Clark County Stormwater Manual

Book 1
Applicability, BMP Selection,
and Submittal

Adoption Draft
September 17, 2015
(for Public Review)

The *Clark County Stormwater Manual: Book 1* –is adapted from the *Stormwater Management Manual for Western Washington*, (Ecology, 2014) Volumes I, II, III, and V and the *Clark County Stormwater Manual 2009*.

Illustrations and drawings are courtesy Washington Department of Ecology or redrawn from Washington Department of Ecology, unless otherwise noted. Illustrations are simplified representations of stormwater facilities; they are not to scale and they require detailed engineering for use in design or construction. Design requirements in text take precedence over figures.

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1.1 Introduction

1.1.1 Purpose

This chapter provides direction on identifying which Department of Ecology Minimum Requirements and Clark County requirements apply to a project. The chapter directs users to the appropriate book and chapter of this manual for meeting requirements. The chapter gives directions for submitting a Stormwater Site Plan to Clark County.

1.1.2 How to Use this Chapter

- Section 1.2 describes projects and activities that are exempt from Clark County Code (CCC) Chapter 40.386 and the *Clark County Stormwater Manual* (CCSM).
- Section 1.3 lists definitions related to the Minimum Requirements. These definitions are essential to understanding the Minimum Requirements.
- Section 1.4 defines thresholds for project type, area and area of land-disturbance that determine which Minimum Requirements apply.
- Section 1.5 lists and describes the Minimum Requirements.
- Section 1.6 describes County technical requirements that apply to projects in addition to the Minimum Requirements.
- Section 1.7 describes how to submit a Stormwater Site Plan for a small project.
- Section 1.8 describes how to submit a Stormwater Site Plan to Clark County.
- Section 1.9 describes the types of administrative and legal submittals (e.g. easements) that may be required.

1.2 Exemptions

Some projects are exempt from the Minimum Requirements, County Requirements or this manual.

1.2.1 Total Exemptions from this Manual

Publicly-funded linear transportation projects may follow the standards of the latest Ecology-approved version of the Washington Department of Transportation's *Highway Runoff Manual* (HRM), except use of the infeasibility criteria used for LID selection in the HRM (both the general criteria in Section 4-5 and the BMP specific criteria in Section 5) is not allowed. Instead, LID infeasibility criteria in in this manual must be used for LID selection.

1.2.2 Total Exemptions from the Minimum Requirements

The following activities are exempt from the Minimum Requirements of this manual. Other Clark County, state and federal requirements may apply.

- Forest practices regulated under Title 222 of the Washington Administrative Code (WAC), except Class IV General Forest Practices that are conversions from timberland to other uses.
- Commercial agricultural practices involving working the land for production. However, the conversion from timberland to agriculture and the construction of impervious surfaces are not exempt.
- Construction of agricultural buildings or other hard surfaces for carrying out agricultural activities; provided, that no stormwater is released from the site directly or indirectly to the County's stormwater conveyance system.
- Normal landscape maintenance activities and gardening.
- Oil and gas field activities or operations, including construction of drilling sites, waste management pits, and access roads, as well as construction of transportation and treatment infrastructure such as pipelines, natural gas treatment plants, natural gas pipeline compressor stations, and crude oil pumping stations. Operators are encouraged to implement and maintain best management practices to minimize erosion and control sediment during and after construction activities to help ensure protection of surface water quality during storm events.
- The following pavement maintenance practices:
    - Pothole and square cut patching.
    - Overlaying existing asphalt or concrete pavement without expanding the area of coverage.
    - Shoulder grading.
    - Regrading/reshaping drainage systems.
    - Crack sealing.
    - Resurfacing with in-kind material without expanding the road prism.
    - Pavement preservation activities that do not expand the road prism.
    - Vegetation management.

1.2.2.1 Clarification of Pavement Maintenance Exemptions

The following pavement maintenance practices are not categorically exempt. They are considered redevelopment. The extent to which the Minimum Requirements applies is explained for each circumstance.

- Removing and replacing a paved surface to base course or lower, or repairing the pavement base: If impervious surfaces are not expanded, Minimum Requirements #1 – #5 apply.

- Extending the pavement edge without increasing the size of the road prism, or paving graveled shoulders: These are considered new impervious surfaces and are subject to the Minimum Requirements that are triggered when the thresholds identified for new or redevelopment projects are met.
- Resurfacing by upgrading from dirt to gravel, asphalt or concrete; upgrading from gravel to asphalt or concrete; or upgrading from a bituminous surface treatment ("chip seal") to asphalt or concrete: These are considered new impervious surfaces and are subject to the Minimum Requirements that are triggered when the thresholds identified for new or redevelopment projects are met.

1.2.3 Exemptions to Individual Minimum Requirements

- Drainage projects that are not new development or redevelopment and do not create new stormwater injection wells are exempt from Minimum Requirement #6, Runoff Treatment, and the Responsible Official may waive all or parts of Minimum Requirement #1, Preparation of a Stormwater Site Plan, if the project meets other applicable requirements of this manual.
- Underground utility projects that replace the ground surface with in-kind material or materials with similar runoff characteristics are subject only to Minimum Requirement #2, Construction Stormwater Pollution Prevention.
- New development and redevelopment that meet the criteria for a Flow Control-Exempt Surface Water (see Section 1.5.7.1) and all of the following criteria are exempt from Minimum Requirement #7, Flow Control:
    - Project meets the exemption requirements for discharges to one of the following water bodies:
        - Columbia River
        - Lake River
        - Lewis River, downstream of the confluence with Quartz Creek
        - East Fork Lewis River, downstream of the confluence with Big Tree Creek
        - Vancouver Lake
    - Runoff from the site is treated in accordance with the thresholds and requirements of Minimum Requirement #6, Runoff Treatment.
    - The discharge structure is designed to avoid erosion during all storms up to the 100-year storm.
    - If an existing discharge structure is used, then either:
        - The discharge structure and conveyance system leading to it must have adequate capacity to meet the requirements of Chapter 7 of this book; or

- The project must detain runoff from the project site that exceeds the existing system's capacity.

- New development and redevelopment are exempt from Minimum Requirement #8, Wetlands Protection, provided that:
  - The project does not change the rate, volume, duration, or location of discharges to and from the project site (e.g. where existing impervious surface is replaced with other impervious surface having similar runoff-generating characteristics, or where pipe/ditch modifications do not change existing discharge characteristics), or
  - The project meets the land cover percentage requirements for full dispersion in accordance to this manual for flow control, or
  - The Responsible Official determines based on information in the Preliminary Stormwater Plan, or information submitted for wetland review per CCC 40.450, that the proposed project will not degrade wetland function.

1.2.4 Exemptions from County Requirements

Publicly-funded road-related development and drainage projects are exempt from Section 1.9, Administrative and Legal Requirements, except for Sections 1.9.8, Stormwater Pipe Testing, and 1.9.9, Infiltration Facility Testing.

1.3 Definitions Related to the Minimum Requirements

Approved Continuous Flow Model – Where referenced in this document, this term applies to continuous simulation hydrologic models approved for use in Clark County by the Department of Ecology. The Western Washington Hydrology Model (WWHM) and MGSFlood are the only two approved models for use in Clark County.

Arterial – A road or street primarily for through traffic. The term generally includes roads or streets considered collectors. It does not include local access roads which are generally limited to providing access to abutting property. See also Clark County Code (CCC) 40.350.

Bioretention – Engineered facilities that treat stormwater by passing it through a specified soil profile and either retain or detain the treated stormwater for flow attenuation.

Certified Erosion and Sediment Control Lead (CESCL) – means an individual who has current certification through an approved erosion and sediment control training program that meets the minimum training standards established by the Washington Department of Ecology (Ecology). A CESCL is knowledgeable in the principles and practices of erosion and sediment control. The CESCL must have the skills to assess site conditions and construction activities that could impact the quality of stormwater and, the effectiveness of erosion and sediment control measures used to control the quality of stormwater discharges. Certification is obtained through an Ecology approved erosion and sediment control course. Course listings are provided online at Ecology's website.

Commercial Agriculture – means those activities conducted on lands defined in RCW 84.34.020(2) and activities involved in the production of crops or livestock for commercial trade. An activity ceases to be considered commercial agriculture when the area on which it is conducted is proposed for conversion to a nonagricultural use or has lain idle for more than five years, unless the idle land is registered in a federal or state soils conservation program, or unless the activity is maintenance of irrigation ditches, laterals, canals, or drainage ditches related to an existing and ongoing agricultural activity.

Converted Vegetation (areas) – The 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.

Effective Impervious Surface – Those impervious surfaces that are connected via sheet flow or discrete conveyance to a drainage system. Impervious surfaces are considered ineffective if: 1) the runoff is dispersed through use of BMP T5.30A or T5.30B; 2) residential roof runoff is infiltrated in accordance with Downspout Full Infiltration Systems in BMP T5.10A or BMP T5:10B; or 3) modeling with an approved continuous simulation hydrologic model indicate that the entire runoff file is infiltrated.

Erodible or Leachable Materials – Wastes, chemicals, or other substances that measurably alter the physical or chemical characteristics of runoff when exposed to rainfall. Examples include erodible soils that are stockpiled, uncovered process wastes, manure, fertilizers, oily substances, ashes, kiln dust, and garbage dumpster leakage.

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

Highway – A main public road connecting towns and cities.

Impervious Surface – A non-vegetated surface area that either prevents or retards the entry of water into the soil mantle as under natural conditions prior to development. A non-vegetated surface area which causes water to run off the surface in greater quantities or at an increased rate of flow from the flow present under natural conditions prior to development. Common impervious surfaces include, but are not limited to, roof tops, walkways, patios, driveways, parking lots or storage areas, concrete or asphalt paving, gravel roads, packed earthen materials, and oiled, macadam or other surfaces which similarly impede the natural infiltration of stormwater. Open, uncovered retention/detention facilities shall not be considered as impervious surfaces for purposes of determining whether the thresholds for application of Minimum Requirements are exceeded. Open, uncovered retention/detention facilities shall be considered impervious surfaces for purposes of runoff modeling.

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, but are not limited to clearing, grading, filling, and excavation. Compaction that is associated with stabilization of structures and road construction shall also be considered a land disturbing activity. Vegetation maintenance practices, including landscape maintenance and gardening, are not considered land-disturbing activity. Stormwater facility maintenance is not considered land disturbing activity if conducted according to established standards and procedures.

Low Impact Development (LID) – A stormwater and land use management strategy that strives to mimic pre-disturbance hydrologic processes of infiltration, filtration, storage, evaporation and transpiration by emphasizing conservation, use of on-site natural features, site planning, and distributed stormwater management practices that are integrated into a project design.

LID Best Management Practices – Distributed stormwater management practices, integrated into a project design, that emphasize pre-disturbance hydrologic processes of infiltration, filtration, storage, evaporation and transpiration. LID BMPs include, but are not limited to, bioretention/rain gardens, permeable pavements, roof downspout controls, dispersion, soil quality and depth, minimal excavation foundations, vegetated roofs, and water re-use.

LID Principles – Land use management strategies that emphasize conservation, use of on-site natural features, and site planning to minimize impervious surfaces, native vegetation loss, and stormwater runoff.

Maintenance – Repair and maintenance includes activities conducted on currently serviceable structures, facilities, and equipment that involves no expansion or use beyond that previously existing and results in no significant adverse hydrologic impact. It includes those usual activities taken to prevent a decline, lapse, or cessation in the use of structures and systems. Those usual activities may include replacement of dysfunctional facilities, including cases where environmental permits require replacing an existing structure with a different type structure, as long as the functioning characteristics of the original structure are not changed. One example is the replacement of a collapsed, fish blocking, round culvert with a new box culvert under the same span, or width, of roadway. In regard to stormwater facilities, maintenance includes assessment to ensure ongoing proper operation, removal of built up pollutants (i.e. sediments), replacement of failed or failing treatment media, and other actions taken to correct defects as identified in the maintenance standards in Book 4 of this manual. See also Pavement Maintenance exemptions in Section 1.2.2.

Native Vegetation – Vegetation comprised of plant species, other than noxious weeds, that are indigenous to the coastal region of the Pacific Northwest and which reasonably could have been expected to naturally occur on the site. Examples include trees such as Douglas Fir, western hemlock, western red cedar, alder, big-leaf maple, and vine maple; shrubs such as willow, elderberry, salmonberry, and salal; and herbaceous plants such as sword fern, foam flower, and fireweed.

New Development – Land disturbing activities, including Class IV -general forest practices that are conversions from timber land to other uses; structural development, including construction or installation of a building or other structure; creation of hard surfaces; and subdivision, short subdivision and binding site plans, as defined and applied in Chapter 58.17 RCW. Projects meeting the definition of redevelopment shall not be considered new development.

On-site Stormwater Management BMPs – As used in this manual, a synonym for Low Impact Development BMPs.

Permeable Pavement – Pervious concrete, porous asphalt, permeable pavers or other forms of pervious or porous paving material intended to allow passage of water through the pavement section. It often includes an aggregate base that provides structural support and acts as a stormwater reservoir.

Pervious Surface – Any surface material that allows stormwater to infiltrate into the ground. Examples include lawn, landscape, pasture, native vegetation areas, and permeable pavements.

Pollution-generating Hard Surface (PGHS) – Those hard surfaces considered to be a significant source of pollutants in stormwater runoff. See the listing of surfaces under pollution-generating impervious surface.

Pollution-generating Impervious Surface (PGIS) – Those impervious surfaces considered to be a significant source of pollutants in stormwater runoff. Such surfaces include those which are subject to: vehicular use; industrial activities (as further defined in the glossary of this manual); storage of erodible or leachable materials, wastes, or chemicals, and which receive direct rainfall or the run-on or blow-in of rainfall; metal roofs unless they are coated with an inert, non-leachable material (e.g., baked-on enamel coating); or roofs that are subject to venting significant amounts of dusts, mists, or fumes from manufacturing, commercial, or other indoor activities.

Pollution-generating Pervious Surfaces (PGPS) – Any non-impervious surface subject to vehicular use, industrial activities (as further defined in the glossary of this manual); or storage of erodible or leachable materials, wastes, or chemicals, and that receive direct rainfall or run-on or blow-in of rainfall, use of pesticides and fertilizers, or loss of soil. Typical PGPS include permeable pavement subject to vehicular use, lawns, and landscaped areas including: golf courses, parks, cemeteries, and sports fields (natural and artificial turf).

Pre-developed Condition – The native vegetation and soils that existed at a site prior to the influence of Euro-American settlement. The pre-developed condition shall be assumed to be a forested land cover unless reasonable, historic information is provided that indicates the site was prairie prior to settlement.

Project Site – That portion of a property, properties, or right of way subject to land disturbing activities, new hard surfaces, or replaced hard surfaces.

Rain Garden – A non-engineered shallow landscaped depression, with compost-amended native soils and suitable plants. The depression is designed to pond and temporarily store stormwater runoff from adjacent areas, and to allow stormwater to pass through the amended soil profile.

Receiving Waters - Bodies of water or surface water systems to which surface runoff is discharged via a point source of stormwater or via sheet flow. Groundwater to which surface runoff is directed by infiltration.

Redevelopment – On a site that is already substantially developed (i.e., has 35% or more of existing hard surface coverage), the creation or addition of hard surfaces; the expansion of a building footprint or addition or replacement of a structure; structural development including construction, installation or expansion of a building or other structure; replacement of hard surface that is not part of a routine maintenance activity; and land disturbing activities.

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.

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

Site – The area defined by the legal boundaries of a parcel or parcels of land that is (are) subject to new development or redevelopment. For road projects, the length of the project site and the right-of-way boundaries define the site.

Source Control BMP – A structure or operation that is intended to prevent pollutants from coming into contact with stormwater through physical separation of areas or careful management of activities that are sources of pollutants. This manual separates source control BMPs into two types. Structural Source Control BMPs are physical, structural, or mechanical devices, or facilities that are intended to prevent pollutants from entering stormwater. Operational BMPs are non-structural practices that prevent or reduce pollutants from entering stormwater.

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). The examples in Figure 1.1, below, illustrate this definition. The purpose of this definition is to clarify how the thresholds of this manual are applied to project sites with multiple discharge points.

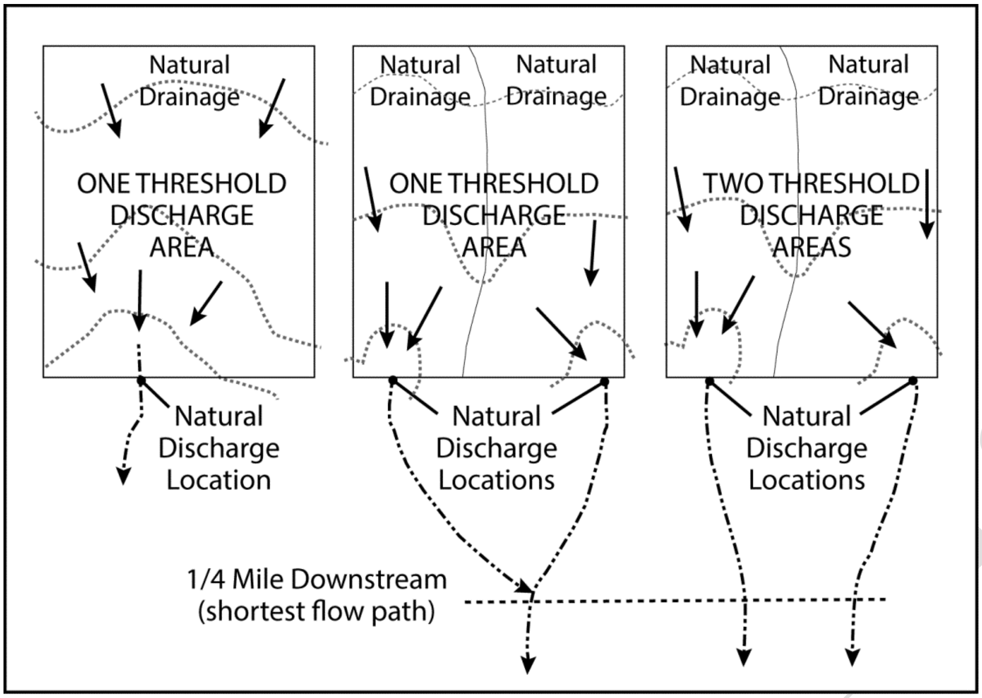

Figure 1.1: Threshold Discharge Area

(Source: modified from Department of Ecology)

1.4 Applicability of the Minimum Requirements

Clark County has other technical requirements and administrative and legal requirements that are not included in the Minimum Requirements. These are identified in Sections 1.6 and 1.9.

Clark County has nine Minimum Requirements for stormwater management. These Minimum Requirements are:

1. Preparation of Stormwater Site Plans
2. Construction Stormwater Pollution Prevention
3. Source Control of Pollution
4. Preservation of Natural Drainage Systems and Outfalls
5. On-site Stormwater Management (Low Impact Development)
6. Runoff Treatment
7. Flow Control
8. Wetlands Protection
9. Operation and Maintenance

Not all of the minimal requirements apply to every project. The applicability varies, depending on the project type, size, and location. To determine which requirements apply to a specific project, see Section 1.4.1 (for new development) or Section 1.4.2 (for redevelopment) and/or consult Figure 1.2 (for new development) and Figure 1.3 (for redevelopment).

Understanding the definitions in Section 1.3 is essential to correctly implementing the Minimum Requirements.

1.4.1 New Development

All new development shall comply with Minimum Requirement #2.

The following new development shall comply with Minimum Requirements #1 – #5 for the new and replaced hard surfaces and the land disturbed:

- Results in 2,000 square feet, or greater, of new, replaced, or new plus replaced hard surface area, or
- Has land disturbing activity of 7,000 square feet or greater.

The following new development shall comply with Minimum Requirements #1 – #9 for the new and replaced hard surfaces and the converted vegetation areas:

- Results in 5,000 square feet, or greater, of new plus replaced hard surface area, or
- Converts ¾ acres, or more, of vegetation to lawn or landscaped areas, or
- Converts 2.5 acres, or more, of native vegetation to pasture.

1.4.2 Redevelopment

All redevelopment shall comply with Minimum Requirement #2.

The following redevelopment shall comply with Minimum Requirements #1 – #5 for the new and replaced hard surfaces and the land disturbed:

- Results in 2,000 square feet, or more, of new plus replaced hard surface area, or
- Has land disturbing activity of 7,000 square feet or greater.

The following redevelopment shall comply with Minimum Requirements #1 – #9 for the new hard surfaces and converted pervious areas:

- Adds 5,000 square feet or more of new hard surfaces or,
- Converts ¾ acres, or more, of vegetation to lawn or landscaped areas, or
- Converts 2.5 acres, or more, of native vegetation to pasture.

Clark County may allow the Minimum Requirements to be met for an equivalent (flow and pollution characteristics) area within the same site. For publicly-funded linear transportation projects, the equivalent area does not have to be within the project limits, but must drain to the same receiving water.

1.4.2.1 Additional Requirements for the Redevelopment Project Site

For road-related projects, runoff from the replaced and new hard surfaces (including pavement, shoulders, curbs, and sidewalks) and the converted vegetated areas shall meet Minimum Requirements #1 – #9 if the new hard surfaces total 5,000 square feet or more and total 50% or more of the existing hard surfaces within the project limits. The project limits shall be defined by the length of the project and the width of the right–of-way.

Other types of redevelopment projects shall comply with Minimum Requirements #1 – #9 for the new and replaced hard surfaces and the converted vegetated areas if the total of new plus replaced hard surfaces is 5,000 square feet or more, and the valuation of proposed improvements – including interior improvements – exceeds 50% of the assessed value of the existing site improvements.

The Responsible Official may exempt or institute a stop-loss provision for redevelopment projects from compliance with Minimum Requirements #5, On-site Stormwater Management; Minimum Requirement #6, Runoff Treatment; Minimum Requirement #7, Flow Control; and/or Minimum Requirement #8, Wetlands Protection as applied to the replaced hard surfaces if Clark County has adopted a plan and a schedule that fulfills those requirements in regional facilities.

The Responsible Official may grant a variance/exception to the application of the flow control requirements to replaced impervious surfaces if such application imposes a severe and unexpected economic hardship. See CCC 40.386.

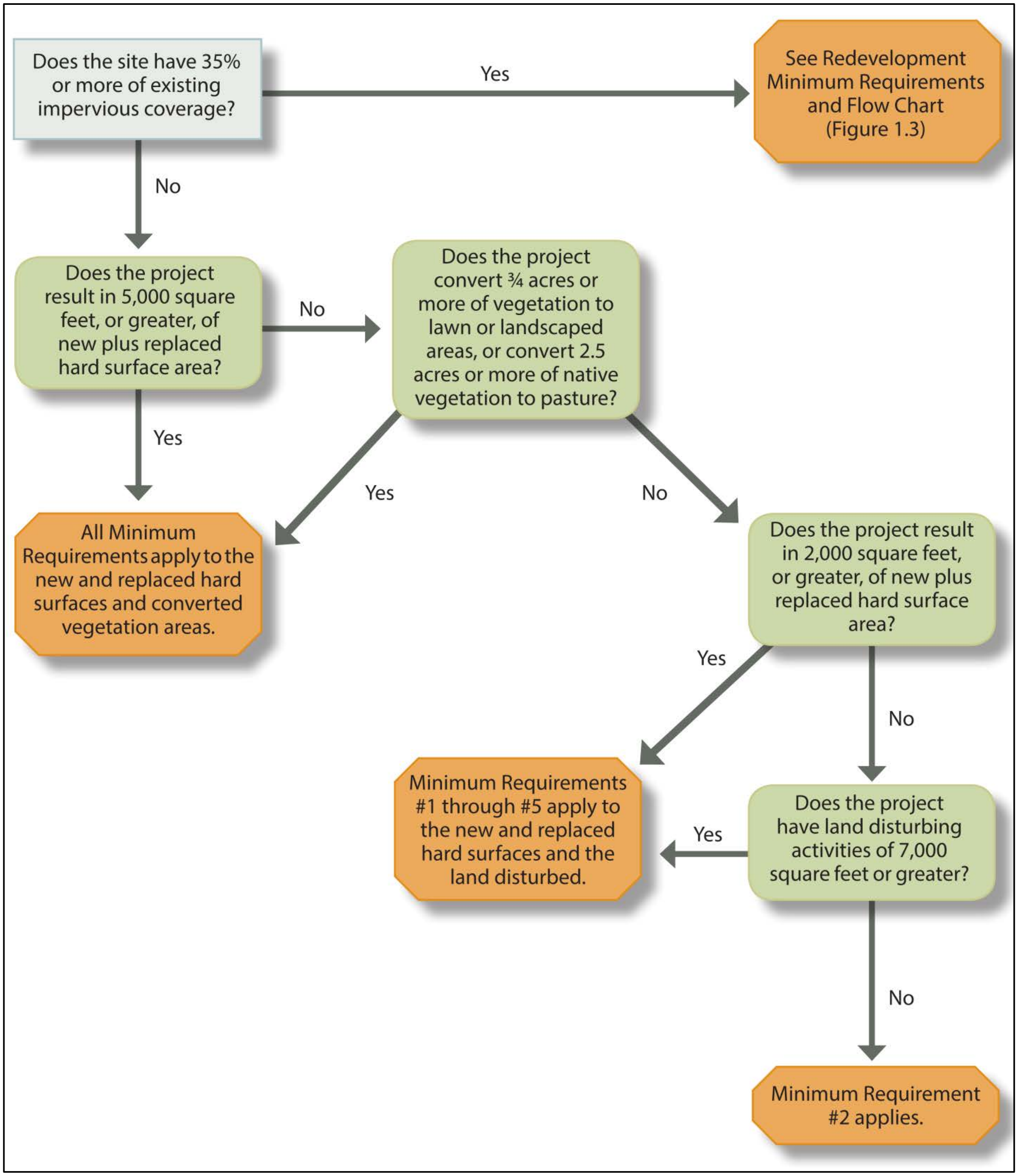

Figure 1.2: New Development Flow Chart

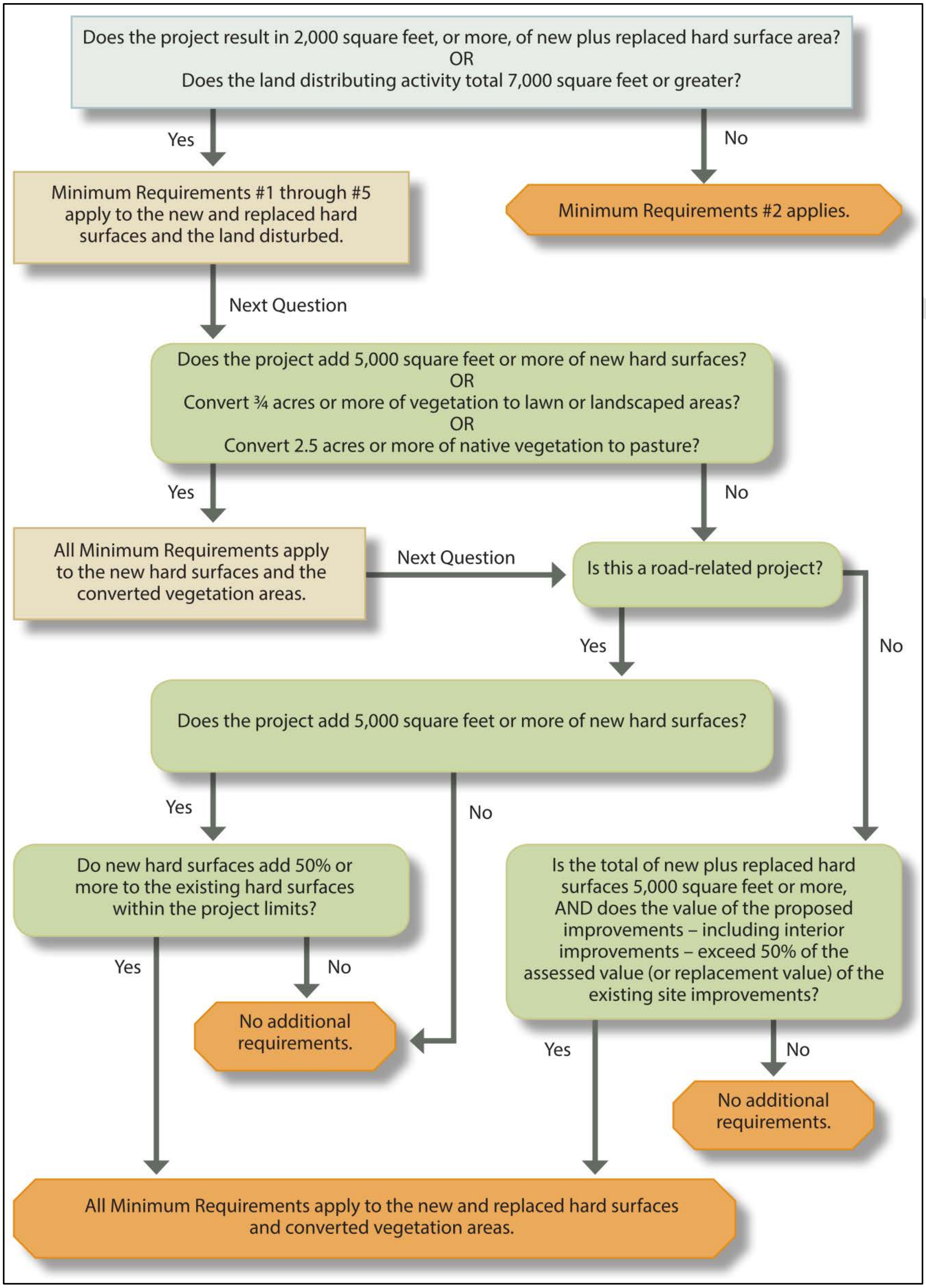

Figure 1.3: Redevelopment Flow Chart

1.4.3 How to Meet the Minimum Requirements

After determining which Minimum Requirements apply to a specific project, read the applicable Minimum Requirements in Section 1.5. Then refer to the list below to determine where to find out how to meet each one.

1: Preparation of Stormwater Site Plans

- Consult **Book 1, Section 1.8** of this manual to fulfill Minimum Requirement #1.
- For sites meeting the definition of a Small Project (see Section 1.7), consult **Book 1, Section 1.7** of this manual to confirm eligibility to use **Stormwater Site Plan Short Form**, in **Appendix 1-I** to fulfill Minimum Requirement #1.

2: Construction Stormwater Pollution Prevention

- Consult **Book 1, Chapter 6** of this manual to fulfill Minimum Requirement #2.

3: Source Control of Pollution

- Consult **Book 3, Source Control** of this manual to fulfill Minimum Requirement #3.

4: Preservation of Natural Drainage Systems and Outfalls

- Consult **Book 1, Section 1.5.4** and **Book 2, Chapter 7** to fulfill Minimum Requirement #4.

5: On-site Stormwater Management

- Consult **Book 1, Chapter 2** and **Book 2, Chapter 2** to fulfill Minimum Requirement #5.

6: Runoff Treatment

- Consult **Book 1, Chapter 3** and **Book 2 Chapters 3** and **4** to fulfill Minimum Requirement #6.

7: Flow Control

- Consult **Book 1, Chapter 4** and **Book 2, Chapters 5** and **6** to fulfill Minimum Requirement #7.

8: Wetlands Protection

- Consult **Book 1, Section 1.5.8** to fulfill Minimum Requirement #8.
- In addition, consult **CCC 40.450** for additional information relating to wetland protection in Clark County.

9: Operation and Maintenance

- Consult **Book 4, Operation and Maintenance** to fulfill Minimum Requirement #9.

1.5 Minimum Requirements

This section describes the Minimum Requirements for stormwater management at development and redevelopment sites. Consult Section 1.4 to determine which requirements apply to any given project and whether the Minimum Requirements apply to new surfaces, replaced surfaces, new and replaced surfaces, or converted vegetation areas.

1.5.1 Minimum Requirement #1: Preparation of Stormwater Site Plans

All projects meeting the thresholds in Section 1.4 shall prepare a Stormwater Site Plan for review by Clark County. Stormwater Site Plans shall use site-appropriate development principles to retain native vegetation and minimize impervious surfaces to the extent feasible. Stormwater Site Plans shall be prepared in accordance with Section 1.8 of this book.

Stormwater Site Plans shall use appropriate development principles to retain native vegetation and minimize impervious surfaces to the extent feasible. See Preservation of Native Vegetation (BMP T5.40) and Better Site Design (BMP T5.41) in Book 2, Chapter 2 for more information.

1.5.2 Minimum Requirement #2: Construction Stormwater Pollution Prevention

1.5.2.1 Thresholds

All new development and redevelopment projects are responsible for preventing erosion and discharge of sediment and other pollutants into receiving waters.

Projects which result in 2,000 square feet or more of new plus replaced hard surface area, or which disturb 7,000 square feet or more of land must prepare and submit a Construction Stormwater Pollution Prevention Plan (SWPPP) as part of the Final Stormwater Plan. Projects that meet the criteria for Small Project, as defined in Section 1.7, may submit the Stormwater Pollution Prevention Plan Short Form in Appendix 1-I.

Projects that result in less than 2,000 square feet of new plus replaced hard surface area or disturb less than 7,000 square feet of land are not required to prepare a Construction SWPPP, but must review the 13 Elements of Construction Stormwater Pollution Prevention and develop controls for each element that pertains to the project site.

The 13 Elements of Construction Stormwater Pollution Prevention are listed and described in Chapter 6.

1.5.2.2 General Requirements

The SWPPP shall include a narrative and drawings. All BMPs shall be clearly referenced in the narrative and marked on the drawings. The SWPPP narrative shall include documentation to explain and justify the pollution prevention decisions made for the project. Each of the 13 elements must be considered and included in the Construction SWPPP unless site conditions render the element unnecessary and the exemption from that element is clearly justified in the narrative.

Clearing and grading activities for developments shall be permitted only if conducted pursuant to an approved site development plan (e.g., subdivision approval) that establishes permitted areas of clearing, grading, cutting, and filling. These permitted clearing and grading areas and any other areas required to preserve critical or sensitive areas, buffers, native growth protection easements, or tree retention areas shall be delineated on the site plans and the development site.

The SWPPP shall be implemented beginning with initial land disturbance and until final stabilization. Sediment and erosion control BMPs shall be consistent with the BMPs contained in Book 2, Chapter 8.

Seasonal Work Limitations

From October 1 through April 30, clearing, grading, and other soil disturbing activities shall only be permitted if shown to the satisfaction of Clark County that silt-laden runoff will be prevented from leaving the site through a combination of the following:

1. Site conditions including existing vegetative coverage, slope, soil type and proximity to receiving waters.
2. Limitations on activities and the extent of disturbed areas.
3. Proposed erosion and sediment control measures.

The following activities are exempt from the seasonal clearing and grading limitations:

1. Routine maintenance and necessary repair of erosion and sediment control BMPs.
2. Routine maintenance of public facilities or existing utility structures that do not expose the soil or result in the removal of the vegetative cover to soil.

3. Activities where there is one hundred percent infiltration of surface water runoff within the site in approved and installed erosion and sediment control facilities.

4. Development projects in compliance with the state's Construction Stormwater General Permit.

1.5.3 Minimum Requirement #3: Source Control of Pollution

All known, available and reasonable source control BMPs must be applied to all projects. Source control BMPs must be selected, designed, and maintained according to Book 3 of this manual.

1.5.4 Minimum Requirement #4: Preservation of Natural Drainage Systems and Outfalls

Natural drainage patterns shall be maintained, and discharges from the project site shall occur at the natural location, to the maximum extent practicable. The manner by which runoff is discharged from the project site must not cause a significant adverse impact to downstream receiving waters and down gradient properties. All outfalls require energy dissipation (see Book 2, Section 7.6).

1.5.5 Minimum Requirement #5: On-site Stormwater Management

Projects shall employ On-site Stormwater Management BMPs in accordance with the following project thresholds, standards, and lists to infiltrate, disperse, and retain stormwater runoff on-site to the maximum extent feasible without causing flooding or erosion impacts.

Projects qualifying as flow control exempt in accordance with Section 1.5.7.1 do not have to achieve the LID Performance Standard, nor consider bioretention, rain gardens, permeable pavement, or full dispersion if using List #1 or List #2. However, those projects must implement the following BMPs, if feasible:

- BMP T5.13, Post-Construction Soil Quality and Depth, in Chapter 2 and Book 2, Chapter 2; and
- BMPs T5.10A or BMP T5.10B, Downspout Full Infiltration; BMP T5.10C, Downspout Dispersion; or BMP T5.10D, Perforated Stub-out Connections, in Chapter 2 and Book 2, Chapter 2; and
- BMPs T5.11, Concentrated Flow Dispersion; or T5.12, Sheet Flow Dispersion, in Chapter 2 and Book 2, Chapter 2.

1.5.5.1 Project Thresholds

Projects triggering only Minimum Requirements #1 – #5 shall either:

1. Use On-site Stormwater Management BMPs from List #1 for all surfaces within each type of surface in List #1; or

2. Demonstrate compliance with the LID Performance Standard. Projects selecting this option cannot use Rain Gardens. They may choose to use Bioretention BMPs as described in Chapter 2 and Book 2, Chapter 2 to achieve the LID Performance Standard. Projects selecting this option must implement BMP T5.13, Post-Construction Soil Quality and Depth, if feasible.

Projects triggering Minimum Requirements #1 – #9, must meet the requirements in Table 1.1.

Table 1.1: On-site Stormwater Management Requirements for Projects Triggering Minimum Requirements #1 - #9

Project Type and Location	Requirement
New development on any parcel inside the UGA, or new development outside the UGA on a parcel less than 5 acres	Low Impact Development Performance Standard and BMP T5.13; or List #2 (applicant option).
New development outside the UGA on a parcel of 5 acres or larger	Low Impact Development Performance Standard and BMP T5.13.
Redevelopment on any parcel inside the UGA, or redevelopment outside the UGA on a parcel less than 5 acres	Low Impact Development Performance Standard and BMP T5.13; or List #2 (applicant option).
Redevelopment outside the UGA on a parcel of 5 acres or larger	Low Impact Development Performance Standard and BMP T5.13.

NOTE: This table refers to the Urban Growth Area (UGA) as designated under the Growth Management Act (GMA) (Chapter 26.70A RCW) of the State of Washington. See Clark County Maps Online at http://gis.clark.wa.gov/mapsonline/ for the location of UGA boundaries.

1.5.5.2 Low Impact Development Performance Standard

Stormwater discharges shall match developed discharge durations to pre-developed durations for the range of pre-developed discharge rates from 8% of the 2-year peak flow to 50% of the 2-year peak flow. Refer to Section 1.5.7.3, Standard Flow Control Requirement of Minimum Requirement #7, for information about the assignment of the pre-developed condition. Project sites that must also meet Minimum Requirement #7, Flow Control must match flow durations between 8% of the 2-year flow through the full 50-year flow.

1.5.5.3 List #1: On-site Stormwater Management BMPs for Projects Triggering Minimum Requirements #1 – #5

For each surface, consider the BMPs in the order listed for that type of surface. Use the first BMP that is considered feasible. No other On-site Stormwater Management BMP is necessary for that surface. Feasibility shall be determined by evaluation against:

1. Limitations and infeasibility criteria identified for each BMP in Chapter 2; and,

2. Competing Needs Criteria listed in Chapter 2.

List #1

Lawn and landscaped areas

- Post-Construction Soil Quality and Depth in accordance with BMP T5.13 in Book 2, Chapter 2 of this manual.

Roofs

1. Full Dispersion in accordance with BMP T5.30A or BMP T5.30B in Chapter 2 and Book 2, Chapter 2, or Downspout Full Infiltration Systems in accordance with BMP T5.10A or BMP T5.10B in Chapter 2 and Book 2, Chapter 2.

2. Rain Gardens in accordance with BMP T5.14A in Chapter 2 and Book 2, Chapter 5 of this manual, or Bioretention in accordance with BMP T5.14B Chapter 2 and Book 2, Chapter 2.

3. Downspout Dispersion Systems in accordance with BMP T5.10C in Chapter 2 and Book 2, Chapter 2.

4. Perforated Stub-out Connections in accordance with BMP T5.10D in Chapter 2 and Book 2, Chapter 2.

Other Hard Surfaces

1. Full Dispersion in accordance with BMP T5.30A or BMP T5.30B in Chapter 2 and Book 2, Chapter 2.

2. Permeable pavement[1] in accordance with BMP T5.15 in Chapter 2 and Book 2, Chapter 5 of this manual, or Rain Gardens in accordance with BMP T5.14 in Chapter 2 and Book 2, Chapter 2, or Bioretention in accordance with Chapter 2 and Book 2, Chapter 2.

3. Sheet Flow Dispersion in accordance with BMP T5.12, or Concentrated Flow Dispersion in accordance with BMP T5.11 in Chapter 2 and Book 2, Chapter 2.

[1] This is not a requirement to pave these surfaces. Where pavement is proposed, it must be permeable to the extent feasible unless full dispersion is employed.

1.5.5.4 List #2: On-site Stormwater Management BMPs for Projects Triggering Minimum Requirements #1 – #9

For each surface, consider the BMPs in the order listed for that type of surface. Use the first BMP that is considered feasible. No other On-site Stormwater Management BMP is necessary for that surface. Feasibility shall be determined by evaluation against:

1. Design criteria, limitations, and infeasibility criteria identified for each BMP in Chapter 2 and Book 2, Chapter 2; and

2. Competing Needs Criteria listed in Chapter 2.

List #2

Lawn and landscaped areas

- Post-Construction Soil Quality and Depth in accordance with BMP T5.13 in Chapter 2 and Book 2, Chapter 2.

Roofs

1. Full Dispersion in accordance with BMP T5.30A or BMP T5.30B in Chapter 2 and Book 2, Chapter 5 of this manual, or Downspout Full Infiltration Systems in accordance with BMP T5.10A or BMP 5.10B in Chapter 2 and Book 2, Chapter 2.

2. Bioretention in accordance with BMP T5.14B in Chapter 2 and Book 2, Chapter 2. Bioretention facilities must have a minimum horizontally projected surface area below the overflow which is at least 5% of the total surface area draining to it.[2]

3. Downspout Dispersion Systems in accordance with BMP T5.10C in Chapter 2 and Book 2, Chapter 2.

4. Perforated Stub-out Connections in accordance with BMP T5.10D in Chapter 2 and Book 2, Chapter 2.

Other Hard Surfaces

1. Full Dispersion in accordance with BMP T5.30A or BMP T5.30B in Chapter 2 and Book 2, Chapter 2.

2. Permeable pavement[3] in accordance with BMP T5.15 in Chapter 2 and Book 2, Chapter 2.

[2] The minimum horizontally projected surface area requirement does not apply to projects meeting the LID Performance Standard.

3. Bioretention BMPs (See Chapter 2 and Book 2, Chapter 2) that have a minimum horizontally projected surface area below the overflow which is at least 5% of the total surface area draining to it.

4. Sheet Flow Dispersion in accordance with BMP T5.12, or Concentrated Flow Dispersion in accordance with BMP T5.11 in Chapter 2 and Book 2, Chapter 2.

1.5.6 Minimum Requirement #6: Runoff Treatment

1.5.6.1 Thresholds

When assessing a project against the following thresholds, only consider those hard and pervious surfaces that are subject to this Minimum Requirement as determined in Section 1.4.

The following require construction of stormwater treatment facilities:

- Projects in which the total of pollution-generating hard surface (PGHS) is 5,000 square feet or more in a threshold discharge area of the project, or
- Projects in which the total of pollution-generating pervious surfaces (PGPS) – not including permeable pavements – is three-quarters (3/4) of an acre or more in a threshold discharge area, and from which there will be a surface discharge in a natural or man-made conveyance system from the site.

The following sites require phosphorus treatment stormwater treatment facilities:

- Projects located in the Lacamas watershed above the dam at the south end of Round Lake.

1.5.6.2 Treatment Facility Sizing

Size stormwater treatment facilities for the entire area that drains to them, even if some of those areas are not pollution-generating, or were not included in the project site threshold decisions (Section 1.4) or the treatment threshold decisions of this Minimum Requirement (Section 1.5.6.1).

Water Quality Design Storm Volume

The water quality design storm volume is the volume of runoff predicted from a 24-hour storm with a 6-month return frequency (a.k.a., 6-month, 24-hour storm). Wetpool facilities are sized based upon the volume of runoff predicted through use of the Natural Resource Conservation Service curve number equations in Appendix 2-A, for the 6-month, 24-hour storm. Alternatively, when using an approved continuous simulation hydrologic model, the water quality design storm volume shall be equal to the simulated daily volume that represents the upper limit of the range of daily volumes that accounts for 91% of the entire runoff volume over a multi-decade period of record.

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[3] This is not a requirement to pave these surfaces. Where pavement is proposed, it must be permeable to the extent feasible unless full dispersion is employed.

Water Quality Design Flow Rate

Preceding Detention Facilities or when Detention Facilities are Not Required

The water quality design flow rate is the flow rate at or below which 91% of the runoff volume, as estimated by an approved continuous simulation hydrologic model, will be treated. Design criteria for treatment facilities are assigned to achieve the applicable performance goal (e.g. 80% TSS removal) at the water quality design flow rate. At a minimum, 91% of the total runoff volume, as estimated by an approved continuous flow model, must pass through the treatment facility(ies) at or below the approved hydraulic loading rate for the facility(ies).

Downstream of Detention Facilities

The water quality design flow rate is the full 2-year release rate from the detention facility.

1.5.6.3 Treatment Facility Selection, Design, and Maintenance

Stormwater treatment facilities shall be:

- Selected in accordance with the process identified in Chapter 3;
- Designed in accordance with the design criteria in Book 2, Chapters 3 and 4;
- Maintained in accordance with the maintenance schedules in Minimum Requirement #9 and Book 4 of this manual.

1.5.6.4 Additional Requirements

Direct discharge of untreated stormwater from pollution-generating hard surfaces to groundwater is prohibited, except for the discharge achieved by infiltration or dispersion of runoff through use of On-site Stormwater Management BMPs, in accordance with Chapter 2 and Book 2, Chapter 2; or by infiltration through soils meeting the soil suitability criteria in Book 2, Section 3.1.5.3.

1.5.7 Minimum Requirement #7: Flow Control

1.5.7.1 Applicability

The requirement below to provide flow control applies to projects that discharge stormwater directly, or indirectly through a conveyance system, into a surface waterbody.

Flow control is not required for projects that discharge directly to, or indirectly to, a waterbody listed in Section 1.2.3 subject to the following restrictions:

- Direct discharge to the exempt receiving water does not result in the diversion of drainage from any perennial stream classified as Types 1, 2, 3, or 4 in the State of Washington Interim Water

Typing System, or Types "S", "F", or "Np" in the Permanent Water Typing System, or from any category I, II, or III wetland; and

- Flow splitting devices or drainage BMPs are applied to route natural runoff volumes from the project site to any downstream Type 5 stream (seasonal non-fish bearing) or category IV wetland:
    - Design of flow splitting devices or drainage BMPs will be based on continuous hydrologic modeling analysis. The design will assure that flows delivered to Type 5 stream reaches will approximate, but in no case exceed, existing condition durations ranging from 50% of the 2-year to the 50-year peak flow.
    - Flow splitting devices or drainage BMPs that deliver flow to category IV wetlands will also be designed using continuous hydrologic modeling to preserve pre-project wetland hydrologic conditions unless specifically waived or exempted by regulatory agencies with permitting jurisdiction; and
- The project site must be drained by a conveyance system that is comprised entirely of manmade conveyance elements (e.g., pipes, ditches, outfall protection, etc.) and extends to the ordinary high water line of the exempt receiving water; and
- The conveyance system between the project site and the exempt receiving water shall have sufficient hydraulic capacity to convey discharges from future build-out conditions (under current zoning) of the site, and the existing condition from non-project areas from which runoff is or will be collected; and
- Any erodible elements of the manmade conveyance system must be adequately stabilized to prevent erosion under the conditions noted above.

If the discharge is to a stream that leads to a wetland, or to a wetland that has an outflow to a stream, both this requirement and Minimum Requirement #8 apply. In these cases the point of compliance is at the wetland.

1.5.7.2 Thresholds

When assessing a project against the following thresholds, consider only those impervious, hard, and pervious surfaces that are subject to this Minimum Requirement as determined in Section 1.4.

The following circumstances require achievement of the standard flow control requirement for western Washington:

- Projects in which the total of effective impervious surfaces is 10,000 square feet or more in a threshold discharge area, or
- Projects that convert ¾ acres or more of vegetation to lawn or landscape, or convert 2.5 acres or more of native vegetation to pasture in a threshold discharge area, and from which there is a surface discharge in a natural or man-made conveyance system from the site, or

- Projects that through a combination of effective hard surfaces and converted vegetation areas cause a 0.10 cubic feet per second increase in the 100-year flow frequency from a threshold discharge area as estimated using an approved continuous flow model and one-hour time steps (or a 0.15 cfs increase using 15-minute time steps). The 0.10 cfs (one-hour time steps) or 0.15 cfs (15-minute time steps) increase shall be a comparison of the post-project runoff to the existing condition runoff. For the purpose of applying this threshold, the existing condition is the pre-project land cover.

1.5.7.3 Standard Flow Control Requirement

Stormwater discharges shall match developed discharge durations to pre-developed durations for the range of pre-developed discharge rates from 50% of the 2-year peak flow up to the full 50-year peak flow. The pre-developed condition to be matched shall be a forested land cover unless one of the following conditions is met:

- Reasonable, historic information is provided that indicates the site was prairie prior to settlement (see Appendix 1-D). These areas are modeled as "pasture" in the approved continuous flow model.
- The drainage area of the immediate stream and all subsequent downstream basins has had at least 40% total impervious area since 1985[4]. In this case, the pre-developed condition to be matched shall be the existing land cover condition. Where basin-specific studies determine a stream channel to be unstable, even though the above criterion is met, the pre-developed condition assumption shall be the "historic" land cover condition, or a land cover condition commensurate with achieving a target flow regime identified by an approved basin study.
- The development site TDA drains to a reach of a stream where an Ecology approved basin plan has been developed that includes an alternative pre-development standard. See Appendix 1-B for these areas.

This standard requirement is waived for sites that will infiltrate all the runoff from hard surfaces and converted vegetation areas.

1.5.7.4 Flow Control Selection, Design and Maintenance

Flow control BMPs shall be

- Selected according to Chapter 4;
- Designed according to Book 2, Chapters 5 and 6;
- Maintained according to Book 4 of this manual.

[4] No areas in Clark County meet this criterion.

Stormwater shall be infiltrated to the maximum extent feasible under the design standards of this manual. Areas or watersheds where alternative flow control standards have been approved for use in Clark County can be found in Appendix 1-B.

The Western Washington Hydrology Model provides ways to represent On-site Stormwater Management BMPs. Using those BMPs reduces the predicted runoff rates and volumes and thus also reduces the size of the required flow control facilities. See Book 2, Chapter 2 and Appendix 2-C for more on modeling On-site Stormwater Management BMPs in WWHM.

1.5.8 Minimum Requirement #8: Wetlands Protection

1.5.8.1 Applicability

The requirements of this section apply to projects proposing to discharge stormwater into a wetland, either directly or indirectly through a conveyance system. See Figure 1.4.

1.5.8.2 Thresholds

The thresholds identified in Minimum Requirement #6, Runoff Treatment and Minimum Requirement #7; Flow Control shall be applied to determine the applicability of Minimum Requirement 8 to discharges to wetlands.

Use the flow chart in Figure 1.4 to determine if Minimum Requirement #8 is applicable. Fill out the checklist in Appendix 1-H and submit it with the Preliminary and Final Development Plan. If Minimum Requirement #8 is applicable, meet the requirements in Section 1.5.8.3.

1.5.8.3 Standard Requirements for Protecting Wetlands from Stormwater Flows

If the standards in Minimum Requirement 8 are triggered, the hydrologic analysis shall use the existing (not pre-developed) land cover condition to determine the existing hydrologic conditions unless directed otherwise by a regulatory agency with jurisdiction.

Use an approved continuous flow model for estimating the increases or decreases in total flows (volume) into a wetland that can result from the development project. These total flows can be modeled for individual days or on a monthly basis. Compare the results from this modeling to the following two criteria.

Criterion 1

The total volume of water into a wetland during a single precipitation event shall not be more than 20% higher or lower than the pre-project volumes.

Modeling algorithm for Criterion 1

1. Daily Volumes can be calculated for each day over 50 years for Pre- and Post-project scenarios. Volumes are to be calculated at the inflow to the wetland or the upslope edge where surface runoff, interflow, and ground water are assumed to enter.

2. Calculate the average of Daily Volume for each day for Pre- and Post-project scenarios. There will be 365 values for the Pre-project scenario and 365 for the Post-project.

Example calculation for each day in a year (e.g., April 1):

- If you use 50 years of precipitation data, there will be 50 values for April 1. Calculate the average of the 50, April 1, Daily Volumes for Pre- and Post-project scenarios.
- Compare the average Daily Volumes for Pre- versus Post-project scenarios for each day. The average Post-project Daily Volume for April 1 must be within +/- 20% of the Pre-project Daily Volume for April 1.

3. Check compliance with the 20% criterion for each day of year. Criterion 1 is met/passed if none of the 365 post-project daily volumes varies by more than 20% from the pre-project daily volume for that day.

Criterion 2

- The total volume of water into a wetland on a monthly basis shall not be more than 15% higher or lower than the pre-project volumes.

This needs to be calculated based on the average precipitation for each month of the year. This criterion is especially important for the summer months when a development may reduce the monthly flows rather than increase them because of reduced infiltration and recharging of ground water.

Modeling algorithm for Criterion 2

1. Monthly Volumes can be calculated for each calendar month over 50 years for Pre- and Post-project scenarios. Volumes are to be calculated at the inflow to the wetland or the upslope edge where surface runoff, interflow, and ground water are assumed to enter.

2. Calculate the average of Monthly Volume for each calendar month for Pre- and Post-project scenarios.

Example calculation for each calendar month in a year (e.g., April):

- If you use 50 years of precipitation data, there will be 50 values for the month of April. Calculate the average of the 50, April, Monthly Volumes for Pre- and Post-project scenarios.

- Compare the Monthly Volumes for Pre- versus Post-project scenarios. Post- project Monthly Volume for April must be within +/- 15% of the Pre- project Monthly Volume for April.

3. Check compliance with the 15% criterion for each calendar month of year. Criterion 2 is met/passed if none of the post- project Monthly Volume varies by more than 15% from the pre- project Monthly Volume for every month.

- Provide the results of both of these analyses in the Final Technical Information Report

1.5.8.4 Additional Requirements

- Stormwater discharges to Category I or Category II wetlands, or to a wetland that contains habitat for threatened or endangered species, must be treated before discharged.
- Refer to Guide Sheets 1 and 2 in Appendix 1-H to determine if wetlands can serve as treatment or flow control facilities.
- Stormwater treatment and flow control facilities shall not be built within a natural vegetated buffer, except for:
    - Necessary conveyance systems as approved by the Responsible Official; or
    - As allowed in wetlands approved for hydrologic modification and/or treatment in accordance with Guide Sheet 2 in Appendix 1-H of this book.
- Protecting a wetland from pollutants generated by a development should include the following measures:
    - Use effective erosion control at construction sites in the wetland's drainage catchment.
    - Institute a program of source control BMPs and minimize the pollutants that will enter storm runoff that drains to the wetland.
    - For wetlands the meet the criteria in Guide Sheet 1, provide a water quality control facility consisting of one or more treatment BMPs to treat runoff entering the wetland.
    - If the wetland is a Category I wetland because of special conditions (forested, bog, estuarine, Natural Heritage, costal lagoon), the facility should include a BMP with the most advanced ability to control nutrients.

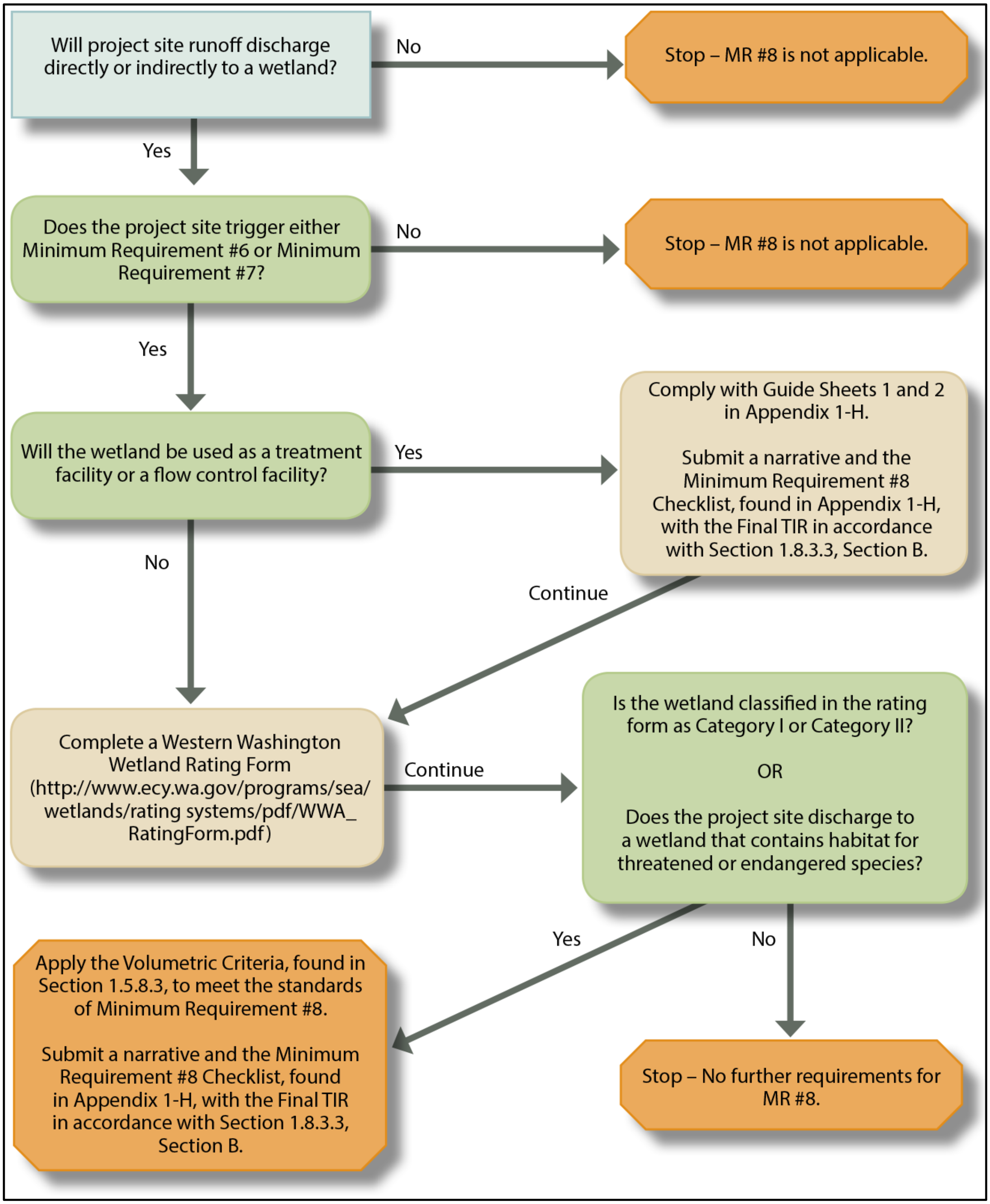

Figure 1.4: Minimum Requirement #8 Flow Chart

1.5.9 Minimum Requirement #9: Operation and Maintenance

A stormwater facility maintenance manual that includes the appropriate elements consistent with the provisions in Book 4 of this manual shall be submitted per Section 1.8 for proposed stormwater facilities and BMPs. The applicant shall identify the party (or parties) responsible for stormwater facility operation and maintenance. For privately owned facilities, a copy of the stormwater facility maintenance manual shall be retained on site or within reasonable access to the site and shall be transferred with the property to the new owner. For publicly owned facilities not maintained by the Clark County Public Works Department, a copy of the stormwater facility maintenance manual shall be retained in the appropriate department. A log of maintenance activity that indicates what maintenance activities were performed shall be kept and be available for inspection by Clark County.

1.6 Clark County Requirements

Requirements in Section 1.6 apply to projects in addition to the Minimum Requirements described above.

1.6.1 Specifications

Stormwater facilities shall be constructed in accordance with the latest edition of the *Standard Specifications for Road, Bridge, and Municipal Construction* as prepared by the Washington Department of Transportation, with exception of Clark County standards as noted in the Clark County Standard Details listed in Book 2, Chapter 9 of this manual.

1.6.2 Facility Signage and Markers

All stormwater facilities, including catch basins and manholes, capable of accepting stormwater shall be signed or marked as listed below:

- Inlets must be marked with a permanently-affixed "Protect water – Only Rain in the Drain" medallion near the inlet. See Book 2, Figure 9.1.
- Stormwater treatment and flow control facilities, including Onsite Management BMPs, must be marked with a sign specific to the type of facility, as shown in Book 2, Figures 9.2 through 9.9.
    - For Permeable Pavement BMPs, place once sign every 200' at a minimum.
- Signs for facilities in right of way must adhere to sign placement requirements in CCC 40.350.

Locations of medallions and signs shall be shown on the Final Development Plan (see Section 1.8.2.2).

1.6.3 Offsite Drainage Impacts

If the Responsible Official determines based on information in the Preliminary Stormwater Plan (see Section 1.8.1) that the proposed project will adversely impact offsite drainage systems, then the applicant shall implement additional flow control or other measures to mitigate those adverse impacts.

1.6.4 Erosion Control

1.6.4.1 General Standards

- All outfalls require energy dissipation (See Book 2, Section 7.6).
- Permanent infiltration BMPs shall not be used as temporary erosion control devices.
- Vehicles not performing a construction activity shall not be permitted off-street. Worker personal vehicles shall be parked on adjacent streets or other approved areas.

1.6.4.2 Underground Utility Construction

The construction of underground utility lines shall be subject to the following:

- BMPs shall be used to control erosion during and after construction.
- BMPs damaged during construction shall be replaced or repaired.

1.6.4.3 Signage

- Erosion control signage approved by the Responsible Official shall be installed at each point of entry on development and redevelopment sites subject to Minimum Requirement #2, as shown in Book 2, Figure 9.10.
- Removal of signage shall occur when either certificates of occupancy have been issued for seventy percent (70%) of the lots or there are less than ten (10) unoccupied lots remaining within the project site, whichever is later, or as determined by the Responsible Official.

1.6.5 On-going Maintenance

Maintenance of stormwater facilities shall be to the standards in Book 4 of this manual pursuant to CCC 13.26A.

1.7 Submittals for Small Projects

A Stormwater Site Plan is required for all new development and redevelopment projects that must comply with Minimum Requirement #1. The submittal requirements described in this section apply to development and redevelopment sites that qualify as small projects. Small projects are defined as development and redevelopment sites that trigger Minimum Requirements #1 – #5 and do not need an engineered design. These are generally projects that:

- Are residential or other buildings that do not require an Engineering Approval from Clark County; and
- Replace or add between 2,000 and 4,999 square feet of impervious and hard surfaces; and/or
- Disturb between 7,000 square feet and one acre of land.

Applicants with qualifying small projects may use the Stormwater Site Plan Report Short Form and the Construction SWPPP Short Form located in Appendix 1-I to meet submittal requirements.

Projects that require Minimum Requirement #2 only can refer to the Construction SWPPP Short Form in Appendix 1-I to meet submittal requirements for erosion control.

For detailed information about the applicability of Minimum Requirements to a specific project see Section 1.4.

> *Applicants with qualifying small projects are not required to use the instructions in the remainder of this manual and should refer to Appendix 1-I for guidance and submittal requirements.*

1.8 Submittals for Large and Engineered Projects

A Stormwater Site Plan is required for all new development and redevelopment projects that must comply with Minimum Requirement #1. The submittal requirements described in this section apply to projects that must meet Minimum Requirements #1 – #9 and to projects that must meet Minimum Requirements #1 – #5 and require an Engineering Approval from Clark County.

A Stormwater Site Plan is defined as the Preliminary Stormwater Plan, and its components; the Final Stormwater Plan, and its components; and the Construction Stormwater Pollution Prevention Plan. The Stormwater Site Plan must be approved by the Responsible Official before land-disturbing activity may begin.

The purpose of the submittal is to allow Clark County to determine whether the stormwater management plan proposed for the project will meet the requirements of CCC 40.386.

Plans and reports must be prepared by a licensed engineer in the state of Washington or another qualified professional as designated in this manual.

For projects that qualify for Minimum Requirement #1-#5 refer to instructions in the Site Plan Short Form located in Appendix 1-I.

1.8.1 Preliminary Stormwater Plan

The Preliminary Stormwater Plan shall identify how stormwater runoff that originates on the site or flows through the site is currently controlled and how this will change with the proposed development or redevelopment project. The Preliminary Stormwater Plan shall be submitted with the land use application.

The goal of the Preliminary Stormwater Plan process is to develop and provide a preliminary stormwater report describing the design strategies that will be used to meet stormwater management requirements. A primary objective of the stormwater plan is to manage runoff created by the project to evaporate, transpire, and infiltrate stormwater, and to achieve the goal of mimicking the pre-development natural hydrologic conditions on the site.

The project engineer shall include a statement that all the required information is included in the Preliminary Stormwater Plan and that the proposed stormwater facilities are feasible. All plans, studies, and reports that are part of the Preliminary Stormwater Plan shall be signed and dated by the professional civil engineer(s) (licensed in the state of Washington), or other qualified professional as designated in this manual, responsible for the preparation of the Preliminary Stormwater Plan and its components.

The Preliminary Stormwater Plan submittal shall consist of:

1) Existing Conditions Plan (Section 1.8.1.2)

2) Preliminary Development Plan (Section 1.8.1.3)

3) Offsite Areas Map (Section 1.8.1.4)

4) Preliminary Technical Information Report (TIR) (Section 1.8.1.5)

5) Soils Report (Section 1.8.3)

At the applicant's option, the applicant may submit a Final Stormwater Plan in accordance with the requirements of Section 1.8.2 in lieu of the Preliminary Stormwater Plan.

1.8.1.1 Modification of Content Requirements

The Responsible Official may waive in writing some or all of the content requirements in the Preliminary Stormwater Plan if:

- The project is included in an approved Stormwater Site Plan that meets the requirements of this manual; or
- The project is located in an area with an approved basin plan that makes some of the information irrelevant.

The waiver of some or all of the content requirements of the Preliminary Stormwater Plan does not relieve the applicant of the requirement to prepare a Final Stormwater Plan.

1.8.1.2 Existing Conditions Plan

The Existing Conditions Plan shall consist of 22-inch x 34-inch or 24-inch x 36-inch drawings; single family residence plans may be at 11-inch x 17-inch. Electronic submittals (in PDF) are encouraged. The Existing Conditions Plan shall include:

1. Existing property boundaries, easements, and rights-of-way.
2. Location of the 100-year floodplain and floodways and shoreline management areas on the site.
3. Existing contours with a 2-foot maximum contour interval, unless the Responsible Official determines a lesser interval is sufficient to show drainage patterns and basin boundaries. Contours with 10-foot or greater intervals are often sufficient for areas with slopes greater than 20%.
4. Natural drainage features on and adjacent to the site, including streams, wetlands, springs, and closed depressions.
5. Manmade drainage features on and adjacent to the site, including existing water quality or flow control BMPs and conveyance systems.
6. Areas of the site identified as geologic hazards as defined in CCC 40.430.
7. Existing on-site water wells, known agricultural drain tiles, structures, utilities, and septic tanks and drain fields.
8. Existing drainage flow routes for each threshold discharge area (TDA) to and from the site, including bypass flows.
9. Locations of existing hard surfaces.

10. Locations of existing pervious surfaces.

11. Existing areas of the site predominantly covered by native vegetation as defined in Appendix 1-A (e.g. native trees, shrubs, and herbaceous plants).

12. The delineated wetland boundary (for sites that discharge stormwater to a wetland, either directly or indirectly through a conveyance system, and that must meet Minimum Requirement #8, Wetlands Protection).

1.8.1.3 Preliminary Development Plan

The Preliminary Development Plan shall consist of 22-inch x 34-inch or 24-inch x 36-inch drawings; single family residence plans may be 11-inch x 17-inch. Electronic submittals (in PDF) are encouraged. The Preliminary Development Plan shall include:

1. Proposed property boundaries, easements, and rights-of-way.

2. Location of the 100-year floodplain and floodways and shoreline management area limits on the site.

3. Proposed contours with a 2-foot maximum contour interval, unless the Responsible Official determines a lesser interval is sufficient to show drainage patterns and basin boundaries.

4. Show the limits of the developed threshold discharge areas (TDAs). If the site will have more than one TDA, then label each one with a unique name. [Note: TDA names must be cross-referenced in the Technical Information Report, computer models, calculation sheets, and other pertinent submittals.]

5. Proposed drainage flow routes for each threshold discharge area (TDA) to and from the site, including bypass flows.

6. Locations of proposed hard surfaces.

7. Locations of proposed pervious surfaces. Locations of proposed structural source control BMPs in accordance with Minimum Requirement #3.

8. Locations of proposed points of discharge from the project site that preserve the natural drainage patterns and existing outfall locations in accordance with Minimum Requirement #4.

9. Areas of the project site where on-site stormwater management BMPs will be located in accordance with Minimum Requirement #5. This includes, but is not limited to, areas of retained native vegetation, location of retained or new trees to be used for surface reduction credit, and required flow paths and lengths of dispersion BMPs.

10. Approximate location and size of proposed runoff treatment and flow control facilities.

11. Include a conceptual grading plan that verifies the constructability of the proposed stormwater facilities.

12. The delineated on-site wetland boundary, and offsite wetland boundaries where stormwater is being discharged to a wetland, either directly or indirectly through a conveyance system.

13. Proposed detention/retention facilities, infiltration facilities, conveyances, discharges, and dispersion flow paths that intersect or are within 50 feet of a geologic hazard as defined in CCC 40.430.

The Responsible Official may require additional site or vicinity information before deeming an application "fully complete" if needed to determine the feasibility of the stormwater proposal.

1.8.1.4 Offsite Areas Map

The offsite areas map shall be a 8-1/2-inch x 11-inch or 11-inch x 17-inch map. Electronic submittals (in PDF) are encouraged. The map shall delineate the offsite areas contributing runoff to the site.

1.8.1.5 Preliminary Technical Information Report (TIR)

The preliminary TIR shall contain all technical information and analyses necessary to determine how applicable Minimum Requirements are being met and that the proposed stormwater facilities are feasible. The required contents of the preliminary TIR are identified below.

Section A – Project Overview

Section A.1: Site Information

Site information shall include:

- The location of the site, either with a parcel number, an address, or adjacent streets and distance to the nearest cross street.
- A description of the topography, natural drainage patterns, vegetative ground cover, and presence of critical areas, which include 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) and Shoreline Master Program Areas (CCC 40.460). Critical areas that receive runoff from the site shall be described to a minimum of ¼ mile away from the site boundary.
- A description of existing onsite stormwater systems and their functions, including drainage patterns to and from adjacent properties. Identify the primary discharge point or points from the site, and the suitability of the use of these BMPs on the site.

- A general description of proposed site improvements, including the size of improvements and proposed methods of mitigating stormwater runoff quantity and quality impacts.

Section A.2 – Determination of Applicable Minimum Requirements

Based upon the preliminary site layout, determine whether Minimum Requirements #1 – #5 or #1 – #9 apply to the project. Include the following information in table format:

- The amount of existing hard surface.
- The amount of new hard surface.
- The amount of replaced hard surface.
- The amount of native vegetation converted to lawn or landscaping.
- The amount of native vegetation converted to pasture.
- The total amount of land-disturbing activity.
- If a redevelopment project, a cost basis.
- The amount of pollution generating hard surface (PGHS); this includes pollution-generating impervious surfaces (PGIS).
- The amount of pollution-generating pervious surfaces (PGPS).
- The total amount of pollution-generating surfaces.
- The total amount of non-pollution generating surfaces.

Provide a statement that confirms which Minimum Requirements apply to the development activity. Trace on the flowchart (Figure 1.2 or Figure 1.3) to show how applicable Minimum Requirements were determined.

For development or redevelopment where Minimum Requirements #1 – #9 must be met:

- Provide the amount of effective impervious area in each TDA, and document through an approved continuous flow model the increase in the 100-year flood frequency from pre-developed to developed conditions for each TDA.
- List the TDAs that must meet the runoff treatment requirements listed in Minimum Requirement #6.
- List the TDAs that must meet the flow control requirements listed in Minimum Requirement #7.
- List the TDAs that must meet the wetlands protection requirements listed in Minimum Requirement #8.

Section B – Minimum Requirements

This section shall discuss how each Minimum Requirement applicable to the project (as identified in Section A.2) will be met.

Minimum Requirement #1 – Preparation of Stormwater Site Plans

All projects meeting the thresholds in Section 1.4 shall submit a Stormwater Site Plan for review by Clark County. Stormwater Site Plans shall use site-appropriate development principles to retain native vegetation and minimize impervious surfaces to the extent feasible.

Minimum Requirement #3 – Source Control of Pollution

If the development activity includes any of the activities listed in Book 3, Appendix 3-A, identify the source control BMPs to be used with the land-disturbing activity. See Book 3 for source control BMPs.

Minimum Requirement #4 – Preservation of Natural Drainage Systems and Outfalls

Describe how natural drainage patterns are being maintained, and how discharges from the project site shall occur at the natural location, to the maximum extent practicable. The manner by which runoff is discharged from the project site must not cause a significant adverse impact to downstream receiving waters and down gradient properties. All outfalls require energy dissipation.

See Book2, Chapter 7 for more information on energy dissipation designs.

Minimum Requirement #5 – On-site Stormwater Management BMPs

Describe how on-site stormwater management BMPs, including LID BMPs, will be effectively implemented on the site, in accordance with this Minimum Requirement.

1. General
    - Describe the suitability of the site for the selected BMPs, including hydrologic soil groups, geologic media, infiltration rates, slopes, and groundwater elevations.
    - Summarize the pertinent results from geotechnical studies or other information used to complete the design of each on-site stormwater BMP.
    - Identify the design criteria in this manual for each on-site stormwater management BMP selected, and describe how the criteria will be met.

2. LID
    - Indicate whether a mandatory list is being used to select LID BMPs or if the LID Performance Standard will be met.

- If using List #1 or List #2, provide written justification, including citation of site conditions identified in the soils report, for any on-site stormwater management BMPs that are determined to be infeasible for the project site. Complete the LID Feasibility Checklist (see Appendix 1-E), and include it in the TIR.
- If meeting the LID Performance Standard, provide:
  - Design details of all BMPs that are used to achieve the standard.
  - A complete computer model report including input files and output files. Projects taking an impervious surface reduction credit for newly planted or retained trees must provide those calculations and show the locations of the trees on the preliminary development plan. Projects using full dispersion or full downspout infiltration BMPs must provide information to confirm conformance with design requirements that allow removal of the associated drainage areas from computer model input.

Minimum Requirement #6 – Runoff Treatment Analysis and Design

For land-disturbing activities where the thresholds within Minimum Requirement #6 (see Section 1.5.6) indicate that runoff treatment facilities are required:

- Document the level of treatment required (basic, enhanced, phosphorus, oil/water separation), based on procedures in Chapter 3.
- Identify the BMPs used in the design, and list the reference or design manual used to design them.
- Include an analysis of initial construction costs and long-term maintenance costs.
- Show the approximate location and size of proposed runoff treatment facilities on the preliminary development plan.

Minimum Requirement #7 – Flow Control Analysis and Design

For land-disturbing activities where the thresholds within Minimum Requirement #7 indicate that flow control facilities are required:

- Summarize the site's suitability for infiltration, including tested infiltration rates, logs of soil borings, and other information provided in the Soils Report.
- If infiltration is infeasible for flow control, provide the following additional information:
  - Identify the areas where flow control credits can be obtained for dispersion, LID, or other measures, in accordance with the requirements in Chapter 2, Book 2, Chapter 2, and the guidance in Appendix 2-C.
  - Provide the approximate sizing and location of flow control facilities for each TDA, per Chapter 4.

- Identify the criteria (and their sources) used to complete the analyses, including pre-developed and post-developed land use characteristics.
- For sites considered to be historic prairie, submit a project site report prepared by a wetland scientist or horticulturist experienced in identifying soils, plant, and other evidence associated with historic prairies that demonstrates the existence of historic prairie on the project site. Areas within Clark County that were historically prairie are identified in Appendix 1-D. Historic prairie areas include Bear Prairie, Fourth Plain, Mill Plain, and Lacamas Prairie, among others. The map may be used only as an indicator of historic prairie, not for specific prairie boundaries.
- Complete a hydrologic analysis for historic and developed site conditions, in accordance with the requirements of CCC 40.386 and Book 2, Chapter 1, using an approved continuous flow model. Compute historic and developed flow durations for all TDAs. Provide an output table from the approved continuous flow model.
- Include and reference all hydrologic computations, equations, graphs, and any other aids necessary to clearly show the methodology and results.
- Include all maps, exhibits, graphics, and references used to determine pre-developed and developed site hydrology.

Minimum Requirement #8 – Wetlands Protection

For projects with stormwater discharges to a wetland, either directly or indirectly through a conveyance system, the preliminary TIR shall describe the analysis performed per Section 1.5.8 and the wetland protection measures to be implemented in accordance with Minimum Requirement #8. Complete and submit the Wetlands Checklist in Appendix 1-H.

Minimum Requirement #9 – Operation and Maintenance

Provide information on who will own, operate, and maintain the stormwater facilities, including LID BMPs that are considered in the design of treatment and flow control facilities meeting Minimum Requirements #5, #6 or #7.

Appendices

Map Submittals

The following maps shall be included with the TIR. All maps shall contain a scale and north arrow.

- **Vicinity Map**: All vicinity maps shall clearly show the project site.
- **Soils Map**: This map shall show soils mapped by the Natural Resources Conservation Service (NRCS) within the contributing area that drains to the site itself. Soils maps may be obtained from the following sources:

- Updated version of the Soil Survey of Clark County, Washington, originally published in 1972, and updated by the NRCS.
- Geographic information system (GIS) maps of soils from Clark County GIS.
- Washington soil survey data as available on the NRCS website (http://websoilsurvey.nrcs.usda.gov).
- If the maps do not appear to accurately represent the soils for the site, the applicant's geologist or geotechnical engineer is responsible for verifying the actual soils for the site.

- Other Maps

The following additional maps shall be required in the situations noted:

- Critical Aquifer Recharge Areas. If the site lies within a Category I or II critical aquifer recharge area (CARA), a map is required showing the extent of these areas in relation to the site. See CCC 40.410 for CARA regulations.
- Floodplains. If a floodplain mapped by the Federal Emergency Management Agency (FEMA) exists on or adjacent to the site, a map showing the floodplain is required. See CCC 40.420 for Flood Hazard Areas regulations.
- Shoreline Management Area. If the site contains or is adjacent to a water body regulated under the Washington Shorelines Management Act, a map showing the boundary of the shoreline management area in relation to the site is required. See CCC 40.460 for Shoreline Management Area regulations.

Other Submittals

1. Soils Report: See Section 1.8.3.

1.8.2 Final Stormwater Plan

In accordance with Minimum Requirement #1, the Final Stormwater Plan provides final engineering design and construction drawings for the stormwater aspects of a proposed new development or redevelopment project. The Final Stormwater Plan shall be submitted and approved by the Responsible Official before construction of the development can begin.

All plans, studies, and reports that are part of the Final Stormwater Plan shall be signed and dated by the professional civil engineer(s) (registered in the state of Washington), or other qualified professional as designated in this manual, responsible for the preparation of the Preliminary Stormwater Plan and its components.

The goal of the Final Stormwater Plan submittal is to allow the Responsible Official to review the following:

1. Any easements, covenants, or agreements necessary to permit construction and maintenance, including for each on-site stormwater management BMP.

2. Design details, figures, and maintenance instructions for each post construction Stormwater Management BMP. These documents must be suitable to serve as a recordable document that can be attached to a declaration of covenant and grant of easement associated with each lot.

3. Final engineering plans that provide sufficient detail to allow construction of the stormwater facilities. These plans shall be stamped, signed, and dated by the engineer(s), registered in the state of Washington, responsible for hydrologic, hydraulic, geotechnical, structural and general civil engineering design and by the project engineer responsible for the preparation of the Final Stormwater Plan. The final engineering plan shall show all utilities to ensure that conflicts between proposed utility lines do not exist.

4. The approved Preliminary Stormwater Plan, with an explanation of any differences between the design concepts included in the preliminary and Final Stormwater Plans. If a Final Stormwater Plan differs from the approved Preliminary Stormwater Plan in a manner that, in the opinion of the Responsible Official, raises significant water quality or quantity control issues, it shall require another SEPA determination (if subject to the State Environmental Policy Act [SEPA]) and a post-decision review, in accordance with CCC Section 40.520.060.

5. A final development plan (which may be a part of the final engineering plans or a separate plan). See the requirements identified below.

6. A final technical information report (TIR). See the requirements identified below.

7. For a subdivision, short plat, or development project on which individual sites or pads will be sold or built under different responsibility, an individual stormwater lot plan is required for each lot or pad. This plan must show the details of all stormwater facilities planned for the site to meet requirements pertaining to and for each specific lot. The project applicant will need to complete all required forms and participate in all required meetings (including on-site inspections) to ensure that lot plans meet stormwater requirements. The plan shall be to a scale that is readable as determined by the Responsible Official. [Note: subsequent construction on the lot(s) will require conformance to the submitted stormwater lot plan.]

The Final Stormwater Plan shall consist of:

1. Final Development Plan (Section 1.8.2.2)

2. Final Technical Information Report (TIR) (Section 1.8.2.3)

3. Soils Report (Section 1.8.3)

4. Administrative and Legal Submittals (Section 1.9)

1.8.2.1 Modification of Content Requirements

The Responsible Official may waive in writing some or all of the content requirements in the Final Stormwater Plan if:

- The project is included in an approved Stormwater Site Plan that meets the requirements of this manual; or
- The project is located in an area with an approved basin plan that makes some of the information irrelevant.

1.8.2.2 Final Development Plan

The Final Development Plan shall be consistent with the Preliminary Development Plan and may be combined with the final engineering plans. In addition to the information required in the Preliminary Development Plan, the final plan requires the following information:

1. Threshold discharge area (TDA) delineations, and hard surface and pervious area delineations and area by TDA.
2. The acreage of pollution-generating pervious surfaces (PGPS) and pollution-generating hard surfaces (PGHS) used in the hydraulic/hydrologic calculations both onsite and offsite that contribute surface runoff.
3. Directions and lengths of overland, pipe, and channel flow.
4. Outfall points from each TDA and overflow routes for the 100-year storm.
5. Onsite conveyance systems, including pipes, catch basins, channels, ditches, swales, and culverts.
6. Energy dissipation designs for all outfalls.
7. Primary flow path arrows for drainage under developed conditions, with the calculated flow rates. Cross-reference the flow rates to the hydrological model output file used to calculate the flow rates.
8. The site's Point of Compliance (POC).
9. Locations of required signs and markers.
10. The Responsible Official may require additional site or vicinity information if needed to determine the feasibility of the stormwater proposal.

1.8.2.3 Final Technical Information Report (TIR)

The final TIR shall be a comprehensive report, supplemental to the final engineering plans, that contains all technical information and analyses necessary to complete final engineering plans based on sound engineering practices and appropriate geotechnical, hydrologic, hydraulic, and water quality design.

The final TIR shall be stamped, signed, and dated by the professional engineer(s), registered in the state of Washington, responsible for hydrologic, hydraulic, geotechnical, structural and general civil engineering design.

The required contents of the final TIR, which is part of the Final Stormwater Plan, are identified below.

Section A – Project Overview

Provide the information from the preliminary TIR, with the following additional elements:

1. Reference the conceptual design proposed in the Preliminary Stormwater Plan, and identify revisions contained within the final engineering plans.

Section B – Minimum Requirements

Provide the information from Section B of the preliminary TIR, revised as necessary for the final design. Confirm the applicable Minimum Requirements identified in the preliminary TIR. For land-disturbing activities where Minimum Requirements #1 – #9 must be met, provide the required information listed in Section B of the preliminary TIR, revised to reflect the final design.

Minimum Requirement #2 – Construction Stormwater Pollution Prevention

All projects are required to comply with Minimum Requirement #2. Provide a statement declaring that a Construction Stormwater Prevention Plan meeting the requirements of Minimum Requirement #2 will be submitted, with the Erosion Control Inspection fee.

Minimum Requirement #3 – Source Control

See the preliminary TIR requirements.

Minimum Requirement #4 – Preservation of Natural Drainage Systems and Outfalls

See the preliminary TIR requirements.

Minimum Requirement #5 – On-site Stormwater Management BMPs

Provide the information from the preliminary TIR, with the following additional elements:

1. Reference the conceptual design proposed in the Preliminary Stormwater Plan, and identify revisions contained within the final engineering plans.

2. For Post-Construction Soil Quality and Depth, provide details on the method used to meet the criteria given in the Design Installation and Specifications section of BMP T5.13 in Book 2, Chapter 2.

3. For Full Dispersion, Provide an analysis that demonstrates standards are met for BMP T5.30A or BMP T5.30B.

4. For bioretention systems and rain gardens, provide the following:

    a. The proposed soil matrix for the facility.

    b. The planting plan, listing proposed plant types and locations.

    c. Detail drawings, including the following:

        - If an underdrain is used, show drain rock, pipe, and filter fabric specifications.

        - All stormwater piping associated with the facility, including manholes, catch basin, pipe materials, sizes, slopes, and invert elevations.

        - Width, length, side slopes, and maximum design water depth for all facilities.

        - Irrigation system, if installed.

        - Designs for any retaining walls proposed. Structural walls shall meet county building permit requirements.

5. For porous pavements, provide supporting design calculations showing adequate infiltration rates to accommodate flows from all impervious surfaces directed onto any porous pavement. Reference standard details used in the design.

6. For reversed slope sidewalks, provide details on the planting plan for areas receiving water from reversed slope sidewalks.

7. Tree retention and planting.

8. Preserving native vegetation.

9. Rainwater harvesting if used as a flow reduction BMP.

10. Vegetated roof if used as a flow reduction BMP

Minimum Requirement #6 – Runoff Treatment Analysis and Design

For land-disturbing activities where the thresholds within Minimum Requirement #6 indicate that runoff treatment facilities are required, provide the information from the preliminary TIR, with the following additional elements:

1. Reference the conceptual runoff treatment design proposed in the Preliminary Stormwater Plan.
2. Identify revisions to the conceptual runoff treatment design contained in the Preliminary Stormwater Plan.
3. Complete a detailed analysis and design of all proposed runoff treatment system elements, in accordance with Book 2, Chapters 3 and 4. Reference runoff treatment system elements to labeled points shown on the site location map or final development plan.
4. Include and reference all computations, equations, charts, nomographs, detail drawings, and other tabular or graphic aids used to design water quality system elements in the technical appendix.
5. Summarize the results of the runoff treatment design and describe how the proposed design meets the requirements of CCC Chapter 40.386 and this manual.

Treatment System Plan

1. Provide an illustrative sketch of the treatment facilities and appurtenances.
2. The sketch shall correspond with the final engineering plans. Alternatively, a final site grading plan that incorporates the above information may be included as an attachment to the Final Stormwater Plan.
3. Provide electronic copies of the drawings used for analysis, measurement, and design inputs for the hydrologic analysis submitted with the final drawing in Portable Document Format (PDF) format.

Minimum Requirement #7 – Flow Control

For land-disturbing activities where the thresholds within Minimum Requirement #7 indicate that flow control facilities are required:

1. Identify revisions to the conceptual design proposed in the Preliminary Stormwater Plan.
2. Identify initial conditions, including stream base flows, beginning water surface elevations, hydraulic or energy grade lines, initial groundwater elevations, beginning storage volumes,

and other data or assumptions used to complete the analyses of initial conditions. Reference the sources of information.

3. Describe any assumptions used to complete the analysis, including flow credits through the use of onsite stormwater BMPs or LID measures.

4. Complete a detailed hydrologic analysis for existing and developed site conditions, in accordance with the requirements of Book 2, Chapter 1, using an approved continuous flow model. Compute pre-developed and developed flow durations for all sub-basins. Provide an output table from the model, including the following:

    a. Flow rates for the 2-, 10-, and 100-year return periods for pre-developed and developed conditions.

    b. A table listing the pass/fail rates for each flow level where duration statistics were calculated.

    c. A graph showing the flow rate on the y axis and percent time exceeding on the x axis for pre-developed conditions and post-developed mitigated conditions, from 50 percent of the 2-year flow rate through the 50-year flow rate.

    d. Written justification for any manual changes to model parameters (e.g. changes to LSUR, SLSUR, NSUR, etc. for the PERLND or IMPERLND parameters in WWHM).

5. Provide a hydraulic analysis of pipes and/or channels that lead to and/or from the outlet structure. The analysis should confirm the capacity of pipes and channels to convey the peak flow rates for the 2-, 10-, 50-, and 100-year return period flow rate with the water surface elevation of the pond at the elevation for those return period flow rates.

6. Submit electronic copies of the approved continuous flow model project files to allow reviewers to run the model and confirm the model results.

7. Include and reference all hydrologic and hydraulic computations, equations, rating curves, stage/storage/discharge tables, graphs, and any other aids necessary to clearly show the methodology and results.

8. Include all maps, exhibits, graphics, and references used to determine pre-development and developed site hydrology.

Flow Control System Plan

1. Provide an illustrative sketch of the flow control facilities and appurtenances.

2. Show basic measurements necessary to confirm storage volumes.

3. Show all orifice, weir, and flow restrictor dimensions and elevations.

4. The sketch shall correspond with final engineering plans. Alternatively, a final site grading plan that incorporates the above information may be included as an attachment to the Final Stormwater Plan.

5. Provide electronic copies of the drawings used for analysis, measurement, and design inputs for the hydrologic analysis submitted with the final drawing in Portable Document Format (PDF) format.

Minimum Requirement #8 – Wetlands Protection

For projects that discharge stormwater to a wetland, either directly or indirectly through a conveyance system, the TIR shall describe wetland protection measures to be implemented in accordance with Minimum Requirement #8. The narrative shall describe the analysis performed (See Section 1.5.8) to define the measures that will maintain the hydrologic conditions and hydrophytic vegetation.

Minimum Requirement #9 – Operation and Maintenance

Provide information on who will own, operate, and maintain the permanent stormwater facilities.

Submit an operation and maintenance manual that includes O&M procedures for each stormwater control or treatment facility that will be privately maintained.

The manual shall be written in an orderly and concise format that clearly describes the design and operation of the facility. The manual shall also provide an outline of required maintenance tasks, with recommended frequencies at which each task should be performed. The manual shall contain or reference procedures from Book 4, *Stormwater Facility Operations and Maintenance*.

See Section 1.9 for details on legal documents such as covenants and plat information.

Section C – Conveyance Systems Analysis and Design

1. Reference the conceptual drainage design proposed in the Preliminary Stormwater Plan.

2. Identify revisions to the conceptual drainage design contained in the Preliminary Stormwater Plan.

3. Include and reference in the technical appendix all computations, equations, charts, nomographs, detail drawings, and other tabular or graphic aids used to design conveyance system elements.

4. Identify and discuss initial conditions, including water surface elevations, hydraulic or energy grade lines, beginning storage elevations, and other data or assumptions used to complete the analyses of initial conditions. Reference the sources of information.

5. Describe any assumptions used to complete the analyses.

6. Complete a detailed hydraulic analysis of all proposed collection and conveyance system elements, including flow splitters, outfall structures, and outlet protection in accordance with Book 2, Chapter 7, Conveyance Design. Compute and tabulate the following:

7. Identify design flows and velocities and conveyance element capacities for all conveyance elements within the development.

8. Identify the 10-year recurrence interval stage for detention facility outfalls (See Book 2, Chapter 7). Provide stage-frequency documentation from an approved continuous flow model.

9. Compute existing 100-year floodplain elevations and lateral limits for all channels, and verify no net loss of conveyance or storage capacity from development.

10. Reference conveyance system elements to labeled points shown on the site location map or development plan.

11. Verify the capacity of each conveyance system element to convey design flow and discharge at non-erosive velocities. Verify the capacity of the onsite conveyance system to convey design flows that result from ultimate build-out of upstream areas.

12. Include and reference all hydraulic computations, equations, pipe flow tables, flow profile computations, charts, nomographs, detail drawings, and other tabular or graphic aids used to design and confirm the performance of conveyance systems.

13. Summarize the results of system analyses, and describe how the proposed design meets the requirements of this manual.

Section D Additional Requirements

Section D.1 – Offsite Analysis

If applicable, provide the results of an offsite analysis prepared in accordance with Chapter 5.

Offsite analysis is required when a project that must meet Minimum Requirements #1 – #9 meets any of the following criteria:

- Adds 35,000 square feet or more of new pervious surface.

- Constructs or modifies a drainage pipe or ditch that is 12 inches or more in size/depth or that receives runoff from a drainage pipe or ditch that is 12 inches or more in size/depth.
- Contains or lies adjacent to a landslide, steep slope, or erosion hazard area.
- Is not exempt from Minimum Requirement #8.
- The project changes the rate, volume, duration, or location of discharges to and from the project site.

Section D.2 - Closed Depression Analysis

If applicable, provide the results of a closed depression analysis prepared in accordance with Book 2, Chapter 1.

Section D.3 – Other Permits

Construction of roads and stormwater facilities may require additional permits from other agencies. These permits may contain requirements that affect the design of the stormwater system. This section lists the titles of other possible required permits, the agencies that require the permits, and the permit requirements, if known, that may affect the Final Stormwater Plan. Approved permits that are critical to the feasibility of the stormwater facility design shall be included in this section.

1. Onsite sewage disposal: Clark County Public Health or Washington Department of Health
2. Developer/local agency agreement: Washington State Department of Transportation (WSDOT) (connection license)
3. Temporary exceedance of State Surface Water Quality Standards – Turbidity Mixing Zone: Washington Department of Ecology (WAC 173-201A)
4. An Ecology general construction stormwater permit for projects that disturb over an acre
5. An Ecology general stormwater permit for industrial activities
6. Hydraulic project approval: Washington Department of Fish and Wildlife (WDFW)
7. Dam safety permit: Ecology
8. Section 10, 404, and 103 permits: U.S. Army Corps of Engineers
9. Surface mining reclamation permits: Washington Department of Natural Resources
10. Clark County critical aquifer recharge area (CARA) permit: CCC Chapter 40.410
11. Clark County floodplain permit: CCC Chapter 40.420

12. Clark County geohazard permit: CCC Chapter 40.430

13. Clark County habitat permit: CCC Chapter 40.440

14. Clark County wetland permit: CCC Chapter 40.450

15. Clark County shoreline management permit: CCC Chapter 40.460

16. Underground injection control (UIC) well registration: Ecology (Clark County requires registration through the Washington State Department of Ecology for all UICs)

Section D.3—Approval Conditions Summary

List each preliminary approval condition related to stormwater control, wetlands, floodplains, and other water-related issues, and describe how the final design addresses or conforms to each condition.

Section D.4 – Special Reports and Studies

Where site-specific characteristics, such as steep slopes, wetlands, and sites located in floodplains or wellhead protection areas, present difficult drainage and water quality design problems, the Responsible Official may require additional information or the preparation of special reports and studies that further address the specific site characteristics, describe the potential for impacts associated with the development, and demonstrate the proposed measures to mitigate impacts. Special reports shall be prepared by professionals with expertise in the particular area of analysis, who shall date, sign, stamp, and otherwise certify the report. Subjects of special reports may include, but are not be limited to:

1. Geotechnical

2. Wetlands

3. Floodplains and floodways

4. Groundwater

5. Structural design

6. Fluvial geomorphology (erosion and deposition).

All special reports and studies shall be included in the technical appendix.

Map Submittals

See the preliminary TIR requirements.

Technical Data

All TIRs shall contain a technical appendix that includes all computations completed in the preparation of the TIR, together with copies of referenced data, charts, graphs, nomographs, hydrographs, stage-storage discharge tables, maps, exhibits, and all other information required to clearly describe the stormwater flow control and runoff treatment design for the proposed development activity. The format of the technical appendix shall follow as closely as possible the section format of the TIR and shall be adequately cross-referenced to ensure that the design may be easily followed, checked, and verified. The technical appendix shall also contain all special reports and studies.

1.8.3 Soils Report

For projects subject to engineering review triggering Minimum Requirements #1 – #5 or Minimum Requirements #1 – #9, a soils report is required. This report must be prepared by a certified 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 or, for projects meeting Minimum Requirements #1 – #5, the report may be prepared by a licensed on-site sewage designer.

The report must include information gathered in the soil assessments and characterization studies described in Chapters 2 and 4, and include the information presented below.

The requirements for this report differ, depending upon which Minimum Requirements are triggered. For sites triggering Minimum Requirements #1 – #5, the following is required.

- The report shall identify:
  - Underlying soils on the site utilizing soil surveys, soil test pits, soil borings, or soil grain analyses (see http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm for soil survey information).
  - The results of infiltration testing using a Clark County approved method (see Chapter 4) to assess infiltration capability and the feasibility of rain gardens, bioretention, and permeable pavement, if applicable. Grain size analyses may substitute for infiltration tests.
  - Submit justification for the number of infiltration tests conducted and the correction factors used per Chapters 2 and 4, if applicable.

  - The results of testing for an hydraulic restriction layer (groundwater, soil layer with less than 0.3 in/hr Ksat, bedrock, etc.) under possible sites for a rain garden, bioretention facility, or permeable pavement.

For sites triggering Minimum Requirements #1 – #9, include the above information, plus the following additional items:

- Soil stratigraphy shall be assessed for low permeability layers, highly permeable sand/gravel layers, depth to groundwater, and other soil structure variability necessary to assess subsurface flow patterns. Soil characterization for each soil unit (soil strata with the same texture, color, density, compaction, consolidation and permeability) shall include:
  - Grain size distribution
  - Textural class
  - Percent clay content
  - Cation exchange capacity
  - Color/mottling
  - Variations and nature of stratification
- Site characterization information as described in Chapter 4.
- The results of infiltration testing to assess infiltration capability and the feasibility of bioretention, and permeable pavement. Use Clark County approved soil testing methods (see Section 4.3.1.3). Grain size analyses may substitute for infiltration tests on sites underlain by unconsolidated sediment.
- The results of testing for an hydraulic restriction layer (groundwater, soil layer with less than 0.3 in/hr Ksat, bedrock, etc.) under possible sites for a bioretention facility, or permeable pavement.
- Results from the groundwater assessment as described in Section 2.3.1.5.

1.8.4 Construction Stormwater Pollution Prevention Plan (SWPPP)

The Construction SWPPP is a required portion of the Stormwater Site Plan and must be approved by the Responsible Official prior to land-disturbing activity.

The Construction SWPPP shall be submitted to the Responsible Official at the applicant's discretion at any time between submittal of the Final Stormwater Plan and 10 working days prior to the pre-construction conference.

Chapter 6 describes requirements for preparation of the Construction SWPPP. The Construction SWPPP shall be prepared by a licensed engineer in the state of Washington or by a person who holds a valid Certified Erosion and Sediment Control Lead (CESCL) certification.

Note: If the Construction SWPPP is not received as part of the Final Stormwater Plan submittal for Final Engineering Review, the Final Engineering Approval will be conditioned on review and approval of the Construction SWPPP before land-disturbing activity is permitted.

Clark County recommends applicants prepare and submit the Construction SWPPP as part of the Final Stormwater Plan submittal for Final Engineering Review.

1.8.5 Stormwater Plan Revisions

If the applicant must make changes or revisions to the Final Stormwater Plan after approval, the proposed revisions shall be submitted to Clark County for review and approval. The submittal shall include the following:

1. Substitute pages from the originally approved Final Stormwater Plan, and identify the proposed changes.

2. Revised drawings, showing any structural changes.

3. Any other supporting information that explains and supports the reason for the change.

All revisions shall be stamped, signed, and dated by the professional engineer(s), registered in the state of Washington, responsible for hydrologic, hydraulic, geotechnical, structural and general civil engineering design.

1.8.6 Record Drawings

Record drawings which completely and accurately represent the project site as constructed shall be provided to the county prior to:

1. The issuance of building permits for single-family/duplex residential subdivisions;

2. Provisional acceptance of stormwater facilities to be owned by the county; and

3. The issuance of occupancy permits for development subject to site plan review.

The record drawings shall include corrected engineering plans for the stormwater facilities, showing constructed dimensions and elevations. In addition, revisions to the Final Stormwater Plan shall be submitted with the record drawings where changes during construction significantly alter the calculations and assumptions contained in the plan.

All record drawings shall be submitted on Mylar (or acceptable media per Community Development) and clearly reproducible. The record drawing submittal shall be stamped, signed and dated by an engineer licensed in the state of Washington.

Record drawings shall also be submitted on computer disk in the following approved file formats: Portable Document Format (.pdf), derived directly from the electronic design software (scans of paper as-builts may be accepted on a case-by-case basis).

Record drawings shall clearly indicate the ownership of any stormwater facilities and who is responsible for the maintenance of each component.

1.9 Administrative and Legal Requirements

All project proponents are required to submit administrative and legal documents as described in this section when applicable to the project.

1.9.1 Documentation of Ownership and Maintenance Responsibilities

1.9.1.1 Authority of Applicant; Obligations of Developer

Each project applicant (Applicant) must submit documentation demonstrating the legal authority to bind the owner and developer of the subject property, and their successors in interest with respect to the subject property (all of which are referred to as Developer), to comply with the requirements and conditions of this manual. The Developer must comply with the requirements, conditions, and any other obligations of this manual.

1.9.1.2 Required Documents

The Applicant shall obtain approval by the Responsible Official of the documented allocation of long-term ownership and maintenance responsibility for stormwater facilities as part of county approval of the Final Stormwater Plan. There are up to five separate documents that describe stormwater facility ownership and maintenance responsibility. These are (1) the final engineering plan; (2) the approved subdivision plat or site plan; (3) the developer covenant to Clark County; (4) the subdivision covenants, conditions and restrictions (CC&R's); and (5) any deed necessary to convey ownership of an easement across property or the property itself. The persons responsible for stormwater facility ownership and maintenance must be clearly identified in each document, and each other document must be consistent with the approved final engineering plan and record drawings.

The Final Stormwater Plan must clearly indicate the owner of and persons responsible for ongoing maintenance of each element of the project stormwater facilities. Plats must include notes specifying the stormwater facility owner and the person or entity responsible for long-term maintenance of every component of the stormwater facilities, including components in easements.

1.9.2 County Ownership of Stormwater Facilities

County ownership of stormwater facilities is required for all such facilities located within a public right-of-way or on a legal tract conveyed to the county.

Clark County will accept ownership only of stormwater treatment and flow control facilities, including low impact development BMPs, that are built as part of single-family residential subdivisions or facilities that include elements of the county storm sewer system that convey stormwater through an easement granted to Clark County.

Permeable pavement, bioretention facilities and enclosed underground systems including UIC regulated structures in residential subdivisions may be placed in public right-of-way subject to the standards of Chapter 40.350 CCC. Except as provided below in this paragraph, all other stormwater treatment and flow control facilities that serve residential subdivisions and short plats must be located on separate lots or tracts. Clark County recommends that these tracts meet minimum zoning lot size requirements. Stormwater conveyance systems that are not on-site stormwater management facilities, treatment facilities or flow control facilities may be placed on easements.

1.9.2.1 County Stormwater Facility Acceptance Process

For stormwater facilities that will be owned by the county, the county will provisionally accept ownership upon (1) approval of the record drawings; (2) approval of a facility inspection; and (3) receipt of a workmanship and materials and maintenance bond (or other secure method) in the amount of 10 percent (10%) of the construction cost (as prepared by the project engineer) acceptable to the Responsible Official. Provisional acceptance of the facilities does not relieve the Developer from any obligation to undertake any remedial measures to correct deficiencies in the design, construction, maintenance, or operation of the facilities.

No sooner than 18 months after the provisional acceptance of the facilities, the Applicant or Developer shall notify the Responsible Official that the facilities are eligible for final acceptance. The Developer shall continue to maintain the facilities until the county inspects and subsequently accepts the facilities.

The county may accept new stormwater facilities for single family residential development that are constructed under a preliminary plat approval that meets all of the following conditions:

1. Improvements in residential plats have been completed for at least 80 percent of the lots, unless this requirement is waived by the county.

2. All stormwater facilities have been tested as required by this manual, inspected, and have been approved by Clark County, and have been in satisfactory operation for at least 2 years.

3. All stormwater facilities reconstructed or repaired during the maintenance period have been approved by Clark County. For facilities that required modification, the Responsible Official may require extension of the maintenance period for an additional 1-2 years.

4. The stormwater facilities, as designed and constructed, conform to the provisions of this manual and to Chapters 13.26A and 40.386 of the Clark County Code.

5. All easements, lots and tracts required under this manual that the county must own or have access across in order to operate, inspect, maintain and repair stormwater facilities have been conveyed to Clark County, and all required conveyances have been recorded with the Clark County Auditor.

6. The Applicant or Developer has provided to Clark County a complete and accurate set of reproducible Mylar as-built (record) drawings from black and white reproductions may be produced without losing information and detail.

7. The Applicant or Developer has provided to Clark County a complete and accurate set of the as-built (record) drawings on computer disk in the following approved file format: Portable Document Format (.pdf) derived directly from the electronic design software (scans of paper as-builts may be accepted on a case-by-case basis).

1.9.2.2 Warranty Period for Maintenance of Stormwater Facilities

For stormwater facilities that will be conveyed to the county, for a period of at least two (2) years following the provisional acceptance of stormwater facilities, or thereafter until the facilities are finally accepted by the county, the Developer shall operate, inspect, maintain, repair, redesign, and reconstruct the facilities as necessary to ensure that they meet this manual's standards. This obligation shall extend to remedying any damage caused to the facilities by accident, acts of nature, other builders or third parties during the warranty period. The required maintenance shall be performed according to the *Clark County Stormwater Manual* pursuant to Chapter 13.26A CCC.

1. During the warranty period, the Developer shall be responsible for and shall complete prior to acceptance all remedial work to correct deficiencies, including design deficiencies. Required remedial work to correct design, maintenance and construction deficiencies shall be completed by the Developer prior to final acceptance and may result in the extension of the maintenance period.

2. Following final acceptance for county ownership, the county shall maintain stormwater facilities.

1.9.3 Private Ownership and Maintenance Responsibility for Stormwater Facilities

If the county does not accept ownership of stormwater facilities, the Applicant shall ensure the assumption of ongoing responsibilities for stormwater facilities according to 1.9.3.1 through 1.9.3.5, below. Prior to county approval of the Final Stormwater Plan, the Responsible Official shall certify that the Developer has established procedures to satisfy each of the following obligations regarding ongoing maintenance of stormwater facilities.

1.9.3.1 Initial Responsibility

The Developer shall be responsible to maintain the stormwater facilities for two years following the recording of a final plat. During this period, the Developer shall operate, inspect, maintain, repair, redesign, and reconstruct the facilities as necessary to ensure that they meet this manual's standards.

1.9.3.2 Stormwater Covenant

The Applicant for a residential subdivision or a site plan review shall submit a "Covenant Running With the Land" (Stormwater Covenant) to Clark County that specifies the responsibility for stormwater facility maintenance, and the Responsible Official shall review and approve the Stormwater Covenant, after which it shall be recorded with the Clark County Auditor. The template for the Stormwater Covenant can be found in Appendix 1-G.

The purposes of the Stormwater Covenant shall be to ensure that all privately owned stormwater facilities are inspected and maintained in compliance with this manual, Chapter 13.26A CCC, and Title 32 CCC.

Pursuant to the Stormwater Covenant, the property owner(s) and all successors, heirs and assigns shall agree to maintain all private facilities and shall grant Clark County irrevocable rights routinely to access and inspect the facilities, and to perform maintenance and repair in an emergency or when required to meet County obligations under its Phase I NPDES Municipal Stormwater Permit, Chapter 13.26A CCC and Title 32 CCC.

If the parties responsible for long-term maintenance fail to maintain their facilities to standards of this manual, the county shall issue a written notice specifying required actions to be taken in order to bring the facilities into compliance. If these actions are not performed in a timely manner, the county shall take enforcement action against parties responsible for the maintenance in accordance with Title 32 CCC. The county shall be entitled to recover its costs associated with repairs or maintenance in accordance with Title 32 CCC.

1.9.3.3 Plat Note

All final plats shall include a note specifying the party(ies) responsible for long-term maintenance of stormwater facilities. Plats must include notes specifying the stormwater facility owner and the person or entity responsible for long-term maintenance of every component of the stormwater facilities, including components in easements.

1.9.3.4 Residential Subdivision

Prior to submitting the final plat for recording, the Applicant shall create a homeowners' association as a legal entity. The documents that create the homeowners' association, or accompanying bylaws, shall, at a minimum, include the following:

a. Members of the homeowners' association shall be jointly and severally responsible for maintenance of stormwater facilities.

b. The homeowners' association shall have the power and duty to assess fees in the amounts necessary to maintain stormwater facilities, and the members shall be liable for assessed fees.

c. The homeowners' association shall be responsible for payment of financial penalties or reimbursements if the county has conducted repairs or other maintenance activities because of hazardous conditions or to bring stormwater facilities into compliance with maintenance standards.

d. When recording the final plat, the Applicant shall record the Stormwater Covenant against the plat, and also against each lot within the subdivision or short division. See Appendix 1-G for an example covenant.

e. When recording the final plat, the Applicant shall record every deed necessary to convey to the homeowners' association the ownership of or easements over the platted property on which stormwater facilities are located.

f. The operation and maintenance manual prepared by the project engineer in accordance with this manual shall be recorded as part of the subdivision CC&R's.

g. The operation and maintenance manual prepared by the project engineer in accordance with this manual, or pertinent section(s) thereof as approved by the Responsible Official, shall be recorded against each lot that is proposed in the Final Stormwater Plan to contain a Rain Garden BMP, a Bioretention BMP, or a Permeable Pavement BMP.

1.9.3.5 Other Land Use

If the project is other than a residential subdivision, the Applicant and Developer shall comply with manual section 1.9.3.2, and if applicable, section 1.9.1.2. The Applicant shall describe in the Final Stormwater Plan, the person or entity that will own and maintain the stormwater facilities, shall convey the interest in real property that will enable that person or entity to maintain the facilities as require, and shall ensure that maintenance activities will be financed.

1.9.4 Conveyance System Easement Standards

1.9.4.1 Publicly Owned Systems

The property owner shall by plat or deed convey to Clark County an easement for access, inspection, maintenance, repair, and reconstruction of each stormwater conveyance system within the site that will be maintained by the county, including streams (natural drainage ways), if used. The minimum widths of easements must allow for access by standard maintenance equipment vehicles to all areas within the stormwater facilities in accordance with the standards of this manual. In addition, minimum easement widths shall be at least as wide as indicated in Table 1.2, although the Responsible Official may require increased widths when necessary to ensure adequate area for equipment access and maintenance.

Table 1.2: Easement Widths for Publicly Owned Conveyance Systems

Easement Widths for Publicly Owned Conveyance Systems	
Pipe Diameter	**Easement Width**
<= 36 inches	20 feet
> 36 inches	20 feet plus the pipe's inside diameter
Open conveyances	Top width of channel plus 15 feet on one side and at least 2 feet to property line
Each pipe shall be located with its center line no closer than one-quarter the easement width from an abutting property line.	

1.9.4.2 Privately Owned Systems

The property owner shall convey to Clark County an easement for access, inspection, maintenance, repair and ability to control discharges to the county storm sewer system, on each stormwater conveyance system within the development site that will be privately owned and maintained, including streams (natural drainage ways), if used. The minimum widths of easements must allow for access by standard maintenance equipment vehicles to all areas within the stormwater facilities in accordance with the standards of this manual. In addition, minimum easement widths shall be at least as wide as indicated in Table 1.2, except under the following conditions:

- For pipes used for rear and side lot drainage collection systems, where the inside diameter of the pipes is less than or equal to 12 inches and the pipes are less than or equal to 5 feet deep at the invert, the easement shall be 10 feet or equal to the lot setback if the pipe is located within the setback.to a minimum of 5 feet.
- No buildings, structures, hard surfaces, or vegetation that would prevent access are permitted within pipe drainage easements.

1.9.5 Deeds and Easements

The following deeds and easements shall be used, as appropriate, to convey property or rights necessary for ownership and maintenance of stormwater facilities:

- Statutory Warranty Deed: Conveys ownership of real property.
- Stormwater Easement:
    - Conveys to Clark County the rights to access across the easement to inspect, maintain, construct, repair, reconstruct, and enforce maintenance standards for any part of a stormwater facility on a specified property. A stormwater easement must be conveyed to Clark County by plat or by deed.
    - Conveys to the private entity responsible for ownership, operation, inspection, maintenance and repair of a private stormwater facility the rights to access across the easement for location, construction, reconstruction, operation, inspection, maintenance and repair for any part of a stormwater facility on a specified property. A stormwater easement must be conveyed to a homeowner's association or other private entity that is responsible long-term maintenance of the facilities by deed.

1.9.6 Performance Security

In lieu of completing required stormwater facilities within a preliminary plat prior to recording, the Applicant may, with the approval of the Responsible Official, post a performance bond or other security acceptable to the Responsible Official in the amount of one hundred fifty percent (150%) of the estimated cost (prepared by the project engineer), as approved by the Responsible Official, of completing construction of the facilities per the approved stormwater plan.

The estimated construction cost shall be calculated to include all stormwater facilities to be constructed under the approved stormwater plan. Costs shall reflect all labor, materials and other costs associated with constructing the stormwater facilities. The costs shall be documented using the most current version of the County's Cost Breakdown Sheet maintained by the County Engineer.

After the Responsible Official determines that all stormwater facilities are constructed in compliance with the approved stormwater plan, that they are performing as designed, and that the maintenance bonding requirements of this manual are met, the performance bond or security shall be released. Other than as allowed under CCC 40.260.175, no building permits shall be issued until the stormwater facilities are completed and provisionally accepted.

New development, redevelopment and drainage projects undertaken by governmental agencies are exempt from posting a performance bond or security.

1.9.7 Maintenance Security

In order to ensure adequate funding is available so that the Applicant will satisfy financial obligations of manual section 1.9.2.2, the Applicant shall post a materials and maintenance bond or other security acceptable to the Responsible Official, in the amount of ten percent (10%) of the estimated costs (prepared by the project engineer), as approved by the Responsible Official. The bond or other security shall be maintained throughout the two- (2-) year initial maintenance period for stormwater facilities and until final acceptance by Clark County.

1.9.8 Stormwater Pipe Testing

All storm sewer pipes shall be cleaned and tested in accordance with WSDOT section 7-04.3(1). Provide County staff with a two working-day notice prior to testing.

All storm sewer lines shall be internally inspected after installation with a tracked, swivel-head television camera. The applicant must provide Clark County with a DVD of the inspection and an inspection record of the entire length of constructed sewer lines. The camera must be stopped at each joint and side sewer and the camera head swiveled to directly view the full circumference of each joint. Each side sewer connection must be similarly inspected. Correct any defects noted during the inspection and re-inspect after the corrections have been completed. The Contractor shall bear all costs for the television inspection and for correcting any found deficiencies.

Storm sewers constructed of thermoplastic pipe shall be tested for deflection not less than 30 days after the trench backfill and compaction has been completed. The test shall be conducted by pulling a properly sized "go-no go" mandrel through the completed pipeline. Testing shall be conducted on a manhole-to-manhole basis and shall be done after the line has been completely flushed out with water.

The mandrel shall be a rigid, nonadjustable mandrel having an effective length of not less than its normal diameter and an odd number of legs (nine legs minimum). Minimum diameter at any point along the full length of the mandrel shall be 95 percent of the base inside diameter of the pipe being tested.

The Contractor shall be required, at no expense to Clark County, to locate and uncover any sections failing to pass the tests and, correctly reinstall or replace the pipe. The use of a vibratory re-rounding device or any process other than removal or reinstallations is not acceptable. The Contractor shall retest the section after replacement of the pipe. Pipe large enough to work inside of may be accepted on the basis of direct measurement.

The Contractor shall restore ground surfaces to conditions specified in the approved construction plans.

1.9.9 Infiltration Facility Testing

During construction of the infiltration facility, a qualified professional who performed the infiltration testing, or an alternate qualified professional, shall observe the excavation and confirm that the soils are consistent with those tests on which the design was based. This observation shall take place prior to the placement of any filter fabric or drain rock specified on the plans and be included in a stamped letter from the qualified professional.

In addition to the observation, the qualified professional shall perform additional infiltration tests to confirm the design test infiltration rates through the base of the facility. This is especially important in layered soils with mixed silt and sand. If the tested coefficient of permeability determined at the time of construction is at least 95 percent of the uncorrected coefficient of permeability used to determine the design rate, construction may proceed. If the tested rate does not meet this requirement, the Applicant shall submit a plan to Clark County that follows the requirements in Chapter 3. This plan shall address steps to correct the problem, including additional testing and/or resizing of the facility to ensure that the system will meet the minimum requirements of this manual.

As a condition of acceptance of any infiltration facility, Clark County shall require the Developer to test the completed facility to demonstrate that it performs as required. If the facility performance is not satisfactory to the county in its sole discretion, the facility shall be modified or expanded as needed to make it function as required.

1.9.10 Late-Comers Agreement

The following costs associated with stormwater facilities may be recoverable through latecomer's agreements (Chapter 35.91 RCW):

1. The costs to over-size facilities on the site above their existing capacity or the capacity required for the proposed new development;
2. A proportionate share of the total cost of off-site facilities; and
3. Compliance with the provisions of RCW 35.91.010 *et seq*.

1.9.11 Regional Stormwater Facilities

Clark County encourages the use of regional stormwater facilities.

1.9.11.1 Conditions of Use

If regional stormwater facilities are used to meet some or all of the requirements of this manual, the following conditions shall be met:

1. Stormwater runoff shall be transported from a project site to a regional stormwater facility through a pipe or manmade open channel conveyance system.

2. The facility must have sufficient capacity to meet the Minimum Requirements specified in this manual at the time of each connection.

3. If mandatory LID BMPs are not planned and installed where feasible in the area draining to the regional facility, the facility must meet the LID Performance Standard in Minimum Requirement #5.

4. If stormwater facilities are required for project sites draining to the facility, the facility design must specify the design requirements to meet each Minimum Requirement of this manual.

5. The Developer shall pay the owner of the regional facility reasonable compensation for the use of the regional facility.

Chapter 2 On-Site Stormwater Management

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2.1 Introduction

2.1.1 Purpose

This chapter presents methods, criteria, and details for analysis and selection of On-site Stormwater Management BMPs as specified in Minimum Requirement #5.

The primary purpose of On-site Stormwater Management BMPs is to reduce the disruption of the natural site hydrology for vegetated sites and partially restore natural hydrology on development sites lacking natural vegetation. Clark County requires projects to use these BMPs to comply with Minimum Requirement #5. These BMPs can also contribute to compliance with Minimum Requirements #6 and #7.

The Low Impact Development Technical Guidance Manual for Puget Sound (Puget Sound Partnership, 2013) is an excellent source of information about LID site planning and BMPs. The requirements in this manual take precedence where conflicts may occur.

Most On-site Stormwater Management BMPs are intended primarily to reduce runoff volume and flow rates and secondarily to provide some level of stormwater treatment benefits.

2.1.2 How to Use this Chapter

- Section 2.2 describes how to determine which LID BMPs the site designer must consider.
- Section 2.3 describes how to assess the soil and infiltration capacity of the site for LID BMPs.
- Section 2.4 describes competing needs.
- Section 2.5 describes selection and infeasibility criteria for On-site Stormwater Management BMPs.

2.1.3 Minimum Requirements

Projects shall employ On-site Stormwater Management BMPs in accordance with the project thresholds, standards, and lists in Section 1.5.5 to infiltrate, disperse, and retain stormwater runoff on-site to the maximum extent feasible without causing flooding or erosion impacts. The full text of Minimum Requirement #5 is contained in Section 1.5.5.

Clark County accepts the use of Full Dispersions BMP T5.30A and BMP T5.30B as meeting Minimum Requirements #6 and #7. Bioretention and Permeable Pavements may be capable of meeting treatment and flow control requirements for their tributary drainage areas depending upon site conditions and sizing. Full dispersion can also be applied to meet Minimum Requirement #8.

Minimum Requirements #6 and #7 are described in Sections 1.5.6 and 1.5.7.

2.2 BMP Selection Process

The following process is required for selecting and planning for LID BMPs and demonstrating compliance with Minimum Requirement #5:

1. Use site design principles to retain native vegetation and minimize impervious surfaces to the extent feasible, including using site design BMPs and vegetation retention BMPs, per Minimum Requirement #1.

2. Determine applicable BMPs per Section 2.2.

3. Perform the Soils Assessment per Section 2.3.

4. Evaluate the feasibility of required BMPs using information in Sections 2.4 and 2.5.

5. Refer to BMP Information Sheets in Book 2, Chapter 2 to design selected BMPs.

Projects subject to Minimum Requirement #5 must consider LID BMPs from one of three tables based on the thresholds and criteria in Minimum Requirement #5. Each table lists the required LID BMPs and the order of use to meet Minimum Requirement #5.

Use Figure 2.1 to determine which LID table the project site designer is required to use. If the flowchart in Figure 2.1 requires:

- The use of BMPs from List #1, then use Table 2.1 to find out which LID BMPs the site designer must consider. Follow instructions in the table.
- The use of BMPs from List #2, then use Table 2.2 to find out which LID BMPs the site designer must consider. Follow instructions in the table.
- If the project drains to a flow exempt water body, then use Table 2.3 to find out which LID BMPs the site designer must consider.
- Meeting the LID Performance Standard, then select any combination of LID and traditional flow control and treatment BMPs that achieve the performance objective in accordance with Minimum Requirement #5.

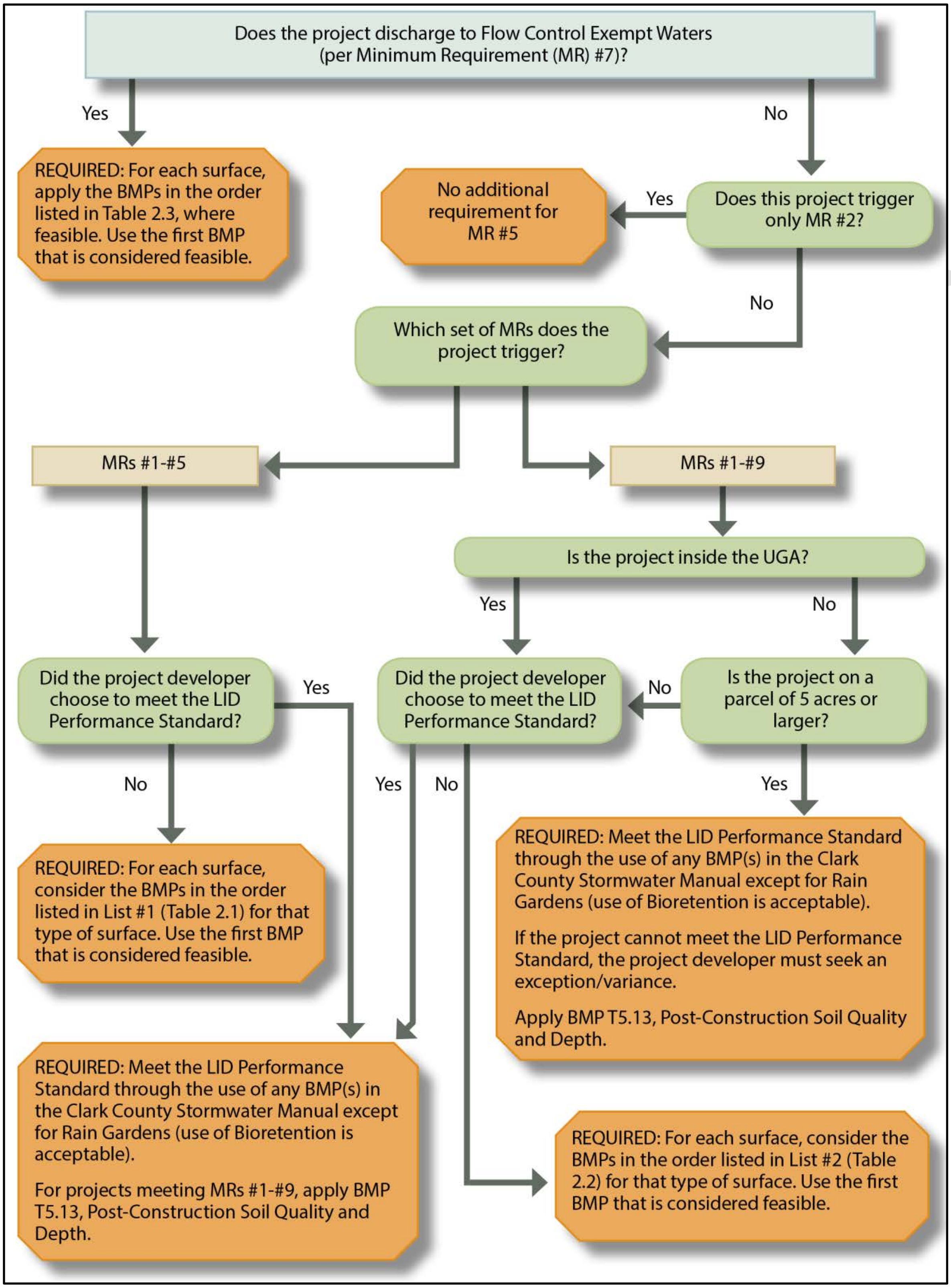

Figure 2.1: Flow Chart for Determining LID Minimum Requirement #5 Requirements

Table 2.1: Required Table of LID BMPs for Projects Subject only to Minimum Requirements #1 – #5

This table is equivalent to List #1 in Minimum Requirement #5.

For each surface, consider BMPs in the sequence indicated for that type of surface. If a sequence number appears on more than one BMP for a surface, then the BMPs labeled with that sequence number may be considered in any order before moving on to the next number in the sequence.

Use the first BMP that is considered feasible. No other On-site Stormwater Management BMP is necessary for that surface.

BMP #	BMP Name	Lawn and Landscape Areas	Roofs	Other Hard Surfaces
T5.13	Post-Construction Soil Quality and Depth	1		
T5.30A/B	Full Dispersion		1	1
T5.10A/T5.10B	Downspout Full Infiltration		1	
T5.15	Permeable Pavement			2
T5.14A	Rain Garden		2	2
T5.14B	Bioretention		2	2
T5.10C	Downspout Dispersion		3	
T5.10D	Perforated Stub-out Connections		4	
T5.12	Sheet Flow Dispersion			3
T5.11	Concentrated Flow Dispersion			3

Table 2.2: Required Table of LID BMPs for Projects Subject to Minimum Requirements #1 – #9 that discharge to a water body that is not flow control exempt per Minimum Requirement #7

This table is equivalent to List #2 in Minimum Requirement #5.

For each surface, consider BMPs in the sequence indicated for that type of surface. If a sequence number appears on more than one BMP for a surface, then the BMPs labeled with that sequence number may be considered in any order before moving on to the next number in the sequence.

Use the first BMP that is considered feasible. No other On-site Stormwater Management BMP is necessary for that surface.

BMP #	BMP Name	Lawn and Landscape Areas	Roofs	Other Hard Surfaces
T5.13	Post-Construction Soil Quality and Depth	1		
T5.30A/B	Full Dispersion		1	1
T5.10A/T5.10B	Downspout Full Infiltration		1	
T5.15	Permeable Pavement			2
T5.14B	Bioretention		2	3
T5.10C	Downspout Dispersion		3	
T5.10D	Perforated Stub-out Connections		4	
T5.12	Sheet Flow Dispersion			4
T5.11	Concentrated Flow Dispersion			4

Table 2.3: Required Table of LID BMPs for Projects Subject to Minimum Requirements #1 – #9 that discharge to a flow control exempt water body per Minimum Requirement #7

Implement the following BMPs where feasible.

For each surface, consider BMPs in the sequence indicated for that type of surface. If a sequence number appears on more than one BMP for a surface, then the BMPs labeled with that sequence number may be considered in any order before moving on to the next number in the sequence.

Use the first BMP that is considered feasible. No other On-site Stormwater Management BMP is necessary for that surface.

BMP #	BMP Name	Lawn and Landscape Areas	Roofs	Other Hard Surfaces
T5.13	Post-Construction Soil Quality and Depth	1		
T5.10A/T5.10B	Downspout Full Infiltration		1	
T5.10C	Downspout Dispersion		2	
T5.10D	Perforated Stub-out Connections		3	
T5.12	Sheet Flow Dispersion			1
T5.11	Concentrated Flow Dispersion			1

2.3 Soils Assessment

Low impact development requires soil and possibly groundwater analysis to determine infiltration rates and soil storage capacity. These analyses are needed for three primary reasons:

1. LID emphasizes storage and infiltration of stormwater in smaller-scale facilities distributed throughout the site.
2. On sites with mixed soil types, areas with permeable soils should be preserved and utilized for infiltration, and impervious areas should be located over less permeable soils.
3. Determining feasibility of LID BMPs.

Soil and subsurface characterization relies to a large extent on infiltration testing and soil testing. The type and number of these tests for site assessments is variable and specific to the site and site design; however some general guidelines are appropriate. Test locations should consider site features such as topography, mapped soil type, hydrologic characteristics and other site features.

A soil and infiltration capacity assessment is necessary to complete the preliminary Stormwater Site Plan once the layout and location of LID stormwater BMPs has been determined. If traditional infiltration BMPs will be used on the site, see requirements in Chapter 4 in addition to this chapter.

The site designer must provide sufficient information to confirm the feasibility of the proposed BMPs to meet Minimum Requirement #5. Information should also be gathered to provide a basis for estimating the facilities' contribution to meeting Minimum Requirements #6 and #7, where applicable.

Document the results of the Soils Assessment in the Soils Report described in Section 1.8.3. For projects qualifying to use the Site Plan Short Form, follow the instructions in the Site Plan Short Form located in Appendix 1-I.

2.3.1.1 Qualified Professionals

Soil and subsurface characterization shall be conducted by a certified 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. For projects meeting Minimum Requirements #1 – #5, a licensed on-site sewage designer can be used to complete the soil description (Section 2.3.1.2) and to conduct infiltration tests (Section 2.3.1.4) where necessary.

2.3.1.2 Soil Description

Perform the following to describe the underlying soils on the site:

- Soil test pits
- Soil borings
- Soil grain size analysis

Provide boring logs and other detailed information to characterize the soil profile. Provide a review of existing geotechnical and geological information from published geology maps, Natural Resource Conservation Service soil surveys, and past geotechnical information. Identify the appropriate hydrologic soil group, and provide a summary of seasonal groundwater elevation information and topsoil depth.

Where downspout infiltration systems are proposed, the soils description must demonstrate that soils suitable for infiltration are present on the site. Prepare at least one soils log at the location of each downspout infiltration system, a minimum of 4 feet in depth from the proposed grade and at least 1 foot below the expected bottom elevation of the infiltration trench or drywell. Identify the NRCS series of the soil, the hydrologic soil group per Appendix 2-A, and the USDA textural class of the soil horizon through the depth of the log. Note any evidence of high groundwater level, such as mottling.

Applicants proposing to meet Minimum Requirement #5 solely with one of the following listed BMPs are not required to complete the remaining aspects of the Soils Assessment described in Sections 2.3.1.3 through 2.3.1.5:

BMP T5.30A/B, Full Dispersion.

BMP T5.10A/B, Roof Downspout Full Infiltration.

BMP T5.10C, Downspout Dispersion.

BMP T5.10D, Perforated Stub-out Connection.

2.3.1.3 Soil Stratigraphy

For projects subject to Minimum Requirements #1 – #9, the soils report should include a description of the soil stratigraphy and groundwater elevations at the site.

Soil stratigraphy must be assessed for low permeability layers, highly permeable sand/gravel layers, depth to groundwater, and other soil structure variability necessary to assess subsurface flow patterns. Soil characterization for each soil unit (soil strata with the same texture, color, density, compaction, consolidation and permeability) should include:

- Grain size distribution
- Textural class
- Percent clay content
- Cation exchange capacity
- Color/mottling
- Variations and nature of stratification

2.3.1.4 Infiltration Rate (Coefficient of Permeability)

Determine the measured infiltration rate for subgrade soil profile (existing soils) beneath areas proposed to have bioretention, rain gardens and permeable pavement. Conduct infiltration tests using one of the methods in Section 4.3.1.3. Conduct tests in locations and at adequate frequency capable of producing a soil profile characterization that fully represents the infiltration capability where the LID infiltration BMPs are proposed.

Prepare detailed logs for each test pit or test hole and a map showing the location of the test pits or test holes. Logs must include, at a minimum: depth of pit or hole, soil descriptions, depth to water, and presence of stratification. Logs must substantiate whether stratification does or does not exist. The qualified professional may consider additional methods of analysis to substantiate the presence of stratification that may influence the design or successful operation of the facility.

Projects Subject Only to Minimum Requirements #1 – #5

Perform an infiltration test at each rain garden location to determine if the minimum measured coefficient of permeability of 0.3 in/hr is exceeded. The qualified professional may consider a reduction in the extent of testing if, in their judgment, information exists confirming that the site is unconsolidated coarse sediment with high infiltration rates, and there is at least one foot to seasonal high water table, bedrock or other impervious layer.

For proposed permeable pavement locations, perform an infiltration test for every 5,000 sq. ft. of permeable pavement. The qualified professional can exercise discretion concerning the need for and extent of infiltration rate testing.

- The depth and number of infiltration tests and soil samples should be increased if, in the judgment of the qualified professional, conditions are highly variable and such increases are necessary to accurately estimate the performance of the infiltration system.
- The professional can consider a reduction in the extent of infiltration testing if, in their judgment, information exists confirming that the site is unconsolidated sediment with high infiltration rates, and there is one foot of separation from the bottom of the base course for permeable pavement to groundwater and site soils are found to be homogeneous and consistent.

In high water table sites, the subsurface exploration sampling need not be conducted lower than two feet below the groundwater table. For all proposed locations of LID infiltration BMPs, determine whether the location has at least one foot minimum clearance to the seasonal high groundwater or other hydraulic restriction layer.

Projects Subject to Minimum Requirements #1 – #9 or Meeting LID Performance Standard

Bioretention

For proposed bioretention locations, infiltration tests shall be conducted as follows:

- On a single, smaller commercial property where one bioretention facility is proposed, one test must be performed at the proposed bioretention location. Tests at more than one site could reveal the advantages of one location over another.
- On larger commercial sites, a test per Section 4.3.1.3 must be performed every 5,000 square feet of PGIS.
- On residential developments where the proposed bioretention facility will receive runoff from one or two lots and less than ¼ acre of impervious surface, conduct one infiltration test at the proposed bioretention location.
- For bioretention facilities proposed to receive runoff from more than two lots or greater than ¼ acre of impervious surface, an infiltration test is required at each potential bioretention site.
- Long, narrow bioretention facilities or bioretention swales, such as one following the road right-

of-way, should have a test location at least every 200 lineal feet, and within each length of road with significant differences in subsurface characteristics.

- The qualified professional can exercise discretion concerning the need for and extent of infiltration rate testing:
    - The depth and number of infiltration tests should be increased if, in the judgment of the qualified professional, conditions are highly variable and such increases are necessary to accurately estimate the performance of the infiltration system.
    - The depth and number of infiltration tests can be decreased, if in the judgement of the qualified professional, information exists confirming that the site is unconsolidated coarse gravel with high infiltration rates, and there is one foot or three foot minimum separation to groundwater from the bottom of a bioretention installation depending upon drainage area size (per BMP T5.14B Infeasibility Criteria; See Section 2.5.4.3).

After conducting an infiltration test, test sites should be over-excavated three feet below the projected infiltration facility's bottom elevation to determine if there are restrictive layers or groundwater. Observations through a winter season can also be used to assist in identifying a seasonal groundwater restriction.

Correction Factors NA

Correction factors are applicable to projects subject to Minimum Requirements #1 – #9 and to projects that must or choose to demonstrate compliance with the LID Performance Standard of Minimum Requirement #5. Note that this is separate design issue from the assignment of a correction factor to the overlying, designed bioretention soil mix. See the bioretention design section in Book 2, Chapter 2 for information on those correction factors. Correction factors are shown in Table 2.4.

Table 2.4: Correction Factors to Infiltration Rate for Bioretention

This table gives correction factors for coefficient of permeability values to estimate the design (long-term) infiltration rates of subgrade soils underlying Bioretention.	
Site Analysis Issue	**Correction Factor**
Site variability and number of locations tested	CF_V =0.50
Degree of influent control to prevent siltation and bio-buildup	No correction factor required

Permeable Pavement

For sites proposing permeable pavement, infiltration tests shall be conducted as follows:

- On commercial property, conduct an infiltration test for every 5,000 sq. ft. of permeable pavement, but not less than one test per section of contiguous permeable pavement.

- On residential developments, conduct infiltration tests at every proposed lot, at least every 200 feet of roadway and within each length of road with significant differences in subsurface characteristics.
- The qualified professional may exercise discretion concerning the need for and extent of infiltration rate testing. The professional may consider a reduction in the extent of infiltration testing if, in their judgment, information exists confirming that the site is unconsolidated sediment material with high infiltration rates, that the soils are homogeneous and consistent, and that there is one foot of separation from the bottom of the base course for permeable pavement to groundwater.

Unless seasonal high groundwater elevations across the site have already been determined, upon conclusion of the infiltration testing, infiltration sites should be over-excavated three foot to see any restrictive layers or groundwater. Observations through a winter season can identify a seasonal groundwater restriction.

Perform infiltration testing in the soil profile at the estimated bottom elevation of base materials for the permeable pavement. If no base materials, (e.g., a permeable concrete sidewalk), perform the testing at the estimated bottom elevation of the pavement.

Correction Factors

Correction factors are applicable to projects subject to Minimum Requirements #1 – #9 and to projects that must or choose to demonstrate compliance with the LID Performance Standard of Minimum Requirement #5.

Tests should be located and be at adequate frequency capable of producing a soil profile characterization that fully represents the infiltration capability where the permeable pavement is located. A correction factor of one (1) for the quality of pavement aggregate base material may be used if the aggregate base is clean washed material with 1% or less fines passing the 200 sieve. Otherwise use a factor of 0.9, as shown in Table 2.5.

Table 2.5: Correction Factors to Infiltration Rate for Permeable Pavement

This table gives correction factors for coefficient of permeability values to estimate design (long-term) infiltration rates of the subgrade for Permeable Pavement.	
Site Analysis Issue	**Correction Factor**
Site variability and number of locations tested	$CF_v = 0.50$
Quality of pavement aggregate base material	$CF_m = 0.9$ to 1

Total correction factor (CF_T) = CF_v x CF_m

2.3.1.5 Groundwater Assessment

For facilities serving over one acre, groundwater monitoring wells or test pits must be installed and monitored in each bioretention facility through at least one winter season (December 21 through March 21) unless:

- GIS groundwater data from Clark County or available field information describing water table elevations within 500 feet of the site indicates that the seasonal high groundwater elevation is at least 15 feet below the base of the proposed facility. Examples of field information that can be used include public well records and groundwater monitoring reports from other development sites.
- The seasonal high groundwater elevation has been found to be at least 15 feet below the facility base from monitoring wells installed at the site where monitoring was conducted during at least one winter season in the preceding three years.

For facilities serving a drainage area less than one acre, establish that the depth to groundwater or other hydraulic restriction layer will be at least 10 feet below the base of the facility. This can be done through the use groundwater monitoring wells as described above, through subsurface explorations or through information from nearby wells (500 feet or closer).

If a single bioretention facility serves a drainage area exceeding one acre and the depth to a hydraulic restricting layer or groundwater from the bottom (subgrade) of the bioretention area is less than 15 feet, a groundwater mounding analysis must be done in accordance with Book 2, Section 5.1.1.2.

2.4 LID Infeasibility due to Competing Needs

The use of On-site Stormwater Management BMPs 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 BMPs contained in the Required Table (see Section 2.2) in the preliminary and final Technical Information Reports (Sections 1.8.1.5 and 1.8.2.3).

2.5 Onsite Stormwater Management BMPs

2.5.1 Roof Downspout Control BMPs

2.5.1.1 Purpose and Description

Roof downspout controls include a mix of simple pre-engineered designs for infiltrating and/or dispersing runoff from roof areas. The pre-engineered downspout controls – Downspout Full Infiltration Drywell, Downspout Full Infiltration Trench, Downspout Dispersion, and Perforated Stub-out Connection – are intended only for use in infiltrating runoff from roof downspout drains on individual residential lots; however they may also be applied to commercial lot developments when the pollutant characteristics are comparable to those from residential lots.

Roof Downspout Controls include:

- BMP T5.30 A/B Full Dispersion
- BMP T5.10A Downspout Full Infiltration – Drywells
- BMP T5.10B Downspout Full Infiltration –Trenches
- BMP T5.10C Downspout Dispersion
- BMP T5.10D Perforated Stub-out Connection
- BMP T5.14A Rain Gardens (for projects that must meet MRs #1 - #5)
- BMP T5.14B Bioretention (for projects that must meet MRs #1 - #9)

These BMPs are mandated where feasible under Lists #1 and #2 in Minimum Requirement #5.

Other innovative downspout control BMPs such as rain barrels, ornamental ponds, downspout cisterns, or other downspout water storage devices may be used to supplement any of the above BMPs.

BMP T5.30A/B, Full Dispersion, BMP T5.14A, Rain Gardens, and BMP T5.14B, Bioretention, may be used to control runoff from other types of surfaces besides roof runoff and are not classified solely as roof downspout controls. See more information in Sections 2.5.3 and Section 2.5.4.

2.5.1.2 Roof Downspout Selection Process

The following types of roof downspout controls must be considered in descending order of preference, as shown in Figure 2.2:

1. Full Dispersion in accordance with BMP T5.30A and/or BMP T5.30B. [Note: Full Dispersion is not exclusively a roof downspout control and can be used to control runoff from other surfaces. See more information on this BMP in Section 2.5.3.]

2. Downspout Full Infiltration Systems in accordance with BMP T5.10A or BMP T5.10B.

3. Rain Gardens in accordance with BMP T5.14A; or if the project area is subject to Minimum Requirements #1 – #9, Bioretention in accordance with BMP T5.14B. [Note: Rain Gardens and Bioretention are not exclusively roof downspout controls and can be used to control runoff from other surfaces. See more information on these BMPs in Section 2.5.4.]

4. Downspout Dispersion Systems in accordance with BMP T5.10C.

5. Perforated Stub-out Connections in accordance with BMP T5.10D.

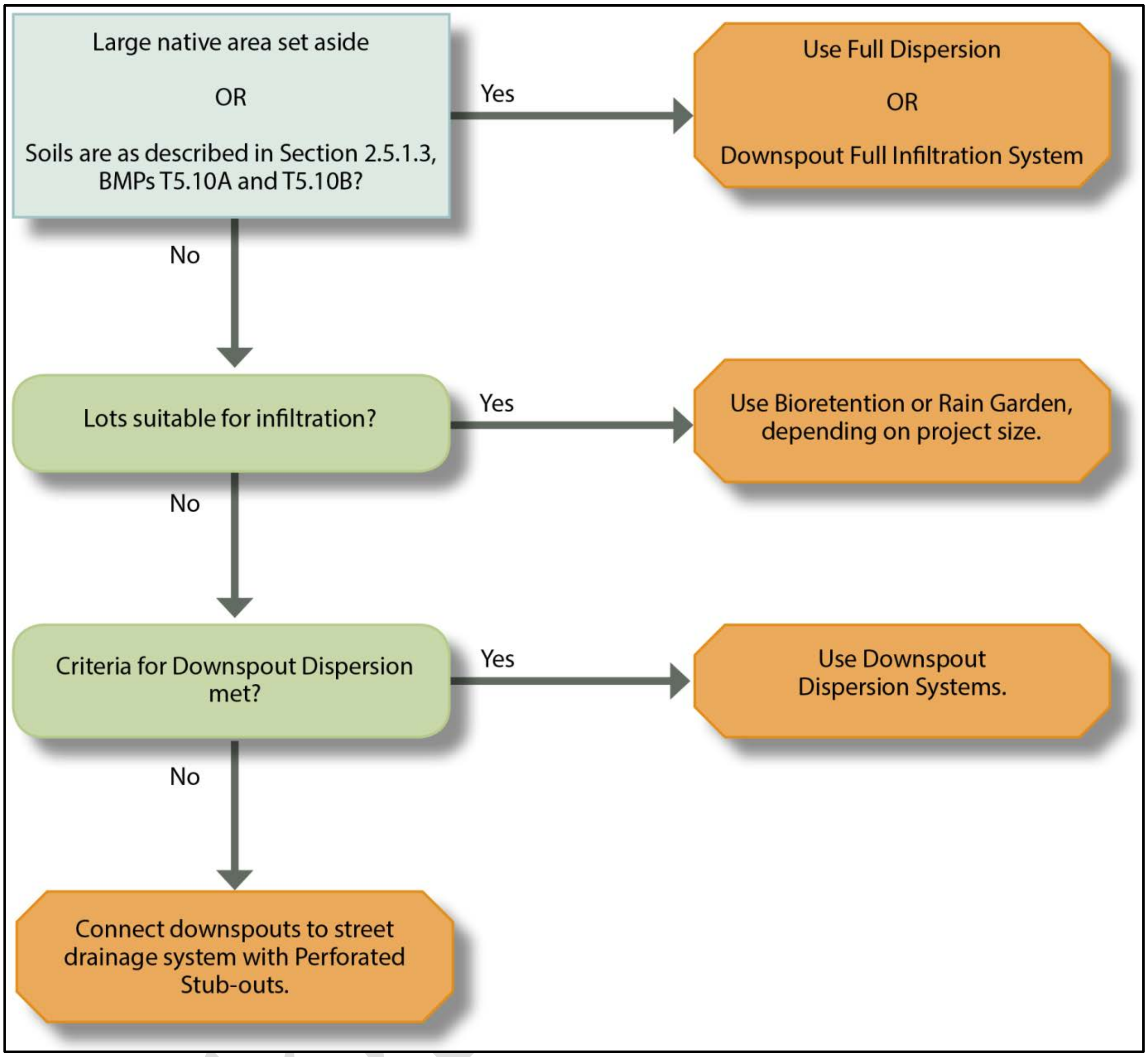

Figure 2.2: Roof Downspout Selection Process

2.5.1.3 Roof Downspout BMP Applications and Limitations

BMP T5.30A: Full Dispersion and BMP T5.30B: Dispersion to Pasture and Cropland

See Section 2.5.3 for applications and limitations associated with these BMPs.

BMP T5.10A: Downspout Full Infiltration – Drywells and BMP T5.10B: Downspout Full Infiltration – Trenches

These systems are deemed feasible without infiltration testing when a qualified professional determines that USDA textural classes ranging from very coarse sand to fine sand, or cobbles and gravels are present in the infiltration zone. If other soils exist, such as loam or clay, these can be used if the design infiltration rate found through testing per Section 4.3.1.3 is at least one inch/hour. Other infeasibility criteria include:

- Less than three feet of permeable soil exists from the proposed finished ground elevation at the drywell or trench location to the seasonal high groundwater table.
- Less than one foot exists between the bottom of the infiltration trench or drywell 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.

BMP T5.10C: Downspout Dispersion

- Downspout dispersion where feasible, must be used on lots where downspout full infiltration, full dispersion, and bioretention/rain gardens are not feasible.
- Splash blocks may be used if a vegetated flow path at least 50 feet in length is available, as measured from the downspout to the downstream property line, structure, slope over 15%, stream, wetland, or other impervious surface. Sensitive area buffers may count toward flow path lengths.
- If the vegetated flow path (measured as defined above) is less than 25 feet, a perforated stub-out connection may be used in lieu of downspout dispersion. 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. For example, this provision might be appropriate for lots constructed on steep hills where downspout discharge could culminate and might pose a potential hazard for lower lying lots, or where dispersed flows could create problems for adjacent off-site lots. This provision does not apply to situations where lots are flat and on-site downspout dispersal would result in saturated yards. Perforated stub-outs are not appropriate

when seasonal water table is <1 foot below trench bottom.

- For sites with septic systems, the discharge point of all dispersion systems must be downgradient of the drainfield. This requirement may be waived if site topography clearly prohibits flows from intersecting the drainfield.

Dispersion trench limitations include:

- A vegetated flow path of at least 25 feet in length must 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 must be maintained between the outlet of the trench and any slope steeper than 15%. Sensitive area buffers may count towards flow path lengths.
- A setback of at least 5 feet between any edge of the trench and any structure or property line must be able to be provided.

BMP T5.10D: Perforated Stub-out Connection

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.

BMP T5.14A: Rain Gardens and BMP T5.14B: Bioretention

See Section 2.5.4 for applications and limitations associated with these BMPs.

2.5.1.4 Roof Downspout Setbacks

The following setbacks are required for Downspout Full Infiltration:

- 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 indicates that subsurface flows will not intersect 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. 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.

The following setbacks are required for Downspout Dispersion:

- 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.
- At least 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.

Setbacks for other BMPs that are not exclusively used for roof downspout controls (e.g. bioretention) are given in their respective sections.

2.5.2 Soil Amendment BMPs

2.5.2.1 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 become pollution generating pervious surfaces due to increased use of pesticides, fertilizers and other landscaping and household/industrial chemicals.

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.

The following BMP is mandatory for all sites required to meet either Minimum Requirements #1 – #5 or Minimum Requirements #1 – #9:

- BMP T5.13 Post Construction Soil Quality and Depth

2.5.3 Dispersion BMPs

2.5.3.1 Purpose and Description

Dispersion BMPs spread runoff over the land and prevent runoff from concentrating over the length of the designated flow path. For flows that are initially concentrated, dispersion BMPs require a long flow path; for flows that are not concentrated, dispersion BMPs can be effective over a shorter flow path.

Dispersion helps attenuate peak flows by slowing entry of runoff into a conveyance system, allowing for some infiltration and providing some water quality benefits.

Dispersion BMPs include:

- BMP T5.11 Concentrated Flow Dispersion
- BMP T5.12 Sheet Flow Dispersion
- BMP T5.18 Reverse Slope Sidewalk
- BMP T5.30A Full Dispersion
- BMP T5.30B Dispersion to Pasture and Cropland

2.5.3.2 Applications and Limitations

- BMP T5.11 Concentrated Flow Dispersion can be used in any situation where concentrated flow can be dispersed through vegetation.
- BMP T5.12 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.
- BMP T5.18. Reverse Slope Sidewalk requires 10 feet of vegetated surface downslope that is not directly connected into the storm drainage system.
- 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.
- BMP T5.30B Dispersion to Pasture and Cropland may be used on single lots or multiple lots under the same ownership, greater than 22,000 square feet, and meeting 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.
- 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.

- 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:
  - 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.
  - 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.
  - There shall be a minimum 3-foot depth to the average annual maximum groundwater elevation.
  - 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 manual occur, the requirements in this section shall apply.
- The following surfaces will be considered "fully dispersed per BMP T5.30A or BMP T5.30B if the meet the feasibility criteria listed for those BMPs, and if they meet the following:

Roof Surfaces

Roof surfaces are considered to be "fully dispersed" if they meet BMP T5.30A or BMP T5.30B and if they either: 1) 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 2) disperse the roof runoff along with the road runoff in accordance with the roadway dispersion BMP section below.

Roadways

Roadway surfaces are considered to be "fully dispersed" if they meet BMP T5.30A or BMP T5.30B and if they comply with the following dispersion requirements:

1. The road section shall be designed to 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.

2. When it is necessary to collect and concentrate runoff from the roadway and adjacent upstream areas (e.g., in a ditch on a cut slope), concentrated flows shall be incrementally discharged from the ditch via cross culverts or at the ends of cut sections. These incremental discharges of newly concentrated flows shall not exceed 0.5 cfs at any one 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.

3. Ditch discharge points with up to 0.2 cfs discharge for the peak 100-year flow shall use rock pads or dispersion trenches to disperse flows. Ditch discharge points with between 0.2 and 0.5 cfs discharge for the 100-year peak flow shall use only dispersion trenches to disperse flows.

4. Dispersion trenches shall be designed to accept surface flows (free discharge) from a pipe, culvert, or ditch end, shall be aligned perpendicular to the flow path, and shall be minimum 2 feet by 2 feet in section, 50 feet in length, filled with ¾-inch to 1½-inch 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 shall have a minimum spacing of 50 feet between centerlines.

5. 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. Runoff may be conveyed to an area meeting these flow path criteria.

6. Ditch discharge points shall be located a minimum of 100 feet up gradient of steep slopes (i.e., slopes steeper than 40%), wetlands, and streams.

Driveways

Driveway surfaces are considered to be "fully dispersed" if they meet BMP T5.30A or BMP T5.30B AND if they either: 1) comply with BMP 5.11 for concentrated flow and BMP T5.12 for sheet flow-and have flow paths of 100 feet or more through native vegetation; or, 2) disperse driveway runoff along with the road runoff in accordance with the roadway dispersion BMP section below.

Cleared Areas

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 in accordance with the following criteria:

1. The topography of the non-native pervious surface must be such that runoff will not concentrate prior to discharge to the dispersal area.

2. Slopes within the dispersal area should be no steeper than 15%.

If the width of the non-native pervious surface is greater than 25 feet, the vegetated flow path segment must be extended 1 foot for every 3 feet of width beyond 25 feet up to a maximum width of 250 feet.

2.5.3.3 Infeasibility Criteria for Dispersion BMPs

The infeasibility criteria in this section apply to the following BMPs:

- BMP T5.11 Concentrated Flow Dispersion
- BMP T5.12 Sheet Flow Dispersion
- BMP T5.30A Full Dispersion
- BMP T5.30B Pasture and Cropland Dispersion

The following criteria describe conditions that make dispersion LID BMPs infeasible to meet Minimum Requirement #5 for the BMPs listed above. It is important to note that even though a LID BMP is infeasible to meet the LID requirement, it may still be designed and used to meet the runoff treatment and/or flow control requirement for the TDA, if applicable.

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 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 in Section 2.5.3.4 cannot be met.

Meeting any one of the criteria renders dispersion BMPs infeasible to meet Minimum Requirement #5 on the site. Citation of any of the infeasibility criteria must be based on an evaluation of site-specific conditions and must be documented in the Preliminary and Final TIR (Sections 1.8.1.5 and 1.8.2.3) on the LID Feasibility Checklist, along with any applicable written recommendations from a qualified professional. See Appendix 1-E for the LID Feasibility Checklist.

2.5.3.4 Setbacks for Dispersion BMPs

- 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.

2.5.4 Bioretention and Rain Garden BMPs

2.5.4.1 Purpose and Description

Bioretention facilities and rain gardens are designed to soak runoff into the ground and treat pollutants by filtering runoff through soil.

Bioretention facilities are engineered facilities that include a designed soil mix to treat pollutants. Rain gardens are non-engineered facilities that use a blend of native soil and compost as treatment media.

Bioretention areas and rain gardens also include plants adapted to the local climate and soil moisture conditions. Bioretention and rain garden BMPs include:

- BMP T5.14A Rain Garden
- BMP T5.14B Bioretention

The term bioretention is used to describe various designs using soil and plant complexes to manage stormwater. The following terminology is used in this manual:

- **Bioretention cells**: Shallow depressions with a designed planting soil mix and a variety of plant material, including trees, shrubs, grasses, and/or other herbaceous plants. Bioretention cells may or may not have an under-drain and are not designed as a conveyance system.
- **Bioretention swales**: Incorporate the same design features as bioretention cells; however, bioretention swales are designed as part of a system that can convey stormwater when maximum ponding depth is exceeded. Bioretention swales have relatively gentle side slopes and ponding depths that are typically 6 to 12 inches.
- **Bioretention planters and planter boxes**: Designed soil mix and a variety of plant material including trees, shrubs, grasses, and/or other herbaceous plants within a vertical walled container usually constructed from formed concrete, but could include other materials. Planter boxes are completely impervious and include a bottom (must include an under-drain). Planters have an open bottom and allow infiltration to the subgrade. These designs are often used in ultra-urban settings.

Where the surrounding native soils have adequate infiltration rates, bioretention can help comply with flow control and treatment requirements. Where the native soils have low infiltration rates, under-drain systems can be installed and the facility used to filter pollutants and detain flows that exceed infiltration capacity of the surrounding soil. However, designs utilizing under-drains provide less flow control benefits.

Rain gardens are generally used on smaller projects such as individual home sites where soils are not sufficiently well drained for roof downspout infiltration wells or trenches.

2.5.4.2 Applications and Limitations

BMP T5.14A: Rain Gardens

Rain gardens are an on-site stormwater management BMP option for projects that have to comply with Minimum Requirements #1 – #5, but they may not be used on sites complying with Minimum Requirements #1 – #9. For projects required to use List #1 of Minimum Requirement #5, Rain Gardens are to be used to the extent feasible for runoff from roofs and other hard surfaces unless a higher priority BMP is feasible.

Other applications and limitations are the same as for bioretention.

BMP T5.14B: Bioretention Facilities

Bioretention facilities are an on-site BMP option for projects that only have to comply with Minimum Requirements #1 – #5 (List #1). For projects required to meet Minimum requirements #1 - #9 and use List #2, bioretention facilities are to be used to the extent feasible for runoff from roofs and other hard surfaces unless a higher priority BMP is feasible.

Because bioretention facilities use an imported soil mix that has a moderate design infiltration rate, they are best applied for small drainages, and near the source of the stormwater. Cells may be scattered throughout a subdivision; a swale may run alongside the access road; or a series of planter boxes may serve the road. In these situations, they can but are not required to fully meet the requirement to treat 91% of the stormwater runoff file from pollution-generating surfaces. But the amount of stormwater that is predicted to pass through the soil profile may be estimated and subtracted from the 91% volume that must be treated. Downstream treatment facilities may be significantly smaller as a result.

Bioretention facilities that infiltrate into the ground can also serve a significant flow reduction function. They can, but are not required to fully meet the flow control duration standard of Minimum Requirement #7. Because they typically do not have an orifice restricting overflow or underflow discharge rates, they typically don't fully meet Minimum Requirement #7. However, their performance contributes to meeting the standard, and that can result in much smaller flow control facilities at the bottom of the project site. When used in combination with other low impact development techniques, they can also help achieve compliance with the Performance Standard option of Minimum Requirement #5.

Bioretention facilities constructed with imported compost materials must not be used within one-quarter mile of phosphorus-sensitive waterbodies if the underlying native soil does not meet the criteria for treatment described in Section 3.2.2.1. Bioretention also must not be used with an underdrain when the underdrain water would be routed to a phosphorus-sensitive receiving water. In Clark County, the Lacamas watershed above the dam at the south end of Round Lake is a phosphorus-sensitive water body.

2.5.4.3 Infeasibility Criteria for Rain Garden and Bioretention BMPs

Meeting any one of the following criteria make the Bioretention and Rain Garden BMPs not required to meet Minimum Requirement #5 on the site. Citation of any of the below infeasibility criteria must be based on an evaluation of site-specific conditions and must be documented in the Preliminary and Final TIR (Section 1.8.1.5 and Section 1.8.2.3) on the LID Feasibility Checklist, along with any applicable written recommendations from a qualified professional. See Appendix 1-E for the LID Feasibility Checklist.

It is important to note that even though a LID BMP is infeasible to meet the LID requirement, it may still be designed and used to meet the runoff treatment and/or flow control requirement, if applicable.

Bioretention and 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 (e.g. projects draining to existing stormwater collection system whose elevation or locale precludes connection to a properly functioning bioretention system).
- 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 bioretention system or a rain garden that would serve a drainage area that is 1) less than 5,000 sq. ft. of pollution-generating impervious surface, and 2) less than 10,000 sq. ft. of impervious surface; and 3) less than ¾ acres of pervious surface.

- Where the minimum vertical separation of three feet to seasonal high water table, bedrock or other impervious layer cannot be achieved below a bioretention system that would 1) serve a drainage area that is a) 5,000 sq. ft. or more of pollution-generating impervious surface, or b) 10,000 sq. ft. or more of impervious surface; or c) ¾ acres or more of pervious surface; and 2) cannot reasonably be broken down into amounts smaller than indicated in (1).
- 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 bioretention or rain garden within setbacks given in Section 2.5.4.4.
- 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 there is a lack of usable space for rain garden/bioretention facilities at re-development sites, or where there is insufficient space within the existing public right-of-way on public road projects.

2.5.4.4 Setbacks

The following setbacks shall be used for bioretention systems and rain gardens:

- 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.
- For a bioretention system or raingarden that would serve a drainage area that is less than 5,000 sq. ft. of pollution-generating impervious surface and less than 10,000 sq. ft. of impervious surface, 10 feet from any structure or property lines.
- For a bioretention system that would serve a drainage area that is 5,000 sq. feet or more of pollution-generating impervious surface or 10,000 sq. ft. or more of impervious surface or ¾ acres or more of pervious surfaces, 20 feet from the downslope side of any foundation, structure, or property line and 100 feet from the upslope side of any foundation. These setbacks may be increased or decreased based on engineering analysis that shows the performance of a building's foundation system will not be adversely affected by the presence of the bioretention facility.

2.5.5 Permeable Pavement

2.5.5.1 Purpose and Description

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. The general categories of permeable paving systems include:

- **Porous hot or warm-mix asphalt pavement** is a flexible pavement similar to standard asphalt that uses a bituminous binder to adhere aggregate together. However, the fine material (sand and finer) is reduced or eliminated and, as a result, voids form between the aggregate in the pavement surface and allow water to infiltrate.
- **Permeable Portland cement concrete** is a rigid pavement similar to conventional concrete that uses a cementitious material to bind aggregate together. However, the fine aggregate (sand) component is reduced or eliminated in the gradation and, as a result, voids form between the aggregate in the pavement surface and allow water to infiltrate.
- **Permeable interlocking concrete pavements (PICP) and aggregate pavers.** PICPs are solid, precast, manufactured modular units. The solid pavers are (impervious) high-strength Portland cement concrete manufactured with specialized production equipment. Pavements

constructed with these units create joints that are filled with permeable aggregates and installed on an open-graded aggregate bedding course. Aggregate pavers (sometime called pervious pavers) are a different class of pavers from PICP. These include modular precast paving units 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.

2.5.5.2 Applications and Limitations

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

Limitations to the use of pervious pavement include:

- 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.

2.5.5.3 Infeasibility Criteria

Meeting any one of the following criteria make Permeable Pavement not required to meet Minimum Requirement #5 on the site. Citation of any of the below infeasibility criteria must be based on an evaluation of site-specific conditions and must be documented in the Preliminary and Final TIR (Section 1.8.1.5 and Section 1.8.2.3) on the LID Feasibility Checklist, along with any applicable written recommendations from a qualified professional. See Appendix 1-E for the LID Feasibility Checklist.

It is important to note that even though an LID BMP is infeasible to meet the LID requirement, it may still be designed and used to meet the runoff treatment and/or flow control requirement, if applicable.

Permeable pavements are considered infeasible under the following conditions:

- Roadways and parking areas where projected average daily traffic volumes are greater than 400 vehicles.

- Where the roadway 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.
- 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 permeable 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 (See Book 2, 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 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 2.5.5.4.
- 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.

The following soil suitability criteria apply to permeable pavement used to meet Minimum Requirement #6. Sites not meeting these criteria are not feasible for permeable pavements for pollution-generating hard surfaces (e.g. roads, driveways, and parking lots):

- One foot depth of soil with any of the following characteristics:

- o Cation Exchange Capacity ≥ 5 milliequivalents CEC/100 g dry soil (USEPA Method 9091)
- o Organic Content > 1%
- o Measured coefficient of permeability < 9 in./hr.

2.5.5.4 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.

2.5.6 Soil and Vegetation Protection and Enhancement BMPs

2.5.6.1 Purpose and Description

Mature native vegetation and soils are necessary to maintain watershed hydrology, stable stream channels, wetland hydro-periods, and healthy aquatic systems (Booth et al., 2002). They are also the most cost-effective and efficient tools for reducing quantity of stormwater produced and for stormwater quality.

Soil and Vegetation Protection and Enhancement BMPs include:

- BMP T5.16 Tree Retention and Tree Planting (Book 2, Chapter 2)
- BMP T5.19 Minimal Excavation Foundation (Book 2, Chapter 2)
- BMP T5.40 Preserving Native Vegetation (Book 2, Chapter 2)
- BMPT5.41 Better Site Design (Book 2, Chapter 2)

Design guidance for these BMPs may also be found in the *Low Impact Technical Guidance Manual for Puget Sound.*

2.5.7 LID Runoff Harvest and Use BMPs

LID Runoff Harvest and Use BMPs detain runoff for use in another application. BMPs include:

- BMP T5.17 Vegetated Roof (Book 2, Chapter 2)
- BMP T5.20 Rainwater Harvesting (Book 2, Chapter 2)

Design guidance for these BMPs may also be found in the *Low Impact Technical Guidance Manual for Puget Sound*.

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Chapter 3 Stormwater Runoff Treatment

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3.1 Introduction

3.1.1 Purpose

Urbanization and land development can cause an increase in the types and quantities of pollutants in surface and groundwaters. Runoff from roads and highways can be contaminated with pollutants from vehicles. Oil and grease, polynuclear aromatic hydrocarbons (PAH's), lead, zinc, copper, cadmium, as well as sediments (soil particles) and road salts are typical pollutants in road runoff. Runoff from industrial areas typically contains even more types of heavy metals, sediments, and a broad range of man-made organic pollutants, including phthalates, PAH's, and other petroleum hydrocarbons. Residential areas contribute the same road-based pollutants to runoff, as well as herbicides, pesticides, nutrients (from fertilizers), bacteria and viruses (from animal waste). All of these contaminants can seriously impair beneficial uses of receiving waters.

Minimum Requirement #6 requires the installation of runoff treatment BMPs for land disturbing activities passing thresholds. See Section 1.5.6 for the thresholds that trigger this Minimum Requirement.

3.1.2 How to Use this Chapter

Consult this chapter to select and design specific runoff treatment BMPs for permanent use development and redevelopment sites. Consult Book 2, Chapters 3 and 4 for the detailed design of each treatment BMP.

- Section 3.1 serves as an introduction and summarizes available options for treatment of stormwater.
- Section 3.2 outlines a step-by-step process for selecting treatment facilities for new development and redevelopment projects.
- Section 3.3 discusses selection criteria for pretreatment BMPs.
- Section 3.4 discusses selection criteria for runoff treatment BMPs.

3.2 Treatment BMP Selection Process

This section describes a step-by-step process for selecting the type of treatment facilities to be applied on an individual project and gives four menus of best management practices (BMPs) for different types of treatment: oil control treatment, phosphorus treatment, enhanced treatment, and basic treatment.

To select an emerging technology treatment BMP, follow the instructions in Section 3.4.7, Emerging Technologies.

3.2.1 Step-by-Step Process for Selecting Treatment Facilities

Use this six-step process to determine the type of treatment facilities applicable to the project. Please refer to Figure 3.1.

Briefly, the steps are:

1. Identify the pollutants of concern based on the proposed land use and determine the receiving waters based on offsite analysis
2. Determine if an Oil Control Facility/Device is Required
3. Determine if Infiltration for Pollutant Removal is Practicable
4. Determine if Phosphorous Control is Required
5. Determine if Enhanced Treatment is Required
6. Select a Basic Treatment Facility

After selecting any BMP in the Step-by-Step Process, refer to the selection criteria in Book 2, Section 3.1, which may affect the design and placement of the facility.

Step 1: Pollutants of Concern/Land Use/Receiving Waters

To obtain a more complete determination of the potential impacts of a stormwater discharge, complete the Offsite Analysis described in Chapter 5. Clark County will verify the identification of the receiving water from the Offsite Analysis. If the discharge is to the local municipal storm drainage system, determine the receiving water for the drainage system.

List the proposed land use(s) of the project.

Proceed to Step 2.

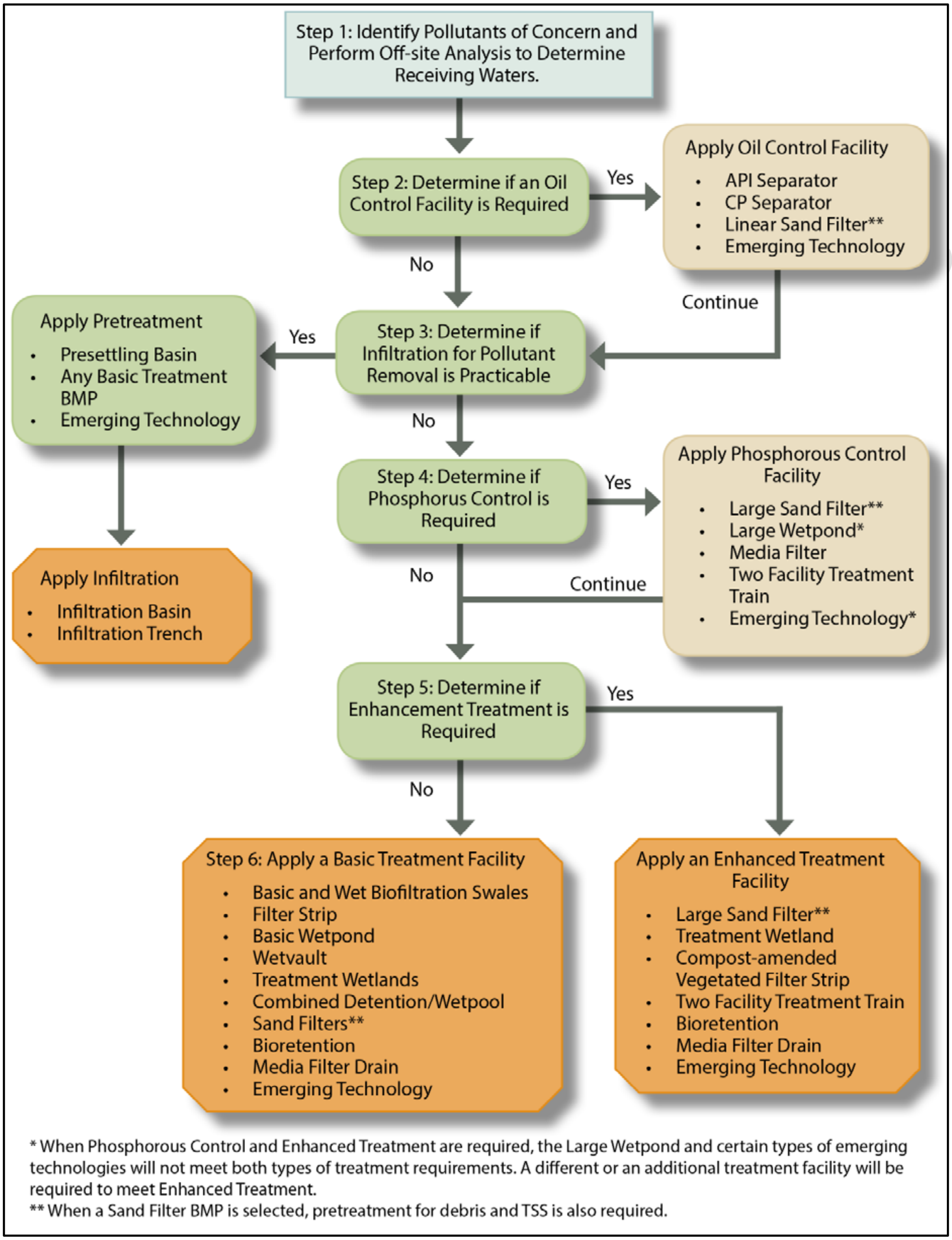

Figure 3.1: Treatment Facility Selection Flow Chart

Step 2: Determine if an Oil Control Facility/Device is Required

The use of oil control devices and facilities is dependent upon the specific land use proposed for development.

Where Applied

The Oil Control Menu applies to projects that have "high-use sites." High-use sites are those that typically generate high concentrations of oil due to high traffic turnover or the frequent transfer of oil. Select an oil control facility/device for sites meeting any the following conditions:

- An area of a commercial or industrial site subject to an expected average daily traffic (ADT) count equal to or greater than 100 vehicles per 1,000 square feet of gross building area.

Note: Gasoline stations, with or without small food stores, will likely exceed the high-use site threshold.

- An area of a commercial or industrial site subject to petroleum storage and transfer in excess of 1,500 gallons per year, not including routinely delivered heating oil. Some examples are discussed below.

Note: The petroleum storage and transfer criterion is intended to address regular transfer operations such as gasoline service stations, not occasional filling of heating oil tanks.

- An area of a commercial or industrial site subject to parking, storage or maintenance of 25 or more vehicles that are over 10 tons gross weight (trucks, buses, trains, heavy equipment, etc.). Some examples are discussed below.

Note: In general, all-day parking areas are not intended to be defined as high-use sites, and should not require an oil control facility.

- A road intersection with a measured ADT count of 25,000 vehicles or more on the main roadway and 15,000 vehicles or more on any intersecting roadway, excluding projects proposing primarily pedestrian or bicycle use improvements.

Note: The traffic count can be estimated from a traffic study prepared by a professional engineer or transportation specialist with experience in traffic estimation or using information from "Trip Generation," published by the Institute of Transportation Engineers (http://www.ite.org).

- The following land uses may have areas that fall within the definition of "high-use sites" and require oil control treatment. Further, these sites require special attention to the oil control treatment selected. Refer to Section 3.2.3.1 and 3.4.1 for more details.
    - Industrial machinery and equipment, and railroad equipment maintenance areas
    - Log storage and sorting yards
    - Aircraft maintenance areas

- Railroad yards
- Fueling stations
- Vehicle maintenance and repair sites
- Construction businesses (paving, heavy equipment storage and maintenance, storage of petroleum products)

Note: Some land use types require the use of a spill control (SC-type) oil/water separator. Those situations are described in Book 3, *Source Control*, and are separate from this treatment requirement.

Some of these sites will also be subject to the Washington Department of Ecology Industrial Stormwater Permit and should ensure that requirements of that permit are met.

For high-use sites located within a larger commercial center, only the impervious surface associated with the high-use portion of the site is subject to oil-control treatment requirements. If common parking for multiple businesses is provided, oil treatment shall be applied to the number of parking stalls required for the high-use business only. However, if the oil treatment collection area also receives runoff from other areas, the treatment facility must be sized to treat all water passing through it.

High-use roadway intersections shall treat lanes where vehicles accumulate during the signal cycle, including left and right turn lanes and through lanes, from the beginning of the left turn pocket. If no left turn pocket exists, the treatable area shall begin at a distance equal to three car lengths from the stop line. If runoff from the intersection drains to more than two collection areas that do not combine within the intersection, treatment may be limited to any two of the collection areas.

If an Oil Control Facility is required, select an appropriate Oil Control Facility from the Oil Control Menu in Section 3.2.3.1. After selecting an Oil Control Facility, proceed to Step 3.

If an Oil Control Facility is not required, proceed directly to Step 3.

Step 3: Determine if Infiltration for Pollutant Removal is Practicable

Infiltration can be effective at treating stormwater runoff, but soil properties must be appropriate to achieve effective treatment. This effectiveness is discussed in Section 3.2.2.1, Soil Type.

A proposed infiltration facility must also be checked to ensure that it does not adversely impact groundwater resources.

Unstable slopes can preclude the use of infiltration.

Infiltration treatment facilities must be preceded by a pretreatment facility, such as a presettling basin or vault, to reduce the occurrence of plugging. Any of the basic treatment facilities, and detention ponds designed to meet flow control requirements, can be used for pretreatment. If an oil/water separator is necessary for oil control, it can function as the presettling basin as long as the influent suspended solids concentrations are not high.

Infiltration through soils that do not meet the criteria for treatment in Section 3.2.2.1 is allowable as a flow control BMP following a treatment facility. Note that if infiltration for flow control occurs within ¼ mile of a phosphorus sensitive receiving water, phosphorus treatment is required. If infiltration for flow control occurs within ¼ mile of a fresh water body designated for aquatic life use or has an aquatic life use, then enhanced treatment is required for the land-use types described in Step 5 below.

If infiltration treatment is practicable, select a pretreatment facility from the Pretreatment Menu and an infiltration treatment facility from the Infiltration Menu. Then stop here.

If infiltration treatment is not practicable, proceed directly to Step 4.

Step 4: Determine if Control of Phosphorous is Required

In Clark County, phosphorus treatment shall be provided in the Lacamas watershed above the dam at the south end of Round Lake for all project sites meeting the thresholds triggering Minimum Requirement #6. This requirement applies to stormwater conveyed to the lake by surface flow as well as to stormwater infiltrated within one-quarter mile of the lake in soils that do not meet the suitability for treatment.

If phosphorus control is required, select and apply a phosphorus treatment facility from the Phosphorus Treatment Menu in Section 3.2.3.4. Select an option from the menu after reviewing the applicability and limitations, site suitability, and design criteria of each for compatibility with the site.

Note: Project sites subject to the Phosphorus Treatment requirement could also be subject to the Enhanced Treatment requirement (see Step 5). In that event, apply a facility or a treatment train that is listed in both the Enhanced Treatment Menu and the Phosphorus Treatment Menu.

If phosphorus treatment is required for the site, provisionally select a Phosphorous Treatment Facility, then proceed to Step 5.

If phosphorus treatment is not required for the site, proceed directly to Step 5.

Step 5: Determine if Enhanced Treatment is Required

Except where specified under Step 6, enhanced treatment to reduce dissolved metals is required for the following project sites that 1) discharge directly to fresh waters or conveyance systems tributary to fresh waters designated for aquatic life use or that have an existing aquatic life use; or 2) use infiltration strictly for flow control – not treatment – and the discharge is within ¼ mile of a fresh water designated for aquatic life use or that has an existing aquatic life use:

- Industrial project sites
- Commercial project sites
- Multi-family residential project sites
- High AADT roads as follows:
  - Within Urban Growth Management Areas:
    - Fully controlled and partially controlled limited access highways with Annual Average Daily Traffic (AADT) counts of 15,000 or more
    - All other roads with an AADT of 7,500 or greater
  - Outside of Urban Growth Management Areas:
    - Roads with an AADT of 15,000 or greater unless discharging to a 4^{th} Strahler order stream or larger;
    - Roads with an AADT of 30,000 or greater if discharging to a 4th Strahler order stream or larger (as determined using 1:24,000 scale maps to delineate stream order).

Areas of the above-listed project sites that are identified as subject to Basic Treatment requirements (see Step 6) are not also subject to Enhanced Treatment requirements. For developments with a mix of land use types, the Enhanced Treatment requirement shall apply when the runoff from the areas subject to the Enhanced Treatment requirement comprises 50% or more of the total runoff within a threshold discharge area.

If the project must apply Enhanced Treatment, select and apply an appropriate Enhanced Treatment facility. Please refer to the Enhanced Treatment Menu in Section 3.2.3.5. Select an option from the menu after reviewing the applicability and limitations, site suitability, and design criteria of each for compatibility with the site.

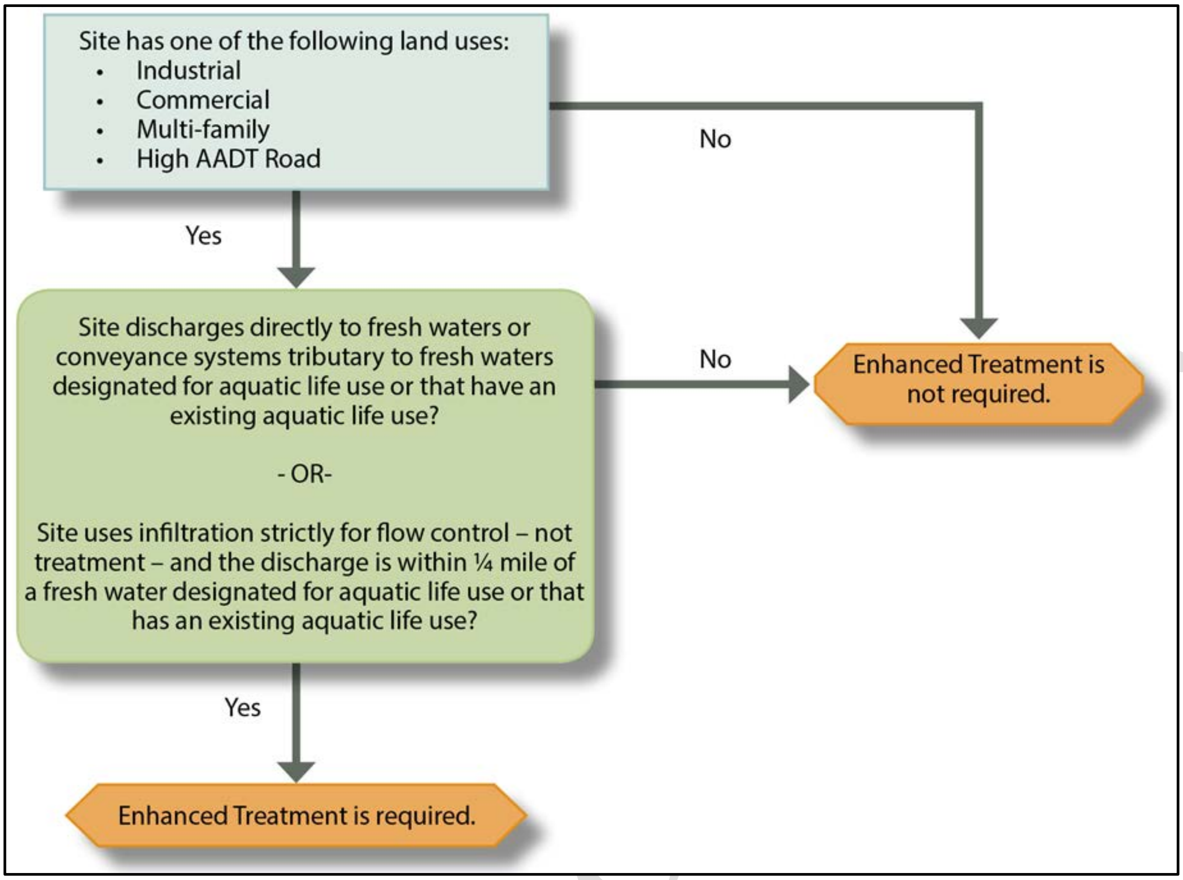

Figure 3.2: Enhanced Treatment Flow Chart

If Enhanced Treatment applies, and Phosphorous Treatment also applies (see Step 4), then select a facility or treatment train that is listed in both the Enhanced Menu and the Phosphorous Treatment menu, then stop here.

If Enhanced Treatment applies, select an appropriate Enhanced Treatment Facility, then stop here.

If Enhanced Treatment does not apply to the site, please proceed to Step 6.

Step 6: Select a Basic Treatment Facility

The Basic Treatment Menu is required in the following circumstances:

- Project sites that discharge to the ground, UNLESS:
    - The criteria for infiltration treatment are met and pretreatment is provided; OR
    - The project uses infiltration strictly for flow control – not treatment – and:
        - the discharge is within ¼-mile of a phosphorus sensitive lake (use the Phosphorus Treatment Menu), or

  - o The land-use type is as is described in Step 5 and is within ¼ mile of a fresh water designated for aquatic life use or that has an existing aquatic life use (use the Enhanced Treatment Menu).
- Single Family Residential projects not otherwise needing phosphorus control in Step 4;
- Project sites discharging directly (or indirectly through a municipal separate storm sewer system) to identified Basic Treatment Receiving Waters. Basic Treatment Receiving Waters in Clark County are:
  - o Columbia River
  - o Lewis River
  - o Washougal River
- Project sites that drain to fresh waters, or to waters tributary to fresh waters, that are not designated for aquatic life use or that do not have an existing aquatic life use;
- Landscaped areas of industrial, commercial, and multi-family project sites, and parking lots of industrial and commercial project sites, dedicated solely to parking of employees' private vehicles, which do not involve any other pollution-generating sources (e.g., industrial activities, customer parking, and storage of erodible or leachable material, wastes or chemicals).

For developments with a mix of land use types, the Basic Treatment requirement shall apply when the runoff from the areas subject to the Basic Treatment requirement comprises 50% or more of the total runoff within a threshold discharge area.

Please refer to the Basic Treatment Menu in Section 3.2.3.6. Select an option from the menu after reviewing the applicability and limitations, site suitability, and design criteria of each for compatibility with the site.

The treatment facility selection process is complete.

3.2.2 Other Treatment Facility Selection Factors

The selection of the most effective treatment facility should consider site physical factors and pollutants of concern. The types of site physical factors that influence facility selection are summarized below.

3.2.2.1 Soil Type

See Table 3.1 and the following for information on soil types suitable for use as treatment. The permeability of the soil underlying a treatment facility has a profound influence on its effectiveness. Facilities situated on soils with high infiltration rates will need a synthetic liner or the soils amended to reduce the infiltration rate and provide treatment. Maintaining a permanent pool in the first cell is necessary to avoid resuspension of settled solids. Biofiltration swales in coarse soils can also be amended to reduce the infiltration rate.

Consider the soil texture and design infiltration rates along with the physical and chemical characteristics specified below to determine if the soil is adequate for removing the target pollutants. The following criteria must be met to use the soil for treatment:

- Treatment soil must have a minimum 0.5 inches per hour design coefficient of permeability.
- Treatment soil must have a maximum measured infiltration rate of 9 inches per hour. Design (long-term) infiltration rates up to 3 inches per hour can also be considered, if in the judgement of the qualified professional, the treatment soil meets the characteristics of this section.
- Cation exchange capacity (CEC) of the treatment soil must be ≥5 milliequivalents CEC/100 g dry soil (USEPA Method 9081). *Consider empirical testing of soil sorption capacity, if practicable.* Ensure that soil CEC is sufficient for expected pollutant loadings, particularly heavy metals. CEC values of >5 meq/100g are expected in loamy sands, according to Rawls, et al.
- Depth of soil used for infiltration treatment must be a minimum of 18 inches. Depth of soil below permeable pavements serving as pollution-generating hard surfaces may be reduced to one foot if the permeable pavement does not accept run-on from other surfaces.
- Organic Content of the treatment soil (ASTM D 2974): Organic matter can increase the sorptive capacity of the soil for some pollutants. A minimum of 1.0 percent organic content is necessary.
- Waste fill materials shall not be used as infiltration soil media nor shall infiltration soil media be placed over uncontrolled or non-engineered fill soils.
- For engineered soils or for soils with very low permeability, the potential to bypass the treatment soil through the side-walls may be significant. In those cases, line the side-walls with at least 18 inches of treatment soil to prevent seepage of untreated flows through the side walls.
- For soils that do not meet the requirements of this section, treatment liners may be used. See Book 2, Section 3.1.6 for more information on treatment liners.

Note: Soil maps show topsoils and may not reflect material found several feet below ground surface. In Clark County it is common for sandy soils to be found under lower permeability topsoil.

Table 3.1 Preliminary Screening of Treatment Facilities Based on Soil Type

Soil Type	Infiltration/ Bioretention	Wet Pond*	Biofiltration* (Swale or Filter Strip)
Coarse Sand or Cobbles	✕	✕	✕
Sand	✔	✕	✕
Loamy Sand	✔	✕	✔
Sandy Loam	✔	✕	✔
Loam	✕	✕	✔
Silt Loam	✕	✕	✔
Sandy Clay Loam	✕	✔	✔
Silty Clay Loam	✕	✔	✔
Sandy Clay	✕	✔	✔
Silty Clay	✕	✔	✕
Clay	✕	✔	✕

Notes:

✔ Indicates that use of the technology is generally appropriate for this soil type.

✕ Indicates that use of the technology is generally not appropriate for this soil type

* Coarser soils may be used for these facilities if a liner is installed to prevent infiltration, or if the soils are amended to reduce the infiltration rate.

Note: Sand filtration is not listed because its feasibility is not dependent on soil type.

Bioretention using engineered media may also be used for treatment.

3.2.3 Treatment Facility Menus

This section identifies choices that comprise the treatment facility menus. The menus in this chapter are discussed in the order of the decision process shown in Figure 3.1 and are as follows:

- Oil Control Menu
- Pretreatment Menu
- Infiltration Menu
- Phosphorus Treatment Menu

- Enhanced Treatment Menu
- Basic Treatment Menu

Use the menus below as follows:

1. Follow the step-by-step selection process for treatment facilities in Section 3.2.1.
2. If the project requires oil control, choose one option in the Oil Control Menu.
3. If infiltration for treatment in practicable, choose one option from the Pretreatment Menu and one option from the Infiltration Menu.
4. Find the treatment menu that applies to the project – Phosphorous, Enhanced or Basic – and select one option from the appropriate menu.
    a. If no options appear to work well for the project site and pollutants of concern, consider selecting an emerging technology as discussed in Section 3.4.7.
5. Detailed facility designs for many possible options are given in Book 2, Chapter 4 of this manual.

3.2.3.1 Oil Control Menu

Note: Where this menu is applicable, it is in addition to facilities required by one of the other Treatment Menus.

Performance Goal

The facility choices in the Oil Control Menu are intended to achieve the goals of no ongoing or recurring visible sheen in the discharge or in the receiving water, and to have a 24-hour average Total Petroleum Hydrocarbon (TPH) concentration no greater than 10 mg/l, and a maximum of 15 mg/l for a discrete sample (grab sample).

Options

Oil control options include facilities that are small, treat runoff from a limited area, and require frequent maintenance. The options also include facilities that treat runoff from larger areas and generally have less frequent maintenance needs.

- API-Type Oil/Water Separator (BMP T11.10)
- Coalescing Plate Oil/Water Separator (BMP T11.11)
- Linear Sand Filter (BMP T8.30)
- Emerging Stormwater Treatment Technologies

Note: The linear sand filter is used in the Basic, Enhanced, and Phosphorus Treatment menus also. If used to satisfy one of those treatment requirements, the same facility cannot also be used to satisfy the oil control requirement.

3.2.3.2 Pretreatment Menu

Options

Any one of the following options may be chosen to satisfy the pretreatment requirement.

- Presettling Basin (BMP T6.10)
- Any Basic Treatment BMP (see Basic Treatment Menu, below)
- Emerging Technologies

3.2.3.3 Infiltration Treatment Menu

Options

Any one of the following options may be chosen if infiltration for treatment can meet the applicable criteria of this manual and allowable in accordance with Section 3.2.2.1, Soil Type.

- Infiltration Basin (also see Book 2, Chapter 5)
- Infiltration Trench (also see Book 2, Chapter 5)
- Bioretention (BMP T5.14B) (also see Book 2, Chapter 2)
- Permeable Pavement (BMP T5.15) (also see Book 2, Chapter 2)

3.2.3.4 Phosphorus Treatment Menu

Performance Goal

The Phosphorus Menu facility choices are intended to achieve a goal of 50% total phosphorus removal for a range of influent concentrations of 0.1 – 0.5 mg/l total phosphorus. In addition, the choices are intended to achieve the Basic Treatment performance goal. The performance goal applies to the water quality design storm volume or flow rate, whichever is applicable.

Options

Any one of the following options may be chosen to satisfy the phosphorus treatment requirement.

- Large Sand Filter (BMP T8.11)
- Large Wetpond (BMP T10.10)

Note: If a Large Wetpond is used to satisfy the phosphorus treatment requirements, the same facility cannot be used to meet the enhanced treatment requirement too.

- Emerging Stormwater Treatment Technologies targeted for phosphorus removal
- Two-Facility Treatment Train (see Table 3.2)
- Infiltration (Chapter 4) with appropriate pretreatment

  If infiltration is through soils meeting treatment requirements, then a presettling basin or a basic treatment facility can serve for pretreatment.

- Infiltration preceded by Basic Treatment

  If infiltration is through soils that do not meet treatment requirements, treatment must be provided by a basic treatment facility unless the soil and site fit the description in the next option below.

- Infiltration preceded by Phosphorus Treatment

If the soils do not meet treatment requirements and the infiltration site is within ¼ mile of a phosphorus-sensitive receiving water, or a tributary to that water, treatment must be provided by a treatment facility option listed here:

  - Large Sand Filter (BMP T8.11)
  - Large Wetpond (BMP T10.10)
  - Two-Facility Treatment Train
  - Emerging Stormwater Treatment Technologies targeted for phosphorus removal

Table 3.2 Treatment Trains for Phosphorous Removal

First Basic Treatment Facility	Second Treatment Facility
Biofiltration Swale	Basic Sand Filter or Sand Filter Vault
Filter Strip	Linear Sand Filter (no presettling needed)
Linear Sand Filter	Filter Strip
Basic Wetpond	Basic Sand Filter or Sand Filter Vault
Wetvault	Basic Sand Filter or Sand Filter Vault
Stormwater Treatment Wetland	Basic Sand Filter or Sand Filter Vault
Basic Combined Detention and Wetpool	Basic Sand Filter or Sand Filter Vault

3.2.3.5 Enhanced Treatment Menu

Performance Goal

The Enhanced Menu facility choices are intended to provide a higher rate of removal of dissolved metals than Basic Treatment facilities (greater than 30% dissolved copper removal, and greater than 60% dissolved zinc removal). In addition, the menu choices are intended to achieve the Basic Treatment performance goal. The performance goal assumes that the facility is treating stormwater with dissolved Copper typically ranging from 0.005 to 0.02 mg/l, and dissolved Zinc ranging from 0.02 to 0.3 mg/l.

The performance goal applies to the water quality design storm volume or flow rate, whichever is applicable.

Options

Any one of the following options may be chosen to satisfy the enhanced treatment requirement:

- Large Sand Filter (BMP T8.11)
- Stormwater Treatment Wetland (BMP T10.30)
- Compost-amended Vegetated Filter Strip (CAVFS) (BMP T7.40)
- Two Facility Treatment Trains (See Table 3.3)
- Bioretention, when 91% of the influent runoff infiltrates through the imported soil mix (BMP T5.14B)
- Media Filter Drain (MFD) (BMP T8.40)
- Emerging Technologies
- Infiltration (Chapter 4) with appropriate pretreatment
    - Infiltration Treatment - If infiltration is through soils meeting treatment requirements (see Section 3.2.2.1), a presettling basin or a basic treatment facility can serve for pretreatment.
    - Infiltration preceded by Basic Treatment - If infiltration is through soils that do not meet treatment requirements per Section 3.2.2.1, treatment must be provided by a basic treatment facility unless the soil and site fit the description in the next option below.
    - Infiltration preceded by Enhanced Treatment - If the soils do not meet treatment requirements per Section 3.2.2.1 and the infiltration site is within ¼ mile of a fresh water designated for aquatic life use or that has an existing aquatic life use, treatment must be provided by one of the other treatment facility options listed above.

Table 3.3 Treatment Trains for Dissolved Metals Removal

First Basic Treatment Facility	Second Treatment Facility
Biofiltration Swale	Basic Sand Filter or Sand Filter Vault or Media Filter(1)
Filter Strip	Linear Sand Filter with no presettling cell needed
Linear Sand Filter	Filter Strip
Basic Wetpond	Basic Sand Filter or Sand Filter Vault or Media Filter(1)
Wetvault	Basic Sand Filter or Sand Filter Vault or Media Filter(1)
Basic Combined Detention/Wetpool	Basic Sand Filter or Sand Filter Vault or Media Filter(1)
Basic Sand Filter or Sand Filter Vault with a presettling cell if the filter isn't preceded by a detention facility	Media Filter(1)

(1) The media must be a type approved for basic or enhanced treatment use by Ecology. See "Emerging Technologies" on page 133 for approved media filters.

3.2.3.6 Basic Treatment Menu

Performance Goal

The Basic Treatment Menu facility choices are intended to achieve 80% removal of total suspended solids for influent concentrations that are greater than 100 mg/l, but less than 200 mg/l. For influent concentrations greater than 200 mg/l, a higher treatment goal may be appropriate. For influent concentrations less than 100 mg/l, the facilities are intended to achieve an effluent goal of 20 mg/l total suspended solids.

The performance goal applies to the water quality design storm volume or flow rate, whichever is applicable. The performance goal assumes that the facility is treating stormwater with a typical particle size distribution (see stormwater monitoring protocol on the Department of Ecology website).

Options

Any one of the following options may be chosen to satisfy the basic treatment requirement:

- Infiltration Treatment
- Sand Filters (BMP T8.10; BMP T8.11; BMP T8.20; BMP T 8.30)
- Basic and Wet Biofiltration Swales (BMP T9.10 and BMPT9.20)

- Basic Filter Strip (BMP T9.40)
- Compost-amended Vegetated Filter Strip (CAVFS) (BMP T7.40)
- Basic Wetpond (BMP T10.10)
- Wetvault (BMP T10.20)
- Stormwater Treatment Wetland (BMP T10.30)
- Combined Detention and Wetpool Facilities (BMP T10.40)
- Bioretention (BMP T5.14B)

  Note: Where bioretention is intended to fully meet treatment requirements for its drainage area, it must be designed, using an approved continuous flow model, to pass at least 91% of the influent runoff file through the imported soil mix.
- Media filter Drain (MFD) (BMP T8.40)
- Emerging Stormwater Treatment Technologies

Note: A wetvault may be used for commercial, industrial, or road projects if there are space limitations. Clark County discourages the use of wetvaults for residential projects. Combined detention/wetvaults are allowed.

3.3 Pretreatment BMPs

3.3.1 Purpose and Description

This section presents the methods that may be used to provide pretreatment prior to basic or enhanced runoff treatment facilities.

Presettling basins are a typical pretreatment BMP used to remove suspended solids. All of the basic runoff treatment facilities may also be used for pretreatment to reduce suspended solids.

A detention pond sized to meet the flow control standard in Chapter 1, Minimum Requirement #7, may be used to provide pretreatment for suspended solids removal.

3.3.2 Applications and Limitations

Pretreatment must be provided in the following applications.

- For sand filters and infiltration BMPs to protect them from excessive siltation and debris.

3.3.3 Best Management Practices (BMPs) for Pretreatment

This section has only one non-proprietary BMP for pretreatment. Clark County also accepts the five proprietary BMPs that have obtained a General Use Level Designation from Ecology's TAPE program as of the printing of this manual. Please reference Section3.4.7, Emerging Technologies.

3.3.3.1 Purpose and Description

A Presettling Basin provides pretreatment of runoff in order to remove suspended solids, which can impact other runoff treatment BMPs.

3.3.3.2 Application, Limitations and Setbacks

- Runoff treated by a Presettling Basin may not be discharged directly to a receiving water; it must be further treated by a basic or enhanced runoff treatment BMP.
- All facilities shall be a minimum of 20 feet from any structure, property line, and any vegetative buffer required by the local government.
- All facilities shall be 100 feet from any septic tank/drainfield (except wet vaults shall be a minimum of 20 feet).
- All facilities shall be a minimum of 50 feet from any steep (greater than 15 percent) slope. A geotechnical report must address the potential impact of a wet pond on a steep slope.
- Embankments that impound water must comply with the Washington State Dam Safety Regulations (Chapter 173-175 WAC). If the impoundment has a storage capacity (including both water and sediment storage volumes) greater than 10 acre-feet (435,600 cubic feet or 3.26 million gallons) above natural ground level, then dam safety design and review are required by Ecology.

3.3.3.3 Pretreatment BMPs List

The following BMPs may be used for Pretreatment. See Book 2, Chapter 4 for specific design criteria.

- BMPT6.10: Presettling Basin
- Any Basic Treatment BMP (see Basic Treatment Menu, below)
- Emerging Technologies (see Section 3.4.7)

3.4 Runoff Treatment BMPS

3.4.1 Oil and Water Separators

This section provides a discussion of oil and water separators, including their application and design criteria. BMPs are described for baffle type and coalescing plate separators.

3.4.1.1 Purpose and Description

Oil and water separators remove oil and other water-insoluble hydrocarbons as well as settleable solids from stormwater runoff.

See Book 2, Chapters 3 and 4 for specific design criteria for the two typical configurations of oil and water separators:

- BMP T11.10: The American Petroleum Institute (API) (also called baffle type) (American Petroleum Institute, 1990).
- BMP T11.11: The coalescing plate (CP) type using a gravity mechanism for separation.

Oil removal separators typically consist of three bays: forebay, separator section, and the afterbay. The CP separators need considerably less space for separation of the floating oil due to the shorter travel distances between parallel plates. A spill control manhole is a simple catch basin with a T-inlet for temporarily trapping small volumes of oil. The spill control manhole may be used for source control (see Book 3) and is included here for comparison only; it is not designed for, or to be used for, treatment purposes.

3.4.1.2 Applications and Limitations

Pretreatment should be considered if the level of TSS in the inlet flow would cause clogging or otherwise impair the long-term efficiency of the separator.

For low concentrations of oil, other treatments may be more applicable. These include sand filters and emerging technologies.

There is concern that oil/water separators used for stormwater treatment have not performed to expectations.(Watershed Protection Techniques, 1994; Schueler, Thomas R., 1992) Therefore, emphasis should be given to proper application, design, maintenance (particularly sludge and oil removal), and prevention of fouling and plugging of the coalescing plate.(US Army of Engineers, 1994) Other treatment systems, such as sand filters and emerging technologies, should be considered for the removal of insoluble oil and TPH.

The following information should be considered when considering the use of API or CP oil/water separators:

- If practicable, determine oil/grease (or TPH) and TSS concentrations, lowest temperature, pH; and empirical oil rise rates in the runoff, and the viscosity, and specific gravity of the oil. Also determine whether the oil is emulsified or dissolved. (Washington State Department of Ecology, 1995). Do not use oil/water separators for the removal of dissolved or emulsified oils such as coolants, soluble lubricants, glycols, and alcohols.

- Locate the separator off-line and bypass the incremental portion of flows that exceed the off-line 15-minute, Water Quality design flow rate multiplied by the ratio indicated in Book 2, Figure 4.3. If it is necessary to locate the separator on-line, try to minimize the size of the area needing oil control, and use the on-line water quality design flow rate multiplied by the ratio indicated in Book 2, Figure 4.2.
- Use only impervious conveyances for oil contaminated stormwater.
- Specify appropriate performance tests after installation and shakedown, and/or certification by a professional engineer that the separator is functioning in accordance with design objectives. Expeditious corrective actions must be taken if it is determined the separator is not achieving acceptable performance levels.
- Add pretreatment for TSS that could cause clogging of the CP separator, or otherwise impair the long-term effectiveness of the separator.

3.4.1.3 Performance Objectives

Oil and water separators should be designed to achieve the goals of no ongoing or recurring visible sheen in the discharge or in the receiving water and to have a 24-hour average Total Petroleum Hydrocarbon (TPH) concentration no greater than 10 mg/l, and a maximum of 15 mg/l for a discrete sample (grab sample).

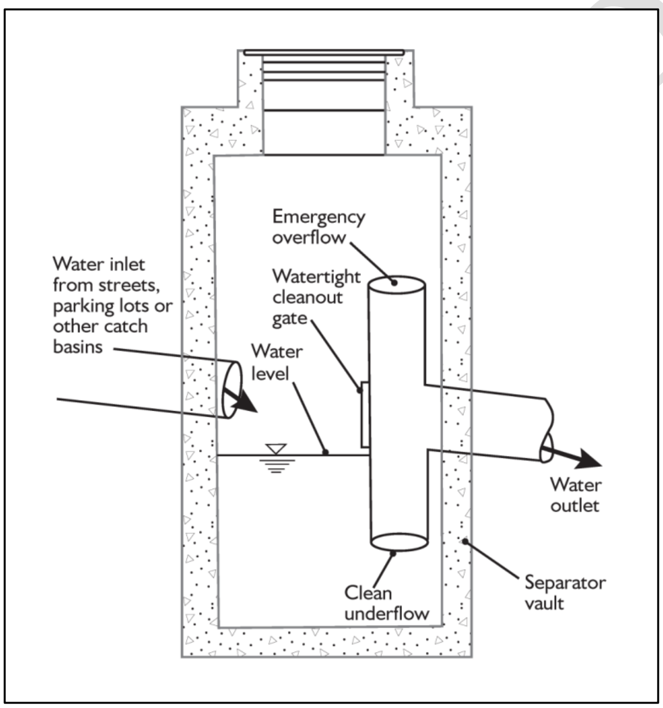

Figure 3.3: Spill Control Manhole for Source Control (not for oil treatment)

(Source: redrawn from 1992 Ecology Manual)

3.4.1.4 Oil and Water Separator BMPs

The following BMPs may be used for Oil Control:

- BMP T11.10: API (Baffle type) Separator Bay
- BMP T11.11: Coalescing Plate Separator

3.4.2 Sand Filter Treatment BMPs

3.4.2.1 Purpose and Description

This section presents criteria for the design, construction and maintenance of runoff treatment sand filters including basin, vault, and linear filters.

Sand filtration treatment facilities collect and treat design runoff volumes to remove total suspended solids (TSS), phosphorus, and insoluble organics (including oils) from stormwater. A typical sand filtration system consists of a pretreatment system, flow spreader(s), sand bed, and underdrain piping. The sand filter bed includes a geotextile fabric between the sand bed and the bottom underdrain system.

The variations of a sand filter include a basic sand filter basin, large sand filter basin, sand filter vault, and linear sand filter. Various sand filter configurations are given in Book 2, Chapter 4.

3.4.2.2 Applications and Limitations

Sand filtration can be used in most residential, commercial, and industrial developments where debris, heavy sediment loads, and oils and greases will not clog or prematurely overload the sand, or where adequate pretreatment is provided for these pollutants.

Locate sand filters off-line before or after detention (Chang, 2000). Sand filters are also suited for locations with space constraints in retrofit, and new/redevelopment situations. Size off-line systems to treat 91% of the runoff volume predicted by an approved continuous flow model. If a project must comply with Minimum Requirement #7, Flow Control, design an overflow of bypass structure to route flows from larger storms to a retention/detention facility.

Pretreatment is necessary to reduce velocities to the sand filter and remove debris, floatables, large particulate matter, and oils. In high water table areas, adequate drainage of the sand filter may require additional engineering analysis and design considerations. Consider an underground filter in areas subject to freezing conditions (Urbonas, 1997).

3.4.2.3 Site Suitability

Consider the following site characteristics when considering a sand filtration system:

- Space availability, including room for a presettling basin
- Sufficient hydraulic head, at least 4 feet from inlet to outlet
- Adequate operation and maintenance capability including accessibility requirements for O & M
- Pretreatment requirements for oil, debris and solids in the tributary runoff

3.4.2.4 Performance Objectives

Basic and Large Sand Filter

Basic sand filters are intended to achieve the following average pollutant removals:

- Basic Performance Treatment Goal: 80% total suspended solids (TSS) at influent Event Mean Concentrations (EMCs) of 100-200 mg/L.
- Oil Performance Treatment Goal: Oil and grease to below 10 mg/L daily average and 15 mg/L at any time, with no ongoing or recurring visible sheen in the discharge.

Large Sand Filter

Large sand filters are intended to meet the Phosphorous Treatment Goal by removing at least 50% of the total phosphorus compounds (influent 0.1 to 0.5 mg/l, as total phosphorus) and by collecting and treating 95% of the runoff volume. (ASCE and WEF, 1998)

3.4.2.5 Best Management Practices (BMPs) for Sand Filtration

The following BMPs are Sand Filtration BMPs:

- BMP T8.10: Basic Sand Filter Basin
- BMP T8.11: Large Sand Filter Basin
- BMP T8.20: Sand Filter Vault
- BMP T8.30: Linear Sand Filter

3.4.3 Media Filter Drains

3.4.3.1 Purpose and Description

The media filter drain (MFD), previously referred to as the ecology embankment, is a linear flow-through stormwater runoff treatment device that can be sited along street or highway side slopes (conventional design) and medians (dual media filter drains), borrow ditches, or other linear depressions. Cut-slope applications may also be considered. The media filter drain can be used where available right of way is limited, sheet flow from the street surface is feasible, and lateral gradients are generally less than 25% (4H:1V).

The Media Filter Drain (MFD) has four basic components: a gravel no-vegetation zone, a grass strip, the MFD mix bed, and a conveyance system for flows leaving the MFD mix. The MFD mix is composed of gravel, perlite, dolomite, and gypsum.

3.4.3.2 Applications and Limitations

Applications

The media filter drain and the dual media filter drain designs are runoff treatment options that can be sited in most right of way confined situations. In many cases, a media filter drain or a dual media filter drain can be sited without the acquisition of additional right of way needed for conventional stormwater facilities or capital-intensive expenditures for underground wet vaults.

Since maintaining sheet flow across the media filter drain is required for its proper function, the ideal locations for media filter drains are along long, linear grades with lateral side slopes less than 4H:1V and longitudinal slopes no steeper than 5%. As side slopes approach 3H:1V, without design modifications, sloughing may become a problem due to friction limitations between the separation geotextile and underlying soils. The longest flow path from the contributing area delivering sheet flow to the media filter drain should not exceed 150 feet.

Limitations

- Steep slopes. Avoid construction on longitudinal slopes steeper than 5%. Avoid construction on 3H:1V lateral slopes, and preferably use less than 4H:1V slopes. In areas where lateral slopes exceed 4H:1V, it may be possible to construct terraces to create 4H:1V slopes or to otherwise stabilize up to 3H:1V slopes. (For details, see Geometry, Components and Sizing Criteria, Cross Section in the Structural Design Considerations section below).
- Wetlands. Do not construct in wetlands and wetland buffers. In many cases, a media filter drain (due to its small lateral footprint) can fit within the highway fill slopes adjacent to a wetland buffer. In those situations where the highway fill prism is located adjacent to wetlands, an interception trench/underdrain will need to be incorporated as a design element in the media filter drain.
- Shallow groundwater. Mean high water table levels at the project site need to be determined to ensure the media filter drain mix bed and the underdrain (if needed) will not become saturated by shallow groundwater.
- Unstable slopes. In areas where slope stability may be problematic, consult a geotechnical engineer.

For more information on Media Filter Drains consult WSDOT's *Highway Runoff Manual*.

3.4.3.3 Performance Objectives

Media filter drains are intended to achieve the:

- Basic Treatment Goal
- Phosphorous Treatment Goal
- Enhanced Treatment Goals: greater than 30% reduction of dissolved copper, and greater than 60% reduction of dissolved zinc.

3.4.4 Biofiltration Treatment BMPs

3.4.4.1 Purpose and Description

This section discusses biofiltration treatment facilities such as swales and filter strips. These include biofiltration swales, wet biofiltration swales, continuous inflow swales, and filter strips.

Wet biofiltration swales are used where a grassy biofiltration swale is desired but not allowed or advisable because one or more of the following conditions exist:

- The swale is on clay soils and is downstream of a detention pond providing flow control.
- Saturated soil conditions are likely because of seeps or base flows on the site.
- Longitudinal slopes are slight (generally less than 2 percent).
- The swale is part of a treatment train.

A continuous inflow biofiltration swale is to be used when inflows are not concentrated, such as locations along the shoulder of a road without curbs. This design may also be used where frequent, small point flows enter a swale, such as through curb inlet ports spaced at intervals along a road, or from a parking lot with frequent curb cuts. In general, no inlet port should carry more than about 10 percent of the flow.

A continuous inflow swale is not appropriate for a situation in which significant lateral flows enter a swale at some point downstream from the head of the swale. In this situation, the swale width and length must be recalculated from the point of confluence to the discharge point in order to provide adequate treatment for the increased flows.

3.4.4.2 Applications and Limitations

Biofiltration can be used as a basic treatment BMP for stormwater runoff from roadways, driveways, parking lots, and highly impervious ultra-urban areas or as the first stage of a treatment train. In cases where hydrocarbons, high TSS, or debris would be present in the runoff, such as high-use sites, a pretreatment system for those components is necessary. An off-line location is preferred to avoid flattening vegetation and the erosive effects of high flows. Consider biofilters in retrofit situations where appropriate.

Data suggest that the performance of biofiltration swales is highly variable from storm to storm. Clark County recommends considering other treatment methods that perform more consistently, such as sand filters, wet ponds, filter vaults and bioretention before choosing a biofiltration swale.

The basic filter strip is typically used on-line and adjacent and parallel to paved areas such as parking lots, driveways, and roadways.

3.4.4.3 Site Suitability

Consider the following factors for determining site suitability:

- Target pollutants that can be treated by biofiltration.
- Accessibility requirements for Operation and Maintenance.
- Suitable growth environment (soil, etc.) for the vegetation.
- Adequate siting for a pretreatment facility if high petroleum hydrocarbon levels (oil/grease) or high TSS loads could impair treatment capacity or efficiency.

3.4.4.4 Best Management Practices (BMPs) for Biofiltration

The following BMPs are Biofiltration BMPs:

- BMP T9.10: Basic Grassy Biofiltration Swale
- BMP T9.20: Wet Biofiltration Swale
- BMP T9.30: Continuous Inflow Biofiltration Swale
- BMP T9:40: Basic Filter Strip
- BMP T7.40: Compost-amended Vegetated Filter Strip (CAVFS)

3.4.5 Wetpool Facilities

3.4.5.1 Purpose and Description

This section presents the methods, criteria, and details for analysis and design of wetponds, wetvaults, and stormwater wetlands.

These facilities have as a common element a permanent pool of water - the wetpool. Each of the wetpool facilities can be joined with a detention or flow control pond in a combined facility.

3.4.5.2 Applications and Limitations

A wetpond can be integrated to the contours of a site fairly easily. In clayey soils and where groundwater is near the land surface, the wetpond holds a permanent pool of water. In more porous soils, wetponds may still be used, but water seepage from unlined cells could result in a dry pond, particularly in the summer months. Lining the first cell with a low permeability liner is one way to deal with this situation. As long as the first cell retains a permanent pool of water during the wet season, this situation will not reduce the pond's effectiveness but may be an aesthetic drawback.

Wetponds work best when the water already in the pond is moved out en masse by incoming flows, a phenomenon called "plug flow." Because treatment works on this displacement principle, the wetpool storage of wetponds may be provided below the groundwater level without interfering unduly with treatment effectiveness. However, if combined with a detention function, the live storage must be above the seasonal high groundwater level.

Wetponds may be single-purpose facilities, providing only runoff treatment, or they may be combined with a detention pond to also provide flow control. If combined, the wetpond can often be stacked under the detention pond with little further loss of development area. See BMP T10.40 for a description of combined detention and wetpool facilities.

A wetvault may be used for commercial, industrial, or roadway projects if there are space limitations precluding the use of other treatment BMPs. The use of wetvaults for residential development is highly discouraged. Combined detention and wetvaults are allowed; see BMP T10.40.

The stormwater wetland design occupies about the same surface area as wetponds, but has the potential for better aesthetic integration because of the abundance of emergent aquatic vegetation. The most critical factor for a successful design is the provision of an adequate supply of water for most of the year. Careful planning is needed to ensure sufficient water will be retained to sustain good wetland plant growth. Since water depths are shallower than in wetponds, water loss by evaporation is an important concern. Stormwater wetlands are a good stormwater treatment facility choice in areas with high winter groundwater levels

Note that BMP T10.40 includes a treatment wetland with detention.

The basis for pollutant removal in combined facilities is the same as in the stand-alone water quality facilities. However, in the combined facility, the detention function creates fluctuating water levels and adds turbulence. For simplicity, the positive effect of the extra live storage volume and the negative effect of increased turbulence are assumed to balance, and are thus ignored when sizing the wetpool volume. For the combined detention/stormwater wetland, criteria that limit the extent of water level fluctuation are specified to better ensure survival of the wetland plants.

Unlike the wetpool volume, the live storage component of the facility should be provided above the seasonal high water table.

3.4.5.3 Best Management Practices (BMPs) for Wetpool Facilities

The four BMPs listed are currently recognized as effective treatment techniques using wetpool facilities. Select the appropriate BMPs using the Step-by-Step process and the Treatment Facility Menus in Section 3.2.3.

- BMP T10.10: Wetpond – Basic and Large
- BMP T10.20: Wetvault
- BMP T10.30: Stormwater Treatment Wetland
- BMP T10.40: Combined Detention and Wetpool

3.4.6 Proprietary BMPs

The following proprietary BMPs have Ecology General Use Level designations and are accepted by Clark County for applicable treatment uses:

- StormFilter® using ZPG Media has General Use Level designation for Basic Treatment.
- Filterra® System and Filterra® Boxless™ have General Use Level designations for Oil Treatment, Basic Treatment, Enhanced Treatment, and Phosphorous Treatment.
- Perk Filter® has a General Use Level designation for Basic Treatment and Phosphorous Treatment.

See Section 3.4.7 for an explanation of General Use Level designation.

Consult manufacturers for design, specifications, and installation criteria.

3.4.7 Emerging Technologies

3.4.7.1 Background

Traditional best management practices (BMPs) such as wetponds and filtration swales may not be appropriate in some situations due to size and space restraints or inability to remove target pollutants. Therefore the stormwater treatment industry emerged to develop new stormwater treatment devices.

Emerging technologies are stormwater treatment devices that are new to the stormwater treatment marketplace. These devices include both permanent and construction site treatment technologies. Many of these devices have not undergone complete performance testing so their performance claims cannot be verified. Emerging technologies often lack a documented maintenance history that supports understanding long-term operational costs.

Washington State Department of Ecology developed the Technology Assessment Protocol – Ecology (TAPE) and Chemical Technology Assessment Protocol Ecology (CTAPE) protocols to help local governments in selecting new stormwater treatment technologies. Ecology posts information on emerging technologies at the emerging technologies website: http://www.ecy.wa.gov/programs/wq/stormwater/newtech/index.html

Use Levels for Emerging Technologies

Ecology's use level designations describe how an emerging technology may be used in Washington. There are three use level designations: pilot use level designation, conditional use level designation, and general use level designation.

Ecology lists technologies that have obtained a use level designation through the TAPE process on its Emerging Technologies website: http://www.ecy.wa.gov/programs/wq/stormwater/newtech/technologies.html.

Pilot Use Level Designation (PULD)

For technologies that have limited performance data, the pilot use level designation allows limited use to conduct field-testing

Conditional Use Level Designation (CULD)

Ecology may give a conditional use level designation if a manufacturer collected field data through a protocol reasonably consistent with but not fully meeting the TAPE protocol. Conditional Use Level Designations have monitoring requirements and expiration dates. Therefore it is uncertain whether they will eventually receive approvable for general use.

General Use Level Designation (GULD)

The general use level designation (GULD) confers a general acceptance for the specified applications (land uses). General Use Level Designation BMPs may be used for new development, redevelopment, or retrofit situations anywhere in Washington, subject to conditions that Ecology places within the Use Designation document.

3.4.7.2 Using Emerging Technology BMPs in Clark County

Clark County accepts several Emerging Technology BMPs as listed in this manual.

The Responsible Official maintains a list of emerging technologies accepted by Clark County. Applicants may petition the Responsible Official to include an emerging technology on the approved list.

Information the Responsible Official may consider before including a new emerging technology on the approved list includes:

- Equivalence with the most current *Stormwater Management Manual for Western Washington* – Washington Department of Ecology approval level.

- Cost of maintenance – information describing the nature and frequency of maintenance actions and materials costs to predict maintenance costs, knowledge to maintain the BMP, and capital costs for maintenance equipment.
- Ease of access – degree of need for confined space entry. Equipment required to perform maintenance.
- Worker safety – The BMP's typical location (e.g. street, tract, etc.), weights of components or materials to be lifted and confined space concerns.
- Long-term serviceability – demonstrated track record of the manufacturer. Ramifications if the manufacturer goes out of business. The use of the BMP regionally or nationally.
- Sole source availability – replacement parts and media are available from more than one source.

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Chapter 4 Flow Control

Chapter Contents

Chapter Tables

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4.1 Introduction

4.1.1 Purpose

This chapter presents methods, criteria, and details for analysis and selection of flow control BMPs. Flow control facilities are detention or infiltration facilities engineered to meet the flow control standards specified in Minimum Requirement #7. This chapter can also be used to meet the LID Performance Standard for Minimum Requirement #5.

4.1.2 How to Use this Chapter

The standards of this chapter must be used to select flow control facilities that meet Minimum Requirement #7.

4.2 Flow Control BMP Selection

Minimum Requirement #7 (Flow Control) includes area thresholds that determine applicability. Those thresholds determine whether each threshold discharge area (TDA) of a project must use flow control facilities designed by a professional engineer. TDAs falling under the threshold may only need to meet Minimum Requirement #5 (On-Site Stormwater Management). The following outlines steps in selecting Flow Control Facilities.

1. Read the definitions in Appendix 1-A to become acquainted with the following terms: effective impervious surface, impervious surface, hard surface, pollution-generating impervious surface (PGIS), pollution-generating hard surface (PGHS), pollution-generating pervious surface (PGPS), converted vegetation areas, and threshold discharge area.

2. Outline the threshold discharge areas (TDA) for the project site.

3. Determine the area of pollution-generating hard surfaces (including pollution-generating permeable pavements) and pollution-generating pervious surfaces (not including permeable pavements) in each TDA. Compare those totals to the project thresholds in Section 1.5.7 to determine where flow control facilities are required. Note that On-site Stormwater Management BMPs (Minimum Requirement #5) are always applicable.

4. Compute the totals for effective impervious surface and converted vegetation areas in each TDA. Compare those totals to the project thresholds in Section 1.5.7 to determine if flow control facilities are required.

5. For each TDA where flow control thresholds are exceeded, use an approved continuous flow model to determine whether there is an increase of 0.1 cfs in the 100-year return frequency flow. (Note: this is the threshold using 1-hour time steps. If using 15-minute time

steps, the threshold is a 0.15 cfs increase.) This requires a comparison to the 100-year return frequency flow predicted for the existing (pre-project; not historic) land cover condition of the same area. If the above threshold is exceeded, flow control is required. Note that On-site Stormwater Management BMPs (Minimum Requirement #5) are always applicable. Proceed to Step 6 below.

6. Select Flow Control BMPs and Facilities. On-site Stormwater Management BMPs must be applied to the maximum extent practicable in accordance with Minimum Requirement #5. In addition, flow control facilities must be provided for discharges from those threshold discharge areas that exceed the Minimum Requirement #7 thresholds. Use an approved continuous flow model and Chapter 5 (infiltration) and Chapter 6 (Detention) in Book 2 to size and design flow control facilities.

7. Select either an infiltration facility and/or a detention facility to meet Minimum Requirement #7, using the following criteria:

A: Determine whether the site is suitable for infiltration.

Perform the site characterization study per Section 4.3.1.2 and infiltration testing per Section 4.3.1.3 to determine if infiltration is feasible to meet Minimum Requirement #7. If infiltration is feasible, use the design criteria for infiltration basins, drywells, or trenches in Book 2, Chapter 5 to design these facilities.

Note that if the soils are suitable, infiltration can be used to meet runoff treatment (Minimum Requirement #6) and flow control (Minimum Requirement #7) requirements. However, since such a facility would have to be located on-line it would be quite large in order to achieve the flow duration standard of Minimum Requirement #7. See Chapter 3 for more information about using infiltration to meet the runoff treatment standard.

B: If infiltration is not feasible, detention facilities must be used to meet Minimum Requirement #7. These facilities must be sized using an approved continuous flow model. Refer to Book 2, Chapter 6 for Detention Facility design.

Note that the more the site is left undisturbed, and the fewer impervious surfaces are created, the smaller the detention facility. In addition, the greater the use of On-site Stormwater Management BMPs, the smaller the detention facility.

4.3 Flow Control BMPs

4.3.1 Infiltration Facilities

Infiltration facilities for flow control are used to reduce the volume and rate of stormwater runoff by conveying flows from new development or redevelopment to the ground after appropriate treatment. Proper design of infiltration facilities requires careful determination of the infiltration rates on the project site.

The following steps must be followed in the selection of infiltration as a flow control BMP:

1. Select a site or sites for potential infiltration facilities and pretreatment facilities.
2. Perform a site characterization study as described in Section 4.3.1.2. The information from this study must be included in the Soils Report (See Section 1.8.3).
3. Perform field tests and determine the field measured coefficient of permeability (the infiltration rate) as described in Section 4.3.1.3 and Appendix 1-C.
4. Apply correction factors per Section 4.3.1.3 to determine the design infiltration rate.
5. Determine if infiltration is feasible (i.e. the infiltration rate is high enough that infiltration of stormwater meeting Minimum Requirement #7 is feasible) and if so select an infiltration BMP.
6. If infiltration is feasible, size the facilities using the design criteria in Book 2, Chapter 5.

Typical BMPs for infiltration include infiltration ponds, infiltration trenches, drywells, and perforated pipe.

4.3.1.1 Regulatory Requirements

Washington State Department of Ecology Underground Injection Control

Below-surface stormwater infiltration facilities, such as drywells and perforated pipes, are classified by Ecology as Underground Injection Control (UIC) wells (See Underground Injection Control Program, Chapter 173-218 WAC). The two major requirements of Ecology's UIC regulations are to register UIC wells with the Washington State Department of Ecology prior to their installation and to make sure that underground sources of ground water are not endangered by pollutants in the discharge (Non-Endangerment Standard). These regulations have requirements on minimum depth to groundwater (5 feet), as well as siting and installation requirements. They also list development activities that are prohibited from using UICs.

Ecology's UIC guidelines, as found in *Guidance for UIC Wells that Manage Stormwater* (Ecology 2006), provides information on what is classified as a UIC, provides design information that must be followed for UIC installation, and provides information on requirements to meet the Non-endangerment Standard.

Clark County requires verification of UIC registration before approval of final plans. Where UIC regulations conflict with County code, the more stringent of the two regulations shall apply, as determined by the Responsible Official.

Clark County Code 40.410 CARA

The county's Critical Aquifer Recharge Area (CARA) regulation, CCC 40.410, prohibits placement of Class V injection wells in Category I CARAs and requires a permit for placement of Class V injection wells for certain non-residential developments in Category II CARAs. Consult CCC 40.410 for further information, and see Maps Online at Clark County's web site for the locations of CARAs (http://gis.clark.wa.gov/mapsonline/).

4.3.1.2 Site Characterization Study

One of the first steps in siting and designing infiltration facilities is to conduct a site characterization study. This study must include the following steps.

Step 1: Surface Features Characterization

1. Gather information on the following site features:
    - Topography within 500 feet of the proposed facility.
    - Location of water supply wells within 500 feet of proposed facility.
    - Location of CARAs regulated under Chapter 40.410 within 500 feet of the proposed facility.
    - A description of local site geology, including soil or rock units likely to be encountered, the groundwater regime, and geologic history of the site.
2. Review the following site suitability criteria. When a site investigation reveals that any of the criteria in this section cannot be met, consider appropriate measures such as relocation or resizing so that the infiltration facility will not pose a threat to safety, health, and the environment and meet the requirements in this section.

Setback Criteria: Setback requirements are listed in Table 4.1.

Table 4.1: Stormwater Infiltration Facility Setbacks

Stormwater infiltration facility setback from:	Distance
Drinking water wells	100 feet minimum
Building foundations	20 feet minimum from the downslope side of foundations 100 feet minimum from the upslope side of foundations These setbacks may be increased or decreased based on engineering analysis that shows the performance of the building's foundation system will not be adversely affected by the presence of the stormwater facility
Slopes equal to or greater than 15%	50 feet minimum from the crests of slopes. This setback may be increased or decreased based on engineering analysis that shows the stability of the slope will not be adversely affected by the presence of the stormwater facility.
Property lines	20 feet from any property line. However, if an infiltration trench is a common system shared by the two or more adjacent lots and contained within an easement for maintenance given to owners of all lots draining to the system, then the setback from the property line(s) shared by the adjacent lots may be waived.

Critical Aquifer Recharge Areas (CARA). Review Section 4.3.1.1 and CCC 40.410 for regulation regarding installation of infiltration facilities within CARA sites.

High Vehicle Traffic Areas: An infiltration BMP can be used in areas of industrial activity and the high vehicle traffic areas described below. For such applications, provide sufficient pollutant removal (including oil removal) upstream of the infiltration facility to ensure that groundwater quality standards will not be violated and that the infiltration facility will not be adversely affected. High Vehicle Traffic Areas are:

- Commercial or industrial sites subject to an expected average daily traffic count (ADT) ≥100 vehicles/1,000 ft^2 gross building area (trip generation).
- Road intersections with an ADT of ≥ 25,000 on the main roadway and ≥ 15,000 on any intersecting roadway.

Step 2: Subsurface Characterization

1. Subsurface explorations (test holes, wells or test pits) for site characterization should include:
    a. For drywells, at least one exploration per drywell(s) location.

b. For infiltration basins, at least one exploration per 5,000 ft^2 of basin infiltrating surface (in no case less than two per basin).

c. For infiltration trenches, at least one exploration per 200 feet of trench length (in no case less than two per trench).

NOTE: The depth and number of exploration, and samples can be adjusted, if in the judgment of an engineer with geotechnical expertise (P.E.), a geologist, engineering geologist, or hydrogeologist licensed in the State of Washington that the conditions are such that the changes still provide enough data to accurately estimate the performance of the infiltration system. Written proof shall be provided in the Soils Report (Section 1.8.3).

2. Subsurface explorations to a depth below the base of the infiltration facility of at least 5 times the maximum design depth of ponded water proposed for the infiltration facility, but not less than 10 feet below the base of the facility. At sites with shallow groundwater (less than 15 feet from the estimated base of facility), and where a groundwater mounding analysis is necessary, determine the thickness of the saturated zone. In high water table sites, the subsurface exploration sampling need not be conducted lower than two (2) feet below the ground water table.

3. Continuous sampling (representative samples from each soil type and/or unit within the infiltration receptor) to a depth below the base of the infiltration facility of 2.5 times the maximum design ponded water depth, but not less than 10 feet. For large infiltration facilities serving drainage areas of 10 acres or more, sampling up to 50 or more feet may be required.

4. If using the soil grain size analysis method for estimating infiltration rates: laboratory testing as necessary to establish the soil gradation characteristics and other properties as necessary, to complete the infiltration facility design. At a minimum, conduct one grain size analysis per soil stratum in each test hole within 2.5 times the maximum design water depth, but not less than 10 feet. When assessing the soil characteristics of the site, soil layers at greater depths must be considered if the licensed professional conducting the investigation determines that deeper layers will influence the rate of infiltration for the facility, requiring soil gradation/classification testing for layers deeper than indicated above.

5. Prepare detailed logs for each test pit or test hole and a map showing the location of the test pits or test holes. Logs must include at a minimum, depth of pit or hole, soil descriptions, depth to water, presence of stratification. NOTE: Logs must substantiate whether stratification does or does not exist. The licensed professional may consider additional methods of analysis to substantiate the presence of stratification that will significantly impact the design of the infiltration facility.

6. Soil characterization for each soil unit (soils of the same texture, color, density, compaction, consolidation and permeability) encountered should include:

- Grain size distribution (ASTM D422 or equivalent AASHTO specification), if using the soil grain size analysis method to estimate infiltration rates;
- Visual grain size classification;
- Percent clay content (include type of clay, if known);
- Color/mottling;
- Variations and nature of stratification.

7. Locate the ground water table and establish its gradient, direction of flow, and seasonal variations, considering the water table aquifer (defined as the uppermost aquifer in open conditions). Groundwater monitoring wells shall be installed to monitor variations in groundwater level through at least one wet season (October 1 through April 30).

8. For facilities serving a drainage area of one acre or over, one groundwater monitoring well shall be installed in each proposed infiltration facility location, unless:
   - GIS groundwater data from Clark County or available field information describing water table elevations within 500 feet of the site indicates that the seasonal high groundwater elevation is at least 15 feet below the base of the proposed facility. Examples of field information that can be used include public well records and groundwater monitoring reports from other development sites.; OR
   - The seasonal high groundwater elevation has been found to be at least 15 feet below the facility base from monitoring wells installed at the site where monitoring was conducted during at least one wet season in the preceding three years.

9. For facilities serving a drainage area less than one acre, establish that the depth to groundwater or other hydraulic restriction layer will be at least 10 feet below the base of the facility. This can be determined through the use groundwater monitoring wells as described above, through subsurface explorations or through information from nearby wells (500 feet or closer).

Step 3: Soil Testing

1. Field measured infiltration test to determine the coefficient of permeability must be conducted using one of the methods listed in Section 4.3.1.3.

2. If the infiltration facility will provide treatment the soil characterization must also include:
   - Cation exchange capacity (CEC) and organic matter content for each soil type and strata where distinct changes in soil properties occur, to a depth below the base of the facility of at least 2.5 times the maximum design water depth, but not less than 6 feet.

4.3.1.3 Coefficient of Permeability

Field-measured coefficient of permeability rates (also termed infiltration rates) can be determined using one of the three in-situ field measurements, or, if the site has unconsolidated and uncemented sediments, by a correlation to grain size distribution from soil samples. The latter method uses the ASTM soil size distribution test procedure (ASTM D422), which considers the full range of soil particle sizes, to develop soil size distribution curves.

Once the coefficient of permeability has been measured in the field, the design rate needs to be determined. This section discusses the procedures for adjusting the field-determined rate for use in designing facilities.

Field Measurements

Select one of the four methods described below to measure the field coefficient of permeability rate at the site. Use the field-measured coefficient of permeability to determine the design (long-term) infiltration rate. Then use the design (long-term) rate for routing and sizing the infiltration facility, and for checking for compliance with the maximum drawdown time of 48 hours. A detailed description of these test methods can be found in Appendix 1-C

1. Modified Single-Ring Falling Head Test

This test was developed by local (Clark County) geotechnical engineers and was approved for use by Ecology in Clark County's 2009 *Stormwater Manual*. More information on this test method can be found in ASCE 2009 and the methodology associated with this test is described in Appendix 1-C.

2. Large-Scale Pilot Infiltration Test (PIT)

The Pilot Infiltration Test (PIT) is a field procedure for estimating the measured coefficient of permeability of the soil profile beneath the proposed infiltration facility. More information on this method can be found in Appendix 1-C.

3. Small-Scale Pilot Infiltration Test

A small-scale PIT can be substituted for the large-scale PIT in any of the following instances:

- The drainage area to the infiltration site is less than one acre.
- The testing is for the LID BMPs of bioretention or permeable pavement that either serve small drainage areas (less than an acre) and /or are widely dispersed throughout a project site.
- The site has a high infiltration rate, making a full-scale PIT difficult, and the site geotechnical investigation suggests uniform subsurface characteristics.
- Site accessibility or safety concerns impede the ability to conduct a large-scale PIT.

More information on this method can be found in Appendix 1-C.

4. Soil Grain Size Analysis Method

If the site has unconsolidated or uncemented sediments, then measured coefficient of permeability rates can be determined by a correlation to grain size distribution from soil samples. This method uses the ASTM soil size distribution test procedure (ASTM D422), which considers the full range of soil particle sizes, to develop soil size distribution curves.

More information on this method can be found in Appendix 1-C.

Correction Factors / Design Infiltration Rate

The coefficient of permeability obtained from the field tests above is a measured rate. This rate must be reduced through correction factors that are appropriate for the design situation to produce a design rate.

Correction factors account for site variability, number of tests conducted, uncertainty of the test method, and the potential for long-term clogging due to siltation and bio-buildup. Table 4.2 summarizes the typical range of correction factors to account for these issues. The specific correction factors used shall be determined based on the professional judgment of the licensed engineer considering all issues that may affect the infiltration rate over the long term, subject to the approval of Clark County.

The correction factors in Table 4.2 shall be used to establish the allowable infiltration rate for both the PIT test and the single-ring falling head test. The safety factor for a sacrificial system can be reduced if the system is designed to infiltrate runoff for a design event with a 2-year return period.

Table 4.2: Infiltration Rate Correction Factors

Base Correction Factor	Tables continues on following page.
The base correction factor is meant to account for soil variability and long-term system degradation due to siltation, crusting, or other factors.	2
Soils Correction Factor	
Additive correction factor recommended by geotechnical professional as a result of soil or groundwater conditions.	Minimum value of 2, or greater as recommended by the geotechnical engineer
System Design Correction Factors	
If the infiltration facility serves a basin with an impervious area greater than 2 acres.	Add ½

If the infiltration facility serves a basin with an impervious area greater than 5 acres.	Add 1
Infiltration facilities in closed depressions.	Add 2
If a sacrificial system is provided and left operational following permanent site stabilization.	Subtract ½

4.3.2 Detention

This section presents criteria for selecting a detention facility to meet Minimum Requirement #7, while detailed design criteria are presented in Book 2, Chapter 6. Detention facilities provide for the temporary storage of increased surface water runoff resulting from development pursuant to the performance standards set forth in Minimum Requirement #7 for flow control. Detention facilities can also provide for retention of stormwater through infiltration in the bottom of the pond.

4.3.2.1 Detention Standard

Stormwater discharges shall match developed discharge durations to pre-developed durations for the range of pre-developed discharge rates from 50% of the 2-year peak flow up to the full 50-year peak flow. The pre-developed condition to be matched shall be a forested land cover unless one of the following conditions is met:

- Reasonable, historic information is provided that indicates the site was prairie prior to settlement (see Appendix 1-D). These areas are modeled as "pasture" in the approved continuous flow model.
- The drainage area of the immediate stream and all subsequent downstream basins has had at least 40% total impervious area since 1985[5]. In this case, the pre-developed condition to be matched shall be the existing land cover condition. Where basin-specific studies determine a stream channel to be unstable, even though the above criterion is met, the pre-developed condition assumption shall be the "historic" land cover condition, or a land cover condition commensurate with achieving a target flow regime identified by an approved basin study.
- The development site TDA drains to a reach of a stream where an Ecology approved basin plan has been developed that includes an alternative pre-development standard. See Appendix 1-B for these areas.

This standard requirement is waived for sites that will infiltrate all the runoff from hard surfaces and converted vegetation areas.

[5] No areas in Clark County meet this criterion.

4.3.2.2 Applications and Limitations

1. Stormwater detention facilities that can impound 10 acre-feet (435,600 cubic feet; 3.26 million gallons) or more with the water level measured at the embankment crest are subject to the state's dam safety requirements, even if water storage is intermittent and infrequent (WAC 173-175-020(1)). For stormwater detention facilities, this means sizing the emergency spillway to accommodate the runoff from the dam safety design storm. Other dam safety requirements include geotechnical issues, construction inspection and documentation, dam breach analysis, inundation mapping, emergency action planning, and periodic inspections by project owners and by Dam Safety engineers. Electronic versions of the guidance documents are available on the Department of Ecology Web site at http://www.ecy.wa.gov/programs/wr/dams/dss.html.

2. Ponds must be designed as flow-through systems (however, parking lot storage may be utilized through a back-up system). Stormwater must enter through a conveyance system separate from the control structure and outflow conveyance system. Maximizing distance between the inlet and outlet is encouraged to promote sedimentation.

3. Pond bottoms should be level and located a minimum of 0.5 foot (preferably 1 foot) below the inlet and outlet to provide sediment storage.

4. A geotechnical analysis and report must be prepared for facilities associated with slopes over 15%, or if located within 200 feet of the top of a slope steeper than 40%, or landslide hazard area. The scope of the geotechnical report should include the assessment of impoundment seepage on the stability of the natural slope where the facility will be located within the setback limits set forth in this section.

4.3.2.3 Detention Ponds in Infiltrative Soils

Detention ponds may be sited on soils that are sufficiently permeable for a properly functioning infiltration system. These detention ponds have a surface discharge and may also utilize infiltration as a second pond outflow. Detention ponds sized with infiltration as a second outflow must meet all the requirements of this chapter, and Book 2, Chapter 5 for infiltration basins, including a soils report, testing, groundwater protection, presettling, and construction techniques.

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Chapter 5 Offsite Analysis

Chapter Contents

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5.1 Introduction

5.1.1 Purpose

5.1.2 How to use this Chapter

Offsite Analysis

An offsite analysis is required when a project that must meet Minimum Requirements #1 – #9 meets any of the following criteria:

- Adds 35,000 square feet or more of new pervious surface.
- Constructs or modifies a drainage pipe or ditch that is 12 inches or more in size/depth or that receives runoff from a drainage pipe or ditch that is 12 inches or more in size/depth.
- Contains or lies adjacent to a landslide, steep slope, or erosion hazard area.
- Is not exempt from Minimum Requirement #8.
- The project changes the rate, volume, duration, or location of discharges to and from the project site.

If any of the above criteria are met, the applicant shall complete the Qualitative Analysis in Section 5.2.1.

Depending upon the presence of existing or predicted flooding, erosion or water quality problems, and on the proposed design of the onsite drainage facilities, the County may require a qualitative analysis further downstream, mitigation measures, or a quantitative analysis.

Existing offsite impacts that are not affected by the project site do not require mitigation. However, in cases where the project site is the cause of the existing impact, the applicant shall mitigate for those impacts.

5.2 Offsite Analysis

5.2.1 Qualitative Analysis

The qualitative downstream analysis shall extend downstream for the entire flow path, from the project site to the receiving water, or up to one-quarter mile, whichever is less. The qualitative analysis may be stopped shorter than the required ¼ mile downstream if the analysis reaches a County identified trunk main. Trunk mains are defined as public stormwater drainage pipes equal to or greater than 36 inches and installed at a minimum slope of 0.5%.

The upstream qualitative analysis shall identify and describe points where water enters the site and the tributary area that contributes water to those run-on locations.

A basin map delineating the onsite and offsite basin upstream and downstream for the site shall be provided. The basin map shall be to a defined scale. Maps printed from the County's GIS website may be used as a base for the basin map, and to obtain contours and existing stormwater facility information. Field verification of county information may be required as directed by the Responsible Official. The following describes components (or tasks) of the qualitative analysis.

Task 1: Inspection of Conveyance System and Outfall

The existing conditions and potential impacts to be evaluated shall include, at a minimum, but not be limited to:

1. Erosion at outfalls
2. Conveyance system capacity.
3. Localized flooding.

The design engineer shall physically inspect the existing onsite and offsite drainage systems of the study area for each discharge location for existing or potential problems and drainage features. An inspection and investigation shall include the following:

1. Collect information on pipe sizes, channel characteristics, and drainage structures.
2. Identify existing/potential constrictions or capacity deficiencies in the drainage system.
3. Identify existing/potential flooding problems.
4. Identify existing/potential erosion, scouring, or bank sloughing at outfalls.
5. Note date and weather at time of inspection.

Task 2: Description of the Drainage System and Its Existing and Predicted Problems

For each drainage system component (e.g., pipe, culvert, bridge, outfall, pond, vault), the analysis shall include the location, physical description, problems, and field observations.

All existing or potential problems (e.g., flooding, erosion) identified in Task 1 shall be described. The descriptions shall be used to determine whether adequate mitigation can be identified or whether more detailed quantitative analysis is necessary. The following information shall be provided for each existing or potential problem:

1. Magnitude of or damage caused by the problem.

2. General frequency and duration.
3. Return frequency of storm or flow when the problem occurs (may require quantitative analysis).
4. Water elevation when the problem occurs.
5. Names and concerns of the parties involved.
6. Current mitigation of the problem.
7. Possible cause of the problem.
8. Whether the project is likely to aggravate the problem or create a new one.

5.2.2 Quantitative Analysis

Upon review of the qualitative analysis, Clark County may require a quantitative analysis, depending on the presence of existing or predicted flooding, erosion, or water quality problems and on the proposed design of the onsite drainage facilities.

The quantitative analysis shall extend downstream for the entire flow path, from the project site to the receiving water, or up to one-quarter mile, whichever is less. The quantitative analysis may be stopped shorter than the required ¼ mile downstream if the analysis reaches a trunk main. Trunk mains are defined as public stormwater drainage pipes equal to or greater than 36 inches and installed at a minimum slope of 0.5%. All existing and proposed offsite stormwater conveyance shall meet the design criteria described in the methods of analyses.

If a capacity problem or streambank erosion problem is found during the quantitative downstream analysis, mitigation measures may be required.

Include the following as part of the quantitative downstream analysis:

- Capacity and percent full in each reach.
- Description of design flows used in analysis.
- Velocity in each reach.
- Upstream and downstream basin maps showing the flow route for both onsite and offsite stormwater.
- Include all model assumptions, outputs, and equations used in the analysis. If model parameters are used that are different than typical standards of practice, justification of the parameters is required.
- Clearly describe headwater and tailwater assumptions.

- The 25-year and 100-year hydraulic gradelines must be shown.
- Include model outputs for both under capacity conditions and if the applicant is proposing to upsize the downstream system, outputs showing the upsized conditions.

The quantitative analysis shall provide information on the severity and frequency of an existing problem or the likelihood of creating a new problem. It shall evaluate proposed mitigation intended to avoid aggravation of the existing problem and creation of a new problem.

As-built drawings may be utilized to obtain structure information to be used in the downstream analysis. If as-built drawings are used, the engineer is responsible for verifying that all elevations are in the same datum. The County may require a field survey of the existing storm drainage system downstream from the project for a minimum of ¼ mile from the point of connection to the existing public drainage system, or may require portions of the system to be field surveyed.

5.2.3 Mitigation Measures

Clark County may require mitigation measures, depending on the results of the off-site analysis. Possible mitigation measures could include upsizing of offsite conveyance or additional flow control measures. Where required, the mitigation will be of a type to be determined by the Responsible Official.

Chapter 6 Construction Stormwater Pollution Prevention

Chapter Contents

Chapter Tables

6.1 Introduction

6.1.1 Purpose

This chapter presents guidance on the selection of BMPs to manage construction site stormwater in accordance with Minimum Requirement #2, Construction Stormwater Pollution Prevention. The chapter also guides the applicant in developing a Stormwater Pollution Prevention Plan (SWPPP) for projects that require it. All new development and redevelopment projects are responsible for preventing erosion and discharge of sediment or other pollutants into receiving waters and to meet Minimum Requirement #2.

Construction stormwater pollution prevention is a set of activities and best management practices (BMPs) focused on managing stormwater impacts associated with construction activities. BMPs that, when properly planned, installed, and maintained, can minimize stormwater impacts, such as heavy stormwater flows, soil erosion, water-borne sediment, and degradation of water quality. Proper implementation of BMPs selected in accordance with this chapter can help minimize construction delays and save money otherwise spent on repairing erosion. These BMPs are usually temporary, lasting as long as construction activity on the site.

All projects that include land disturbing activities such as development projects, grading projects and building construction are responsible for preventing erosion and discharge of sediment and other pollutants into receiving waters. Thresholds and requirements are defined in Chapter 1.

For more information on the impacts of erosion and sediment on the environment and how erosion occurs, see Volume II, Sections 1.4 through 1.6 of the Stormwater Management Manual for Western Washington (Ecology, 2014).

6.1.2 How to Use this Chapter

Chapter 6 addresses preparing for and implementing construction stormwater pollution prevention plans (SWPPPs). Use this chapter to develop a plan and select BMPs to control erosion, sediment and other pollutants during construction. Submit the Construction SWPPP according to the submittal requirements in Section 1.8.

- Section 6.2 gives guidance to project proponents that must develop a SWPPP for the County and also must obtain a NPDES Construction Stormwater General Permit from Department of Ecology.
- Section 6.3 describes the SWPPP and presents a step-by-step method for developing a Construction SWPPP. It includes lists of suggested BMPs to meet each of the 13 elements of construction stormwater pollution prevention.

- Section 6.4 lists and describes the required 13 elements of a Construction SWPPP. All elements must be included in the SWPPP.
- Section 6.5 lists BMPs for construction stormwater control and site management, including BMPs for source control and BMPs that address runoff, conveyance, and treatment.

For projects that trigger only Minimum Requirement #2 in Section 1.4 or that qualify for a Small Project submittal in accordance with Section 1.7, use the instructions in the Construction SWPPP Short Form in Appendix 1-I to develop and submit the SWPPP.

6.2 Relationship to Construction Stormwater General Permit

Many projects permitted in Clark County will also require a NPDES Construction Stormwater General Permit from Washington Department of Ecology. Generally, projects that disturb an acre or more of land and discharge stormwater to surface waters of the state require the state construction permit in addition to the land use, engineering and building permits required by the county. Some exceptions are noted in the Construction Stormwater General Permit itself.

Clark County erosion and sediment control requirements are equivalent to the 2014 *Stormwater Management Manual for Western Washington*. The state construction permit has its own set of requirements that are very similar. The state permit includes requirements such as site discharge monitoring and water quality reporting requirements that are not included in county code.

If a development site permitted under Clark County code 40.386 and the Department of Ecology also requires a NPDES Construction Stormwater General Permit (CSWGP), then the site operator is obligated to follow both sets of construction stormwater prevention rules. Use Table 6.1 as a general guideline for how to meet both with the least duplication of effort. Clark County makes no guarantee that the guidance provided in Table 6.1 will result in timely processing or issuance of the Construction Stormwater General Permit by Department of Ecology.

Note: the guidance in Table 6.1 does not apply to sites that do not require a CSWGP.

Table 6.1 Coordinating Construction Stormwater General Permit with Minimum Requirement #2

Construction permit Document / Action	Clark County Requirement	Ecology Construction Permit	Do This
Notice of Intent (NOI)	Not Required	Submit NOI to Ecology and Clark County 60 days prior to discharging stormwater from the site.[6]	Submit NOI to Ecology and Clark County at least 60 days prior to discharging stormwater from the site.[6]
Public Notice	Not Required (specific to stormwater discharges from the site)	1 x each week for 2 consecutive weeks, at least 7 days apart. Specific language is in the CSWGP.	Advertise a public notice 1 x each week for 2 consecutive weeks, at least 7 days apart. Follow guidelines for specific language in the CSWGP.
Erosivity Waiver	Not Applicable	Optional	If the site qualifies for an erosivity waiver from the CSWGP, submit the waiver to Ecology. Continue to use the CCSM to meet Minimum Requirement #2 for Clark County.
Stormwater Pollution Prevention Plan (SWPPP)	Prepare a SWPPP according to the CCSM, including 13 Elements. Clark County allows fewer BMPs to select from than CSWGP. Submit to Clark County with Erosion Control Inspection fee.	Prepare a SWPPP according to CSWGP, including 12 elements[7].	Prepare a SWPPP according instructions in the CCSM and add a contingency plan per Section S9B(1)(e) of the CSWGP to the narrative. Submit to Clark County with the Erosion Control inspection fee and before discharging stormwater from the site.
Monitoring	Not Required	Required, depending on site size. Use Section S4 beginning on page 12 of the CSWGP to determine requirements.	Monitor the construction site per Section of the CSWGP.
Table continues on following page.			

[6] Submission of the NOI 60 days prior to discharging stormwater is a minimum established by Washington Department of Ecology. However, Ecology may take significantly longer than 60 days to review a NOI in some circumstances. The applicant is responsible for communicating with Ecology directly to determine Ecology's review timelines in different circumstances and for submitting the NOI accordingly.

[7] At time of publication, Ecology has issued a draft CSWGP that contains the 13 elements of a SWPPP currently required by Clark County. Clark County assumes that the updated CSWGP permit will go into effect around the time this manual becomes effective in Clark County.

Construction permit Document / Action	Clark County Requirement	Ecology Construction Permit	Do This
Site Log Book	Required	Required as part of Monitoring, Section S4.	Maintain a site log book that contains a record of the implementation of the SWPPP. Ensure the log is available for county and state inspectors.
Inspections	Operator is required to inspect, maintain and repair using qualified personnel all BMPs as needed to assure continued performance of their intended function.	Required as Part of Monitoring in Section S4 of the CSWGP.	Follow inspection requirements in Section S4 of the CSWGP.
CESCL	Required for sites that disturb 1 acre or more or that use a licensed contractor for land-disturbing activity	Required for sites that disturb 1 acre or more	Identify a CESCL in the SWPPP.
Sampling for water quality criteria for discharges to specific water bodies listed by Ecology	Not Required	Required depending on size of disturbed area. Specialized sampling is required depending on receiving water body.	Follow sampling requirements in Section S4 of the CSWGP and in Special Condition S8.
Notice of Termination (NOT)	Not Required	Required after final site stabilization or temporary stabilization and homeowners have taken possession of residences	Follow NOT requirements in S10 of the CSWGP.

6.3 Stormwater Pollution Prevention Plan Development

A Construction Stormwater Pollution Prevention Plan (SWPPP) is required if the project triggers Minimum Requirements #1 – #5 or Minimum Requirements #1 – #9 (see Section 1.4).

The Construction SWPPP must include each of the 13 elements listed in Section 6.4 unless site conditions render any of the elements unnecessary and the exemption from that element is clearly justified in writing.

A complete description of each element and associated BMPs is given Section 6.4.

The Construction SWPPP must describe best management practices (BMPs) to prevent erosion and sedimentation, and to identify, reduce, eliminate or prevent stormwater contamination and water pollution from construction activity. The primary project proponent shall evaluate, with input from utilities and other contractors, the stormwater management requirements for the entire project, including the utilities, when preparing the Construction SWPPP.

6.3.1 What is a Construction SWPPP?

A Construction Stormwater Pollution Prevention Plan (SWPPP) is a written plan to implement measures to identify, prevent, and control the contamination of point source discharge of stormwater. The Construction SWPPP explains and illustrates the measures, usually in the form of best management practices (BMPs), to take on a construction site to control potential pollution problems. The primary pollutant of concern on construction sites is sediment from erosion.

As site work progresses, the plan must be modified routinely in prescribed time periods to reflect changing site conditions. The Construction SWPPP must be located on the construction site or within reasonable access to the site for construction and inspection personnel, although a copy of the drawings must be kept on the construction site at all times.

6.3.2 BMP Selection, Standards, and Specifications

Section 6.5 contains list of approved BMPs for each of the 13 elements of a SWPPP. BMPs must be selected from the lists, or from other approved BMPs in this manual, and designed and installed in accordance with the standards and specifications given in Book 2, Chapter 8. BMPs may be used singularly or in combination. The Responsible Official may allow BMPs from other guidance documents or manuals which Washington Department of Ecology has approved as equivalent under the NPDES Phase I Municipal Stormwater Permit.

6.3.3 Construction SWPPP Process

The Construction SWPPP consists of two parts: a narrative and drawings. Both parts shall contain information specific to the construction site.

6.3.3.1 Narrative

The Construction SWPPP narrative must address the following subject areas:

- Site and Project Description
    - Project description: Describe the nature and purpose of the construction project. Include the total size of the area, any increase in existing impervious area; the total area expected to be disturbed by clearing, grading, excavation or other construction activities, including offsite borrow and fill areas; and the volumes of grading cut and fill that are proposed.

- Existing site conditions: Describe the existing topography, vegetation, and drainage. Include a description of any structures or development on the parcel including the area of existing impervious surfaces.
- Adjacent areas: Describe adjacent areas, including streams, lakes, wetlands, residential areas, and roads that might be affected by the construction project. Describe how areas draining to the project may affect the site. Provide a description of the upstream drainage leading to the site and the downstream drainage leading from the site to the receiving body of water.
- Critical areas: Describe areas on or adjacent to the site that are classified as critical areas. Critical areas that receive runoff from the site shall be described up to ¼ mile away. Describe special requirements for working near or within these areas.
- Soil: Describe the soil on the site, giving such information as soil names, mapping unit, erodibility, settleability, permeability, depth, depth to groundwater, texture, and soil structure.
- Potential erosion problem areas: Describe areas on the site that have potential erosion problems.

- The Thirteen Elements: Describe how the Construction SWPPP addresses each of the 13 required elements. Include the type and location of BMPs used to satisfy the required element. If an element is not applicable to a project, provide a written justification for why it is not necessary.
- Construction Schedule and Phasing: Describe the construction schedule. If the schedule extends into the wet season, describe what activities will continue during the wet season and how the transport of sediment from the construction site to receiving waters will be prevented. Describe the intended sequence and timing of construction activities and any proposed construction phasing.
- Financial/ownership Responsibilities: Describe ownership and obligations for the project. Include bond forms and other evidence of financial responsibility for environmental liabilities associated with construction.
- Engineering calculations: Attach any calculations made for the design of such items as sediment ponds, diversions, and waterways, as well as calculations for runoff and stormwater detention design (if applicable). Engineering calculations must bear the signature and stamp of an engineer licensed in the state of Washington.
- Certified Erosion and Sediment Control Lead (CESCL): Identify a CESCL along with their contact information and expiration of their CESCL certification.

6.3.3.2 Drawings

1. Vicinity map - Provide a map with enough detail to identify the location of the construction site, adjacent roads, and receiving waters.

2. Site map - Provide a site map(s) showing the following features:
3. A legal description of the property boundaries or an illustration of property lines (including distances) in the drawings.
4. The direction of north in relation to the site.
5. Existing structures and roads, if present.
6. Boundaries and labeling of different soil types.
7. Areas of potential erosion problems.
8. Any on-site and adjacent surface waters, critical areas, their buffers, FEMA base flood boundaries, and shoreline management boundaries.
9. Existing contours and drainage basins and the direction of flow for the different drainage areas.
10. Final and interim grade contours as appropriate, drainage basins, and the direction of stormwater flow during and upon completion of construction.
11. Areas of proposed soil disturbance, including all areas affected by clearing, grading and excavation.
12. Locations where stormwater discharges to surface waters during and upon completion of construction.
13. Existing unique or valuable vegetation and the vegetation that is to be preserved.
14. Cut and fill slopes indicating top and bottom of slope catch lines.
15. Stockpile, waste storage, and vehicle storage/maintenance areas.
16. Total cut and fill quantities and the method of disposal for excess material.
17. Conveyance systems - Provide a map that shows the following temporary and permanent conveyance features:
    a. Locations for temporary and permanent swales, interceptor trenches, or ditches.
    b. Drainage pipes, ditches, or cut-off trenches associated with erosion and sediment control and stormwater management.
    c. Temporary and permanent pipe inverts and minimum slopes and cover.

d. Grades, dimensions, and direction of flow in all ditches and swales, culverts, and pipes.

e. Details for bypassing offsite runoff around disturbed areas.

f. Locations and outlets of any dewatering systems.

18. Location of detention BMPs – Provide a map that shows the locations of stormwater detention BMPs.

19. Erosion and Sediment Control (ESC) BMPs – provide a map that shows all major structural and nonstructural ESC BMPs including:

    a. The location of sediment pond(s), pipes and structures.

    b. Dimension pond berm widths and inside and outside pond slopes.

    c. The trap/pond storage required and the depth, length, and width dimensions.

    d. Typical section views through pond and outlet structure.

    e. Typical details of gravel cone and standpipe, and/or other filtering devices.

    f. Stabilization technique details for inlets and outlets.

    g. Control/restrictor device location and details.

    h. Stabilization practices for berms, slopes, and disturbed areas.

    i. Rock specifications and detail for rock check dam, if used.

    j. Spacing for rock check dams as required.

    k. Front and side sections of typical rock check dams.

    l. The location, detail, and specification for silt fence.

20. The construction entrance location and a detail.

21. Other Maps – Provide a map that indicates:

    a. Pollutant BMPs – the location of BMPs to be used for the control of pollutants other than sediment, such as high or low pH and hydrocarbons.

    b. Monitoring locations – water quality sampling locations, if sampling is required by Clark County.

22. Detailed drawings – Any structural source control practices used that are not referenced in this manual or other manuals approved as equivalent by Ecology must be explained and illustrated with detailed drawings.

23. Notes addressing construction phasing and scheduling must be included on the drawings.

6.3.4 Step-By-Step Procedure

There are three basic steps in producing a Construction SWPPP:

Step 1 – Data Collection

Step 2 – Data Analysis

Step 3 – Construction SWPPP Development and Implementation

Guidance for developing a Construction SWPPP is included as the Construction SWPPP Checklist in Appendix 1-F.

6.3.4.1 Step 1 - Data Collection

Evaluate existing site conditions and gather information that will help develop the most effective Construction SWPPP. The Construction SWPPP author may use the information collected during the development of the Stormwater Site Plan to provide the information listed below.

Topography

Prepare a topographic drawing of the site to show the existing contour elevations at intervals of 1 to 5 feet depending upon the slope of the terrain.

Drainage

Locate and clearly mark existing drainage swales and patterns on the drawing, including existing storm drain pipe systems.

Soils

Identify and label soil type(s) and erodibility (low, medium, high or an index value) on the drawing or in the narrative.

Characterize soils for permeability, percent organic matter, and effective depth. This information is available in generalized descriptions for the county in a federal Natural Resource Conservation Service report. Typical general descriptions include:

- A sieve analysis of the soils

- Permeability (in/hr)
- Available water-holding capacity (in/in)
- The percent of organic matter

Soils information can be obtained from a Natural Resource Conservation Service (NRCS) manual or the NRCS' Web Soil Survey website at http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm.

Washington state soil survey information is available at:
http://soils.usda.gov/survey/printed_surveys/state.asp?state=Washington&abbr=WA

Additionally, site-specific soil data can be obtained through site soil analysis as a part of preparation of a Technical Information Report and a Soils Report (see Section 1.8.1.5 and Section 1.8.3).

Ground Cover and Native Vegetation

Label existing vegetation on the drawing. Show features such as tree clusters, grassy areas, and unique or sensitive vegetation. Unique vegetation may include existing trees above a given diameter. Indicate existing denuded or exposed soil areas. Show other special features such as individual trees and areas of native vegetation required to be protected during construction. Projects may protect areas of native vegetation to meet LID requirements.

Critical Areas

Delineate critical areas adjacent to or within the site on the drawing. Show features such as steep slopes, erosion hazard areas, riparian habitat buffers, streams, floodplains, lakes, wetlands and wetland buffers, and geologic hazard areas. Delineate setbacks and buffer limits for these features on the drawings. On the drawings, show other related jurisdictional boundaries such as Shorelines Management and the Federal Emergency Management Agency (FEMA) base floodplain.

Adjacent Areas

Identify existing buildings, roads, and facilities adjacent to or within the project site on the drawings. Identify existing and proposed utility locations, construction clearing limits and erosion and sediment control BMPs on the drawings.

Existing Encumbrances

Identify wells, existing and abandoned septic drainfield, utilities, easements, setbacks, and site constraints.

Precipitation Records

Determine the average monthly rainfall and rainfall intensity for the required design storm events. These records may be available from the local permitting agency. Volume III also has resources for determining rainfall values.

6.3.4.2 Step 2 - Data Analysis

Consider the data collected in Step 1 to identify potential problems and limitations of the site. The following are some important factors to consider in data analysis:

Topography

The primary topographic considerations are slope steepness and length. Steeper and longer slopes have greater erosion potential than do flat and short slopes. A qualified engineer, licensed geologist, soil professional, or certified erosion and sediment control lead should determine erosion potential.

Drainage

Convey runoff through the use of natural drainage patterns that consist of overland flow, swales and depressions to avoid constructing an artificial drainage system. Properly stabilize man-made ditches and waterways so they do not create erosion problems. Take care to ensure that increased runoff from the site will not erode or flood the existing natural drainage system. Consider possible sites for temporary stormwater retention and detention.

Direct construction away from areas of saturated soil where groundwater may be encountered and away from critical areas where drainage will concentrate. Preserve natural drainage patterns on the site.

Soils

Evaluate soil properties such as surface and subsurface runoff characteristics, depth to impermeable layer, depth to seasonal groundwater table, permeability, shrink-swell potential, texture, settleability, and erodibility. Develop the Construction SWPPP based on known soil characteristics and topography.

Protect infiltration sites from clay and silt, which will reduce infiltration capacities.

Ground Cover

Ground cover is the most important factor in terms of preventing erosion. Preserving existing vegetation will prevent erosion better than constructing BMPs to treat polluted runoff. Trees and other vegetation protect the soil structure. If the existing vegetation cannot be saved, consider such practices as phasing construction, temporary seeding, and mulching. Phasing construction involves stabilizing one part of the site before disturbing another. In this way, the entire site is not disturbed at once.

Critical Areas

Any critical areas within or adjacent to the development should exert a strong influence on land development decisions. Delineate critical areas and their buffers on the drawings and clearly flag critical areas in the field. For example, chain link fencing may be more useful than flagging to assure that equipment operators stay out of critical areas. Only unavoidable work should take place within critical areas and their buffers. Such unavoidable work will require special BMPs, county critical area permitting, restrictions, and mitigation plans.

Adjacent Areas

An analysis of adjacent properties should focus on areas upslope and downslope from the project. Water bodies that will receive direct runoff from the site are a major concern. Evaluate the types, values, and sensitivities of and risks to downstream resources, such as property, stormwater facilities, infrastructure or aquatic systems. Select erosion and sediment controls accordingly.

Precipitation Records

Refer to Book 2, Chapter 1 to determine the required rainfall records and the method of analysis for design of BMPs such as ponds and Book 2, Chapter 7 for design of conveyances.

Timing of the Project

Consider the timing and duration of the project when selecting BMPs. Projects that will proceed during the wet season and projects that will last through several seasons must take all necessary precautions to remain in compliance with the water quality standards.

6.3.4.3 Step 3 – Develop and Implement the Construction SWPPP

After collecting and analyzing the data to determine the site limitations, develop a Construction SWPPP. The project proponent shall include each of the 13 elements in the Construction SWPPP, unless site conditions render the element unnecessary and the exemption from that element is clearly justified in the narrative of the SWPPP. All items in each element are required, as long as the project is not exempt from the element.

6.4 The Thirteen Elements Described

6.4.1 Element #1: Preserve Vegetation/Mark Clearing Limits

- Before beginning land disturbing activities, including clearing and grading, clearly mark all clearing limits, sensitive areas and their buffers, and trees that are to be preserved within the construction area.
- Retain the duff layer, native top soil, and natural vegetation in an undisturbed state to the maximum degree practical. If not practical to retain it in place, then stockpile it on-site, cover it to prevent erosion, and replace it immediately when the site is ready for stabilization.

Suggested BMPs

- BMP C101: Preserving Natural Vegetation
- BMP C102: Buffer Zones
- BMP C103: High Visibility Plastic or Metal Fence
- BMP C233: Silt Fence

6.4.2 Element #2: Establish Construction Access

- Limit construction vehicle access and exit to one route, if possible.
- Stabilize access points with a pad of quarry spalls, crushed rock, or other equivalent BMPs, to minimize tracking sediment onto roads.
- Locate wheel wash or tire baths on site, if the stabilized construction entrance is not effective in preventing tracking sediment onto roads.
- If sediment is tracked off site, clean the affected roadway thoroughly at the end of each day, or more frequently as necessary (for example, during wet weather). Remove sediment from roads by shoveling, sweeping, or pick up and transport the sediment to a controlled sediment disposal area.
- Conduct street washing only after sediment is removed in accordance with the above bullet.
- Control street wash wastewater by pumping back on site or otherwise preventing it from discharging into systems tributary to waters of the State.

Suggested BMPs

- BMP C105: Stabilized Construction Entrance/Exit
- BMP C106: Wheel Wash
- BMP C107: Construction Road/Parking Area Stabilization

6.4.3 Element #3: Control Flow Rates

- Protect properties and waterways downstream of development sites from erosion and the associated discharge of turbid waters due to increases in the velocity and peak volumetric flow rate of stormwater runoff from the project site.
- Where necessary to comply with the bullet above, construct permanent stormwater retention or detention facilities as one of the first steps in grading. Such facilities must function properly before constructing site improvements (e.g. impervious surfaces).
- If permanent infiltration basins are used for flow control during construction, protect these facilities from siltation during the construction phase. The Responsible Official may require installation of a temporary sedimentation pond.

Sites that must implement flow control for the developed site condition must also control stormwater release rates during construction. Construction site stormwater discharges shall not exceed the discharge durations of the pre-developed condition for the range of pre-developed discharge rates from ½ of the 2-year flow through the 10-year flow as predicted by an approved continuous flow model. The pre-developed condition to be matched shall be the land cover condition immediately prior to the development project. This restriction on release rates can affect the size of the storage pond and treatment cells.

Suggested BMPs

- BMP C203: Water Bars
- BMP C207: Check Dams
- BMP C209: Outlet Protection
- BMP C235: Wattles
- BMP C240: Sediment Trap
- BMP C241: Temporary Sediment Pond
- Refer to Chapter 4 for selection of ponds, and Book 2, Chapter 6 for design of ponds; also see Book 2, Chapter 7 for design of conveyance

6.4.4 Element #4: Install Sediment Controls

- Design, install and maintain effective erosion controls and sediment controls to minimize the discharge of pollutants.
- Construct sediment control BMPs (sediment ponds, traps, filters, etc.) as one of the first steps in grading. These BMPs shall be functional before other land disturbing activities take place.
- Minimize sediment discharges from the site. The design, installation and maintenance of erosion and sediment controls must address factors such as the amount, frequency, intensity and

duration of precipitation, the nature of resulting stormwater runoff, and soil characteristics, including the range of soil particle sizes expected to be present on the site.

- Direct stormwater runoff from disturbed areas through a sediment pond or other appropriate sediment removal BMP, before the runoff leaves a construction site or before discharge to an infiltration facility. Runoff from fully stabilized areas may be discharged without a sediment removal BMP, but must meet the flow control performance standard in Element #3, bullet #1.
- Locate BMPs intended to trap sediment on site in a manner to avoid interference with the movement of juvenile salmonids attempting to enter off-channel areas or drainages.
- Where feasible, design outlet structures that withdraw impounded stormwater from the surface to avoid discharging sediment that is still suspended lower in the water column.

Suggested BMPs

- BMP C231: Brush Barrier
- BMP C232: Gravel Filter Berm
- BMP C233: Silt Fence
- BMP C234: Vegetated Strip
- BMP C235: Wattles
- BMP C240: Sediment Trap
- BMP C241: Temporary Sediment Pond
- BMP C250: Construction Stormwater Chemical Treatment
- BMP C251: Construction Stormwater Filtration

6.4.5 Element #5: Stabilize Soils

- Stabilize exposed and unworked soils by application of effective BMPs that prevent erosion. Control stormwater volume and velocity within the site to minimize soil erosion.
- Control stormwater discharges, including both peak flow rates and total stormwater volume, to minimize erosion at outlets and to minimize downstream channel and stream bank erosion.
- Soils must not remain exposed and unworked for more than the time periods set forth below:
    - During the dry season (May 1 - Sept. 30): 7 days
    - During the wet season (October 1 - April 30): 2 days
- Stabilize soils at the end of the shift before a holiday or weekend if needed based on the weather forecast.
- Stabilize soil stockpiles from erosion, protect with sediment trapping measures, and where possible, locate away from storm drain inlets, waterways, and drainage channels.

- Minimize the amount of soil exposed during construction activity.
- Minimize the disturbance of steep slopes.
- Minimize soil compaction and, unless infeasible, preserve topsoil.

Suggested BMPs

- BMP C120: Temporary and Permanent Seeding
- BMP C121: Mulching
- BMP C122: Nets and Blankets
- BMP C123: Plastic Covering
- BMP C124: Sodding
- BMP C125: Topsoiling/Composting
- BMP C126: Polyacrylamide for Soil Erosion Protection
- BMP C130: Surface Roughening
- BMP C131: Gradient Terraces
- BMP C140: Dust Control

6.4.6 Element #6: Protect Slopes

- Design and construct cut-and-fill slopes in a manner to minimize erosion. Applicable practices include, but are not limited to, reducing continuous length of slope with terracing and diversions, reducing slope steepness, and roughening slope surfaces (for example, track walking).
- Divert offsite stormwater (run-on) or groundwater away from slopes and disturbed areas. Manage offsite stormwater separately from stormwater generated on the site.
- At the top of slopes, collect drainage in pipe slope drains or protected channels to prevent erosion.
    - Temporary pipe slope drains must handle the peak 10-minute velocity of flow from a Type 1A, 10-year, 24-hour frequency storm for the developed condition. Alternatively, the 10-year, 1-hour flow rate predicted by an approved continuous flow model, increased by a factor of 1.6, may be used. The hydrologic analysis must use the existing land cover condition for predicting flow rates from tributary areas outside the project limits. For tributary areas on the project site, the analysis must use the temporary or permanent project land cover condition, whichever will produce the highest flow rates. If using an approved continuous flow model to predict flows, bare soil areas should be modeled as "landscaped" area.
- Place excavated material on the uphill side of trenches, consistent with safety and space considerations.

- Place check dams at regular intervals within constructed channels that are cut down a slope.

Additional Guidance

- BMP combinations are the most effective method of protecting slopes with disturbed soils. For example use both mulching and straw erosion control blankets in combination.

Suggested BMPs

- BMP C120: Temporary and Permanent Seeding
- BMP C121: Mulching
- BMP C122: Nets and Blankets
- BMP C130: Surface Roughening
- BMP C131: Gradient Terraces
- BMP C200: Interceptor Dike and Swale
- BMP C201: Grass-Lined Channels
- BMP C203: Water Bars
- BMP C204: Pipe Slope Drains
- BMP C205: Subsurface Drains
- BMP C206: Level Spreader
- BMP C207: Check Dams
- BMP C208: Triangular Silt Dike (Geotextile-Encased Check Dam)

6.4.7 Element #7: Protect Drain Inlets

- Protect storm drain inlets made operable during construction and existing storm drain inlets that receive runoff from the site so that stormwater runoff does not enter the conveyance system without first being filtered or treated to remove sediment.
- Clean or remove and replace inlet protection devices when sediment has filled one-third of the available storage or when the standard specified by the product manufacturer is exceeded.
- Inspect inlets weekly, at a minimum, and daily during storm events.

Suggested BMPs

- BMP C220: Storm Drain Inlet Protection

6.4.8 Element #8: Stabilize Channels and Outlets

- Design, construct, and stabilize all on-site conveyance channels to prevent erosion from the following expected peak flows:
    - Channels must handle the peak 10-minute velocity of flow from a Type 1A, 10-year, 24-hour frequency storm for the developed condition. Alternatively, the 10-year, 1-hour flow rate indicated by an approved continuous flow model, increased by a factor of 1.6, may be used. The hydrologic analysis must use the existing land cover condition for predicting flow rates from tributary areas outside the project limits. For tributary areas on the project site, the analysis must use the temporary or permanent project land cover condition, whichever will produce the highest flow rates. If using an approved continuous flow model to predict flows, bare soil areas should be modeled as "landscaped area".
- Provide stabilization and armoring, adequate to prevent erosion of outlets, adjacent streambanks, slopes, and downstream reaches at the outlets of all conveyance systems.

Suggested BMPs

- BMP C202: Channel Lining
- BMP C122: Nets and Blankets
- BMP C201: Grass-Lined Channels
- BMP C206: Level Spreader
- BMP C207: Check Dams
- BMP C208: Triangular Silt Dike (Geotextile-Encased Check Dam)
- BMP C209: Outlet Protection

6.4.9 Element #9: Control Pollutants

- Design, install, implement and maintain effective pollution prevention measures to minimize the discharge of pollutants.
- Handle and dispose of all pollutants, including waste materials and demolition debris that occur on-site in a manner that does not cause contamination of stormwater.
- Provide cover, containment, and protection from vandalism for all chemicals, liquid products, petroleum products, and other materials that have the potential to pose a threat to human health or the environment. On-site fueling tanks must include secondary containment. Secondary containment means placing tanks or containers within an impervious structure capable of containing 110% of the volume contained in the largest tank within the containment structure. Double-walled tanks do not require additional secondary containment.
- Conduct maintenance, fueling, and repair of heavy equipment and vehicles using spill prevention and control measures. Clean contaminated surfaces immediately following any spill incident.

Emergency repairs may be performed on-site using temporary plastic placed beneath and, if raining, over the vehicle.

- Discharge wheel wash or tire bath wastewater to a separate on-site treatment system that prevents discharge to surface water, such as closed-loop recirculation or upland land application, or to the sanitary sewer, with local sewer district approval.
- Apply fertilizers and pesticides in a manner and at application rates that will not result in loss of chemical to stormwater runoff. Follow manufacturers' label requirements for application rates and procedures.
- Use BMPs to prevent contamination of stormwater runoff by pH-modifying sources. The sources for this contamination include, but are not limited to, bulk cement, cement kiln dust, fly ash, new concrete washing and curing waters, waste streams generated from concrete grinding and sawing, exposed aggregate processes, dewatering concrete vaults, concrete pumping and mixer washout waters.
- Adjust the pH of stormwater if necessary to prevent violations of the water quality standards.
- Assure that washout of concrete trucks is performed offsite or in designated concrete washout areas only. Do not wash out concrete trucks onto the ground, or into storm drains, open ditches, streets, or streams. Do not dump excess concrete on site, except in designated concrete washout areas. Concrete spillage or concrete discharge to surface waters of the State is prohibited.
- Obtain written approval from the Department of Ecology before using chemical treatment other than CO_2 or dry ice to adjust pH.

Suggested BMPs

- BMP C151: Concrete Handling
- BMP C152: Sawcutting and Surfacing Pollution Prevention
- BMP C153: Material Delivery, Storage and Containment
- BMP C154: Concrete Washout Area
- BMP C250: Construction Stormwater Chemical Treatment
- BMP C251: Construction Stormwater Filtration
- BMP C252: High pH Neutralization Using CO_2
- BMP C253: pH Control for High pH Water
- See Book 4 – Source Control

6.4.10 Element #10: Control De-Watering

- Discharge foundation, vault, and trench dewatering water, which have characteristics similar to stormwater runoff at the site, into a controlled conveyance system before discharge to a sediment trap or sediment pond.
- Discharge clean, non-turbid de-watering water, such as well-point groundwater, to systems tributary to, or directly into surface waters of the state, as specified in Element #8, provided the de-watering flow does not cause erosion or flooding of receiving waters or interfere with the operation of the system. Do not route clean dewatering water through stormwater sediment ponds. Note that "surface waters of the State" may exist on a construction site as well as off site; for example, a creek running through a site.
- Handle highly turbid or contaminated dewatering water separately from stormwater.
- Other treatment or disposal options may include:
    - Infiltration.
    - Transport offsite in a vehicle, such as a vacuum flush truck, for legal disposal in a manner that does not pollute state waters.
    - Ecology-approved on-site chemical treatment or other suitable treatment technologies.
    - Sanitary sewer discharge with local sewer district approval, if there is no other option.
    - Use of a sedimentation bag with outfall to a ditch or swale for small volumes of localized dewatering.

Suggested BMPs

- BMP C203: Water Bars
- BMP C236: Vegetative Filtration

6.4.11 Element #11: Maintain BMPs

- Maintain and repair all temporary and permanent erosion and sediment control BMPs as needed to assure continued performance of their intended function in accordance with BMP specifications.
- Remove all temporary erosion and sediment control BMPs within 30 days after achieving final site stabilization or after the temporary BMPs are no longer needed, unless the BMP is biodegradable and designed to remain in place after construction (e.g. compost socks).
- Protect all BMPs installed for the permanent control of stormwater from sediment and compaction. All BMPs that are to remain in place following completion of construction shall be examined and placed in full operating conditions. If sediment enters the BMPs during

construction, it shall be removed and the facility shall be returned to the conditions specified in the construction documents.

- Remove or stabilize trapped sediment on site. Permanently stabilize disturbed soil resulting from removal of BMPs or vegetation.

Suggested BMPs

- BMP C150: Materials On Hand
- BMP C160: Certified Erosion and Sediment Control Lead

6.4.12 Element #12: Manage the Project

- Phase development projects to the maximum degree practicable and take into account seasonal work limits.
- Inspect, maintain, and repair all BMPs as needed to assure continued performance of their intended function.
    - All land disturbing activities performed by licensed contractors must have site inspections conducted by an individual who possesses a valid CESCL certification.
    - All projects disturbing one acre or more must have site inspections conducted by an individual who possesses a valid CESCL certification.
    - Prior to initiating land-disturbing activities, all sites must identify an inspector, which will be the CESCL on sites meeting criteria above, in the SWPPP.
        - The inspector/CESCL must attend the Preconstruction Conference and the Preconstruction Site Inspection.
    - The inspector/CESCL shall be present on-site or be on-call at all times.
- Construction site operators shall maintain, update, and implement the Construction SWPPP.

Site Inspection Requirements

- The CESCL or inspector must assess the:
    - Site conditions and construction activities that could impact the quality of stormwater.
    - Effectiveness of erosion and sediment control measures used to control the quality of stormwater discharges.
- The CESCL or inspector must examine stormwater visually for the presence of suspended sediment, turbidity, discoloration, and oil sheen. They must evaluate the effectiveness of BMPs and determine if it is necessary to install, maintain, or repair BMPs to improve the quality of stormwater discharges.

Based on the results of the inspection, construction site operators must correct problems identified by:

- o Reviewing the SWPPP for compliance with the 13 construction SWPPP elements and making appropriate revisions within 7 days of the inspection.
- o Immediately beginning the process of fully implementing and maintaining appropriate source control and/or treatment BMPs as soon as possible, addressing the problems no later than within 10 days of the inspection. If installation of necessary treatment BMPs is not feasible within 10 days, the construction site operator may request an extension from the Responsible Official within the initial 10-day response period.
- o Documenting BMP implementation and maintenance in the site log book (sites larger than 1 acre).

- The CESCL or inspector must inspect all areas disturbed by construction activities, all BMPs, and all stormwater discharge points at least once every calendar week and within 24 hours of any discharge from the site. (For purposes of this condition, individual discharge events that last more than one day do not require daily inspections. For example, if a stormwater pond discharges continuously over the course of a week, only one inspection is required that week.) The CESCL or inspector may reduce the inspection frequency for temporarily stabilized, inactive sites to once every calendar month

Wet Season Requirements

- From October 1 through April 30, clearing, grading, and other soil disturbing activities is permitted only if shown to the satisfaction of Clark County that the site operator will prevent silt-laden runoff from leaving the site through a combination of the following:
  - o Site conditions including existing vegetative coverage, slope, soil type, and proximity to receiving waters.
  - o Limit activities and the extent of disturbed areas.
  - o Proposed erosion and sediment control measures.
  - o Based on the information provided and/or local weather conditions, the Responsible Official may expand or restrict the seasonal limitation on site disturbance. The Responsible Official may take enforcement action – such as a notice of violation, administrative order, penalty, or stop-work order under any of the following circumstances:
    - ▪ If, during the course of any construction activity or soil disturbance during the seasonal limitation period, sediment leaves the construction site causing a violation of the surface water quality standard.
    - ▪ If clearing and grading limits or erosion and sediment control measures shown in the approved plan are not maintained.

The following activities are exempt from the seasonal clearing and grading limitations:

- o Routine maintenance and necessary repair of erosion and sediment control BMPs.
- o Routine maintenance of public facilities or existing utility structures that do not expose the soil or result in the removal of the vegetative cover to soil.
- o Activities where there is one hundred percent infiltration of surface water runoff within the site in approved and installed erosion and sediment control facilities.

Suggested BMPs

- BMP C150: Materials On Hand
- BMP C160: Certified Erosion and Sediment Control Lead
- BMP C162: Scheduling

6.4.13 Element #13: Protect Low Impact Development BMPs

- Protect all bioretention and rain garden BMPs from sedimentation through installation and maintenance of erosion and sediment control BMPs on portions of the site that drain into them. Restore the BMPs to their fully functioning condition if they accumulate sediment during construction. Restoring the BMP must include removal of sediment and any sediment-laden bioretention/rain garden soils, and replacing the removed soils with soils meeting the design specification.
- Prevent compacting bioretention and rain garden BMPs by excluding construction equipment and foot traffic. Protect completed lawn and landscaped areas from compaction by construction equipment.
- Control erosion and avoid introducing sediment from surrounding land uses onto permeable pavements. Do not allow muddy construction equipment on the base material or pavement. Do not allow sediment-laden runoff onto permeable pavements or base materials.
- Pavements fouled with sediments or no longer passing an initial infiltration text must be cleaned using procedures from Book 4 or the manufacturer's procedures.
- Keep all heavy equipment off existing soils under LID facilities that have been excavated to final grade to retain the infiltration rate of the soils.

See Chapter 5: Precision Site Preparation and Construction in the LID Technical Guidance Manual for Puget Sound for more detail on protecting LID integrated management practices.

Suggested BMPs

- BMP C102: Buffer Zone
- BMP C103: High Visibility Fence

- BMP C200: Interceptor Dike and Swale
- BMP C201: Grass-Lined Channels
- BMP C207: Check Dams
- BMP C208: Triangular Silt Dike (TSD) (Geotextile-Encased Check Dam)
- BMP C231: Brush Barrier
- BMP C233: Silt Fence
- BMP C234: Vegetated Strip

6.5 BMP Selection

Table 6.2 summarizes the Source Control BMPS that are applicable to the 13 Elements. Use this table to help select source control BMPs for the project site. Elements not shown are not satisfied through installation of Source Controls. BMP Information Sheets for design and installation of the BMPs are found in Book 2, Chapter 8.

Table 6.3 summarizes the Conveyance and Treatment BMPS that are applicable to the 13 Elements. Use this table to help select conveyance and treatment BMPs for the project site. Elements not shown are not satisfied through installation of runoff conveyance and treatment BMPs. BMP Information Sheets for design and installation of the BMPs are found in Book 2, Chapter 8.

Table 6.2 Source Control BMPs by SWPPP Element

Element Name	Preserve Vegetation / Mark Clearing Limits	Establish Construction Access	Stabilize Soils	Protect Slopes	Stabilize Channels and Outlets	Control Pollutants	Maintain BMPs	Manage the Project	Protect Low Impact Development BMPs
▼ BMP Element No. ▶	1	2	5	6	8	9	11	12	13
BMP C101: Preserving Natural Vegetation	✔								
BMP C102: Buffer Zones	✔								✔
BMP C103: High Visibility Plastic or Metal Fence	✔								✔
BMP C105: Stabilized Construction Entrance/Exit		✔							
BMP C106: Wheel Wash		✔							
BMP C107: Construction Road/ Parking Stabilization		✔							
BMP C120: Temporary & Permanent Seeding			✔	✔					
BMP C121: Mulching			✔	✔					
BMP C122: Nets & Blankets			✔	✔	✔				
BMP C123: Plastic Covering			✔						
BMP C124: Sodding			✔						
BMP C125: Topsoiling/ Composting			✔						
BMP C126: Polyacrylamide for Soil Erosion Protection			✔						
BMP C130: Surface Roughening			✔	✔					
BMP C131: Gradient Terraces			✔	✔					
BMP C140: Dust Control			✔						
BMP C150: Materials on Hand							✔	✔	
BMP C151: Concrete Handling						✔			
BMP C152: Sawcutting and Surfacing Pollution Prevention						✔			
BMP C153: Material Delivery, Storage & Containment						✔			
BMP C154: Concrete Washout Area						✔			
BMP C160: Certified Erosion & Sediment Control Lead							✔	✔	
BMP C162: Scheduling								✔	

Table 6.3 Runoff Conveyance and Treatment BMPs by SWPPP Element

Element Name	Control Flow Rates	Install Sediment Controls	Protect Slopes	Protect Drain Inlets	Stabilize Channels and Outlets	Control Pollutants	Control Dewatering	Protect Low Impact Development BMPs
▼ BMP Element No. ▶	**3**	**4**	**6**	**7**	**8**	**9**	**10**	**13**
BMP C200: Interceptor Dike and Swale			✔					✔
BMP C201: Grass-lined Channels			✔					✔
BMP C202: Channel Lining					✔			
BMP C203: Water Bars	✔		✔				✔	
BMP C204: Pipe Slope Drains			✔					
BMP C205: Surface Drains			✔					
BMP C206: Level Spreader			✔				✔	✔
BMP C207: Check Dams	✔		✔		✔			✔
BMP C208: Triangular Silt Dike (Geotextile Encased Check Dam)			✔					
BMP C209: Outlet Protection	✔				✔			
BMP C220: Storm Drain Inlet Protection				✔				
BMP C231: Brush Barrier		✔						✔
BMP C232: Gravel Filter Berm		✔						
BMP C233: Silt Fence		✔						✔
BMP C234: Vegetated Strip		✔						✔
BMP C235: Wattles	✔	✔						
BMP C236: Vegetated Filtration							✔	
BMP C240: Sediment Trap	✔	✔						
BMP C241: Temporary Sediment Pond	✔	✔						
BMP C250: Construction Stormwater Chemical Treatment		✔				✔		
BMP C251: Construction Stormwater Filtration		✔				✔		
BMP C252: High pH Neutralization Using CO_2						✔		
BMP C253: pH Control for High pH Water						✔		

6.5.1 Products Approved as Equivalent

Ecology has approved products as equivalent to some BMPs in this chapter. The products did not pass through the Technology Assessment Protocol – Ecology (TAPE) process. Clark County may choose not to accept a product approved as equivalent. The products are available for review on Ecology's website at http://www.ecy.wa.gov/programs/wq/stormwater/newtech/equivalent.html

BMPs that have approved equivalents will contain a notation in the Conditions of Use. Obtain approval in the Construction SWPPP from the Responsible Official prior to using an approved equivalent.

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Book 1 Appendices

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Appendix 1-B	Basin Plans
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Appendix 1-A

Glossary

Glossary

The following terms are provided for reference and use with this manual. They shall be superseded by any other definitions for these terms adopted by ordinance, unless they are defined in a Washington State WAC or RCW, or are used and defined as part of the Minimum Requirements for all new development and redevelopment.

AASHTO classification	The official classification of soil materials and soil aggregate mixtures for highway construction, used by the American Association of State Highway and Transportation Officials**.**
Absorption	The penetration of a substance into or through another, such as the dissolving of a soluble gas in a liquid.
Adjacent steep slope	A slope with a gradient of 15 percent or steeper within five hundred feet of the site.
Adjustment	A variation in the application of a Minimum Requirement to a particular project. Adjustments provide substantially equivalent environmental protection.
Adsorption	The adhesion of a substance to the surface of a solid or liquid; often used to extract pollutants by causing them to be attached to such adsorbents as activated carbon or silica gel. Hydrophobic, or water-repulsing adsorbents, are used to extract oil from waterways when oil spills occur. Heavy metals such as zinc and lead often adsorb onto sediment particles.
Aeration	The process of being supplied or impregnated with air. In waste treatment, the process used to foster biological and chemical purification. In soils, the process by which air in the soil is replenished by air from the atmosphere. In a well aerated soil, the soil air is similar in composition to the atmosphere above the soil. Poorly aerated soils usually contain a much higher percentage of carbon dioxide and a correspondingly lower percentage of oxygen.
Aerobic	Living or active only in the presence of free (dissolved or molecular) oxygen.
Aerobic bacteria	Bacteria that require the presence of free oxygen for their metabolic processes.
Aggressive plant species	Opportunistic species of inferior biological value that tend to out-compete more desirable forms and become dominant; applied to native species in this manual.

Algae	Primitive plants, many microscopic, containing chlorophyll and forming the base of the food chain in aquatic environments. Some species may create a nuisance when environmental conditions are suitable for prolific growth.
Algal bloom	Proliferation of living algae on the surface of lakes, streams or ponds; often stimulated by phosphate over-enrichment. Algal blooms reduce the oxygen available to other aquatic organisms.
American Public Works Association (APWA)	The Washington State Chapter of the American Public Works Association.
Anadromous	Fish that grow to maturity in the ocean and return to rivers for spawning.
Anaerobic	Living or active in the absence of oxygen.
Anaerobic bacteria	Bacteria that do not require the presence of free or dissolved oxygen for metabolism.
Annual flood	The highest peak discharge on average which can be expected in any given year.
Antecedent moisture conditions	The degree of wetness of a watershed or within the soil at the beginning of a storm.
Anti-seep collar	A device constructed around a pipe or other conduit and placed through a dam, levee, or dike for the purpose of reducing seepage losses and piping failures.
Anti-vortex device	A facility placed at the entrance to a pipe conduit structure such as a drop inlet spillway or hood inlet spillway to prevent air from entering the structure when the pipe is flowing full.
Applicable BMPs	As used in SMMWW Volume IV, applicable BMPs are those source control BMPs that are expected to be required by local governments at new development and redevelopment sites. This manual substitutes the term "Required BMPs" in Book 3.
Applicant	The person who has applied for a development permit or approval.
Appurtenances	Machinery, appliances, or auxiliary structures attached to a main structure, but not considered an integral part thereof, for the purpose of enabling it to function.
Aquifer	A geologic stratum containing ground water that can be withdrawn and used for human purposes.
Arterial	A road or street primarily for through traffic. The term generally includes roads or streets considered collectors. It does not include local access roads which are generally limited to providing access to abutting property. See also RCW 35.78.010, RCW 36.86.070, and RCW 47.05.021.

As-built drawings	Engineering plans which have been revised to reflect all changes to the plans which occurred during construction.
As-graded	The extent of surface conditions on completion of grading.
BSBL	See Building set back line.
Background	A description of pollutant levels arising from natural sources, and not because of man's immediate activities.
Backwater	Water upstream from an obstruction which is deeper than it would normally be without the obstruction.
Baffle	A device to check, deflect, or regulate flow.
Bankfull discharge	A flow condition where streamflow completely fills the stream channel up to the top of the bank. In undisturbed watersheds, the discharge conditions occur on average every 1.5 to 2 years and controls the shape and form of natural channels.
Base flood	A flood having a one percent chance of being equaled or exceeded in any given year. This is also referred to as the 100-year flood.
Base flood elevation	The water surface elevation of the base flood. It shall be referenced to the National Geodetic Vertical Datum of 1929 (NGVD).
Baseline sample	A sample collected during dry-weather flow (i.e., it does not consist of runoff from a specific precipitation event).
Basin plan	A plan that assesses, evaluates, and proposes solutions to existing and potential future impacts to the beneficial uses of, and the physical, chemical, and biological properties of waters of the state within a basin. Basins typically range in size from 1 to 50 square miles. A plan should include but not be limited to recommendations for:

- Stormwater requirements for new development and redevelopment;
- Capital improvement projects;
- Land Use management through identification and protection of critical areas, comprehensive land use and transportation plans, zoning regulations, site development standards, and conservation areas;
- Source control activities including public education and involvement, and business programs;
- Other targeted stormwater programs and activities, such as maintenance, inspections and enforcement;
- Monitoring; and
- An implementation schedule and funding strategy.

A plan that is “adopted and implemented” must have the following characteristics:

- It must be adopted by legislative or regulatory action of jurisdictions with responsibilities under the plan;
- Ordinances, regulations, programs, and procedures recommended by the plan should be in effect or on schedule to be in effect; and,
- An implementation schedule and funding strategy that is in progress.

Bearing capacity The maximum load that a material can support before failing.

Bedrock The more or less solid rock in place either on or beneath the surface of the earth. It may be soft, medium, or hard and have a smooth or irregular surface.

Bench A relatively level step excavated into earth material on which fill is to be placed.

Berm A constructed barrier of compacted earth, rock, or gravel. In a stormwater facility, a berm may serve as a vertical divider typically built up from the bottom.

Best management practice (BMP) The schedules of activities, prohibitions of practices, maintenance procedures, and structural and/or managerial practices, that when used singly or in combination, prevent or reduce the release of pollutants and other adverse impacts to waters of Washington State.

Biochemical oxygen demand (BOD) An indirect measure of the concentration of biologically degradable materials present in organic wastes. The amount of free oxygen utilized by aerobic organisms when allowed to attack the organic material in an aerobically maintained environment at a specified temperature (20°C) for a specific time period (5 days), and thus stated as BOD5. It is expressed in milligrams of oxygen utilized per liter of liquid waste volume (mg/l) or in milligrams of oxygen per kilogram of waste solution (mg/kg = ppm = parts per million parts). Also called biological oxygen demand.

Biodegradable Capable of being readily broken down by biological means, especially by microbial action. Microbial action includes the combined effect of bacteria, fungus, flagellates, amoebae, ciliates, and nematodes. Degradation can be rapid or may take many years depending upon such factors as available oxygen and moisture.

Bioengineering The combination of biological, mechanical, and ecological concepts (and methods) to control erosion and stabilize soil through the use of vegetation or in combination with construction materials.

Biofilter A designed treatment facility using a combined soil and vegetation system for filtration, infiltration, adsorption, and biological uptake of

	pollutants in stormwater when runoff flows over and through. Vegetation growing in these facilities acts as both a physical filter which causes gravity settling of particulates by regulating velocity of flow, and also as a biological sink when direct uptake of dissolved pollutants occurs. The former mechanism is probably the most important in western Washington where the period of major runoff coincides with the period of lowest biological activity.
Biofiltration	The process of reducing pollutant concentrations in water by filtering the polluted water through biological materials.
Biological control	A method of controlling pest organisms by means of introduced or naturally occurring predatory organisms, sterilization, the use of inhibiting hormones, or other means, rather than by mechanical or chemical means.
Biological magnification	The increasing concentration of a substance along succeeding steps in a food chain. Also called biomagnification.
Bioretention BMP	Engineered vegetated facilities that store and treat stormwater by passing it through a specified soil profile, and either retain or detain the treated stormwater for flow attenuation. Refer to Book 1, Chapter 3; and Book 2, Chapter 1 for Bioretention BMP types and design specifications.
Bollard	A post (may or may not be removable) used to prevent vehicular access.
Bond	A surety bond, cash deposit or escrow account, assignment of savings, irrevocable letter of credit or other means acceptable to or required by the manager to guarantee that work is completed in compliance with the project's drainage plan and in compliance with all local government requirements.
Borrow area	A source of earth fill material used in the construction of embankments or other earth fill structures.
Buffer	The zone contiguous with a sensitive area that is required for the continued maintenance, function, and structural stability of the sensitive area. The critical functions of a riparian buffer (those associated with an aquatic system) include shading, input of organic debris and coarse sediments, uptake of nutrients, stabilization of banks, interception of fine sediments, overflow during high water events, protection from disturbance by humans and domestic animals, maintenance of wildlife habitat, and room for variation of aquatic system boundaries over time due to hydrologic or climatic effects. The critical functions of terrestrial buffers include protection of slope stability, attenuation of surface water flows from stormwater runoff and precipitation, and erosion control.

Building setback line (BSBL) A line measured parallel to a property, easement, drainage facility, or buffer boundary, that delineates the area (defined by the distance of separation) where buildings or other obstructions are prohibited (including decks, patios, outbuildings, or overhangs beyond 18 inches). Wooden or chain link fences and landscaping are allowable within a building setback line. In this manual the minimum building setback line shall be 5 feet.

CIP See Capital Improvement Project.

Capital Improvement Project or Program (CIP) A project prioritized and scheduled as a part of an overall construction program or, the actual construction program.

Catch basin A chamber or well, usually built at the curb line of a street, for the admission of surface water to a sewer or subdrain, having at its base a sediment sump designed to retain grit and detritus below the point of overflow.

Catchline The point where a severe slope intercepts a different, more gentle slope.

Catchment Surface drainage area.

Cation Exchange Capacity (CEC) The amount of exchangeable cations that a soil can adsorb. Units are milli-equivalents per 100 g of soil, typically abbreviated simply as meq. Soil found to have a CEC of 5 meq at pH 7 will have CEC < 5 meq when pH < 7..

CESCL See Certified Erosion and Sediment Control Lead

Certified Erosion and Sediment Control Lead (CESCL) An individual who has current certification through an approved erosion and sediment control training program that meets the minimum training standards established by Ecology (see BMP C160 of Volume II). A CESCL is knowledgeable in the principles and practices of erosion and sediment control. The CESCL must have the skills to assess site conditions and construction activities that could impact the quality of stormwater and, the effectiveness of erosion and sediment control measures used to control the quality of stormwater discharges. Certification is obtained through an Ecology approved erosion and sediment control course. Course listings are provided online at Ecology’s website.

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

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

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

Channel stabilization Erosion prevention and stabilization of velocity distribution in a channel using vegetation, jetties, drops, revetments, and/or other measures.

Channel storage Water temporarily stored in channels while enroute to an outlet.

Channelization Alteration of a stream channel by widening, deepening, straightening, cleaning, or paving certain areas to change flow characteristics.

Check dam Small dam constructed in a gully or other small watercourse to decrease the streamflow velocity, minimize channel scour, and promote deposition of sediment.

Chemical oxygen demand (COD) A measure of the amount of oxygen required to oxidize organic and oxidizable inorganic compounds in water. The COD test, like the BOD test, is used to determine the degree of pollution in water.

Civil engineer A professional engineer licensed in the State of Washington in Civil Engineering.

Civil engineering The application of the knowledge of the forces of nature, principles of mechanics and the properties of materials to the evaluation, design and construction of civil works for the beneficial uses of mankind.

Clay lens A naturally occurring, localized area of clay which acts as an impermeable layer to runoff infiltration.

Clearing The destruction and removal of vegetation by manual, mechanical, or chemical methods.

Closed depression An area greater than 5, 000 square feet at overflow elevation that is low-lying and that has no or such a limited surface water outlet that the area acts as a stormwater retention facility. The primary loss of water volume from a closed depression is through evapotranspiration and discharge into the ground rather than through surface flow.

Coefficient of permeability The quality of saturated soil that enables water or air to move through it. Also known as hydraulic conductivity.

Cohesion The capacity of a soil to resist shearing stress, exclusive of functional resistance.

Coliform bacteria Microorganisms common in the intestinal tracts of man and other warm-blooded animals; all the aerobic and facultative anaerobic, gram-negative, nonspore-forming, rod-shaped bacteria which ferment lactose with gas formation within 48 hours at 35°C. Used as an indicator of bacterial pollution.

Commercial agriculture Those activities conducted on lands defined in RCW 84.34.020(2), and activities involved in the production of crops or livestock for wholesale trade. An activity ceases to be considered commercial agriculture when the area on which it is conducted is proposed for conversion to a nonagricultural use or has lain idle for more than five

(5) years, unless the idle land is registered in a federal or state soils conservation program, or unless the activity is maintenance of irrigation ditches, laterals, canals, or drainage ditches related to an existing and ongoing agricultural activity.

Common Plan of Development or Sale A site where multiple separate and distinct construction activities may be taking place at different times on different schedules and/or by different contractors, but still under a single plan. Examples include: 1) phase projects and projects with multiple filings or lots, even if the separate phases or filings/lots will be constructed under separate contract or by separate owners (e.g., a development where lots are sold to separate builders); 2) a development plan that may be phased over multiple years, but is still under a consistent plan for long-term development; 3) projects in a contiguous area that may be unrelated but still under the same contract, such as construction of a building extension and a new parking lot at the same facility; and 4) linear projects such as roads, pipelines, or utilities. If the project is part of a common plan of development or sale, the disturbed area of the entire plan must be used in determine permit requirements.

Compaction The densification, settlement, or packing of soil in such a way that permeability of the soil is reduced. Compaction effectively shifts the performance of a hydrologic group to a lower permeability hydrologic group. For example, a group B hydrologic soil can be compacted and be effectively converted to a group C hydrologic soil in the way it performs in regard to runoff.

Compaction may also refer to the densification of a fill by mechanical means.

Compensatory storage New excavated storage volume equivalent to the flood storage capacity eliminated by filling or grading within the flood fringe. Equivalent shall mean that the storage removed shall be replaced by equal volume between corresponding one-foot contour intervals that are hydraulically connected to the floodway through their entire depth.

Compost Organic solid waste that has undergone biological degradation and transformation under controlled conditions designed to promote aerobic decomposition at a solid waste facility in compliance with the requirements of Chapter 173-350 WAC, or biosolids composted in compliance with Chapter 173-308 WAC. Composting is a form of organic material recycling. Natural decay of organic solid waste under uncontrolled conditions does not result in composted material. (Note: various BMPs have restrictions on the percentage of biosolids in compost, or do not allow biosolids in compost.)

Comprehensive planning	Planning that takes into account all aspects of water, air, and land resources and their uses and limits.
Conservation district	A public organization created under state enabling law as a special-purpose district to develop and carry out a program of soil, water, and related resource conservation, use, and development within its boundaries, usually a subdivision of state government with a local governing body and always with limited authority. Often called a soil conservation district or a soil and water conservation district.
Constructed wetland	Those wetlands intentionally created on sites that are not wetlands for the primary purpose of wastewater or stormwater treatment and managed as such. Constructed wetlands are normally considered as part of the stormwater collection and treatment system.
Construction Stormwater Pollution Prevention Plan	A document that describes the potential for pollution problems on a construction project and explains and illustrates the measures to be taken on the construction site to control those problems.
Contour	An imaginary line on the surface of the earth connecting points of the same elevation.
Converted Vegetation (Areas)	The 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.
Conveyance	A mechanism for transporting water from one point to another, including pipes, ditches, and channels.
Conveyance system	The drainage facilities, both natural and man-made, which collect, contain, and provide for the flow of surface and stormwater from the highest points on the land down to a receiving water. The natural elements of the conveyance system include swales and small drainage courses, streams, rivers, lakes, and wetlands. The human-made elements of the conveyance system include gutters, ditches, pipes, channels, and most retention/detention facilities.
Cover crop	A close-growing crop grown primarily for the purpose of protecting and improving soil between periods of permanent vegetation.
Created wetland	Means those wetlands intentionally created from nonwetland sites to produce or replace natural wetland habitat (e.g., compensatory mitigation projects).
Critical Areas	At a minimum, areas which include wetlands, areas with a critical recharging effect on aquifers used for potable water, fish and wildlife habitat conservation areas, frequently flooded areas, geologically hazardous areas, including unstable slopes, and associated areas and ecosystems.

Critical Drainage Area	An area with such severe flooding, drainage and/or erosion/sedimentation conditions that the area has been formally adopted as a Critical Drainage Area by rule under the procedures specified in an ordinance.
Critical reach	The point in a receiving stream below a discharge point at which the lowest dissolved oxygen level is reached and stream recovery begins.
Culvert	Pipe or concrete box structure that drains open channels, swales or ditches under a roadway or embankment. Typically with no catchbasins or manholes along its length.
Cut	Portion of land surface or area from which earth has been removed or will be removed by excavating; the depth below original ground surface to excavated surface.
Cut-and-fill	Process of earth moving by excavating part of an area and using the excavated material for adjacent embankments or fill areas.
Cut slope	A slope formed by excavating overlying material to connect the original ground surface with a lower ground surface created by the excavation. A cut slope is distinguished from a bermed slope, which is constructed by importing soil to create the slope.
DNS	See Determination of Nonsignificance.
Dead storage	The volume available in a depression in the ground below any conveyance system, or surface drainage pathway, or outlet invert elevation that could allow the discharge of surface and stormwater runoff.
Dedication of land	Refers to setting aside a portion of a property for a specific use or function.
Degradation	(Biological or chemical) The breakdown of complex organic or other chemical compounds into simpler substances, usually less harmful than the original compound, as with the degradation of a persistent pesticide. (Geological) Wearing down by erosion. (Water) The lowering of the water quality of a watercourse by an increase in the pollutant loading.
Degraded (disturbed) wetland (community)	A wetland (community) in which the vegetation, soils, and/or hydrology have been adversely altered, resulting in lost or reduced functions and values; generally, implies topographic isolation; hydrologic alterations such as hydroperiod alteration (increased or decreased quantity of water), diking, channelization, and/or outlet modification; soils alterations such as presence of fill, soil removal, and/or compaction; accumulation of toxicants in the biotic or abiotic components of the wetland; and/or low plant species richness with dominance by invasive weedy species.

Denitrification	The biochemical reduction of nitrates or nitrites in the soil or organic deposits to ammonia or free nitrogen.
Depression storage	The amount of precipitation that is trapped in depressions on the surface of the ground.
Design engineer	The professional civil engineer licensed in the State of Washington who prepares the analysis, design, and engineering plans for an applicant's permit or approval submittal.
Design storm	A prescribed hyetograph and total precipitation amount (for a specific duration recurrence frequency) used to estimate runoff for a hypothetical storm of interest or concern for the purposes of analyzing existing drainage, designing new drainage facilities or assessing other impacts of a proposed project on the flow of surface water. (A hyetograph is a graph of percentages of total precipitation for a series of time steps representing the total time during which the precipitation occurs.)
Detention	The release of stormwater runoff from the site at a slower rate than it is collected by the stormwater facility system, the difference being held in temporary storage.
Detention facility	An above or below ground facility, such as a pond or tank, that temporarily stores stormwater runoff and subsequently releases it at a slower rate than it is collected by the drainage facility system. There is little or no infiltration of stored stormwater.
Detention time	The theoretical time required to displace the contents of a stormwater treatment facility at a given rate of discharge (volume divided by rate of discharge).
Determination of Nonsignificance (DNS)	The written decision by the responsible official of the lead agency that a proposal is not likely to have a significant adverse environmental impact, and therefore an EIS is not required.
Development	Means new development, redevelopment, or both. See definitions for each.
Discharge	Runoff leaving a new development or redevelopment via overland flow, built conveyance systems, or infiltration facilities. A hydraulic rate of flow, specifically fluid flow; a volume of fluid passing a point per unit of time, commonly expressed as cubic feet per second, cubic meters per second, gallons per minute, gallons per day, or millions of gallons per day.
Dispersion	Release of surface and stormwater runoff such that the flow spreads over a wide area and is located so as not to allow flow to concentrate anywhere upstream of a drainage channel with erodible underlying granular soils.

Ditch	A long narrow excavation dug in the earth for drainage with its top width less than 10 feet at design flow.
Divide, Drainage	The boundary between one drainage basin and another.
Drain	A buried pipe or other conduit (closed drain). A ditch (open drain) for carrying off surplus surface water or ground water.
(To) Drain	To provide channels, such as open ditches or closed drains, so that excess water can be removed by surface flow or by internal flow. To lose water (from the soil) by percolation.
Drainage	Refers to the collection, conveyance, containment, and/or discharge of surface and stormwater runoff.
Drainage basin	A geographic and hydrologic subunit of a watershed.
Drainage channel	A drainage pathway with a well-defined bed and banks indicating frequent conveyance of surface and stormwater runoff.
Drainage course	A pathway for watershed drainage characterized by wet soil vegetation; often intermittent in flow.
Drainage easement	A legal encumbrance that is placed against a property's title to reserve specified privileges for the users and beneficiaries of the drainage facilities contained within the boundaries of the easement.
Drainage pathway	The route that surface and stormwater runoff follows downslope as it leaves any part of the site.
Drainage project	Excavation or construction of pipes, culverts, channels, embankments, or other flow-altering structures in any stream, stormwater facility, or wetland in Clark County.
Drainage review	An evaluation by Plan Approving Authority staff of a proposed project's compliance with the drainage requirements in this manual or its technical equivalent.
Drainage, Soil	As a natural condition of the soil, soil drainage refers to the frequency and duration of periods when the soil is free of saturation; for example, in well-drained soils the water is removed readily but not rapidly; in poorly drained soils the root zone is waterlogged for long periods unless artificially drained, and the roots of ordinary crop plants cannot get enough oxygen; in excessively drained soils the water is removed so completely that most crop plants suffer from lack of water. Strictly speaking, excessively drained soils are a result of excessive runoff due to steep slopes or low available water-holding capacity due to small amounts of silt and clay in the soil material. The following classes are used to express soil drainage: Well drained - Excess water drains away rapidly and no mottling occurs within 36 inches of the surface.

- Moderately well drained - Water is removed from the soil somewhat slowly, resulting in small but significant periods of wetness. Mottling occurs between 18 and 36 inches.
- Somewhat poorly drained - Water is removed from the soil slowly enough to keep it wet for significant periods but not all of the time. Mottling occurs between 8 and 18 inches.
- Poorly drained - Water is removed so slowly that the soil is wet for a large part of the time. Mottling occurs between 0 and 8 inches.
- Very poorly drained - Water is removed so slowly that the water table remains at or near the surface for the greater part of the time. There may also be periods of surface ponding. The soil has a black to gray surface layer with mottles up to the surface.

Drawdown Lowering of the water surface (in open channel flow), water table or piezometric surface (in ground water flow) resulting from a withdrawal of water.

Drop-inlet spillway Overall structure in which the water drops through a vertical riser connected to a discharge conduit.

Drop spillway Overall structure in which the water drops over a vertical wall onto an apron at a lower elevation.

Drop structure A structure for dropping water to a lower level and dissipating its surplus energy; a fall. A drop may be vertical or inclined.

Dry weather flow The combination of ground water seepage and allowed non-stormwater flows found in storm sewers during dry weather. Also that flow in streams during the dry season.

EIS See Environmental Impact Statement.

ESC Erosion and Sediment Control (Plan).

Earth material Any rock, natural soil or fill and/or any combination thereof. Earth material shall not be considered topsoil used for landscape purposes. Topsoil used for landscaped purposes shall comply with ASTM D 5268 specifications. Engineered soil/landscape systems are also defined independently.

Easement The legal right to use a parcel of land for a particular purpose. It does not include fee ownership, but may restrict the owner's use of the land.

Effective Impervious Surface Those impervious surfaces that are connected via sheet flow or discrete conveyance to a drainage system. Impervious surfaces are considered ineffective if: 1) the runoff is dispersed through at least one hundred feet of native vegetation in accordance with BMP T5.30 – "Full Dispersion" as described in Chapter 5 of Volume V; 2) residential roof runoff is infiltrated in accordance with Downspout Full Infiltration Systems in BMP 5.10A Volume III; or 3) approved continuous runoff modeling methods indicate that the entire runoff file is infiltrated.

Embankment A structure of earth, gravel, or similar material raised to form a pond bank or foundation for a road.

Emergent plants Aquatic plants that are rooted in the sediment but whose leaves are at or above the water surface. These wetland plants often have high habitat value for wildlife and waterfowl, and can aid in pollutant uptake.

Emergency spillway A vegetated earth channel used to safely convey flood discharges in excess of the capacity of the principal spillway.

Emerging technology Treatment technologies that have not been evaluated with approved protocols, but for which preliminary data indicate that they may provide a necessary function(s) in a stormwater treatment system. Emerging technologies need additional evaluation to define design criteria to achieve, or to contribute to achieving, state performance goals, and to define the limits of their use.

Energy dissipater Any means by which the total energy of flowing water is reduced. In stormwater design, they are usually mechanisms that reduce velocity prior to, or at, discharge from an outfall in order to prevent erosion. They include rock splash pads, drop manholes, concrete stilling basins or baffles, and check dams.

Energy gradient The slope of the specific energy line (i.e., the sum of the potential and velocity heads).

Engineered soil/ landscape system This is a self-sustaining soil and plant system that simultaneously supports plant growth, soil microbes, water infiltration, nutrient and pollutant adsorption, sediment and pollutant biofiltration, water interflow, and pollution decomposition. The system shall be protected from compaction and erosion. The system shall be planted and/or mulched as part of the installation.

The engineered soil/plant system shall have the following characteristics:

a. Be protected from compaction and erosion.

b. Have a plant system to support a sustained soil quality.

c. Possess permeability characteristics of not less than 6.0, 2.0, and 0.6 inches/hour for hydrologic soil groups A, B, and C, respectively (per ASTM D 3385). D is less than 0.6 inches/hour.

d. Possess minimum percent organic matter of 12, 14, 16, and 18 percent (dry-weight basis) for hydrologic soil groups A, B, C, and D, respectively (per ASTM D 2974).

Engineering geology	The application of geologic knowledge and principles in the investigation and evaluation of naturally occurring rock and soil for use in the design of civil works.
Engineering plan	A plan prepared and stamped by a professional civil engineer.
Enhancement	To raise value, desirability, or attractiveness of an environment associated with surface water.
Environmental Impact Statement (EIS)	A document that discusses the likely significant adverse impacts of a proposal, ways to lessen the impacts, and alternatives to the proposal. They are required by the national and state environmental policy acts when projects are determined to have significant environmental impact.
Erodible granular soils	Soil materials that are easily eroded and transported by running water, typically fine or medium grained sand with minor gravel, silt, or clay content. Such soils are commonly described as Everett or Indianola series soil types in the SCS classification. Also included are any soils showing examples of existing severe stream channel incision as indicated by unvegetated streambanks standing over two feet high above the base of the channel.
Erodible or leachable materials	Wastes, chemicals, or other substances that measurably alter the physical or chemical characteristics of runoff when exposed to rainfall. Examples include erodible soils that are stockpiled, uncovered process wastes, manure, fertilizers, oily substances, ashes, kiln dust, and garbage dumpster leakage.
Erosion	The wearing away of the land surface by running water, wind, ice, or other geological agents, including such processes as gravitational creep. Also, detachment and movement of soil or rock fragments by water, wind, ice, or gravity. The following terms are used to describe different types of water erosion: Accelerated erosion - Erosion much more rapid than normal or geologic erosion, primarily as a result of the influence of the activities of man or, in some cases, of the animals or natural catastrophes that expose bare surfaces (e.g., fires). • Geological erosion - The normal or natural erosion caused by geological processes acting over long geologic periods and resulting in the wearing away of mountains, the building up of floodplains, coastal plains, etc. Synonymous with natural erosion. • Gully erosion - The erosion process whereby water accumulates in narrow channels and, over short periods, removes the soil from this narrow area to considerable depths, ranging from 1 to 2 feet to as much as 75 to 100 feet.

- Natural erosion - Wearing away of the earth's surface by water, ice, or other natural agents under natural environmental conditions of climate, vegetation, etc., undisturbed by man. Synonymous with geological erosion.
- Normal erosion - The gradual erosion of land used by man which does not greatly exceed natural erosion.
- Rill erosion - An erosion process in which numerous small channels only several inches deep are formed; occurs mainly on recently disturbed and exposed soils. See Rill.
- Sheet erosion - The removal of a fairly uniform layer of soil from the land surface by runoff.
- Splash erosion - The spattering of small soil particles caused by the impact of raindrops on wet soils. The loosened and spattered particles may or may not be subsequently removed by surface runoff.

Erosion classes (soil survey)	A grouping of erosion conditions based on the degree of erosion or on characteristic patterns. Applied to accelerated erosion, not to normal, natural, or geological erosion. Four erosion classes are recognized for water erosion and three for wind erosion.
Erosion and sedimentation control	Any temporary or permanent measures taken to reduce erosion; control siltation and sedimentation; and ensure that sediment-laden water does not leave the site.
Erosion and sediment control facility	A type of drainage facility designed to hold water for a period of time to allow sediment contained in the surface and stormwater runoff directed to the facility to settle out so as to improve the quality of the runoff.
Erosion impacts	See "Flooding and erosion impacts"
Escarpment	A steep face or a ridge of high land.
Estuarine wetland	Generally, an eelgrass bed; salt marsh; or rocky, sandflat, or mudflat intertidal area where fresh and salt water mix. (Specifically, a tidal wetland with salinity greater than 0.5 parts per thousand, usually semi-enclosed by land but with partially obstructed or sporadic access to the open ocean).
Estuary	An area where fresh water meets salt water, or where the tide meets the river current (e.g., bays, mouths of rivers, salt marshes and lagoons). Estuaries serve as nurseries and spawning and feeding grounds for large groups of marine life and provide shelter and food for birds and wildlife.
Eutrophication	Refers to the process where nutrient over-enrichment of water leads to excessive growth of aquatic plants, especially algae.

Evapotranspiration	The collective term for the processes of evaporation and plant transpiration by which water is returned to the atmosphere.
Excavation	The mechanical removal of earth material.
Exception	Relief from the application of a Minimum Requirement to a project.
Exfiltration	The downward movement of runoff through the bottom of an infiltration BMP into the soil layer or the downward movement of water through soil.
FIRM	See Flood Insurance Rate Map.
Fertilizer	Any material or mixture used to supply one or more of the essential plant nutrient elements.
Fill	A deposit of earth material placed by artificial means.
Filter fabric	A woven or nonwoven, water-permeable material generally made of synthetic products such as polypropylene and used in stormwater management and erosion and sediment control applications to trap sediment or prevent the clogging of aggregates by fine soil particles.
Filter fabric fence	A temporary sediment barrier consisting of a filter fabric stretched across and attached to supporting posts and entrenched. The filter fence is constructed of stakes and synthetic filter fabric with a rigid wire fence backing where necessary for support. Also commonly referred to in the Washington Department of Transportation standard specifications as "construction geotextile for temporary silt fences."
Filter strip	A grassy area with gentle slopes that treats stormwater runoff from adjacent paved areas before it concentrates into a discrete channel.
Flocculation	The process by which suspended colloidal or very fine particles are assembled into larger masses or floccules which eventually settle out of suspension. This process occurs naturally but can also be caused through the use of such chemicals as alum.
Flood	An overflow or inundation that comes from a river or any other source, including (but not limited to) streams, tides, wave action, storm drains, or excess rainfall. Any relatively high stream flow overtopping the natural or artificial banks in any reach of a stream.
Flood control	Methods or facilities for reducing flood flows and the extent of flooding.
Flood control project	A structural system installed to protect land and improvements from floods by the construction of dikes, river embankments, channels, or dams.

Flood frequency	The frequency with which the flood of interest may be expected to occur at a site in any average interval of years. Frequency analysis defines the "n-year flood" as being the flood that will, over a long period of time, be equaled or exceeded on the average once every "n" years.
Flood fringe	That portion of the floodplain outside of the floodway which is covered by floodwaters during the base flood; it is generally associated with slower moving or standing water rather than rapidly flowing water.
Flood hazard areas	Those areas subject to inundation by the base flood. Includes, but is not limited to streams, lakes, wetlands, and closed depressions.
Flood Insurance Rate Map (FIRM)	The official map on which the Federal Emergency Management Agency has delineated many areas of flood hazard, floodway, and the risk premium zones.
Flood Insurance Study	The official report provided by the Federal Emergency Management Agency that includes flood profiles and the FIRM.
Flood peak	The highest value of the stage or discharge attained by a flood; thus, peak stage or peak discharge.
Floodplain	The total area subject to inundation by a flood including the flood fringe and floodway.
Flood-proofing	Adaptations that ensure a structure is substantially impermeable to the passage of water below the flood protection elevation that resists hydrostatic and hydrodynamic loads and effects of buoyancy.
Flood protection elevation	The base flood elevation or higher as defined by the local government.
Flood protection facility	Any levee, berm, wall, enclosure, raise bank, revetment, constructed bank stabilization, or armoring, that is commonly recognized by the community as providing significant protection to a property from inundation by flood waters.
Flood routing	An analytical technique used to compute the effects of system storage dynamics on the shape and movement of flow represented by a hydrograph.
Flood stage	The stage at which overflow of the natural banks of a stream begins.
Flooding or erosion impacts	Flooding of septic systems, crawl spaces, living areas, outbuildings, etc.; increased ice or algal growth on sidewalks/roadways; earth movement or settlement; erosion and other potential damage.
Floodway	The channel of the river or stream and those portions of the adjoining floodplains that is reasonably required to carry and discharge the base flood flow. The portions of the adjoining floodplains which are

considered to be "reasonably required" are defined by flood hazard regulations.

Flow control BMP (or facility) A drainage facility designed to mitigate the impacts of increased surface and stormwater runoff flow rates generated by development. Flow control facilities are designed either to hold water for a considerable length of time and then release it by evaporation, plant transpiration, and/or infiltration into the ground, or to hold runoff for a short period of time, releasing it to the conveyance system at a controlled rate.

Flow duration The aggregate time that peak flows are at or above a particular flow rate of interest. For example, the amount of time that peak flows are at or above 50% of the 2-year peak flow rate for a period of record.

Flow frequency The inverse of the probability that the flow will be equaled or exceeded in any given year (the exceedance probability). For example, if the exceedance probability is 0.01 or 1 in 100, that flow is referred to as the 100-year flow.

Flow path The route that stormwater runoff follows between two points of interest.

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

Forest practice Any activity conducted on or directly pertaining to forest land and relating to growing, harvesting, or processing timber, including but not limited to:

a. Road and trail construction.
b. Harvesting, final and intermediate.
c. Precommercial thinning.
d. Reforestation.
e. Fertilization.
f. Prevention and suppression of diseases and insects.
g. Salvage of trees.
h. Brush control.

Forested communities (wetlands) In general terms, communities (wetlands) characterized by woody vegetation that is greater than or equal to 6 meters in height; in this manual the term applies to such communities (wetlands) that represent a significant amount of tree cover consisting of species that offer wildlife habitat and other values and advance the performance of wetland functions overall.

Freeboard The vertical distance between the highest designed water surface elevation and the elevation of the crest of the facility. For example, in pond design, freeboard is the vertical distance between the emergency overflow water surface and the top of the pond embankment.

Frequently flooded areas	The 100-year floodplain designations of the Federal Emergency Management Agency and the National Flood Insurance Program or as defined by the local government.
Frost-heave	The upward movement of soil surface due to the expansion of water stored between particles in the first few feet of the soil profile as it freezes. May cause surface fracturing of asphalt or concrete.
Frequency of storm (design storm frequency)	The anticipated period in years that will elapse, based on average probability of storms in the design region, before a storm of a given intensity and/or total volume will recur; thus a 10-year storm can be expected to occur on the average once every 10 years. Sewers designed to handle flows that occur under such storm conditions would be expected to be surcharged by any storms of greater amount or intensity.
Full Stabilization	Characterization of a site that has been disturbed when all erodible soils on the site are fully covered in paving, quarry spalls, rolled erosion control products, bonded fiber matrix products, vegetative cover or other permanent erosion prevention measures that fully prevent soil erosion on the site.
Fully controlled limited access highway	A highway where the right of owner or occupants of abutting land or other persons to access, light, air, or view in connection with the highway is controlled to give preference to through traffic by providing access connections with selected public roads only, and by prohibiting crossings or direct private driveway connections at grade. (See WAC 468-58-010)
Function(s)	The ecological (physical, chemical, and biological) processes or attributes of a wetland without regard for their importance to society (see also values). Wetland functions include food chain support, provision of ecosystem diversity and fish and wildlife habitat, floodflow alteration, ground water recharge and discharge, water quality improvement, and soil stabilization.
Gabion	A rectangular or cylindrical wire mesh cage (a chicken wire basket) filled with rock and used as a protecting agent, revetment, etc., against erosion. Soft gabions, often used in streambank stabilization, are made of geotextiles filled with dirt, in between which cuttings are placed.
Gage or gauge	Device for registering precipitation, water level, discharge, velocity, pressure, temperature, etc. Also, a measure of the thickness of metal; e.g., diameter of wire, wall thickness of steel pipe.
Gaging station	A selected section of a stream channel equipped with a gage, recorder, or other facilities for determining stream discharge.
Geologist	A person who has earned a degree in geology from an accredited college or university or who has equivalent educational training and has at least five years of experience as a practicing geologist or four

	years of experience and at least two years post-graduate study, research or teaching. The practical experience shall include at least three years work in applied geology and landslide evaluation, in close association with qualified practicing geologists or geotechnical professional/civil engineers.
Geologically hazardous areas	Areas that because of their susceptibility to erosion, sliding, earthquake, or other geological events, are not suited to the siting of commercial, residential, or industrial development consistent with public health or safety concerns.
Geometrics	The mathematical relationships between points, lines, angles, and surfaces used to measure and identify areas of land.
Geotechnical professional civil engineer	A practicing, geotechnical/civil engineer licensed as a professional Civil Engineer with the State of Washington who has at least four years of professional employment as a geotechnical engineer in responsible charge, including experience with landslide evaluation.
Grade	The slope of a road, channel, or natural ground. The finished surface of a canal bed, roadbed, top of embankment, or bottom of excavation; any surface prepared for the support of construction such as paving or the laying of a conduit.
(To) Grade	To finish the surface of a canal bed, roadbed, top of embankment or bottom of excavation.
Gradient terrace	An earth embankment or a ridge-and-channel constructed with suitable spacing and an acceptable grade to reduce erosion damage by intercepting surface runoff and conducting it to a stable outlet at a stable nonerosive velocity.
Grassed waterway	A natural or constructed waterway, usually broad and shallow, covered with erosion-resistant grasses, used to conduct surface water from an area at a reduced flow rate. See also biofilter.
Gross building area	The total floor area of the building measuring from the outer surface of exterior walls and windows and including all vertical penetrations (e.g. elevator shafts, etc.) and basement space.
Ground water	Water in a saturated zone or stratum beneath the land surface or a surface waterbody.
Ground water recharge	Inflow to a ground water reservoir.
Ground water table	The free surface of the ground water, that surface subject to atmospheric pressure under the ground, generally rising and falling with the season, the rate of withdrawal, the rate of restoration, and other conditions. It is seldom static.

Gully A channel caused by the concentrated flow of surface and stormwater runoff over unprotected erodible land.

Habitat The specific area or environment in which a particular type of plant or animal lives. An organism's habitat must provide all of the basic requirements for life and should be protected from harmful biological, chemical, and physical alterations.

Hardpan A cemented or compacted and often clay-like layer of soil that is impenetrable by roots. Also known as glacial till.

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

Harmful pollutant A substance that has adverse effects to an organism including immediate death, chronic poisoning, impaired reproduction, cancer or other effects.

Head (hydraulics) The height of water above any plane of reference. The energy, either kinetic or potential, possessed by each unit weight of a liquid, expressed as the vertical height through which a unit weight would have to fall to release the average energy possessed. Used in various compound terms such as pressure head, velocity head, and head loss.

Head loss Energy loss due to friction, eddies, changes in velocity, or direction of flow.

Heavy metals Metals of high specific gravity, present in municipal and industrial wastes, that pose long-term environmental hazards. Such metals include cadmium, chromium, cobalt, copper, lead, mercury, nickel, and zinc.

High-use site High-use sites are those that typically generate high concentrations of oil due to high traffic turnover or the frequent transfer of oil. High-use sites include:

- An area of a commercial or industrial site subject to an expected average daily traffic (ADT) count equal to or greater than 100 vehicles per 1,000 square feet of gross building area;
- An area of a commercial or industrial site subject to petroleum storage and transfer in excess of 1,500 gallons per year, not including routinely delivered heating oil;
- An area of a commercial or industrial site subject to parking, storage or maintenance of 25 or more vehicles that are over 10 tons gross weight (trucks, buses, trains, heavy equipment, etc.);
- A road intersection with a measured ADT count of 25,000 vehicles or more on the main roadway and 15,000 vehicles or more on any intersecting roadway, excluding projects proposing primarily pedestrian or bicycle use improvements.

Highway A main public road connecting towns and cities.

Hog fuel	Wood-based mulch.
Horton overland flow	A runoff process whereby the rainfall rate exceeds the infiltration rate, so that the precipitation that does not infiltrate flows downhill over the soil surface.
HSPF	**Hydrological Simulation Program-Fortran.** A continuous simulation hydrologic model that transforms an uninterrupted rainfall record into a concurrent series of runoff or flow data by means of a set of mathematical algorithms which represent the rainfall-runoff process at some conceptual level.
Humus	Organic matter in or on a soil, composed of partly or fully decomposed bits of plant tissue or from animal manure.
Hydraulic Conductivity	The quality of saturated soil that enables water or air to move through it. Also known as coefficient of permeability.
Hydraulic gradient	Slope of the potential head relative to a fixed datum.
Hydrodynamics	Means the dynamic energy, force, or motion of fluids as affected by the physical forces acting upon those fluids.
Hydrograph	A graph of runoff rate, inflow rate or discharge rate, past a specific point over time.
Hydrologic cycle	The circuit of water movement from the atmosphere to the earth and return to the atmosphere through various stages or processes as precipitation, interception, runoff, infiltration, percolation, storage, evaporation, and transpiration.
Hydrologic Soil Groups	A soil characteristic classification system defined by the U.S. Soil Conservation Service in which a soil may be categorized into one of four soil groups (A, B, C, or D) based upon infiltration rate and other properties. <u>Type A:</u> Low runoff potential. Soils having high infiltration rates, even when thoroughly wetted, and consisting chiefly of deep, well drained to excessively drained sands or gravels. These soils have a high rate of water transmission. <u>Type B:</u> Moderately low runoff potential. Soils having moderate infiltration rates when thoroughly wetted, and consisting chiefly of moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission. <u>Type C:</u> Moderately high runoff potential. Soils having slow infiltration rates when thoroughly wetted, and consisting chiefly of soils with a layer that impedes downward movement of water, or soils with moderately fine to fine textures. These soils have a slow rate of water transmission.

Type D: High runoff potential. Soils having very slow infiltration rates when thoroughly wetted, and consisting chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a hardpan, till, or clay layer at or near the surface, soils with a compacted subgrade at or near the surface, and shallow soils or nearly impervious material. These soils have a very slow rate of water transmission.[1]

[1] Vladimir Novotny and Harvey Olem. *Water Quality Prevention, Identification, and Management of Diffuse Pollution,* Van Nostrand Reinhold: New York, 1994, p. 109.

Hydrology — The science of the behavior of water in the atmosphere, on the surface of the earth, and underground.

Hydroperiod — A seasonal occurrence of flooding and/or soil saturation; it encompasses depth, frequency, duration, and seasonal pattern of inundation.

Hyetograph — A graph of percentages of total precipitation for a series of time steps representing the total time in which precipitation occurs.

Illicit discharge — All non-stormwater discharges to stormwater drainage systems that cause or contribute to a violation of state water quality, sediment quality or ground water quality standards, including but not limited to sanitary sewer connections, industrial process water, interior floor drains, car washing, and greywater systems.

Illustration — A drawing, diagram, plan, profile or image that illustrates an engineering design or concept and provides suggested dimensions or specifications, which may not be used directly in a design without further engineering design and certification by a licensed professional engineer in the state of Washington.

Impact basin — A device used to dissipate the energy of flowing water. Generally constructed of concrete in the form of a partially depressed or partially submerged vessel, it may utilize baffles to dissipate velocities.

Impervious — A surface which cannot be easily penetrated. For instance, rain does not readily penetrate paved surfaces.

Impervious surface — A non-vegetated surface area which either prevents or retards the entry of water into the soil mantle as under natural conditions prior to development. A non-vegetated surface area which causes water to run off the surface in greater quantities or at an increased rate of flow from the flow present under natural conditions prior to development. Common impervious surfaces include, but are not limited to, roof tops, walkways, patios, driveways, parking lots or storage areas, concrete or asphalt paving, gravel roads, packed earthen materials, and oiled, macadam or other surfaces which similarly impede the natural infiltration of stormwater. Open, uncovered retention/detention facilities shall not be considered as impervious surfaces for the purposes of determining whether the thresholds for application of minimum requirements are exceeded. Open, uncovered retention/detention facilities shall be considered impervious surfaces for purposes of runoff modeling.

Impoundment	A natural or man-made containment for surface water.
Improvement	Streets (with or without curbs or gutters), sidewalks, crosswalks, parking lots, water mains, sanitary and storm sewers, drainage facilities, street trees and other appropriate items.
Industrial activities	Material handling, transportation, or storage; manufacturing; maintenance; treatment; or disposal. Areas with industrial activities include plant yards, access roads and rail lines used by carriers of raw materials, manufactured products, waste material, or by-products; material handling sites; refuse sites; sites used for the application or disposal of process waste waters; sites used for the storage and maintenance of material handling equipment; sites used for residual treatment, storage, or disposal; shipping and receiving areas; manufacturing buildings; storage areas for raw materials, and intermediate and finished products; and areas where industrial activity has taken place in the past and significant materials remain and are exposed to stormwater.
Infill	Infill projects (as defined in CCC section 40.260.110) are a type of new development or redevelopment for the purposes of this manual.
Infiltration	Means the downward movement of water from the surface to the subsoil.
Infiltration facility (or system)	A drainage facility designed to use the hydrologic process of surface and stormwater runoff soaking into the ground, commonly referred to as a percolation, to dispose of surface and stormwater runoff.
Infiltration rate	The rate, usually expressed in inches/hour, at which water moves downward (percolates) through the soil profile. Short-term infiltration rates may be inferred from soil analysis or derived from field measurements. Long-term infiltration rates are affected by variability in soils and subsurface conditions at the site, the effectiveness of pretreatment or influent control, and the degree of long-term maintenance of the infiltration facility.
Ingress/egress	The points of access to and from a property.
Inlet	A form of connection between surface of the ground and a drain or sewer for the admission of surface and stormwater runoff.
Insecticide	A substance, usually chemical, that is used to kill insects.

Interception (Hydraulics)	The process by which precipitation is caught and held by foliage, twigs, and branches of trees, shrubs, and other vegetation. Often used for "interception loss" or the amount of water evaporated from the precipitation intercepted.
Interflow	That portion of rainfall that infiltrates into the soil and moves laterally through the upper soil horizons until intercepted by a stream channel or until it returns to the surface for example, in a roadside ditch, wetland, spring or seep. Interflow is a function of the soil system depth, permeability, and water-holding capacity.
Intermittent stream	A stream or portion of a stream that flows only in direct response to precipitation. It receives little or no water from springs and no long-continued supply from melting snow or other sources. It is dry for a large part of the year, ordinarily more than three months.
Invasive weedy plant species	Opportunistic species of inferior biological value that tend to out-compete more desirable forms and become dominant; applied to non-native species in this manual.
Invert	The lowest point on the inside of a sewer or other conduit.
Invert elevation	The vertical elevation of a pipe or orifice in a pond that defines the water level.
Isopluvial map	A map with lines representing constant depth of total precipitation for a given return frequency.
Lag time	The interval between the center of mass of the storm precipitation and the peak flow of the resultant runoff.
Lake	An area permanently inundated by water in excess of two meters deep and greater than 20 acres in size as measured at the ordinary high water marks.
Land disturbing activity	Any activity that results in a change in the existing soil cover (both vegetative and nonvegetative) and/or the existing soil topography. Land disturbing activities include, but are not limited to clearing, grading, filling, and excavation. Vegetation maintenance practices, including landscape maintenance and gardening, are not considered land-disturbing activity. Stormwater facility maintenance is not considered land disturbing activity if conducted according to established standards and procedures.
Landslide	Episodic downslope movement of a mass of soil or rock that includes but is not limited to rockfalls, slumps, mudflows, and earthflows. For the purpose of these rules, snow avalanches are considered to be a special case of landsliding.
Landslide hazard areas	Those areas subject to a severe risk of landslide.

Leachable materials Those substances that, when exposed to rainfall, measurably alter the physical or chemical characteristics of the rainfall runoff. Examples include erodible soils, uncovered process wastes, manure, fertilizers, oil substances, ashes, kiln dust, and garbage dumpster leakage.

Leachate Liquid that has percolated through soil and contains substances in solution or suspension.

Leaching Removal of the more soluble materials from the soil by percolating waters.

Legume A member of the legume or pulse family, Leguminosae, one of the most important and widely distributed plant families. The fruit is a "legume" or pod. Includes many valuable food and forage species, such as peas, beans, clovers, alfalfas, sweet clovers, and vetches. Practically all legumes are nitrogen-fixing plants.

Level pool routing The basic technique of storage routing used for sizing and analyzing detention storage and determining water levels for ponding water bodies. The level pool routing technique is based on the continuity equation: Inflow – Outflow = Change in storage.

Level spreader A temporary ESC device used to spread out stormwater runoff uniformly over the ground surface as sheet flow (i.e., not through channels). The purpose of level spreaders is to prevent concentrated, erosive flows from occurring, and to enhance infiltration.

LID See Low Impact Development

Low flow channel An incised or paved channel from inlet to outlet in a dry basin which is designed to carry low runoff flows and/or baseflow, directly to the outlet without detention.

Low Impact Development (LID) A stormwater and land use management strategy that strives to mimic pre-disturbance hydrologic processes of infiltration, filtration, storage, evaporation and transpiration by emphasizing conservation, use of on-site natural features, site planning, and distributed stormwater management practices that are integrated into a project design.

Low Impact Development (LID) Best Management Practices Distributed stormwater management practices, integrated into a project design, that emphasize pre-disturbance hydrologic processes of infiltration, filtration, storage, evaporation and transpiration. LID BMPs include, but are not limited to, bioretention/rain gardens, permeable pavements, roof downspout controls, dispersion, soil quality and depth, minimal excavation foundations, vegetated roofs, and water re-use.

Low Impact Development (LID) Principles Land use management strategies that emphasize conservation, use of on-site natural features, and site planning to minimize impervious surfaces, native vegetation loss, and stormwater runoff.

Low permeable liner A layer of compacted till or clay, or a geomembrane.

Lowest floor The lowest enclosed area (including basement) of a structure. An area used solely for parking of vehicles, building access, or storage, in an area other than a basement area, is not considered a building's lowest floor, provided that the enclosed area meets all of the structural requirements of the flood hazard standards.

MDNS A Mitigated Determination of Nonsignificance (See DNS and Mitigation).

Maintenance Repair and maintenance includes activities conducted on currently serviceable structures, facilities, and equipment that involves no expansion or use beyond that previously existing and results in no significant adverse hydrologic impact. It includes those usual activities taken to prevent a decline, lapse, or cessation in the use of structures and systems. Those usual activities may include replacement of dysfunctioning facilities, including cases where environmental permits require replacing an existing structure with a different type structure, as long as the functioning characteristics of the original structure are not changed. One example is the replacement of a collapsed, fish blocking, round culvert with a new box culvert under the same span, or width, of roadway. In regard to stormwater facilities, maintenance includes assessment to ensure ongoing proper operation, removal of built-up pollutants (i.e., sediments), replacement of failed or failing treatment media, and other actions taken to correct defects as identified in the maintenance standards of Chapter 4, Volume V. See also Pavement Maintenance exemptions in Section 2.2 of Volume I.

Manning's equation An equation used to predict the velocity of water flow in an open channel or pipelines:

$$V = \frac{1.486 R^{2/3} S^{1/2}}{n}$$

where:

V is the mean velocity of flow in feet per second

R is the hydraulic radius in feet

S is the slope of the energy gradient or, for assumed uniform flow, the slope of the channel in feet per foot; and

n is Manning's roughness coefficient or retardance factor of the channel lining.

Mass wasting The movement of large volumes of earth material downslope.

Master drainage plan — A comprehensive drainage control plan intended to prevent significant adverse impacts to the natural and manmade drainage system, both on and off-site.

Mean annual water level fluctuation — Derived as follows:

(1) Measure the maximum water level (e.g., with a crest stage gage, Reinelt and Horner 1990) and the existing water level at the time of the site visit (e.g., with a staff gage) on at least eight occasions spread through a year.

(2) Take the difference of the maximum and existing water level on each occasion and divide by the number of occasions.

Mean depth — Average depth; cross-sectional area of a stream or channel divided by its surface or top width.

Mean velocity — The average velocity of a stream flowing in a channel or conduit at a given cross-section or in a given reach. It is equal to the discharge divided by the cross-sectional area of the reach.

Measuring weir — A shaped notch through which water flows is measured. Common shapes are rectangular, trapezoidal, and triangular.

Mechanical analysis — The analytical procedure by which soil particles are separated to determine the particle size distribution.

Mechanical practices — Soil and water conservation practices that primarily change the surface of the land or that store, convey, regulate, or dispose of runoff water without excessive erosion.

Metals — Elements, such as mercury, lead, nickel, zinc and cadmium, which are of environmental concern because they do not degrade over time. Although many are necessary nutrients, they are sometimes magnified in the food chain, and they can be toxic to life in high enough concentrations. They are also referred to as heavy metals.

Microbes — The lower trophic levels of the soil food web. They are normally considered to include bacteria, fungi, flagellates, amoebae, ciliates, and nematodes. These in turn support the higher trophic levels, such as mites and earthworms. Together they are the basic life forms that are necessary for plant growth. Soil microbes also function to bioremediate pollutants such as petroleum, nutrients, and pathogens.

Mitigation — Means, in the following order of preference:

a. Avoiding the impact altogether by not taking a certain action or part of an action;

b. Minimizing impacts by limiting the degree or magnitude of the action and its implementation, by using appropriate technology, or by taking affirmative steps to avoid or reduce impacts;

c. Rectifying the impact by repairing, rehabilitating or restoring the affected environment;

d. Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; and

e. Compensating for the impact by replacing, enhancing, or providing substitute resources or environments.

Modification, modified (wetland) A wetland whose physical, hydrological, or water quality characteristics have been purposefully altered for a management purpose, such as by dredging, filling, forebay construction, and inlet or outlet control.

Monitor To systematically and repeatedly measure something in order to track changes.

Monitoring The collection of data by various methods for the purposes of understanding natural systems and features, evaluating the impacts of development proposals on such systems, and assessing the performance of mitigation measures imposed as conditions of development.

NGPE See Native Growth Protection Easement.

NGVD National Geodetic Vertical Datum.

NPDES The National Pollutant Discharge Elimination System as established by the Federal Clean Water Act.

National Pollutant Discharge Elimination System (NPDES) The part of the federal Clean Water Act, which requires point source dischargers to obtain permits. These permits are referred to as NPDES permits and, in Washington State, are administered by the Washington State Department of Ecology.

Native Growth Protection Easement (NGPE) An easement granted for the protection of native vegetation within a sensitive area or its associated buffer. The NGPE shall be recorded on the appropriate documents of title and filed with the County Records Division.

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

Natural location Means the location of those channels, swales, and other non-manmade conveyance systems as defined by the first documented topographic contours existing for the subject property, either from maps or photographs, or such other means as appropriate. In the case of outwash soils with relatively flat terrain, no natural location of surface discharge may exist.

New development — Land disturbing activities, including Class IV -general forest practices that are conversions from timber land to other uses; structural development, including construction or installation of a building or other structure; creation of hard surfaces; and subdivision, short subdivision and binding site plans, as defined and applied in Chapter 58.17 RCW. Projects meeting the definition of redevelopment shall not be considered new development.

Nitrate (NO_3) — A form of nitrogen which is an essential nutrient to plants. It can cause algal blooms in water if all other nutrients are present in sufficient quantities. It is a product of bacterial oxidation of other forms of nitrogen, from the atmosphere during electrical storms and from fertilizer manufacturing.

Nitrification — The biochemical oxidation process by which ammonia is changed first to nitrites and then to nitrates by bacterial action, consuming oxygen in the water.

Nitrogen, Available — Usually ammonium, nitrite, and nitrate ions, and certain simple amines available for plant growth. A small fraction of organic or total nitrogen in the soil is available at any time.

Nonpoint source pollution — Pollution that enters a waterbody from diffuse origins on the watershed and does not result from discernible, confined, or discrete conveyances.

Normal depth — The depth of uniform flow. This is a unique depth of flow for any combination of channel characteristics and flow conditions. Normal depth is calculated using Manning's Equation.

Normal landscape maintenance — Repair and maintenance includes activities conducted on currently serviceable structures, facilities, and equipment that involves no expansion of use beyond that previously existing and results in no significant adverse hydrologic impact. If includes those usual activities taken to prevent a decline, lapse, or cessation in the use of structures and systems. Those usual activities may include replacement of dysfunctional facilities, including cases where environmental permits require replacing an existing structure with a different type structure, as long as the functioning characteristics of the original structure are not changed. One example is the replacement of a collapsed, fish blocking, round culvert with a new box culvert under the same span, or width, of roadway. In regard to stormwater facilities, maintenance includes assessment to ensure ongoing proper operation, removal of built up pollutants (i.e. sediments), replacement of failed or failing treatment media, and other actions taken to correct defects.

Noxious Weed — The legal term for any invasive, non-native plant that threatens agricultural crops, local ecosystems or fish and wildlife habitat. Washington State law establishes several classes of noxious weed. Class A weeds are non-native plant species whose distribution in Washington is still limited. Preventing new infestations is the highest priority. Eradication of all Class A plants is required by law. Class B weeds are non-native species presently limited to portions of the state. Where Class B weeds are not yet widespread, preventing new infestations is the highest priority. Where Class B weeds are already abundant, a control strategy is decided at the local level with containment as the primary goal.

NRCS Method — A single-event hydrologic analysis technique for estimating runoff based on the Curve Number method. The Curve Numbers are published by NRCS in *Technical Release No. 55: Urban Hydrology for Small Watersheds, 1986*. With the change in name to the Natural Resource Conservation Service, the method may be referred to as the NRCS Method.

Nutrients — Essential chemicals needed by plants or animals for growth. Excessive amounts of nutrients can lead to degradation of water quality and algal blooms. Some nutrients can be toxic at high concentrations.

Off-line facilities — Water quality treatment facilities to which stormwater runoff is restricted to some maximum flow rate or volume by a flow-splitter.

Off-site — Any area lying upstream of the site that drains onto the site and any area lying downstream of the site to which the site drains.

Off-system storage — Facilities for holding or retaining excess flows over and above the carrying capacity of the stormwater conveyance system, in chambers, tanks, lagoons, ponds, or other basins that are not a part of the subsurface sewer system.

Oil/water separator — A vault, usually underground, designed to provide a quiescent environment to separate oil from water.

On-line facilities — Water quality treatment facilities which receive all of the stormwater runoff from a drainage area. Flows above the water quality design flow rate or volume are passed through at a lower percent removal efficiency.

On-site — The entire property that includes the proposed development.

On-site Stormwater Management BMPs — As used in this manual, a synonym for Low Impact Development BMPs.

Operational BMPs — Operational BMPs are a type of Source Control BMP. They are schedules of activities, prohibition of practices, and other managerial practices to prevent or reduce pollutants from entering stormwater. Operational BMPs include formation of a pollution prevention team, good housekeeping, preventive maintenance procedures, spill prevention and clean-up, employee training, inspections of pollutant sources and BMPs, and record keeping. They can also include process changes, raw material/product changes, and recycling wastes.

Ordinary high water mark
The term ordinary high water mark means the line on the shore established by the fluctuations of water and indicated by physical characteristics such as a clear, natural line impressed on the bank; shelving; changes in the character of soil destruction on terrestrial vegetation, or the presence of litter and debris; or other appropriate means that consider the characteristics of the surrounding area.

The ordinary high water mark will be found by examining the bed and banks of a stream and ascertaining where the presence and action of waters are so common and usual, and so long maintained in all ordinary years, as to mark upon the soil a character distinct from that of the abutting upland, in respect to vegetation. In any area where the ordinary high water mark cannot be found, the line of mean high water shall substitute. In any area where neither can be found, the channel bank shall be substituted. In braided channels and alluvial fans, the ordinary high water mark or substitute shall be measured so as to include the entire stream feature.

Organic matter
Organic matter as decomposed animal or vegetable matter. It is measured by ASTM D 2974. Organic matter is an important reservoir of carbon and a dynamic component of soil and the carbon cycle. It improves soil and plant efficiency by improving soil physical properties including drainage, aeration, and other structural characteristics. It contains the nutrients, microbes, and higher-form soil food web organisms necessary for plant growth. The maturity of organic matter is a measure of its beneficial properties. Raw organic matter can release water-soluble nutrients (similar to chemical fertilizer). Beneficial organic matter has undergone a humification process either naturally in the environment or through a composting process.

Orifice
An opening with closed perimeter, usually sharp-edged, and of regular form in a plate, wall, or partition through which water may flow, generally used for the purpose of measurement or control of water.

Outlet
Point of water disposal from a stream, river, lake, tidewater, or artificial drain.

Outlet channel
A waterway constructed or altered primarily to carry water from man-made structures, such as terraces, tile lines, and diversions.

Outwash soils
Soils formed from highly permeable sands and gravels.

Overflow	A pipeline or conduit device, together with an outlet pipe, that provides for the discharge of portions of combined sewer flows into receiving waters or other points of disposal, after a regular device has allowed the portion of the flow which can be handled by interceptor sewer lines and pumping and treatment facilities to be carried by and to such water pollution control structures.
Overflow rate	Detention basin release rate divided by the surface area of the basin. It can be thought of as an average flow rate through the basin.
Overtopping	To flow over the limits of a containment or conveyance element.
Partially controlled limited access highway	A highway where the right of owner or occupants of abutting land or other persons to access, light, air, or view in connection with the highway is controlled to give preference to through traffic to a degree that, in addition to access connections with selected public roads, there may be some crossings and some private driveway connections at grade. (See WAC 468-58-010)
Particle Size	The effective diameter of a particle as measured by sedimentation, sieving, or micrometric methods.
Peak discharge	The maximum instantaneous rate of flow during a storm, usually in reference to a specific design storm event.
Peak-shaving	Controlling post-development peak discharge rates to pre-development levels by providing temporary detention in a BMP.
Percolation	The movement of water through soil.
Percolation rate	The rate, often expressed in minutes/inch, at which clear water, maintained at a relatively constant depth, will seep out of a standardized test hole that has been previously saturated. The term percolation rate is often used synonymously with infiltration rate (short-term infiltration rate).
Permanent Stormwater Control (PSC) Plan	A plan which includes permanent BMPs for the control of pollution from stormwater runoff after construction and/or land disturbing activity has been completed
Permeable pavement	Pervious concrete, porous asphalt, permeable pavers or other forms of pervious or porous paving material intended to allow passage of water through the pavement section. It often includes an aggregate base that provides structural support and acts as a stormwater reservoir.
Permeable soils	Soil materials with a sufficiently rapid infiltration rate so as to greatly reduce or eliminate surface and stormwater runoff. These soils are generally classified as SCS hydrologic soil types A and B.
Person	Any individual, partnership, corporation, association, organization, cooperative, public or municipal corporation, agency of the state, or local government unit, however designated.

Perviousness	Related to the size and continuity of void spaces in soils; related to a soil's infiltration rate.
Pervious Surface	A surface material that allows stormwater to infiltrate into the ground. Examples include lawn, landscape, pasture, native vegetation areas, and permeable pavements.
Pesticide	A general term used to describe any substance - usually chemical - used to destroy or control organisms; includes herbicides, insecticides, algicides, fungicides, and others. Many of these substances are manufactured and are not naturally found in the environment. Others, such as pyrethrum, are natural toxins that are extracted from plants and animals.
pH	A measure of the alkalinity or acidity of a substance which is conducted by measuring the concentration of hydrogen ions in the substance. A pH of 7.0 indicates neutral water. A 6.5 reading is slightly acid.
Physiographic	Characteristics of the natural physical environment (including hills).
Plan Approval Authority	The Plan Approval Authority is defined as that department within a local government that has been delegated authority to approve stormwater site plans.
Planned unit development (PUD)	A special classification authorized in some zoning ordinances, where a unit of land under control of a single developer may be used for a variety of uses and densities, subject to review and approval by the local governing body. The locations of the zones are usually decided on a case-by-case basis.
Plat	A map or representation of a subdivision showing the division of a tract or parcel of land into lots, blocks, streets, or other divisions and dedications.
Plunge pool	A device used to dissipate the energy of flowing water that may be constructed or made by the action of flowing. These facilities may be protected by various lining materials.
Point discharge	The release of collected and/or concentrated surface and stormwater runoff from a pipe, culvert, or channel.
Point of compliance	The location at which compliance with a discharge performance standard or a receiving water quality standard is measured.
Pollution	Contamination or other alteration of the physical, chemical, or biological properties, of waters of the state, including change in temperature, taste, color, turbidity, or odor of the waters, or such discharge of any liquid, gaseous, solid, radioactive or other substance into any waters of the state as will or is likely to create a nuisance or render such waters harmful, detrimental or injurious to the public health, safety or welfare, or to domestic, commercial, industrial,

agricultural, recreational, or other legitimate beneficial uses, or to livestock, wild animals, birds, fish or other aquatic life.

Pollution-generating hard surface (PGHS) Those hard surfaces considered to be a significant source of pollutants in stormwater runoff. See the listing of surfaces under pollution-generating impervious surface.

Pollution-generating impervious surface (PGIS) Those impervious surfaces considered to be a significant source of pollutants in stormwater runoff. Such surfaces include those which are subject to: vehicular use; industrial activities (as further defined in this glossary); or storage of erodible or leachable materials, wastes, or chemicals, and which receive direct rainfall or the run-on or blow-in of rainfall; metal roofs unless they are coated with an inert, non-leachable material (e.g., baked-on enamel coating); or roofs that are subject to venting significant amounts of dusts, mists, or fumes from manufacturing, commercial, or other indoor activities.

Pollution-generating pervious surface (PGPS) Any non-impervious surface subject to vehicular use, industrial activities (as further defined in this glossary); or storage of erodible or leachable materials, wastes or chemicals, and that receive direct rainfall or run-on or blow-in of rainfall, use of pesticides and fertilizers, or loss of soil. Typical PGPS include permeable pavement subject to vehicular use, lawns and landscaped areas including: golf courses, parks, cemeteries, and sports fields (natural and artificial turf).

Predeveloped Condition The native vegetation and soils that existed at a site prior to the influence of Euro-American settlement. The pre-developed condition shall be assumed to be forested land cover unless reasonable, historic information is provided that indicates the site was prairie prior to settlement.

Prediction For the purposes of this document an expected outcome based on the results of hydrologic modeling and/or the judgment of a trained professional civil engineer or geologist.

Pretreatment The removal of material such as solids, grit, grease, and scum from flows prior to physical, biological, or physical treatment processes to improve treatability. Pretreatment may include screening, grit removal, settling, oil/water separation, or application of a Basic Treatment BMP prior to infiltration.

Priority peat systems Unique, irreplaceable fens that can exhibit water pH in a wide range from highly acidic to alkaline, including fens typified by Sphagnum species, Ledum groenlandicum (Labrador tea), Drosera rotundifolia (sundew), and Vaccinium oxycoccos (bog cranberry); marl fens; estuarine peat deposits; and other moss peat systems with relatively diverse, undisturbed flora and fauna. Bog is the common name for peat systems having the Sphagnum association described, but this term applies strictly only to systems that receive water income from precipitation exclusively.

Professional civil engineer A person registered with the state of Washington as a professional engineer in civil engineering.

Project Any proposed action to alter or develop a site. The proposed action of a permit application or an approval, which requires drainage review.

Project site That portion of a property, properties, or right of way subject to land disturbing activities, new hard surfaces, or replaced hard surfaces.

Properly Functioning Soil System (PFSS) Equivalent to engineered soil/landscape system. This can also be a natural system that has not been disturbed or modified.

Puget Sound basin Puget Sound south of Admiralty Inlet (including Hood Canal and Saratoga Passage); the waters north to the Canadian border, including portions of the Strait of Georgia; the Strait of Juan de Fuca south of the Canadian border; and all the lands draining into these waters as mapped in Water Resources Inventory Areas numbers 1 through 19, set forth in WAC 173-500-040.

R/D See Retention/detention facility.

Rain garden A non-engineered shallow, landscaped depression, with compost-amended native soils and adapted plants. The depression is designed to pond and temporarily store stormwater runoff from adjacent areas, and to allow stormwater to pass through the amended soil profile.

Rare, threatened, or endangered species Plant or animal species that are regional relatively uncommon, are nearing endangered status, or whose existence is in immediate jeopardy and is usually restricted to highly specific habitats. Threatened and endangered species are officially listed by federal and state authorities, whereas rare species are unofficial species of concern that fit the above definitions.

Rational method A means of computing storm drainage flow rates (Q) by use of the formula Q = CIA, where C is a coefficient describing the physical drainage area, I is the rainfall intensity and A is the area. This method is no longer used in the technical manual.

Reach A length of channel with uniform characteristics.

Receiving waters Bodies of water or surface water systems to which surface runoff is discharged via a point source of stormwater or via sheet flow. Ground water to which surface runoff is directed by infiltration.

Recharge The addition of water to the zone of saturation (i.e., an aquifer).

Recommended BMPs As used in Book 3, recommended BMPs are those BMPs that are not mandatory at new development and redevelopment sites or at existing business sites. However, they may improve pollutant control efficiency, and may provide better source control of pollutants.

Redevelopment	On a site that is already substantially developed (i.e., has 35% or more of existing hard surface coverage), the creation or addition of hard surfaces; the expansion of a building footprint or addition or replacement of a structure; structural development including construction, installation or expansion of a building or other structure; replacement of hard surface that is not part of a routine maintenance activity; and land disturbing activities.
Regional	An action (here, for stormwater management purposes) that involves more than one discrete property.
Regional detention facility	A stormwater quantity control structure designed to correct existing surface water runoff problems of a basin or subbasin. The area downstream has been previously identified as having existing or predicted significant and regional flooding and/or erosion problems. This term is also used when a detention facility is sited to detain stormwater runoff from a number of new developments or areas within a catchment.
Release rate	The computed peak rate of surface and stormwater runoff from a site.
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.
Replaced impervious surface	For structures, the removal and replacement of impervious surfaces down to the foundation. For other impervious surfaces, the removal down to bare soil or base course and replacement.
Required BMPs	As used in Book 3, required BMPs are those operational and structural source control BMPs that are mandatory at new development and redevelopment sites, where applicable, and at commercial, industrial, and multifamily properties, where applicable.
Residential density	The number of dwelling units per unit of surface area. Net density includes only occupied land. Gross density includes unoccupied portions of residential areas, such as roads and open space.
Responsible official	The Clark County Manager or their designee.
Restoration	Actions performed to reestablish wetland functional characteristics and processes that have been lost by alterations, activities, or catastrophic events in an area that no longer meets the definition of a wetland.
Retention	The process of collecting and holding surface and stormwater runoff with no surface outflow.

Retention/detention facility (R/D)	A type of drainage facility designed either to hold water for a considerable length of time and then release it by evaporation, plant transpiration, and/or infiltration into the ground; or to hold surface and stormwater runoff for a short period of time and then release it to the surface and stormwater management system.
Retrofitting	The renovation of an existing structure or facility to meet changed conditions or to improve performance.
Return frequency	A statistical term for the average time of expected interval that an event of some kind will equal or exceed given conditions (e.g., a stormwater flow that occurs every 2 years).
Rhizome	A modified plant stem that grows horizontally underground.
Riffles	Fast sections of a stream where shallow water races over stones and gravel. Riffles usually support a wider variety of bottom organisms than other stream sections.
Rill	A small intermittent watercourse with steep sides, usually only a few inches deep. Often rills are caused by an increase in surface water flow when soil is cleared of vegetation.
Riprap	A facing layer or protective mound of rocks placed to prevent erosion or sloughing of a structure or embankment due to flow of surface and stormwater runoff.
Riparian	Pertaining to the banks of streams, wetlands, lakes, or tidewater.
Riser	A vertical pipe extending from the bottom of a pond BMP that is used to control the discharge rate from a BMP for a specified design storm.
Road-related Development	Land-disturbing activity where the sole objective is the development or redevelopment of roads, sidewalks, and bike lanes.
Rodenticide	A substance used to destroy rodents.
Runoff	Water originating from rainfall and other precipitation that is found in drainage facilities, rivers, streams, springs, seeps, ponds, lakes and wetlands as well as shallow ground water. As applied in this manual, it also means the portion of rainfall or other precipitation that becomes surface flow and interflow.
SCS	Soil Conservation Service (now the Natural Resources Conservation Service), U.S. Department of Agriculture.
SCS Method	See NRCS Method.
NRCS Method	A single-event hydrologic analysis technique for estimating runoff based on the Curve Number method. The Curve Numbers are published by NRCS in *Technical Release No. 55: Urban Hydrology for Small Watersheds, 1986*. With the change in name to the Natural Resource Conservation Service, the method may be referred to as the NRCS Method.

Secondary Containment Placing tanks or containers within an impervious structure capable of containing 110% of the volume contained in the largest tank within the containment structure.

SEPA See State Environmental Policy Act.

Salmonid A member of the fish family Salmonidae. Chinook, coho, chum, sockeye and pink salmon; cutthroat, brook, brown, rainbow, and steelhead trout; Dolly Varden, kokanee, and char are examples of salmonid species.

Sand filter A man-made depression or basin with a layer of sand that treats stormwater as it percolates through the sand and is discharged via a central collector pipe.

Saturation point In soils, the point at which a soil or an aquifer will no longer absorb any amount of water without losing an equal amount.

Scour Erosion of channel banks due to excessive velocity of the flow of surface and stormwater runoff.

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

Sedimentation The depositing or formation of sediment.

Sensitive emergent vegetation communities Assemblages of erect, rooted, herbaceous vegetation, excluding mosses and lichens, at least some of whose members have relatively narrow ranges of environmental requirements, such as hydroperiod, nutrition, temperature, and light. Examples include fen species such as sundew and, as well as a number of species of Carex (sedges).

Sensitive life stages Stages during which organisms have limited mobility or alternatives in securing the necessities of life, especially including reproduction, rearing, and migration periods.

Sensitive scrub-shrub vegetation communities Assemblages of woody vegetation less than 6 meters in height, at least some of whose members have relatively narrow ranges of environmental requirements, such as hydroperiod, nutrition, temperature, and light. Examples include fen species such as Labrador tea, bog laurel, and cranberry.

Settleable solids Those suspended solids in stormwater that separate by settling when the stormwater is held in a quiescent condition for a specified time.

Sheet erosion The relatively uniform removal of soil from an area without the development of conspicuous water channels.

Sheet flow Runoff that flows over the ground surface as a thin, even layer, not concentrated in a channel.

Shoreline development The proposed project as regulated by the Shoreline Management Act. Usually the construction over water or within a shoreline zone

	(generally 200 feet landward of the water) of structures such as buildings, piers, bulkheads, and breakwaters, including environmental alterations such as dredging and filling, or any project which interferes with public navigational rights on the surface waters.
Short circuiting	The passage of runoff through a BMP in less than the design treatment time.
Siltation	The process by which a river, lake, or other waterbody becomes clogged with sediment. Silt can clog gravel beds and prevent successful salmon spawning.
Site	The area defined by the legal boundaries of a parcel or parcels of land that is (are) subject to new development or redevelopment. For road projects, the length of the project site and the right-of-way boundaries define the site.
Slope	Degree of deviation of a surface from the horizontal; measured as a numerical ratio, percent, or in degrees. Expressed as a ratio, the first number is the horizontal distance (run) and the second is the vertical distance (rise), as 2:1. A 2:1 slope is a 50 percent slope. Expressed in degrees, the slope is the angle from the horizontal plane, with a 90° slope being vertical (maximum) and 45° being a 1:1 or 100 percent slope.
Sloughing	The sliding of overlying material. It is the same effect as caving, but it usually occurs when the bank or an underlying stratum is saturated or scoured.
Soil	The unconsolidated mineral and organic material on the immediate surface of the earth that serves as a natural medium for the growth of land plants. See also topsoil, engineered soil/landscape system, and properly functioning soil system.
Soil group, hydrologic	A classification of soils by the Soil Conservation Service into four runoff potential groups. The groups range from A soils, which are very permeable and produce little or no runoff, to D soils, which are not very permeable and produce much more runoff.
Soil horizon	A layer of soil, approximately parallel to the surface, which has distinct characteristics produced by soil-forming factors.
Soil profile	A vertical section of the soil from the surface through all horizons, including C horizons.
Soil structure	The relation of particles or groups of particles which impart to the whole soil a characteristic manner of breaking; some types are crumb structure, block structure, platy structure, and columnar structure.
Soil permeability	The ease with which gases, liquids, or plant roots penetrate or pass through a layer of soil.

Soil stabilization	The use of measures such as rock lining, vegetation or other engineering structures to prevent the movement of soil when loads are applied to the soil.
Soil Texture Class	The relative proportion, by weight, of particle sizes, based on the USDA system, of individual soil grains less than 2 mm equivalent diameter in a mass of soil. The basic texture classes in the approximate order of increasing proportions of fine particles include: sand, loamy sand, sandy loam, loam, silt loam, silt, clay loam, sandy clay, silty clay, and clay.
Sorption	The physical or chemical binding of pollutants to sediment or organic particles.
Source control BMP	A structure or operation that is intended to prevent pollutants from coming into contact with stormwater through physical separation of areas or careful management of activities that are sources of pollutants. This manual separates source control BMPs into two types. *Structural Source Control BMPs* are physical, structural, or mechanical devices or facilities that are intended to prevent pollutants from entering stormwater. *Operational BMPs* are non-structural practices that prevent or reduce pollutants from entering stormwater. See Volume IV for details.
Spill control device	A Tee section or turn down elbow designed to retain a limited volume of pollutant that floats on water, such as oil or antifreeze. Spill control devices are passive and must be cleaned-out for the spilled pollutant to actually be removed.
Spillway	A passage such as a paved apron or channel for surplus water over or around a dam or similar obstruction. An open or closed channel, or both, used to convey excess water from a reservoir. It may contain gates, either manually or automatically controlled, to regulate the discharge of excess water.
Standard Detail	An engineering design for a facility object or facility, stamped by a registered professional engineer in the state of Washington, provided by Clark County for use in engineering designs for the convenience of design and review engineers that must be used exactly as shown in Clark County's official standard details book.
State Environmental Policy Act (SEPA) **RCW 43.21C**	The Washington State law intended to minimize environmental damage. SEPA requires that state agencies and local governments consider environmental factors when making decisions on activities, such as development proposals over a certain size and comprehensive plans. As part of this process, environmental documents are prepared and opportunities for public comment are provided.
Steep slope	Slopes of 40 percent gradient or steeper within a vertical elevation change of at least ten feet. A slope is delineated by establishing its toe

and top, and is measured by averaging the inclination over at least ten feet of vertical relief. For the purpose of this definition:

The toe of a slope is a distinct topographic break in slope that separates slopes inclined at less than 40% from slopes 40% or steeper. Where no distinct break exists, the toe of a steep slope is the lower-most limit of the area where the ground surface drops ten feet or more vertically within a horizontal distance of 25 feet; AND

The top of a slope is a distinct topographic break in slope that separates slopes inclined at less than 40% from slopes 40% or steeper. Where no distinct break exists, the top of a steep slope is the upper-most limit of the area where the ground surface drops ten feet or more vertically within a horizontal distance of 25 feet.

Storage routing A method to account for the attenuation of peak flows passing through a detention facility or other storage feature.

Storm drains The enclosed conduits that transport surface and stormwater runoff toward points of discharge (sometimes called storm sewers).

Storm frequency The time interval between major storms of predetermined intensity and volumes of runoff for which storm sewers and other structures are designed and constructed to handle hydraulically without surcharging and backflooding, e.g., a 2-year, 10-year or 100-year storm.

Storm sewer A sewer that carries stormwater and surface water, street wash and other wash waters or drainage, but excludes sewage and industrial wastes. Also called a storm drain.

Stormwater That portion of precipitation that does not naturally percolate into the ground or evaporate, but flows via overland flow, interflow, pipes and other features of a stormwater drainage system into a defined surface waterbody, or a constructed infiltration facility.

Stormwater drainage system Constructed and natural features which function together as a system to collect, convey, channel, hold, inhibit, retain, detain, infiltrate, divert, treat or filter stormwater.

Stormwater facility A constructed component of a stormwater drainage system, designed or constructed to perform a particular function, or multiple functions. Stormwater facilities include, but are not limited to, pipes, swales, ditches, culverts, street gutters, detention ponds, retention ponds, constructed wetlands, infiltration devices, catch basins, oil/water separators, and biofiltration swales.

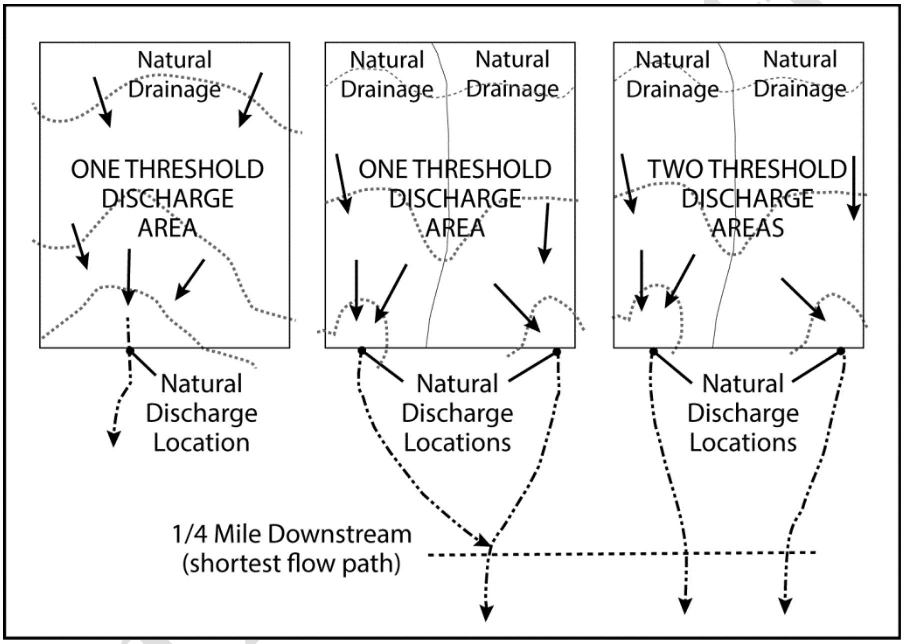
Stormwater Management Manual for Western Washington (SMMWW)	A manual, prepared by Ecology, that contains BMPs to prevent, control or treat pollution in stormwater and reduce other stormwater-related impacts to waters of the State. The Stormwater Manual is intended to provide guidance on measures necessary in western Washington to control the quantity and quality of stormwater runoff from new development and redevelopment.
Stormwater Program	Either the Basic Stormwater Program or the Comprehensive Stormwater Program (as appropriate to the context of the reference) called for under the Puget Sound Water Quality Management Plan.
Stormwater Site Plan	The comprehensive report containing all of the technical information and analysis necessary for Clark County to evaluate a proposed new development or redevelopment project for compliance with stormwater requirements. Contents of the Stormwater Site Plan will vary with the type and size of the project, and individual site characteristics. For large project submittals, the Stormwater Site Plan is defined further in Book 1, Section 1.8. For small project submittals, the Stormwater Site Plan is prepared by completing the Stormwater Site Plan Short Form and the Construction SWPPP Short Form; these forms are found in Appendix 1-I.
Stream gaging	The quantitative determination of stream flow using gages, current meters, weirs, or other measuring instruments at selected locations. See Gaging station.
Streambanks	The usual boundaries, not the flood boundaries, of a stream channel. Right and left banks are named facing downstream.
Streams	Those areas where surface waters flow sufficiently to produce a defined channel or bed. A defined channel or bed is an area that demonstrates clear evidence of the passage of water and includes, but is not limited to, indicated by hydraulically sorted sediments or the removal of vegetative litter or loosely rooted vegetation by the action of moving water. The channel or bed need not contain water year-round. This definition is not meant to include irrigation ditches, canals, stormwater runoff devices or other entirely artificial watercourses unless they are used to convey streams naturally occurring prior to construction. Those topographic features that resemble streams but have no defined channels (i.e. swales) shall be considered streams when hydrologic and hydraulic analyses done pursuant to a development proposal predict formation of a defined channel after development.
Structure	A catchbasin or manhole in reference to a storm drainage system.
Structural source control BMPs	Physical, structural, or mechanical devices or facilities that are intended to prevent pollutants from entering stormwater. Structural source control BMPs typically include:

- Enclosing and/or covering the pollutant source (building or other enclosure, a roof over storage and working areas, temporary tarp, etc.).
- Segregating the pollutant source to prevent run-on of stormwater, and to direct only contaminated stormwater to appropriate treatment BMPs.

Stub-out	A short length of pipe provided for future connection to a storm drainage system.
Subbasin	A drainage area that drains to a water-course or waterbody named and noted on common maps and which is contained within a basin.
Subcatchment	A subdivision of a drainage basin (generally determined by topography and pipe network configuration).
Subdrain	A pervious backfilled trench containing stone or a pipe for intercepting ground water or seepage.
Subgrade	A layer soil used as the underlying base for a BMP.
Subsoil	The B horizons of soils with distinct profiles. In soils with weak profile development, the subsoil can be defined as the soil below the plowed soil (or its equivalent of surface soil), in which roots normally grow. Although a common term, it cannot be defined accurately. It has been carried over from early days when "soil" was conceived only as the plowed soil and that under it as the "subsoil."
Substantial completion	Substantial completion means: a) following inspection, stormwater facilities are operational and constructed to county standards; b) streets are constructed and at least one lift of asphalt is installed when paving is required; and c) the project is in full compliance with CCC 40.386.
Substrate	The natural soil base underlying a BMP.
Surcharge	The flow condition occurring in closed conduits when the hydraulic grade line is above the crown of the sewer.
Surface and stormwater	Water originating from rainfall and other precipitation that is found in drainage facilities, rivers, streams, springs, seeps, ponds, lakes, and wetlands as well as shallow ground water.
Surface and stormwater management system	Drainage facilities and any other natural features that collect, store, control, treat and/or convey surface and stormwater.
Suspended solids	Organic or inorganic particles that are suspended in and carried by the water. The term includes sand, mud, and clay particles (and associated pollutants) as well as solids in stormwater.
Swale	A shallow drainage conveyance with relatively gentle side slopes, generally with flow depths less than one foot.

Terrace — An embankment or combination of an embankment and channel across a slope to control erosion by diverting or storing surface runoff instead of permitting it to flow uninterrupted down the slope.

Threshold Discharge Area (TDA) — An on-site area draining to a single natural discharge location or multiple natural discharge locations that combines within one-quarter mile downstream (as determined by the shortest flowpath). The purpose of this definition is to clarify how the thresholds of this manual are applied to project sites with multiple discharge points.



Tightline — A continuous length of pipe that conveys water from one point to another (typically down a steep slope) with no inlets or collection points in between.

Tile, Drain — Pipe made of burned clay, concrete, or similar material, in short lengths, usually laid with open joints to collect and carry excess water from the soil.

Tile drainage — Land drainage by means of a series of tile lines laid at a specified depth and grade.

Till — A layer of poorly sorted soil deposited by glacial action that generally has very low infiltration rates.

Time of concentration — The time period necessary for surface runoff to reach the outlet of a subbasin from the hydraulically most remote point in the tributary drainage area.

Topography — General term to include characteristics of the ground surface such as plains, hills, mountains, degree of relief, steepness of slopes, and other physiographic features.

Topsoil	The upper portion of a soil, usually dark colored and rich in organic material. It is more or less equivalent to the upper portion of an A horizon in an ABC soil.
Total dissolved solids	The dissolved salt loading in surface and subsurface waters.
Total Petroleum Hydrocarbons (TPH)	TPH-Gx: The qualitative and quantitative method (extended) for volatile (“gasoline”) petroleum products in water; and TPH-Dx: The qualitative and quantitative method (extended) for semi-volatile (“diesel”) petroleum products in water.
Total solids	The solids in water, sewage, or other liquids, including the dissolved, filterable, and nonfilterable solids. The residue left when the moisture is evaporated and the remainder is dried at a specified temperature, usually 130°C.
Total suspended solids	That portion of the solids carried by stormwater that can be captured on a standard glass filter.
Total Maximum Daily Load (TMDL) – Water Cleanup Plan	A calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, and an allocation of that amount to the pollutant’s sources. A TMDL (also known as a Water Cleanup Plan) is the sum of the allowable loads of a single pollutant from all contributing point and nonpoint sources. The calculation must include a margin of safety to ensure that the waterbody can be used for the purposes the State has designated. The calculation must also account for seasonable variation in water quality. Water quality standards are set by states, territories, and tribes. They identify the uses for each waterbody, for example, drinking water supply, contact recreation (swimming), and aquatic like support (fishing), and the scientific criteria to support that use. The Clean Water Act, section 303, establishes the water quality standards and TMDL programs.
Toxic	Poisonous, carcinogenic, or otherwise directly harmful to life.
Tract	A legally created parcel of property designated for special nonresidential and noncommercial uses.
Trash rack	A structural device used to prevent debris from entering a spillway or other hydraulic structure.
Travel time	The estimated time for surface water to flow between two points of interest.
Treatment BMP or Facility	A BMP that is intended to remove pollutants from stormwater. A few examples of treatment BMPs are Wetponds, oil/water separators, biofiltration swales, and constructed wetlands.
Treatment liner	A layer of soil that is designed to slow the rate of infiltration and provide sufficient pollutant removal so as to protect ground water quality.

Treatment train A combination of two or more treatment facilities connected in series.

Turbidity Dispersion or scattering of light in a liquid, caused by suspended solids and other factors; commonly used as a measure of suspended solids in a liquid.

Underdrain Plastic pipes with holes drilled through the top, installed on the bottom of an infiltration BMP, which are used to collect and remove excess runoff.

Undisturbed buffer A zone where development activity shall not occur, including logging, and/or the construction of utility trenches, roads, and/or surface and stormwater facilities.

Undisturbed low gradient uplands Forested land, sufficiently large and flat to infiltrate surface and storm runoff without allowing the concentration of water on the surface of the ground.

Unstable slopes Those sloping areas of land which have in the past exhibited, are currently exhibiting, or will likely in the future exhibit, mass movement of earth.

Unusual biological community types Assemblages of interacting organisms that are relatively uncommon regionally.

Urbanized area Areas designated and identified by the U.S. Bureau of Census according to the following criteria: an incorporated place and densely settled surrounding area that together have a maximum population of 50,000.

U.S. EPA The United States Environmental Protection Agency.

Values Wetland processes or attributes that are valuable or beneficial to society (also see Functions). Wetland values include support of commercial and sport fish and wildlife species, protection of life and property from flooding, recreation, education, and aesthetic enhancement of human communities.

Variance See Exception.

Vegetation All organic plant life growing on the surface of the earth.

Vegetated Flow Path When used for dispersion BMPs, the route stormwater follows between two points over land that contains undisturbed native vegetation or an area that meets BMP T5.13.

Vehicular Use Regular use of an impervious or pervious surface by motor vehicles. The following are subject to regular vehicular use: roads, un-vegetated road shoulders, bike lanes within the traveled lane of a roadway, driveways, parking lots, unrestricted access fire lanes, vehicular equipment storage yards, and airport runways.

The following are not considered subject to regular vehicular use: paved bicycle pathways separated from and not subject to drainage from roads for motor vehicles, restricted access fire lanes, and infrequently used maintenance access roads.

Waterbody — Surface waters including rivers, streams, lakes, marine waters, estuaries, and wetlands.

Water Cleanup Plan — See Total Maximum Daily Load

Water quality — A term used to describe the chemical, physical, and biological characteristics off water, usually in respect to its suitability for a particular purpose.

Water quality design storm — The 24-hour rainfall amount with a 6-month return frequency. Commonly referred to as the 6-month, 24-hour storm.

Water quality standards — Minimum requirements of purity of water for various uses; for example, water for agricultural use in irrigation systems should not exceed specific levels of sodium bicarbonate, pH, total dissolved salts, etc. In Washington, the Department of Ecology sets water quality standards.

Watershed — A geographic region within which water drains into a particular river, stream, or body of water. Watersheds can be as large as those identified and numbered by the State of Washington Water Resource Inventory Areas (WRIAs) as defined in Chapter 173-500 WAC.

Water table — The upper surface or top of the saturated portion of the soil or bedrock layer, indicates the uppermost extent of ground water.

Weir — Device for measuring or regulating the flow of water.

Weir notch — The opening in a weir for the passage of water.

Wetlands — Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas. Wetlands do not include those artificial wetlands intentionally created from non-wetland sites, including, but not limited to, irrigation and drainage ditches, grass-lined swales, canals, detention facilities, wastewater treatment facilities, farm ponds, and landscape amenities, or those wetlands created after July 1, 1990, that were unintentionally created as a result of the construction of a road, street, or highway. Wetlands may include those artificial wetlands intentionally created from non-wetland areas to mitigate the conversion of wetlands.

Wetland edge — Delineation of the wetland edge shall be based on the U.S. Army Corps of Engineers Wetlands Delineation Manual, Technical Report Y-87-1, U.S. Army Engineers Waterways Experiment Station, Vicksburg, Miss. (1987)

Wetponds and wetvaults — Drainage facilities for water quality treatment that contain permanent pools of water that are filled during the initial runoff from a storm event. They are designed to optimize water quality by providing retention time in order to settle out particles of fine sediment to which pollutants such as heavy metals absorb, and to allow biologic activity to occur that metabolizes nutrients and organic pollutants.

Wetpool — A pond or constructed wetland that stores runoff temporarily and whose normal discharge location is elevated so as to maintain a permanent pool of water between storm events.

Wet Season — October 1 to April 30

Winter Season — December 21 to March 21

Zoning ordinance — An ordinance based on the police power of government to protect the public health, safety, and general welfare. It may regulate the type of use and intensity of development of land and structures to the extent necessary for a public purpose. Requirements may vary among various geographically defined areas called zones. Regulations generally cover such items as height and bulk of buildings, density of dwelling units, off-street parking, control of signs, and use of land for residential, commercial, industrial, or agricultural purposes. A zoning ordinance is one of the major methods for implementation of a comprehensive plan.

Appendix 1-B

Alternative Flow Control Standards from Basin Plans

Mill Creek Alternative Flow Control Standard

Projects draining to Mill Creek downstream of NE 67th Avenue shall use the following pre-developed land cover based upon interpretation of Clark County 2002 aerial photography:

- Areas that are forested in 2002 shall be modeled as pre-developed forest
- Areas that are impervious surfaces, landscaped areas and pasture shall be modeled as pre-developed pasture.

Projects draining to Mill Creek upstream of NE 67th Avenue shall use forested pre-developed land cover unless reasonable historic information is provided that indicates the site was prairie prior to settlement.

Appendix 1-C

Infiltration Test Methods

Infiltration Test Methods

ASCE Approach: Single-Ring Falling Head Infiltration Test

This section describes both the field test procedure and calculations necessary for determining the field-measured coefficient of permeability. This coefficient must be adjusted using correction factors before being used for designing infiltration facilities.

Test Procedure

This test procedure is based in large part on mathematical equations derived from Darcy's Law for saturated flow in homogeneous isotropic media. Begin the infiltration test procedure by embedding a 6-inch-diameter, 15-inch-long, rigid standpipe 6 inches (L, as shown in Figure 4.1) into the ground at the depth and location of the proposed test. The standpipe should be as thin-walled as practical, and the pipe should be carefully pressed or inserted vertically into the soil. Saturate or presoak the soil by maintaining measurable water in the standpipe for at least 4 hours. (A 4-hour presoak phase is assumed to allow adequate soil saturation to properly measure and calculate the coefficient of permeability. This should be verified by ensuring that the cumulative water drop in inches during the saturation period exceeds the standpipe embedment depth.) Figure 4.1 shows the test configuration and relevant parameters.

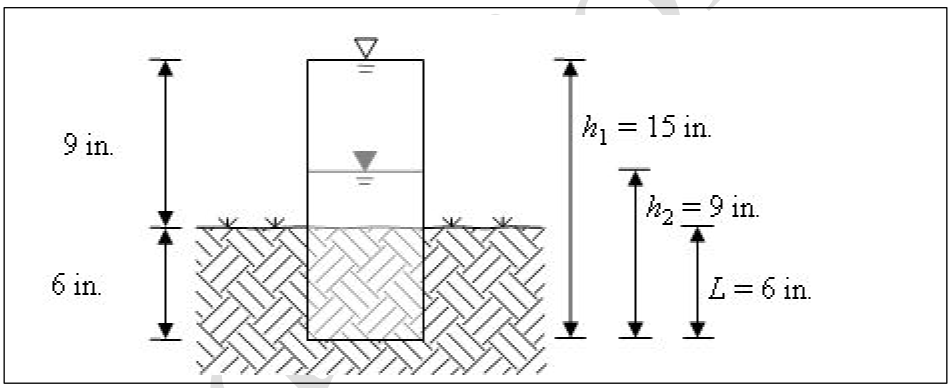


Figure 1: Single-Ring Falling Head Infiltration Test Procedure

(Source: ASCE 2009)

After the saturation period, fill the pipe to the top (i.e., the pipe will contain a 9-inch vertical column of free water). Note that although the pipe contains 9 inches of water, the initial system head (h_1) is 15 inches because head is measured from the top of the free water surface to the bottom of the soil specimen inside the pipe. Perform as many repeated 6-inch drawdown trials as can be completed in a 1-hour time period (i.e., allow the water in the pipe to drop from 15 to 9 inches [h_1 to h_2], and then repeat the process). Conclude the field test and record the following parameters:

field observed drawdown rate

L = length of flow (in)
t = time (hr)
h_1 = initial head (in)
h_2 = final head (in)

If the water level does not drop 6 inches in a 1-hour time period, the test can be concluded after 1 hour by recording the drawdown rate as the drop over the 1-hour time period. The applicable test parameters (L, t, h_1, and h_2) should also be recorded. In this case, h_2 would equal h_1 minus the amount of water drop observed over the 1-hour time period.

If desired, 6-inch drawdown trials may be performed during the saturation period. If three consecutive 6-inch drawdown trials indicate the rate has stabilized to within 5 percent variation between all three trials, the test may be concluded and the average rate of the three tests may be recorded as the drawdown rate. The applicable test parameters should also be recorded.

Calculations

After the field test procedure has been performed and the relevant test parameters recorded, the coefficient of permeability is calculated using Equation 4-1. The coefficient of permeability obtained from Equation 4-1 is the approximate rate at which water can be expected to infiltrate vertically into a given soil surface under long-term saturated flow conditions. This value should be reported by the geotechnical engineer/geologist as the soil coefficient of permeability for the tested location.

Equation 1

$$k = (L/t) \cdot \ln(h_1/h_2)$$

where:

k = coefficient of permeability (in/hr)
L = length of flow (in)
t = time (hr)
h_1 = initial head (in)
h_2 = final head (in)

The recommended test configuration and procedure has been developed so that the observed drawdown rate can be divided in half to achieve the approximate coefficient of permeability. However, different test configurations can be used to fit varying site conditions or test depths. In all cases, the coefficient of permeability shall be calculated using Equation 4-1 and the principles outlined in the following procedure.

Modification to the Recommended Single-Ring Falling Head Infiltration Test Procedures

The recommended test configuration described above has been designed to produce an observed drawdown rate that is approximately twice the coefficient of permeability due to careful selection of the test configuration and geometry. It is important to note that the coefficient of permeability will equal approximately one-half of the observed drawdown rate only when full 6-inch drawdown trials are conducted, and the relevant test parameters equal those indicated in the standpipe schematic shown in Figure 4.1. However, the test configuration, standpipe length, embedment depth, and other parameters may be modified by an experienced geotechnical professional, provided that Equation 4-1 is used to calculate the coefficient of permeability. This provides the professional consultant with flexibility to modify or tailor the test configuration, based on site-specific conditions. When the test configuration or procedure is modified, implications of the modifications such as the ones listed below must be considered.

- Standpipe diameters smaller than 6 inches may be adversely affected by the presence of large gravels or cobbles.
- Standpipe embedments of less than 6 inches in some granular soils may result in an inadequate seal around the pipe and subsequent seepage around the pipe tip, which may result in an overestimate of the coefficient of permeability.

Excessive head in the standpipe may result in an overestimate of the coefficient of permeability. The head shall be limited to one-half the height of the anticipated water depth in the proposed infiltration system (e.g., a field test for a pond with a maximum retained water depth of 3 feet shall have a maximum head of 1.5 feet).

Alternative Test Procedure – Auger Borehole

While the test pit and falling head method recommended above are the preferred methods for infiltration testing, they are neither feasible nor practical in some environments. Examples of such environments include cohesionless soils where open test pits pose a collapse hazard, systems at depths deeper than the reach of standard construction excavation equipment, or developed sites with existing asphalt or concrete pavements.

In such situations, infiltration testing is often conducted in exploratory hollow-stem auger boreholes by geotechnical engineers and geologists. Auger borehole infiltration testing is an acceptable alternative to the suggested methods, provided the test method and calculation of the coefficient of permeability follow the test procedure below.

Test Procedure – Auger Borehole

Advance an auger borehole to the desired elevation of the infiltration test. The auger must be hollow-stem, or the boring must be cased to prevent lateral leakage. Sample subsurface soils at depth to confirm that appropriately granular soils are present at or below the auger tip. Log the boring (as described in Section 4.4) in accordance with Unified Soil Classification System (USCS) specifications, and collect a soil sample from the zone where the infiltration test is performed.

As the tip of the auger reaches the test zone, apply down pressure to the drill pipe and advance the auger slightly into the soil to form a seal. Withdraw the inner plug and rod from the hollow-stem auger to expose the test zone soil inside the auger. Measure and record the inner auger diameter (d).

Pour water into the standpipe or auger and saturate the soils, as described for the standard test.

After the presoak period, establish an initial head of water in the auger (h_1). Depending on the soil gradation, range of expected infiltration rates, and proposed depth of retained water in the future infiltration system, the head level may vary based on the geotechnical professional's recommendations. However, an initial head in excess of 4 feet or greater than the future depth of retained water in the system is not recommended. Also, water levels should not rise above joints between auger sections, so water does not leak out of the joints and skew drawdown readings.

Begin conducting the infiltration test by recording the time (t) required for the head in the auger to drop from the initial head (h_1) to the final head (h_2). Refill the standpipe or auger and conduct multiple test runs until relatively constant rates are achieved (less than 5 percent variation between three consecutive trials). An electric water level probe, indicator rod with pegs set at a 6-inch interval, or a float and tape may be used to accurately measure the drop in head over elapsed time. Figure 4.2 shows the auger borehole test configuration and relevant parameters.

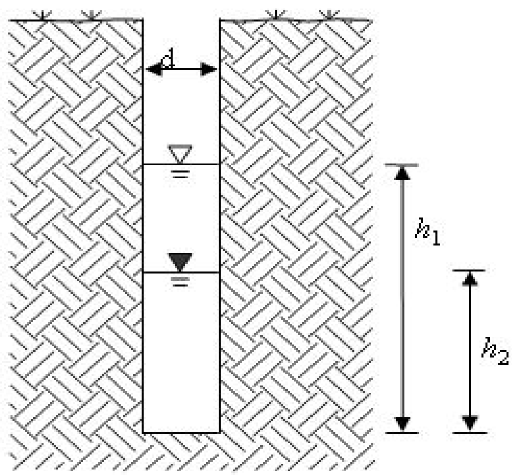


Figure 2: Single-Ring Falling Head Infiltration Test Procedure (Auger Borehole Method)

(Source: ASCE 2009 d, h_1, h_2, and t).

Calculations – Auger Borehole

After the field test procedure has been performed and the relevant test parameters recorded, the coefficient of permeability should be calculated using Equation 4-2 (Lambe and Whitman 1969). Equation 4-2 applies only for coefficient of permeability calculations using the auger borehole method. The value obtained from Equation 4-2 should be reported by the geotechnical professional as the soil coefficient of permeability for the tested location.

Equation 2

$k = (\pi * d)/(11 * t) * \ln(h_1/h_2)$
where:
k = coefficient of permeability (in/hr)
d = diameter of borehole (in)
t = time (hr)
h_1 = initial head (in)
h_2 = final head (in)

Test Limitations

It should be noted that the coefficient of permeability calculations identified above are based on ideal homogenous isotropic media. Because Clark County soils are often fluvially deposited, stratified, and interbedded, they are frequently neither homogenous nor isotropic. This may result in permeability coefficients that vary with depth and direction. Groundwater mounding or an elevated seasonal groundwater table may also affect the infiltration rate. In rare cases, the soil's ability to infiltrate water may be determined by its horizontal rather than vertical coefficient of permeability. The design professional should verify whether these are reasonable assumptions to allow for an approximate estimate of the soil coefficient of permeability. If not, specialized testing or analysis may be required.

Infiltration systems can be expected to undergo long-term degradation of infiltration capacity as a result of siltation, debris collection, and soil crusting; therefore, a correction factor must be calculated into the coefficient of permeability for the design of infiltration systems. Correction factors as described in Section 4.5.4 must be applied to the calculated coefficient of permeability to determine the allowable design infiltration rate.

The test limitations described above for the suggested standard methods also apply to the auger borehole method. In addition, the borehole method assumes flush soil at the bottom of the auger and groundwater levels sufficiently below the depth of the test.Soil swelling, segregation, and consolidation are assumed to be negligible. Hydraulic loss in the auger is also assumed to be negligible.

Large-Scale Pilot Infiltration Test (PIT)

Large-scale in-situ infiltration measurements, using the Pilot Infiltration Test (PIT) described below can be used for estimating the measured (initial) coefficient of permeability of the soil profile beneath the proposed infiltration facility. It is not a standard test but rather a field procedure recommended by a Technical Advisory Committee put together by the Washington State Department of Ecology.

Infiltration Test

- Excavate the test pit to the estimated surface elevation of the proposed infiltration facility. Lay back the slopes sufficiently to avoid caving and erosion during the test. Alternatively, consider shoring the sides of the test pit.
- The horizontal surface area of the bottom of the test pit should be approximately 100 square feet. Accurately document the size and geometry of the test pit.
- Install a vertical measuring rod (minimum 5-ft. long) marked in half-inch increments in the center of the pit bottom.
- Use a rigid 6-inch diameter pipe with a splash plate on the bottom to convey water to the pit and reduce side-wall erosion or excessive disturbance of the pond bottom. Excessive erosion and bottom disturbance will result in clogging of the infiltration receptor and yield lower than actual infiltration rates.
- Add water to the pit at a rate that will maintain a water level between 6 and 12 inches above the bottom of the pit. A rotameter can be used to measure the flow rate into the pit.

  Note: The depth should not exceed the proposed maximum depth of water expected in the completed facility. For infiltration facilities serving large drainage areas, designs with multiple feet of standing water can have infiltration tests with greater than 1 foot of standing water.

- Every 15-30 min, record the cumulative volume and instantaneous flow rate in gallons per minute necessary to maintain the water level at the same point on the measuring rod.
- Keep adding water to the pit until one hour after the flow rate into the pit has stabilized (constant flow rate; a goal of 5% variation or less variation in the total flow) while maintaining the same pond water level. The total of the pre-soak time plus one hour after the flow rate has stabilized should be no less than 6 hours.
- After the flow rate has stabilized for at least one hour, turn off the water and record the rate of infiltration (the drop rate of the standing water) in inches per hour from the measuring rod data, until the pit is empty. Consider running this falling head phase of the test several times to estimate the dependency of infiltration rate with head.
- At the conclusion of testing, over-excavate the pit to see if the test water is mounded on shallow

restrictive layers or if it has continued to flow deep into the subsurface. The depth of excavation varies depending on soil type and depth to hydraulic restricting layer, and is determined by the engineer or certified soils professional. Mounding is an indication that a mounding analysis is necessary.

Data Analysis

Calculate and record the saturated hydraulic conductivity rate in inches per hour in 30 minutes or one-hour increments until one hour after the flow has stabilized.

Note: Use statistical/trend analysis to obtain the hourly flow rate when the flow stabilizes. This would be the lowest hourly flow rate.

Apply appropriate correction factors to determine the site-specific design infiltration rate. See the discussion of correction factors for infiltration facilities in Section 4.5.4 and the discussion of correction factors for bioretention facilities and permeable pavement in Section 3.4.

Example

The area of the bottom of the test pit is 8.5-ft. by 11.5-ft. Water flow rate was measured and recorded at intervals ranging from 15 to 30 minutes throughout the test. Between 400 minutes and 1,000 minutes the flow rate stabilized between 10 and 12.5 gallons per minute or 600 to 750 gallons per hour, or an average of (9.8 + 12.3) / 2 = 11.1 inches per hour.

Small-Scale Pilot Infiltration Test

A smaller-scale PIT can be substituted for the large-scale PIT in any of the following instances.

- The drainage area to the infiltration site is less than 1 acre.
- The testing is for the LID BMPs of bioretention or permeable pavement that either serve small drainage areas and /or are widely dispersed throughout a project site.
- The site has a high infiltration rate, making a full-scale PIT difficult, and the site geotechnical investigation suggests uniform subsurface characteristics.

Infiltration Test

- Excavate the test pit to the estimated surface elevation of the proposed infiltration facility. In the case of bioretention, excavate to the estimated elevation at which the imported soil mix will lie on top of the underlying native soil. For permeable pavements, excavate to the elevation at which the imported subgrade materials, or the pavement itself, will contact the underlying native soil. If the native soils (road subgrade) will have to meet a minimum subgrade compaction requirement, compact the native soil to that requirement prior to testing. Note that the permeable pavement design guidance recommends compaction not exceed 90% - 92%. Finally, lay back the slopes sufficiently to avoid caving and erosion during the test. Alternatively, consider shoring the sides of the test pit.
- The horizontal surface area of the bottom of the test pit should be 12 to 32 square feet. It may be circular or rectangular, but accurately document the size and geometry of the test pit.
- Install a vertical measuring rod adequate to measure the ponded water depth and that is marked in half-inch increments in the center of the pit bottom.
- Use a rigid pipe with a splash plate on the bottom to convey water to the pit and reduce side-wall erosion or excessive disturbance of the pond bottom. Excessive erosion and bottom disturbance will result in clogging of the infiltration receptor and yield lower than actual infiltration rates. Use a 3 inch diameter pipe for pits on the smaller end of the recommended surface area, and a 4 inch pipe for pits on the larger end of the recommended surface area.
- Pre-soak period: Add water to the pit so that there is standing water for at least 6 hours. Maintain the pre-soak water level at least 12 inches above the bottom of the pit.
- At the end of the pre-soak period, add water to the pit at a rate that will maintain a 6-12 inch water level above the bottom of the pit over a full hour. The depth should not exceed the proposed maximum depth of water expected in the completed facility.
- Every 15 minutes, record the cumulative volume and instantaneous flow rate in gallons per minute necessary to maintain the water level at the same point (between 6 inches and 1 foot) on the measuring rod. The specific depth should be the same as the maximum designed ponding depth (usually 6 – 12 inches).
- After one hour, turn off the water and record the rate of infiltration (the drop rate of the

standing water) in inches per hour from the measuring rod data, until the pit is empty.

- A self-logging pressure sensor may also be used to determine water depth and drain-down.
- At the conclusion of testing, over-excavate the pit to see if the test water is mounded on shallow restrictive layers or if it has continued to flow deep into the subsurface. The depth of excavation varies depending on soil type and depth to hydraulic restricting layer, and is determined by the engineer or certified soils professional. The soils professional should judge whether a mounding analysis is necessary.

Data Analysis

See the explanation under the guidance for large-scale pilot infiltration tests.

Soil Grain Size Analysis Method

For each defined layer below the infiltration pond to a depth below the pond bottom of 2.5 times the maximum depth of water in the pond, but not less than 10 feet, estimate the initial coefficient of permeability(COP) in cm/sec using the following relationship (see Massmann 2003, and Massmann et al., 2003). For large infiltration facilities serving drainage areas of 10 acres or more, soil grain size analyses should be performed on layers up to 50 feet deep (or no more than 10 feet below the water table).

Equation 1

$$log_{10}(COP) = -1.57+1.90D_{10}+0.015D_{60}-0.013D_{90}-2.08f_{fines}$$

Where, D_{10}, D_{60} and D_{90} are the grain sizes in mm for which 10 percent, 60 percent and 90 percent of the sample is more fine and f_{fines} is the fraction of the soil (by weight) that passes the number-200 sieve (COP is in cm/s).

For bioretention facilities, analyze each defined layer below the top of the final bioretention area subgrade to a depth of at least 3 times the maximum ponding depth, but not less than 3 feet (1 meter). For permeable pavement, analyze for each defined layer below the top of the final subgrade to a depth of at least 3 times the maximum ponding depth within the base course, but not less than 3 feet (1 meter).

If the licensed professional conducting the investigation determines that deeper layers will influence the rate of infiltration for the facility, soil layers at greater depths must be considered when assessing the site's hydraulic conductivity characteristics. Massmann (2003) indicates that where the water table is deep, soil or rock strata up to 100 feet below an infiltration facility can influence the rate of infiltration. Note that only the layers near and above the water table or low permeability zone (e.g., a clay, dense glacial till, or rock layer) need to be considered, as the layers below the ground water table or low permeability zone do not significantly influence the rate of infiltration. Also note that this equation for estimating COP assumes minimal compaction consistent with the use of tracked (i.e., low to moderate ground pressure) excavation equipment.

If the soil layer being characterized has been exposed to heavy compaction (e.g., due to heavy equipment with narrow tracks, narrow tires, or large lugged, high pressure tires) the hydraulic conductivity for the layer could be approximately an order of magnitude less than what would be estimated based on grain size characteristics alone (Pitt, 2003). In such cases, compaction effects must be taken into account when estimating hydraulic conductivity.

For clean, uniformly graded sands and gravels, the reduction in COP due to compaction will be much less than an order of magnitude. For well-graded sands and gravels with moderate to high silt content, the reduction in COP will be close to an order of magnitude. For soils that contain clay, the reduction in COP could be greater than an order of magnitude.

If greater certainty is desired, the in-situ saturated conductivity of a specific layer can be obtained through the use of a pilot infiltration test (PIT). Note that these field tests generally provide a COP combined with a hydraulic gradient. In some of these tests, the hydraulic gradient may be close to 1.0; therefore, in effect, the test infiltration rate result is the same as the hydraulic conductivity. In other cases, the hydraulic gradient may be close to the gradient that is likely to occur in the full-scale infiltration facility. The hydraulic gradient will need to be evaluated on a case-by-case basis when interpreting the results of field tests. It is important to recognize that the gradient in the test may not be the same as the gradient likely to occur in the full-scale infiltration facility in the long-term (i.e., when ground water mounding is fully developed).

Once the COP for each layer has been identified, determine the effective average COP below the pond. COP estimates from different layers can be combined using the harmonic mean:

Equation 2

$$K_{equiv} = \frac{d}{\sum \frac{d_i}{K_i}}$$

Where, d is the total depth of the soil column, d_i is the thickness of layer "*i*" in the soil column, and K_i is the coefficient of permeability of layer "*i*" in the soil column. The depth of the soil column, d, typically would include all layers between the pond bottom and the water table. However, for sites with very deep water tables (>100 feet) where ground water mounding to the base of the pond is not likely to occur, it is recommended that the total depth of the soil column in Equation 2 be limited to approximately 20 times the depth of pond, but not more than 50 feet. This is to ensure that the most important and relevant layers are included in the hydraulic conductivity calculations. Deep layers that are not likely to affect the infiltration rate near the pond bottom should not be included in Equation 2.

Equation 2 may over-estimate the effective COP value at sites with low conductivity layers immediately beneath the infiltration pond. For sites where the lowest conductivity layer is within five feet of the base of the pond, it is suggested that this lowest COP value be used as the equivalent hydraulic conductivity rather than the value from Equation 2. Using the layer with the lowest COP is advised for designing bioretention facilities or permeable pavements. The harmonic mean given by Equation 2 is the appropriate effective hydraulic conductivity for flow that is perpendicular to stratigraphic layers, and will produce conservative results when flow has a significant horizontal component such as could occur due to ground water mounding.

Appendix 1-D

Clark County Historic Prairie Areas

Prairie Areas
Prior to European Settlement
Clark County, WA

Source: Pre-Settlement Prairie Areas in Vancouver, WA (Otak, 2009)

Legend

Historic Prairie

Appendix 1-E

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 Preliminary TIR (see Section 1.8.1.5).*

Step 1: Indicate which mandatory list of LID BMPs is applicable to the project in accordance with Minimum Requirement #5 and the flow chart in Figure 2.1 in Book 1. Check the corresponding box in Section 1 below. For projects meeting the LID Performance Standard, this checklist does not apply.

Step 2: Indicate which type(s) of surfaces will be present within the TDA in Section 2.

Step 3: Consider feasibility criteria and setbacks in Section 3.

Section 1: Required LID BMPs

☐ List #1 (Table 3.1) ☐ List #2 (Table 3.2) ☐ BMPs in Table 3.3

Section 2: Surfaces

☐ Roofs ☐ Hard surfaces other than roofs

Section 3: Feasibility Criteria

For each type of surface selected in Section 2, consider BMPs in the order indicated in the required list or table selected in Section 1.

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, 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 type of surface, 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. Please see Book 1, Chapter 2 for more information.

FULL DISPERSION BMP T5.30A	Roof		Other Hard	
Feasibility Criteria and Setbacks	**YES**	**NO**	**YES**	**NO**
Will the project protect and maintain less than 65% of the TDA in a forested native condition?				
Does a professional geotechnical evaluation recommend dispersion not be used due to reasonable concerns about erosion, slope failure or down gradient flooding?				
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 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?				
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?				
Determination: Is this BMP feasible? ……………………………………………………………………………………				

DISPERSION TO PASTURE OR CROPLAND BMP T5.30B	Roof		Other Hard	
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?				
Does a professional geotechnical evaluation recommend dispersion not be used due to reasonable concerns about erosion, slope failure or down gradient flooding?				
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 on a slope greater than 5%?				
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?				
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?				
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?				
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 surfaces other than roofs.	Has a qualified professional determined that soils in the infiltration zone at the location of the infiltration BMP do not fall within USDA textural classes ranging from very coarse sand to fine sand, or cobbles and gravels, or, if other soils are present in the infiltration zone, such as loam or clay, these have been found to have an infiltration rate of less than one inch per hour?				
	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 on a slope of 25% (4:1) or greater 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?				
	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 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 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?				
	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.]				
Determination: Is this BMP feasible? ……………………………………………………………………………………					

DOWNSPOUT DISPERSION BMP T5.10C		Roof			
	Setbacks	YES	NO		
Note: this BMP is not applicable to surfaces other than roofs.	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.]				
Determination: Is this BMP feasible? ……………………………………………………………………………………					

SHEET FLOW DISPERSION BMP T5.12 and CONCENTRATED FLOW DISPERSION BMP T5.11		Roof		Other Hard	
	Feasibility Criteria and Setbacks	YES	NO	YES	NO
	Does a professional geotechnical evaluation recommend dispersion not be used due to reasonable concerns about erosion, slope failure or down gradient flooding?				
	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 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 by CCC 40.430?				
	Is the only area available for the BMP less than 10 feet from any structure, property line, or sensitive area?				
Determination: Is this BMP feasible? ……………………………………………………………………………………					

RAIN GARDEN BMP T5.14A and BIORETENTION BMP T5.14B	Roof		Other Hard	
Infeasibility Criteria and Setbacks	**YES**	**NO**	**YES**	**NO**
Has the Responsible Official determined that the BMP is not compatible with surrounding drainage systems (e.g. projects draining to existing stormwater collection system whose elevation or locale precludes connection to a properly functioning bioretention system)?				
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?				
Can the site not 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:				
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.]				
For a bioretention system or a rain garden that would serve a drainage area that is 1) less than 5,000 sq. ft. of pollution-generating impervious surface, and 2) less than 10,000 sq. ft. of impervious surface, and 3) less than ¾ acres of pervious surface, is the minimum vertical separation of one foot to seasonal high water table, bedrock or other impervious layer unable to be achieved below the BMP?				
For a bioretention system that would 1) serve a drainage area that is a) 5,000 sq. ft. or more of pollution-generating impervious surface, or b) 10,000 sq. ft. or more of impervious surface, or c) ¾ acres or more of pervious surface, and 2) cannot reasonably be broken down into amounts smaller than indicated in (1), is the minimum vertical separation of three feet to seasonal high water table, bedrock or other impervious layer unable to be achieved below the BMP?				
Does field testing indicates that soils have a measured (a.k.a. initial) native soil coefficient of permeability less than 0.3 inches per hour?				
Is the BMP less than 50 feet from the top of a slope greater than 20% or with more than 10 feet of vertical relief and cannot reasonably be located elsewhere?				
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?				
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?				
For a bioretention system or rain garden that would serve a drainage area of less than 5,000 sq. ft. of pollution-generating impervious surface and less than 10,000 sq. ft. of impervious surface, is the BMP less than 10 feet away from any structure or property line and cannot reasonably be located elsewhere?				
For a bioretention system that would serve a drainage area of 5,000 sq. ft. or greater of pollution-generating impervious surface or 10,000 sq. ft. or greater of impervious surface or 3/4 acre or more of pervious surfaces, is the BMP less than 20 feet from the downslope side of any foundation, structure or property line and cannot reasonably be located elsewhere?				
For a bioretention system that would serve a drainage area of 5,000 sq. ft. or greater of pollution-generating impervious surface or 10,000 sq. ft. or greater of impervious surface or 3/4 acre or more of pervious surfaces, is the BMP less than 100 feet from the upslope side of any foundation and cannot reasonably be located elsewhere?				
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?				
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 the municipal separate storm sewer system or to a private storm sewer system?				
Is the site a redevelopment project that lacks usable space for the BMP?				
Is the site a public road project that lacks sufficient space within existing public right-of-way for the BMP?				
Determination: Is this BMP feasible? ……………………………………………………………………………………				

PERMEABLE PAVEMENT BMP T5.15	Roof		Other Hard	
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?				
Is the surface to be paved on a property with known soil or groundwater contamination (typically federal Superfund sites or state cleanup sites under the Model Toxics Control Act (MTCA)) and meets 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.]				
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%)?				
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 the measured coefficient of permeability in the area for permeable pavement less than 0.3 inches per hour?				
Is the project replacing existing impervious surface, unless the existing surface is a non-pollution generating surface over a 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?				
Is the area for permeable pavement where routine, heavy applications of sand will occur in frequent snow zones to maintain traction during weeks of snow and ice accumulations?				
<u>If</u> 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 <u>fail any</u> of the following criteria: - At least one foot depth of soil with the following characteristics: - Cation Exchange Capacity $\geq$ 5 milliequivalents CEC/100 g dry soil (USEPA Method 9081) - Organic Content > 1% - Measured coefficient of permeability < 9 inches/hour				
Is the area to be paved less than 50 feet from the top of a slope greater than 20% or with more than 10 feet of vertical relief?				
Is the area to be paved less than 100 feet from an active or closed landfill?				
<u>If</u> the surface to be paved is a pollution-generating hard surface, is the area to be paved less than 100 feet from a drinking water well or a spring used for drinking water?				
Is the area to be paved less than 10 feet from on-site sewage drainage?				
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?				
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 to be paved downslope of steep, erosion prone areas that are likely to deliver sediment?				
Is the area to be paved over fill soils that can become unstable when saturated?				
Is the area to be paved 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 to be paved in an area needed to support heavy loads at an industrial facility (such as a port) that exceed the strength of the permeable pavement?				
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? ……………………………………………………………………………………				

Appendix 1-F

Construction SWPPP Checklist

Construction Stormwater Pollution Prevention Plan Checklist

Project Name: ____
City Reference No. ____
Construction Permit No. ____
Review Date: ____
On-site Inspection Review Date: ____
Construction SWPPP Reviewer: ____

Section I – Construction SWPPP Narrative

Construction Stormwater Pollution Prevention Elements

1. ___ Describe how each of the Construction Stormwater Pollution Prevention Elements has been addressed though the Construction SWPPP.
2. ___ Identify the type and location of BMPs used to satisfy the required element.
3. ___ Provide written justification identifying the reason an element is not applicable to the proposal.

Thirteen Required Elements - Construction Stormwater Pollution Prevention Plan

1. ___ Mark Clearing Limits
2. ___ Establish Construction Access
3. ___ Control Flow Rates
4. ___ Install Sediment Controls
5. ___ Stabilize Soils
6. ___ Protect Slopes
7. ___ Protect Drain Inlets
8. ___ Stabilize Channels and Outlets
9. ___ Control Pollutants
10. ___ Control De-Watering
11. ___ Maintain BMPs
12. ___ Manage the Project
13. ___ Protect Low Impact Development BMPs

Project Description

1. ___ Total project area
2. ___ Total proposed impervious area
3. ___ Total proposed area to be disturbed, including off-site borrow and fill areas
4. ___ Total volumes of proposed cut and fill

Construction Stormwater Pollution Prevention Plan Checklist

Project Name: ____

Construction Permit No. ____

City Reference No. ____

Existing Site Conditions

1. ___ Description of the existing topography
2. ___ Description of the existing vegetation
3. ___ Description of the existing drainage

Adjacent Areas

1. Description of adjacent areas which may be affected by site disturbance or drain to project site.

___ a. Streams
___ b. Lakes
___ c. Wetlands
___ d. Residential Areas
___ e. Roads
___ f. Other

2. ___ Description of the downstream drainage path leading from the site to the receiving body of water. (Minimum distance of 400 yards.)

Critical Areas

1. ___ Description of critical areas that are on or adjacent to the site.
2. ___ Description of special requirements for working in or near critical areas.

Soils

1. Description of on-site soils.

___ a. Soil name(s)
___ b. Soil mapping unit
___ c. Erodibility
___ d. Settleability
___ e. Permeability
___ f. Depth
___ g. Texture
___ h. Soil Structure

Construction Stormwater Pollution Prevention Plan Checklist

Project Name: ____
Construction Permit No. ______________________________________
City Reference No. ____

Erosion Problem Areas

1. ___ Description of potential erosion problems on site.

Construction Phasing

1. ___ Construction sequence
2. ___ Construction phasing (if proposed)

Construction Schedule

1. ___ Provide a proposed construction schedule.
2. ___ Wet Season Construction Activities
   ___ a. Proposed wet season construction activities.
   ___ b. Proposed wet season construction restraints for environmentally sensitive/critical areas.

Financial/Ownership Responsibilities

1. ___ Identify the property owner responsible for the initiation of bonds and/or other financial securities.
2. ___ Describe bonds and/or other evidence of financial responsibility for liability associated with erosion and sedimentation impacts.

Engineering Calculations

1. ___Provide Design Calculations.
   ___ a. Sediment Ponds/Traps
   ___ b. Diversions
   ___ c. Waterways
   ___ d. Runoff/Stormwater Detention Calculations

Construction Stormwater Pollution Prevention Plan Checklist

Project Name: ____
Construction Permit No. ____
City Reference No. ____

Section II - Erosion and Sediment Control Plans

General

1. ___ Vicinity Map
2. ___ City/County of ________________ Clearing and Grading Approval Block
3. ___ Erosion and Sediment Control Notes

Site Plan

1. ___ Note legal description of subject property.
2. ___ Show North Arrow.
3. ___ Indicate boundaries of existing vegetation, e.g. tree lines, pasture areas, etc.
4. ___ Identify and label areas of potential erosion problems.
5. ___ Identify on-site or adjacent surface waters, critical areas and associated buffers.
6. ___ Identify FEMA base flood boundaries and Shoreline Management boundaries (if applicable).
7. ___ Show existing and proposed contours.
8. ___ Indicate drainage basins and direction of flow for individual drainage areas.
9. ___ Label final grade contours and identify developed condition drainage basins.
10. ___ Delineate areas that are to be cleared and graded.
11. ___ Show all cut and fill slopes indicating top and bottom of slope catch lines.

Conveyance Systems

1. ___ Designate locations for swales, interceptor trenches, or ditches.
2. ___ Show all temporary and permanent drainage pipes, ditches, or cut-off trenches required for erosion and sediment control.
3. ___ Provide minimum slope and cover for all temporary pipes or call out pipe inverts.
4. ___ Show grades, dimensions, and direction of flow in all ditches, swales, culverts and pipes.
5. ___ Provide details for bypassing off-site runoff around disturbed areas.
6. ___ Indicate locations and outlets of any dewatering systems.

Location of Detention BMPs

1. ___ Identify location of detention BMPs.

Construction Stormwater Pollution Prevention Plan Checklist

Project Name: ____

Construction Permit No. ____

City Reference No. ____

Erosion and Sediment Control Facilities

1. ___ Show the locations of sediment trap(s), pond(s), pipes and structures.
2. ___ Dimension pond berm widths and inside and outside pond slopes.
3. ___ Indicate the trap/pond storage required and the depth, length, and width dimensions.
4. ___ Provide typical section views through pond and outlet structure.
5. ___ Provide typical details of gravel cone and standpipe, and/or other filtering devices.
6. ___ Detail stabilization techniques for outlet/inlet.
7. ___ Detail control/restrictor device location and details.
8. ___ Specify mulch and/or recommended cover of berms and slopes.
9. ___ Provide rock specifications and detail for rock check dam(s), if applicable.
10. ___ Specify spacing for rock check dams as required.
11. ___ Provide front and side sections of typical rock check dams.
12. ___ Indicate the locations and provide details and specifications for silt fabric.
13. ___ Locate the construction entrance and provide a detail.

Detailed Drawings

1. ___ Any structural practices used that are not referenced in the Ecology Manual should be explained and illustrated with detailed drawings.

Other Pollutant BMPs

1. ___ Indicate on the site plan the location of BMPs to be used for the control of pollutants other than sediment, e.g., concrete wash water.

Monitoring Locations

1. ___ Indicate on the site plan the water quality sampling locations to be used for monitoring water quality on the construction site, if applicable.

Appendix 1-G

Legal Forms

RECORDING REQUESTED BY
AND WHEN RECORDED RETURN TO:

Grantor	:
Grantee	:
Abbreviated Legal	:
Assessor's Tax Parcel Nos.	:
Prior Excise Tax No.	:
Other Reference No(s).	:

COVENANT RUNNING WITH THE LAND

A covenant to Clark County, State of Washington, hereinafter "County," entered into in conjunction with the construction of a church structure on certain real property described herein below whereby the owner of said real property, hereinafter "Owner," on behalf of themselves and all their heirs, assigns, and successors-in-interest into whose ownership said parcel may pass, covenant to the County that the property located at approximately ____, Washington, Tax Parcel No. ______________, more particularly described in Exhibit "A", attached hereto and incorporated herein by this reference, will be subject to the terms and conditions set forth below.

Owner herein covenants and agrees with the County on behalf of themselves and all their heirs, assigns and successors-in-interest into whose ownership the below-described property might pass as follows, it being specifically agreed and covenanted that this is a covenant running with the land hereinafter described.

1. The undersigned owner is the sole and exclusive owner of the following described real property located in Clark County, State of Washington: Tax Parcel No. ___________, and legally described in Exhibit "A", attached hereto and by this reference incorporated herein.

2. The Owner is seeking or has been granted permit approval for the project identified as ______________________________________. As part of the project, a stormwater facility is required.

3. Clark County generally requires fencing around such stormwater facilities, and will waive the requirement upon the Owner assuming full responsibility and liability for any injuries or other damages suffered by any person because of the lack of fencing that the County would otherwise require.

4. The Owner(or include homeowners assoc. as appropriate) agrees to maintain the facility in compliance with the engineer approved plan attached as ________.

5. The Owner hereby assumes full responsibility for any injuries or damages suffered by any person that are the result of the lack of fencing, and Owner further shall hold the County harmless for any and all damages relating to the lack of fencing around the stormwater facility. The Owner hereby agrees to indemnity the County for any judgment or costs for which the County may be adjudged to have responsibility because of the failure of the County to require fencing around the stormwater facility.

6. A copy of this Covenant will be filed with the Clark County Auditor, so as to appear as a covenant within the chain of title of Tax Parcel No. ___________, as legally described in Exhibit "A". A copy of this Covenant will be recorded prior to occupancy approval by the County.

6. If any provision of this Covenant or the application of any provision to any person or circumstance is declared invalid, then the rest of the Covenant, or the application of the provision to other persons or circumstances, shall not be affected. The provisions of this Covenant are enforceable in law or in equity by the parties and their successors and assigns.

7. This Covenant and all of its provisions shall be binding upon the Owner and any and all of their heirs, assigns and successors-in-interest into whose ownership the above-described real property may pass, and any obligations undertaken by the Owner above described shall be enforceable against all of those heirs, assigns and successors-in-interest into whose ownership the above-described real property may pass.

DATED this _______ day of ___________________, 200___.

GRANTOR:

By: ______________________________
Name: __________________________
Title: ___________________________

CLARK COUNTY

By: ______________________________
Name: __________________________
Title: ___________________________

Approved as to form:
ARTHUR D. CURTIS
Prosecuting Attorney

By: ______________________________
Deputy Prosecuting Attorney

STATE OF WASHINGTON)
: ss.
COUNTY OF CLARK)

On this ______ day of _____________, 2004, before me personally appeared ________________________________, to me known to be the ___________ of __________________________________, that executed the within and foregoing instrument, and acknowledged said instrument to be the free and voluntary act and deed of said corporation, for the uses and purposes therein mentioned, and on oath stated that he/she was authorized to execute said instrument and that the seal affixed is the corporate seal of said corporation.

DATED this _______ day of _____________, 2004.

____
Notary Public for Washington
____
(Printed or Stamped Name of Notary)
Residing at _____________________
My appointment expires: ___________

STATE OF WASHINGTON)
: ss.
COUNTY OF CLARK)

I certify that I know or have satisfactory evidence that __________________ ______________ is the person who appeared before me, and said person acknowledged that he/she signed this instrument and acknowledged it to be his/her free and voluntary act for the uses and purposes mentioned in the instrument.

DATED this _______ day of __________________, 2004.

____
Notary Public for Washington
____
(Printed or Stamped Name of Notary)
Residing at _____________________
My appointment expires: ___________

STATE OF WASHINGTON)
: ss.
COUNTY OF CLARK)

On this ______ day of _____________, 2004, before me personally appeared _________________________________, to me known to be the ___________ of CLARK COUNTY, WASHINGTON, that executed the within and foregoing instrument, and acknowledged said instrument to be the free and voluntary act and deed of said municipal corporation, for the uses and purposes therein mentioned, and on oath stated that he/she was authorized to execute said instrument and that the seal affixed is the corporate seal of said corporation.

DATED this _______ day of _____________, 2004.

____
Notary Public for Washington
____
(Printed or Stamped Name of Notary)
Residing at ________________________
My appointment expires: ____________

COVENANT RUNNING WITH THE LAND

A **COVENANT** to Clark County, State of Washington, hereinafter "County", entered into in conjunction with (Subdivision / Site Plan) Review # ______________, of certain real property as more particularly described in Exhibit "A", hereinafter "**SITE**", whereby the owners of said real property on behalf of themselves and all their heirs, assigns and successors in interest into whose ownership said property may pass, covenant that the County will have access to the stormwater control and treatment facilities as shown on an expanded portion of the plat of ___________________ , attached hereto and incorporated herein by reference as Exhibit "B", hereinafter "**FACILITIES**".

Owners herein covenant and agree to Clark County on behalf of themselves and all of their heirs, assigns and successors in interest into whose ownership the SITE might pass, as follows, it being specifically agreed and covenanted that this is a covenant running with the land described in Exhibit "A".

1. It is the purpose of this covenant to ensure that the County is allowed access to the stormwater control and treatment facilities as shown on Exhibit "B". The purpose of County access is for the inspection of facilities for compliance with CCC 40.385, Stormwater and Erosion Control Ordinance and CCC 13.26A Water Quality and their successors. A secondary purpose is for emergency maintenance to prevent flooding or pollution of other properties.
2. If the parties responsible for long-term maintenance fail to maintain their facilities to County standards, the County shall issue a written notice specifying required actions to be taken in order to bring the facilities into compliance. Required maintenance shall be performed according to the County Stormwater Facility Maintenance Manual as adopted by Chapter 40.385 and Chapter 13.26A CCC. If these actions are not performed in a timely manner, the County may perform this maintenance and bill the parties responsible for the maintenance in accordance with CCC 32.04.60.

3. Nothing in this covenant shall be construed to provide for public use of or entry into the stormwater quantity and quality facilities area as shown on Exhibit “B”. However, representatives and agents of Clark County are hereby authorized to make reasonable entry upon such land for purposes related to administering this covenant.

4. The provisions of this covenant are enforceable in law or equity by Clark County and its successors.

5. This covenant and all of its provisions, and each of them shall be binding upon the owner and any and all of their heirs, assigns and successors in interest into whose ownership **FACILITIES** may pass, and any obligations made herein by owners, shall be enforceable against all of their heirs, assigns and successors in interest into whose ownership the **FACILTIES** may pass.

6. The provisions of this Covenant are enforceable in law or equity by Clark County and its successors; provided, however, that in the event the real property is annexed into a City that the enforcement and modification of the Covenant shall be transferred to the annexing jurisdiction upon the effective date of the annexation and Clark County shall not be required to review or consent to any modification or to be involved in any enforcement of said covenant.

IN WITNESS WHEREOF, the parties hereto have caused this agreement to be executed the day and year indicated below.

Dated this __________ day of ______________________________.

APPROVED AS TO FORM ONLY:

By: ___________________________
Chris Horne
Civil Deputy Prosecuting Attorney

By: _____________________________
Developer

By: _____________________________
Developer

STATE OF WASHINGTON)
:SS
COUNTY OF CLARK)

I hereby certify that I know or have satisfactory evidence that ____________________ Signed this instrument and acknowledge it to be __________ free and voluntary act for the uses and purposes mention in this instrument.

Dated: __________________________ ____________________________
Notary's Signature

My Appointment Expires:

Appendix 1-H

Wetlands Guidelines

Guide Sheet 1: Criteria that excludes wetlands from serving as a treatment or flow control BMP/facility

The following types of wetlands are not suitable as a treatment or flow control BMPs/facilities. Engineering structural or hydrologic changes within the wetland itself to improve stormwater flows and water quality are not allowed. Do not increase or decrease the water regime in these wetlands beyond the prescribed limits. Provide these wetlands with the maximum protection from urban impacts:

1. The wetland is currently a Category I wetland because of special conditions (forested, bog, estuarine, Natural Heritage, coastal lagoon).

2. The wetland provides a high level of many functions. These are Category I and II wetlands as determined by the Washington State Wetland Rating System of Western Washington.

3. The wetland provides habitat for threatened or endangered species. Determining whether or not the conserved species will be affected by the proposed project requires a careful analysis in relation to the anticipated habitat changes. Consult with the appropriate agencies with jurisdiction over the specific threatened or endangered species on the site.

If a wetland type listed above needs to be included in a stormwater system then this activity is considered an impact. It will be treated as any other impact and will need to be mitigated according to the rules for wetland mitigation. Project proponents will have to demonstrate that they have done everything to avoid and minimize impacts before proceeding to compensatory mitigation.

The wetlands listed above cannot receive flows from a stormwater system unless the criteria in Book 1, Figure 1.5 are met.

Guide Sheet 2: Criteria for including wetlands as a treatment or flow control BMP/facility

A wetland can be physically or hydrologically altered to meet the requirements of a treatment or flow control BMP/facility if ALL of the following criteria are met:

Modifications that alter the structure of a wetland or its soils will require permits. Existing functions and values that are lost would have to be compensated/replaced.

1. It is classified in Category IV in the "Washington State Wetland Rating System of Western Washington," or a Category III wetland with a habitat score of 19 points or less.

2. You can demonstrate that there will be "no net loss" of functions and values of the wetland as a result of the structural or hydrologic modifications done to provide control of runoff and water quality. This includes the impacts from the machinery used for the construction. Heavy equipment can often damage the soil structure of a wetland. However, the functions and values of degraded wetlands may sometimes be increased by such alterations and thus would be self-mitigating. Functions and values that are not replaced on site will have to be mitigated elsewhere.

    a. Modifications that alter the structure of a wetland or its soils will require permits. Check with the agency(ies) issuing the permits for the modification(s) to determine which method to use to establish "no net loss."

    b. A wetland will usually sustain fewer impacts if the required storage capacity can be met through a modification of the outlet rather than through raising the existing overflow.

3. The wetland does not contain a breeding population of any native amphibian species.

4. The hydrologic functions of the wetland can be improved as outlined in questions 3,4,5 of Chart 4 and questions 2,3,4 of Chart 5 in the "Guide for Selecting Mitigation Sites Using a Watershed Approach," (available here: http://www.ecy.wa.gov/biblio/0906032.html); or the wetland is part of a priority restoration plan that achieves restoration goals identified in a Shoreline Master Program or other local or regional watershed plan.

5. The wetland lies in the natural routing of the runoff, and the discharge follows the natural routing.

Definitions

The following terms are applicable only to this appendix (Appendix 1-H).

Baseline sampling	Sampling performed to define the existing environmental and biological conditions present before any modification occurs.
Bioengineering	Bioengineering for streams and wetlands --The use of living and nonliving plant materials in combination with naturea and synthetic support materials for slope stabilization, erosion reduction, and vegetative establishment.
Buffer	The area (either upland, open water, or another wetland) that surrounds a wetland and that reduces adverse impacts to it from adjacent development.
Constructed wetland	A wetland intentionally created from a non-wetland site.
Degraded wetland	A wetland whose functions and values have been reduced as a result of human activities
Enhancement	The manipulation of the physical, chemical, or biological characteristics of a wetland site to heighten, intensify or improve specific function(s) or to change the growth stage or composition of

	the vegetation present. Enhancement is undertaken for specified purposes such as water quality improvement, flood water retention or wildlife habitat. Activities typically consist of planting vegetation, controlling non-native or invasive species, modifying site elevations or the proportion of open water to influence hydroperiods, or some combination of these. Enhancement results in a change in some wetland functions and can lead to a decline in other wetland functions, but does not result in a gain in wetland acres.
Estuarine wetland	Generally, a vegetated wetland where the salinity of the surface or port waters is greater than 0.5 parts per thousand.
Functions	The ecological (physical, chemical, and biological) processes or attributes of a wetland. Functions are often defined in terms of the processes that provide value to society, but they can be defined on processes that are not value based. Wetland functions include food chain support, provision of ecosystem diversity and fish and wildlife habitat, flood flow alteration, ground water recharge and discharge, water quality improvement, and soil stabilization.
Hydrodynamics	The science involving the energy and forces acting on water or other liquids and the resulting impact on the motion of the liquid.
Hydroperiod	The seasonal occurrence of flooding and/or soil saturation; encompasses the depth, frequency, duration, and seasonal pattern of inundation.
Invasive plant species	Opportunistic plant species (either native or non-native) that colonize disturbed ecosystems and come to dominate the plant community in ways that are seen by us as reducing the values provided by the previous plant community. Most often, opportunistic plants are considered invasive if they reduce the value of an area as habitat for valuable species.
Landscape unit	An area of land that has a specified boundary used for planning purposes that defines an area of interrelated physical, chemical, and biological processes. A watershed or drainage basin is a common type of landscape unit. A ground water aquifer is another type of landscape unit.
Modified wetland	A wetland whose physical, hydrological, or water quality characteristics have been purposefully altered for a management purpose, such as by dredging, filling, forebay construction, and inlet or outlet control.
On-site	An action (here, for stormwater management purposes) taken within the property boundaries of the site to which the action applies.
Post-project	The conditions present across a landscape after a specific stormwater management project (e. g., raising the outlet, building an outlet control structure) are placed in the wetland or a land use change that occurs in the landscape unit that will potentially affect the wetland.

Pre-project	The conditions present across a landscape before a specific stormwater management project (e. g., raising the outlet, building an outlet control structure) are placed in the wetland or a land use change occurs in the landscape unit that will potentially affect the wetland.
Redevelopment	Conversion of an existing development to another land use, or addition of a material improvement to an existing development.
Regional	An action (here, for stormwater management purposes) that involves more than one discrete property.
Re-establishment	Actions performed to reestablish wetland functional characteristics and processes that have been lost by alterations, activities, or catastrophic events in an area that no longer meets the definition of a wetland.
Values	Wetland processes or attributes that are valuable or beneficial to society (also see Functions). Wetland values include support of commercial and sport fish and wildlife species, protection of life and property from flooding, recreation, education, and aesthetic enhancement of human communities.
Wetlands	Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas. Wetlands do not include those artificial wetlands intentionally created from nonwetland sites, including, but not limited to, irrigation and drainage ditches, grass-lined swales, canals, detention facilities, wastewater treatment facilities, farm ponds, and landscape amenities, or those wetlands created after July 1, 1990, that were unintentionally created as a result of the construction of a road, street, or highway. Wetlands may include those artificial wetlands intentionally created from nonwetland areas to mitigate the conversion of wetlands. (Waterbodies not included in the definition of wetlands as well as those mentioned in the definition are still waters of the state.)

Minimum Requirement 8 Review Checklist

Minimum Requirement 8 Checklist

Note: An additional Wetland Determination maybe required for wetlands that are not located on the project site.

A. Is there a direct or indirect stormwater discharge to a wetland?

- ☐ Yes **– Go on to Question B**
- ☐ No **–Stop**

B. Is the wetland being included in a treatment or flow control BMP/Facility?

- ☐ Yes – Comply with Guide Sheets 1 and 2 in Appendix 1-K. **Stop**
- ☐ No **– Go on to Question C.**

C. Complete a Wetland Rating Form for the receiving wetland using the Washington State Wetland Rating System for Western Washington. Is the wetland classified by the rating form as Category I or Category II?

- ☐ Yes **– Complete the checklist below**
- ☐ No **–Stop**

D. Hydroperiod Analysis per Section 1.5.8

- ☐ Monthly change in total discharge volume is 15% or less (per the WWHM); and
- ☐ Change in total discharge volume from any single precipitation event is 20% or less (per the WWHM). **–Stop**
- ☐ Either discharge threshold exceeded. **– Go on to Section E**

E. Minimum Requirement 8 is not met

Appendix I-I

Small Projects Submittal Forms

Stormwater Site Plan Short Form
Construction Stormwater SWPPP Short Form

Stormwater Site Plan Report Short Form

Table of Contents

The Stormwater Site Plan Report 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. Eligible projects typically fall within both the following thresholds:

1. The project adds or replaces between 2,000 and 4,999 square feet of hard surface.
2. The project disturbs more than 7,000 square feet and less than one acre of land.

The guidelines in this form help apply the requirements of Clark County Code 40.386 and the *Clark County Stormwater Manual* (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:

- Completed Site Plan Short Form Sections 2 – 6
- Soils Assessment (see Section 5)
- Construction Site Stormwater Pollution Prevention Plan (see Section 6, Minimum Requirement #2)
- Maps, Plans, and Drawings (see Section 7)

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.

If the site includes more than one Threshold Discharge Area, 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	
Replaced hard surfaces	
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. A non-vegetated surface which causes 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) – Those hard surfaces considered to be a significant source of pollutants in stormwater runoff. Such surfaces include those which are subject to: vehicular use; industrial activities; storage of erodible or leachable materials, wastes, or chemicals, and which receive direct rainfall or the run-on; metal roofs unless they are coated with an inert, non-leachable material; or roofs that are subject to venting significant amounts of dusts, mists, or fumes from manufacturing, commercial, or other indoor activities.

Converted Vegetation (areas) – The 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 considered land-disturbing activity.

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 to the right.

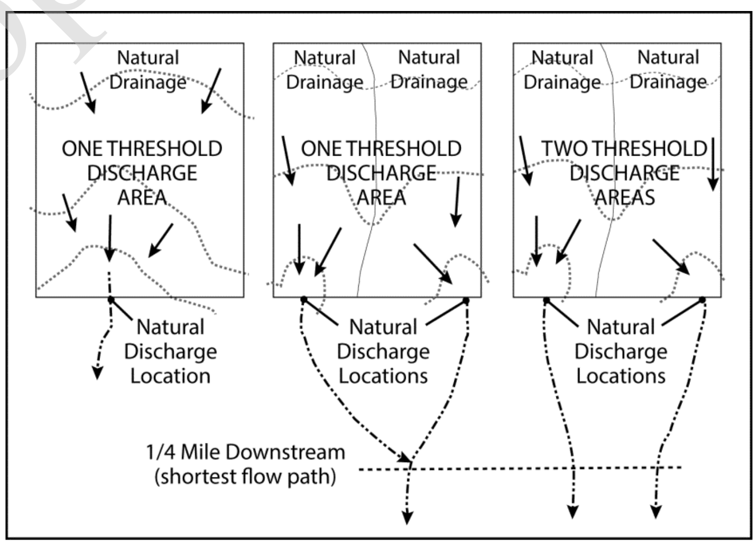


Figure 1: Threshold Discharge Area

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† ☐ Lakes/Ponds ☐ Wetlands† ☐ Steep Slopes/Geohazard†
☐ Floodplain ☐ Springs ☐ Habitat† ☐ Critical Aquifer Recharge Area

† 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‡ ☐ Lakes ☐ Wetlands‡ ☐ Steep Slopes/Geohazards‡
☐ Residential Areas ☐ Roads ☐ Ditches, pipes, culverts
☐ Other ____

____

____

____

____

____

‡ 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:

____

____

____

____

____

Section 4 — Offsite Analysis

Examine the roads, ditches, pipes, and properties downstream and downhill of the site to determine how water from the site might impact other lands, resources, and infrastructure. Do not enter private property without permission.

Date of inspection: _________________________

Weather during inspection (temperature, precipitation): _________________________________

1. Describe the downstream drainage path leading from the site (show on site map):

____

____

____

____

2. Describe existing downstream/downhill drainage or flooding problems that you know about:

____

____

____

____

Section 5 — Soils Assessment

Obtain a Soils Assessment performed by a qualified professional. Ask the qualified professional to fill out items 1 – 3, below, and attach a written assessment to this form.

Qualified professionals include certified 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 in accordance with CCSM Book 1, Section 2.3.1.2, Soil Description.
☐ Soils Report is attached.

Describe the soils on the site:

____

____

____

____

2. Infiltration Rate Testing

Infiltration rate testing is required for sites that are proposing to use rain gardens or permeable pavements to fulfill Minimum Requirement #5 (see Section 6).

☐ Infiltration rate testing N/A

☐ Infiltration rate testing conducted by a qualified professional in accordance with CCSM Book 1, Section 2.3.1.3, 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 Assessment

A groundwater assessment is required if permeable pavement is proposed and the seasonal high groundwater elevation in the area is known to be less than five feet below the proposed surface.

☐ Groundwater assessment N/A

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

☐ Groundwater assessment attached or included with the Soils Report.

Section 6 — Discussion of Minimum Requirements

The applicant must demonstrate how the 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 (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 described below.

Minimum Requirement #1 — Preparation of a Stormwater Site Plan

Minimum Requirement

All projects shall prepare and submit a Stormwater Site Plan for review by Clark County. 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, Sections 2 – 6 (this form)

☐ Soils Assessment

Groundwater Assessment: ☐ Attached ☐ N/A

☐ Construction Stormwater Pollution Prevention Plan Short Form

Drawings

☐ Vicinity Map

☐ Existing Site Map

☐ Site Plan

☐ BMP Drawings

Minimum Requirement #2 — Construction Stormwater Pollution Prevention

Minimum Requirement

All new development and redevelopment projects are responsible for preventing erosion and discharge of sediment and other pollutants into receiving waters. Applicants shall prepare and submit a Construction Stormwater Pollution Prevention Plan (SWPPP).

Documentation

☐ The Construction Stormwater Pollution Prevention Plan Short Form is attached.

☐ Other ____

Minimum Requirement #3 — Source Control of Pollution

Minimum Requirement

Development and redevelopment projects must use all known, available and reasonable source control best management practices (BMPs). Source control BMPs must be selected and designed in accordance with Book 3 of the CCSM.

Description

Construction sites must be maintained to minimize contact of rain and stormwater runoff with construction materials, debris, chemicals, dirt/soil, and stockpiles.

Commercial sites that will include any of the following activities (see Commercial Site Activities list, below) must include any required structural source control BMPs in the site plan and must list any required operational source control BMPs in the "Documentation" section below. For any activities checked, consult CCSM Book 3, and determine the structural and operational source control BMPs that are required for the site.

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

Element 1: All Sites

☐ The construction site will be maintained to minimize contact of rain and stormwater runoff with construction materials, debris, chemicals, dirt/soil, and stockpiles as described in the Construction SWPPP.

Element 2: Commercial Sites

☐ Consult CCSM Book 3 and list all required BMPs to be installed to provide source control for activities checked above:

____

____

____

____

☐ Show any required <u>structural</u> source control BMPs on the site plan.

Minimum Requirement #4 — Preservation of Natural Drainage Systems and Outfalls

Minimum Requirement

Natural drainage patterns shall be maintained, and discharges from the project site shall occur at the natural location, to the maximum extent practicable.

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 to the extent feasible without causing flooding or erosion impacts.

Description

Stormwater generated from hard surfaces on the site must be controlled on the site as much as possible using BMPs such as rain gardens, infiltration trenches and drywells, and dispersion.

Applicants must select BMPs in order of priority as described below.

Selection

Project sites will construct or create up to three types of surfaces that will generate stormwater runoff – lawn and landscaped areas, roofs, and other hard surfaces.

For each type of surface, a prioritized list of BMPs is provided on the following page. Applicants must select a BMP for each type of surface from the prioritized list. Applicants must select the first BMP in the list that is not infeasible.

Flow charts are provided on the following pages to illustrate the selection process. The determination of infeasibility is an important step in this process; it is described below.

Establishing Infeasibility

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 8. 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.

Infeasibility must be documented in writing using the LID Feasibility Checklist in Section 9.

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

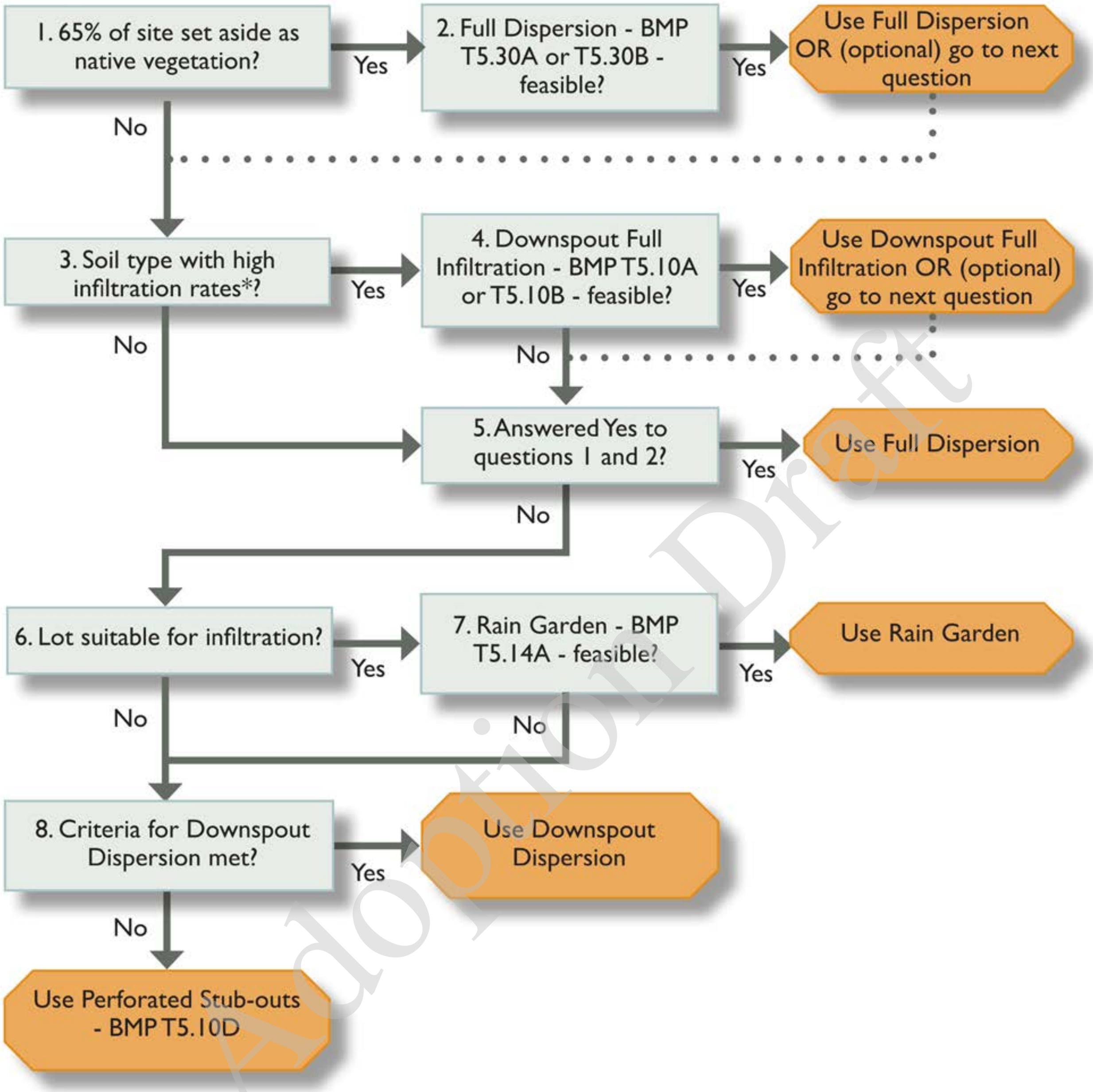
Roofs

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

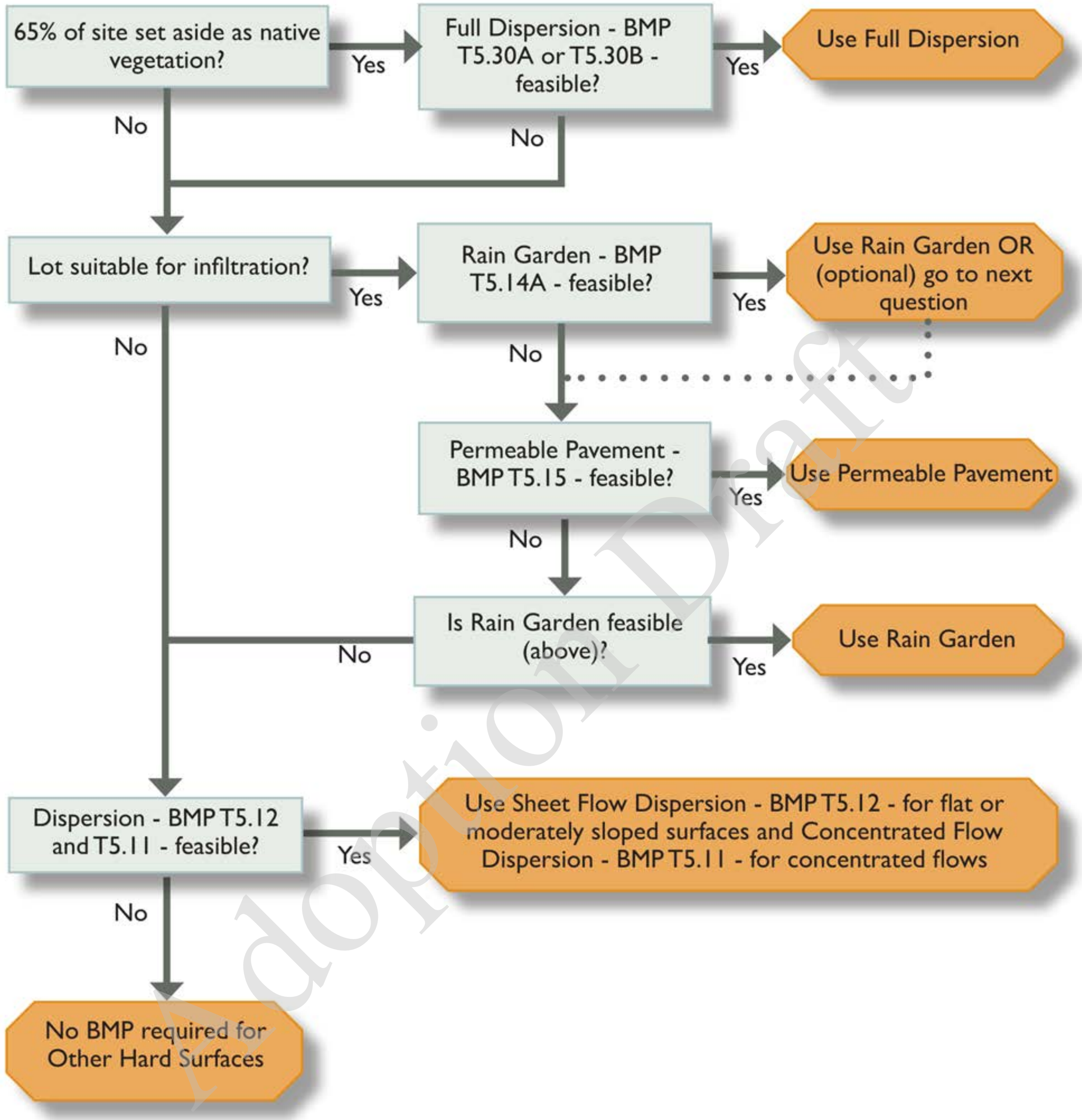
1. Full Dispersion BMP T5.30A and BMP T5.30B.
2. Rain Garden BMP T5.14A or Permeable Pavement BMP T5.15 (evaluate in any order)
3. Sheet Flow Dispersion BMP T5.12 or Concentrated Flow Dispersion BMP T5.11

Figure 2: BMP Selection Process for Roofs



*Results of Soils Investigation by qualified professional show that infiltration is appropriate (e.g. soil type is gravel, sand, or loam at location of downspout.

Figure 3: BMP Selection Process for Other Hard Surfaces



Documentation

For each surface in the list below, list the first BMP that is feasible using the selection processes shown in Figures 2 and 3.

☐ 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.

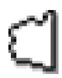
BMP Selected for Other Hard Surfaces: ___________________________________

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 24 for blank graph paper. Examples of each required drawing begin on page 20.

1. Vicinity Map — Mark the site on a vicinity map showing the nearest cross-streets; include a North arrow.
2. Existing Site Map. 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 showing 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 – 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)

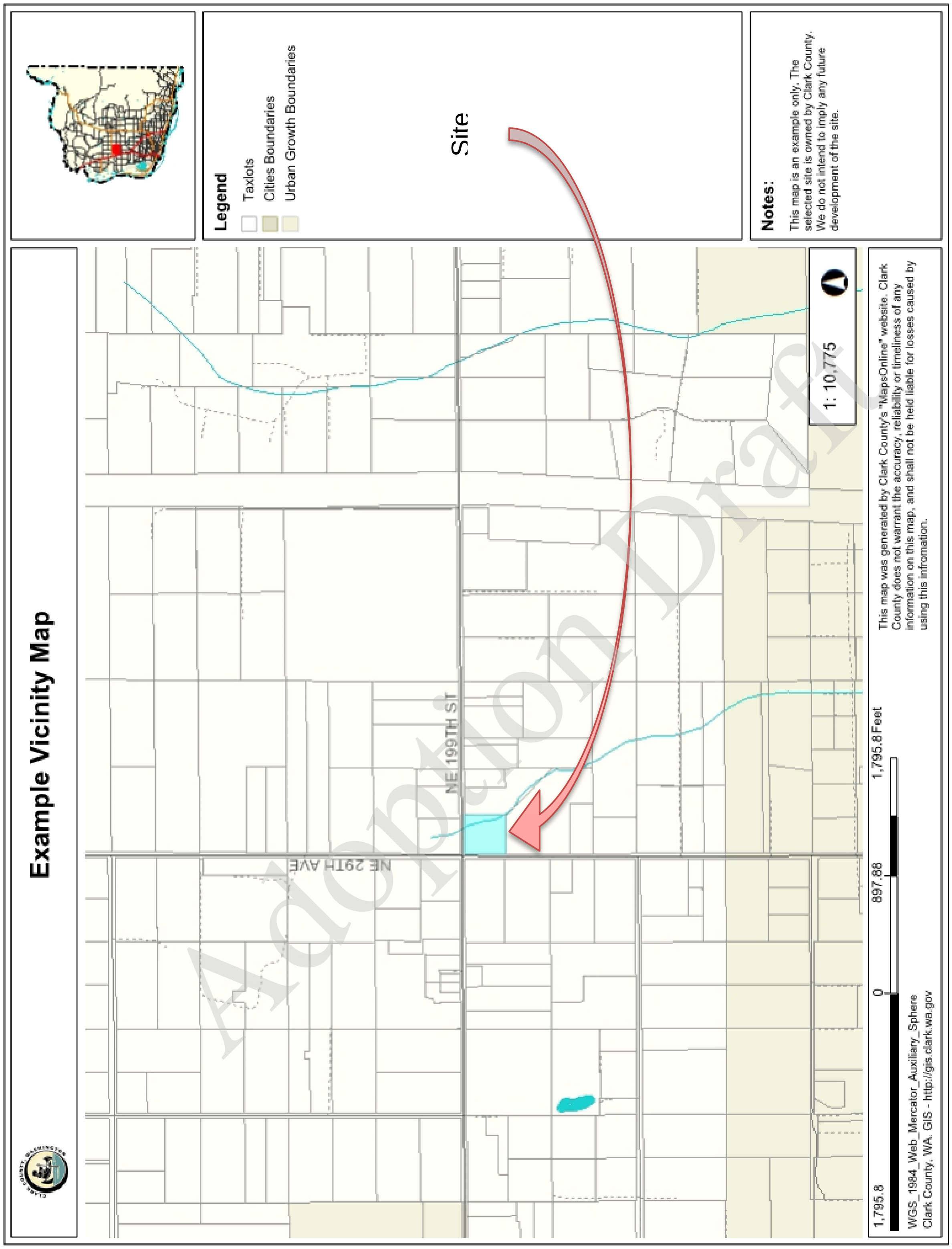


Figure 4: Example Vicinity Map

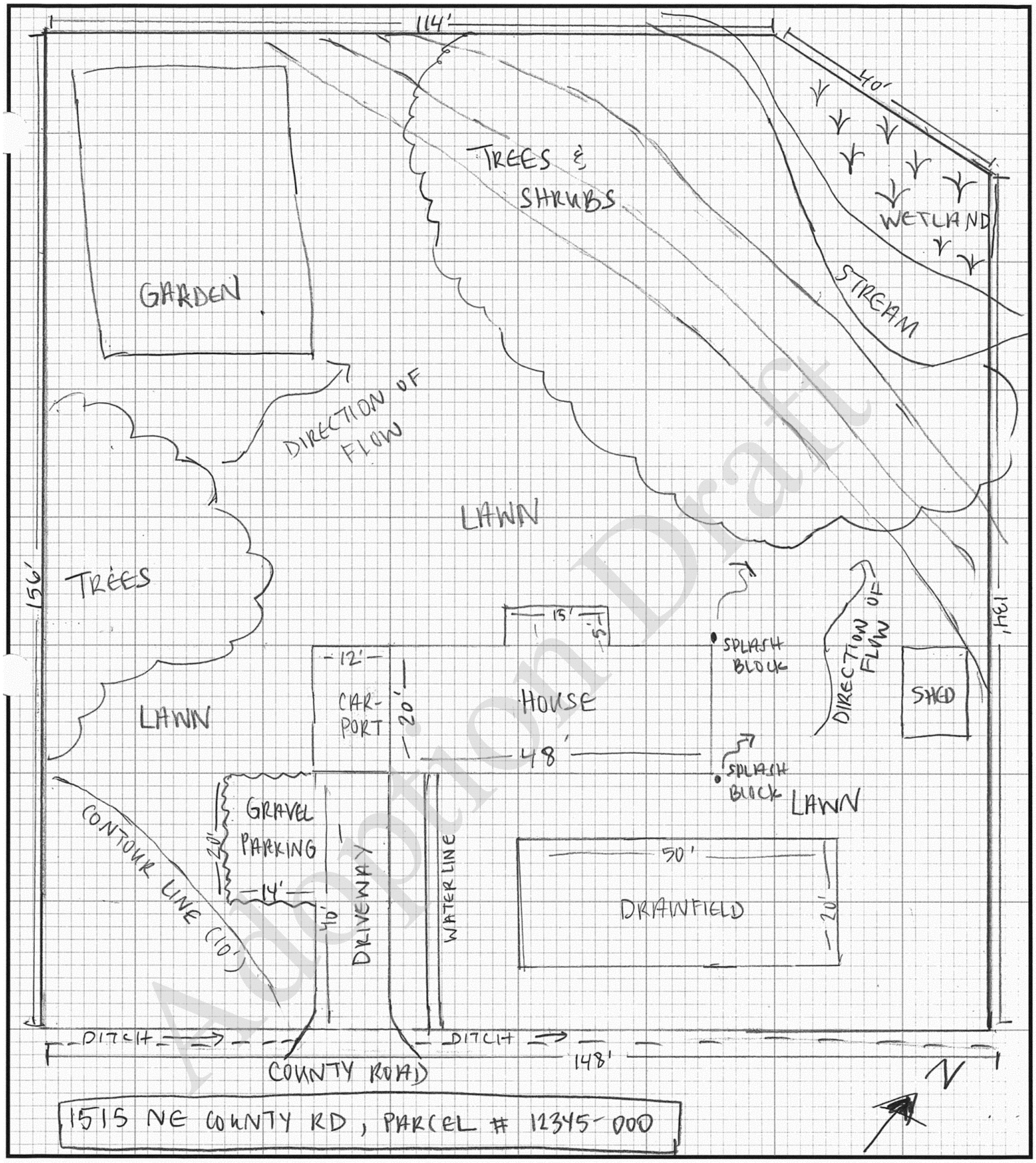


Figure 5: Example Existing Site Map

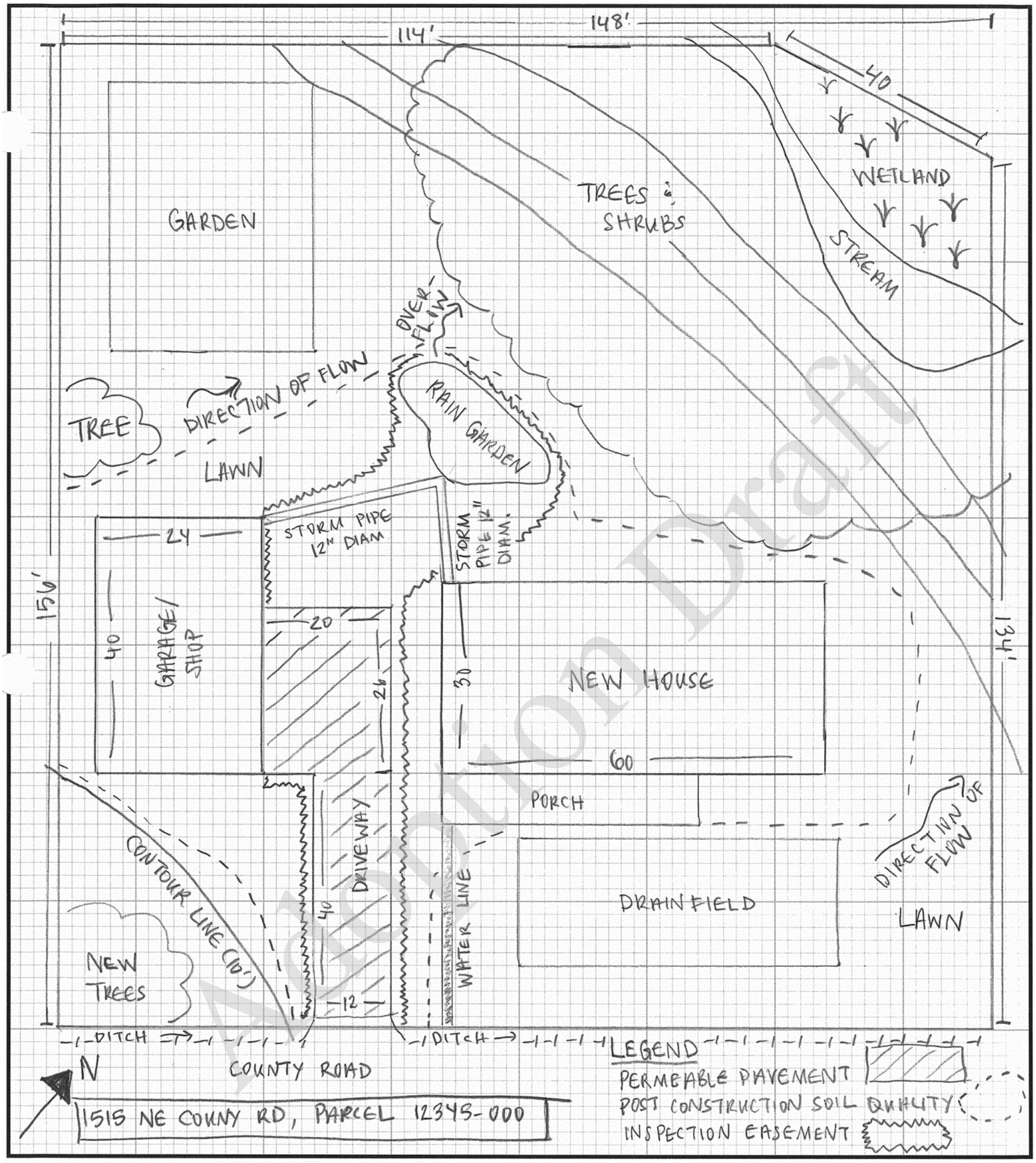


Figure 6: Example Site Plan

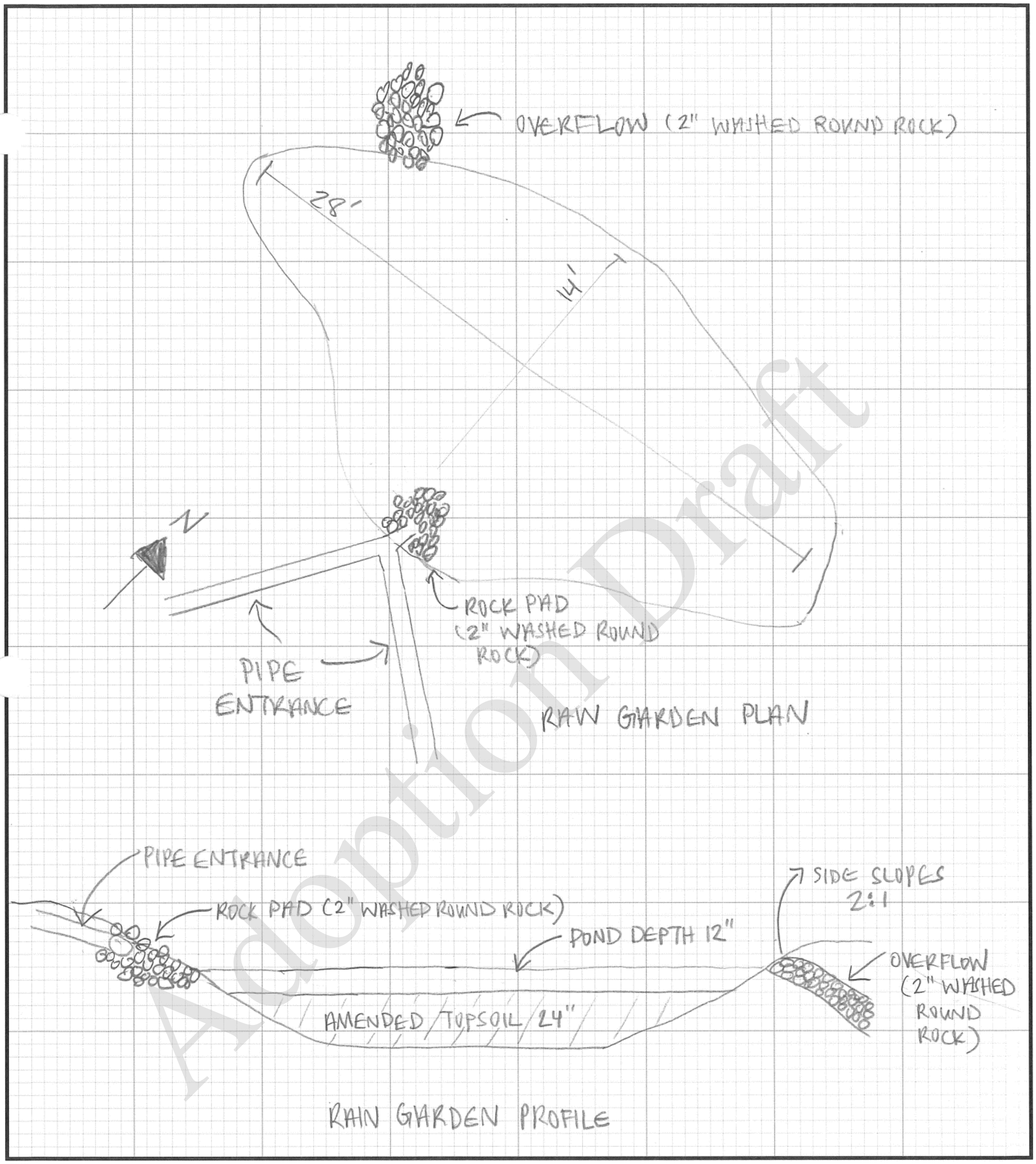


Figure 7: Example BMP Plan and Profile Drawing

Section 8 — BMP Design Criteria and Drawings

Use the BMP design criteria and illustrations in this section to design 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.

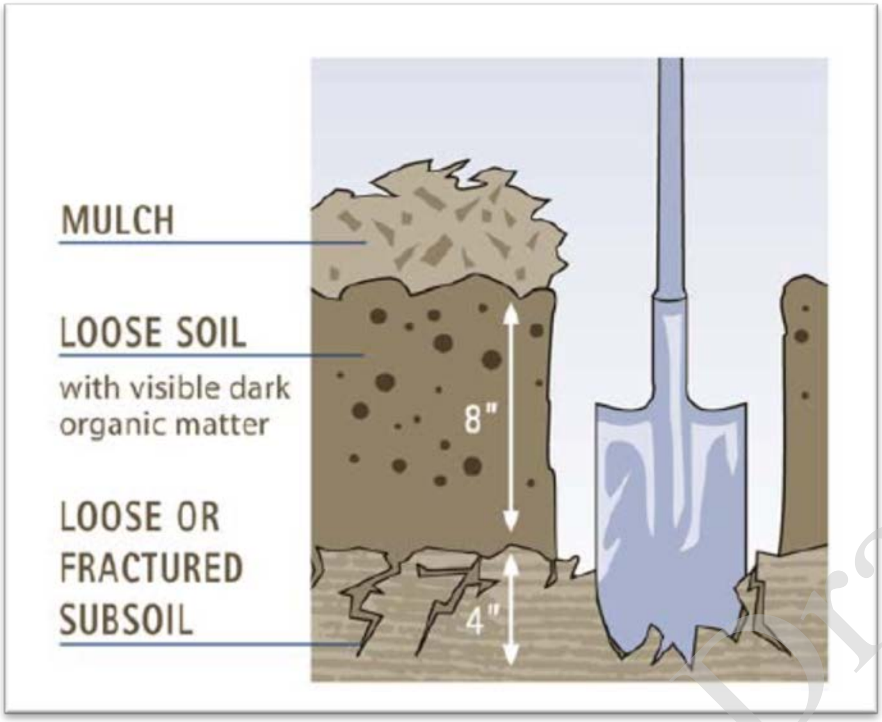


Figure 8: Typical Planting Bed Cross-section

(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 a 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 9: 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.

- 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
- 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.
- 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.
- 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.

Setbacks

Because Full Dispersion relies on the dispersion devices and design criteria for various dispersion BMPs, setbacks for the 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 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.
- 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 10: 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 designed to infiltrate runoff from roof downspout drains and cannot be used to directly infiltrate runoff from pollutant-generating surfaces. These facilities can be pre-manufactured structures, or they can be simply holes in the ground filled with rock.

Applications, Limitations and Setbacks

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.

Roof downspout drywells are deemed feasible without infiltration testing when a qualified professional determines that USDA textural classes ranging from very coarse sand to fine sand, or cobbles and gravels are present in the infiltration zone. If other soils are present in the infiltration zone, such as loam or clay, these can be used if the design infiltration rate found through testing per Book 1, Section 4.3.1.3 is at least one inch/hour.

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 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 ranging from very coarse sand to fine sand, or cobbles and gravels and that, if other soils are present in the infiltration zone, such as loam or clay, these have been found to have an infiltration rate of less than one inch/hour.
- 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.

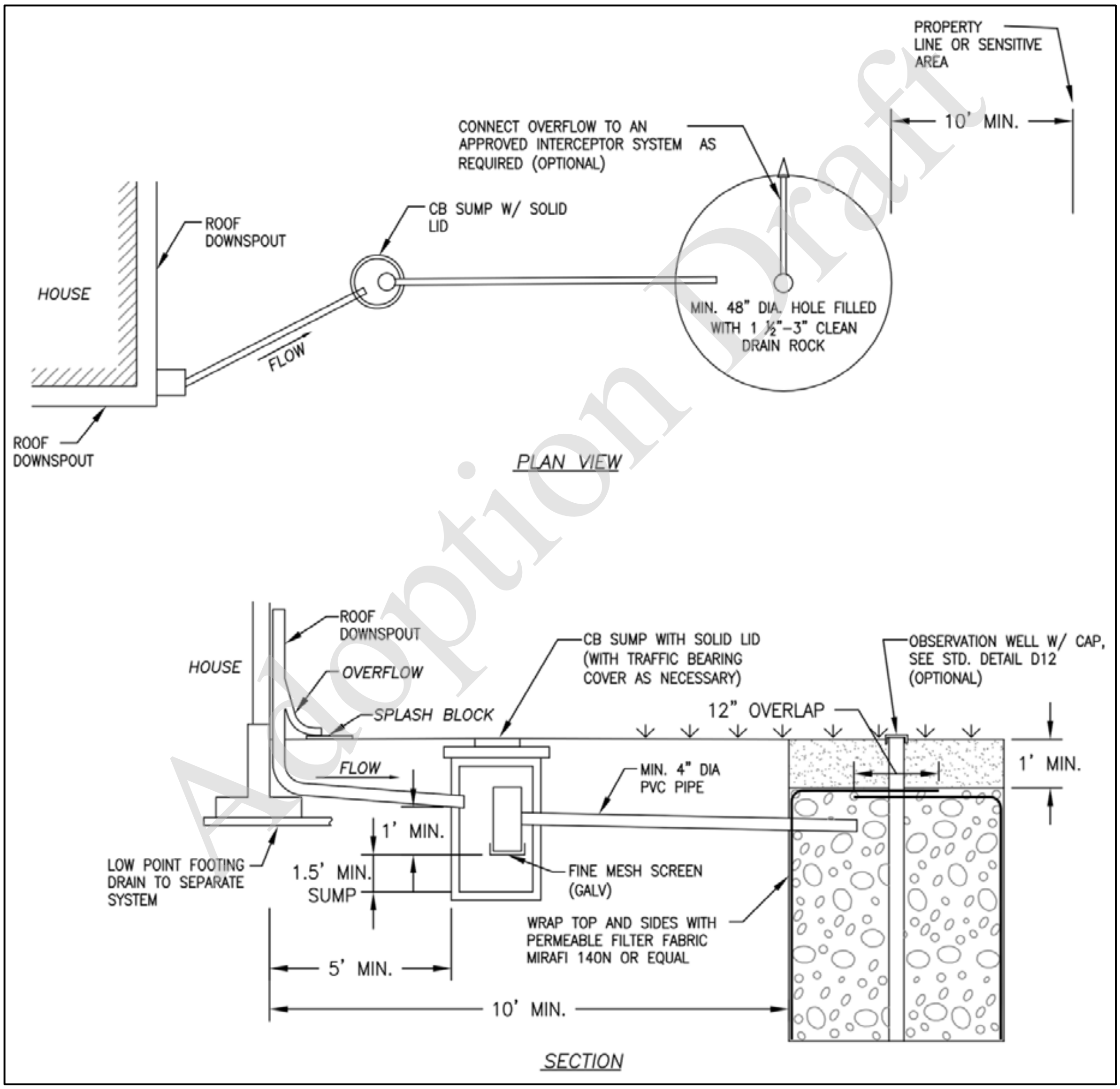


Figure 11: Typical Downspout Infiltration Drywell

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

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

Infiltration trenches are trenches fill with rock and containing perforated pipe that are designed to infiltrate runoff from roof downspout drains. They cannot be used to directly infiltrate runoff from pollutant-generating surfaces.

Applications, Limitations and Setbacks

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

Roof downspout infiltration trenches are deemed feasible without infiltration testing when a qualified professional determines that USDA textural classes ranging from very coarse sand to fine sand, or cobbles and gravels are present in the infiltration zone. If other soils are present in the infiltration zone, such as loam or clay, these can be used if the design infiltration rate found through testing is at least one inch/hour.

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 trench do not fall within USDA textural classes ranging from very coarse sand to fine sand, or cobbles and gravels, and, if other soils exist in the infiltration zone, such as loam or clay, these have been found to have an infiltration rate of less than one inch/hour.
- Less than three feet of permeable soil exists from the proposed finished ground elevation at the trench location to the seasonal high groundwater table.
- 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:
    - Soil Group 1: 20 linear feet.
    - Soil Group 2: 50 feet.
    - Soil Group 3: 150 feet.
    - Soil Groups 4 and 5: infiltration cannot be used.

    These soil groups are defined in Appendix 2-A.
- Maximum length of trench is 100 feet from the inlet sump. If the minimum length is greater than 100 feet, such as for Soil Group 3, flow should be split 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.

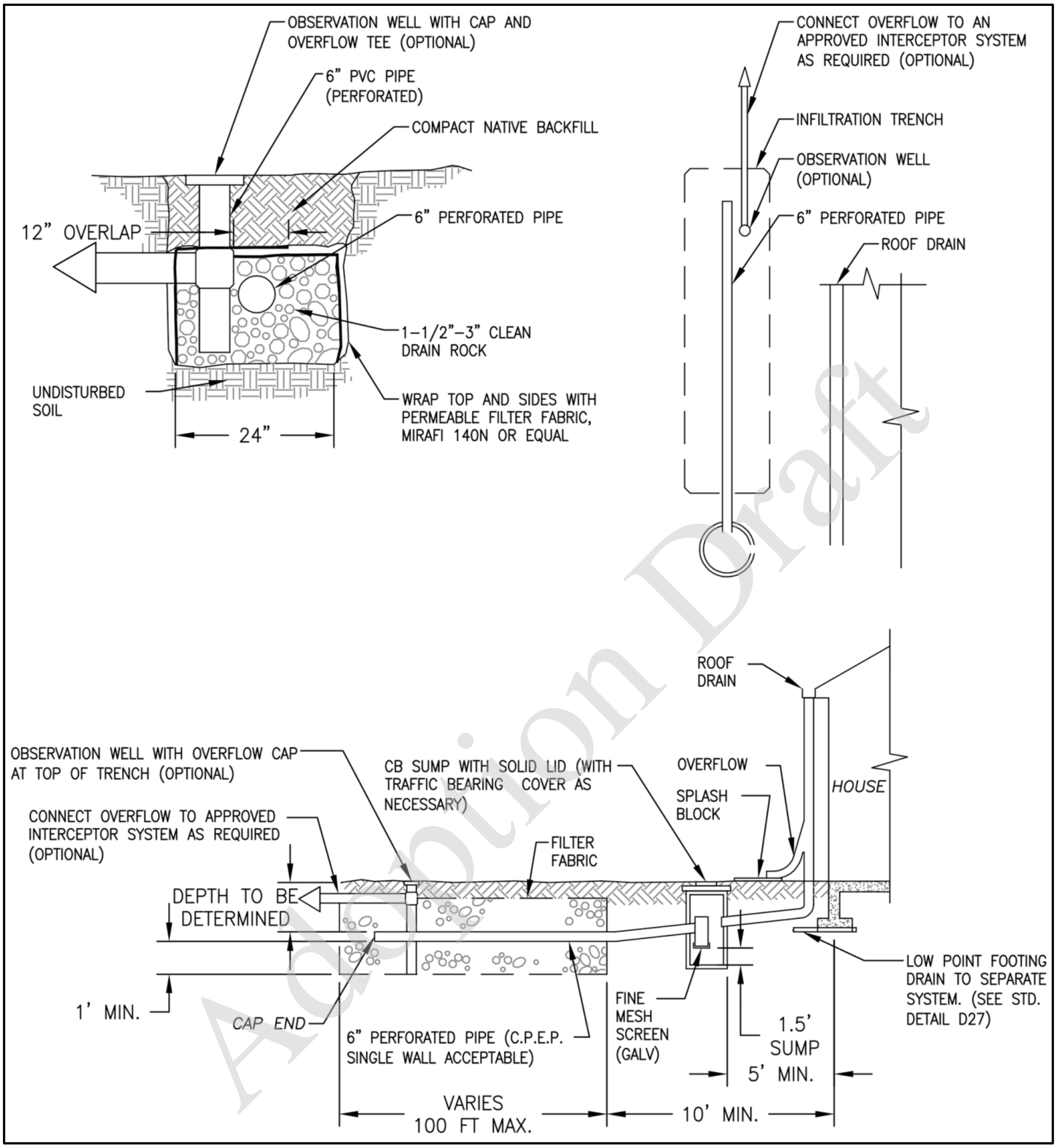


Figure 12: Typical Downspout Infiltration Trench

(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 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.

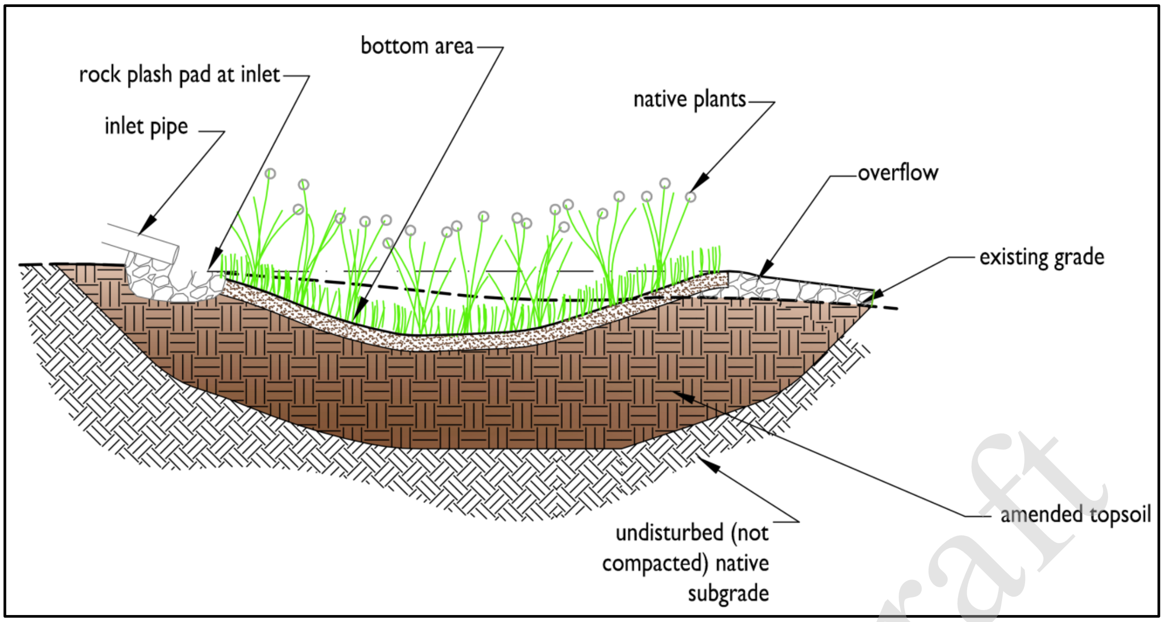


Figure 13: Schematic of Typical Rain Garden

(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

Refer to the Rain Garden Handbook for Western Washington: A Guide for Design, Installation, and Maintenance (Ecology, 2013), or as revised, for additional rain garden design specifications and construction guidance. Where information in that manual may conflict 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 the use of rain gardens. A rain garden should not:

- Be placed over existing utilities. Contact utility locate services in the early design stages.
- 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.
- 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.

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.

Pond Area (Sizing)

- The ponding depth shall be 6 inches, minimum and 12" maximum
- Rain gardens must have a horizontally projected surface area below the overflow which is at least 5% of the total surface area draining to it.

- 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.
- 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.

Designers should refer to the Rain Garden Sizing Chart in the *Rain Garden Handbook for Western Washington* to determine sizing utilizing rain zone, drainage rate, and performance goals.

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

- Depth of rain garden soil mix should be between 12 inches and 24 inches.

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

- Excavate full depth and replace existing soil with a rain garden soil mix. A rain garden soil mix typically contains about 60% sand content and 40% compost by volume. Fully replace soil if:
    - Clay content is greater than 5%. (Drainage rate less than .24 inches per hour)
    - In gravel soils as plant growth will be inhibited.(Drainage rates typically above 2.5 inches per hour)
- Excavate and amend existing soil (Drainage rate of .25 to .49 inches per hour)
    - Use with moderately draining soils
    - Use 1/3 compost to every 2/3 of existing soil.
- Amend soil. Use this option only if the infiltration rate is 1 inch per hour or greater. Amend soil by excavating to the ponding depth plus 3 inches. Spread 3 inches of compost and till to depth of 4 to 5 inches to fully incorporate compost component. The compost shall:
    - 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, uncomposted 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 pond) to relatively dry (rim of pond). 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 0.1: 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 List. Refer to clark.wa.gov/weed/ for a current list of noxious weeds.

*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 Section 2.5.5.3 in Book 2 for a full list of infeasibility criteria, and refer to Table 2.3 for typical applications of pervious pavements.

- 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)

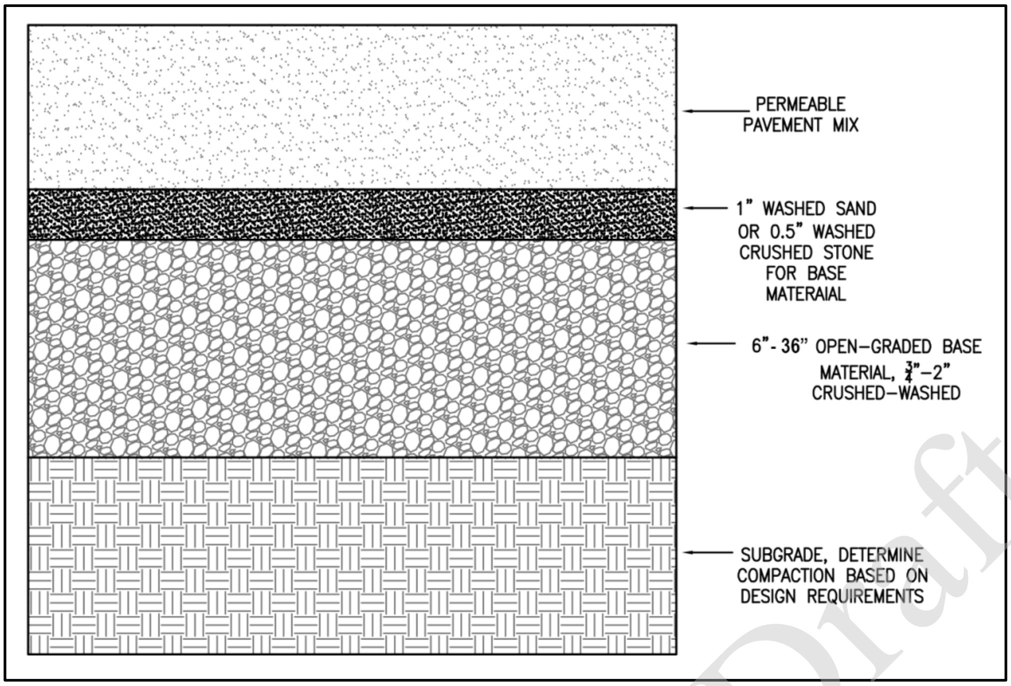


Figure 15: Permeable Pavement typical section

(Source: redrawn from City of Portland)

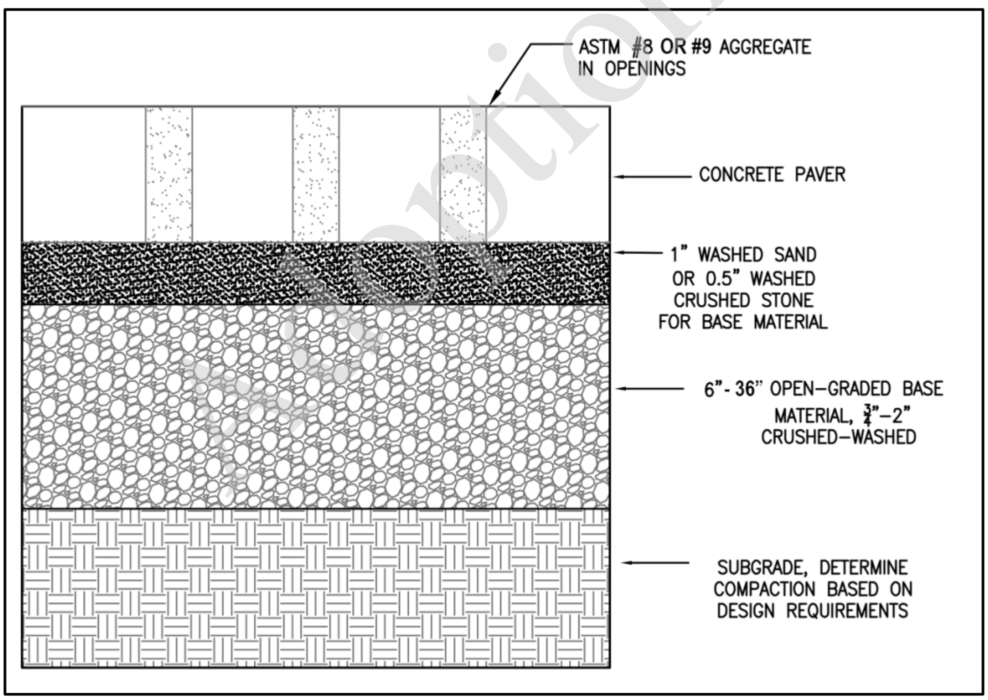


Figure 16: Permeable Pavement typical section of pavers

(Source: redrawn from City of Portland)

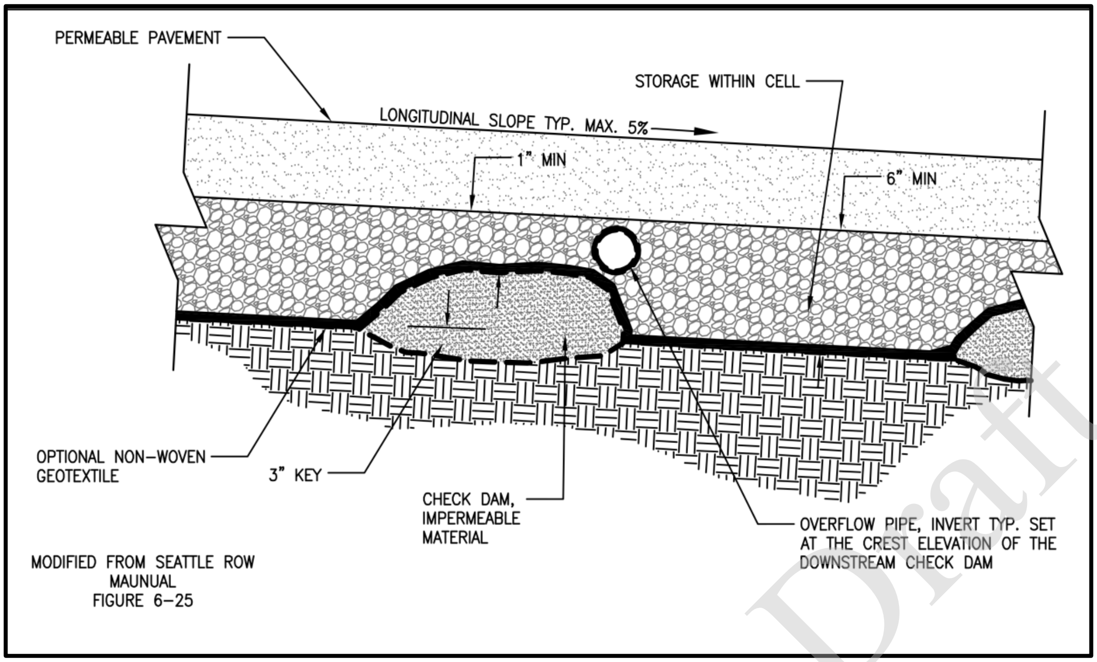


Figure 17: Permeable Pavement check dam for sloped pavement

(Source: 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.
- Use on soil types A through C

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 or Geogrid

- For all permeable pavements, geotextile is recommended along the pavement perimeter between the graded base and subgrade if concrete curbs or impermeable liners that extend the full depth of the base are not provided.
- If geotextile is used:
    - The material used should be recommended by the manufacturer's specifications and recommendations of the geotechnical engineer for the particular subgrade soil and aggregate base being used.
    - The fabric should extend up the sides of the excavation.
    - Adjacent strips of fabric should overlap at least 2 feet.
    - After placement of base aggregate and again once the pavement has been placed, the filter fabric (if being used) should be folded over these placements to protect from sediment inputs.

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)

Note that if an underdrain is placed at or near the bottom of the aggregate base in a permeable pavement design, the permeable pavement is no longer considered an LID BMP and cannot be used to satisfy Minimum Requirement #5. However, designs utilizing an underdrain that is elevated within the aggregate base course to protect the pavement wearing course from saturation is considered an LID BMP and can be used to satisfy Minimum Requirement #5. See Appendix III-C and the WWHM User's Manual for guidance in modeling permeable pavements with underdrains.

Permeable interlocking concrete pavements (PICP) Seed Mix

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

Table 2: 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
- Submit gradation testing certification of base material
- The contractor should place test panels using mix proportions, materials, personnel, and equipment proposed for the project. Test the fresh and hardened density and thickness of the test panel(s). See the current version of ACI 522 for test procedures and tolerances. If the test panel is outside acceptable limits for one or more of the verification tests, the panel is to be removed and replaced at the contractor's expense. If the test panel is accepted it may be incorporated into the completed installation.
- Obtain a minimum of $1ft^3$ sample for fresh density testing for each day of placement (see ACI 522 for test procedures and tolerances.
- Remove 3 cores per 5000 ft^2 not less than seven days after placement to verify placement hardened density and thickness. See ACI 522 for test procedures and tolerances. If the tested portion of the installation is outside acceptable limits for 1or more of the verification tests, the installation is subject to rejection and should be removed and replaced at the contactors expense unless accepted by owner.
- 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.

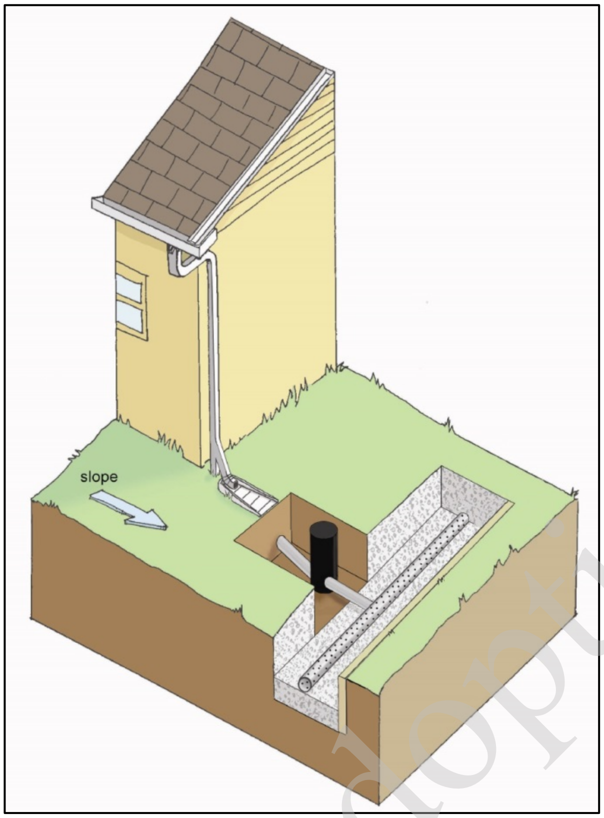


Figure 18: Illustration of Downspout Dispersion Trench

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.

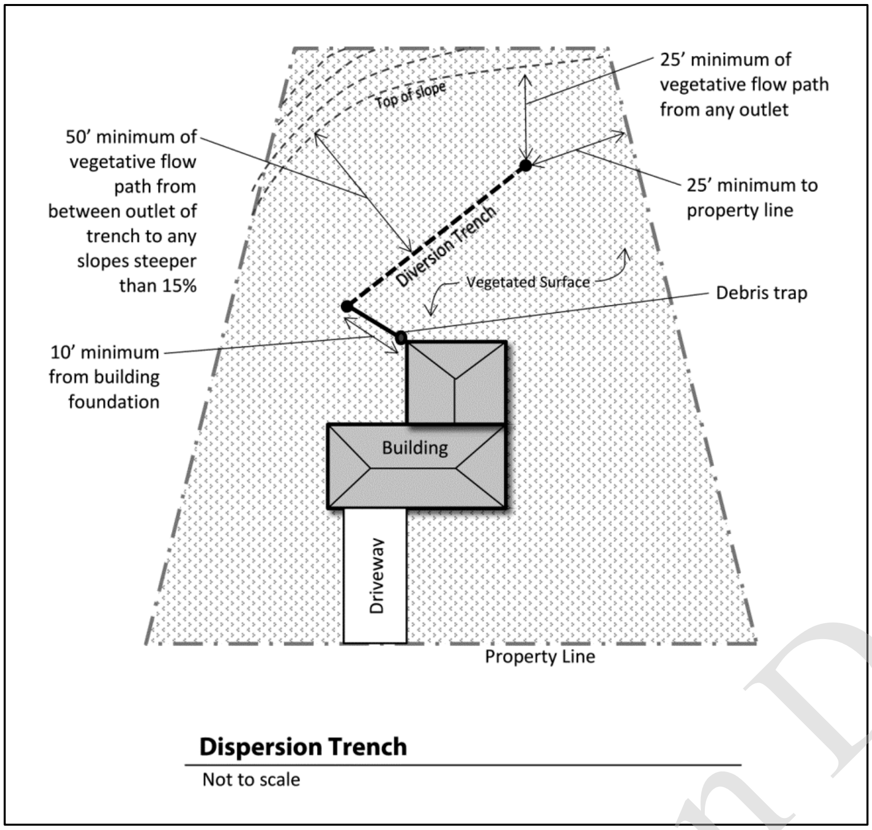


Figure 19: Typical Dispersion Trench Site Plan

(Source: Clark County)

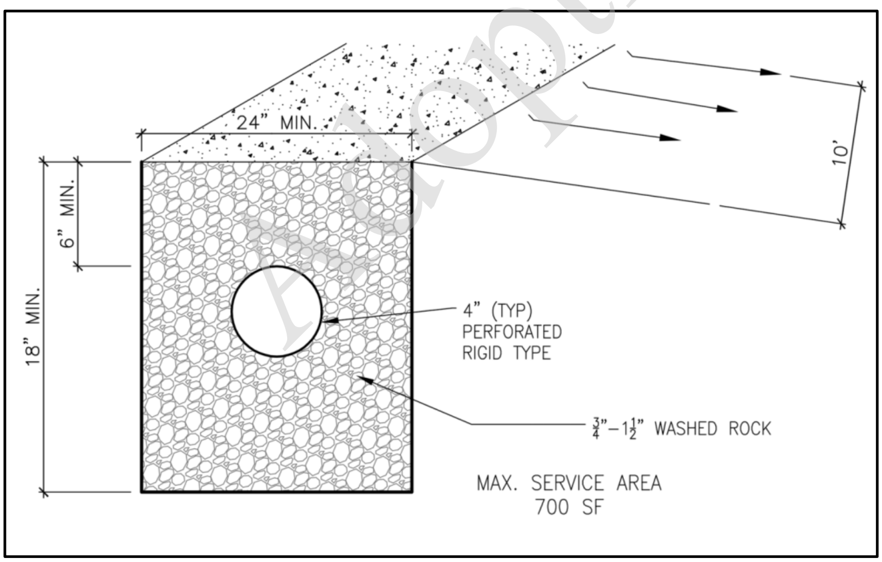


Figure 20: Downspout Dispersion Trench Cross-Section

(Source: modified from Department of Ecology)

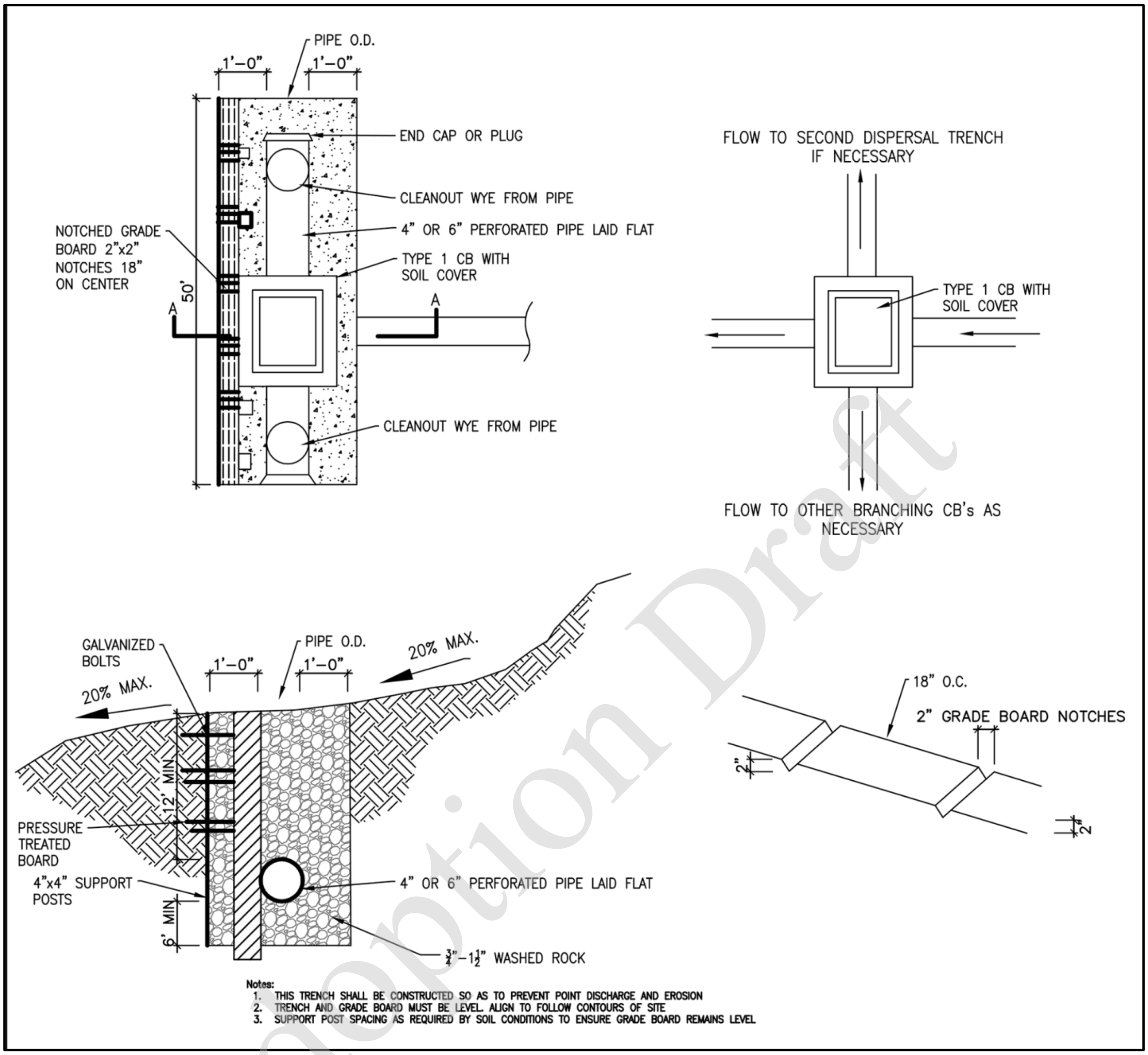


Figure 21: Dispersion Trench with Notched Grade Board

(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.

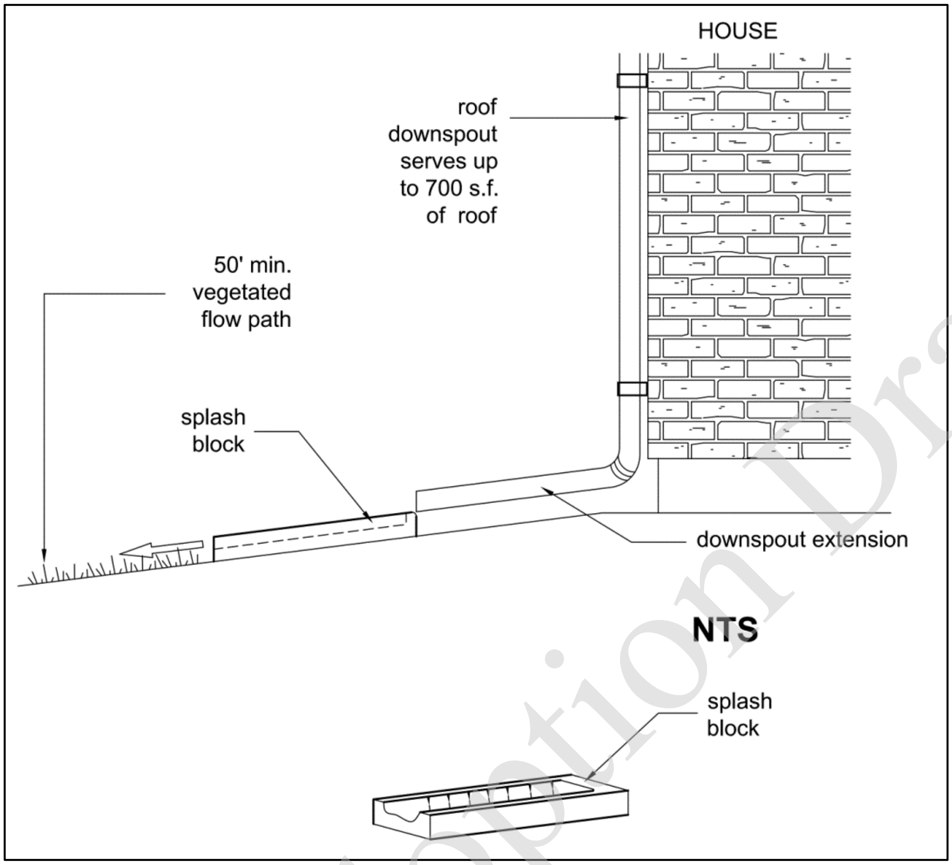


Figure 22: Typical Splashblock

(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.

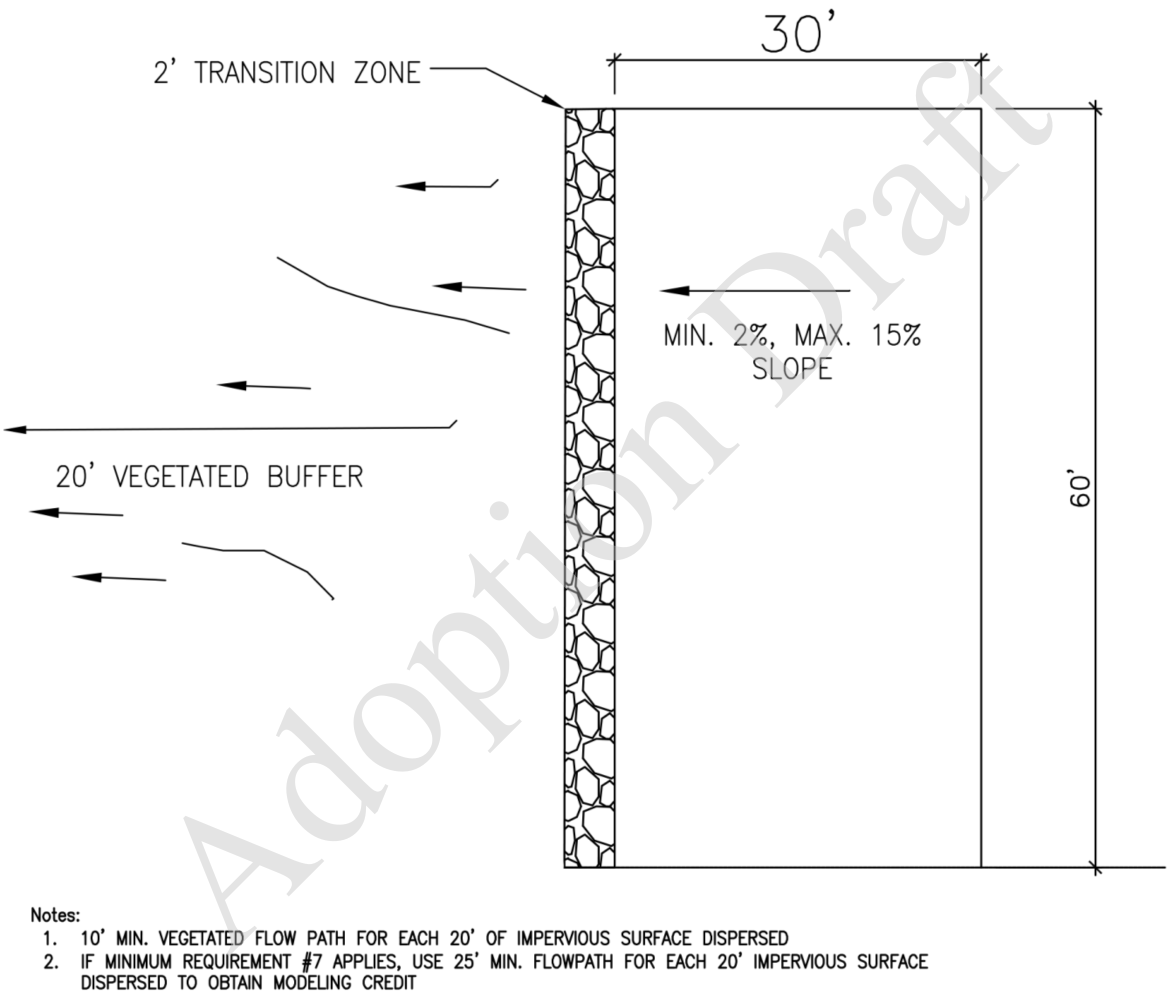


Figure 23: Sheet Flow Dispersion for Flat and Moderate Sloped Surfaces

(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.

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.

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 2.7.
- No erosion or flooding of downstream properties shall result.
- 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.

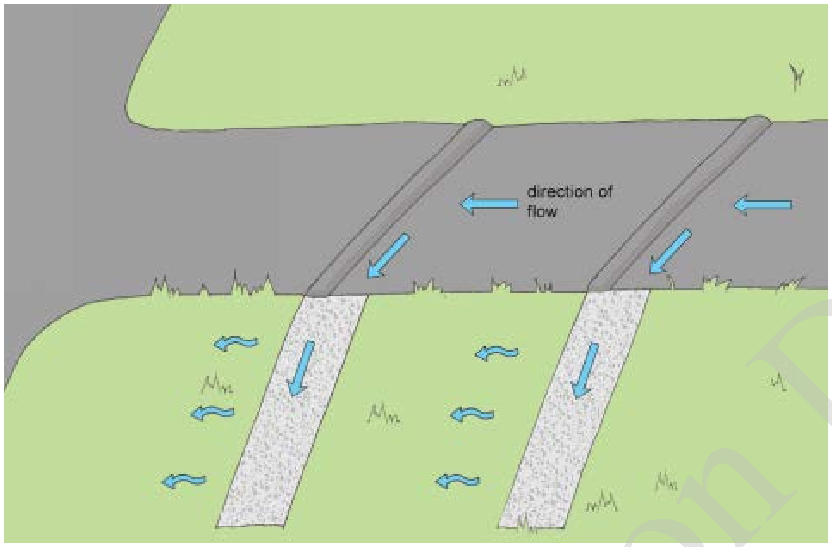


Figure 24: Illustration of Driveway Dispersion Using Berms and Dispersion Trenches

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.

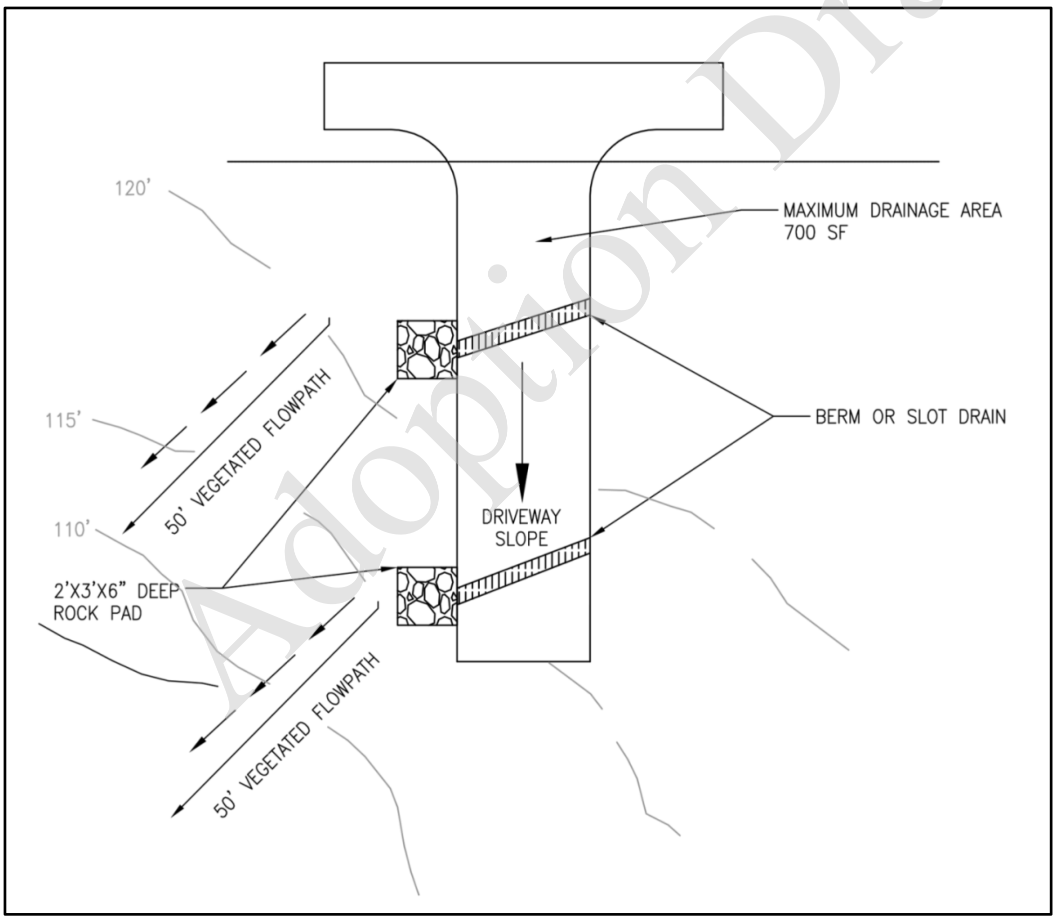


Figure 25: Concentrated Flow Dispersion Using Rock Pad

(Source: Clark County)

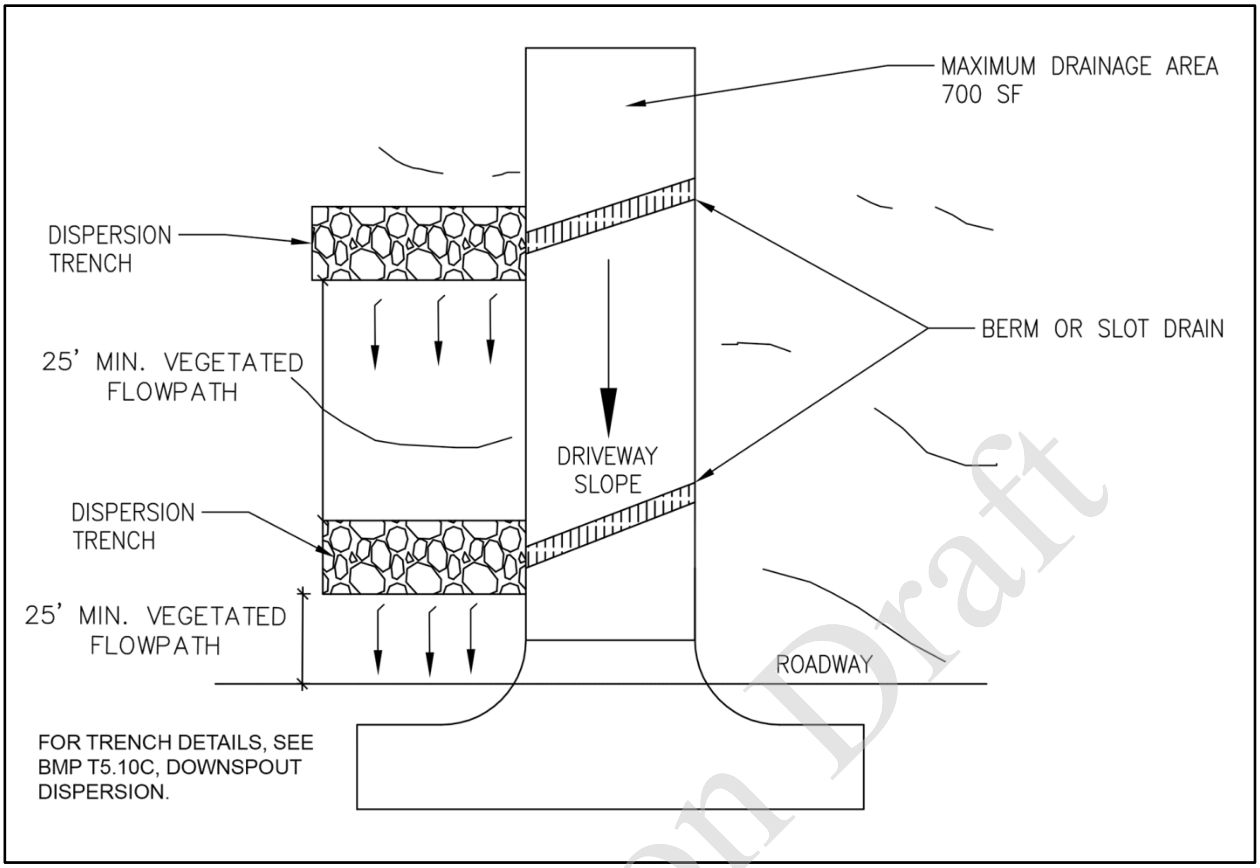


Figure 26: Concentrated Flow Dispersion Using Dispersion Trench

(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.

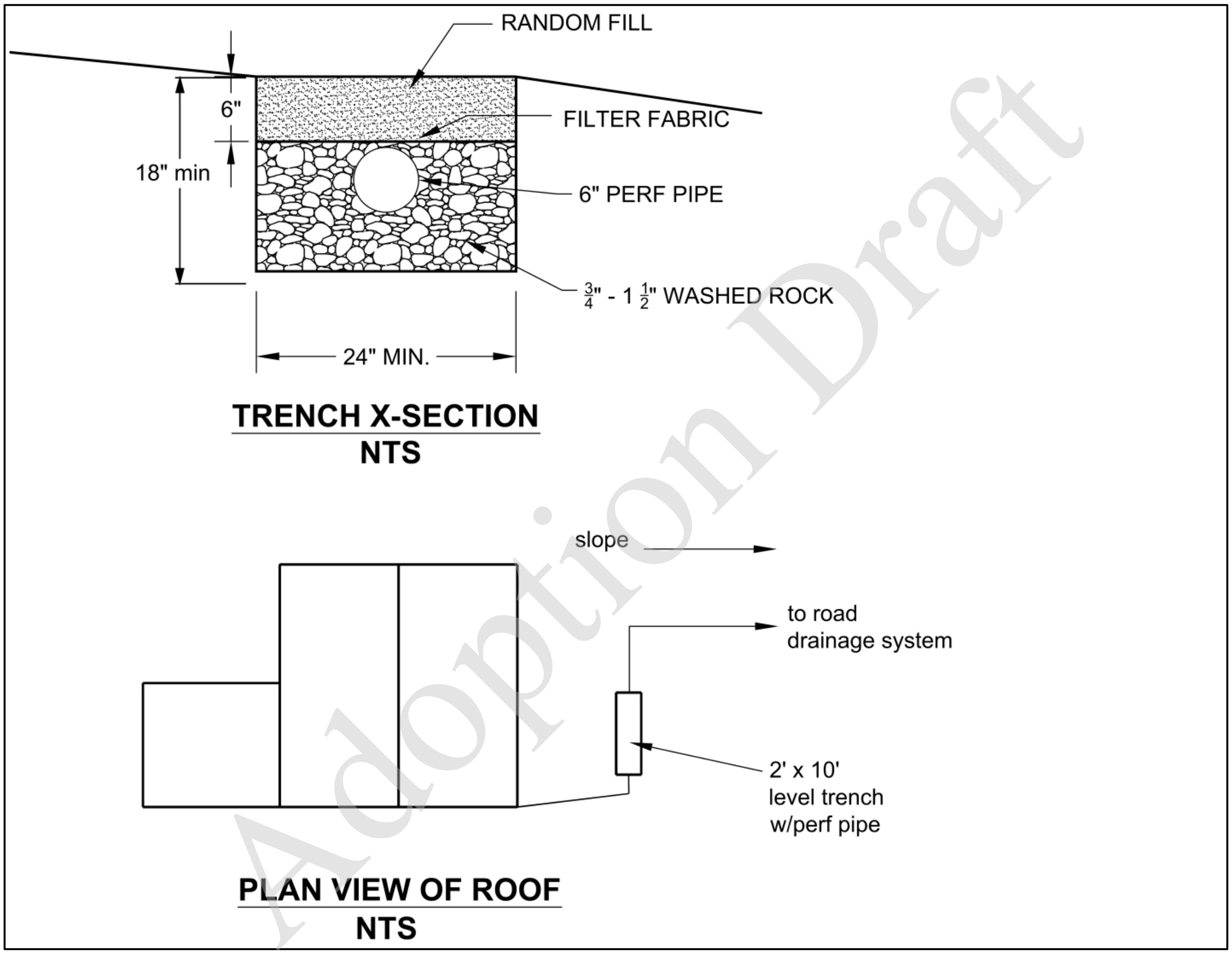


Figure 27: Typical Perforated Stub-out Connection

(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 9 — LID Feasibility Checklist

Preface

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 8, above. 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 meeting 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

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

Section 2: Feasibility Criteria

For each type of surface selected in Section 1, 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, 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.

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.	Has a qualified professional determined that soils in the infiltration zone at the location of the infiltration BMP do not fall within USDA textural classes ranging from very coarse sand to fine sand, or cobbles and gravels, or, if other soils are present in the infiltration zone, such as loam or clay, these have been found to have an infiltration rate of less than one inch per hour?				
	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 on a slope of 25% (4:1) or greater 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?				
	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 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 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?				
	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.]				
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.]				
Determination: Is this BMP feasible?					

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 in a forested native condition?				
	Does a professional geotechnical evaluation recommend dispersion not be used due to reasonable concerns about erosion, slope failure or down gradient flooding?				
	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 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?				
	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?				
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?				
	Does a professional geotechnical evaluation recommend dispersion not be used due to reasonable concerns about erosion, slope failure or down gradient flooding?				
	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 on a slope greater than 5%?				
	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?				
	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?				
	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?				
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**
	Does a professional geotechnical evaluation recommend dispersion not be used due to reasonable concerns about erosion, slope failure or down gradient flooding?				
	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 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 by CCC 40.430?				
	Is the only area available for the BMP less than 10 feet from any structure, property line, or sensitive area?				
Determination: Is this BMP feasible? ……………………………………………………………………………………					

RAIN GARDEN BMP T5.14A		Roof		Other Hard Surfaces	
	Infeasibility Criteria and Setbacks	**YES**	**NO**	**YES**	**NO**
	Has the Responsible Official determined that the BMP is not compatible with surrounding drainage systems?				
	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?				
	Can the site not 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:				
	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?				
Questions continue on following page	*[End soil / groundwater contamination sub-list.]*				

	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?				
	Does field testing indicates that soils have a measured (a.k.a. initial) native soil coefficient of permeability less than 0.3 inches per hour?				
	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?				
	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?				
	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?				
	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?				
	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 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? ……………………………………………………………………………					

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.]				
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?				

Questions continue on following page.

	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 criteria 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?				
	<u>If</u> 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 <u>fail</u> 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?				
	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?				
	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 has groundwater that drains into an erosion hazard or landslide hazard area?				
Questions continue on following page.	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? ……………………………………………………………………………					

Construction SWPPP Short Form

Table of Contents

The Construction Stormwater Pollution Prevention Plan (SWPPP) 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. Eligible projects typically fall within the following thresholds:

1. The project adds or replaces between 2,000 and 4,999 square feet of hard surface.
2. The project disturbs less than 1 acre of land.

Section 1 — Project Overview

County Permit

Building Permit Number(s): ____

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

____

Applicant Info

Name: ____

Address: ____

Phone Number: ______________________ E-mail: ______________________

Property Owner Info

Name: ____

Address: ____

Phone Number: ________________________ E-mail: _________________________

Erosion Control Inspector

Designate an erosion control inspector who has the skills to assess the site conditions and construction activities that could impact the quality of stormwater and the effectiveness of erosion and sediment control BMPs. The erosion control inspector must be on-site or on-call at all times. If construction is carried out by a licensed contractor, the erosion control inspector must be a Certified Erosion and Sediment Control Lead (CESCL).

Name: ____

Address: ____

Phone Number: ________________________ Emergency Phone: ________________

Property Info

Project Address: ____

Parcel Number _________________________ Size of Parcel (acres or sq. ft.): _______

Section 2 — Required Submittals

A Construction SWPPP consists of both a project narrative and a site plan. The project narrative describes the existing conditions on the site, the proposed conditions, and how construction site runoff will be managed until final site stabilization. Any additional relevant information should be included in the project narrative.

The information required in Section 3, below, is the project narrative. All Best Management Practices (BMPs) that will be utilized on the site shall be printed and included as part of the project narrative. If additional best management practices will be used, a narrative and appropriate details describing the BMP (its function, installation method, and maintenance activities) are be required.

The site plan is a drawing which shows the location of the proposed BMPs. The site plan is described in Section 4, below.

Section 3 — Project Narrative

Complete the following steps for the Project Narrative:

1. Complete Sections A – E, below.
2. Print and attach selected Erosion and Sediment Control BMP residential design drawings.

Note: From October 1 thru April 30, clearing, grading, and other soil disturbing activities shall only be permitted by special authorization from Clark County.

A. Project Description

Check all that apply.

☐ New Structure / Building
☐ Building Addition
☐ Grading/Excavation
☐ Paving
☐ Utilities
☐ Other ____

Total Project Area (square feet)	
Total Proposed Impervious and Hard Area (square feet)	
Total Existing Impervious and Hard Area (square feet)	
Total Area to be Disturbed (square feet)	
Total Volume of Cuts (cubic yards)	
Total Volume of Fill (cubic yards)	

Additional Project Information:

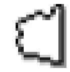
____

____

____

____

B. Existing Site Conditions

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.

Describe the existing site conditions.

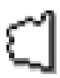
☐ Forest ☐ Prairie ☐ Pasture ☐ Pavement

1. ☐ Landscaping ☐ Brush ☐ Trees ☐ Other

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

3. ☐ Overland ☐ Gutter ☐ Catch Basin ☐ Ditch/Swale

☐ Storm sewer pipes ☐ Stream/Creek ☐ Other

 Are sensitive and/or critical areas present on the site?

4.

☐ Streams ☐ Lakes/Ponds ☐ Wetlands ☐ Steep Slopes/Geohazard

☐ Floodplain ☐ Springs ☐ Habitat ☐ Critical Aquifer Recharge Area

5. Existing utilities and underground objects?

☐Storm ☐ Water ☐ Sewer ☐ Other

☐Fuel tanks ☐ Septic systems ☐ Groundwater wells

1. ## C. Adjacent Areas

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

☐ Streams ☐ Lakes ☐ Wetlands ☐ Steep Slopes/Geohazards

☐ Residential Areas ☐ Roads ☐ Ditches, pipes, culverts

☐ Other ____

____

____

____

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

____

____

____

____

____

3. Describe the downstream drainage path leading from the site to the receiving body of water. (Minimum distance of ¼-mile (1320 feet)) Include information on the condition of the drainage structures:

____

____

____

____

D. Soils Information

If the project is proposing construction on or near slopes 15% or greater or proposing to infiltrate construction site stormwater runoff, the County may require that additional soils information be presented before allowing construction on these sites.

1. Does the project propose construction on or near slopes 15% or greater?

☐ Yes ☐No

2. Does the project propose to infiltrate construction stormwater?

☐ Yes ☐No

E. Thirteen Elements of a Construction SWPPP

The following 13 elements are required for each SWPPP. For each element that applies to the project, at least one BMP must be selected and used on the site. If an element does not apply to the project site describe why the element does not apply.

Table 1 contains a matrix for BMPs that can be used to meet the requirements of the 13 elements. Only those erosion and sediment control techniques most pertinent to small construction sites are included in Table 1.

Instructions for using and installing each BMP are given in Section 5. Drawings of many BMPs are shown in Section 6.

Instructions

1. Review the 13 elements of a construction SWPPP, below.
2. Review the matrix in Table 1 and the BMP descriptions in Section 5 to select at least one BMP for each element.
3. In Table 1, place a checkmark next to the selected BMPs.
4. Below, fill in the number and name of each selected BMP for each element, or describe why the element is not applicable to the project.
5. If a selected BMP has a corresponding drawing in Section 6, then print the drawing and attach it to the Construction SWPPP Short Form.

For phased construction plans, clearly indicate erosion control methods to be used for each phase of construction.

Element #1 – Preserve Vegetation and Mark Clearing Limits

Retain the duff layer, native topsoil, and natural vegetation in an undisturbed state to the maximum extent practicable. If it is not practicable to retain the duff layer in place, it should be stockpiled onsite, covered to prevent erosion, and replaced immediately upon completion of the ground-disturbing activity.

All construction projects must clearly mark any clearing limits, sensitive areas and their buffers, and any trees that will be preserved prior to beginning any land disturbing activities. Clearly mark the limits both in the field and on the plans. 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: ___________________________________

____

____

Element #2 – Establish Construction Access

All construction projects subject to vehicular traffic shall provide a means of preventing vehicle "tracking" of soil from the site onto streets or neighboring properties. Limit vehicle ingress and egress to one route if possible. All access points shall be stabilized with a rock pad construction entrance in accordance with BMP C105. The applicant should consider placing the entrance in the area for future driveway(s), as it may be possible to use the rock as a driveway base material. The entrance(s) must be inspected weekly, at a minimum, to ensure no excess sediment buildup or missing rock.

If sediment is tracked offsite, it shall be swept or shoveled from the paved surface immediately. Keep streets clean at all times. Street washing for sediment removal is not allowed as it can transport sediment to downstream water courses and clog the downstream stormwater system.
The proposed construction entrance must be identified on the site plan.

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

____

Or

☐ This element is not required for the project because: ______________________________

____

Element #3 – Control Flow Rates

Protect properties and waterways downstream of the development site from erosion due to increases in volume, velocity, and peak flow of stormwater runoff from the project site.

Permanent infiltration facilities shall not be used for flow control during construction unless specifically approved in writing by Environmental Services. Sediment traps can provide flow control for small sites by allowing water to pool and allowing sediment to settle out of the water.

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

____

____

Or
☐ This element is not required for this project because: ______________________________

____

Element #4 – Install Sediment Controls

Prior to leaving a construction site or discharging into an infiltration facility, surface water runoff from disturbed areas must pass through an appropriate sediment removal device. Sediment barriers are typically used to slow sheet flow of stormwater and allow the sediment to settle out behind the barrier.

Install/construct the sediment removal BMP before site grading.

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

____

Or

☐ This element is not required for this project because: ________________________________

____

Element #5 – Stabilize Soils

Stabilize exposed and unworked soils by applying BMPs that protect the soils from raindrop impact, flowing water, and wind.

From October 1 through April 30, no soils shall remain exposed or unworked for more than 2 days. From May 1 to September 30, no soils shall remain exposed and unworked for more than 7 days. This applies to all soils on site whether at final grade or not.

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

____

Or

☐ This element is not required for this project because: ________________________________

____

Element #6 – Protect Slopes

Protect slopes by diverting water at the top of the slope. Reduce slope velocities by minimizing the continuous length of the slope, which can be accomplished by terracing and roughening slope sides. Establishing vegetation on slopes will protect them as well.

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

____

Or

☐ This element is not required for this project because: ________________________________

____

Element #7 – Protect Drain Inlets

Protect all storm drain inlets that are operable during construction so that stormwater runoff does not enter the conveyance system without first being filtered or treated 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: ___________________________________

____

Or

☐ This element is not required for this project because: ________________________________

____

Element #8 – Stabilize Channels and Outlets

Stabilize all temporary onsite conveyance channels. Provide stabilization to prevent erosion of outlets, adjacent stream banks, slopes, and downstream reaches at the outlets of conveyance systems.

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

____

Or (*see next page*)

☐ This element is not required for this project because: ______________________________

____

Element #9 – Control Pollutants

Handle and dispose of all pollutants, including demolition debris and other solid wastes, in a manner that does not cause contamination of the stormwater. Provide cover and containment for all chemicals, liquid products (including paint), petroleum products, and other materials. Apply fertilizers and pesticides following manufacturers' instructions for application rates and procedures. Handle all concrete and concrete waste appropriately

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

____

Or

☐ This element is not required for this project because: ______________________________

____

Element #10 – Control Dewatering

Clean, non-turbid dewatering water, such as groundwater, can be discharged to the stormwater system provided the dewatering flow does not cause erosion or flooding of receiving waters. Do not mix clean dewatering water with turbid or contaminated dewatering water. Treat or dispose of turbid or contaminated dewatering water through a sediment pond or trap or to the local sanitary sewer, if permitted.

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

____

Or

☐ This element is not required for this project because: ______________________________

____

Element #11 – Maintain BMPs

Maintain and repair temporary 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 http://www.clark.wa.gov/development/building/documents/erosion-control-log.pdf.

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: ___________________________________

____

Or

☐ This element is not required for this project because: _________________________________

____

Element #12 – Manage the Project

Phase development projects in order to prevent soil erosion and the transport of sediment from the project site during construction.

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 shall have a current certification for Certified Erosion and Sediment Control Lead (CESCL).

The erosion control inspector is responsible for ensuring that the proposed erosion and sediment control BMPs are appropriate for the site and are functioning. They are also responsible for updating the Construction SWPPP Short Form as necessary as site conditions warrant. The erosion control inspector must be on the site or on-call 24 hours a day to ensure compliance.

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

____

Or (*see next page*)

☐ This element is not required for this project because: ________________________________

____

Element #13 – Protect Low Impact Development BMPs

Protect all bioretention and rain garden BMPs from sedimentation through installation and maintenance of erosion and sediment control BMPs on portions of the site that drain into them.

Restore the BMPs to their fully functioning condition if they accumulate sediment during construction. Restoring the BMP must include removal of sediment and any sediment-laden bioretention/rain garden soils, and replacing the removed soils with soils meeting the design specification.

Prevent compacting bioretention and rain garden BMPs by excluding construction equipment and foot traffic. Protect completed lawn and landscaped areas from compaction by construction equipment.

Control erosion and avoid introducing sediment from surrounding land uses onto permeable pavements. Do not allow muddy construction equipment on the base material or pavement. Do not allow sediment-laden runoff onto permeable pavements. Permeable pavements fouled with sediments or no longer passing an initial infiltration text must be cleaned using procedures from Book 4 or the manufacturer's procedures.

Keep all heavy equipment off existing soils under LID facilities that have been excavated to final grade to retain the infiltration rate of the soils.

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

____

Or

☐ This element is not required for this project because: ________________________________

____

F. Construction Sequencing/Phasing

The standard construction sequence is as follows:

- Mark clearing/grading limits.
- Call Building Inspector to inspect clearing/grading limits.
- 1. Install initial erosion control practices (construction entrance, silt fence, catch basin inserts).
- Contact Building Inspector to inspect initial erosion control practices.
- Clear, grade, and fill site as outlined in the site plan while implementing and maintaining temporary erosion and sediment control practices at the same time.
- Install proposed site improvements (impervious surface, landscaping, etc.).
- Contact Building Inspector for approval of permanent erosion protection and site grades.
- Remove erosion control methods as permitted by the Building Inspector and repair permanent erosion protection as necessary.
- Monitor and maintain permanent erosion protection until fully established.

List any changes from the standard construction sequence outlined above.

____

____

____

2. ____

Construction phasing: If construction is going to occur in separate phases, describe:

____

____

3. ____

____

Construction Schedule

Provide a proposed construction schedule (dates construction starts and ends, and dates for any construction phasing).

Start Date:______________________ End Date: ______________________________

Interim Phasing Dates: ____

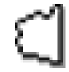
Wet Season Construction Activities: describe any construction activities that will occur between October 1 and April 30.

Table 1: BMP Matrix

BMP No.	Name	Standard Drawing Figure Number (Section 6)	Check Here if BMP Will Be Used
			(Table spans multiple pages.)
Element #1: Preserve Vegetation and Mark Clearing Limits			
BMP C101	Preserving Natural Vegetation		
BMP C102	Buffer Zones		
BMP C103	High Visibility Fence		
BMP C233	Silt Fence	Figure 32	
Element #2: Establish Construction Entrance			
BMP C105	Stabilized Construction Entrance	Figure 33	
BMP C106	Wheel Wash	Figure 34	
BMP C107	Construction Road/Parking Area Stabilization		
Element #3: Control Flow Rates			
BMP C240	Sediment Trap	Figure 35	
BMP C203	Water Bar		
BMP C207	Check Dams	Figures 36, 37	
BMP C235	Wattles	Figure 38	
Element #4: Install Sediment Controls			
BMP C231	Brush Barrier	Figure 39	
BMP C232	Gravel Filter Berm	Figure 39	
BMP C233	Silt Fence	Figure 32	
BMP C234	Vegetated Strip		
BMP C235	Wattles	Figure 38	
BMP C240	Sediment Trap	Figure 35	
Element #5: Stabilize Soils			
BMP C120	Temporary and Permanent Seeding		
BMP C121	Mulching		
BMP C122	Nets and Blankets	Figures 40, 41, 42	
BMP C123	Plastic Covering	Figure 43	
BMP C124	Sodding		
BMP C125	Compost		
BMP C126	Topsoiling		
BMP C131	Gradient Terraces		
BMP C130	Surface Roughening	Figure 44	
BMP C140	Dust Control		
Element #6: Protect Slopes			
BMP C200	Interceptor Dike and Swale	Figure 45	
BMP C201	Grass-Lined Channels		
BMP C203	Water Bars		

BMP No.	Name	Standard Drawing Figure Number (Section 6)	Check Here if BMP Will Be Used
			(Table spans multiple pages.)
BMP C204	Pipe Slope Drains	Figure 46	
BMP C206	Level Spreader		
BMP C207	Check Dams	Figures 36, 37	
BMP C208	Triangular Silt Dike	Figure 47	
Element #7: Protect Drain Inlets			
BMP C220	Storm Drain Inlet Protection	Figures 48, 49, 50, 51, 52	
Element #8: Stabilize Channels and Outlets			
BMP C122	Nets and Blankets	Figures 40, 41, 42	
BMP C202	Channel Lining		
BMP C207	Check Dams	Figures 36, 37	
BMP C209	Outlet Protection	Figures 53, 54	
Element #9: Control Pollutants			
BMP C150	Materials On Hand		
BMP C151	Concrete Handling		
BMP C152	Sawcutting and Surfacing Pollution Prevention		
BMP C153	Materials, Delivery, Storage and Containment		
BMP C154	Concrete Washout Area		
Element #10: Control Dewatering			
BMP C203	Water Bars		
BMP C236	Vegetative Filtration		
Element #11: Maintain BMPs			
BMP C150	Materials on Hand		
BMP C160	Certified Erosion and Sediment Control Lead		
Element #12: Manage the Project			
BMP C160	Certified Erosion and Sediment Control Lead		
BMP C162	Scheduling		
Element #13: Protect Low Impact Development BMPs			
BMP C102	Buffer Zone		
BMP C103	High Visibility Fence		
BMP C200	Interceptor Dike and Swale	Figure 45	
BMP C201	Grass-Lined Channels		
BMP C207	Check Dams	Figures 36, 37	
BMP C208	Triangular Silt Dike	Figure 47	
BMP C231	Brush Barrier	Figure 39	
BMP C233	Silt Fence	Figure 32	
BMP C234	Vegetated Strip		

Section 4 — Erosion and Sediment Control Site Plan

Submit an erosion and sediment control site plan on 8½ x11 or 11x17 paper. The  icon means that information may be found using Clark County Maps Online.

The plan may be drawn by hand on graph paper or may be drafted electronically. See page for blank graph paper. An example of an erosion and sediment control site plan is on page , below.

The erosion and sediment control site plan must show the location of improvements, grading, filling, and construction stormwater and erosion control BMPs. Show the following items on the site plan:

- Address, Parcel Number, and Street names
- North Arrow
- Indicate boundaries of existing vegetation (e.g. tree lines, grassy areas, pasture areas, fields, etc.)
- Identify any on-site or adjacent critical areas and associated buffers (e.g. wetlands, steep slopes, streams, etc.).
- Show existing and proposed contours.
- Delineate areas that are to be cleared and graded.
- Show all cut and fill slopes, indicating top and bottom of slope catch lines
- Show locations where upstream run-on enters the site and locations where runoff leaves the site.
- Indicate existing surface water flow direction(s).
- Label final grade contours and indicate 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.
- Indicate locations and outlets of any dewatering systems (usually to sediment trap).
- Identify and locate all erosion control techniques to be used during and after construction.
- Finish floor elevations of all structures.

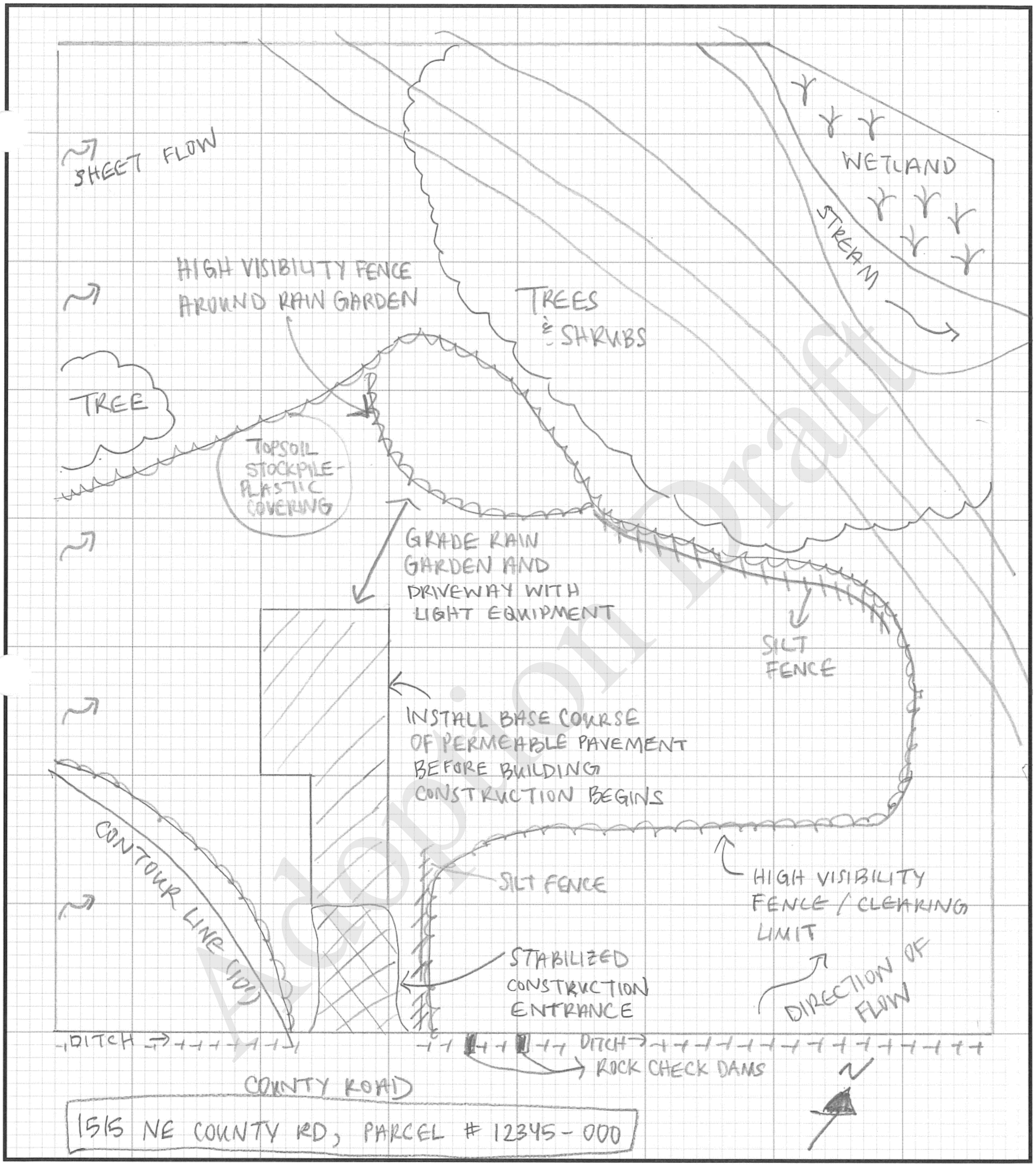


Figure 1: Example Erosion and Sediment Control Site Plan

Section 5 — Best Management Practices

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BMP C101: Preserving Natural Vegetation

Purpose and Definition

Preserving vegetation, both native and non-native 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.

Quick References

Use For Element(s):	1	**Standard Drawing**	n/a

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

- Inventory vegetation prior to construction, remove hazard trees and identify vegetation to be saved and protected, document the health and vigor of the vegetation to be protected;
- Identify the critical root zone for vegetation to be protected (within the drip line of the vegetation – see figure below), place the 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.
- Phase construction to preserve natural vegetation 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. Prevent ground disturbance and compaction at least as far out as the dripline of trees to be saved, if feasible.
- 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.

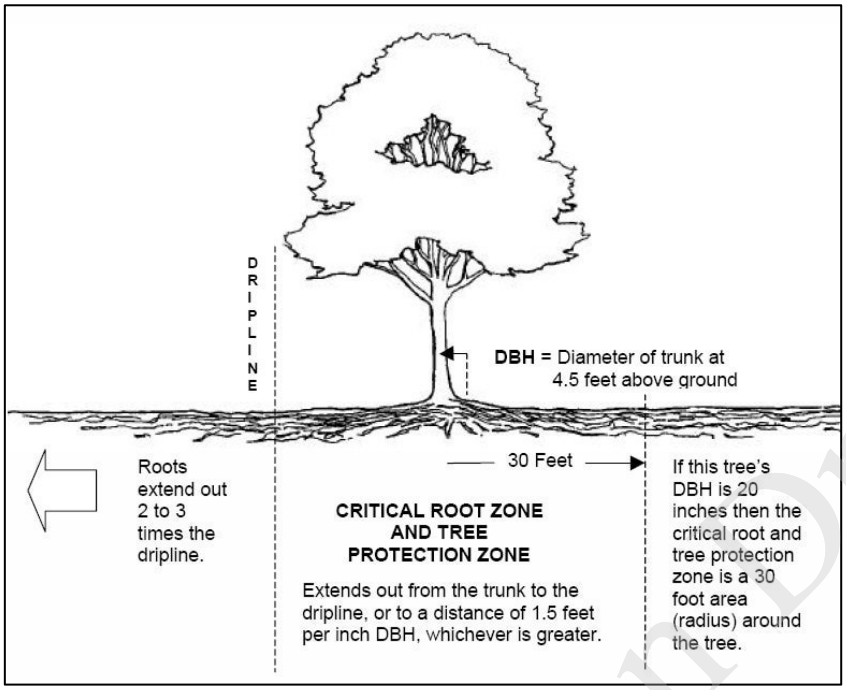


Figure 2: Illustration of Tree's Critical Root Zone

(Source: Athens-Clarke County Community Tree Program, Georgia)

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 Definition

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

Quick References

Use For Element(s):	1, 13	**Standard Drawing**	n/a

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 Definition

Fencing is intended to:

1. Restrict clearing to approved limits.
2. Prevent disturbance of sensitive areas, buffers, and other areas required to be left undisturbed.
3. Limit construction traffic to designated construction entrances, exits, or internal roads.
4. Protect areas where marking with survey tape may not provide adequate protection.

Quick References

Use For Element(s):	1, 13	**Standard Drawing**	n/a

Conditions of Use

Use whenever necessary to establish clearing limits and to exclude construction equipment from and prevent clearing of sensitive areas, their buffers, and other areas to be left uncleared.

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.

BMP C105: Stabilized Construction Entrance / Exit

Purpose and Definition

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

Quick References

Use For Element(s):	2	**Standard Drawing**	Figure 33

Conditions of Use

Construction entrances shall be stabilized wherever traffic will be entering or leaving a construction site if paved roads or other paved areas are within 1,000 feet of the site.

For residential construction, provide stabilized construction entrances for each building site under construction in addition to at the main subdivision entrance. Stabilized surfaces shall be of sufficient length/width to provide vehicle access/parking, based on lot size/configuration.

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

Figure 3: Stabilized Construction Entrance on a small site

Design Criteria

Construct a stabilized pad of quarry spalls at entrances and exits for construction sites.

A 100' minimum length of the entrance may be reduced to the maximum practicable size when the size or configuration of the site does not allow the full length.

Construct stabilized construction entrances with a 12-inch thick pad of 2-inch to 6-inch quarry spalls, a 4-inch course of asphalt treated base (ATB), or use existing pavement. Do not use crushed concrete, cement, or calcium chloride.

A separation geotextile shall be placed under the spalls to prevent fine sediment from pumping up into the rock pad. The geotextile shall meet the following standards:

Grab Tensile Strength (ASTM D4751)	200 psi min.
Grab Tensile Elongation (ASTM D4632)	30% max.
Mullen Burst Strength (ASTM D3786-80a)	400 psi min.
AOS (ASTM D4751)	20-45 (U.S. standard sieve size)

Fencing (see BMP C103) shall be installed as necessary to restrict traffic to the construction entrance.

Whenever possible, the entrance shall be constructed on a firm, compacted subgrade. This can substantially increase the effectiveness of the pad and reduce the need for maintenance.

Construction entrances should avoid crossing existing sidewalks and back of walk drains if at all possible. If a construction entrance must cross a sidewalk or back of walk drain, the full length of the sidewalk and back of walk drain must be covered and protected from sediment leaving the site.

Maintenance Standards

Quarry spalls shall be added if the pad is no longer in accordance with the specifications.

- If the entrance is not preventing sediment from being tracked onto pavement, then alternative measures to keep the streets free of sediment shall be used. This may include replacement/cleaning of the existing quarry spalls, street sweeping, an increase in the dimensions of the entrance, or the installation of a wheel wash (BMP C106).
- Any sediment that is tracked onto pavement shall be removed by shoveling or street sweeping. The sediment collected by sweeping shall be removed or stabilized on site. The pavement shall not be cleaned by washing down the street, except when high efficiency sweeping is ineffective and there is a threat to public safety. If it is necessary to wash the streets, the construction of a

small sump to contain the wash water shall be considered. The sediment would then be washed into the sump where it can be controlled.

- Perform street sweeping by hand or with a high efficiency sweeper. Do not use a non-high efficiency mechanical sweeper because this creates dust and throws soils into storm systems or conveyance ditches.
- Remove any quarry spalls that end up on the roadway immediately.
- If vehicles are entering or exiting the site at points other than the construction entrance(s), fencing (see BMP C103) shall be installed to control traffic.
- Upon project completion and site stabilization, all construction accesses intended as permanent access for maintenance shall be permanently stabilized.

BMP C106: Wheel Wash

Purpose and Definition

A wheel wash is a paved or fabricated structure containing water through which vehicles are driven. It reduces the amount of sediment transported onto paved roads by motor vehicles.

Quick References

Use For Element(s):	2	Standard Drawing	Figure 34

Conditions of Use

Use a wheel wash when a stabilized construction entrance (BMP C105) is not preventing sediment from being tracked onto pavement.

- Wheel washing is generally an effective BMP when installed with careful attention to topography. For example, a wheel wash can be detrimental if installed at the top of a slope abutting a right-of-way where the water from the dripping truck can run unimpeded into the street.
- Pressure washing combined with an adequately sized and surfaced pad with direct drainage to a large 10-foot x 10-foot sump can be very effective.
- Discharge wheel wash or tire bath wastewater to a separate on-site treatment system that prevents discharge to surface water, such as closed-loop recirculation or upland land application, or to the sanitary sewer with local sewer district approval.
- Wheel wash or tire bath wastewater should not include wastewater from concrete washout areas.

Design Criteria

Design specifications are shown in Figure 34 in Section 6. The Responsible Official may allow other designs.

Pavement should be a minimum of 6 inches of asphalt treated base (ATB) over crushed base material or 8 inches over compacted subgrade.

Before paving, use a low clearance truck to test clearance of the wheel wash.

Maintain the water level from 12 to 14 inches deep.

Install midpoint spray nozzles if the wheel wash alone is not effective at preventing sediment transport off the site.

Design the wash with a small grade change, 6- to 1-inches for a 10-foot-wide pond, to allow sediment to flow to the low side of pond to help prevent re-suspension of sediment.

Install a drainpipe with a 2- to 3-foot riser on the low side of the pond to allow for cleaning and refilling.

Polymers may be used to promote coagulation and flocculation in a closed-loop system. Polyacrylamide (PAM) may be added to the wheel wash water at a rate of 0.25 - 0.5 pounds per 1,000 gallons of water.

Commercial temporary wheel wash systems are available and may be used if they meet the design specifications.

Maintenance Standards

Replace wheel wash water at the start of each working day. During each working day, replace wheel wash water again at least once, or more often on large earthwork jobs where more than 10-20 trucks per hour leave the site.

Water removed from the wheel wash must be properly disposed of. The preferred disposal option is discharge to a sanitary sewer at an approved location. Other disposal options include discharge back into a pretreatment facility on the site. See Appendix 3-E in Book 3 for additional guidance.

BMP C107: Construction Road/Parking Area Stabilization

Purpose and Definition

Stabilizing subdivision roads, parking areas, and other on-site vehicle transportation routes immediately after grading reduces erosion caused by construction traffic or runoff.

Quick References

Use For Element(s):	2	**Standard Drawing**	n/a

Conditions of Use

Roads or parking areas shall be stabilized wherever they are constructed, whether permanent or temporary, for use by construction traffic.

High Visibility Fencing (see BMP C103) shall be installed, if necessary, to limit the access of vehicles to only those roads and parking areas that are stabilized.

Design Criteria

- On areas that will receive asphalt as part of the project, install the first lift as soon as possible.
- Apply 6 inches of 2- to 4-inch crushed rock, gravel base, or crushed surfacing base course immediately after grading or utility installation. A 4-inch course of asphalt treated base (ATB) may also be used, or the road/parking area may be paved. If cement or cement kiln dust is used for roadbase stabilization, pH monitoring and BMPs (BMPs C252 and C253) are required to evaluate and minimize the effects on stormwater. If the area will not be used for permanent roads, parking areas, or structures, a 6-inch depth of hog fuel may also be used. Whenever possible, construction roads and parking areas shall be placed on a firm, compacted subgrade.
- Temporary road gradients shall not exceed 15 percent. Roadways shall be carefully graded to drain.
    - If runoff is concentrated, then do either 1 or 2, and also do 3 below:
        1. Provide drainage ditches on each side of the roadway in the case of a crowned section
        2. Provide a drainage ditch on one side of the roadway in the case of a super-elevated section.
        3. Direct drainage ditches to a sediment control BMP.

- If the road is graded so that runoff sheetflows, then direct flow into a Vegetated Strip (BMP C234).

- Protect storm drain inlets to prevent sediment-laden water entering the storm drain system (see BMP C220).

Maintenance Standards

- Inspect stabilized areas regularly, especially after large storm events.
- Add crushed rock, gravel base, etc. as required to maintain a stable driving surface and to stabilize any areas that have eroded.
- If areas are paved, perform street cleaning at the end of each day or more often if necessary.
- Following construction, restore these areas to pre-construction condition or better to prevent future erosion.

BMP C120: Temporary and Permanent Seeding

Purpose and Definition

Seeding reduces erosion by stabilizing exposed soils with vegetative cover. A well-established vegetative cover is one of the most effective methods of reducing erosion.

Quick References

Use For Element(s):	5	**Standard Drawing**	n/a

Conditions of Use

Use seeding throughout the project on disturbed areas that have reached final grade or that will remain unworked for more than 30 days.

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

Design Criteria

Timing

Between July 1 and August 30 seeding requires irrigation until 75 percent grass cover is established.

Between October 1 and March 30 seeding requires a cover of mulch with straw or an erosion control blanket until 75 percent grass cover is established.

Review all disturbed areas in late August to early September and complete all seeding by the end of September.

Seed and mulch all disturbed areas not otherwise vegetated at final site stabilization. Final stabilization means the completion of all soil disturbing activities at the site and the establishment of a permanent vegetative cover, or equivalent permanent stabilization measures (such as pavement, riprap, gabions or geotextiles) which will prevent erosion.

Seed

The seed mixes listed in the tables below include recommended mixes for both temporary and permanent seeding in various conditions.

Apply seed mixes in accordance with the supplier's recommended application rate for each seed mix.

Other mixes may be appropriate depending on site conditions. The Responsible Official may approve alternative seed mixes recommended in writing for the project site by the Clark Conservation District.

Table 2: Temporary Erosion Control Seed

	% Weight
Annual rye grass *Lolium multiflorium*	100

Table 3: Low-Growing Turf Seed Mix

	% Weight	**% Purity**	**% Germination**
Dwarf tall fescue (several varieties) *Festuca arundinacea var.*	45	98	90
Dwarf perennial rye (Barclay) *Lolium perenne var. barclay*	30	98	90
Red fescue Festuca rubra	20	98	90
Colonial bentgrass *Agrostis tenuis*	5	98	90
Add One of the Following to Mix:	**Lbs per Acre**		
Poco barley *Hordeum vulgare var Poco*	50		
Regreen wheat x wheatgrass hybrid *Triticum aestivum × Elytrigia elongata*	50		

Use the low-growing turf seed mix in dry situations where there is no need for watering.

Table 4: Bioswale Seed Mix

Bioswale Seed Mix
See Table 4.7.

Use the bioswale seed mix for bioswales and other intermittently wet areas.

Table 5: Wet Area Seed Mix

	% Weight	% Purity	% Germination
Tall or meadow fescue *Festuca arundinacea or* *Festuca elatior*	60-70	98	90
Seaside/Creeping bentgrass *Agrostis palustris*	10-15	98	85
Meadow foxtail *Alepocurus pratensis*	10-15	90	80
Alsike clover *Trifolium hybridum*	1-6	98	90
Redtop bentgrass *Agrostis alba*	1-6	92	85
Add One of the Following to Mix:	**Lbs per Acre**		
Poco barley *Hordeum vulgare var Poco*	50		
Regreen wheat x wheatgrass hybrid *Triticum aestivum x Elytrigia elongata*	50		

Use the wet area seed mix for very wet areas that are not regulated wetlands. Apply wet area seed mix in accordance with the supplier's recommended application rate for each seed mix.

Seeding should take place in September or very early October in order to obtain adequate establishment prior to the winter months.

Hydroseeding

- Hydroseed applications shall include a minimum of 1,500 pounds per acre of mulch with 3 percent tackifier. See BMP C121: Mulching for specifications.

- Re-install topsoil on the disturbed soil surface before application. Areas that will have seeding only and not landscaping may need compost or meal-based mulch included in the hydroseed in order to establish vegetation.

Hand-Seeding

Seed may be installed by hand in only the following circumstances:

- For establishing temporary vegetation
    - Cover by straw, mulch, or topsoil
- For establishing permanent vegetation in areas less than 1 acre
    - Cover with mulch, topsoil, or erosion blankets

Mulch

Use of mulch for seeding is required. Mulch may be applied on top of the seed or simultaneously by hydroseeding. See BMP C121: Mulching for specifications.

Seeding Vegetated Channels

Install channels intended for vegetation before starting major earthwork and hydroseed with a Bonded Fiber Matrix. For vegetated channels that will have high flows, install erosion control blankets over hydroseed. Before allowing water to flow in vegetated channels, establish 75 percent vegetation cover. If vegetated channels cannot be established by seed before water flow; install sod in the channel bottom—over hydromulch and erosion control blankets.

Confirm the installation of all required surface water control measures to prevent seed from washing away.

Roughening and Rototilling

The seedbed should be firm and rough. Roughen all soil no matter what the slope.

If engineering purposes require compaction, then track walk slopes before seeding. Do not backblade or smooth slopes greater than 4H:1V if they are to be seeded.

Restoration-based landscape practices require deeper incorporation than that provided by a simple single-pass rototilling treatment. Wherever practical, initially rip the subgrade to improve long-term permeability, infiltration, and water inflow qualities. At a minimum, permanent areas shall use soil amendments to achieve organic matter and permeability performance defined in engineered soil/landscape systems. For systems that are deeper than 8 inches complete the rototilling process in multiple lifts, or prepare the engineered soil system per specifications and place to achieve the specified depth.

Fertilizer

Soil tests are recommended to determine the most effective fertilizer mix and application rate. Based on the results, add appropriate level of fertilizer, such as a slow release 10-4-6 (N-P-K) fertilizer.

Use a slow-release 10-4-6 N-P-K (nitrogen-phosphorus-potassium) fertilizer at a rate of 90 pounds per acre. For hydroseeding applications, do not add fertilizer to the hydromulch machine, or agitate, more than 20 minutes before use to prevent destruction of the slow-release coating.

The Responsible Official may authorize the use of other products that take the place of chemical fertilizers, such as products containing seaweed extracts, or mulches containing 100% cottonseed meal.

Bonded Fiber Matrix and Mechanically Bonded Fiber Matrix

On steep slopes use Bonded Fiber Matrix (BFM) or Mechanically Bonded Fiber Matrix (MBFM) products. Apply BFM/MBFM products at a minimum rate of 3,000 pounds per acre of mulch with approximately 10 percent tackifier. Achieve a minimum of 95 percent soil coverage during application. Install products per manufacturer's instructions. Most products require 24-36 hours to cure before rainfall and cannot be installed on wet or saturated soils. Generally, products come in 40-50 pound bags and include all necessary ingredients except for seed and fertilizer.

Maintenance Standards

For areas that receive sheet or concentrated flows, reseed any area that fails to establish 100 percent cover. For other areas, reseed areas that fail to establish at least 80 percent cover. Reseed and protect by mulch any areas that experience erosion after establishment.

If reseeding is ineffective, use an alternate method such as sodding (BMP C124), mulching (BMP C121), or nets/blankets (BMP C122). If winter weather prevents adequate grass growth, the Responsible Official may relax the time limitation when sensitive areas would otherwise be protected.

Supply seeded areas with adequate moisture, but do not water to the extent that it causes runoff or erosion.

BMP C121: Mulching

Purpose and Definition

Mulching 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. This section discusses the most common types of mulch, although many more are available.

Quick References

Use For Element(s):	5	**Standard Drawing**	n/a

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

For mulch materials, application rates, and specifications, see Table 6, below.

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.

Coarse Compost

- 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.

Tackifier, if used, shall be plant-based, such as guar or alpha plantago, or chemical-based such as polyacrylamide or polymers.

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.

Mulch used within the ordinary high-water mark of surface waters should be selected to minimize potential flotation of organic matter. Composted organic materials have higher specific gravities (densities) than straw, wood, or chipped material.

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.

Table 6: Mulch Standards and Guidelines

Mulch Material	Quality Standards	Application Rates*	Remarks (Table spans multiple pages)
Straw	Straw mulch shall meet quality standards established in WSDOT Standard Specifications, 9-14.4(1).	2"-3" thick; 5 bales per 1,000 sf or 2-3 tons per acre	Cost-effective protection when applied with adequate thickness. Hand-application generally requires greater thickness than blown straw. The thickness of straw may be reduced by half when used in conjunction with seeding. In windy areas straw must be held in place by crimping, using a tackifier, or covering with netting. Blown straw always has to be held in place with a tackifier as even light winds will blow it away. Straw, however, has several deficiencies that should be considered when selecting mulch materials. It often introduces and/or encourages the propagation of weed species and it has no significant long-term benefits. It should also not be used within the ordinary high-water elevation of surface waters (due to flotation).
Hydromulch	No growth inhibiting factors.	Approx. 25-30 lbs per 1,000 sf or 1,500 - 2,000 lbs per acre	Shall be applied with hydromulcher. Shall not be used without seed and tackifier unless the application rate is at least doubled. Fibers longer than about ¾-1 inch clog hydromulch equipment. Fibers should be kept to less than ¾ inch.
Compost	No visible water or dust during handling. Must be produced in accordance with	2" thick min.; approx. 100 tons per acre (approx. 800 lbs per yard)	More effective control can be obtained by increasing thickness to 3". Excellent mulch for protecting final grades until landscaping because it can be directly seeded or tilled into soil as an amendment. Compost used for mulch has a coarser size gradation than compost used for BMP C125 or

Mulch Material	Quality Standards	Application Rates*	Remarks (Table spans multiple pages)
	WAC 173-350, Solid Waste Handling Standards, but may have up to 35% biosolids .		BMP T5.13. It is more stable and practical to use in wet areas and during rainy weather conditions. Do not use near wetlands or near phosphorous impaired water bodies.
Chipped Site Vegetation	Average size shall be several inches. Gradations from fines to 6 inches in length for texture, variation, and interlocking properties.	2" thick min.;	This is a cost-effective way to dispose of debris from clearing and grubbing, and it eliminates the problems associated with burning. Generally, it should not be used on slopes above approx. 10% because of its tendency to be transported by runoff. It is not recommended within 200 feet of surface waters. If seeding is expected shortly after mulch, the decomposition of the chipped vegetation may tie up nutrients important to grass establishment.
Wood-based Mulch or Wood Straw	No visible water or dust during handling. Must be purchased from a supplier with a Solid Waste Handling Permit or one exempt from solid waste regulations.	2" thick min.; approx. 100 tons per acre (approx. 800 lbs. per cubic yard)	This material is often called "hog or hogged fuel." The use of mulch ultimately improves the organic matter in the soil. Special caution is advised regarding the source and composition of wood-based mulches. Its preparation typically does not provide any weed seed control, so evidence of residual vegetation in its composition or known inclusion of weed plants or seeds should be monitored and prevented (or minimized).
Wood Strand Mulch	A blend of loose, long, thin wood pieces derived from native conifer or deciduous trees with high length-to-width ratio.	2" thick min.	Cost-effective protection when applied with adequate thickness. 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. (WSDOT specification (9-14.4(4))

* Application rates in the table are minimums. 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.

BMP C122: Nets and Blankets

Purpose and Definition

Erosion control nets and blankets are intended to prevent erosion and hold seed and mulch in place on steep slopes and in channels so that vegetation can become well established. The application of appropriate netting or blanket to drainage ditches and swales can protect bare soil from channelized runoff while vegetation is established. Nets and blankets also can capture a great deal of sediment due to their open, porous structure. In addition, some nets and blankets can be used to permanently reinforce turf to protect drainage ways during high flows. Nets (commonly called matting) are strands of material woven into an open, but high-tensile strength net. Blankets are strands of material that are loosely woven and form a layer of interlocking fibers, typically held together by a biodegradable or photodegradable netting. They generally have lower tensile strength than nets, but cover the ground more completely. Coir (coconut fiber) fabric comes as both nets and blankets.

Quick References

Use For Element(s):	5, 8	**Standard Drawing**	Figures 40, 41, 42

Conditions of Use

Erosion control nets and blankets should be used:

- To aid permanent vegetated stabilization of slopes 2H:1V or greater and with more than 10 feet of vertical relief.
- To protect bare soil from channelized runoff while vegetation is established in drainage ditches and swales (highly recommended). Nets and blankets may be used to permanently stabilize channels and may provide a cost-effective, environmentally preferable alternative to riprap.

Design Criteria

- See two figures below for typical orientation and installation of blankets used in channels and as slope protection. Note: these are typical only; install all blankets per the manufacturer's instructions.
- The blanket or net must maintain ground contact along the entire surface.
- Install mulch (BMP C121) with most nets (e.g. jute matting). Excelsior, woven straw blankets and coir (coconut fiber) blankets may be installed without mulch.
- Use synthetic blankets on extremely steep, unstable, wet, or rocky slopes and on riverbanks, beaches and other high-energy environments. Hydromulch the soil before installing a synthetic blanket.

Installation of Blankets on Slopes

Follow the Design Criteria above and these additional instructions. Install products per manufacturer's specifications. General instructions are:

1. Complete final grade and track walk up and down the slope.

2. Install hydromulch with seed and fertilizer.

3. Dig a small trench, approximately 12 inches wide by 6 inches deep along the top of the slope.

4. Install the leading edge of the blanket into the small trench and staple or stake approximately every 18 inches.

5. Roll the blanket slowly down the slope as installer walks backwards and install staples per manufacturer's instructions as product is unrolled. Do not allow the blanket to roll down the slope on its own. Do not walk on the blanket after it is in place.

6. If the blanket is not long enough to cover the entire slope length, the trailing edge of the upper blanket should overlap the leading edge of the lower blanket and be stapled. On steeper slopes, this overlap should be installed in a small trench, stapled, and covered with soil.

Maintenance Standards

- Repair and staple any areas of the net or blanket that are damaged or not in close contact with the ground.
- If erosion occurs as a result of poorly controlled drainage, fix the problem and protect the eroded areas.

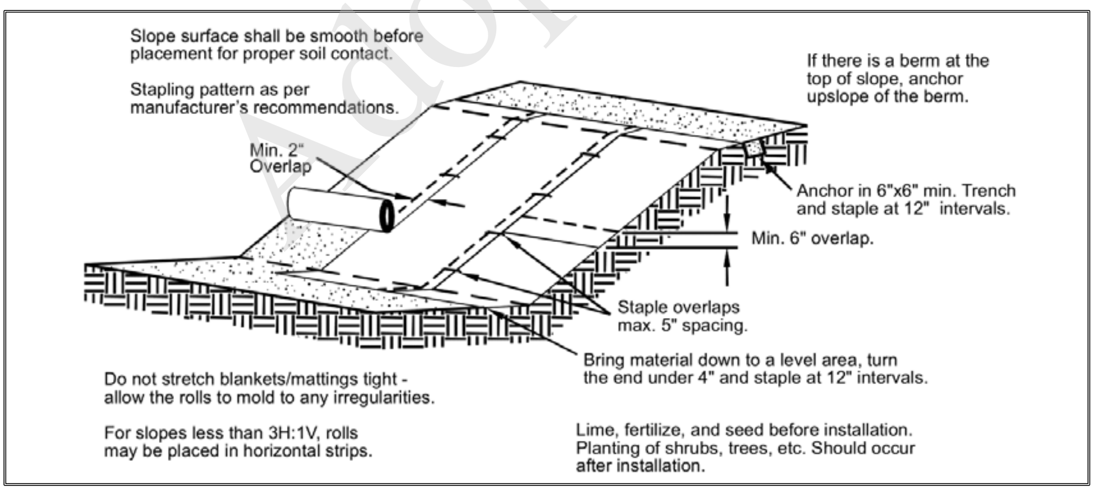
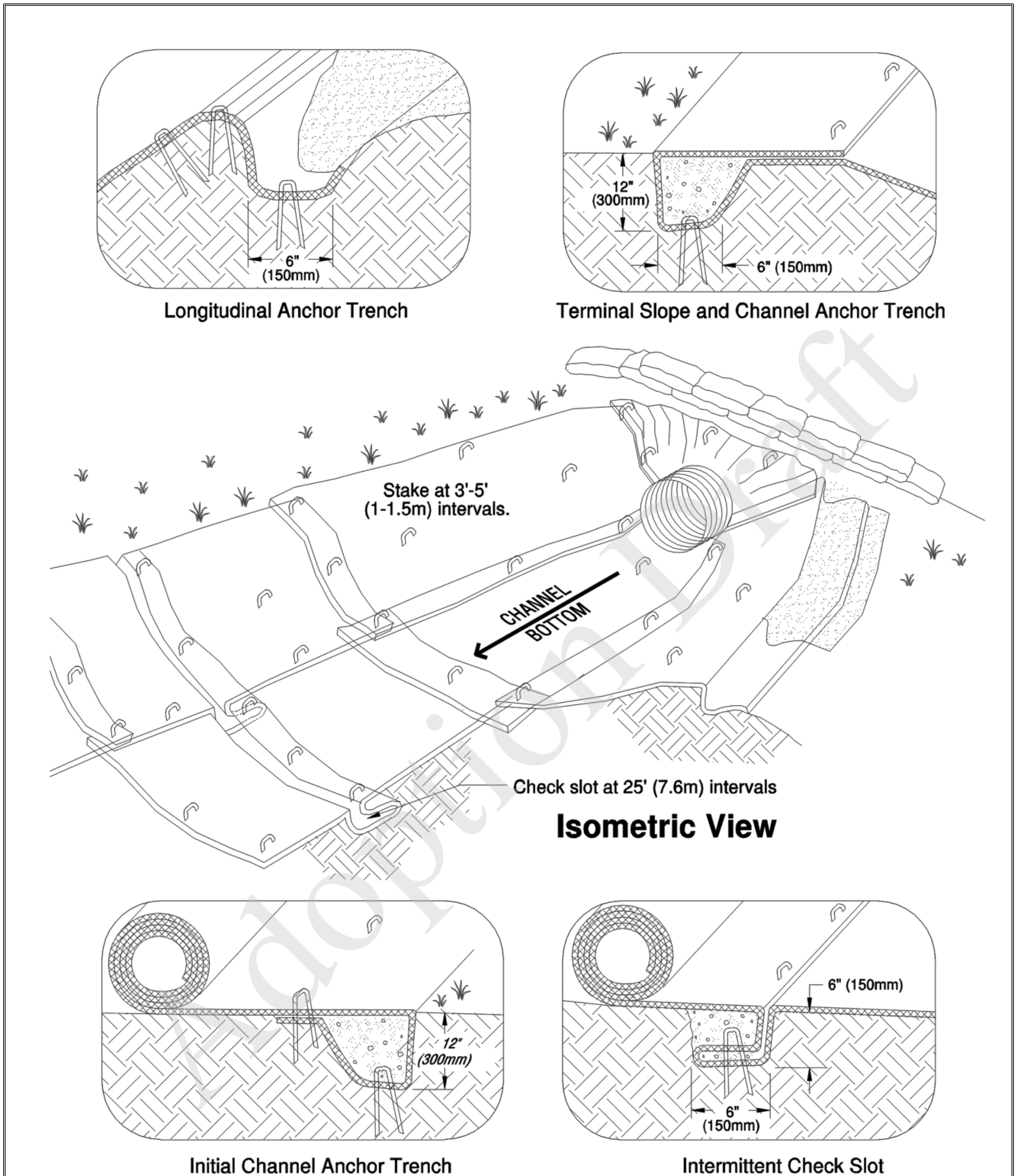


Figure 4: Slope Installation - Blankets and Nets

(Source: SMMWW)



NOTES:
1. Check slots to be constructed per manufacturers specifications.
2. Staking or stapling layout per manufacturers specifications.

Figure 5: Channel Installation - Blankets and Nets

(Source: WA State Dept. of Ecology)

BMP C123: Plastic Covering

Purpose and Definition

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

Quick References

Use For Element(s):	5	**Standard Drawing**	Figure 43

Figure 6: 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.
- Other uses for plastic include:

  1. Temporary ditch liner.
  2. Pond liner in temporary sediment pond.
  3. Liner for bermed temporary fuel storage area if plastic is not reactive to the type of fuel being stored.
  4. Emergency slope protection during heavy rains.
  5. Temporary drainpipe ("elephant trunk") used to direct water.

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

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 C124: Sodding

Purpose and Definition

The purpose of sodding is to establish permanent turf for immediate erosion protection and to stabilize drainage ways where concentrated overland flow will occur.

Quick References

Use For Element(s):	5	**Standard Drawing**	n/a

Conditions of Use

Sodding may be used in the following areas:

- Disturbed areas that require short-term or long-term cover.
- Disturbed areas that require immediate vegetative cover.
- All drainageways that require vegetative lining.

Design Criteria

Sod shall be free of weeds, of uniform thickness (approximately 1-inch thick), and shall have a dense root mat for mechanical strength.

The following steps are recommended for sod installation:

- Shape and smooth the surface to final grade in accordance with the approved grading plan. over-excavated 4 to 6 inches below design elevation to allow room for soil amendments and sod.
- Amend 4 inches (minimum) of compost into the top 8 inches of the soil if the organic content of the soil is less than ten percent or the permeability is less than 0.6 inches per hour.
- Fertilize according to the supplier's recommendations. Work lime and fertilizer 1 to 2 inches into the soil, and smooth the surface.
- Lay strips of sod beginning at the lowest area to be sodded and perpendicular to the direction of water flow. Wedge strips securely into place. Square the ends of each strip to provide for a close, tight fit. Stagger joints at least 12 inches. Staple on slopes steeper than 3H:1V. Staple the upstream edge of each sod strip.
- Roll the sodded area and irrigate.
- When sodding is carried out in alternating strips or other patterns, seed the areas between the sod immediately after sodding.

Maintenance Standards

If the grass is unhealthy, determine the cause and take appropriate action to reestablish a healthy groundcover. If necessary, remove the sod and install a different BMP.

BMP C125: Topsoiling / Composting

Purpose

Topsoiling and composting provide a suitable growth medium for final site stabilization with vegetation. While not a permanent cover practice in itself, topsoiling and composting are an integral component of providing permanent cover in those areas where there is an unsuitable soil surface for plant growth. Use this BMP in conjunction with other BMPs such as seeding, mulching, or sodding.

Note that this BMP is functionally equivalent to BMP T5.13, Post-Construction Soil Quality and Depth, which is required for all disturbed areas that will be developed as lawn or landscaped areas at the completed project site.

Native soils and disturbed soils that have been organically amended not only retain much more stormwater, but they also serve as effective biofilters for urban pollutants and, by supporting more vigorous plant growth, reduce the water, fertilizer and pesticides needed to support installed landscapes. Topsoil does not include any subsoils but only the material from the top several inches including organic debris.

This BMP also includes standards for managing soil stock piles on site.

Quick References

Use For Element(s):	5	**Standard Drawing**	n/a

Conditions of Use

- Permanent landscaped areas shall contain healthy topsoil that reduces the need for fertilizers, improves overall topsoil quality, provides for better vegetal health and vitality, improves hydrologic characteristics, and reduces the need for irrigation.
- Leave native soils and the duff layer undisturbed to the maximum extent practicable. Do not strip existing, properly functioning soil system and vegetation if the only purpose is topsoiling later.
- Areas that already have good topsoil, such as undisturbed areas, do not require soil amendments.
- Restore, to the maximum extent practical, native soils disturbed during clearing and grading to a condition equal to or better than the original site condition's moisture-holding capacity. Use on-site native topsoil, incorporate amendments into on-site soil, or import blended topsoil.
- When topsoiling is required when establishing vegetation on shallow soils, and soils of critically low pH (high acid) levels.

Design Criteria

Meet the following requirements for disturbed areas that will be developed as lawn or landscaped areas at the completed project site:

- Maximize the depth of the topsoil wherever possible to provide the maximum possible infiltration capacity and beneficial growth medium. Topsoil shall have:
    - A minimum depth of 8-inches. Scarify subsoils below the topsoil layer at least 4-inches with some incorporation of the upper material to avoid stratified layers, where feasible. Ripping or re-structuring the subgrade may also provide additional benefits regarding the overall infiltration and interflow dynamics of the soil system.
    - A minimum organic content of 10% dry weight in planting beds and 5% organic matter content in turf areas. Incorporate organic amendments to a minimum 8-inch depth except where tree roots or other natural features limit the depth of incorporation.
    - A pH between 6.0 and 8.0 or matching the pH of the undisturbed soil.
    - If blended topsoil is imported, then fines should be limited to 25 percent passing through a 200 sieve.
    - Mulch planting beds with 2 inches of organic material.
- Accomplish the required organic content, depth, and pH by returning native topsoil to the site, importing topsoil of sufficient organic content, and/or incorporating organic amendments.
    - When using the option of incorporating amendments to meet the organic content requirement, use compost that meets the compost specifications for Bioretention (see BMP T5.14B), with the exception that the compost may have up to 35% biosolids or manure.
    - Sections three through seven of the document entitled, *Guidelines and Resources for Implementing Soil Quality and Depth BMP T5.13 in WDOE Stormwater Management Manual for Western Washington*, provides useful guidance for implementing whichever option is chosen. It includes guidance for pre-approved default strategies and guidance for custom strategies. Check with your local jurisdiction concerning its acceptance of this guidance. It is available through the organization Soils for Salmon. As of this printing the document may be found at: http://www.soilsforsalmon.org/pdf/Soil_BMP_Manual.pdf.

Select composition and construction of the soil system based on plant species desired to cover the area. For example, incorporation of topsoil may favor grasses, while layering with mildly acidic, high-carbon amendments may favor more woody vegetation.

- Allow sufficient time in scheduling for topsoil spreading prior to seeding, sodding, or planting.

- Take care when applying top soil to subsoils with contrasting textures. Sandy topsoil over clayey subsoil is a particularly poor combination, as water creeps along the junction between the soil layers and causes the topsoil to slough. If topsoil and subsoil are not properly bonded, water will not infiltrate the soil profile evenly and it will be difficult to establish vegetation. The best method to prevent a lack of bonding is to actually work the topsoil into the layer below for a depth of at least 6 inches.
- Field exploration of the site shall be made to determine if there is surface soil of sufficient quantity and quality to justify stripping. Topsoil shall be friable and loamy (loam, sandy loam, silt loam, sandy clay loam, and clay loam). Avoid areas of natural groundwater recharge.
- Stripping shall be confined to the immediate construction area. A 4-inch to 6-inch stripping depth is common, but depth may vary depending on the particular soil. All surface runoff control structures shall be in place prior to stripping.
- Do not place topsoil while in a frozen or muddy condition, when the subgrade is excessively wet, or when conditions exist that may otherwise be detrimental to proper grading or proposed sodding or seeding.
- In 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. Stockpiled topsoil is to be reapplied to other portions of the site where feasible. Stockpiling of topsoil shall occur in the following manner:
    - Side slopes of the stockpile shall not exceed 2H:1V.
    - Between October 1 and April 30:
        - An interceptor dike with gravel outlet and silt fence shall surround all topsoil.
        - Within 2 days either complete erosion control seeding, or cover stockpiles with clear plastic or mulch.
    - Between May 1 and September 30:
        - An interceptor dike with gravel outlet and silt fence shall surround all topsoil if the stockpile will remain in place for a longer period of time than active construction grading.
        - Within 7 days, either complete erosion control seeding, or cover stockpiles with mulch.
- Retain or restore mycorrhizal bacteria, earthworms, and other beneficial organisms.
    - When using off-site topsoil, use commercially available mycorrhiza products.
    - When using native topsoil stockpiled from the site, ensure that the beneficial organisms will not be destroyed by:
        1. Re-install topsoil within 4 to 6 weeks.

2. Do not allow the saturation of topsoil with water.

3. Do not use plastic covering.

Maintenance Standards

- Inspect stockpiles regularly, especially after large storm events. Stabilize any areas that have eroded using any BMP appropriate to address Element #5.
- 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 and mulch soil 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 C130: Surface Roughening

Purpose and Definition

Surface roughening aids in the establishment of vegetative cover, reduces runoff velocity, increases infiltration, and provides for sediment trapping. Horizontal depressions are created by operating a tiller or other suitable equipment on the contour or by leaving slopes in a roughened condition by not fine grading them.

Use this BMP in conjunction with other BMPs such as seeding, mulching, or sodding.

Quick References

Use For Element(s):	5	**Standard Drawing**	Figure 44

Conditions for Use

- Slopes steeper than 3H:1V and greater than 5 vertical feet require surface roughening to a depth of 2 to 4 inches prior to seeding.
- Areas that will not be stabilized immediately may be roughened to reduce runoff velocity until seeding takes place.
- Slopes with a stable rock face do not require roughening.
- Slopes where mowing is planned should not be excessively roughened (see specifications below).

Design Criteria

There are different methods for achieving a roughened soil surface on a slope, and the selection of an appropriate method depends upon the type of slope. Roughening methods include stair-step grading, grooving, contour furrows, and tracking. See figure below for tracking and contour furrows. Factors to be considered in choosing a method are slope steepness, mowing requirements, and whether the slope is formed by cutting or filling.

- Disturbed areas that will not require mowing may be stair-step graded, grooved, or left rough after filling.
- Stair-step grading is particularly appropriate in soils containing large amounts of soft rock. Each "step" catches material that sloughs from above, and provides a level site where vegetation can become established. Stairs should be wide enough to work with standard earth moving equipment. Stair steps must be on contour or gullies will form on the slope.
- Areas that will be mowed (these areas should have slopes less steep than 3H:1V) may have small furrows left by disking, harrowing, raking, or seed-planting machinery operated on the contour.

- Graded areas with slopes steeper than 3H:1V but less than 2H:1V should be roughened before seeding. This can be accomplished in a variety of ways, including "track walking," or driving a crawler tractor up and down the slope, leaving a pattern of cleat imprints parallel to slope contours.
- Tracking is done by operating equipment up and down the slope to leave horizontal depressions in the soil.

Maintenance Standards

- Areas that are roughened should be seeded as quickly as possible.
- Regular inspections should be made of the area. If rills appear, they should be re-graded and re-seeded immediately.

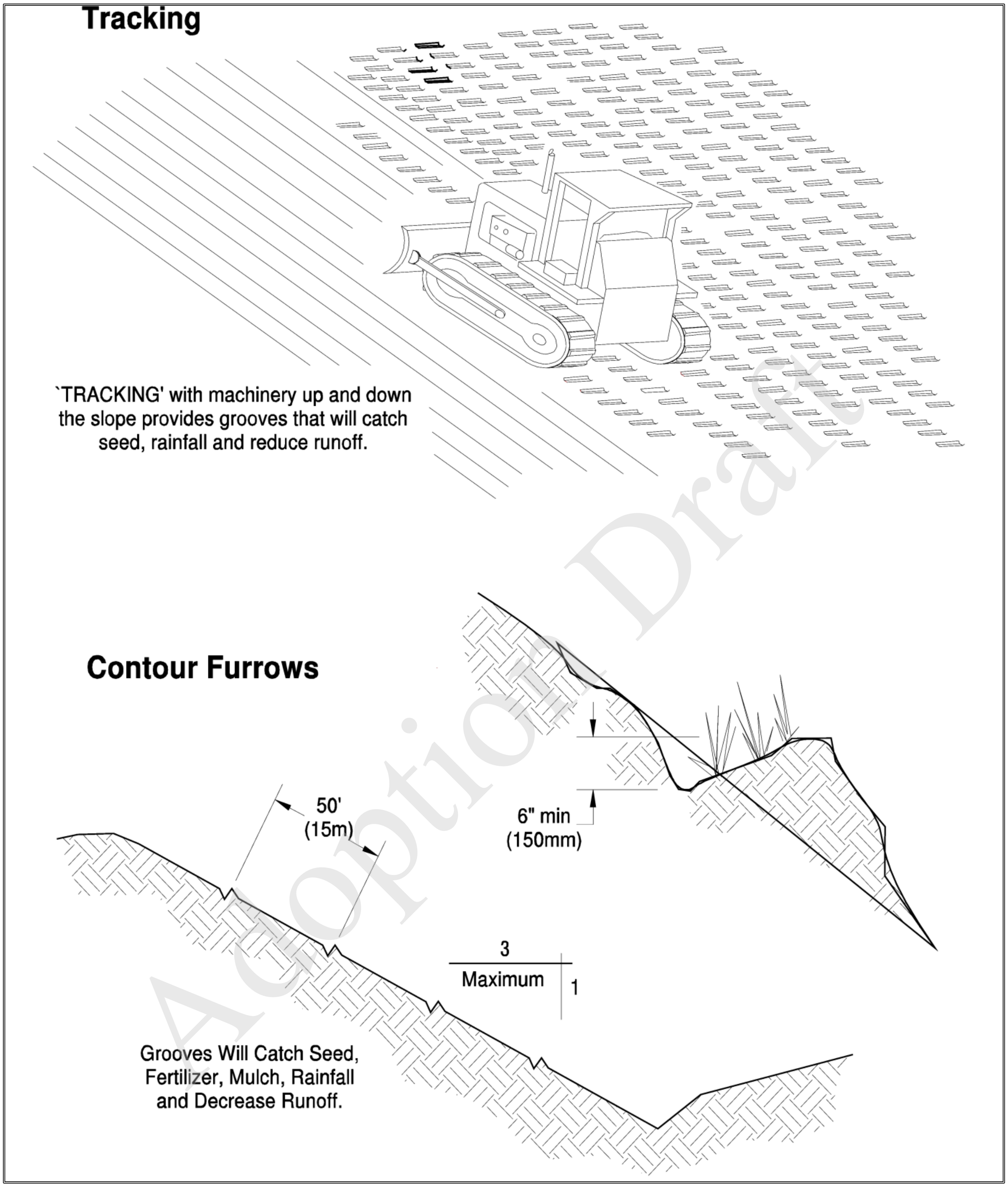


Figure 7: Surface Roughening by Tracking and Contour Furrows

(Source: WA State Dept. of Ecology)

BMP C131: Gradient Terraces

Purpose and Definition

Gradient terraces reduce erosion damage by intercepting surface runoff and conducting it to a stable outlet at a non-erosive velocity.

Quick References

Use For Element(s):	5	Standard Drawing	n/a

Conditions of Use

Gradient terraces normally are limited to denuded land having a water erosion problem. They should not be constructed on deep sands or on soils that are too stony, steep, or shallow to permit practical and economical installation and maintenance. Gradient terraces may be used only where suitable outlets are or will be made available. See figure below.

Design Criteria

- The maximum vertical spacing of gradient terraces should be determined by the following method:

$$VI = (0.8)s + y$$

Where:
- VI = *vertical interval in feet*
- s = *land rise per 100 feet, expressed in feet*
- y = *a soil and cover variable with values from 1.0 to 4.0*

Values of “y” are influenced by soil erodibility and cover practices. The lower values are applicable to erosive soils where little to no residue is left on the surface. The higher value is applicable only to erosion-resistant soils where a large amount of residue (1½ tons of straw/acre equivalent) is on the surface.

- The minimum constructed cross-section should meet the design dimensions.
- The top of the constructed ridge should not be lower at any point than the design elevation plus the specified overfill for settlement. The opening at the outlet end of the terrace should have a cross-section equal to that specified for the terrace channel.
- Channel grades may be either uniform or variable with a maximum grade of 0.6 feet per 100 feet length (0.6%). For short distances, terrace grades may be increased to improve alignment. The channel velocity should not exceed that which is non-erosive for the soil type.
- All gradient terraces should have adequate outlets. Such an outlet may be a grassed waterway, vegetated area, or tile outlet. In all cases the outlet must convey runoff from the terrace or

terrace system to a point where the outflow will not cause damage. Vegetative cover should be used in the outlet channel.

- The design elevation of the water surface of the terrace should not be lower than the design elevation of the water surface in the outlet at their junction, when both are operating at design flow.
- Vertical spacing determined by the above methods may be increased as much as 0.5 feet or 10 percent, whichever is greater, to provide better alignment or location, to avoid obstacles, to adjust for equipment size, or to reach a satisfactory outlet. The drainage area above the terrace should not exceed the area that would be drained by a terrace with normal spacing.
- The terrace should have enough capacity to handle the peak runoff expected from a 2-year, 24-hour design storm without overtopping.
- The terrace cross-section should be proportioned to fit the land slope. The ridge height should include a reasonable settlement factor. The ridge should have a minimum top width of 3 feet at the design height. The minimum cross-sectional area of the terrace channel should be 8 square feet for land slopes of 5 percent or less, 7 square feet for slopes from 5 to 8 percent, and 6 square feet for slopes steeper than 8 percent. The terrace can be constructed wide enough to be maintained using a small vehicle.

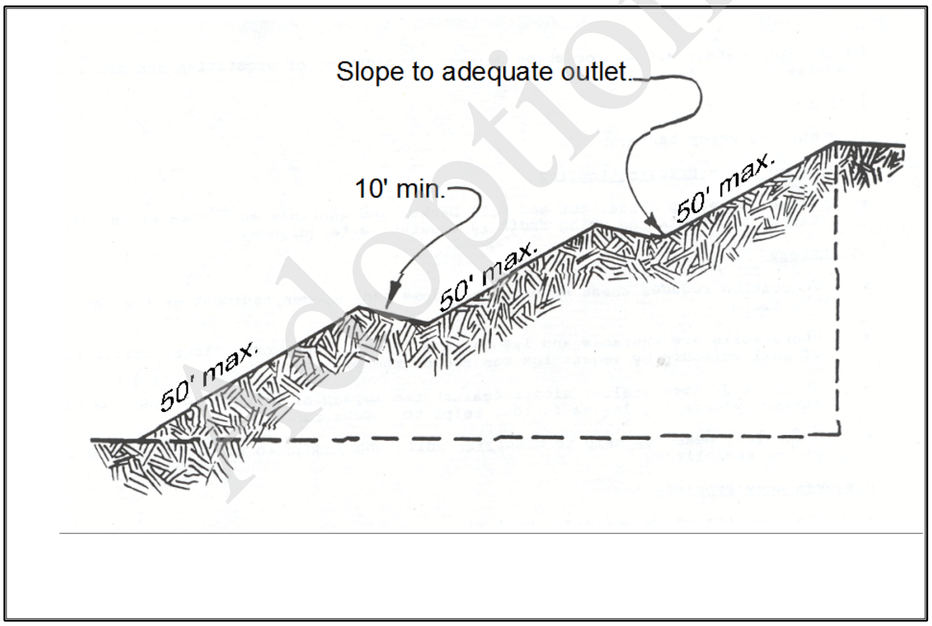


Figure 8: Gradient Terraces

(Source: WA State Department of Ecology)

BMP C140: Dust Control

Purpose and Definition

Dust control prevents wind transport of dust from disturbed soil surfaces onto roadways, drainage ways, and surface waters.

Quick References

Use For Element(s):	5	**Standard Drawing**	n/a

Conditions of Use

- In areas (including roadways) subject to surface and air movement of dust where on-site and off-site impacts to roadways, drainage ways, or surface waters are likely.

Design Criteria

- Vegetate or mulch areas that will not receive vehicle traffic. In areas where planting, mulching, or paving is impractical, apply gravel or landscaping rock.
- Limit dust generation by clearing only those areas where immediate activity will take place, leaving the remaining area(s) in the original condition. Maintain the original ground cover as long as practical.
- Construct natural or artificial windbreaks or windscreens. These may be designed as enclosures for small dust sources.
- Sprinkle the site with water until surface is wet. Repeat as needed. To prevent carryout of mud onto street, refer to Stabilized Construction Entrance (BMP C105).
- Irrigation water can be used for dust control. Irrigation systems should be installed as a first step on sites where dust control is a concern.

Techniques that can be used for unpaved roads and lots include:

- Lower speed limits. High vehicle speed increases the amount of dust stirred up from unpaved roads and lots.
- Upgrade the road surface strength by improving particle size, shape, and mineral types that make up the surface and base materials.
- Add surface gravel to reduce the source of dust emission. Limit the amount of fine particles (those smaller than .075 mm) to 10 to 20 percent.
- Use geotextile fabrics to increase the strength of new roads or roads undergoing reconstruction.
- Encourage the use of alternate, paved routes, if available.

- Restrict use of paved roadways by tracked vehicles and heavy trucks to prevent damage to road surface and base.
- Pave unpaved permanent roads and other trafficked areas.
- Use vacuum street sweepers.
- Remove mud and other dirt promptly so it does not dry and then turn into dust.
- Limit dust-causing work on windy days.
- Contact the Southwest Washington Clean Air Agency http://www.swcleanair.org/ for guidance and training on control measures. Compliance with the local Air Pollution Control Authority constitutes compliance with this BMP.

Maintenance Standards

Respray area as necessary to keep dust to a minimum.

BMP C150: Materials on Hand

Purpose and Definition

Keep quantities of 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. Having these materials on-site reduces the time needed to implement BMPs when inspections indicate that existing BMPs are not meeting the Construction SWPPP requirements.

Quick References

Use For Element(s):	9
Standard Drawing	n/a

Conditions of Use

- Construction projects of any size or type can benefit from having materials on hand. A small commercial development project could have a roll of plastic and some gravel available for immediate protection of bare soil and temporary berm construction. A large earthwork project, such as highway construction, might have several tons of straw, several rolls of plastic, flexible pipe, sandbags, geotextile fabric and steel "T" posts.
- Materials are stockpiled and readily available before any site clearing, grubbing, or earthwork begins. A large contractor or developer could keep a stockpile of materials that are available for use on several projects.
- 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.

Design Criteria

Depending on project type, size, complexity, and length, materials and quantities will vary. A good minimum list of items that will cover numerous situations includes:

- Clear Plastic, 6mil
- Drainpipe, 6 or 8 inch diameter
- Sandbags, filled
- Straw bales for mulching
- Quarry spalls
- Washed gravel

- Geotextile fabric
- Catch basin inserts
- Steel "T" posts
- Silt fence material
- Straw wattles

Maintenance Standards

- All materials with the exception of the quarry spalls, steel "T" posts, and gravel should be kept covered and out of both sun and rain.
- Re-stock materials used as needed.

BMP C151: Concrete Handling

Purpose and Definition

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.

Quick References

Use For Element(s):	9	**Standard Drawing**	n/a

Conditions of Use

Any time concrete is used, utilize these management practices. Concrete construction projects include, but are not limited to, the following:

- Curbs and Sidewalks
- Roads
- Bridges
- Foundations
- Floors

Design Criteria

- Assure that washout of concrete trucks, chutes, pumps, and internals is performed at an approved off-site location or in designated concrete washout areas (BMP C154). 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, except in designated concrete washout areas.
- Wash off hand tools including, but not limited to, screeds, shovels, rakes, floats, and trowels into formed areas only.
- Wash equipment difficult to move, such as concrete pavers in areas that do not directly drain to natural or constructed stormwater conveyances.
- Do not allow washdown from areas, such as concrete aggregate driveways, to drain directly to natural or constructed stormwater conveyances.
- When no formed areas are available, contain washwater and leftover product in a lined 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.
- Refer to BMPs C252 and C253 for pH adjustment to stormwater that has come into contact with fresh concrete.

Maintenance Standards

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

BMP C152: Sawcutting and Surfacing Pollution Prevention

Purpose and Definition

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

Quick References

Use For Element(s):	9	**Standard Drawing**	n/a

Conditions of Use

Utilize these management practices anytime sawcutting or surfacing operations take place. Sawcutting and surfacing operations include, but are not limited to, the following:

- Sawing
- Coring
- Grinding
- Roughening
- Hydro-demolition
- Bridge and road surfacing

Design Criteria

- Vacuum slurry and cuttings during cutting and surfacing operations.
- Slurry and cuttings shall not remain on permanent concrete or asphalt pavement overnight.
- Slurry and cuttings shall not drain to any natural or constructed drainage conveyance including stormwater systems. This may require temporarily blocking catch basins.
- Dispose of collected slurry and cuttings in a manner that does not violate groundwater or surface water quality standards.
- Do not allow process water generated during hydro-demolition, surface roughening or similar operations to drain to any natural or constructed drainage conveyance including stormwater systems. Dispose process water in a manner that does not violate groundwater or surface water quality standards.

- Handle and dispose cleaning waste material and demolition debris in a manner that does not cause contamination of water. Dispose of sweeping material from a pick-up sweeper at an appropriate disposal site.

Maintenance Standards

Continually monitor operations to determine whether slurry, cuttings, or process water could enter waters of the state. If inspections show that a violation of water quality standards could occur, stop operations and immediately implement preventive measures such as berms, barriers, secondary containment, and vacuum trucks.

BMP C153: Material Delivery, Storage and Containment

Purpose and Definition

Prevent, reduce, or eliminate the discharge of pollutants to the stormwater system or watercourses from material delivery and storage. Minimize the storage of hazardous materials on-site, store materials in a designated area, and install secondary containment.

Refer to Book 3 for specific BMPs to control pollutants for materials delivery, storage, use and containment.

Quick References

Use For Element(s):	9	**Standard Drawing**	n/a

Conditions of Use

These procedures are suitable for use at all construction sites with delivery and storage of the following materials:

- Petroleum products such as fuel, oil and grease
- Fertilizers, pesticides and herbicides
- Detergents
- Asphalt and concrete compounds
- Hazardous chemicals such as acids, lime, adhesives, paints, solvents and curing compounds
- Any other material that may be detrimental if released to the environment

Design Criteria

The following steps should be taken to minimize risk:

- Temporary storage area should be located away from vehicular traffic, near the construction entrance(s), and away from waterways or storm drains.
- Material Safety Data Sheets (MSDS) should be supplied for all materials stored. Chemicals should be kept in their original labeled containers.
- Hazardous material storage on-site should be minimized.
- Hazardous materials should be handled as infrequently as possible.
- During the wet weather season (Oct 1 – April 30), consider storing materials in a covered area.

- Materials should be stored in secondary containments, such as earthen dike, horse trough, or even a children's wading pool for non-reactive materials such as detergents, oil, grease, and paints. Small amounts of material may be secondarily contained in "bus boy" trays or concrete mixing trays.
- Do not store chemicals, drums, or bagged materials directly on the ground. Place these items on a pallet and, when possible, and within secondary containment.
- If drums must be kept uncovered, store them at a slight angle to reduce ponding of rainwater on the lids to reduce corrosion. Domed plastic covers are inexpensive and snap to the top of drums, preventing water from collecting.

Material Storage Areas and Secondary Containment Practices:

- Liquids, petroleum products, and substances listed in 40 CFR Parts 110, 117, or 302 shall be stored in approved containers and drums and shall not be overfilled. Containers and drums shall be stored in temporary secondary containment facilities.
- Temporary secondary containment facilities shall provide for a spill containment volume able to contain 10% of the total enclosed container volume of all containers, <u>or</u> 110% of the capacity of the largest container within its boundary, whichever is greater.
- Secondary containment facilities shall be impervious to the materials stored therein for a minimum contact time of 72 hours.
- Secondary containment facilities shall be maintained free of accumulated rainwater and spills. In the event of spills or leaks, accumulated rainwater and spills shall be collected and placed into drums. These liquids shall be handled as hazardous waste unless testing determines them to be non-hazardous.
- Sufficient separation should be provided between stored containers to allow for spill cleanup and emergency response access.
- During the wet weather season (Oct 1 – April 30), each secondary containment facility shall be covered during non-working days, prior to and during rain events.
- Keep material storage areas clean, organized and equipped with an ample supply of appropriate spill clean-up material (spill kit).
- The spill kit should include, at a minimum:
    - 1-Water Resistant Nylon Bag
    - 3-Oil Absorbent Socks 3"x 4'
    - 2-Oil Absorbent Socks 3"x 10'
    - 12-Oil Absorbent Pads 17"x19"
    - 1-Pair Splash Resistant Goggles
    - 3-Pair Nitrile Gloves
    - 10-Disposable Bags with Ties

BMP C154: Concrete Washout Facilities

Purpose and Definition

Prevent or reduce the discharge of pollutants to stormwater from concrete waste by conducting washout off-site, or performing on-site washout in a designated area to prevent pollutants from entering surface waters or groundwater.

Discharge of concrete materials to the County storm drainage system and surface water is a violation of County code and state law.

Quick References

Use For Element(s):	9	**Standard Drawing**	n/a

Conditions of Use

Concrete washout area best management practices are implemented on construction projects where:

- Concrete is used as a construction material
- It is not possible to dispose of all concrete wastewater and washout off-site (ready mix plant, etc.).
- Concrete trucks, pumpers, or other concrete coated equipment are washed on-site.

Usage Instructions:

- Perform washout of concrete trucks off-site or in designated concrete washout areas only.
- Do not wash out concrete trucks onto the ground, or into storm drains, open ditches, streets, or streams.
- Do not allow excess concrete to be dumped on-site, except in designated concrete washout areas.

Design Criteria

Design

- Concrete washout areas may be prefabricated concrete washout containers, or self-installed structures (above-grade or below-grade).
    - o If self-installed concrete washout areas are used, below-grade structures are preferred over above-grade structures because they are less prone to spills and leaks.
    - o Self-installed above-grade structures should only be used if excavation is not practical.

- The total volume of all concrete washout facilities must be adequate to contain all liquid and concrete waste generated by washout operations.

Location and Placement

- All washout facilities shall be located at least 50 feet from storm drains, open ditches, or water bodies, including wetlands.
- If trucks need to leave a paved area to access washout, prevent track-out with a pad of rock or quarry spalls (see BMP C105). These areas should be far enough away from other construction traffic to reduce the likelihood of accidental damage and spills.

On-site Temporary Concrete Washout Facility, Transit Truck Washout Procedures

- Concrete washout from concrete pumper bins can be washed into concrete pumper trucks and discharged into designated washout area or properly disposed of off-site.
- Once concrete wastes are washed into the designated area and allowed to harden, the concrete should be broken up, removed, and disposed of per applicable solid waste regulations. Dispose of hardened concrete on a regular basis.
- Place a secure, non-collapsing, non-water collecting cover over the concrete washout facility prior to predicted wet weather to prevent accumulation and overflow of precipitation.
- Perform washout of concrete trucks off-site or in designated concrete washout areas only.
- If less than 10 concrete trucks or pumpers need to be washed out on-site, the washwater may be disposed of in a formed area awaiting concrete or an upland disposal site where it will not contaminate surface or groundwater. The upland disposal site shall be at least 50 feet from sensitive areas such as storm drains, open ditches, or water bodies, including wetlands.

Temporary Above-Grade Concrete Washout Facility

- Temporary concrete washout facility (above grade) should be constructed as shown on the details below, with a recommended minimum length and minimum width of 10 feet.
- Plastic lining material should be a minimum of 10 mil polyethylene sheeting and must be free of holes, tears, or other defects that compromise the impermeability of the material.

Temporary Below-Grade Concrete Washout Facility

- Temporary concrete washout facilities (below grade) should be constructed as shown on the details below, with a recommended minimum length and minimum width of 10 feet.
- Lath and flagging should be commercial type.
- Plastic lining material shall be a minimum of 10 mil polyethylene sheeting and must be free of holes, tears, or other defects that compromise the impermeability of the material.
- Liner seams shall be installed in accordance with manufacturers' recommendations.

- Soil base shall be prepared free of rocks or other debris that may cause tears or holes in the plastic lining material.

Education

- Discuss the concrete management techniques described in this BMP with the ready-mix concrete supplier, employees and subcontractors before concrete operations begin.
- Arrange for contractor's superintendent or Certified Erosion and Sediment Control Lead (CESCL) to oversee and enforce concrete waste management procedures.
- Install a sign adjacent to each temporary concrete washout facility to inform concrete equipment operators to utilize the proper facilities.
- Consider using contract agreements with suppliers and contractors to address these requirements.

Maintenance Standards

Inspection

- Inspect and verify that concrete washout BMPs are in place prior to the commencement of concrete work.
- During periods of concrete work, inspect daily to verify continued performance.
    - Check overall condition and performance.
    - Check remaining capacity.
    - If using self-installed washout facilities, verify plastic liners are intact and sidewalls are not damaged.
    - If using prefabricated containers, check for leaks.
- Inspect each facility after removal of materials for signs of weakening or damage.

Maintenance

- Facilities must be repaired when signs of weakening or damage are present.
- Washout facilities shall be maintained to provide adequate holding capacity with a minimum freeboard of 12 inches.
- Washout facilities must be cleaned, or new facilities must be constructed and ready for use once the washout is 75% full.
- If the washout is nearing capacity, vacuum and dispose of the waste material in an approved manner.
    - Do not discharge liquid or slurry to waterways, storm drains or directly onto ground.

- Do not use sanitary sewer without approval from the local sewer authority. Remove and dispose of hardened concrete and return the structure to a functional condition. Concrete may be reused on-site or hauled away for disposal or recycling.

- After each cleaning (removal of materials), re-line the structure with new plastic liners.

Removal of Temporary Concrete Washout Facilities

- When temporary concrete washout facilities are no longer required for the work, the hardened concrete, slurries and liquids shall be removed and properly disposed of.
- Materials used to construct temporary concrete washout facilities shall be removed from the site of the work and disposed of or recycled.
- Holes, depressions or other ground disturbance caused by the removal of the temporary concrete washout facilities shall be backfilled, repaired, and stabilized to prevent erosion.

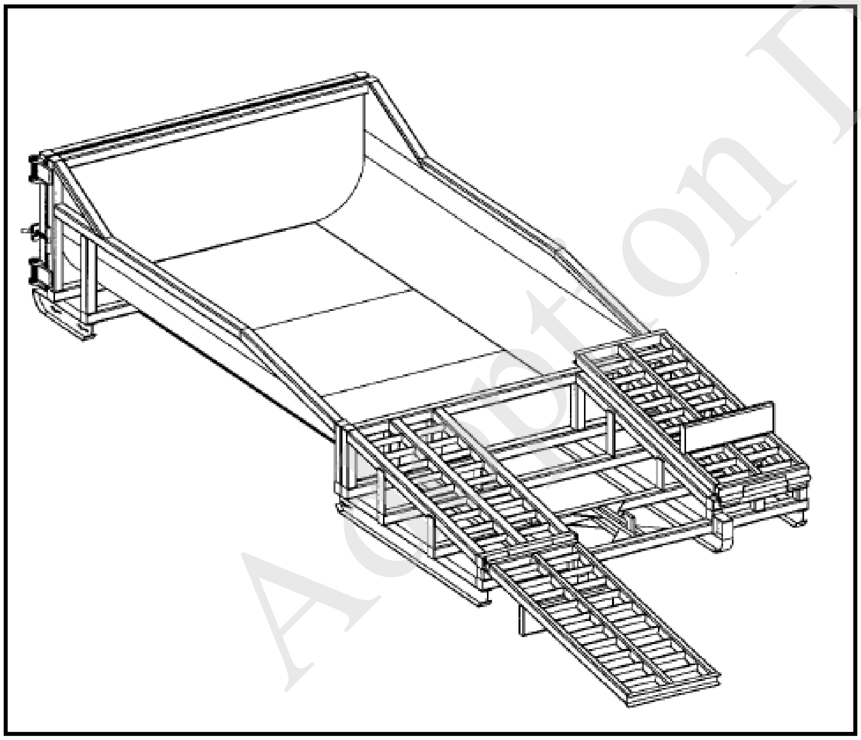


Figure 9: Prefabricated Concrete Washout Container with Ramp

(Source: Stormwater Management Manual for Western Washington, 2014)

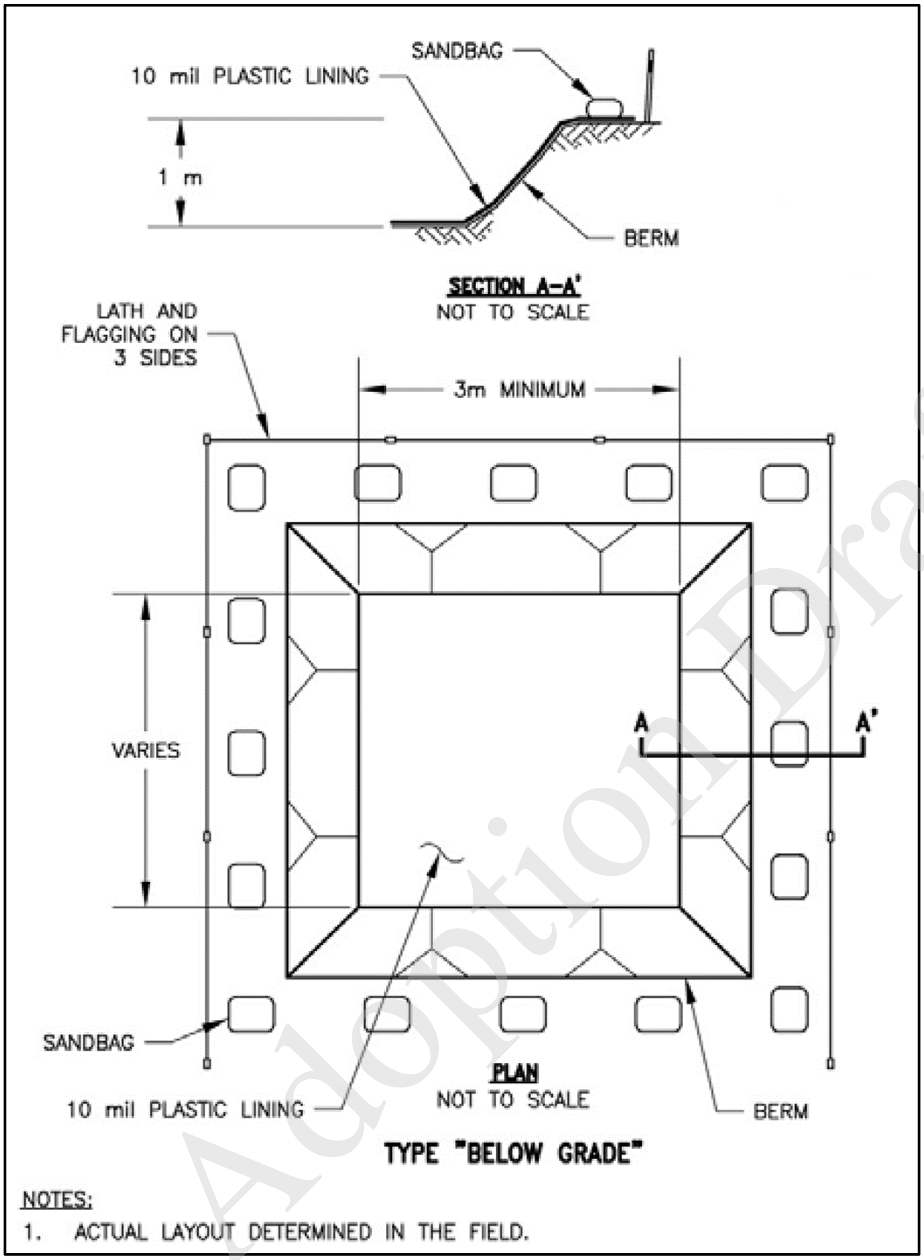


Figure 10: Concrete Washout Area (Below Grade)

(Source: modified from Department of Ecology)

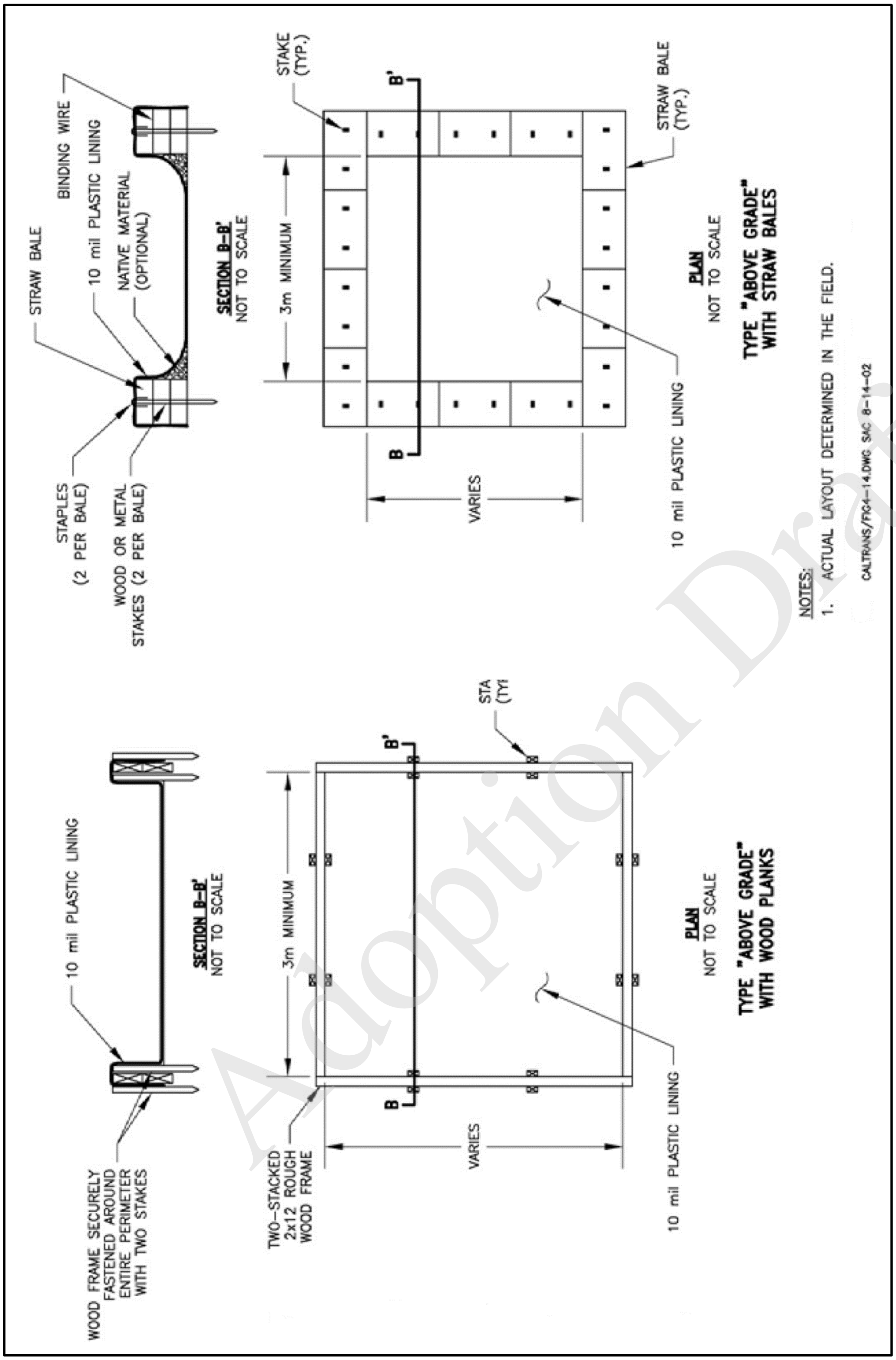


Figure 11: Concrete Washout Area (Above Grade)

(Source: modified from Department of Ecology)

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

Purpose and Definition

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.

Quick References

Use For Element(s):	11, 12	**Standard Drawing**	n/a

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.
- A CESCL may provide inspection and compliance services for multiple construction projects in the same geographic region.

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

- Maintaining permit file on site at all times which includes the Construction SWPPP and any associated permits and plans.
- Directing BMP installation, inspection, maintenance, modification, and removal.
- Updating all project drawings and the Construction SWPPP with changes made.
- Facilitate, participate in, and take corrective actions resulting from inspections performed by outside agencies or the owner.

- Keeping daily logs, and inspection reports. Inspection reports should include:
  - Inspection date/time.
  - Weather information; general conditions during inspection and approximate amount of precipitation since the last inspection.
  - A summary or list of all BMPs implemented, including observations of all erosion/sediment control structures or practices. The following shall be noted:

    1. Locations of BMPs inspected.
    2. Locations of BMPs that need maintenance.
    3. Locations of BMPs that failed to operate as designed or intended.
    4. Locations of where additional or different BMPs are required.
  - Visual monitoring results, including a description of discharged stormwater. The presence of suspended sediment, turbid water, discoloration, and oil sheen shall be noted, as applicable.
  - Any water quality monitoring performed during inspection.
  - General comments and notes, including a brief description of any BMP repairs, maintenance or installations made as a result of the inspection.

BMP C162: Construction Sequence Schedule

Purpose and Definition

Sequencing a construction project reduces the amount and duration of soil exposed to erosion by wind, rain, runoff, and vehicle tracking.

Quick References

Use For Element(s):	12	**Standard Drawing**	n/a

Conditions of Use

The construction sequence schedule is an orderly listing of all major land-disturbing activities together with the necessary erosion and sedimentation control measures planned for the project. The schedule guides the contractor on work to be done before other work is started so that serious erosion and sedimentation problems can be avoided.

Following a specified work schedule that coordinates the timing of land-disturbing activities and the installation of control measures is perhaps the most cost-effective way of controlling erosion during construction. The removal of surface ground cover leaves a site vulnerable to accelerated erosion. Construction procedures that limit land clearing, provide timely installation of erosion and sedimentation controls, and restore protective cover quickly can significantly reduce the erosion potential of a site.

Design Considerations

- Minimize construction during rainy periods.
- Schedule projects to disturb only small portions of the site at any one time. Complete grading as soon as possible. Immediately stabilize the disturbed portion before grading the next portion. Practice staged seeding in order to revegetate cut and fill slopes as the work progresses.

BMP C200: Interceptor Dike and Swale

Purpose and Definition

An interceptor dike or swale is a ridge of compacted soil, or a ridge with an upslope swale, at the top or base of a disturbed slope or along the perimeter of a disturbed construction area used to intercept and convey stormwater. Use the dike and/or swale to intercept the runoff from unprotected areas and direct it to areas where erosion can be controlled. This can prevent storm runoff from entering the work area or sediment-laden runoff from leaving the construction site.

Quick References

Use For Element(s):	6, 13	**Standard Drawing**	Figure 45

Conditions of Use

Use an interceptor dike or swale where the runoff from an exposed site or disturbed slope must be conveyed to an erosion control facility which can safely convey the stormwater.

- Locate upslope of a construction site to prevent runoff from entering disturbed area.
- To reduce the amount and velocity of runoff flowing down a disturbed slope, place horizontally across a disturbed slope.
- Locate downslope to collect runoff from a disturbed area and direct water to a sediment basin.

Design Criteria

- Dike and/or swale and channel must be stabilized with temporary or permanent vegetation or other channel protection during construction.
- Channel requires a positive grade for drainage; steeper grades require channel protection and check dams.
- Review construction for areas where overtopping may occur.
- Can be used at top of new fill before vegetation is established.
- May be used as a permanent diversion channel to carry the runoff.
- Sub-basin tributary area should be one acre or less.
- For temporary facilities, design capacity for the peak flow from a 10-year, 24-hour storm, assuming a Type 1A rainfall distribution or use 1.6 times the 10-year, 1-hour flow indicated by an approved continuous flow model.

- For facilities that will also serve on a permanent basis, consult Book 2, Chapter 7 for design requirements.

Interceptor Dikes

Interceptor dikes shall meet the following criteria:

- The upslope side of the dike shall provide positive drainage to the dike outlet. No erosion shall occur at the outlet. Provide energy dissipation measures as necessary. Sediment-laden runoff must be released through a sediment trapping facility.
- Minimize construction traffic over temporary dikes. Use temporary cross culverts for channel crossings.

Top Width	2 feet minimum
Height	1.5 feet minimum on berm
Side Slope	2H:1V or flatter
Grade	Depends on topography; however, dike system minimum is 0.5% and maximum is 1%
Compaction	Minimum of 90% ASTM D698 standard proctor

Horizontal Spacing

Average Slope	Slope Percent	Flow path Length
20H:1V or less	3-5%	300 feet
(10 to 20)H:1V	5-10%	200 feet
(4 to 10)H:1V	10-25%	100 feet
(2 to 4)H:1V	25-50%	50 feet

Stabilization

Stabilization depends on velocity and reach.

Slopes <5% Seed and mulch applied within 5 days of dike construction (see BMP C121, Mulching).

Slopes 5 - 40% Dependent on runoff velocities and dike materials. Stabilization should be done immediately using either sod or riprap or other measures to avoid erosion.

Interceptor Swales

Interceptor swales shall meet the following criteria:

Bottom Width	2 feet minimum; the cross-section bottom shall be level
Depth	1 foot minimum
Side Slope	2H:1V or flatter
Grade	Maximum 5%, with positive drainage to a suitable outlet (such as a sediment pond)

Stabilization

Stabilization	Seed as per BMP C120, Temporary and Permanent Seeding, or *BMP C202*, Channel Lining, 12 inches thick riprap pressed into the bank and extending at least 8 inches vertical from the bottom.

Maintenance

- Inspect diversion dikes and interceptor swales once a week and after every rainfall. Immediately remove sediment from the flow area.
- Damage caused by construction traffic or other activity must be repaired before the end of each working day.
- Check outlets and make timely repairs as needed to avoid gully formation. When the area below the temporary diversion dike is permanently stabilized, remove the dike, then fill and stabilize the channel to blend with the natural surface.

BMP C201: Grass-Lined Channels

Purpose and Definition

Grass-lined channels convey stormwater runoff. See figure below for typical grass-lined channels.

Quick References

Use For Element(s):	1, 13	**Standard Drawing**	n/a

Conditions of Use

This practice applies to construction sites where concentrated runoff needs to be contained to prevent erosion or flooding.

- When a vegetative lining can provide sufficient stability for the channel cross-section and at lower velocities of water (normally dependent on grade). This means that the channel slopes are generally less than 5 percent and space is available for a relatively large cross-section.
- Typical uses include roadside ditches, channels at property boundaries, outlets for diversions, and other channels and drainage ditches in low areas.

Design Criteria

- Grass-lined channels that will also function as a permanent stormwater conveyance facilities shall be designed in accordance with Book 2, Chapter 7.

Location

- Locate the channel where it can conform to the topography and other features such as roads.
    - Locate them to use natural drainage systems to the greatest extent possible.
    - Avoid sharp changes in alignment or bends and changes in grade.
    - Do not reshape the landscape to fit the drainage channel.

Shape and Side Slope

- V-shaped grass channels generally apply where the quantity of water is small, such as in short reaches along roadsides. The V-shaped cross-section is least desirable because it is difficult to stabilize the bottom where velocities may be high.
- Trapezoidal grass channels are used where runoff volumes are large and slope is low so that velocities are non-erosive to vegetated linings. (Note: it is difficult to construct small parabolic shaped channels.)

- Grassed channel side slopes generally are constructed 3H:1V or flatter to aid in the establishment of vegetation and for maintenance.
- Construct channels a minimum of 0.2 foot larger around the periphery to allow for soil bulking during seedbed preparations and sod buildup.

Design Flow

- The maximum design velocity shall be based on soil conditions, type of vegetation, and method of revegetation, but at no times shall velocity exceed 5 feet/second. The channel shall not be overtopped by the peak runoff from a 10-year, 24-hour storm, assuming a Type 1A rainfall distribution. Alternatively, use 1.6 times the 10-year, 1-hour flow indicated by an approved continuous flow model to determine a flow rate which the channel must contain.
- Grass channels, at a minimum, should carry peak runoff for temporary construction drainage facilities from the 10-year, 24-hour storm without eroding. Where flood hazard exists, increase the capacity according to the potential damage.

Vegetation and Erosion Protection

- Vegetated channels should be installed before major earthwork and hydroseeded with a bonded fiber matrix (BFM). The vegetation must be well established (i.e., 75 percent cover) before water is allowed to flow in the ditch, unless stabilized with nets or blankets.
- If design velocity of a channel to be vegetated by seeding exceeds 2 ft/sec, a temporary channel liner is required. Geotextile or special mulch protection such as fiberglass roving or straw and netting provides stability until the vegetation is fully established. See figure below.
- Channels that will carry high flows should have erosion control blankets installed over the hydroseed. If vegetation cannot be established from seed before water is allowed in the ditch, sod should be installed in the ditch in lieu of hydromulch and blankets.
- If vegetation is established by sodding, the permissible velocity for established vegetation may be used and no temporary liner is needed.
- Check dams 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.
- Subsurface drainage, or riprap channel bottoms, may be necessary on sites that are subject to prolonged wet conditions due to long duration flows or a high water table.
- Provide outlet protection at culvert ends and at channel intersections.

Sediment

- Do not subject grass-lined channel to sedimentation from disturbed areas. Use sediment-trapping BMPs upstream of the channel.

Maintenance Standards

- During the establishment period, check grass-lined channels after every rainfall that produces runoff.
- After grass is established, periodically check the channel; check it after every heavy rainfall event. Immediately make repairs.
- It is particularly important to check the channel outlet and all road crossings for bank stability and evidence of piping or scour holes.
- Remove all significant sediment accumulations to maintain the designed carrying capacity. Keep the grass in a healthy, vigorous condition at all times, since it is the primary erosion protection for the channel.

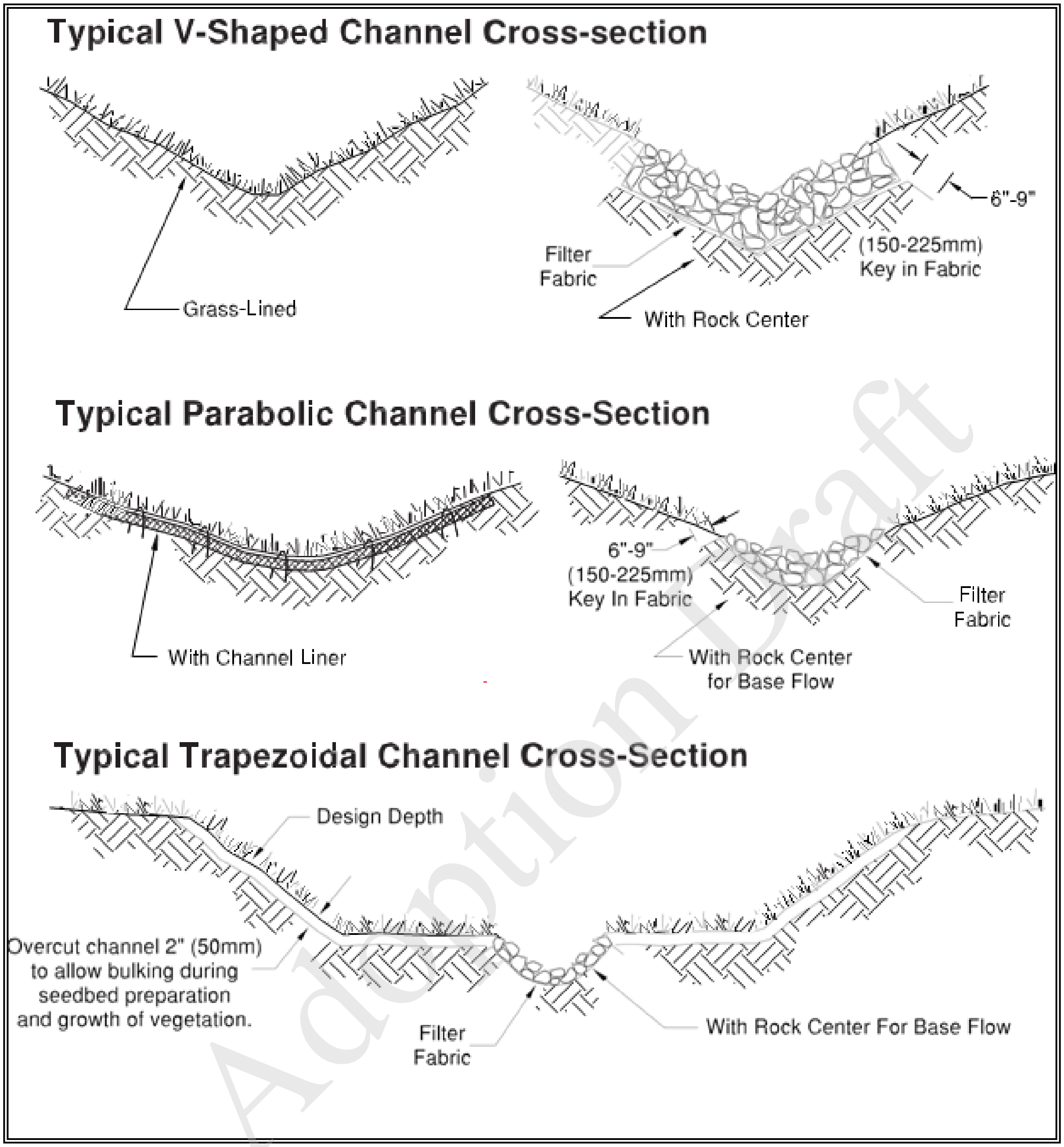


Figure 12: Typical Grass-Lined Channels

(Source: SMMWW)

BMP C202: Channel Lining

Purpose and Definition

To protect channels by providing a channel liner using either blankets or riprap.

Quick References

Use For Element(s):	8	**Standard Drawing**	n/a

Conditions of Use

Use channel linking when natural soils or vegetated stabilized soils in a channel are not adequate to prevent channel erosion or when a permanent ditch or pipe system is to be installed and a temporary measure is needed to prevent erosion.

Design Criteria

Selecting a Material

- In almost all cases, synthetic and organic coconut blankets are more effective than riprap for protecting channels from erosion. Blankets can be used with and without vegetation. Blanketed channels can be designed to handle any expected flow and longevity requirement. Some synthetic blankets have a predicted life span of 50 years or more, even in sunlight.
- Blankets usually require manual labor to place while rock for riprap usually requires heavy equipment to place.
- The Federal Highway Administration recommends not using flexible liners whenever the slope exceeds 10 percent or the shear stress exceeds 8 lbs/ft^2.

Blankets

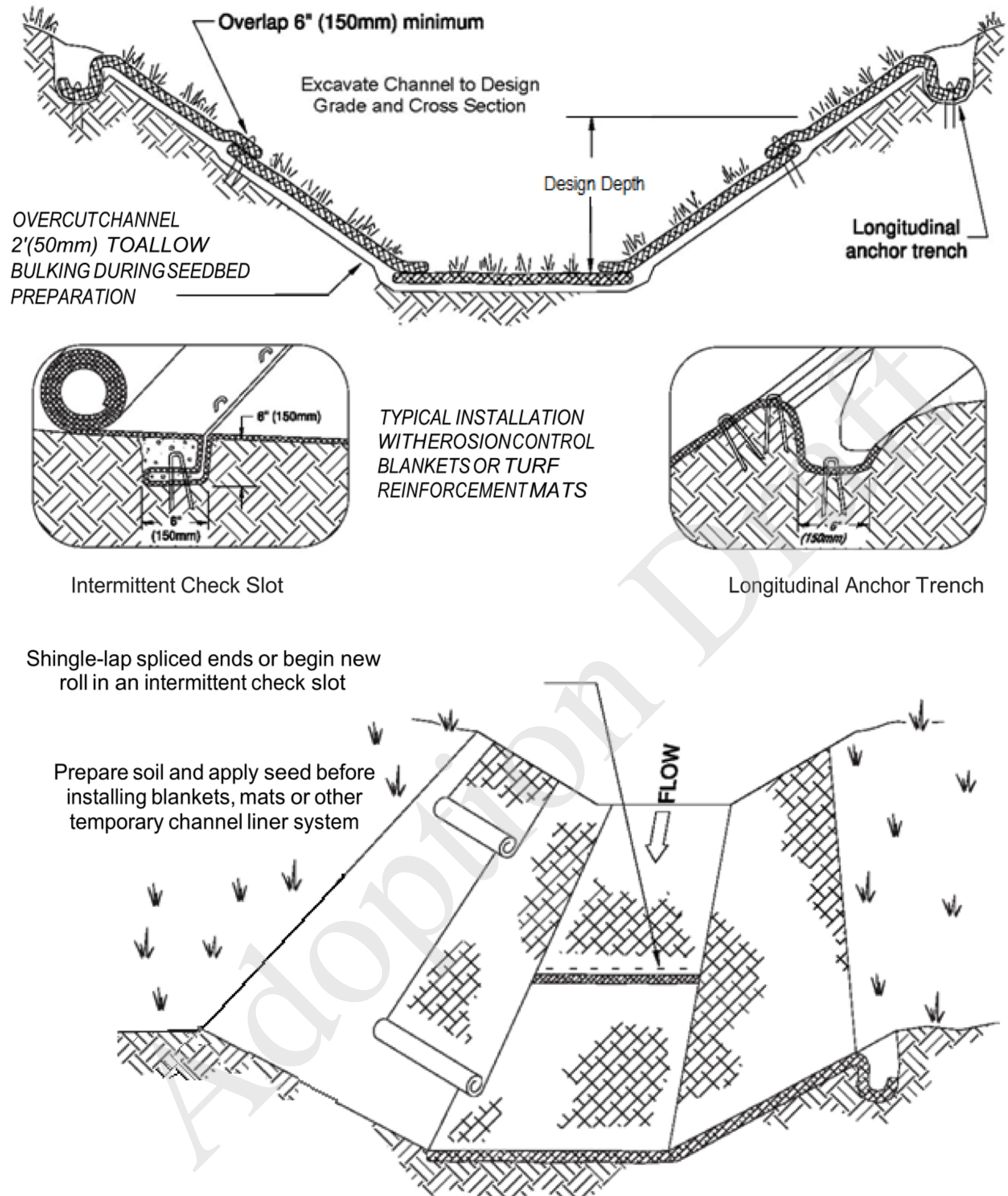
Erosion control blankets shall conform to the requirements of BMP C122, Nets and Blankets.

Riprap

Since riprap is used where erosion potential is high, construction must be sequenced so that the riprap is put in place with the minimum possible delay.

- Disturbance of areas where riprap is to be placed should be undertaken only when final preparation and placement of the riprap can follow immediately behind the initial disturbance. Where riprap is used for outlet protection, the riprap should be placed before or in conjunction with the construction of the pipe or channel so that it is in place when the pipe or channel begins to operate.

- The designer, after determining the riprap size that will be stable under the flow conditions, shall consider that size to be a minimum size and then, based on riprap gradations actually available in the area, select the size or sizes that equal or exceed the minimum size.
- Stone for riprap shall consist of field stone or quarry stone of approximately rectangular shape. The stone shall be hard and angular and of such quality that it will not disintegrate on exposure to water or weathering and it shall be suitable in all respects for the purpose intended.
- A lining of engineering filter fabric (geotextile) shall be placed between the riprap and the underlying soil surface to prevent soil movement into or through the riprap. The geotextile should be keyed in at the top of the bank.
- Filter fabric shall not be used on slopes greater than 1-1/2H:1V as slippage may occur. It should be used in conjunction with a layer of coarse aggregate (granular filter blanket) when the riprap to be placed is 12 inches and larger.



NOTES:

1 Design velocities exceeding 2 ft/sec (0.5m/sec) require temporary blankets, mats or similar liners to protect seed and soil until vegetation becomes established.

2 Grass-lined channels with design velocities exceeding 6 ft/sec (2m/sec) should include turf reinforcement mats.

Figure 13: Temporary Channel Liners

(Source: SMMWW)

BMP C203: Water Bars

Purpose and Definition

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

Quick References

Use For Element(s):	3, 6, 10	**Standard Drawing**	n/a

Conditions of Use

Clearing right-of-way and construction of access for power lines, pipelines, and other similar installations often require long narrow right-of-ways over sloping terrain. Disturbance and compaction promotes gully formation in these cleared strips by increasing the volume and velocity of runoff. Gully formation may be especially severe in tire tracks and ruts. To prevent gullying, runoff can often be diverted across the width of the right-of-way to undisturbed areas by using small predesigned diversions.

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.

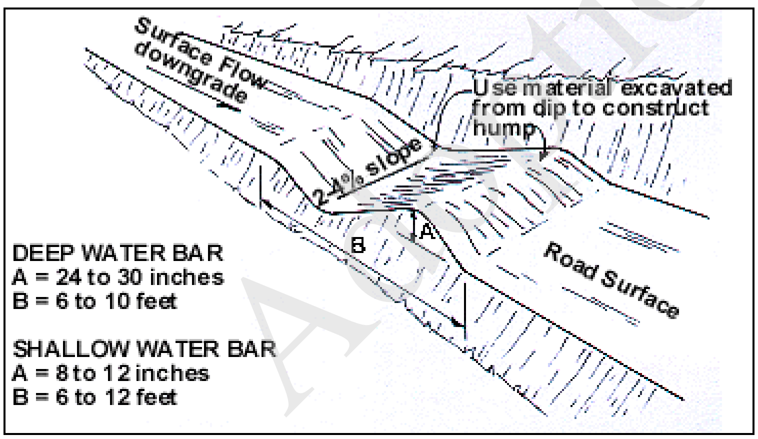


Figure 14: Water Bar

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.

BMP C204: Pipe Slope Drains

Purpose and Definition

Pipe slope drains are used to convey stormwater after it is diverted away from or over bare soil to prevent gullies, channel erosion, and saturation of slide-prone soils.

Quick References

Use For Element(s):	6	**Standard Drawing**	Figure 46

Conditions of Use

Pipe slope drains should be used when a temporary or permanent stormwater conveyance is needed to move the water down a steep slope to avoid erosion

On highway projects, pipe slope drains should be used at bridge ends to collect runoff and pipe it to the base of the fill slopes along bridge approaches. Another use on road projects is to collect runoff from pavement and pipe it away from side slopes at least until curbs, gutters, and permanent drainage facilities are installed. Pipe slope drains may be used effectively in conjunction with sand bags, triangular silt dikes or other temporary diversion devices.

Pipe slope drains can be:

- Connected to new catch basins and used temporarily until all permanent piping is installed.
- Used to drain water collected from aquifers exposed on cut slopes and take it to the base of the slope.
- Used to collect clean runoff from plastic sheeting and direct it away from exposed soil.
- Installed in conjunction with silt fence to drain collected water to a controlled area.
- Used to divert small seasonal streams away from construction. They have been used successfully on culvert replacement and extension jobs. Large flex pipe can be used on larger streams during culvert removal, repair, or replacement.
- Connected to existing down spouts and roof drains and used to divert water away from work areas during building renovation, demolition, and construction projects.

There are now several commercially available collectors that are attached to the pipe inlet and help prevent erosion at the inlet.

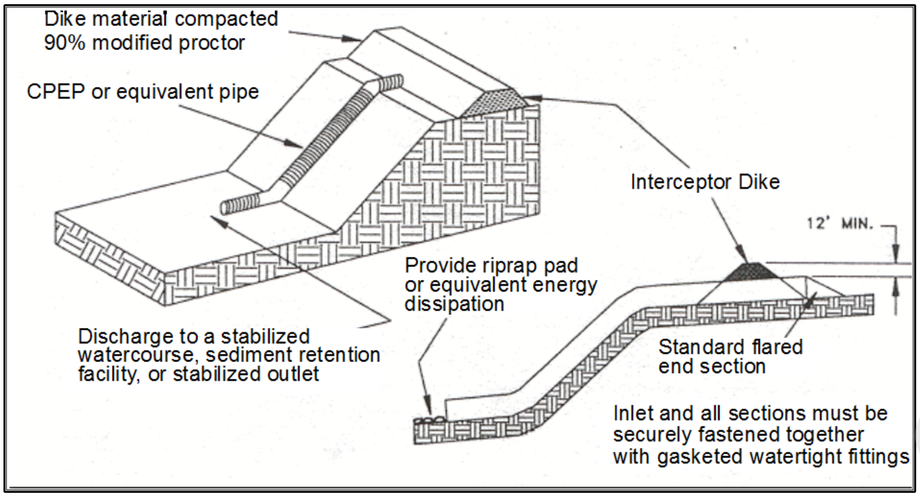


Figure 15: Pipe Slope Drain

Design Criteria

Pipe slops drains that will operate as permanent facilities must be designed and installed in accordance with Book 2, Chapter 7.

Design Flow

The capacity for temporary drains shall be sufficient to handle the peak flow from a 10-year, 24-hour storm event, assuming a Type 1A rainfall distribution. Alternatively, use 1.6 times the 10-year, 1-hour flow indicated by an approved continuous flow model. The hydrologic analysis must use the existing land cover condition for predicting flow rates from tributary areas outside the project limits. For tributary areas on the project site, the analysis must use the temporary or permanent project land cover condition, whichever will produce the highest flow rates. If using the Western Washington Hydrology Model (WWHM) to predict flows, bare soil areas should be modeled as "landscaped" area

Materials

- Materials specifications for any permanent piped system shall be set by the local government.

Pipe Entrance

- Piping of water through the berm at the entrance area is a common failure mode. Pay special attention to construction of the pipe entrance to avoid piping.
- Use diversion dikes or swales to collect water at the top of the slope.
- Ensure that the entrance area is stable and large enough to direct flow into the pipe.
- The entrance shall consist of a standard flared end section for culverts 12 inches and larger with a minimum 6-inch metal toe plate to prevent runoff from undercutting the pipe inlet. The slope

of the entrance shall be at least 3 percent. Sand bags may also be used at pipe entrances as a temporary measure.

- The soil around and under the pipe and entrance section shall be thoroughly compacted to prevent undercutting.
- The flared inlet section shall be securely connected to the slope drain and have watertight connecting bands.
- Interceptor dikes shall be used to direct runoff into a slope drain. The height of the dike shall be at least 1 foot higher at all points than the top of the inlet pipe.

Clearing

- Use care in clearing vegetated slopes for installation.
- Re-establish cover immediately on areas disturbed by installation.
- Use temporary drains on new cut or fill slopes.

Connections

- Slope drain sections shall be securely fastened together, fused or have gasketed watertight fittings, and shall be securely anchored into the soil.
- Thrust blocks should be installed anytime 90 degree bends are utilized. Depending on size of pipe and flow, these can be constructed with sand bags, straw bales staked in place, "t" posts and wire, or ecology blocks.
- Pipe needs to be secured along its full length to prevent movement. This can be done with steel "t" posts and wire. A post is installed on each side of the pipe and the pipe is wired to them. This should be done every 10-20 feet of pipe length or so, depending on the size of the pipe and quantity of water to divert.

Outlet

- The area below the outlet must be stabilized with a riprap apron (see BMP C209, Outlet Protection, for the appropriate outlet material).

Sediment

- If the pipe slope drain is conveying sediment-laden water, direct all flows into the sediment trapping facility.

Maintenance Standards

Check inlet and outlet points regularly, especially after storms.

The inlet should be free of undercutting, and no water should be going around the point of entry. If there are problems, the headwall should be reinforced with compacted earth or sand bags.

- The outlet point should be free of erosion and installed with appropriate outlet protection.
- For permanent installations, inspect pipe periodically for vandalism and physical distress such as slides and wind-throw.
- Normally the pipe slope is so steep that clogging is not a problem with smooth wall pipe, however, debris may become lodged in the pipe.

BMP C206: Level Spreader

Purpose and Definition

Level spreaders convert concentrated runoff to sheet flow and release it onto areas stabilized by existing vegetation or an engineered filter strip.

Quick References

Use For Element(s):	6	**Standard Drawing**	n/a

Conditions of Use

Used when a concentrated flow of water needs to be dispersed over a large area with existing stable vegetation.

Items to consider are:

- Will the discharge point increase flow onto an adjoining property?
- What is the risk of erosion or damage if the flow may become concentrated?
- Is an easement required if discharged to adjoining property?
- Most of the flow should be as groundwater and not as surface flow.
- Is there an unstable area downstream that cannot accept additional groundwater?

Use only where the slopes are gentle, the water volume is relatively low, and the soil will adsorb most of the low flow events.

Design Criteria

Figures below provide a cross-section and a detail of a level spreader.

- There must be 100 feet of densely vegetated, shallow slope downstream of the level spreader.
- Discharge area below the outlet must be uniform with a slope flatter than 5H:1V.
- Outlet to be constructed level in a stable, undisturbed soil profile (not on fill).
- The runoff shall not re-concentrate after release unless intercepted by another downstream measure.
- The grade of the channel for the last 20 feet of the dike or interceptor entering the level spreader shall be less than or equal to 1 percent. The grade of the level spreader shall be 0 percent to ensure uniform spreading of storm runoff.

- A 6-inch high gravel berm placed across the level lip shall consist of washed crushed rock, 2- to 4-inch or 3/4-inch to 1½-inch size.
- The spreader length shall be determined by estimating the peak flow expected from the 10-year, 24-hour design storm. The length of the spreader shall be a minimum of 15 feet for 0.1 cfs and shall increase by 10 feet for each 0.1 cfs thereafter to a maximum of 0.5 cfs per spreader. Use multiple spreaders for higher flows.
- The width of the spreader should be at least 6 feet.
- The depth of the spreader as measured from the lip should be at least 6 inches and it should be uniform across the entire length.
- Level spreaders shall be set back from the property line unless there is an easement for flow.
- Level spreaders, when installed every so often in grassy swales, keep the flows from concentrating. Materials that can be used include sand bags, lumber, logs, concrete, pipe, and capped perforated pipe. To function properly, the material needs to be installed level and on contour

Maintenance Standards

The spreader should be inspected after every runoff event to ensure that it is functioning correctly.

- Do not place any material on the structure.
- Do not allow construction traffic from crossing over the structure.
- If the spreader is damaged by construction traffic, it shall be immediately repaired.

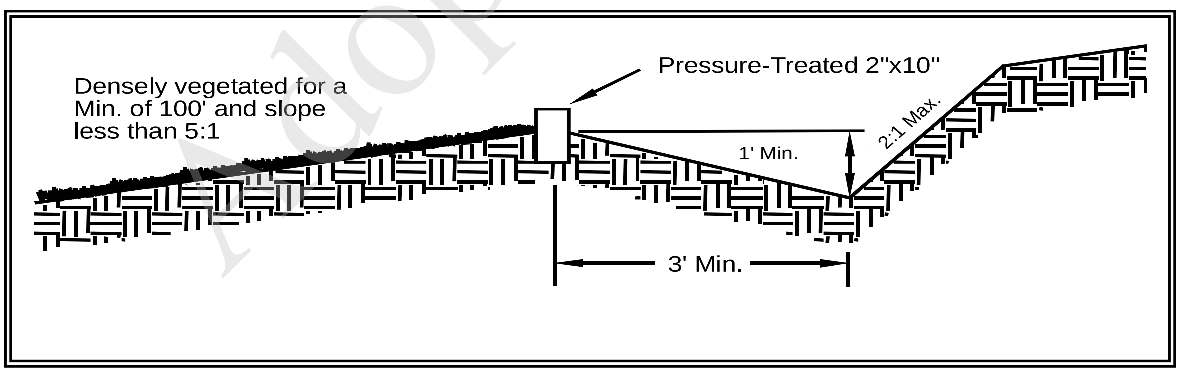


Figure 16: Cross-section of Level Spreader

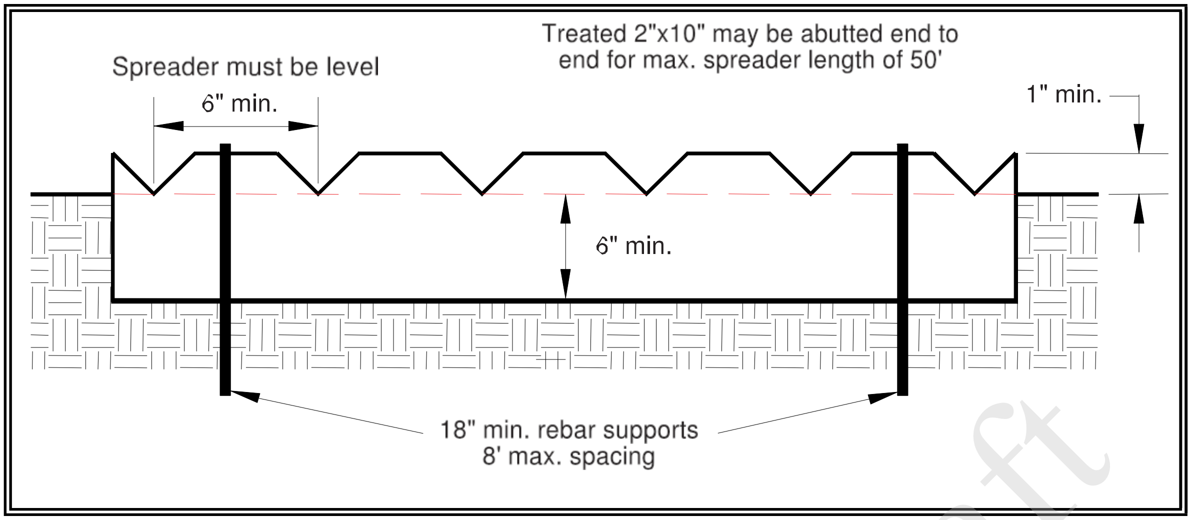


Figure 17: Detail of Level Spreader

BMP C207: Check Dams

Purpose and Definition

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

Quick References

Use For Element(s):	3, 6, 8, 13	**Standard Drawing**	Figures 36, 37

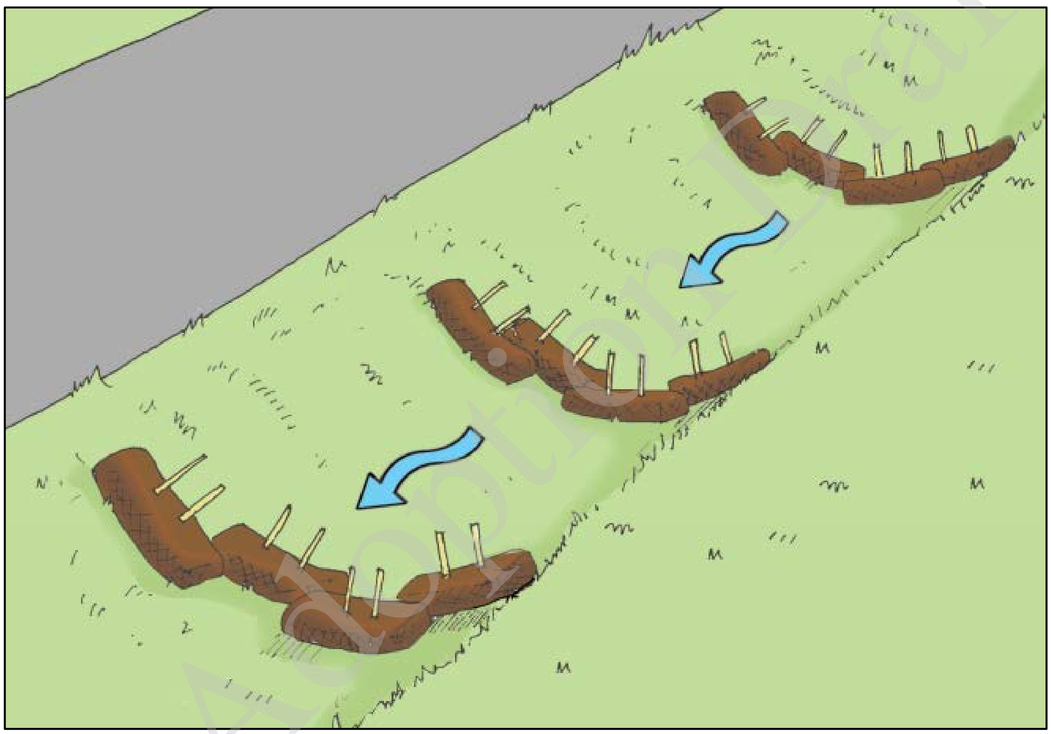


Figure 18: Illustration of Check Dams

Conditions of Use

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

Note: Placement of check dams is receiving waters and wetlands may require approved from Washington State Department of Fish and Wildlife or other state and federal permitting agency.

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

Design Criteria

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.

Materials

- Construct rock check dams from appropriately sized rock. The rock used must be large enough to stay in place given the expected design flow through the channel. The rock must be placed by hand or by mechanical means (no dumping of rock to form dam) to achieve complete coverage of the ditch or swale and to ensure that the center of the dam is lower than the edges.
- Check dams may also be constructed of either rock or pea-gravel filled bags. Numerous new products are also available for this purpose. They tend to be re-usable, quick and easy to install, effective, and cost efficient.

Shape and Size

- The 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.

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.

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

Purpose and Definition

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.

Quick References

Use For Element(s):	6, 13	**Standard Drawing**	Figure 47

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 Definition

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

Quick References

Use For Element(s):	8	**Standard Drawing**	Figures 53, 54

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 natural or manmade drainage feature such as a stream, wetland, lake, or ditch.

Design Criteria

- New pipe outfalls can provide an opportunity for low-cost fish habitat improvements. For example, an alcove of low-velocity water can be created by constructing the pipe outfall and associated energy dissipater back from the stream edge and digging a channel, over-widened to the upstream side, from the outfall. Overwintering juvenile and migrating adult salmonids may use the alcove as shelter during high flows. Bank stabilization, bioengineering, and habitat features may be required for disturbed areas. This work may require a HPA. See Book 1, Section 7.6 for more information on outfall system design.
- 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.
- Standard wingwalls, and tapered outlets and paved channels should also be considered when appropriate for permanent culvert outlet protection. (See WSDOT Hydraulic Manual).
- 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:

- o 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.
- o 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.
- o For outlets at the base of steep slope pipes (pipe slope greater than 10 percent), an engineered energy dissipater shall be used.
- o 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 Definition

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

Quick References

Use For Element(s):	7	**Standard Drawing**	Figures 48, 49, 50, 51, 52

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.

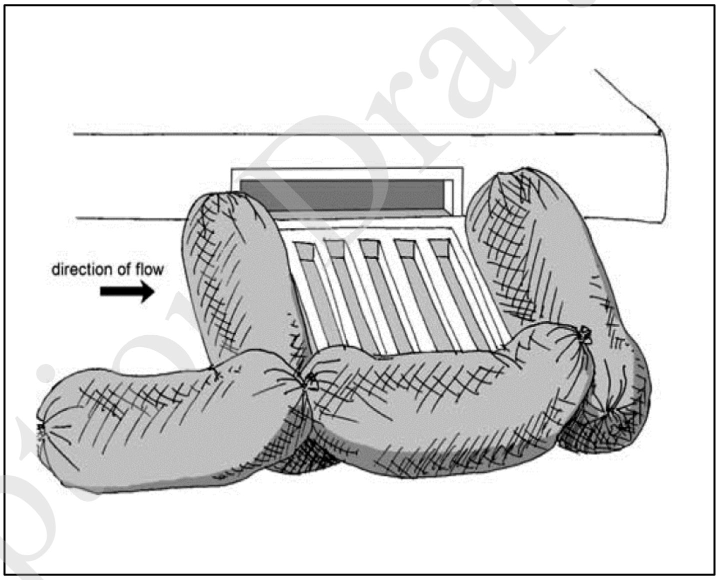


Figure 19: Illustration of Storm Drain Inlet Protection

(Source: Clark County)

The table below lists several options for inlet protection. All of the methods for storm drain inlet protection tend to plug and require a high frequency of maintenance. Limit drainage areas to one acre or less. Possibly provide emergency overflows with additional end-of-pipe treatment where stormwater ponding would cause a hazard.

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

Table 7: Storm Drain Inlet Protection

Storm Drain Inlet Protection			
Type of Inlet Protection	**Emergency Overflow**	**Applicable Surfaces**	**Conditions of Use**
Drop Inlet Protection			
Excavated drop inlet protection	Yes, temporary flooding will occur	Earthen	Applicable for heavy flows. Easy to maintain. Large area Requirement: 30' X 30'/acre
Block and gravel drop inlet protection	Yes	Paved or Earthen	Applicable for heavy concentrated flows. Will not pond.
Gravel and wire drop inlet protection	No		Applicable for heavy concentrated flows. Will pond. Can withstand traffic.
Catch basin filters	Yes	Paved or Earthen	Frequent maintenance required.
Curb Inlet Protection			
Curb inlet protection with a wooden weir	Small capacity overflow	Paved	Used for sturdy, more compact installation.
Block and gravel curb inlet protection	Yes	Paved	Sturdy, but limited filtration.
Culvert Inlet Protection			
Culvert inlet sediment trap			18 month expected life.

Design Criteria

Excavated Drop Inlet Protection

This is an excavated impoundment around the storm drain. Sediment settles out of the stormwater prior to entering the storm drain.

- Provide a depth of 1-2 ft as measured from the crest of the inlet structure.
- Slope sides of excavation no steeper than 2H:1V.
- Minimum volume of excavation is 35 cubic yards.
- Shape basin to fit site with longest dimension oriented toward the longest inflow area.
- Install provisions for draining to prevent standing water problems.
- Clear the area of all debris.

- Grade the approach to the inlet uniformly.
- Drill weep holes into the side of the inlet.
- Protect weep holes with screen wire and washed aggregate.
- Seal weep holes when removing structure and stabilizing area.
- Build a temporary dike, if necessary, to the down slope side of the structure to prevent bypass flow.

Block and Gravel Filter

This is a barrier formed around the storm drain inlet with standard concrete blocks and gravel. See .

- Provide a height of 1 to 2 feet above inlet.
- Recess the first row 2-inches into the ground for stability.
- Support subsequent courses by placing a 2x4 through the block opening.
- Do not use mortar.
- Lay some blocks in the bottom row on their side for dewatering the pool.
- Place hardware cloth or comparable wire mesh with ½-inch openings over all block openings.
- Place gravel just below the top of blocks on slopes of 2H:1V or flatter.
- An alternative design is a gravel donut.
- Provide an inlet slope of 3H:1V.
- Provide an outlet slope of 2H:1V.
- Provide a1-foot wide level stone area between the structure and the inlet.
- Use inlet slope stones 3 inches in diameter or larger.
- Use gravel ½- to ¾-inch at a minimum thickness of 1-foot for the outlet slope.

(Source: Clark County standard detail E3a, 2008)

Gravel and Wire Mesh Filter

This is a gravel barrier placed over the top of the inlet. This structure does not provide an overflow.

- Use a hardware cloth or comparable wire mesh with ½-inch openings.
- Use coarse aggregate.
- Provide a height 1-foot or more, 18-inches wider than inlet on all sides.
- Place wire mesh over the drop inlet so that the wire extends a minimum of 1-foot beyond each side of the inlet structure.

- Overlap the strips if more than one strip of mesh is necessary.
- Place coarse aggregate over the wire mesh.
- Provide at least a 12-inch depth of gravel over the entire inlet opening and extend at least 18-inches on all sides.

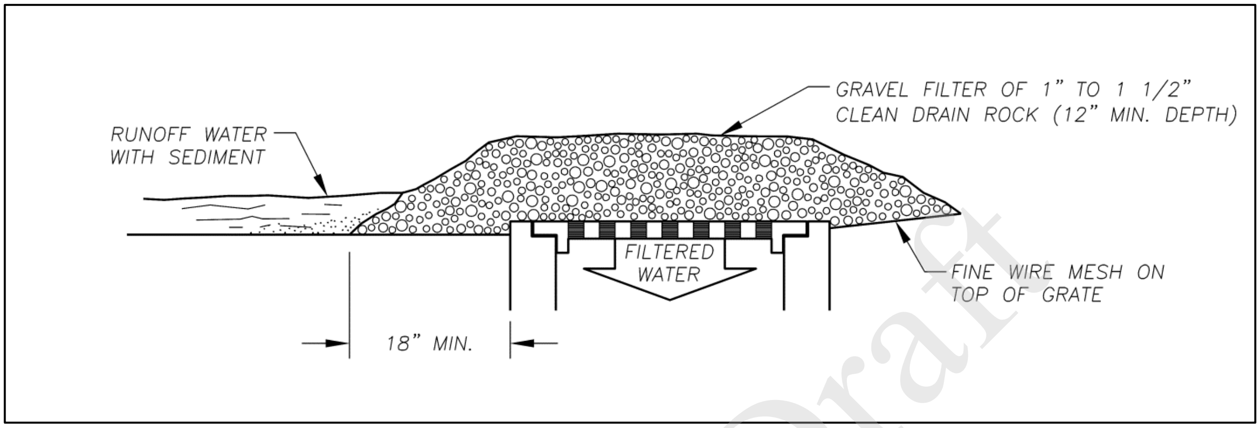


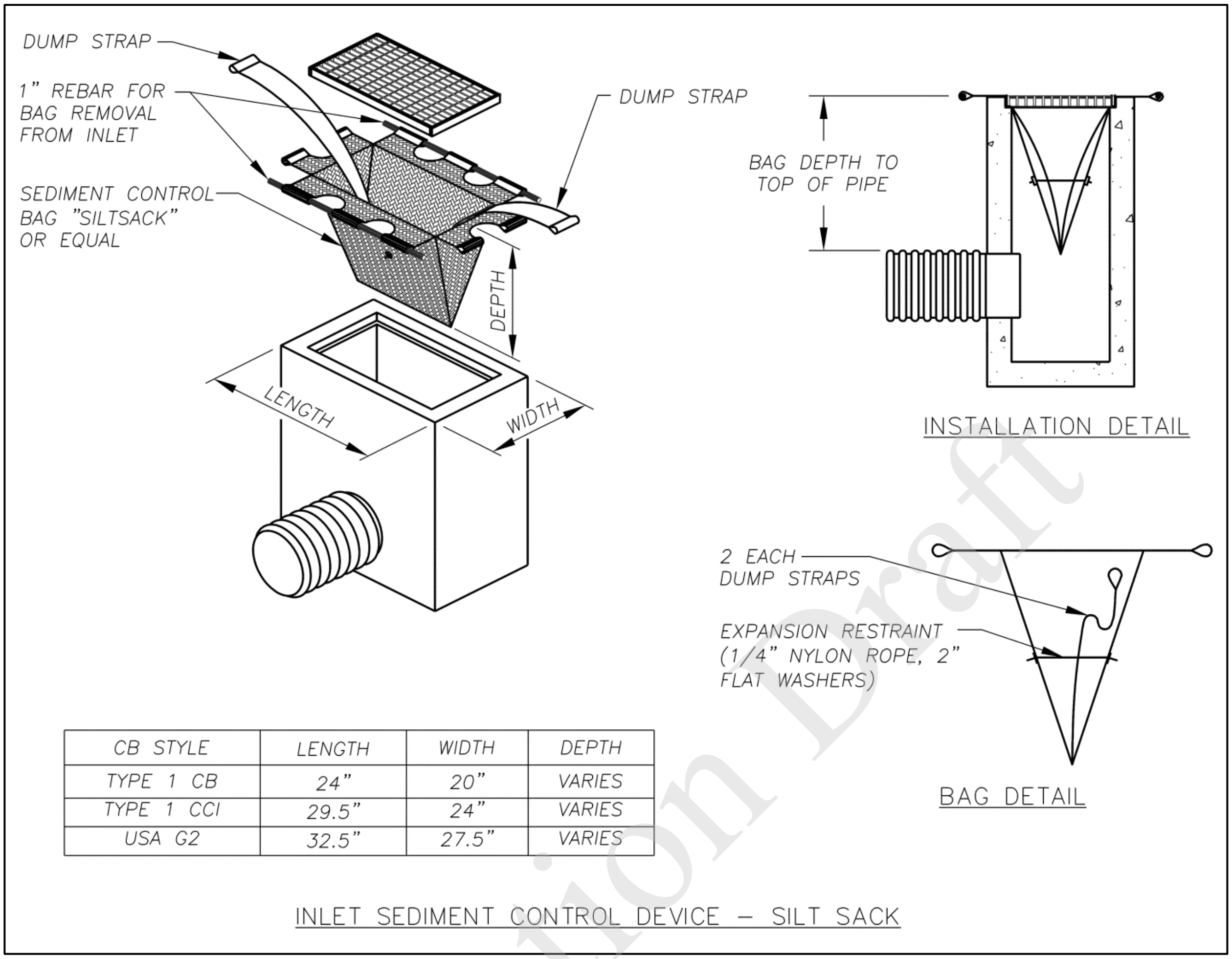
Figure 20: Gravel and Wire Mesh Filter

(Source: Clark County standard detail E3, 2008)

Catchbasin Filters

Use inserts designed by manufacturers for construction sites. The limited sediment storage capacity increases the amount of inspection and maintenance required, which may be daily for heavy sediment loads. To reduce maintenance requirements combine a catchbasin filter with another type of inlet protection. This type of inlet protection provides flow bypass without overflow and therefore may be a better method for inlets located along active rights-of-way.

- 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 21: Silt Sack Detail

(Source: Clark County)

Curb Inlet Protection with Wooden Weir

This is a barrier formed around a curb inlet with a wooden frame and gravel.

- Use wire mesh with ½-inch openings.
- Use extra strength filter cloth.
- Construct a frame.
- Attach the wire and filter fabric to the frame.
- Pile coarse washed aggregate against wire/fabric.
- Place weight on frame anchors.

Block and Gravel Curb Inlet Protection

This is a barrier formed around a curb inlet with concrete blocks and gravel. Use wire mesh with ½-inch openings.

- Place two concrete blocks on their sides abutting the curb at either side of the inlet opening. These are spacer blocks.
- Place a 2x4 stud through the outer holes of each spacer block to align the front blocks.
- Place blocks on their sides across the front of the inlet and abutting the spacer blocks.
- Place wire mesh over the outside vertical face.
- Pile coarse aggregate against the wire to the top of the barrier.

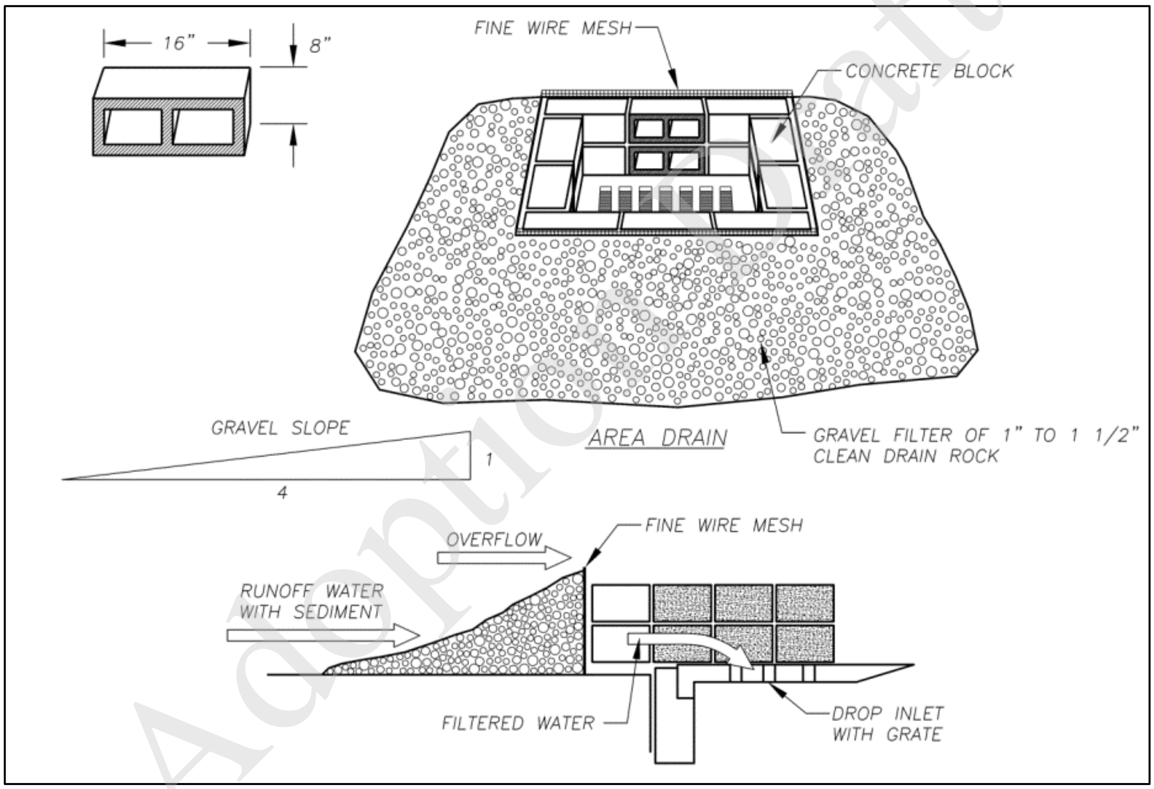
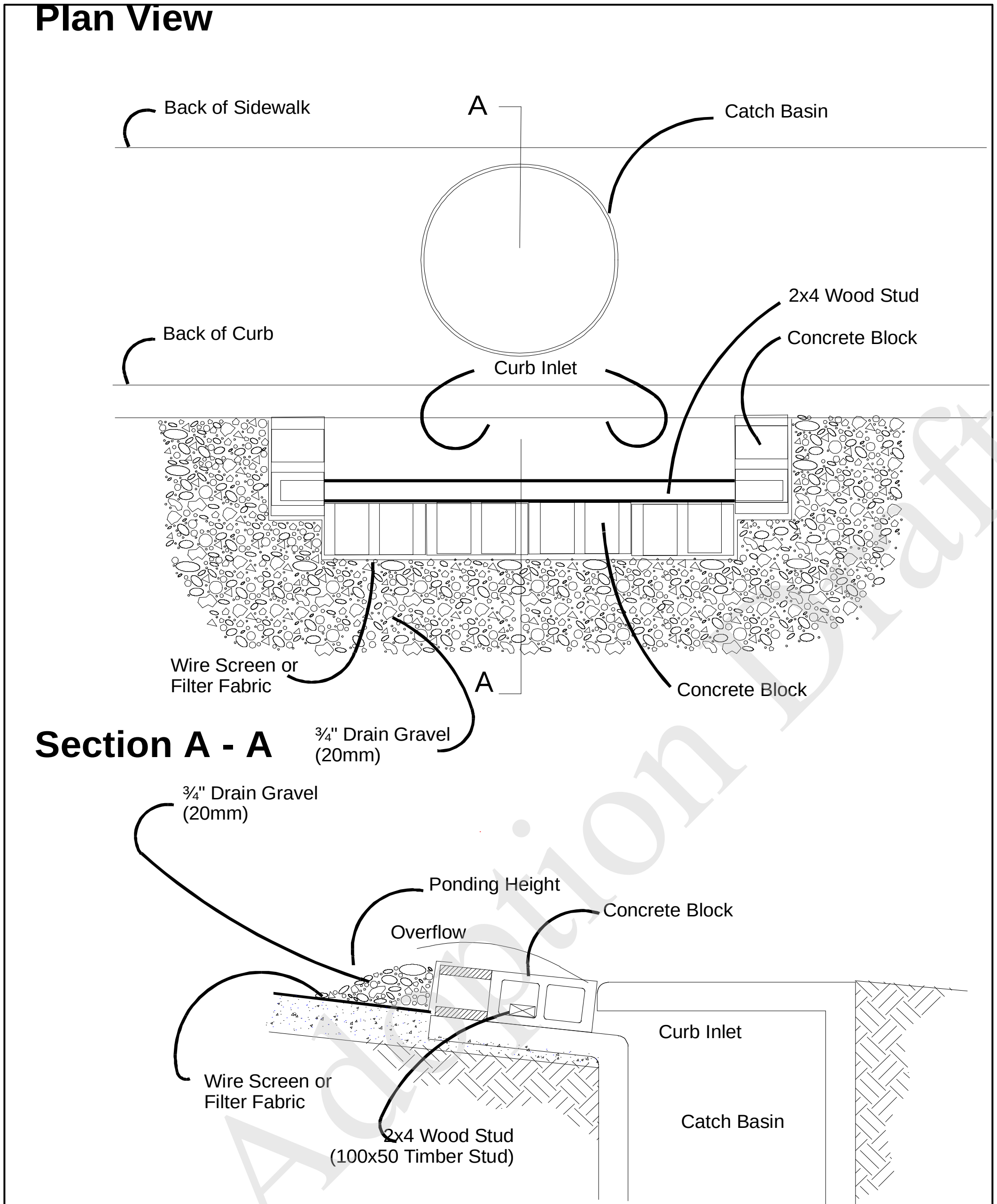


Figure 22: Block and Gravel Filter for Drop Inlets

(Source: Department of Ecology)



NOTES:

1. Use block and gravel type sediment barrier when curb inlet is located in gently sloping street segment, where water can pond and allow sediment to separate from runoff.
2. Barrier shall allow for overflow from severe storm event.
3. Inspect barriers and remove sediment after each storm event. Sediment and gravel must be removed from the traveled way immediately.

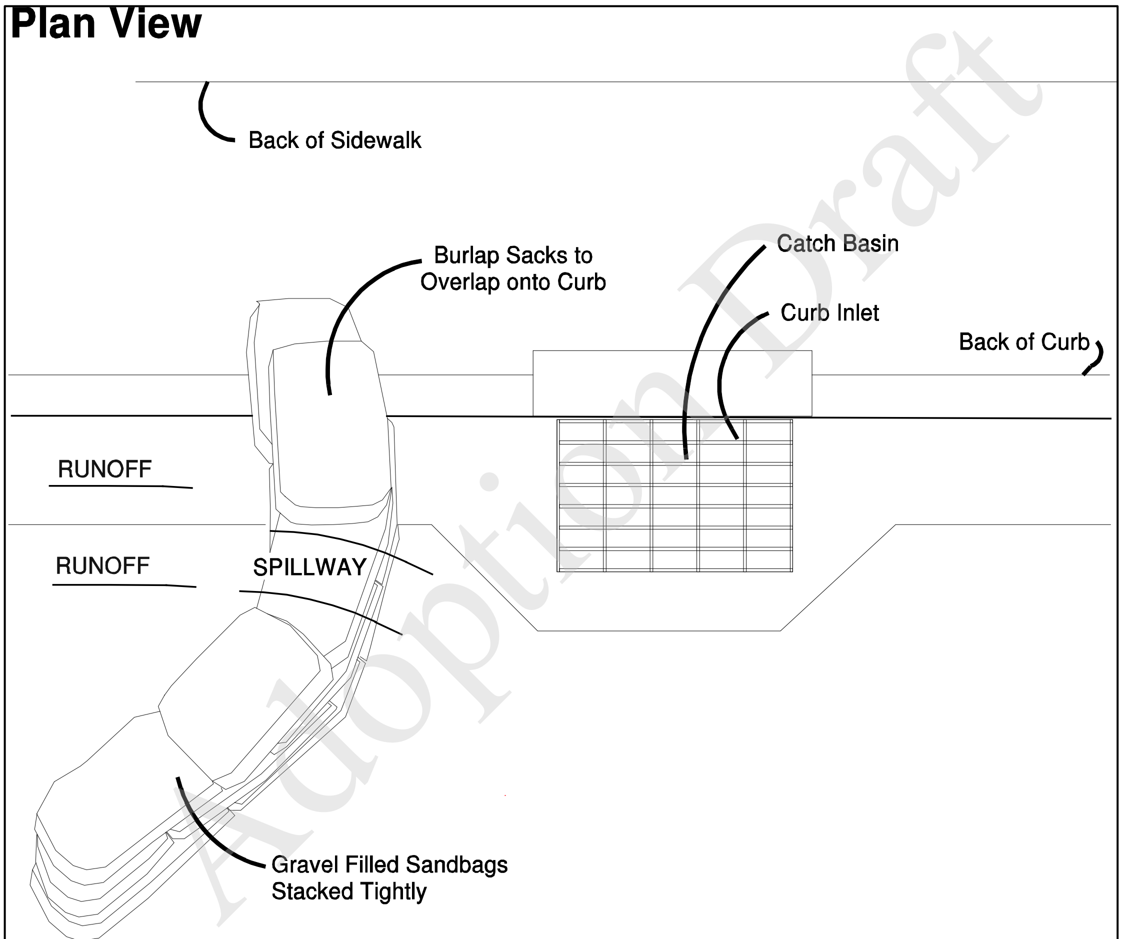
Figure 23: Block and Gravel Curb Inlet Protection

(Source: Stormwater Management Manual for Western Washington, 2014)

Curb and Gutter Sediment Barrier

This is a sandbag or rock berm (riprap and aggregate) 3 feet high and 3 feet wide in a horseshoe shape.

- Construct a horseshoe shaped berm, faced with coarse aggregate if using riprap, 3 feet high and 3 feet wide, at least 2 feet from the inlet.
- Construct a horseshoe shaped sedimentation trap on the outside of the berm sized to sediment trap standards for protecting a culvert inlet.



NOTES:
1. Place curb type sediment barriers on gently sloping street segments, where water can pond and allow sediment to separate from runoff.
2. Sandbags of either burlap or woven `geotextile' fabric, are filled with gravel, layered and packed tightly.
3. Leave a one sandbag gap in the top row to provide a spillway for overflow.
4. Inspect barriers and remove sediment after each storm event. Sediment and gravel must be removed from the traveled way immediately.

Figure 24: Curb and Gutter Sediment Barrier

Maintenance Standards

Inspect catch basin filters frequently, especially after storm events. Clean and replace clogged inserts. For systems with clogged stone filters: pull away the stones from the inlet and clean or replace. An alternative approach would be to use the clogged stone as fill and put fresh stone around the inlet.

Do not wash sediment into storm drains while cleaning. Spread all excavated material evenly over the surrounding land area or stockpile and stabilize as appropriate.

BMP C231: Brush Barrier

Purpose and Definition

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.

Quick References

Use For Element(s):	4, 13	Standard Drawing	Figure 39

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.

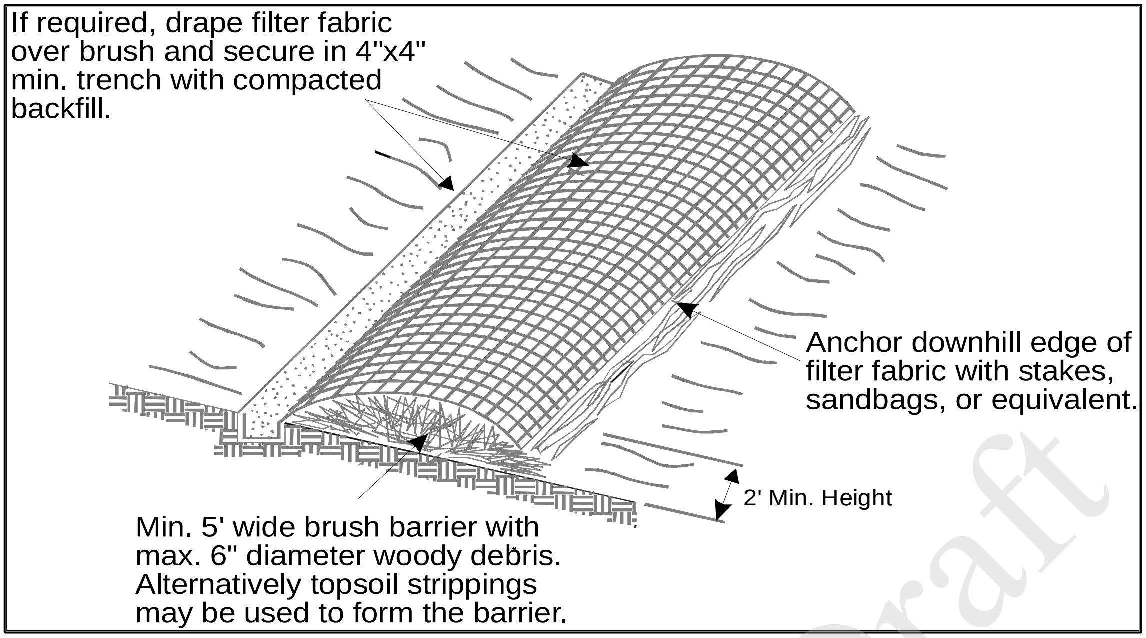


Figure 25: Brush Barrier

(Source: WA State Dept. of Ecology)

BMP C232: Gravel Filter Berm

Purpose and Definition

A gravel filter berm retains sediment by using a filter berm of gravel or crushed rock.

Quick References

Use For Element(s):	4	**Standard Drawing**	Figure 39

Conditions of Use

Where a temporary measure is needed to retain sediment from rights-of-way or in traffic areas on construction sites.

Design Criteria

- See Clark County Standard Detail E12: Filter Berm – Rock.
- Berm material shall be ¾ to 3 inches in size, washed well-grade gravel or crushed rock with less than 5 percent fines.
- Spacing of berms:
    - Every 300 feet on slopes less than 5 percent
    - Every 200 feet on slopes between 5 percent and 10 percent
    - Every 100 feet on slopes greater than 10 percent
- Berm dimensions:
    - 1 foot high with 3H:1V side slopes
    - 8 linear feet per 1 cfs runoff based on the 10-year, 24-hour design storm

Maintenance Standards

- Regular inspection is required. Sediment shall be removed and filter material replaced as needed.

BMP C233: Silt Fence

Purpose and Definition

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.

Quick References

Use For Element(s):	1, 4, 13	**Standard Drawing**	Figure 32

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.

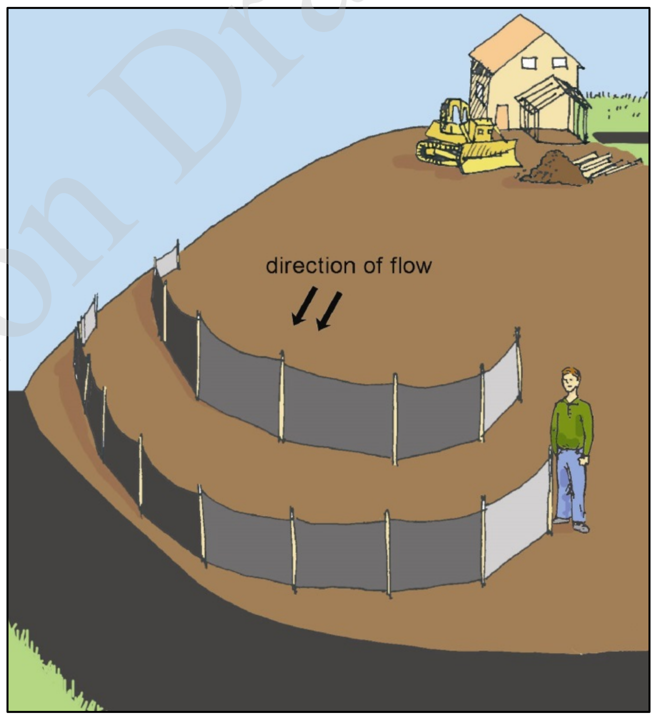


Figure 26: Illustration of Silt Fence

(Source: Clark County)

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.
- The geotextile used shall meet the following standards. All geotextile properties listed below are minimum average roll values (i.e., the test result for any sampled roll in a lot shall meet or exceed the values shown in Table 8).

Table 8: Geotextile Standards for Silt Fence

Geotextile Standards	
Polymeric Mesh AOS (ASTM D4751)	0.60 mm maximum for slit film woven (#30 sieve). 0.30 mm maximum for all other geotextile types (#50 sieve). 0.15 mm minimum for all fabric types (#100 sieve).
Water Permittivity (ASTM D4491)	0.02 sec^{-1} minimum
Grab Tensile Strength (ASTM D4632)	180 lbs. Minimum for extra strength fabric. 100 lbs minimum for standard strength fabric.
Grab Tensile Strength (ASTM D4632)	30% maximum
Ultraviolet Resistance (ASTM D4355)	70% minimum

- 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 following Standard Notes shall be included in the construction plans and specifications:
    - The contractor shall install and maintain temporary silt fences at the locations shown in the Plans.
    - The silt fences shall be constructed in areas of clearing, grading, or drainage prior to starting those activities.
    - 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 the Contractor can demonstrate, to the satisfaction of the Engineer, 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.

- Support the filter fabric with wire or plastic mesh, dependent on the properties of the geotextile selected for use. If wire or plastic mesh is used, fasten the mesh securely to the up-slope side of the posts with the filter fabric up-slope of the mesh.
  - Mesh support, if used, shall consist of steel wire with a maximum mesh spacing of 2-inches, or a prefabricated polymeric mesh. The strength of the wire or polymeric mesh shall be equivalent to or greater than 180 lbs. grab tensile strength. The polymeric mesh must be as resistant to the same level of ultraviolet radiation as the filter fabric it supports.
- 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.
- Drive or place the fence posts into the ground a minimum depth of 18 inches, provided that a minimum depth of 12 inches is allowed if topsoil or other soft subgrade soil is not present and 18-inches cannot be reached. Fence post depth shall be increased by 6 inches if the fence is located on slopes 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.

- Gravel check dams shall be approximately 1-foot deep at the back of the fence. Gravel check dams shall be continued perpendicular to the fence at the same elevation until the top of the check dam intercepts the ground surface behind the fence.
- Gravel check dams shall consist of crushed surfacing base course, gravel backfill for walls, or shoulder ballast. Gravel check dams shall be located every 10 feet along the fence where the fence must cross contours.

Silt fence installation using the slicing method specifications:

- The base of both end posts must be at least 2 to 4 inches above the top of the filter fabric on the middle posts for ditch checks to drain properly. Use a hand level or string level, if necessary, to mark base points before installation.
- Install posts 3 to 4 feet apart in critical retention areas and 6 to 7 feet apart in standard applications.
- Install posts 24-inches deep on the downstream side of the silt fence, and as close as possible to the filter fabric, enabling posts to support the filter fabric from upstream water pressure.
- Install posts with the nipples facing away from the filter fabric.
- Attach the filter fabric to each post with three ties, all spaced within the top 8-inches of the filter fabric. Attach each tie diagonally 45 degrees through the filter fabric, with each puncture at least 1-inch vertically apart. Each tie should be positioned to hang on a post nipple when tightening to prevent sagging.
- Wrap approximately 6-inches of fabric around the end posts and secure with 3 ties.
- No more than 24 inches of a 36-inch filter fabric is allowed above ground level.
- Compact the soil immediately next to the filter fabric with the front wheel of the tractor, skid steer, or roller exerting at least 60 pounds per square inch. Compact the upstream side first and then each side twice for a total of four trips. Check and correct the silt fence installation for any deviation before compaction. Use a flat-bladed shovel to tuck fabric deeper into the ground if necessary.

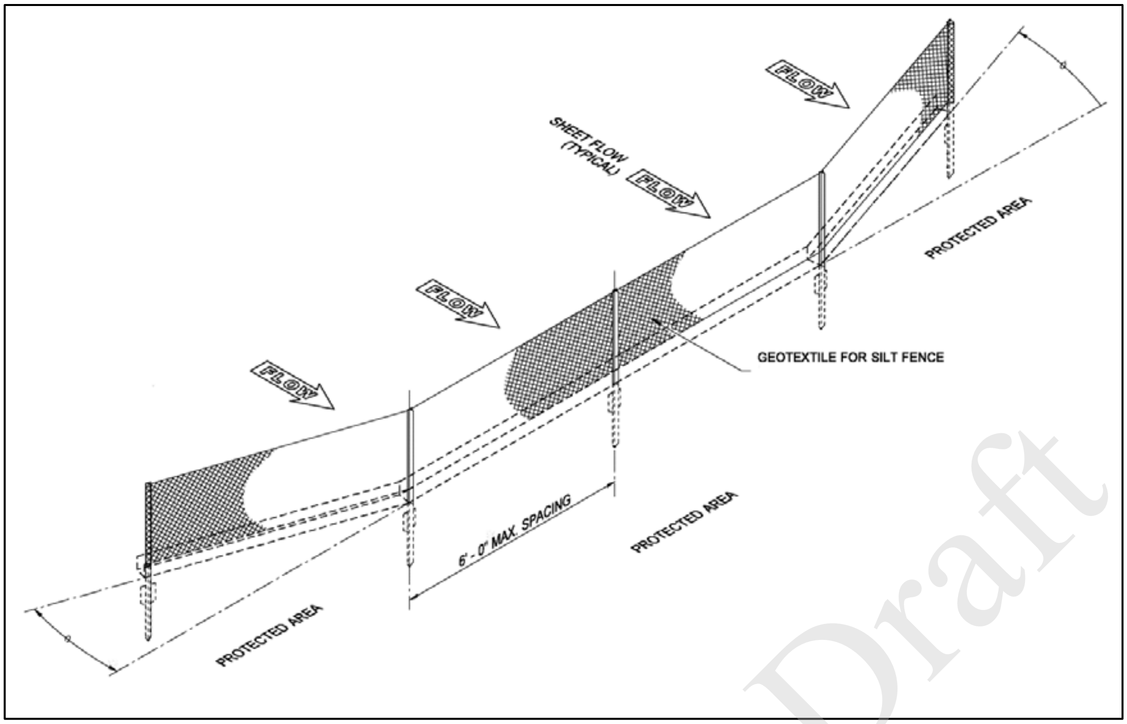


Figure 27: Silt Fence

(Source: WSDOT Standard Plan I-30.15-02, 2013)

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 Definition

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.

Quick References

Use For Element(s):	4, 13	**Standard Drawing**	n/a

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 9 are met.

Table 9: 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 Definition

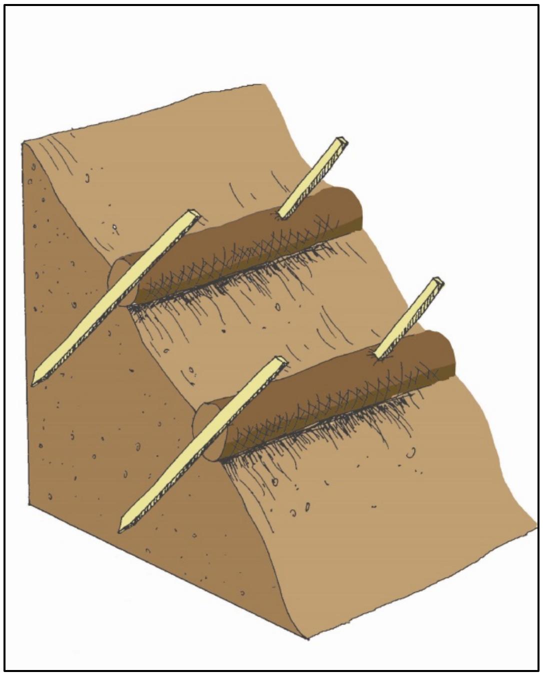


Figure 28: Illustration of Wattles

(Source: Clark County)

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.

Refer to WSDOT Standard Plan I-30.30-00 for information on Wattles (http://www.wsdot.wa.gov/Design/Standards/Plans.htm#SectionI)

Quick References

Use For Element(s):	3, 4	**Standard Drawing**	Figure 38

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 C236: Vegetative Filtration

Purpose and Definition

Vegetative Filtration accepts pumped collected construction stormwater, dewatering discharges, and other similar water containing sediment (often in conjunction with BMP C241 Temporary Sediment Ponds and BMP C206 Level Spreader) surface intake to improve turbidity levels of stormwater discharges by filtering through existing vegetation where undisturbed forest floor duff layer or established lawn with thatch layer are present. Vegetative Filtration can also be used to infiltrate dewatering waste from foundations, vaults, and trenches as long as runoff does not occur.

Quick References

Use For Element(s):	10	**Standard Drawing**	n/a

Conditions of Use

Wetlands shall not be used for filtration.

Do not use this BMP in areas with a high groundwater table, or in areas that will have a high seasonal groundwater table during the use of this BMP.

Design Criteria

- The ratio of disturbed soil area to vegetated dispersion shall be at least 5:1.
- Install a pump and downstream distribution manifold depending on the project size. Generally, the main distribution line should reach 100 to 200-feet long (many large projects, or projects on tight soil, will require systems that reach several thousand feet long with numerous branch lines off of the main distribution line).
- The manifold should have several valves, allowing for control over the distribution area in the field.
- Install several branches of 4" schedule 20, swaged-fit common septic tight-lined sewer line, or 6" fire hose, which can convey the turbid water out to various sections of the field.
- Determine the branch length based on the field area geography and number of branches. Typically, branches stretch from 200-feet to several thousand feet. Always, lay branches on contour with the slope.
- On uneven ground, sprinklers perform well. Space sprinkler heads so that spray patterns do not overlap.
- On relatively even surfaces, a level spreader using 4-inch perforated pipe may be used as an alternative option to the sprinkler head setup. Install drain pipe at the highest point on the field

and at various lower elevations to ensure full coverage of the filtration area. Pipe should be place with the holes up to allow for a gentle weeping of stormwater evenly out all holes. Leveling the pipe by staking and using sandbags may be required.

- To prevent the over saturation of the field area, rotate the use of branches or spray heads. Do this as needed based on monitoring the spray field.
- Monitor the spray field on a daily basis to ensure that over saturation of any portion of the field doesn't occur at any time. The presence of standing puddles of water or creation of concentrated flows visually signify that over saturation of the field has occurred.
- Since the operator is handling contaminated water, physically monitor the vegetated spray field all the way down to the nearest surface water, or furthest spray area, to ensure that the water has not caused overland or concentrated flows, and has not created erosion around the spray nozzle.
- Monitoring usually needs to take place 3-5 times per day to ensure sheet-flow into state waters. Do not exceed water quality standards for turbidity.
- Ecology strongly recommends that a separate inspection log be developed, maintained and kept with the existing site logbook to aid the operator conducting inspections. This separate "Field Filtration Logbook" can also aid the facility in demonstrating compliance with permit conditions.

Maintenance Standards

- Inspect the spray nozzles daily, at a minimum, for leaks and plugging from sediment particles.
- If erosion, concentrated flows, or over saturation of the field occurs, rotate the use of branches or spray heads or move the branches to a new field location.
- Check all branches and the manifold for unintended leaks.
- Stop distributing water into the vegetated area if standing water or erosion results.

Flow path Guidelines for Vegetative Filtration		
Average Slope	**Average Area % Slope**	**Estimated Flow path Length (ft)**
1.5H:1V	67%	250
2H:1V	50%	200
4H:1V	25%	150
6H:1V	16.7%	115
10H:1V	10%	100

Figure 29: Manifold and Branches in a wooded, vegetated spray field

(Source: SMMWW)

BMP C240: Sediment Trap

Purpose and Definition

A sediment trap is a small temporary ponding area with a gravel outlet used to collect and store sediment from sites cleared and/or graded during construction.

Quick References

Use For Element(s):	3, 4	**Standard Drawing**	Figure 35

Conditions of Use

Sediment traps, along with other perimeter controls, shall be installed before any land disturbance takes place in the drainage area.

Prior to leaving a construction site, stormwater runoff must pass through a sediment pond or trap or other appropriate sediment-removal BMP. Non-engineered sediment traps may be used on-site prior to an engineered sediment trap or sediment pond to provide additional sediment removal capacity.

A sediment trap is intended for use on sites where the tributary drainage area is less than 3 acres, with no unusual drainage features, and a projected build-out time of six months or less. The sediment trap is a temporary measure with a design life of approximately 6 months and shall be maintained until the site area is permanently protected against erosion by vegetation and/or structures.

Sediment traps and ponds are only effective in removing sediment down to about the medium silt size fraction. Runoff with sediment of finer grades (fine silt and clay) will pass through untreated, and must be either avoided or treated using another appropriate BMP.

Whenever possible, sediment-laden water shall be discharged into on-site, relatively level, vegetated areas (see BMP C234 – Vegetated Strip). This is the only way to effectively remove fine particles from runoff unless chemical treatment or filtration is used. This can be particularly useful after initial treatment in a sediment trap or pond. The areas of release must be evaluated on a site-by-site basis in order to determine appropriate locations for and methods of releasing runoff. Vegetated wetlands shall not be used for this purpose. Frequently, it may be possible to pump water from the collection point at the downhill end of the site to an upslope vegetated area. Pumping shall only augment the treatment system, not replace it, because of the possibility of pump failure or runoff volume in excess of pump capacity.

Projects that are constructing permanent facilities for runoff quantity control should use the rough-graded or final-graded permanent facilities for traps. This includes combined facilities and infiltration facilities.

Either a permanent control structure or the temporary control structure (described in BMP C241, Temporary Sediment Pond) can be used. If a permanent control structure is used, it may be advisable to partially restrict the lower orifice with gravel to increase residence time while still allowing dewatering of the pond. A shut-off valve may be added to the control structure to allow complete retention of stormwater in emergency situations. In this case, an emergency overflow weir must be added.

A skimmer may be used for the sediment trap outlet if approved by the Responsible Official.

Sediment traps may not be feasible on utility projects due to the limited work space or the short-term nature of the work. Portable tanks may be used in place of sediment traps for utility projects.

Design Criteria

- If permanent runoff control facilities are part of the project, they should be used for sediment retention.
- To aid in determining sediment depth, all sediment traps shall have a staff gauge with a prominent mark 1 foot above the bottom of the trap.

Determining Trap Geometry

To determine the sediment trap geometry, first calculate the design surface area (SA) of the trap, measured at the invert of the weir. Use the following equation:

$$SA = FS(Q_2/V_S)$$

where

Q_2 = *Design inflow based on the peak discharge from the developed 2-year runoff event from the contributing drainage area as computed in the hydrologic analysis. The 10-year peak flow shall be used if the project size, expected timing and duration of construction, or downstream conditions warrant a higher level of protection. If no hydrologic analysis is required, the Rational Method may be used.*

V_S = *The settling velocity of the soil particle of interest. The 0.02 mm (medium silt) particle with an assumed density of 2.65 g/cm^3 has been selected as the particle of interest and has a settling velocity (V_S) of 0.00096 ft/sec.*

FS = *A safety factor of 2 to account for non-ideal settling.*

Therefore, the equation for computing surface area becomes:

SA = $2 \times Q_2/0.00096$ *or 2080 square feet per cfs of inflow*

Note: Even if permanent facilities are used, they must have a surface area that is at least as large as that derived from the above formula. If they do not, the pond must be enlarged.

Maintenance Standards

- Sediment shall be removed from the trap when it reaches 1 foot in depth.
- Any damage to the pond embankments or slopes shall be repaired.

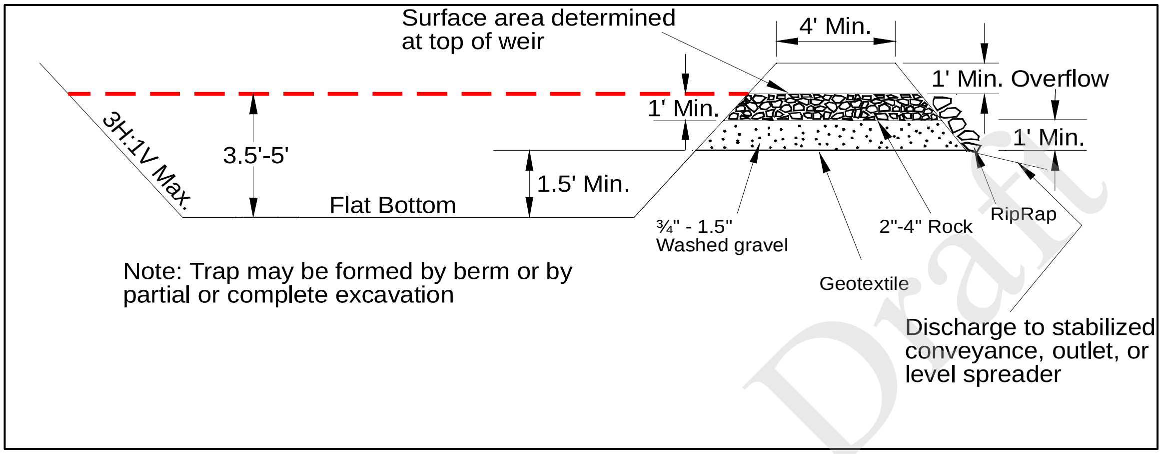


Figure 30: Sediment Trap Cross-section

(Source: WA State Dept. of Ecology)

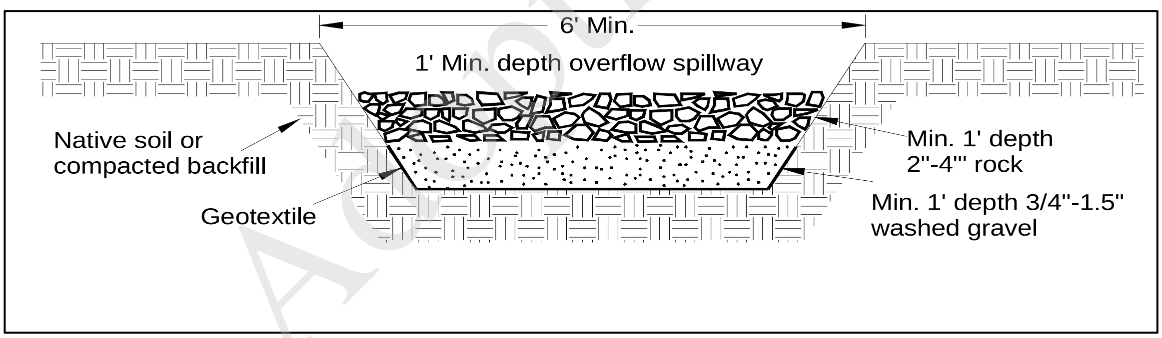


Figure 31: Sediment Trap Outlet

(Source: WA State Dept. of Ecology)

Section 6 — Standard Drawings

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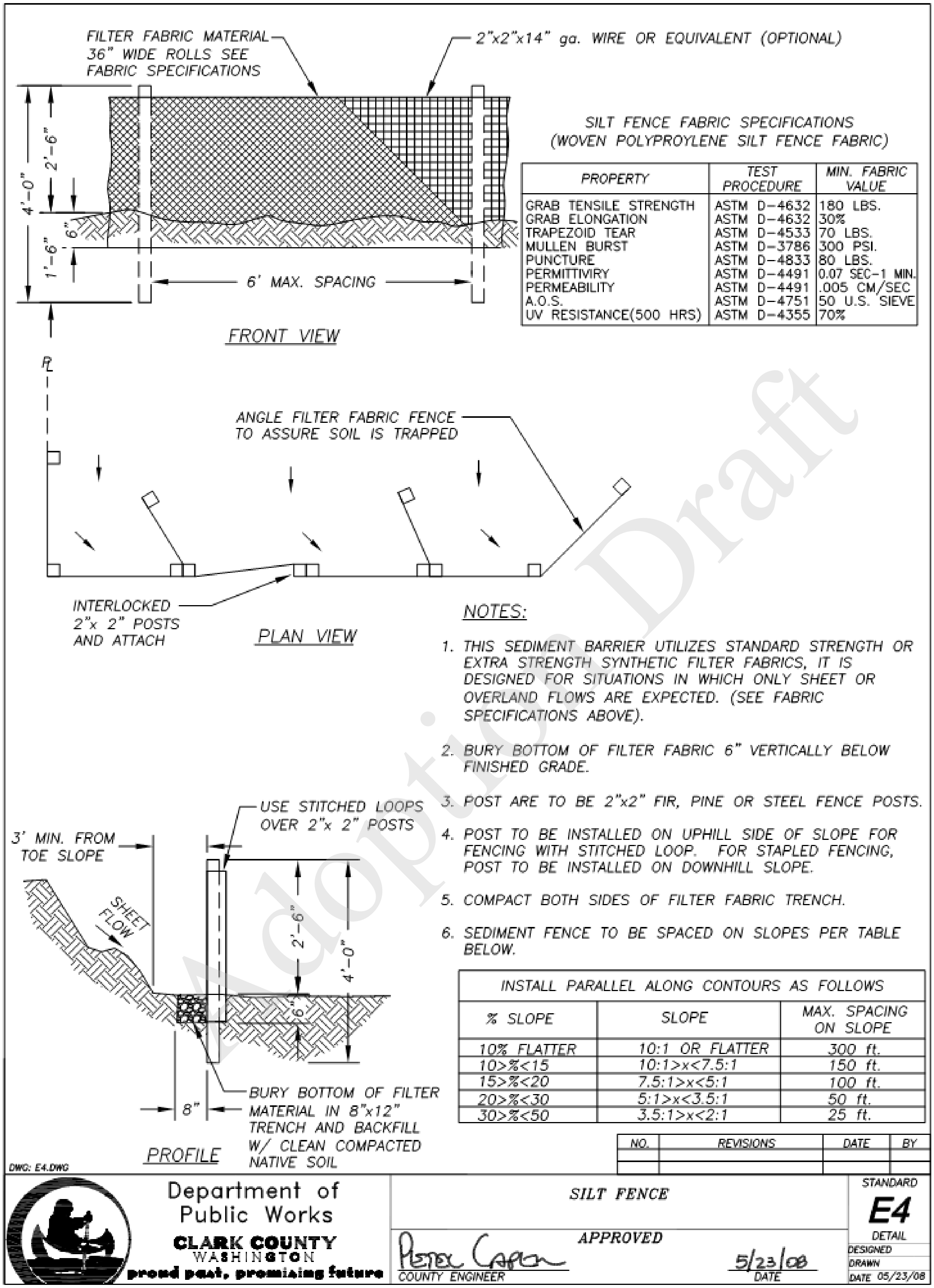

SILT FENCE FABRIC SPECIFICATIONS
(WOVEN POLYPROYLENE SILT FENCE FABRIC)

PROPERTY	TEST PROCEDURE	MIN. FABRIC VALUE
GRAB TENSILE STRENGTH	ASTM D-4632	180 LBS.
GRAB ELONGATION	ASTM D-4632	30%
TRAPEZOID TEAR	ASTM D-4533	70 LBS.
MULLEN BURST	ASTM D-3786	300 PSI.
PUNCTURE	ASTM D-4833	80 LBS.
PERMITTIVIRY	ASTM D-4491	0.07 SEC-1 MIN.
PERMEABILITY	ASTM D-4491	.005 CM/SEC
A.O.S.	ASTM D-4751	50 U.S. SIEVE
UV RESISTANCE(500 HRS)	ASTM D-4355	70%

NOTES:

1. THIS SEDIMENT BARRIER UTILIZES STANDARD STRENGTH OR EXTRA STRENGTH SYNTHETIC FILTER FABRICS, IT IS DESIGNED FOR SITUATIONS IN WHICH ONLY SHEET OR OVERLAND FLOWS ARE EXPECTED. (SEE FABRIC SPECIFICATIONS ABOVE).
2. BURY BOTTOM OF FILTER FABRIC 6" VERTICALLY BELOW FINISHED GRADE.
3. POST ARE TO BE 2"x2" FIR, PINE OR STEEL FENCE POSTS.
4. POST TO BE INSTALLED ON UPHILL SIDE OF SLOPE FOR FENCING WITH STITCHED LOOP. FOR STAPLED FENCING, POST TO BE INSTALLED ON DOWNHILL SLOPE.
5. COMPACT BOTH SIDES OF FILTER FABRIC TRENCH.
6. SEDIMENT FENCE TO BE SPACED ON SLOPES PER TABLE BELOW.

INSTALL PARALLEL ALONG CONTOURS AS FOLLOWS		
% SLOPE	SLOPE	MAX. SPACING ON SLOPE
10% FLATTER	10:1 OR FLATTER	300 ft.
10>%<15	10:1>x<7.5:1	150 ft.
15>%<20	7.5:1>x<5:1	100 ft.
20>%<30	5:1>x<3.5:1	50 ft.
30>%<50	3.5:1>x<2:1	25 ft.

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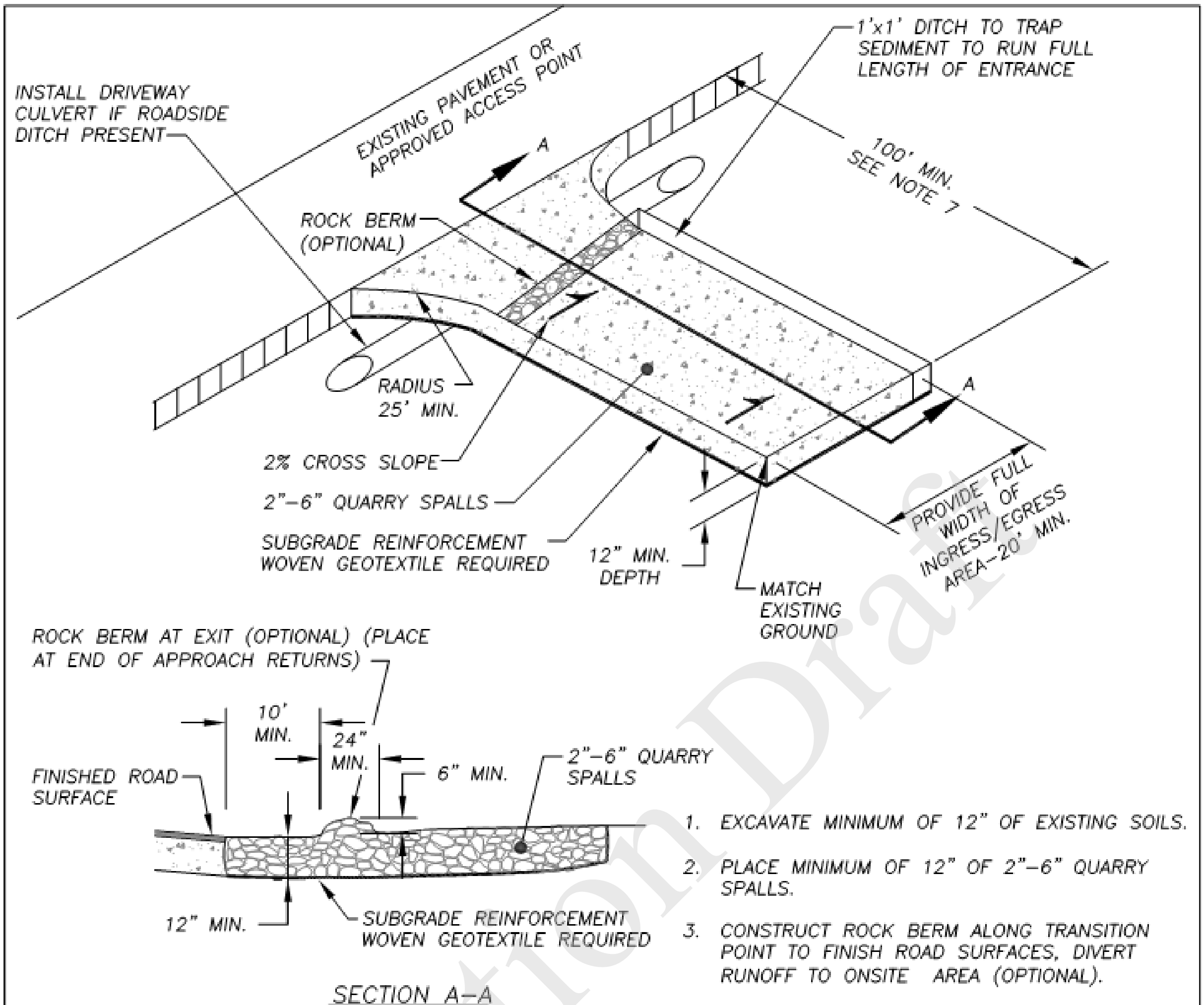
Figure 32: BMP C104 - Silt Fence



NOTES:

1. FOR DEVELOPMENT PROJECTS REVIEWED BY ENGINEERING SERVICES. NOT FOR USE WITH SINGLE FAMILY OR DUPLEX RESIDENTIAL BUILDING PERMITS. SEE BUILDING DEPT. FOR GRAVEL CONSTRUCTION ENTRANCE PLAN.
2. NSTALL WOVEN GEOTEXTILE FABRIC TO PREVENT SUB–SOIL PUMPING.
3. VEHICLE WASHDOWN AREA, IF REQUIRED, IS TO BE INSTALLED AND USED TO REMOVE SEDIMENT FROM VEHICLES THAT ARE ABOUT TO ENTER AN ESTABLISHED ROAD.
4. WASHDOWN AREA TO BE MADE UP OF CLEAN 2"– 6" QUARRY SPALLS, 12" DEEP (MIN) OVER WOVEN GEOTEXTILE FABRIC. WASHDOWN AREA TO BE FULL WIDTH OF ENTRANCE AND 50' LENGTH (MIN.), AND 100' IF EXPOSED SOIL IS OVER 5 ACRES.
5. AT TIME OF PRECONSTRUCTION MEETING, THE COUNTY INSPECTOR MAY REQUIRE THE ENTRANCE TO BE PAVED TO THE EDGE OF THE RIGHT–OF–WAY PRIOR TO THE INSTALLATION OF A WASHDOWN ENTRANCE TO AVOID DAMAGE TO THE EXISTING ROADWAY.
6. THE RESPONSIBLE EROSION CONTROL INDIVIDUAL IS TO ENSURE THAT ALL VEHICLES USE THIS ENTRANCE AND ARE TO BE INSPECTED AND CLEANED OF SOILS BEFORE LEAVING PROJECT, AND THAT THE ENTRANCE IS TO BE KEPT CLEAN AT ALL TIMES.
7. THE 100' MINIMUM LENGTH OF ENTRANCE SHALL BE REDUCED TO THE MAXIMUM PRATICABLE SIZE WHEN THE SIZE OR CONFIGURATION OF THE SITE DOES NOT ALLOW THE FULL LENGTH (100').

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1	STORMWATER UPDATES	11/06/08	PC

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STABILIZED CONSTRUCTION ENTRANCE

APPROVED

COUNTY ENGINEER

5/23/08
DATE

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E1
DETAIL
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DRAWN
DATE 05/23/08

Figure 33: BMP C105 - Stabilized Construction Entrance

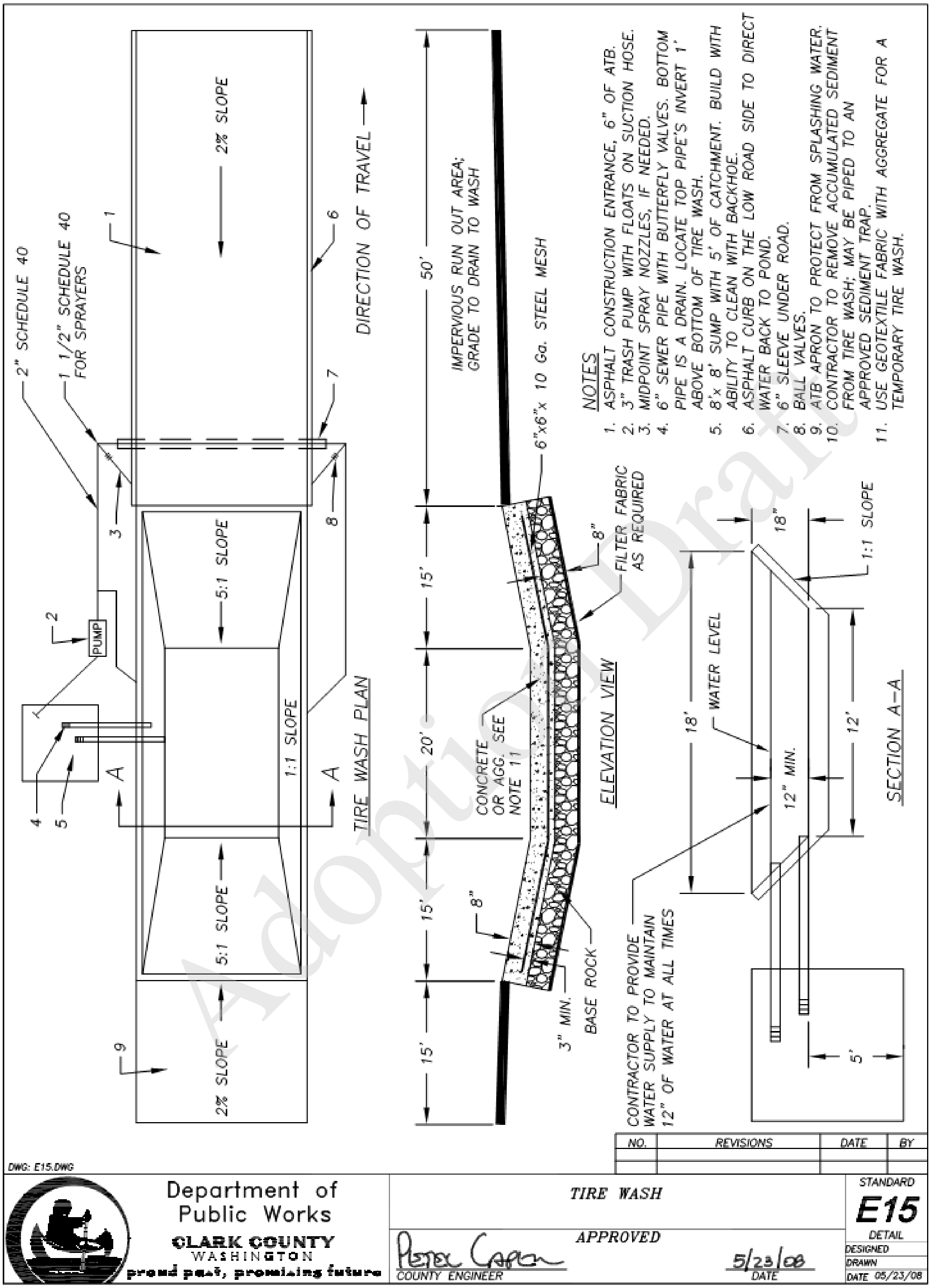
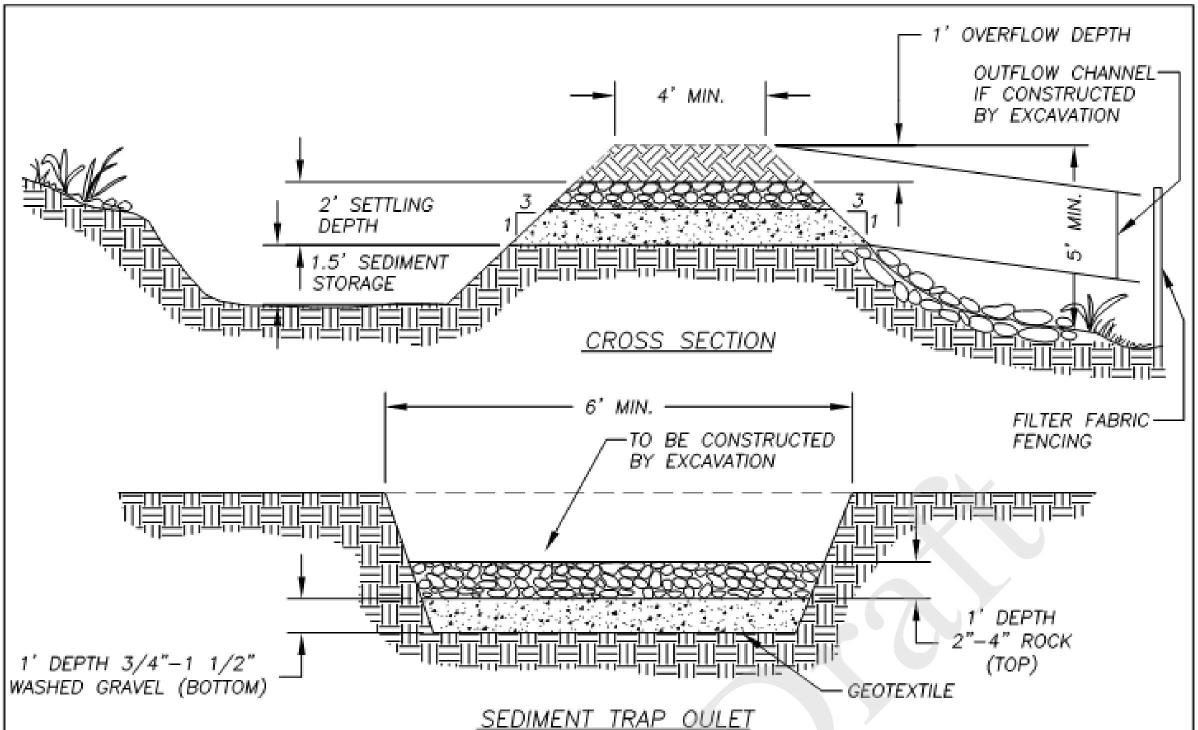


Figure 34: BMP C106 - Wheel Wash



NOTES:

1. THE SEDIMENT TRAP MAY BE FORMED COMPLETELY BY EXCAVATION OR BY CONSTRUCTION OF A COMPACTED EMBANKMENT, AND IS TO BE CONSTRUCTED PRIOR TO ANY UPSLOPE CLEARING AND GRADING.
2. TRAP IS TO BE LOCATED IN A LOW AREA WHERE THE TRAP WILL INTERCEPT ALL OR MOST OF THE RUNOFF FROM THE DISTURBED AREA. MUST BE ACCESSIBLE FOR MAINTENANCE.
3. PROVIDE DIVERSION DIKES AND DITCHES, AS NEEDED TO COLLECT AND DIVERT WATER SEDIMENT LADEN FLOWS TO TRAPS AND PONDS.
4. SEDIMENT TRAPS SHALL BE LIMITED TO A TRIBUTARY AREA OF LESS THAN 3 ACRES. SEE THE BMP MANUAL SECTION II-5.8.6 DESIGN CRITERIA, FOR SEDIMENT STORAGE VOLUME.
5. SEDIMENT TRAPS AND PONDS ARE TO HAVE A LEVEL BOTTOM, 3:1 OR FLATTER SIDE SLOPES AND A L:W RATIO OF 3.
6. WATER TEMPERATURE IN TRAPS AND PONDS MAY BE TOO HIGH FOR DIRECT RELEASE. ALWAYS MODERATE THE WATER TEMPERATURE BEFORE IT DRAINS INTO A LAKE, STREAM, WETLAND OR WATERWAY. WHENEVER POSSIBLE, RELEASE THE DISCHARGE ONSITE ONTO A RELATIVELY LEVEL, DENSELY GRASSED AREA AT LEAST 50 FEET FROM A WATERWAY OR WETLAND.
7. INSPECT ONCE PER WEEK ON ACTIVE SITES, ONCE EVERY TWO WEEKS ON INACTIVE SITES, AND WITHIN 24 HOURS FOLLOWING A 0.5 INCH RAIN EVENT.
8. CONSTANT MAINTENANCE IS ESSENTIAL FOR PROPER FUNCTIONING.
9. REMOVE SEDIMENT FROM THE TRAP WHEN IT REACHES ONE FOOT IN DEPTH, AND REPAIR ANY DAMAGE TO THE TRAP, THE EMBANKMENT OR THE SLOPES.
10. CARE MUST BE GIVEN TO CONSIDERING LOCATION OF TRAPS FOR SAFETY IN CASE THE STRUCTURE FAILS. FENCING MUST ALSO BE CONSIDERED FOR SAFETY.

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STANDARD SEDIMENT TRAP

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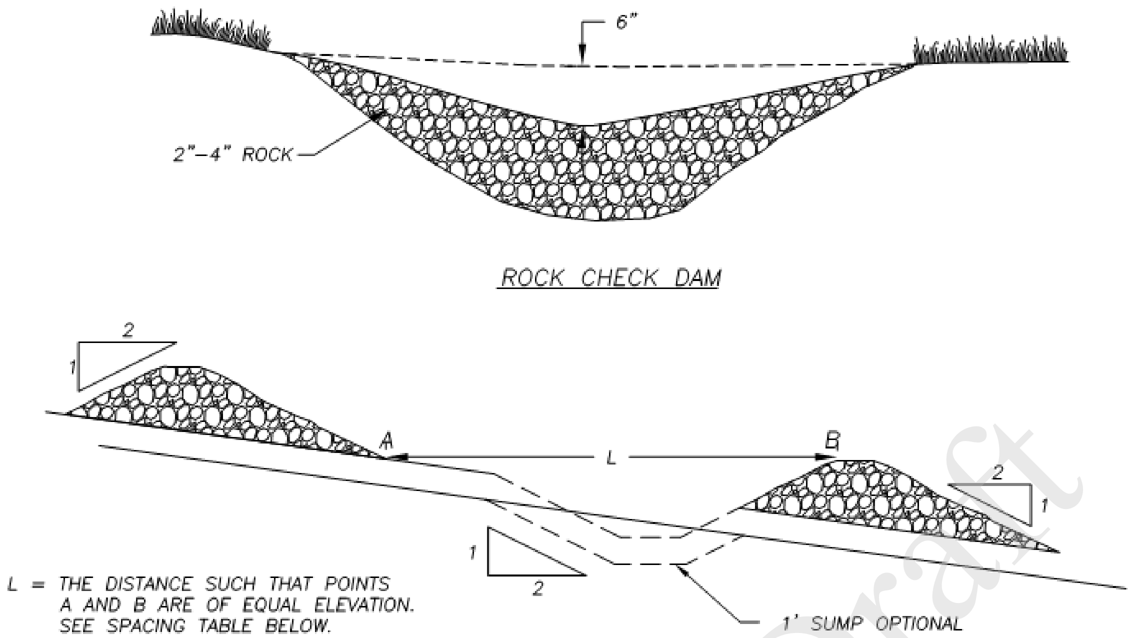
Figure 35: BMP C240 - Sediment Trap



SPACING BETWEEN CHECK DAMS

CHECK DAM NOTES:

1. CHECK DAMS ARE CONSTRUCTED ACROSS A SWALE OR DITCH TO REDUCE VELOCITIES OF CONCENTRATED FLOWS, THEREBY REDUCING EROSION AND ALLOWING A SIGNIFICANT AMOUNT OF SUSPENDED SEDIMENT TO SETTLE OUT.
2. CHECK DAMS SHALL BE USED IN TEMPORARY OR PERMANENT CHANNELS THAT DRAIN 10 ACRES OR LESS, ARE NOT YET VEGETATED, AND WHEN INSTALLING CHANNEL LINING IS NOT FEASIBLE.
3. USE TYPICAL ROCK SIZE OF 2–4 INCH. PLACE ROCK BY HAND OR BY MECHANICAL MEANS RATHER THAN DUMPING THE ROCK. BRIDGE ENTIRE DITCH OR SWALE WIDTH AND ENSURE THE CENTER OF THE DAM IS 6" LOWER THAN THE OUTER ENDS. FOR HIGHER VELOCITY FLOWS: ±5 FPS USE 6"–12" RIPRAP, AND HAND PLACE LARGER ROCK ON UPSTREAM SIDE OF DAM.
4. REMOVE CHECK DAMS FROM GRASS–LINED DITCHES AND SWALES ONCE THE GRASS IS ESTABLISHED. SEED, MULCH OR MAT THE AREA WHERE THE CHECK DAMS WERE, IMMEDIATELY FOLLOWING REMOVAL.
5. INSPECT ONCE PER WEEK ON ACTIVE SITES, ONCE EVERY TWO WEEKS ON INACTIVE SITES, AND WITHIN 24 HOURS FOLLOWING A 0.5 INCH RAIN EVENT. REMOVE SEDIMENT ONCE IT REACHES ONE–THIRD THE DEPTH OF THE ROCK WEIR. REPLACE ROCK WEIR WHEN FILTERING CAPACITY IS REDUCED BY ONE–HALF.
6. SPACING TABLE FOR CHECK DAMS:

DITCH GRADE	MINIMUM WEIR DEPTH		
	6 INCH	12 INCH	18 INCH
6%	**	L=16 ft O.C.	L=26 ft O.C.
5%	**	L= 20 ft	L= 30 ft
4%	**	L= 26 ft	L= 40 ft
3%	15 ft	L= 33 ft	L= 50 ft
2%	25 ft	L= 50 ft	L= 80 ft

**NOT ALLOWED

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ROCK CHECK DAM

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Figure 36: BMP C207 - Check Dams - Rock Check Dam

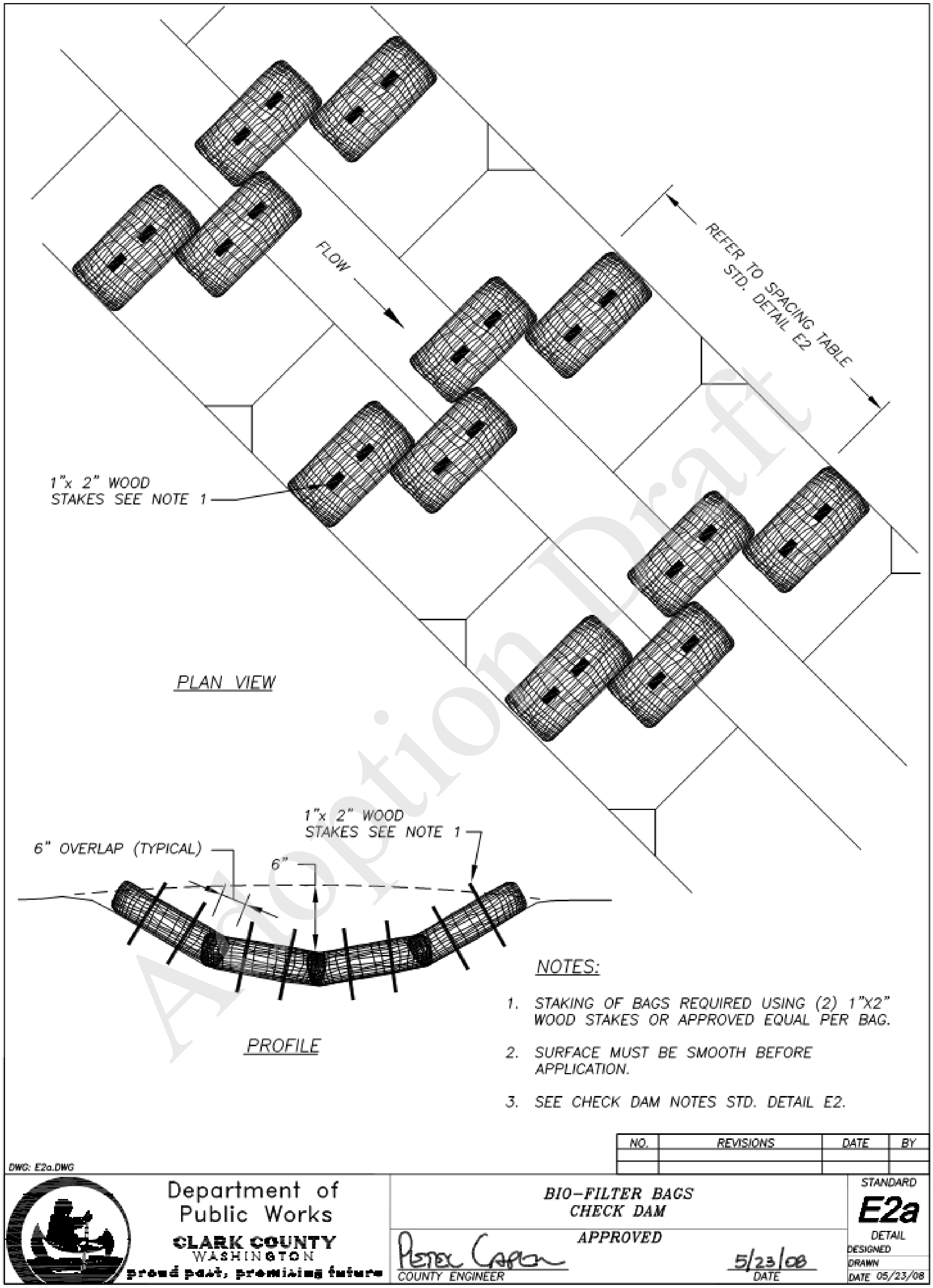

Figure 37: BMP C207 - Check Dams - Bio-Filter Bags Check Dam

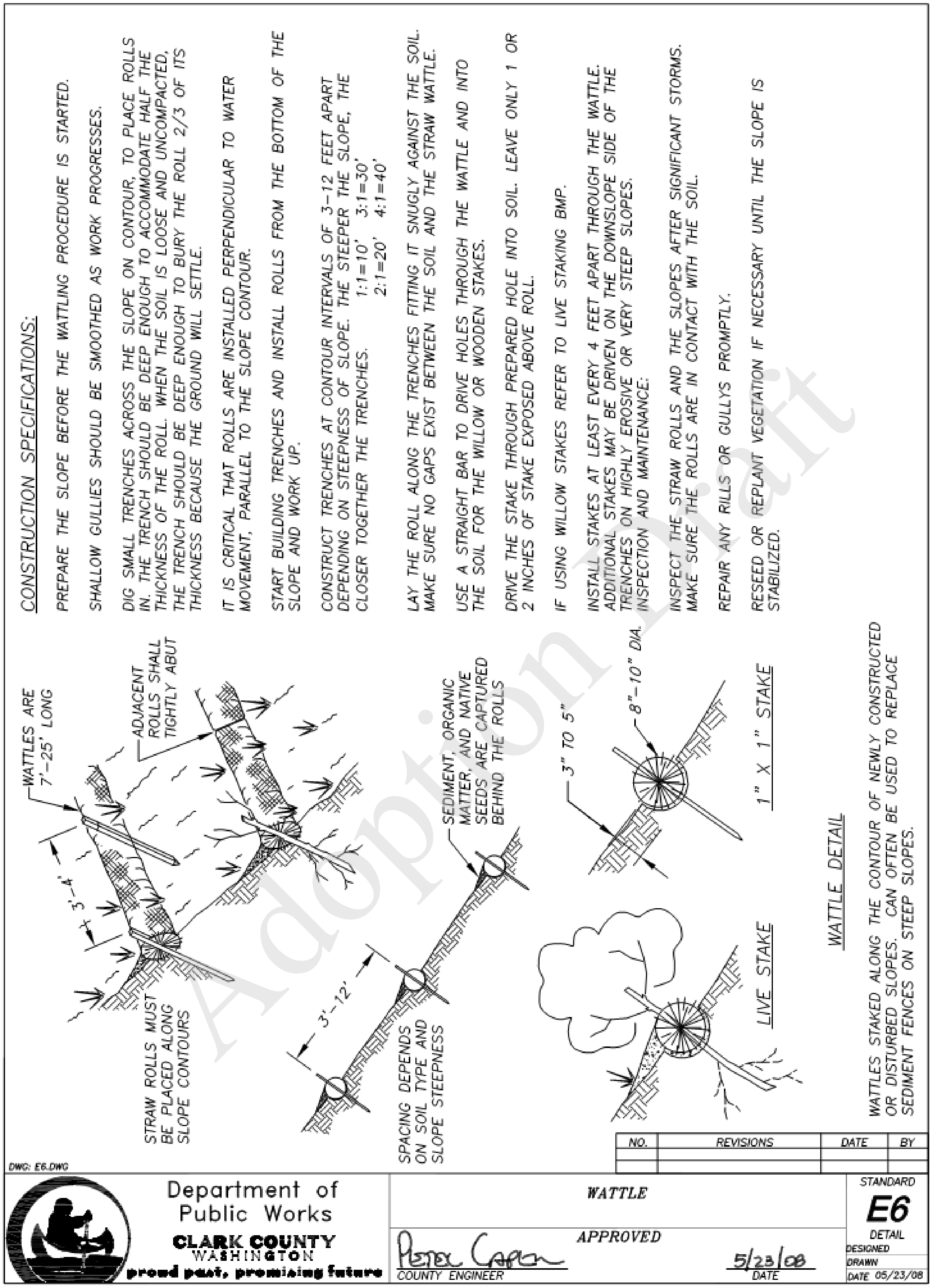

Figure 38: BMP C235 - Wattles

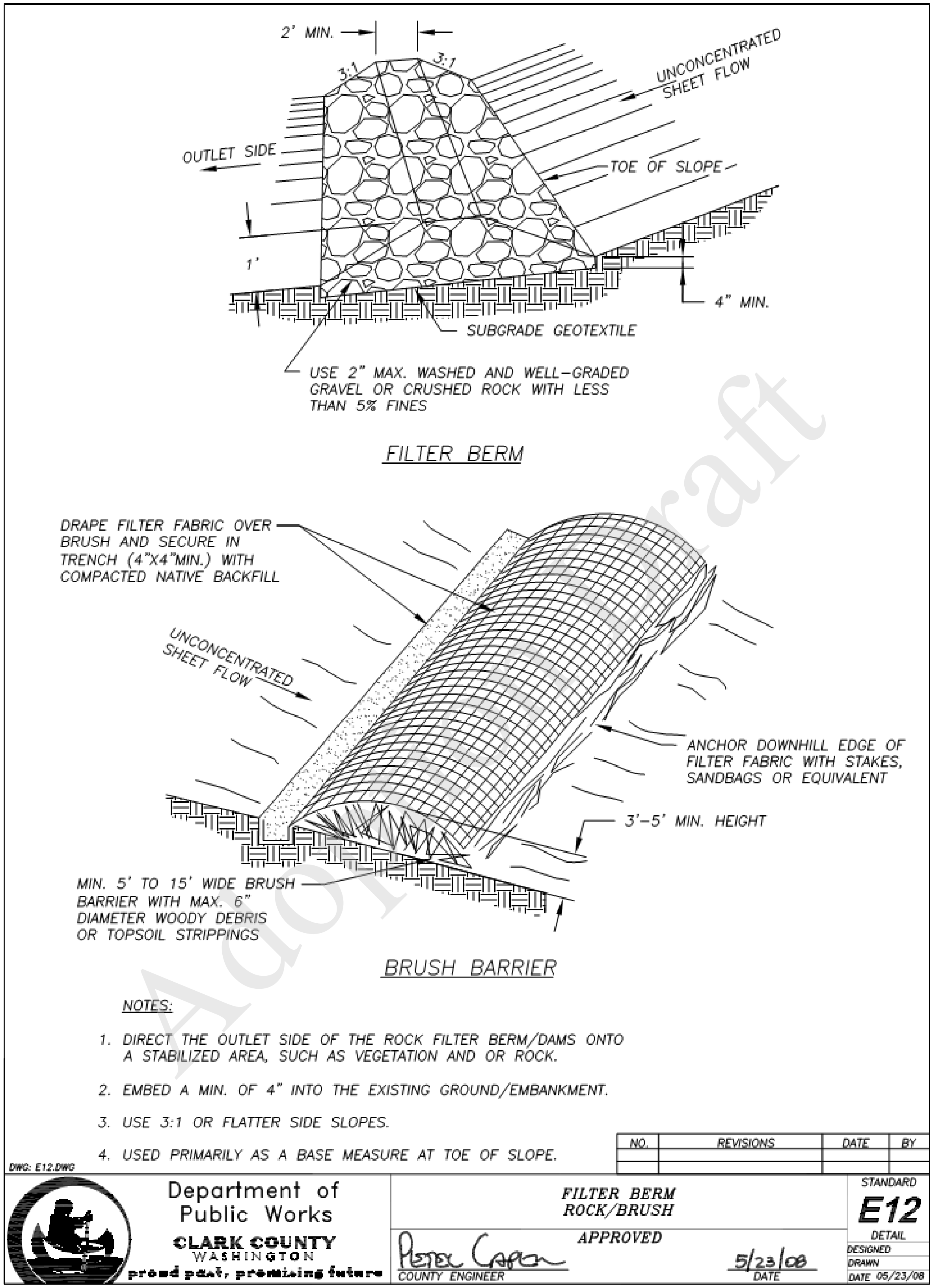

Figure 39: BMP C231 - Brush Barrier & C232 Gravel Filter Berm - Filter Berm Rock/Brush

MATTING NOTES:

1. THERE ARE A WIDE RANGE OF MATERIALS AND COMBINATION OF MATERIALS USED TO PRODUCE MATTING INCLUDING, BUT NOT LIMITED TO: STRAW, JUTE, WOOD FIBER, COIR (COCONUT FIBER), PLASTIC NETTING, AND BONDED FIBER MATRIX. THE SELECTION OF MATTING MATERIAL FOR A SITE CAN MAKE A SIGNIFICANT DIFFERENCE IN THE EFFECTIVENESS OF THE BMP.
2. GENERALLY, MATTING IS USED ON SLOPES 2:1 AND STEEPER.
3. SURFACE MUST BE GRADED SMOOTH TO REMOVE ALL DEBRIS AND UNDULATIONS LARGER THAN 2" IN ANY DIRECTION.
4. APPLY SEED AND FERTILIZER PRIOR TO MATTING. INSTALL SO THAT MATTING IS IN COMPLETE CONTACT WITH SOIL SURFACE.
5. STAPLES ARE TO BE INSTALLED PER MANUFACTURES SPECIFICATIONS.
6. ORGANIC MATTING MATERIALS (EXCELSIOR, JUTE, AND COIR) BIODEGRADE AND ARE USEFUL FOR APPLICATIONS REQUIRING STABILIZATION FOR UP TO THREE MONTHS. USE ORGANIC BLANKETS, WHICH RETAIN MOISTURE AND PROVIDE ORGANIC MATTER TO THE SOIL, FOR SLOPE PROTECTION AND SHORT–TERM WATERWAY PROTECTION AND TO IMPROVE THE SPEED AND SUCCESS OF REVEGETATION.
   – EXCELSIOR BRAND (ASPEN WOOD FIBER), WOVEN STRAW, AND COIR BLANKETS MAY BE INSTALLED WITHOUT MULCH BECAUSE THEY PROVIDE COMPLETE SURFACE PROTECTION.
7. SYNTHETIC MATS ARE MADE FROM NON–BIODEGRADABLE MATERIALS AND WILL REMAIN IN PLACE FOR YEARS (SOME PHOTODEGRADATION DOES OCCUR). USE PURELY SYNTHETIC BLANKETS FOR LONG–TERM STABILIZATION OF WATERWAYS.
   – TURF REINFORCEMENT MATS (TRM) ARE MADE FROM POLYMER NETTING OR MONOFILAMENTS FORMED INTO A SYNTHETIC 3–D MAT. TRMs PROTECT SEED AND INCREASE GERMINATION AND ALSO ACTS AS PART OF THE ROOT STRUCTURE; GIVING THE TURF HIGHER STRENGTH.
   – EROSION CONTROL AND REVEGETATION MATS (ECRM), COMPOSED OF HEAT–FUSED MONOFILAMENTS AND MONOFILAMENTS STITCHED BETWEEN NETTING ACT AS PERMANENT MULCH. ECRM ALLOW GROWTH THROUGH THE MAT.
8. <u>CHANNEL OR SWALE APPLICATIONS:</u> LENGTHWISE OVERLAP MATTING A MINIMUM OF 12"; CROSSWISE OVERLAP A MINIMUM OF 6", AND AVOID JOINING MATERIAL IN CENTER OF DITCH OR SWALE.
9. <u>SLOPE APPLICATION:</u> LENGTHWISE OVERLAP MATTING A MINIMUM OF 6"; CROSSWISE OVERLAP A MINIMUM OF 6"; AT TOP OF SLOPE, ENTRENCH MATERIAL IN A 6"x6" TRENCH AND STAPLE AT 12" INTERVAL; AT BOTTOM OF SLOPE, EXTEND MAT 2 FEET BEYOND THE TOE OF THE SLOPE, TURN MATERIAL UNDER 4" AND STAPLE AT 12" INTERVAL; ON 4:1 SLOPES, ROLLS CAN BE PLACED IN HORIZONTAL STRIPS; MATS MUST BE STAPLED IN PLACE AS THEY ARE INSTALLED DOWN THE SLOPE FACE EVERY 4' UNTIL YOU REACH THE BOTTOM. THIS KEEPS BLANKET IN A RELAXED POSITION, ELIMINATING THE POTENTIAL FOR UNDER–RILLING.
10. INSPECT ONCE PER WEEK ON ACTIVE SITES, ONCE EVERY TWO WEEKS ON INACTIVE SITES, AND WITHIN 24 HOURS FOLLOWING A 0.5 INCH RAIN EVENT.
11. REPAIR ANY DAMAGED AREAS OF THE NET OR BLANKET AND STAPLE INTO THE GROUND ANY AREAS NOT IN CLOSE CONTACT WITH THE GROUND SURFACE.
12. IF EROSION OCCURS, REPAIR AND PROTECT THE ERODED AREA.

NO.	REVISIONS	DATE	BY

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MATTING
GENERAL NOTES

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Peter Capell
COUNTY ENGINEER
5/23/08
DATE

STANDARD
E17
DETAIL
DESIGNED
DRAWN
DATE 05/23/08

Figure 40: BMP C122 - Nets & Blankets - Matting General Notes

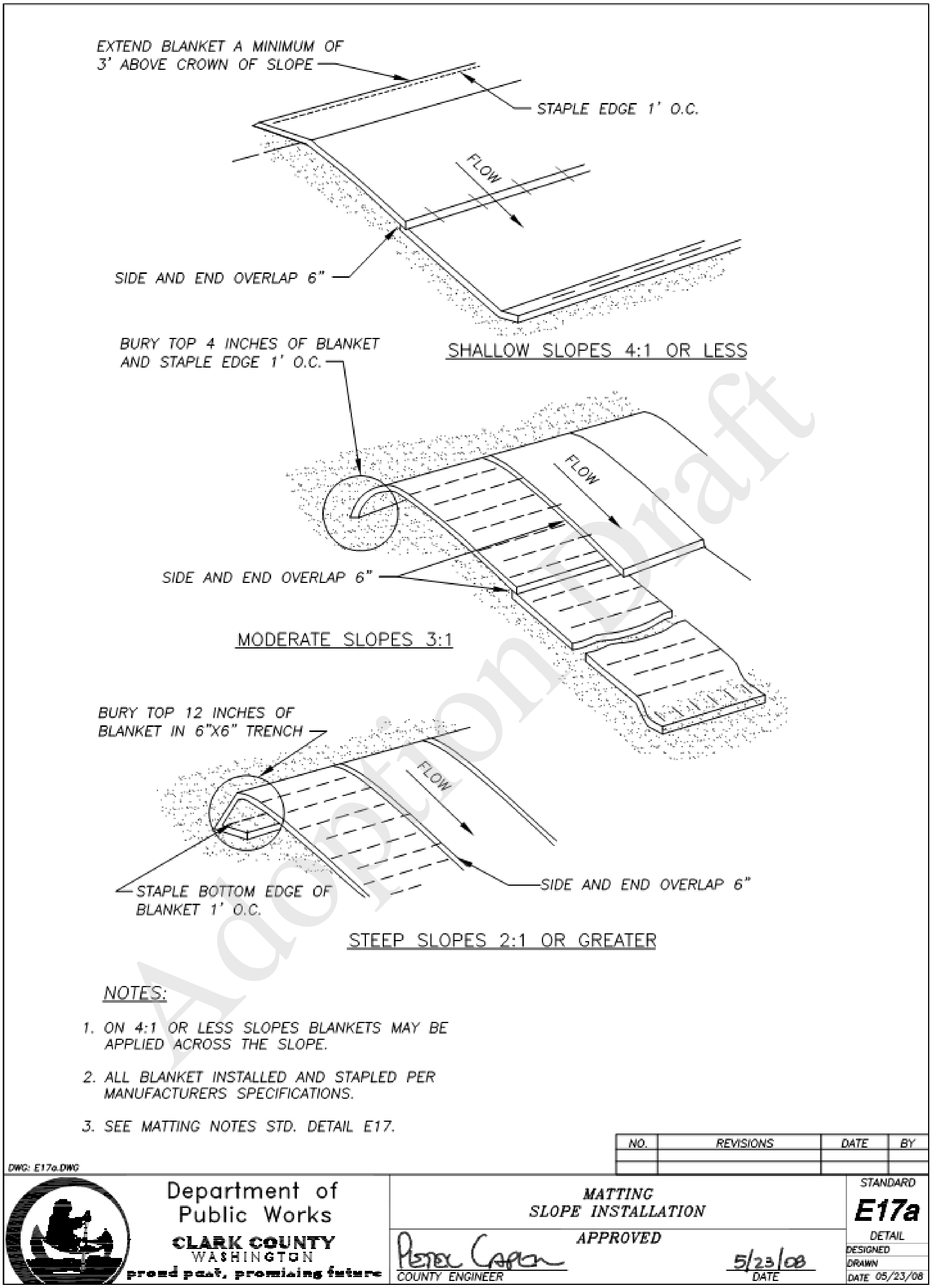
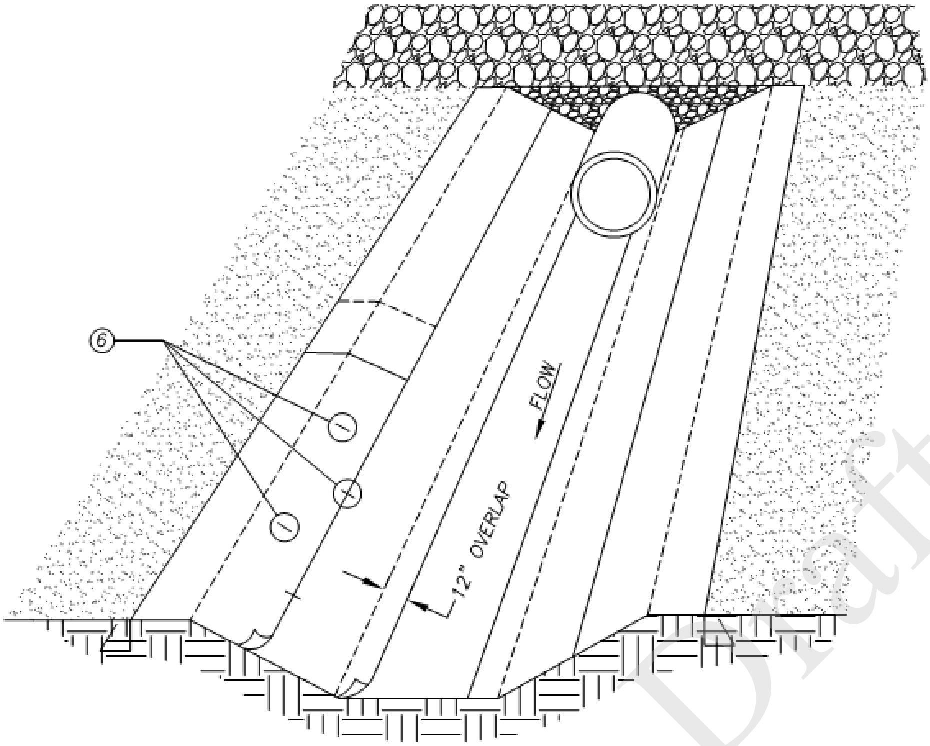


Figure 41: BMP C122 - Nets & Blankets - Matting Slope Installation



CHANNEL INSTALLATION

NOTES:

1. INFORMATION PROVIDED IS MINIMUM REQUIREMENTS. MANUFACTURERS REQUIREMENTS WHICH ARE MORE STRINGENT SHALL BE USED.
2. INSTALL MAT PARALLEL IN CENTER OF CHANNEL IN THE DIRECTION OF FLOW. FOR CULVERT OUTFALLS, PLACE MAT UNDER CULVERT OR RIP RAP A MIN. OF 12".
3. IN CHANNEL BOTTOM, OVERLAP LENGTH ENDS A MINIMUM OF 12 INCHES.
4. REFER TO STD. DETAIL E-17 FOR MATTING NOTES.
5. STAPLE PER MANUFACTURERS SPECIFICATIONS.
6. LENGTH OF STAPLES SHALL BE DETERMINED BY SOIL TYPE- COHESIVE SOIL USE 6 INCH, NON-COHESIVE SOILS 8-12 INCH.

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MATTING
CHANNEL INSTALLATION
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E17b
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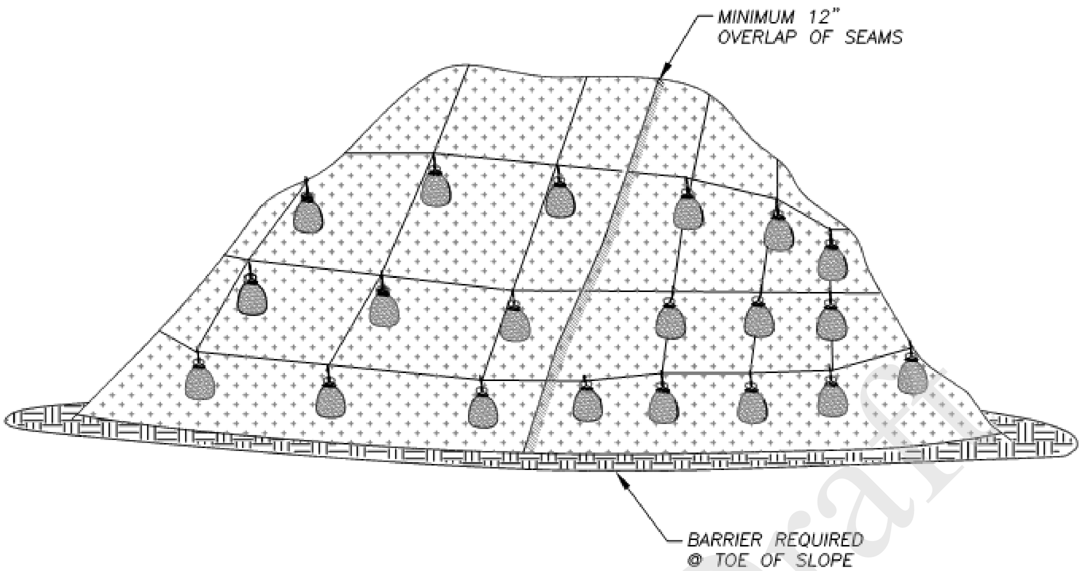
Figure 42: BMP C122 - Nets and Blankets - Matting Channel Installation



PLASTIC SHEETING

NOTES:

1. PLASTIC SHEETING IS USED TO PROVIDE IMMEDIATE PROTECTION TO SLOPES AND STOCKPILES.
2. DO NOT USE PLASTIC COVERING UPSLOPE OF AREAS SUCH AS STEEP AND/OR UNSTABLE SLOPES THAT MIGHT BE ADVERSELY AFFECTED BY CONCENTRATED RUNOFF.
3. WHEN POSSIBLE, INSTALL AN INTERCEPTER DIKE AT THE TOP OF THE PLASTIC TO DIVERT FLOWS AWAY FROM THE PLASTIC.
4. TOE–IN THE TOP OF THE SHEETING IN A 6"x6" TRENCH BACKFILLED WITH COMPACTED NATIVE MATERIAL.
5. INSTALL A GRAVEL BERM, RIPRAP, OR OTHER SUITABLE PROTECTION AT THE TOP OF THE SLOPE IN ORDER TO DISSIPATE RUNOFF VELOCITY.
6. ANCHOR THE PLASTIC USING SANDBAGS OR OTHER SUITABLE TETHERED ANCHOR SYSTEM SPACED ON A 10' GRID SPACING IN ALL DIRECTIONS.
7. OVERLAP SEAMS 1–2', TAPE, ROLL AND STAKE THE SEAMS AND THEN WEIGH DOWN THE ENTIRE LENGTH.
8. BARRIER IS REQUIRED @ TOE OF STOCK PILE.
9. REPLACE TORN SHEETS AND REPAIR OPEN SEAMS. COMPLETELY REMOVE AND REPLACE PLASTIC WHEN IT BEGINS TO DETERIORATE.

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Figure 43: BMP C123 - Plastic Covering

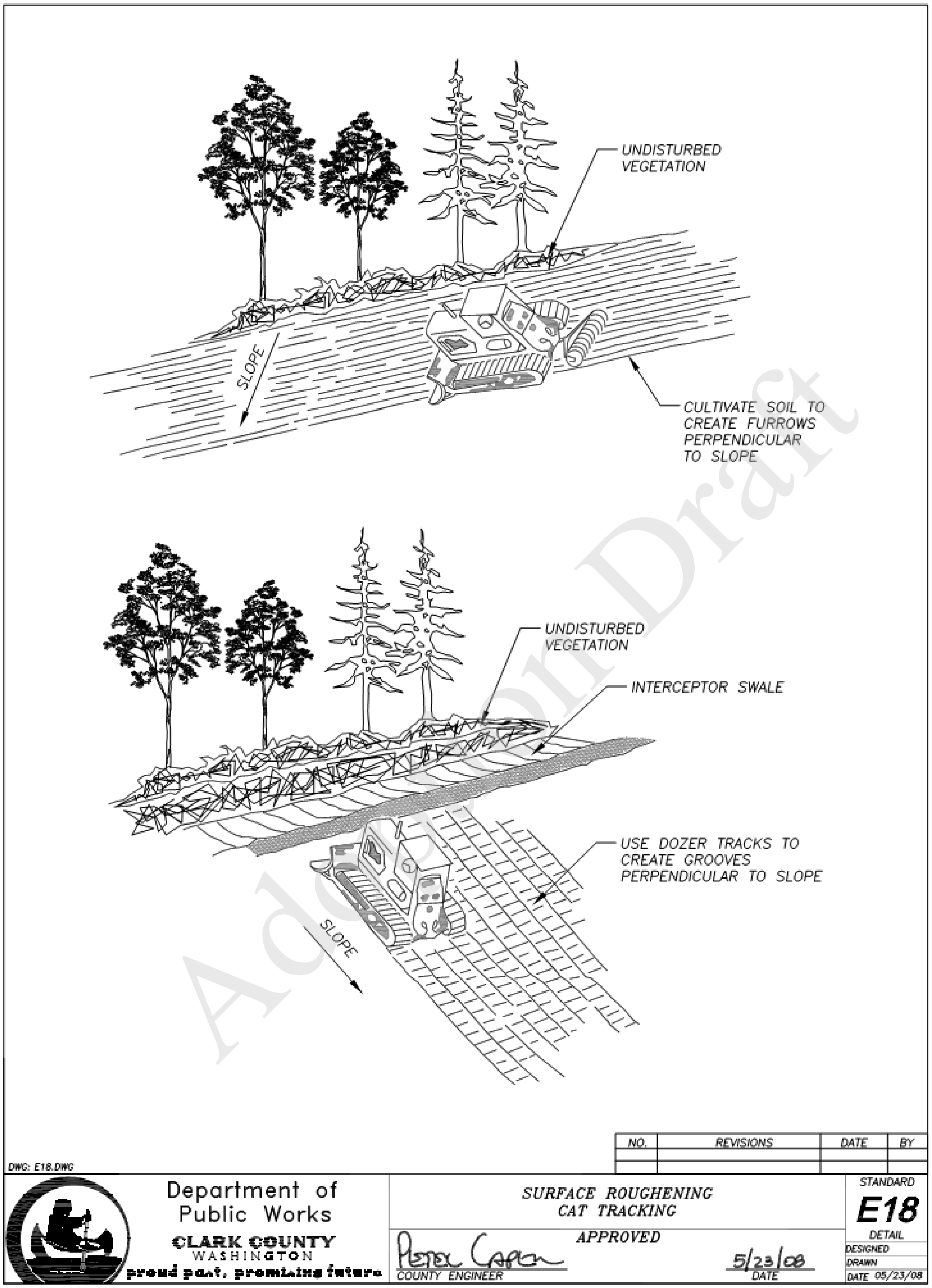
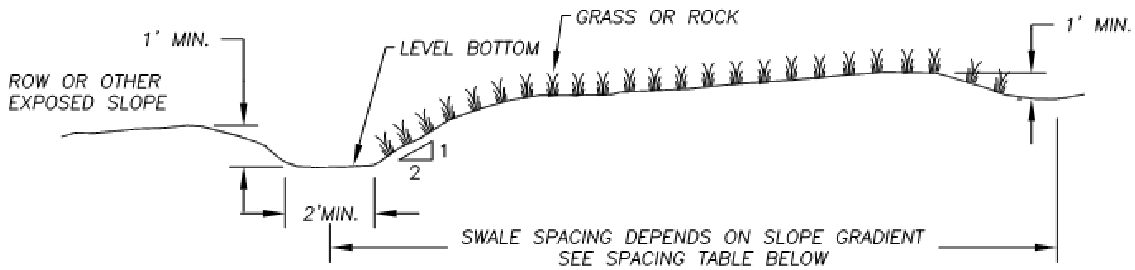
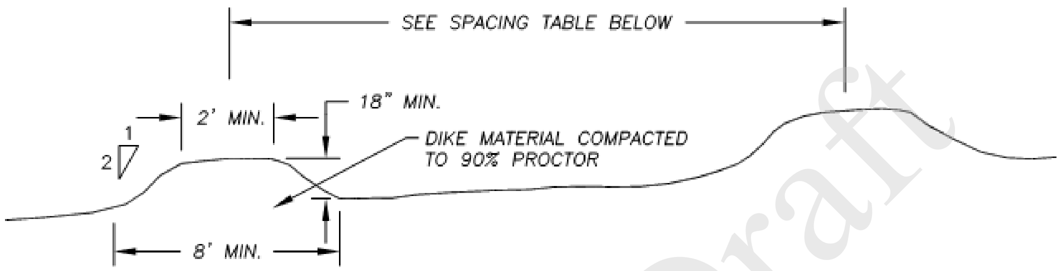


Figure 44: BMP C130 - Surface Roughening



DIVERSION SWALE



TEMPORARY DIVERSION DIKE

NOTES:

1. DIKE OR SWALES ARE INSTALLED TO INTERCEPT AND CONVEY SMALLER FLOWS ALONG LOW-GRADIENT DRAINAGE WAYS TO LARGER CONVEYANCES SUCH AS DITCHES OR PIPE SLOPE DRAINS OR TO A STABILIZED OUTLET, AND CAN BE USE SINGULARLY OR IN COMBINATION WITH EACH OTHER.
2. REFER TO TABLES BELOW FOR DESIGN CRITERIA FOR DIVERSION DIKES AND SWALES. INSTALL THE DIKES AND/OR SWALES HORIZONTALLY AT INTERVALS ACROSS A DISTURBED SLOPE AT SPACING ACCORDING TO TABLES.
3. FOR SLOPES OF ERODIBLE SOILS STEEPER THAN 2:1 WITH MORE THAN 10 FT. OF VERTICAL RELIEF, CONSTRUCT BENCHES OR SHORTEN DISTANCE BETWEEN DIKES AND SWALES.
4. DISCHARGE THE RUNOFF TO A STABLE CONVEYANCE THAT ROUTES THE SEDIMENT LADEN RUNOFF TO A SEDIMENT TRAP OR POND.
5. MAY NEED MATTING TO PROTECT SEED BED AND CHANNEL FROM EROSION.

DIVERSION DIKE DESIGN CRITERIA

TOP WIDTH	24" MIN.	
HEIGHT	20" MIN (90% COMPACTION)	
SIDE SLOPES	2:1 OR FLATTER	
DIKE GRADE	BETWEEN 0.5–1%	
SLOPE OF DISTURBED AREA VS. HORZ. SPACING	<5%	300 ft
	5–10%	200 ft
	10–25%	100 ft
	25–50%	50 ft
SLOPE STABILIZATION	<5%	SEED AND MULCH WITHIN 5 DAYS FOLLOWING DIKE CONSTRUCTION
OUTLET	UPSLOPE SIDE OF DIKE PROVIDES POSITIVE DRAINAGE TO OUTLET, PROVIDE RIPRAP AS NECESSARY TO PREVENT EROSION RELEASE TO SEDIMENT TRAPPING FACILITY.	

DIVERSION SWALE DESIGN CRITERIA

BOTTOM WIDTH	24" MIN. LEVEL BOTTOM ACROSS SWALE	
DEPTH	12"	
SIDE SLOPES	2:1 OR FLATTER	
GRADE	MAX. 5% POSITIVE DRAINAGE TO OUTLET	
SLOPE OF DISTURBED AREA VS. HORZ. SPACING	<5%	300 ft
	5–10%	200 ft
	10–25%	100 ft
	25–50%	50 ft
SLOPE STABILIZATION	TEMPORARILY SEED OR LINE WITH RIPRAP 12" THICK AND PRESS INTO BANK ± 3–4"	
OUTLET	LEVEL SPREADER OR RIPRAP TO STABILIZED OUTLET/SEDIMENTATION POND	

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Figure 45: BMP C200 - Interceptor Dike and Swale

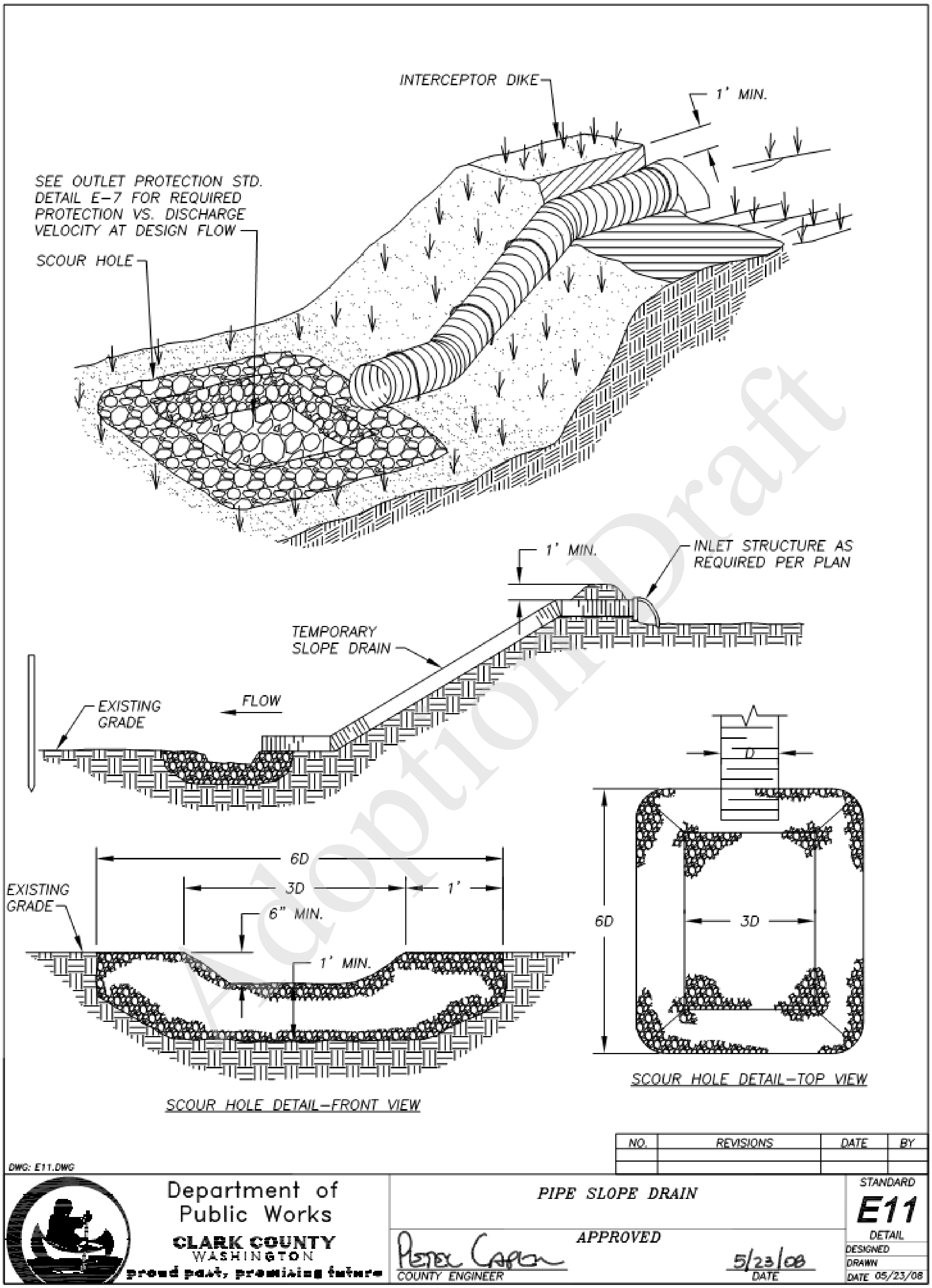


Figure 46: BMP C204 - Pipe Slope Drain

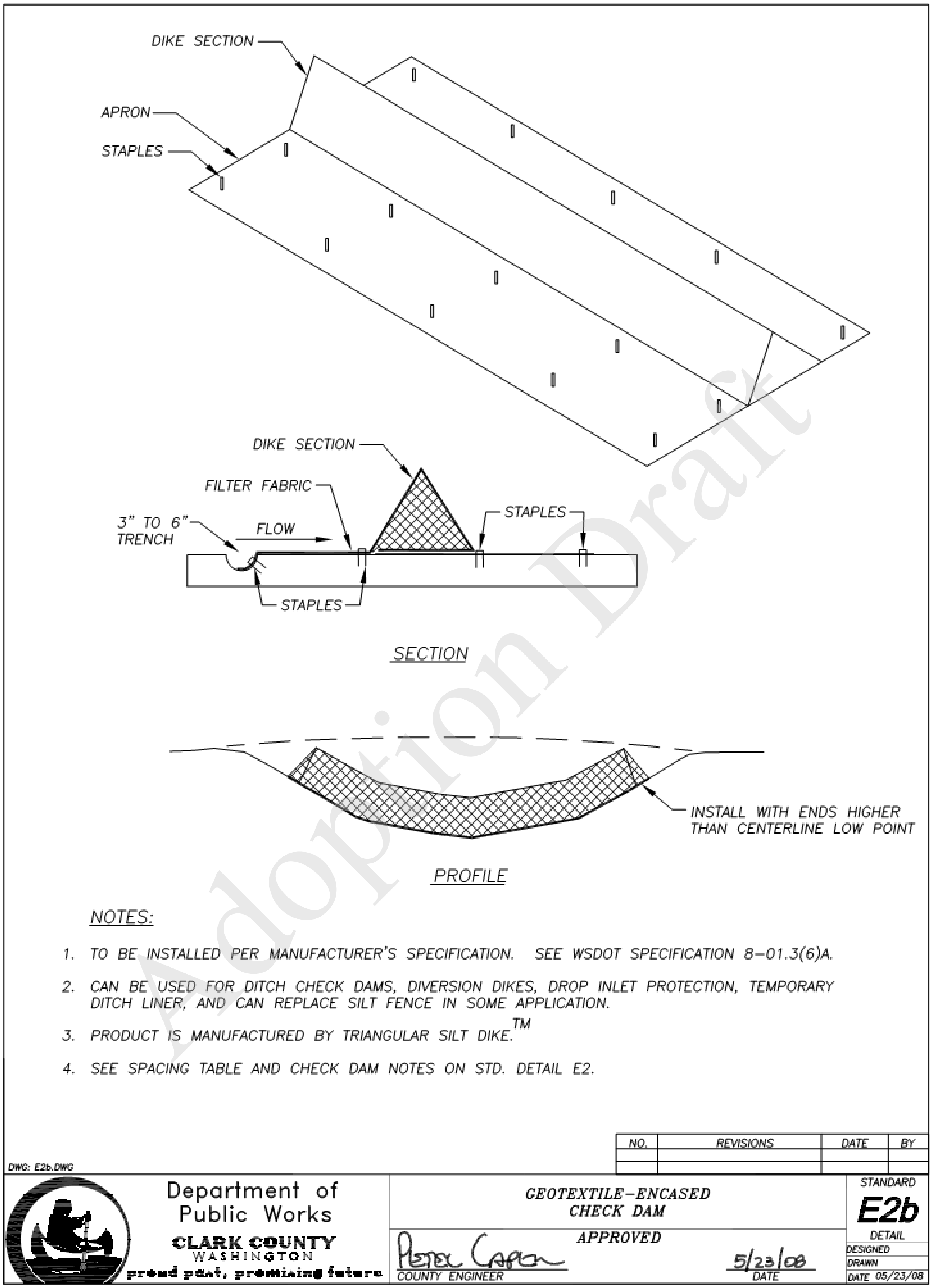
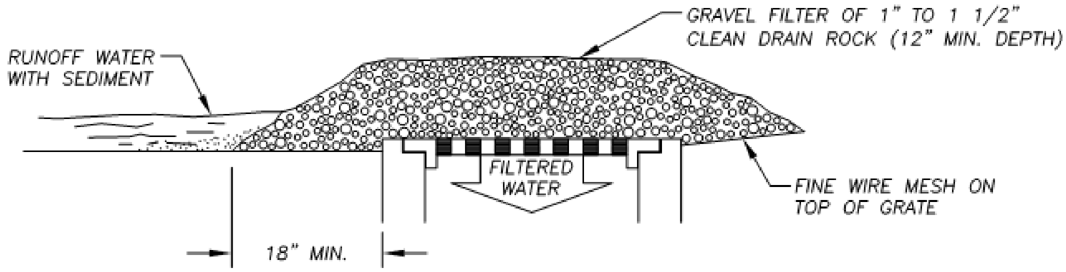


Figure 47: BMP C208 - Triangular Silt Dike - Geotextile-encased Check Dam



GRAVEL & WIRE MESH

NOT TO BE USED IN TRAVELED WAY IF
IT MAY RESULT IN A TRAFFIC HAZARD

INLET PROTECTION NOTES:

1. INLET PROTECTION IS INTENDED TO PREVENT COARSE SEDIMENT FROM ENTERING STORM DRAINAGE SYSTEMS BY FILTERING RUNOFF AND RETAINING SEDIMENT BEFORE IT REACHES A DRAINAGE OR STORM SEWER SYSTEM.
2. PLACE INLET PROTECTION IN AREAS WHERE WATER CAN POND, AND WHERE PONDING WILL NOT HAVE ADVERSE IMPACTS.
3. INLET PROTECTION MUST ALLOW FOR OVERFLOW IN A SEVERE STORM EVENT.
4. INLET PROTECTION TYPES INCLUDE:
   - TYPE 1 – GRAVEL AND WIRE MESH
   - TYPE 2 – MASONRY AND ROCK
   - TYPE 3 – SILT FENCE
   - TYPE 4 – BIO-FILTER BAGS
   - TYPE 5 – SILT SACK INSERT
5. INSPECT ONCE PER WEEK ON ACTIVE SITES, ONCE EVERY TWO WEEKS ON INACTIVE SITES, AND WITHIN 24 HOURS FOLLOWING A 0.5 INCH RAIN EVENT.
6. CLEAN INLET PROTECTION DURING AND AFTER EACH SIGNIFICANT STORM AND REMOVE SEDIMENT FROM BEHIND STRUCTURE AFTER EVERY STORM.
7. IF ROCK BECOMES CLOGGED WITH SEDIMENT, IT MUST BE CAREFULLY REMOVED FROM THE INLET AND EITHER CLEANED OR REPLACED.
8. ASSESS THE IMPACT OF ALLOWING WATER TO POND AT THE INLET AND PROVIDE AN OVERFLOW WEIR OR SOME OTHER TYPE OF RELIEF AS NEEDED.
9. CONSIDER THE EFFECT PLACING OBSTRUCTIONS AT INLETS ON GRADE MAY HAVE ON THEIR EFFICIENCY.
10. USE MECHANICAL MEANS TO REMOVE SEDIMENT DEPOSITS (SHOVEL, BROOM, SWEEPER/VACTOR UNIT).
11. REMOVE SEDIMENT ACCUMULATED ON OR AROUND THE PROTECTION AS NEEDED TO MAINTAIN INTENDED FUNCTION.
12. REPAIR OR REPLACE MATERIALS AS NEEDED TO ENSURE PROPER FUNCTION.

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INLET PROTECTION TYPE 1
GRAVEL AND WIRE MESH

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Figure 48: BMP C220 - Inlet Protection - Type 1 Gravel and Wire Mesh

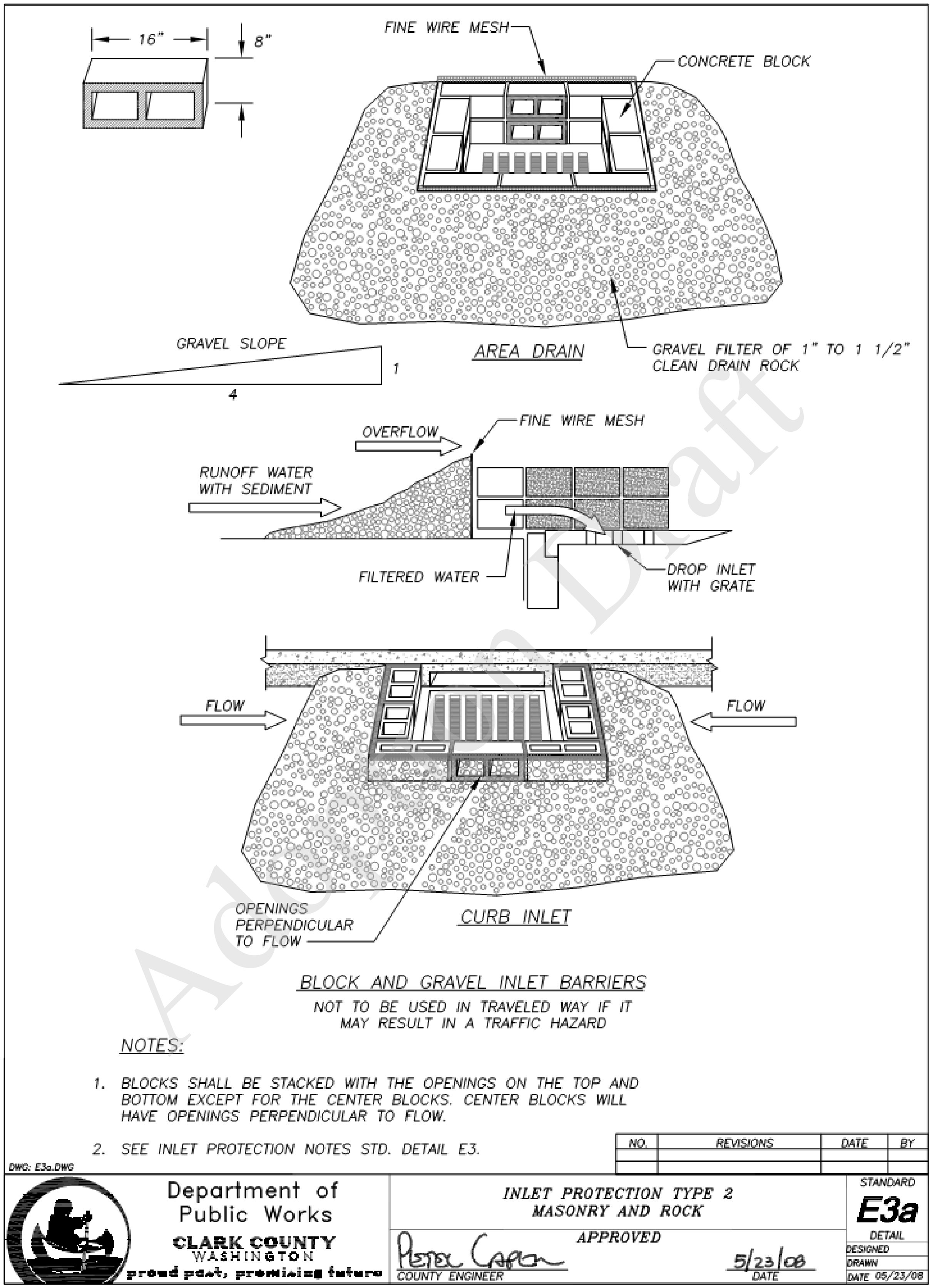


Figure 49: BMP C220 - Inlet Protection -Type 2 Masonry and Rock

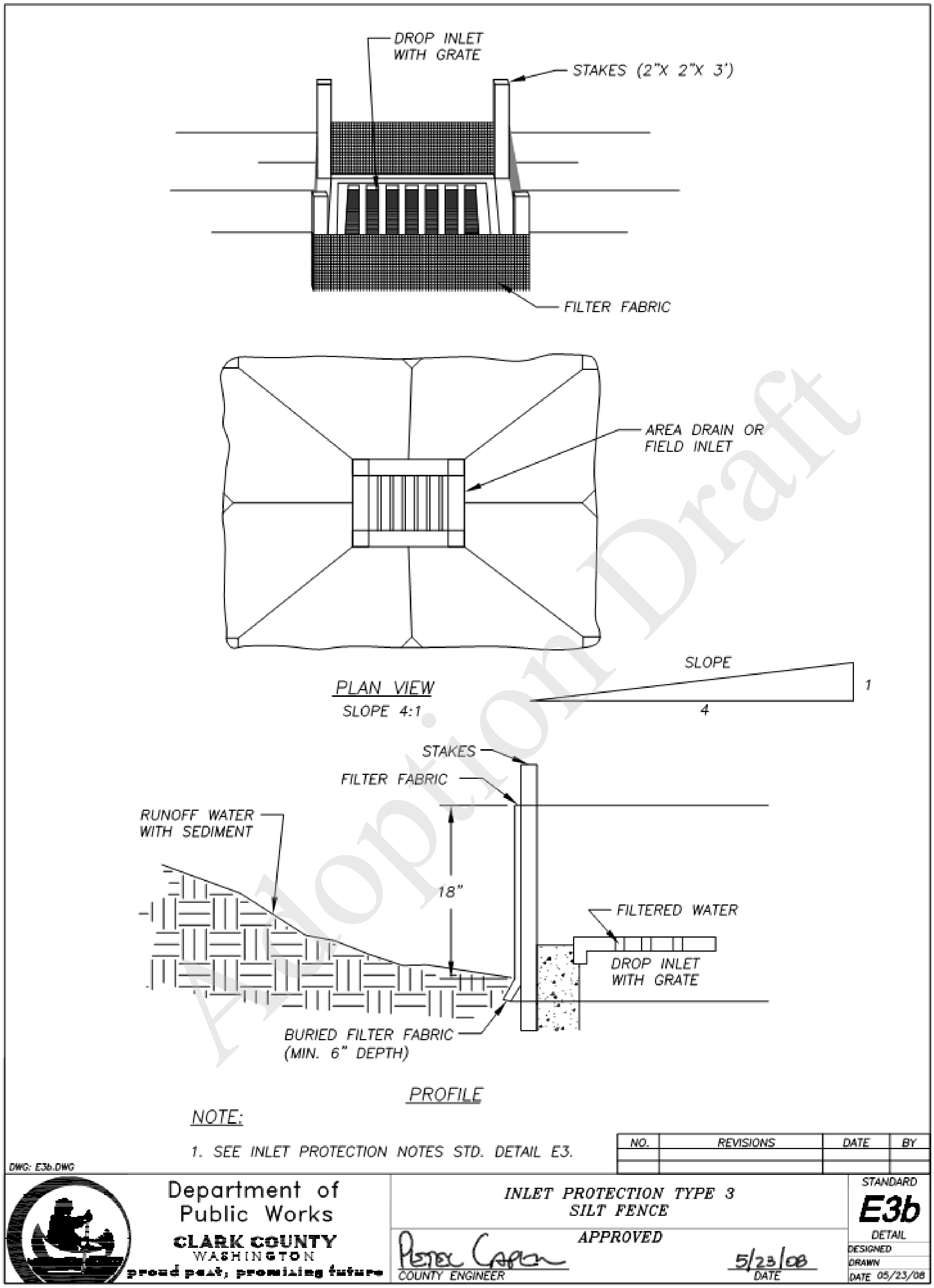
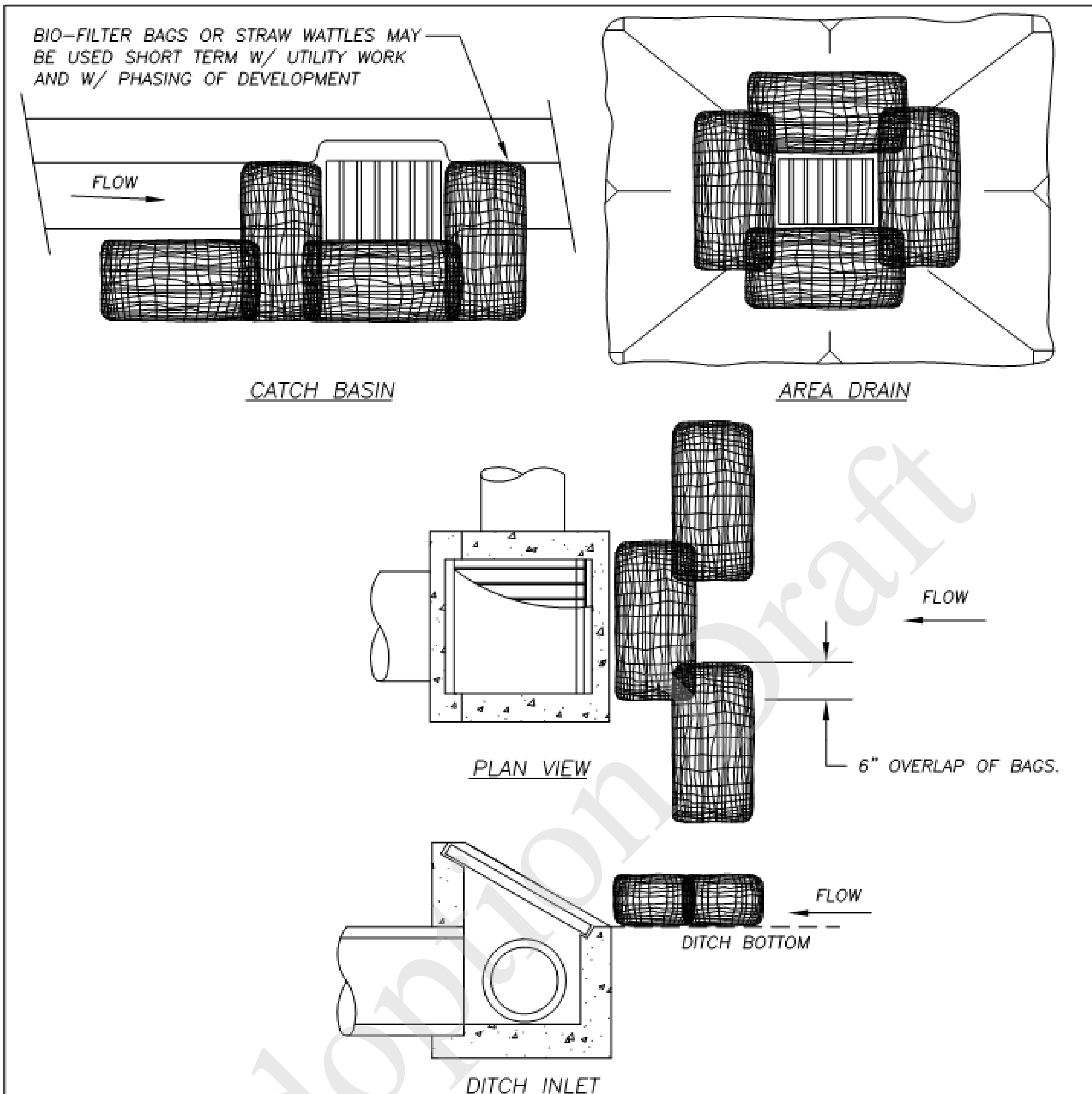


Figure 50: BMP C220 - Inlet Protection - Type 3 Silt Fence



NOTES:

1. ADDITIONAL MEASURES MUST BE CONSIDERED DEPENDING ON SOIL TYPE.
2. BIO-FILTER BAGS SHOULD BE STAKED WHERE APPLICABLE USING (2) 1"x2" WOODEN STAKES OR APPROVED EQUAL PER BAG.
3. STRAW WATTLES MUST BE STABILIZED BY ATTACHING WIRE CLIPS TO THE CATCH BASIN PER MANUFACTURERS SPECIFICATIONS.
4. INLET PROTECTION MUST BE REGULARLY INSPECTED BY THE EROSION CONTROL INDIVIDUAL TO INSURE PROPER PLACEMENT/FUNCTION AND MAINTENANCE.
5. SEE INLET PROTECTION NOTES STD. DETAIL E3.

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INLET PROTECTION TYPE 4
BIO-FILTER BAGS

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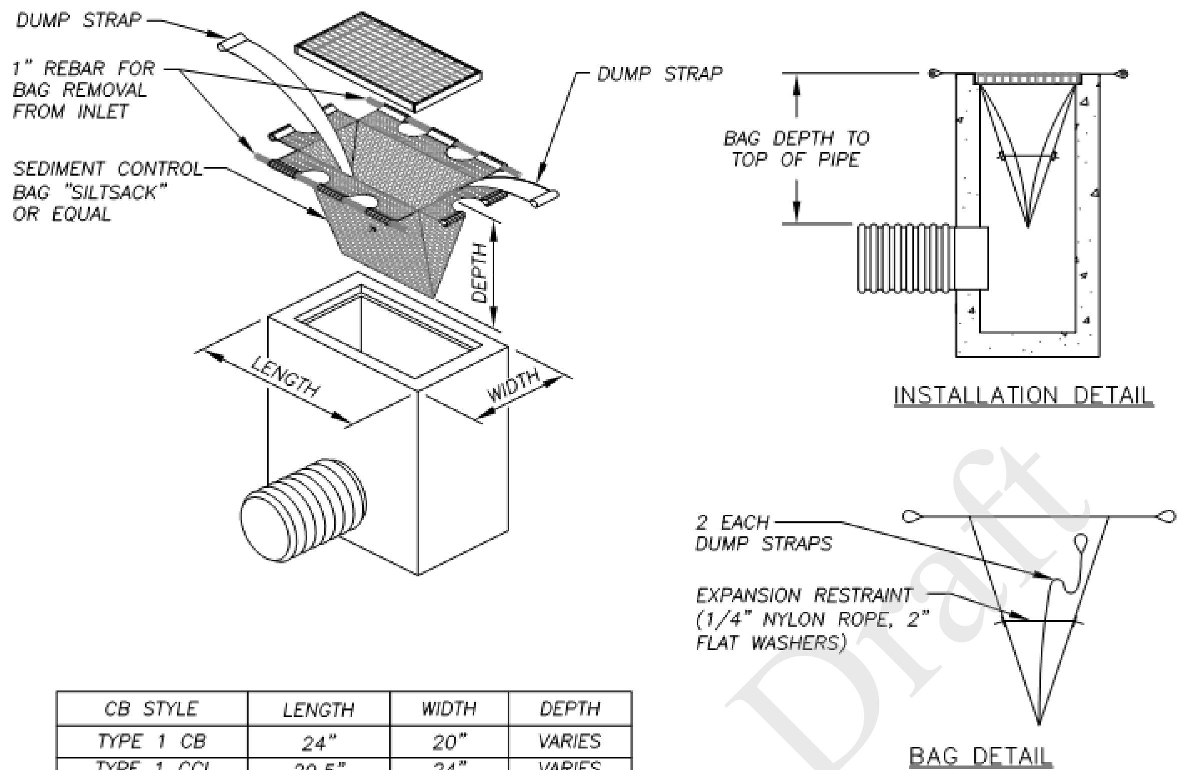
Figure 51: BMP C220 - Inlet Protection - Type 4 Bio-Filter Bags



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

INLET SEDIMENT CONTROL DEVICE – SILT SACK

NOTES:

1. THE DIMENSION CHART ABOVE IS FOR STANDARD CATCH BASINS AND INLETS ONLY. THE CONTRACTOR IS RESPONSIBLE FOR PROVIDING THE CORRECT SIZE DEVICE FOR EACH INLET.
2. FOR NON-STANDARD CATCH BASINS AND INLETS, THE CONTRACTOR SHALL MEASURE DIMENSIONS IN THE FIELD AND ORDER THE APPROPRIATE SIZE(S).
3. THE INLET SEDIMENT CONTROL DEVICE SHALL BE OF HIGH FLOW DESIGN (200 GAL/MIN/FT), AS PER THE MANUFACTURER'S SPECS.
4. THE SEDIMENT CONTROL DEVICE SHALL BE INSPECTED DAILY BY THE CONTRACTOR AND MAINTAINED A MINIMUM ONCE PER MONTH OR WITHIN THE 48 HOURS FOLLOWING A STORM EVENT. FILTER SHALL BE CLEANED IN A MANNER WHICH ENSURES THAT ALL SEDIMENT REMAINS ON SITE.
5. SUBSTITUTION OF A SHEET OF FILTER FABRIC PLACED OVER THE OPENING OF THE INLET IS NOT APPROVED.
6. RECESSED CURB INLET CATCH BASINS MUST BE BLOCKED WHEN USING FILTER FABRIC INLET SACKS, SIZE OF FILTER INLET SACK TO BE DETERMINED BY MANUFACTURER.
7. THE FILTER SHALL BE REPLACED OR CLEANED WHEN THE BAG BECOMES HALF FULL.
8. SEE INLET PROTECTION NOTES STD. DETAIL E3.

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INLET PROTECTION TYPE 5
SILT SACK

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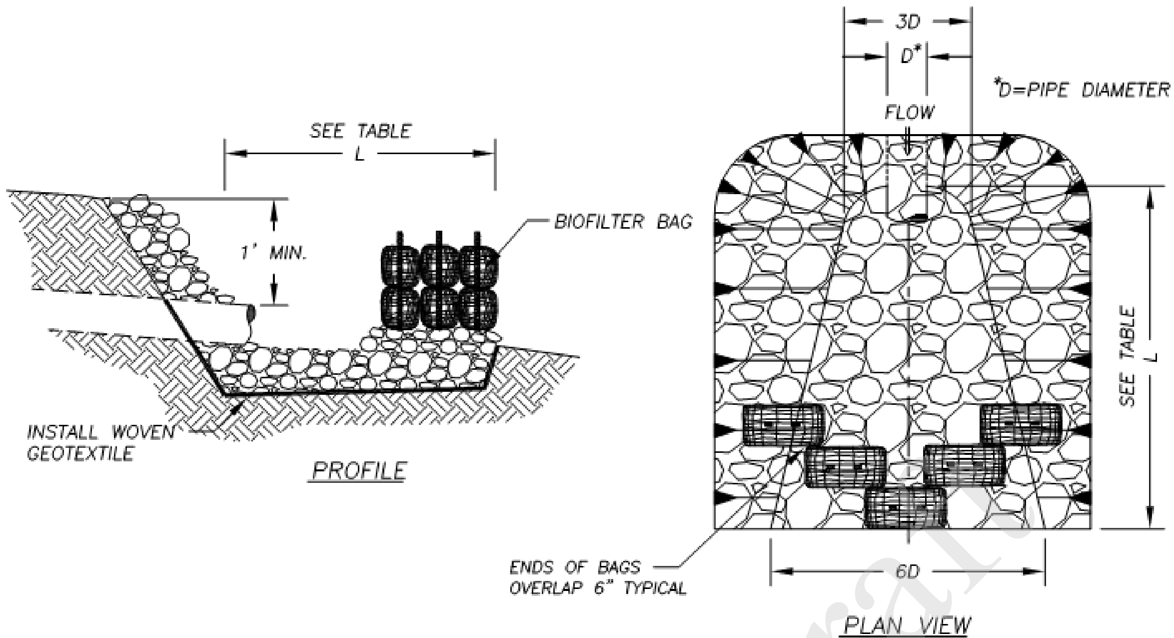
Figure 52: BMP C220 - Inlet Protection - Type 5 Silt Sack



NOTES:

1. BIO-BAGS ONLY REQUIRED WHEN DISCHARGING SEDIMENT LADEN WATER. STAKING OF BAGS REQUIRED WITH EITHER METHOD USING (2) 1"x2" WOOD STAKES OR APPROVED EQUAL PER BAG.
2. RIP-RAP SIZING GOVERNED BY THE SIDE SLOPES ON THE OUTLET CHANNEL, ASSUMED TO BE 3:1.
3. PLACE WOVEN GEOTEXTILE ALONG BOTTOM AND SIDE SLOPES TO CROWN OF PIPE, AND INSTALL ROCK TO 1' ABOVE PIPE CROWN ALONG BOTH SIDES OF CHANNEL.
4. RIP-RAP SHALL BE IN ACCORDANCE WITH SECTION 9-13.1 OF THE WSDOT STANDARD SPECIFICATIONS. RIP-RAP ROCK SIZE SHALL BE AS SHOWN IN THE TABLE BELOW.
5. RIP-RAP SHALL BE HAND LAID AND REASONABLY GRADED.
6. INSPECT ONCE PER WEEK ON ACTIVE SITES, ONCE EVERY TWO WEEKS ON INACTIVE SITES, AND WITHIN 24 HOURS FOLLOWING A 0.5 INCH RAIN EVENT.
7. IF THERE IS SCOURING AT THE OUTLET, PROTECT THE ERODED AREA BY INCREASING THE SIZE OF THE ENERGY DISSIPATOR FACILITY.
8. REMOVE ACCUMULATED SEDIMENT FREQUENTLY.
9. USE THIS DETAIL FOR OUTLET PROTECTION AS A MINIMUM. CONSIDER SITE CONDITIONS TO DETERMINE IF A MORE COMPLEX ENERGY DISSIPATOR MAY BE REQUIRED.

DISCHARGE VELOCITY AT DESIGN FLOW (FPS)	REQUIRED PROTECTION MINIMUM DIMENSIONS	
	TYPE	LENGTH (L)
0 TO <5	RIP-RAP*	8' OR 3D (WHICHEVER IS GREATER)
6 TO <10	RIP-RAP**	12' OR 4D (WHICHEVER IS GREATER)
11 TO <20	GABION	AS REQUIRED
>20	ENGINEERED ENERGY DISSIPATER REQUIRED	

* 8" MAXIMUM, 6" MEDIAN, 2" MINIMUM
** 24" MAXIMUM, 16" MEDIAN, 4" MINIMUM

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OUTLET PROTECTION
RIP-RAP

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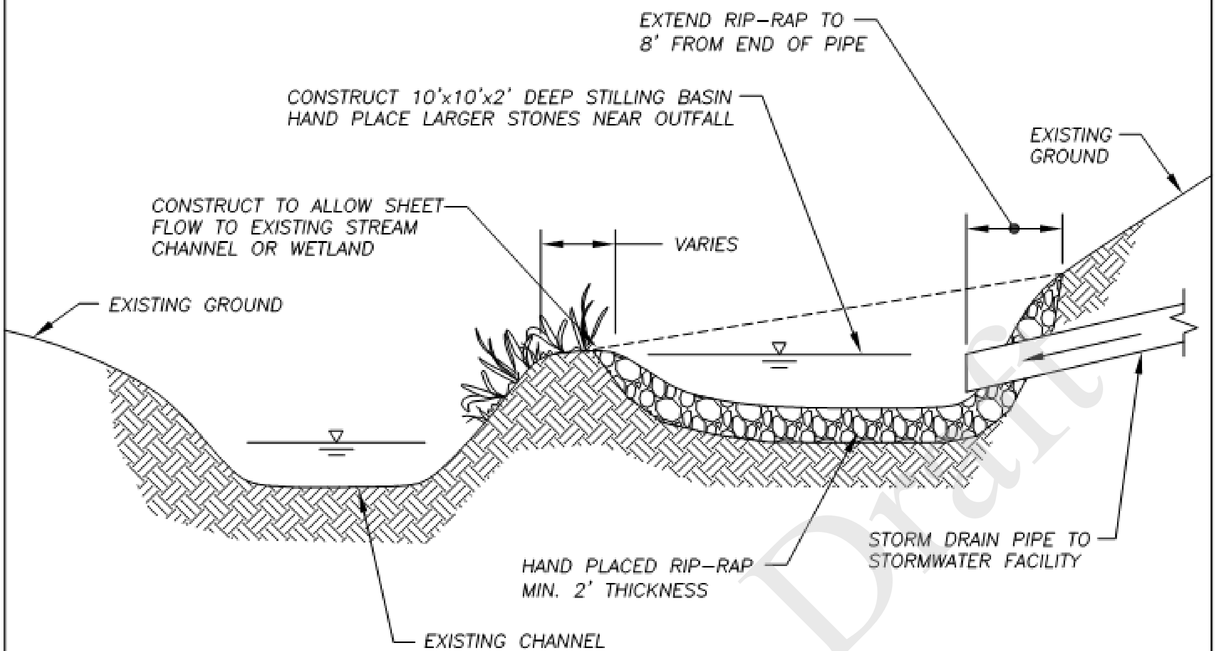
Figure 53: BMP C209 - Outlet Protection - Rip-Rap



NOTES:

1. HAND PLACED RIPRAP PER WSDOT STD. SPECIFICATION 9–13.2.
2. USE STD. DETAIL E7 FOR OUTLET PROTECTION AS A MINIMUM. CONSIDER SITE CONDITIONS TO DETERMINE IF A MORE COMPLEX ENERGY DISSIPATOR MAY BE REQUIRED.
3. CONTRACTOR TO COMPLY WITH CONDITIONS AND REQUIREMENTS OF COUNTY FLOODPLAIN, SHORELINE, HABITAT AND WETLANDS REVIEWS, HYDRAULIC PERMIT (HPA), AND CORPS PERMITS WHEN APPLICABLE.

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OUTLET PROTECTION
STILLING BASIN

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Figure 54: BMP C209 - Outlet Protection - Stilling Basin