wattles are typically 8 to 10 inches in diameter and 25 to 30 feet in length.

Wattles are placed in shallow trenches and staked along the contour of disturbed or newly constructed slopes.

Figure 39: Illustration of Wattles

Conditions of Use

Use wattles:

- In disturbed areas that require immediate erosion protection.
- On exposed soils during the period of short construction delays, or over winter months.
- On slopes requiring stabilization until permanent vegetation can be established.

Generally, wattles are effective for one to two seasons before they break down.

This BMP has products approved as equivalent by Ecology. See Book 1, Section 6.5.1.

Design Criteria

- Install wattles perpendicular to the flow direction and parallel to the slope contour.
- Dig narrow trenches across the slope on contour to a depth of 3 to 5 inches on clay soils and soils with gradual slopes. On loose soils, steep slopes, and areas with high rainfall, dig trenches to a depth of 5 to 7 inches, or 1/2 to 2/3 of the thickness of the wattle.

- Start building trenches and installing wattles from the base of the slope and work up. Spread excavated material evenly along the uphill slope and compact using hand tamping or other methods.
- Construct trenches at intervals of 10 to 25 feet depending on the steepness of the slope, soil type, and rainfall. The steeper the slope the closer together the trenches.
- Install the wattles snugly into the trenches and abut tightly end to end. Do not overlap the ends.
- Install stakes at each end of the wattle, and at 4-foot centers along entire length of wattle. Stakes should be driven through the middle of the wattle, leaving 2 to 3 inches of the stake protruding above the wattle to enable removal.
- If required, install pilot holes for the stakes using a straight bar to drive holes through the wattle and into the soil.
- Wooden stakes should have minimum dimensions of 3/4 x 3/4 x 24 inches. Willow cuttings or 3/8-inch rebar can also be used for stakes.

Maintenance Standards

- Wattles may require maintenance to ensure they are in contact with soil and thoroughly entrenched, especially after significant rainfall on steep sandy soils.
- Inspect the slope after significant storms and repair any areas where wattles are not tightly abutted or water has scoured beneath the wattles.

BMP C233-A: Bio-filter Bags - Sediment Barrier

Purpose and Description

Bio-filter bags or wattles may be used as a sediment barrier and alternative to silt fence along sidewalks on single-family residential construction.

Conditions of Use

- Can only be used on single-family residential construction sites.
- Can only be placed after installation of the sidewalk.

Design Criteria

- Install bio-filter bags or wattles parallel to the sidewalk.
- Overlap bags or wattles by at least 6 inches.
- Stake each bag using two 1"x2" wood stakes.

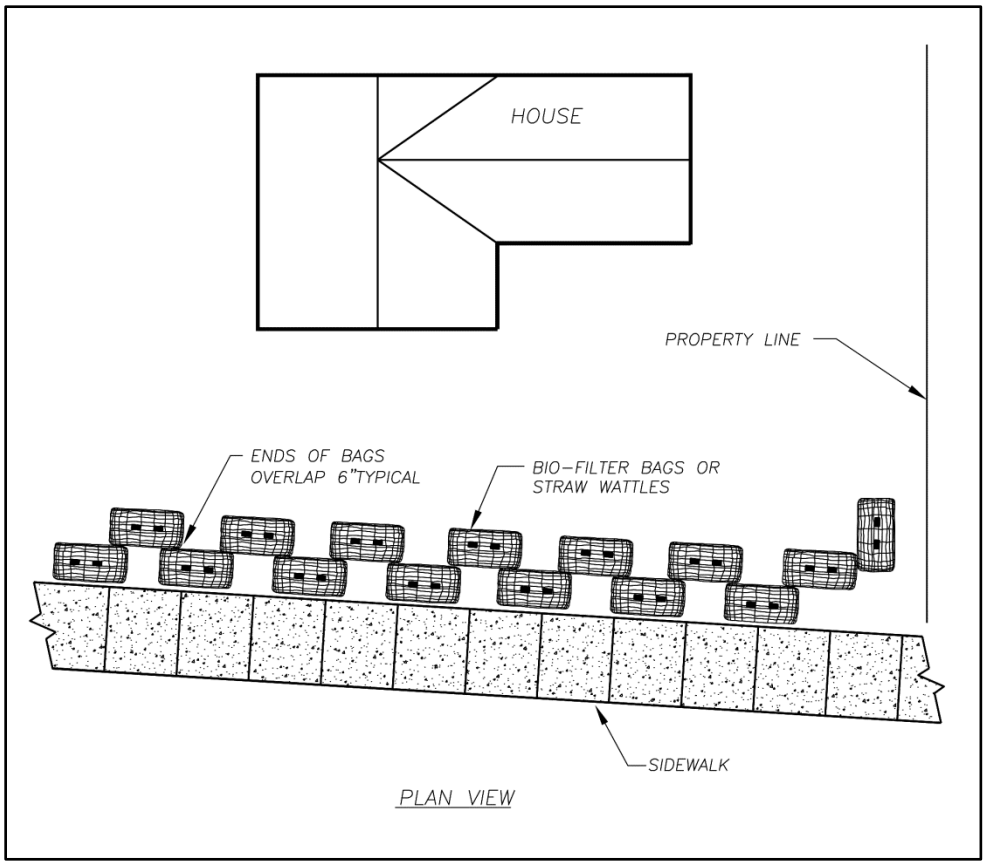


Figure 40: Bio-filter Bags Sediment Barrier

(Source: Clark County)