

Clark County Stormwater Manual 2026

Book I – Applicability, BMP Selection, and Submittals

~~July 2021~~

Ecology Review Draft

June 2025

This Ecology review draft contains only Ecology's mandated updates (see Table 10.1) and significant updates to Book I that go beyond Ecology's list of significant changes (see Table 10.2).

Ecology's mandated updates (Table 10.1) are presented in green strikeout and underline.

Significant updates that go beyond Ecology's list of significant changes (Table 10.2) are presented in brown strikeout and underline.

The Clark County Stormwater Manual: Book 1

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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Introduction to Book 1

Book 1 of the *Clark County Stormwater Manual* contains regulatory requirements for applicability and selection of permanent and temporary stormwater controls that apply to new development, redevelopment, and construction sites.

Book 1 describes investigations and selection processes prerequisite to planning for site development and developing a stormwater site plan. It describes nine Minimum Requirements established by Washington Department of Ecology and implemented by Clark County, as well as numerous County requirements. Book 1 also lists submittal requirements for projects.

This book is both regulatory and technical. Use this book in conjunction with Book 2, which has specific requirements for engineering analyses and design of stormwater controls selected for the site.

BMP numbers used in this manual have been modified from those used in the *Stormwater Management Manual for Western Washington* (Ecology, 2019); however, the two often coincide.

Chapter I Minimum Requirements, County Requirements and Submittals

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I.1 Introduction

I.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.

I.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.

I.2 Exemptions

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

~~The purpose of this section is to identify activities whose resulting surfaces may be considered “exempt” from the Minimum Requirements, even though those surfaces, per the definitions in Section 1.3. Definitions Related to Minimum Requirements, would be considered replaced hard surfaces or land disturbed.~~

~~Unless otherwise indicated in this section, the surfaces that result from the activities described below are exempt from the Minimum Requirements. Exempt surfaces do not need to be included when evaluating the Project Level Thresholds or TDA Level Thresholds as described in Section 1.4.~~

~~The following list further defines how these exemptions may be used:~~

- A project may combine different types of exempt activities. If the project includes only exempt activities, then the whole project is exempt.
- If the “exempt” activity is part of, directly related to, or caused by a new development or redevelopment project, then it is not considered an exempt activity. It is considered part of the new development or redevelopment project.
- If an exempt activity requires making an ADA update per the federal Americans with Disabilities Act requirements, then the ADA update is considered part of the exempt activity, and the exemption applies to the surfaces disturbed for the ADA update. Note that this exemption does not extend to additional work, such as extending a sidewalk beyond what is necessary for the ADA update.

1.2.1 Total Exemptions from this Manual

Publicly-funded linear transportation projects may follow the minimum design requirements and BMPs of the 2014 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 Sections 4-5 and the BMP specific criteria in Section 5) is not allowed. Instead, LID infeasibility criteria 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.
- Agricultural practices involving working the land for production, but not including converting forested land to agriculture.
- Construction of agricultural buildings or other hard surfaces made of compacted earth materials for the sole purpose of carrying out commercial 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, except as defined as a land disturbing activity per the definition in [Appendix 1-A](#).
- 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 ~~activities~~ practices:
 - Pothole patching, ~~and~~ square cut patching, ~~or other targeted preservation work~~.
 - Overlaying (including grinding and overlaying, so long as the base coarse is not exposed) existing asphalt or concrete pavement, ~~without expanding the area of coverage~~ Examples of overlay materials include bituminous surface treatment (BST or “chip seal”), asphalt, or concrete.
 - Shoulder grading.
 - Regrading/reshaping drainage systems (including adding curb/gutter and/or wedge curbs).
 - Crack sealing.
 - ~~○ Resurfacing with in-kind material without expanding the road prism.~~
 - ~~○ Pavement preservation activities that do not expand the road prism.~~
 - Vegetation management associated with the right of way.
- Pavement maintenance activities include only targeted pavement repairs or maintenance. The limits of the exempt surfaces include only the area that must be disturbed to repair or maintain the pavement. Pavement maintenance activities do not:
 - Change the characteristics of a roadway (e.g. changing a four-way intersection to a roundabout).
 - Increase the traffic capacity of a roadway or parking area (e.g. include restriping to add lanes or parking spaces).
 - Expand the area of coverage (i.e. add new hard surfaces).

1.2.2.1 Clarification of Pavement Maintenance Exemptions

The following are not pavement maintenance ~~practices~~ activities, and 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 pavement paved surface to base course or lower, or repairing the pavement base (except for pothole or square cut patching). These are considered replaced hard surfaces. If impervious surfaces are not expanded, Minimum Requirements #1 – #5 apply.
- Extending the pavement edge, or paving graveled shoulders. These are considered new hard surfaces. ~~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 ~~or~~ Upgrading from dirt to gravel, a bituminous surface treatment (“chip seal”), asphalt, or concrete, or permeable pavement; upgrading from gravel to chip seal, asphalt, or

concrete, or permeable pavement; or upgrading from ~~a bituminous surface treatment (“chip seal”)~~ to asphalt, or concrete, or permeable pavement. These are considered new hard 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 include installing maintaining, and/or upgrading an underground utility. The limits of the exempt surfaces include only the area disturbed by the trench work necessary for the underground utility work (including any over excavating necessary for the utility trench). For an underground utility activity to be exempt, it cannot be part of, directly related to, or caused by a new development or redevelopment project. Underground utility activities must ~~that~~ replace the ground surface with in-kind material or materials with similar runoff characteristics. Underground utility activities are subject only to Minimum Requirement #2, Construction Stormwater Pollution Prevention (SWPPP).
- Pavement replaced as part of a Clark County Structural Stormwater Control project retrofitting existing stormwater facilities to comply with the NPDES phase I municipal stormwater permit must comply with requirements for underground utility projects under 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 Book 2; 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 with 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.

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. Ecology-approved models are listed in the Additional Resources pages for the on-line 2019 SWMMWW.

ADT – Average Daily Traffic

Bioretention – Engineered stormwater facilities that provide Runoff Treatment treat stormwater by passing ~~it~~ stormwater through a specified soil profile (Bioretention Soil Mix, or BSM), and typically either retain or detain the treated stormwater for ~~£~~ Flow Control. attenuation. Bioretention facilities include a variety of plant material including trees, shrubs, grasses, and/or other herbaceous plants adapted to the local climate and soil moisture conditions. Bioretention is typically implemented as an LID practice, and as such is typically sited to receive stormwater runoff from a small contributing area.

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 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.

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. Phased 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 determining permit requirements.

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 fully 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) all runoff from the impervious surface is infiltrated (i.e. modeling with an-approved continuous simulation hydrologic model indicates 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 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.

- For purposes of determining whether the thresholds for application of Minimum Requirements are exceeded, o 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/ or detention ~~facilities~~ BMPs shall be considered impervious surfaces for purposes of runoff modeling.
- When an underdrain (not intended to infiltrate) is used below an artificial turf surface, that surface shall be considered (and modeled) as impervious surface.

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.

New Hard Surface – A surface that is:

- Upgraded from dirt to gravel, a bituminous surface treatment (“chip seal”), asphalt, concrete, permeable pavement, a structure with a vegetated roof, or an impervious structure; or
- Upgraded from gravel to chip seal, asphalt, concrete, permeable pavement, a structure with a vegetated roof, or an impervious structure; or
- Upgraded from chip seal to asphalt, concrete, permeable pavement, a structure with a vegetated roof, or an impervious structure.

Note that if asphalt or concrete has been overlaid by a chip seal, the existing condition should be considered as asphalt or concrete.

On-site Stormwater Management BMPs – Development and mitigation techniques that serve to infiltrate, disperse, and retain stormwater runoff on a project site. 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 ([as defined in this manual](#)); 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 [artificial turf or any pervious non-impervious](#) surface subject to vehicular use ([as defined in this manual](#)), 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~~ [and](#) 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.

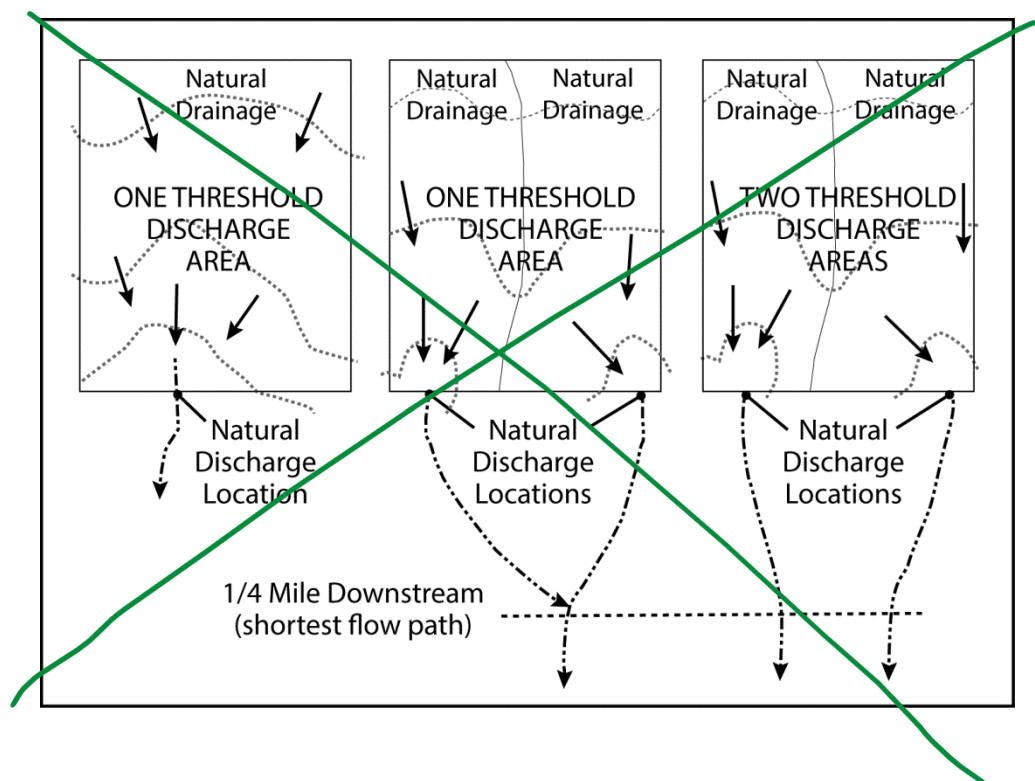
Replaced Hard Surface – For structures, the removal ~~and replacement of hard surfaces~~ down to (i.e. exposing the top of) the foundation ~~and replaced~~. For other hard surfaces, the removal down to (i.e. exposing the top of) bare soil or base course and replacement.

Replaced Impervious Surface – For structures, the removal down to (i.e. exposing the top of) the foundation and replacement ~~of impervious surfaces down to the foundation~~. For other impervious surfaces, the removal down to (i.e. exposing the top of) 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. A site may include multiple parcels and/or sections of right-of-way, if multiple parcels and/or sections of right-of-way are subject to the new development or redevelopment project.

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.



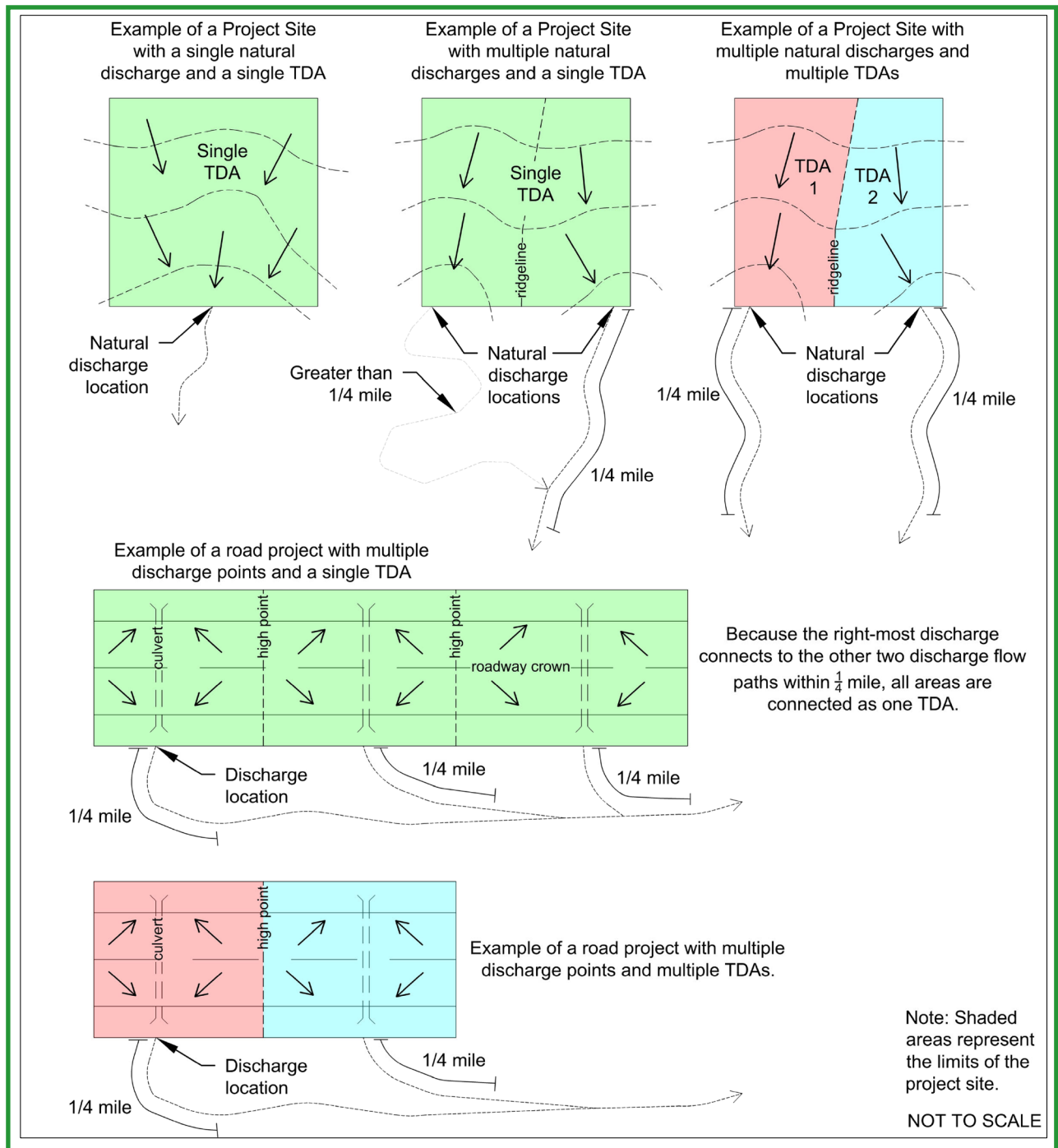


Figure 1.1: Threshold Discharge Area

(Source: ~~modified from~~ Department of Ecology)

If the project site does not currently discharge at the natural location and is such that it is impractical (as determined by Clark County) to return the discharge to the natural location, then the TDA delineation would be based on the discharge(s) at the existing location(s). An example of this case is a site in an ultra urban environment, where fully built-out conveyance systems exist and are not in the natural (i.e. historic) locations.

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,
- Railway lines, including light rail elevated and non-elevated guideways/tracks, and
- Airport runways and other surfaces intended for movement and/or storage of aircraft.

The following are not considered subject to regular vehicle use:

- Sidewalks not subject to drainage from roads for motor vehicles,
- 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.

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).

[If the project is part of a common plan of development or sale, the disturbed area of the entire plan must be used in determining applicability of Minimum Requirements.](#)

All permits issued pursuant to the regulations contained in [Chapter 40.386](#) or earlier stormwater code before July 1, ~~2024~~ [2026](#) expire on July 1, ~~2026~~ [2031](#), except if approved construction has begun on site before July 1, ~~2026~~ [2031](#). Beginning construction means, at a minimum, the site work associated with and directly related to the approved project has begun. For example: grading the project site to final grade, or the installation of utilities. Simply clearing the project site does not constitute the beginning of construction.

For governmental projects performed under the authority of the responsible official, which are subject to public bid laws, started construction means the project has been advertised per public bids laws, legislatively approved for construction, awarded to contractor, site work has begun, and the contractor has a schedule for completion.

For purposes of applying the manual thresholds to a proposed single family residential subdivision (i.e., a plat or short plat project), assume 4,000 sq. ft. of hard surface (8,000 sq. ft. on lots of 5 acres or more) for each newly created lot, unless the project proponent has otherwise formally declared other values for each lot in the complete land division application.

Understanding the definitions in [Section 1.3](#) is essential to correctly implementing the Minimum Requirements.

I.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 $\frac{3}{4}$ acres, or more, of native vegetation, pasture, scrub/shrub, or unmaintained non-native vegetation to lawn, or landscaped areas, or
- Converts 1 acre or more of vegetation to stabilized soil on projects lacking an approved Final Engineering Plan, or
- Converts 2.5 acres, or more, of native vegetation to pasture.

I.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 vegetation areas:

- Adds 5,000 square feet or more of new hard surfaces or,

- Converts $\frac{3}{4}$ acres, or more, of vegetation to lawn, or landscaped areas, or
- Converts 1 acre or more of vegetation to stabilized soil on projects lacking an approved Final Engineering Plan, 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 TDA. If the equivalent area is outside the TDA, or off site, the equivalent area must drain to the same receiving water and the guidance for equivalent facilities using in-basin transfers must be followed, as detailed in “I-D.6 Regional Facility Area Transfers” in the SWMMWW. 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

Road-related projects shall comply with All Minimum Requirements for the new and replaced hard surfaces and the converted vegetation areas if both of the following two thresholds are crossed:

- The Project adds 5,000 square feet or more of new plus replaced hard surfaces; and
- The new plus replaced hard surfaces total 50% or more of the existing hard surfaces within the 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 all of the Minimum Requirements ~~#1 – #9~~ for the new and replaced hard surfaces and the converted vegetated areas if either of the two thresholds below are crossed:

- Threshold 1: the project adds the total of new plus replaced hard surfaces is 5,000 square feet or more and
 - ~~For commercial or industrial projects; and~~ the valuation of proposed improvements, including interior improvements, exceeds 50% of the assessed value of the existing project site improvements. for commercial and industrial projects or 50 percent of the assessed value of the existing site improvements for all other projects.
 - For all other projects: the valuation of the proposed improvements, including interior improvements, exceeds 50% of the assessed value of the existing Site improvements.

- Threshold 2 (for commercial and industrial sites only):
 - The Project adds 5,000 square feet or more of new plus replaced hard surfaces, and
 - The new plus hard surfaces total 50% or more of the existing hard surfaces within the Site.

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](#).

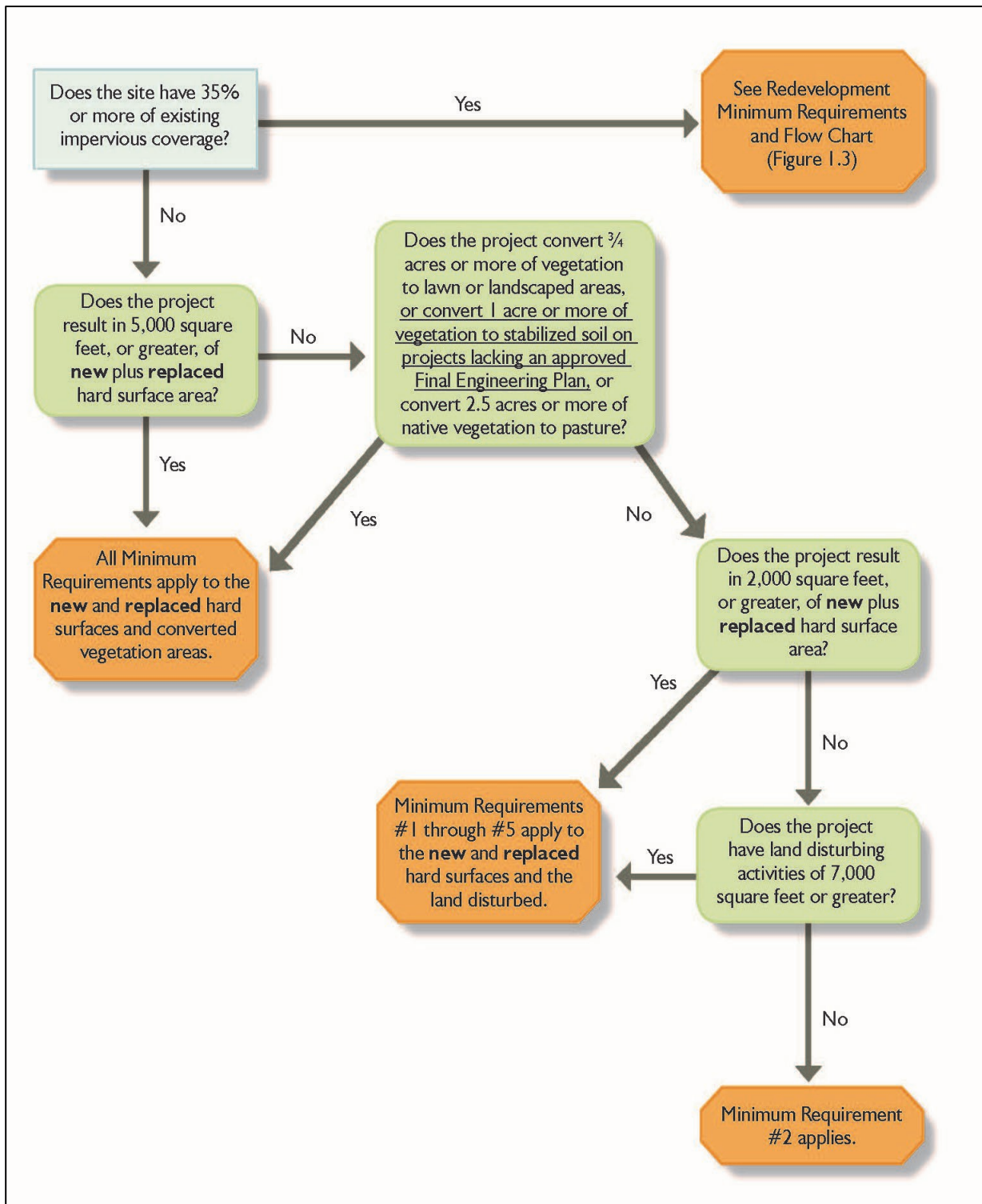


Figure 1.2: New Development Flow Chart

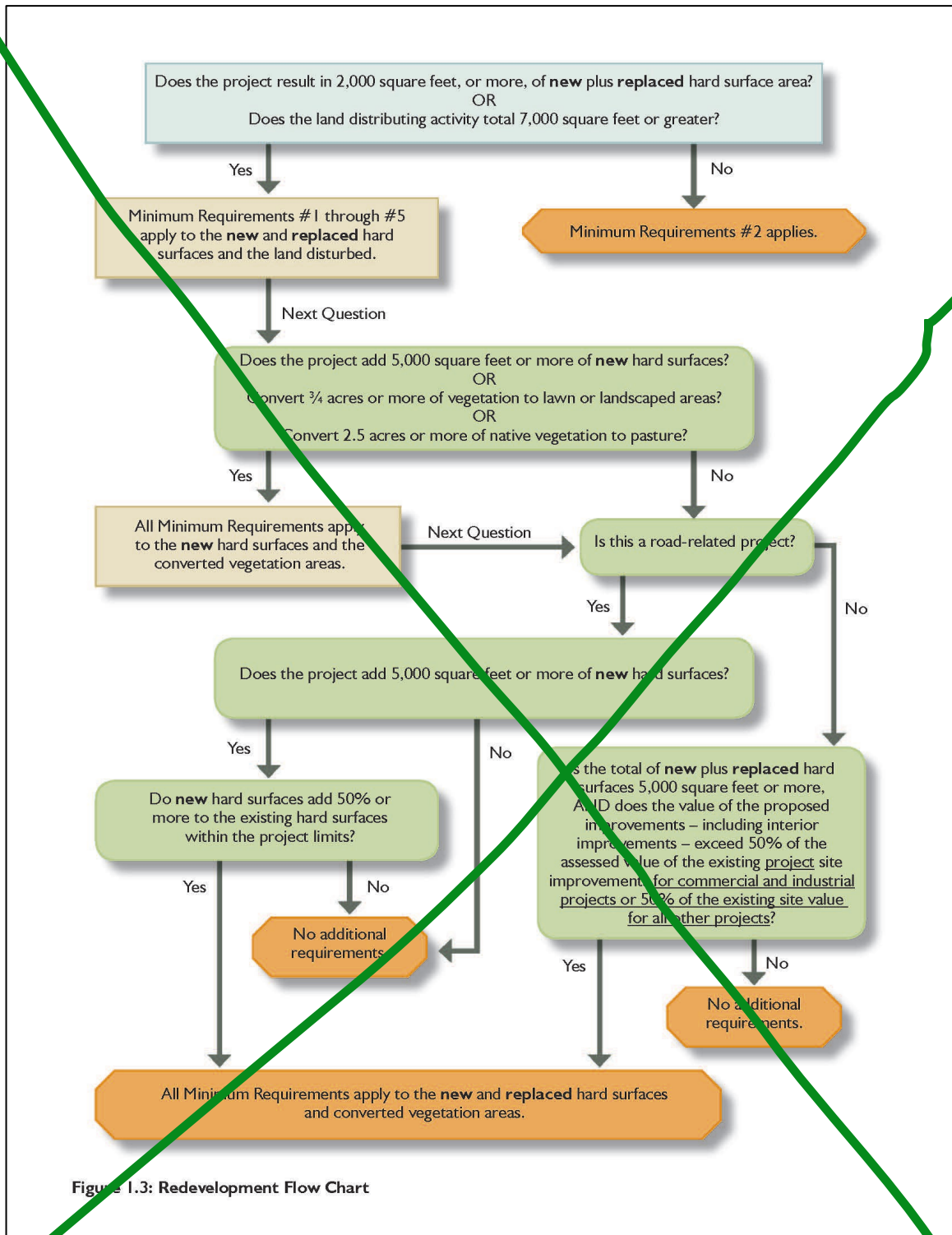


Figure 1.3: Redevelopment Flow Chart

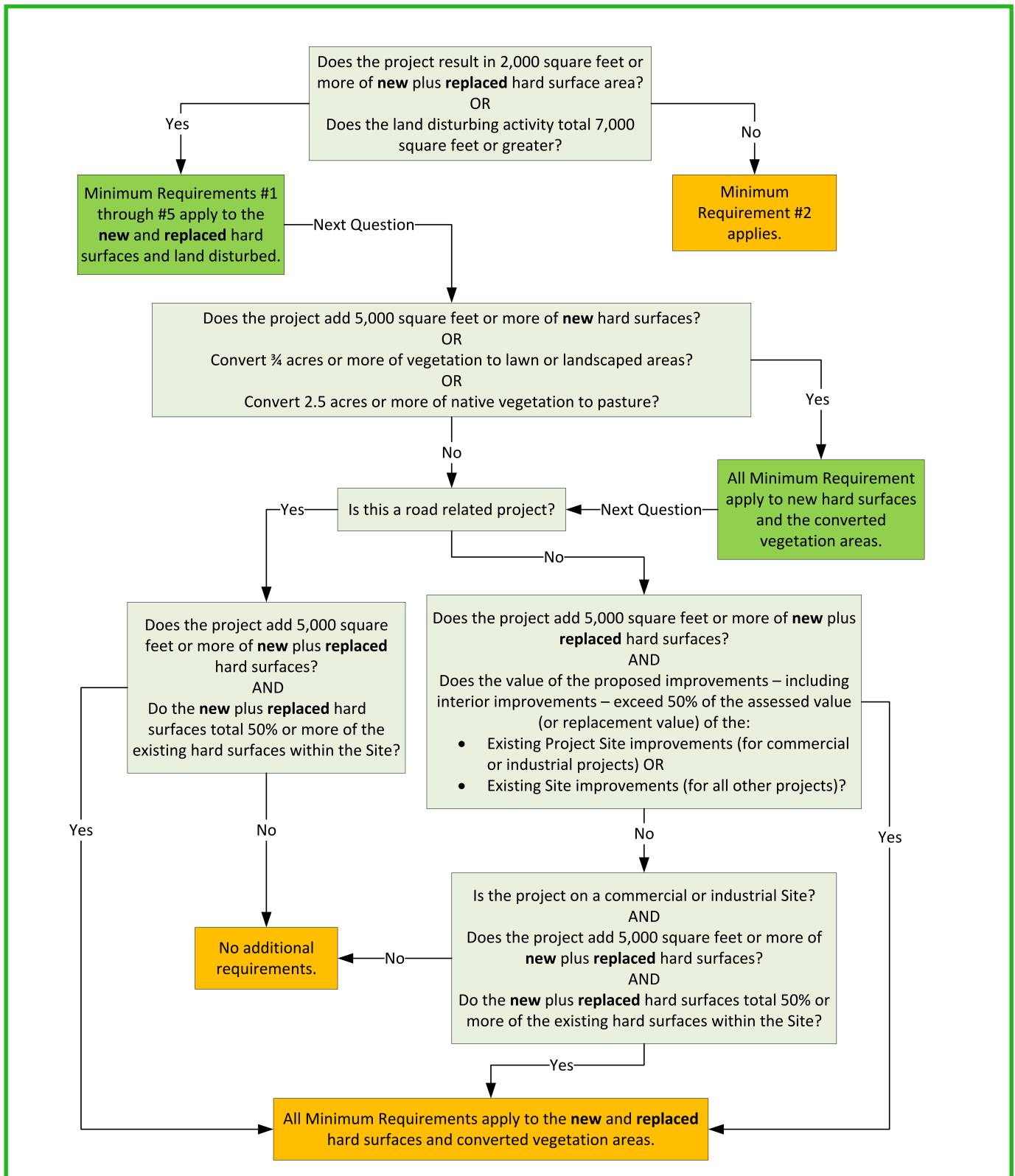


Figure 1.3: Redevelopment Flow Chart

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 [Sections 1.7](#) and [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.

Different methods of preparing a SWPPP are discussed in [Sections 1.7](#) and [1.8](#) of this book.

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 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 9 or the 2019 SWMMWW Volume II, Chapter 3.

The applicant may comply with Minimum Requirement #2 at a site covered under the Construction Stormwater General Permit - National Pollutant Discharge Elimination System and State Waste Discharge Permit for Stormwater Discharges Associated with Construction Activity by fully implementing the permit- required SWPPP.

If a Construction SWPPP is found to be inadequate (with respect to erosion and sediment control requirements), then the Responsible Official shall require that other Construction Stormwater BMPs be implemented, as appropriate.

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.

I.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.

I.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 7.7](#)).

I.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 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](#).

I.5.5.1 Project Compliance Options

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.

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, or when the project TDAs do not drain directly or indirectly to a municipal storm sewer system, List 2 may be used.
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, or when the project TDAs do not drain directly or indirectly to a municipal storm sewer system, List 2 may be used.

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.

I.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](#). A rain gardens or bioretention facility must have a minimum horizontally projected surface area below the overflow which is at least 5% of the total surface area draining to it.¹
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](#).

¹ The minimum horizontally projected surface area requirement does not apply to projects meeting the LID Performance Standard.

2. Permeable pavement² 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](#).

1.5.5.4 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.³
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](#).

² 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.

³ The minimum horizontally projected surface area requirement does not apply to projects meeting the LID Performance Standard.

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 pavement⁴ in accordance with [BMP T5.15](#) in [Chapter 2](#) and [Book 2, Chapter 2](#).
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](#).

I.5.6 Minimum Requirement #6: Runoff Treatment

I.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.~~
- [Projects located on any land draining either directly or through a tributary to Vancouver Lake or Lake River.](#)

I.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](#)).

⁴ 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 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.

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](#).

I.5.7 Minimum Requirement #7: Flow Control

I.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.

I.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 $\frac{3}{4}$ acres or more of native vegetation, pasture, scrub/shrub, or unmaintained non-native 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 1985⁵. 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.

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.

I.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.

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](#).

I.5.8 Minimum Requirement #8: Wetlands Protection

I.5.8.1 Applicability

The requirements of this section apply to project TDAs proposing to discharge stormwater into a wetland, either directly or indirectly through a conveyance system. See [Figure 1.4](#).

I.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. If Minimum Requirement #8 is applicable, meet the requirements in [Section 1.5.8.3](#).

I.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.

Refer to [Appendix H](#) for the applicable Wetland Hydroperiod Method based on Figure 1.4.

Levels of Wetland Protection

The following levels of protection are further explained in Appendix 1-H.

A. General Protection

General Protection includes practices that protect wetlands of all types.

B. Protection From Pollutants

Protection from Pollutants includes measures to protect the wetland from pollutants in storm-water runoff. Measures of protection include Construction Stormwater BMPs, Source Control BMPs, LID practices and principles, and Runoff Treatment BMPs.

C. Wetland Hydroperiod Protection

Wetland Hydroperiod Protection includes measures to avoid excessive hydrologic alteration of existing wetlands from development. There are two methods within Wetland Hydroperiod Protection:

a. Method 1: Monitoring and Wetland Stage Modeling

This method requires data collection specific to the wetland, as well as continuous simulation modeling to demonstrate that the proposed project will not negatively alter the wet-land hydrology.

b. Method 2: Site Discharge Modeling

This method requires continuous simulation modeling of the runoff from the TDA to demonstrate that the changes in total discharge volume to the wetland will remain similar to the pre-development condition.

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.
- 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 Appendix 1-H, Section H.6 of this book.

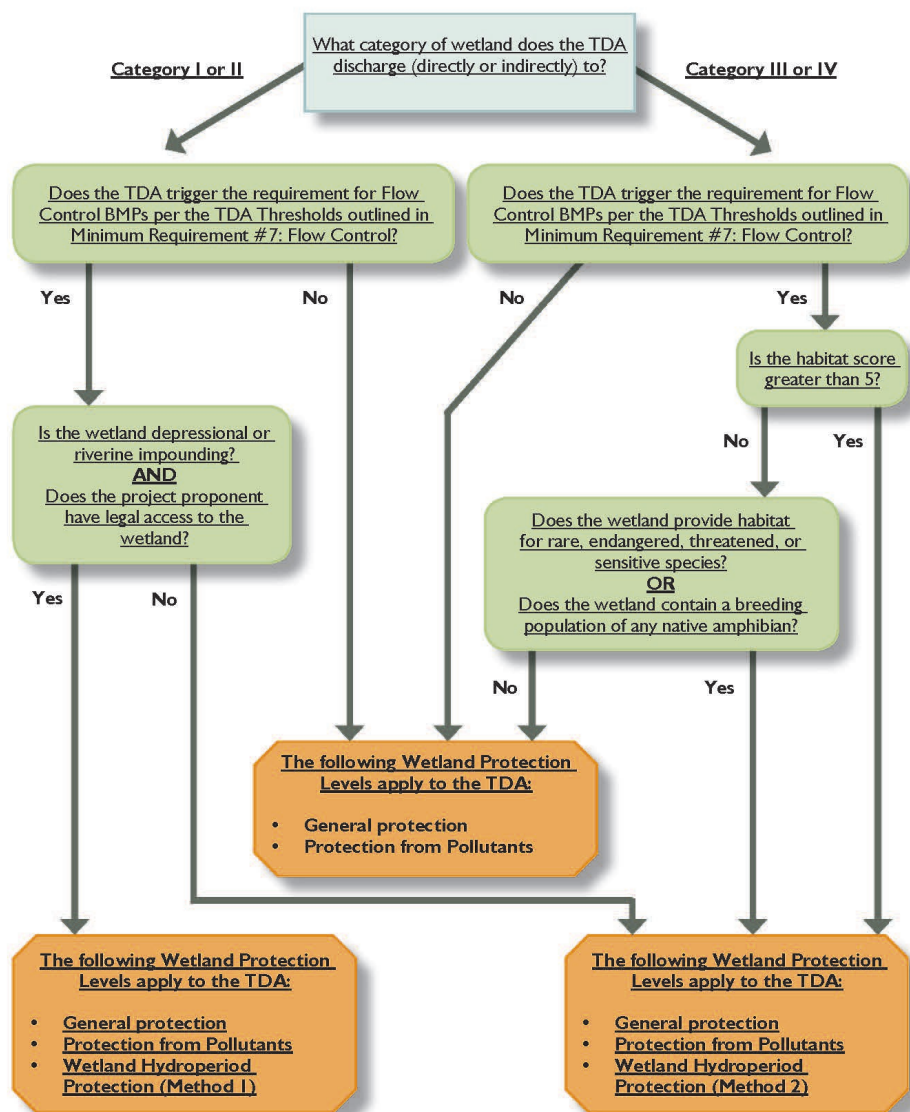


Figure 1.4: Minimum Requirement #8 Flow Chart

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 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

Clark County requirements in this section apply to all 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 referenced in Book 2 Introduction of this manual.

Signs placed on Clark Public Utilities utility poles must be no larger than 12" by 16".

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 described below. Locations of medallions and signs shall be shown on the Final Development Plan (see [Section 1.8.2.2](#)).

Inlets must be marked with a permanently-affixed "Protect water – Only Rain in the Drain" medallion near the inlet.

Inlet medallions may be used in place of a bioretention sign for bioretention facilities in roads. The medallions must be placed at each facility inlet.



Figure 1.5: Stormwater Medallion (4" diameter)

Stormwater treatment and flow control facilities, including On-site Stormwater Management BMPs, must be marked with a sign specific to the type of facility, as shown in Figures 1.6 through 1.14, below. For fenced stormwater facilities, a sign must be placed at the entrance and on each side facing a road or sidewalk. For Permeable Pavement BMPs, place one sign every 200' at a minimum. Signs for facilities in right of way must adhere to sign placement requirements in [CCC 40.350](#).

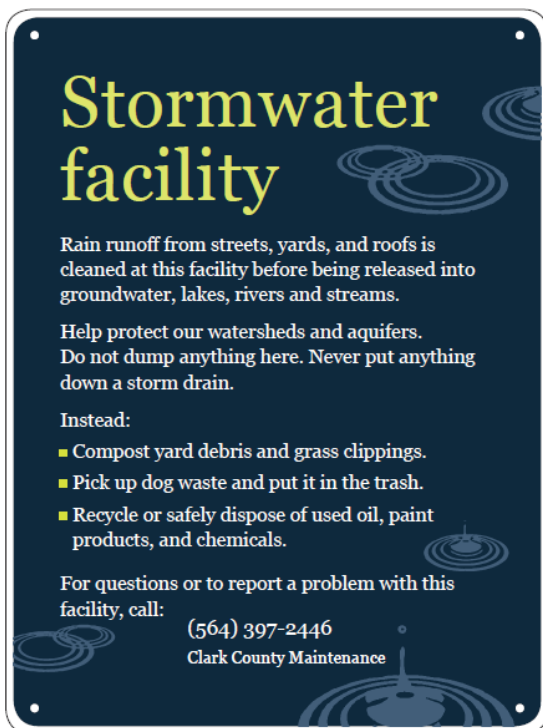


Figure 1.6: Standard Clark County Stormwater Sign (12" x 16")



Figure 1.7: Standard Clark County Bioretention Sign (12" x 16")

Inlet medallions may be used in place of signs for facilities in roads.



Figure 1.8: Standard Clark County Rain Garden Sign (12" x 16")



Figure 1.9: Standard Clark County Pervious Concrete Sign (12" x 16")



Figure 1.10: Standard Clark County Porous Asphalt Sign (12" x 16")



Figure 1.11: Standard Clark County Permeable Pavers Sign (12" x 16")



Figure 1.12: Standard Clark County Native Plantings Sign (12" x 16")



Figure 1.13: Standard Clark County Vegetated Roof Sign (12" x 16")



Figure 1.14: Standard Clark County Vegetation Preservation Sign (9"x 11.75")

1.6.3 Off-site 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 off-site drainage systems, then the applicant shall implement additional flow control or other measures to mitigate those adverse impacts. No new development, redevelopment, or drainage project shall be allowed to materially increase or concentrate stormwater runoff onto an adjacent property or block existing drainage from adjacent lots.

1.6.4 Erosion Control

1.6.4.1 General Standards

- All outfalls require energy dissipation (See [Book 2, Section 7.7](#)).
- 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 any development or redevelopment site subject to Minimum Requirement #2, as shown below.
- 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.



Figure 1.15: Standard Clark County Erosion Control Sign (4' x 8')

I.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](#).

I.6.6 Stormwater Facility Access

All stormwater facilities must allow for access by standard maintenance equipment and vehicles needed to remove sediment and maintain structures in accordance with the standards of this manual. Maintenance access must be provided using a minimum of a 10-foot wide roadway constructed using an all-weather surface or an alternative surface type approved by the county; the responsible office may waive this requirement where a road is not necessary for accessing the facility. Access criteria for specific BMPs are given in [Book 2](#). All private stormwater facilities that are gated and locked are required to have a double locking system for inspection purposes. It is preferred to use a chain with a county lock and the private lock.

I.6.7 Flood Plain Requirements

Any reduction of existing conveyance capacity, and any net loss of existing storage capacity for the base flood, are prohibited in FEMA Special Flood Hazard Areas (SFHA). Compensatory storage provided to offset any loss of flood storage capacity must be hydraulically equivalent to the areas where flood storage is reduced (i.e.: fill put in below the 10-year flood elevation should be compensated by removal of soil below that elevation elsewhere in the floodplain).

I.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 projects that qualify as small projects. A small project is defined as a development or redevelopment project that meets all of the following criteria:

1. Triggers Minimum Requirements #1 – #5.
2. Is less than one acre.
3. Does not construct a public road.
4. Does not require an Engineering Approval.

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 Short Form located in [Appendix 1-I](#) to meet submittal requirements.

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.

I.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 stamped 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) Off-site 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.

I.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. Include BMP number and name from Book 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, required flow paths, and lengths of dispersion BMPs. Include BMP number and name from Book 2.
10. Approximate location and size of proposed runoff treatment and flow control facilities. Include BMP number and name from Book 2.
11. Include a conceptual grading plan that verifies the constructability of the proposed stormwater facilities.

12. The delineated on-site wetland boundary, and off-site 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 Off-site Areas Map

The off-site areas map shall be an 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 off-site 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 1/4 mile away from the site boundary.
- A description of existing on-site 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. Use the CCSM BMP number and name when discussing BMPs.

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 [Book 2, 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~~ [metals](#), 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.
- The 1996 flood aerial photograph from Clark County MapsOnline if the GIS depth to water map shows groundwater depth is less than 20 feet.

Other Submittals

- 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 Final 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 plan sheet showing the entire stormwater drainage system on a single sheet to facilitate mapping assets in the GIS and Construction Inspection. Each BMP must be identified using the BMP number from Book 2.
7. A final technical information report (TIR). See the requirements identified below.
8. 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](#))

I.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.

I.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 on-site and off-site 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. Catchment areas for each Stormwater Treatment and Flow Control BMP.
11. 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 Pollution 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, as well as any stormwater system that includes or requires plantings in or over the proposed stormwater system, provide the following:
 - a. The proposed soil matrix for the facility.
 - b. The planting plan, listing proposed plant types, sizes, and locations. Planting plan shall include proposed grading (1-foot contours) and stormwater system layout to ensure minimal conflict between plantings and stormwater system.
 - 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 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 on-site 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*.

For private facilities in residential subdivisions, provide an estimate of the average annual operation and maintenance cost for facilities owned by an HOA. This will give the HOA a basis for collecting revenue to maintain the facility in accordance with Clark County's NPDES permit requirements.

Include a planting maintenance plan to ensure that plantings survive the two-year applicant maintenance period.

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.
7. Compute and tabulate the following:
 - a. Identify design flows and velocities and conveyance element capacities for all conveyance elements within the development.
 - b. 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.
 - c. Compute existing 100-year floodplain elevations and lateral limits for all channels and verify no net loss of conveyance or storage capacity from development.
 - d. Verify the capacity of each conveyance system element to convey design flow and discharge at non-erosive velocities. Verify the capacity of the on-site conveyance system to convey design flows that result from ultimate build-out of upstream areas.
8. Reference conveyance system elements to labeled points shown on the site location map or development plan.
9. 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.
10. 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 – Off-site Analysis

If applicable, provide the results of an off-site analysis prepared in accordance with [Chapter 5](#).

Off-site 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 40.410](#)

11. Clark County floodplain permit: [CCC 40.420](#)
12. Clark County geohazard permit: [CCC 40.430](#)
13. Clark County habitat permit: [CCC 40.440](#)
14. Clark County wetland permit: [CCC 40.450](#)
15. Clark County shoreline management permit: [CCC 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.4—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.5 – 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.

Appendices

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 a 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 a 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 component 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. Those projects that will disturb less than one acre of land may use the Abbreviated Construction SWPPP in [Appendix 1-J](#) in lieu of the instructions in [Chapter 6](#).

The Construction SWPPP shall be prepared by a licensed engineer in the state of Washington or, if preparation of the SWPPP does not require the practice of engineering, by a person who holds a valid Certified Erosion and Sediment Control Lead (CESCL) certification.

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 Responsible Official 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 or building permits for residences with Stormwater Treatment and Flow Control BMPs.

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 owner and the person or entity responsible for long-term maintenance of every component of the stormwater facilities, including components in easements.

See [Appendix 1-G](#) for developer covenant example forms.

1.9.2 County Ownership of Stormwater Facilities

County ownership of stormwater facilities is required for all such facilities located within a Clark County 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.

Applicants must follow county policy for conveyance of open space, critical areas, undevelopable remnant lands, and stormwater tracts in Appendix 1-K.

Permeable pavement, bioretention facilities and enclosed underground systems including UIC regulated structures in residential subdivisions may be placed in Clark County 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).

I.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. Elements of facility construction that are most likely to cause problems which may extend the warranty period beyond two years include marginal soil conditions for the facility design; unusual, complex, or experimental design elements; unusual maintenance requirements; and potential for failing walls, slopes, or discharge points. 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.

I.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, single family residence, or other building project having stormwater treatment and flow control BMPs, 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.

I.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 Bioretention BMP or a Permeable Pavement BMP.

I.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 Easement Standards

1.9.4.1 Stormwater Facilities

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 facility 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. Maintenance access must be provided using an all-weather surface or an alternative surface type approved by the county.

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.

1.9.4.2 Conveyance Systems

Publicly Owned Systems

Minimum easement widths for conveyance systems 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.	

Privately Owned Systems

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.

I.9.4.3 Full Dispersion and Preserving Native Vegetation BMPs

For land divisions and site plans, the preserved area(s) for BMP T5.30A Full Dispersion and BMP T5.40 Preserving Native Vegetation shall be placed in a separate tract or protected through recorded easements for individual lots. For individual residences or other building projects on existing lots, the dispersion area must be included in a covenant running with the land to preserve it.

I.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.

I.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 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.*

1.9.9 Regional Stormwater Facilities

Clark County encourages the use of regional stormwater facilities.

1.9.9.1 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.

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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 Dispersion [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.
- Meet 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 and apply BMP T5.13 Post-Construction Soil Quality and Depth.

Clark County accepts and encourages the use of other on-site stormwater management BMPs that are not listed in the selection process for required BMPs. These BMPs are described in [Sections 2.5.6](#) and [2.5.7](#), and include Better Site Design ([BMP T5.41](#)), Tree Retention and Tree Planting ([BMP T5.16](#)), and others.

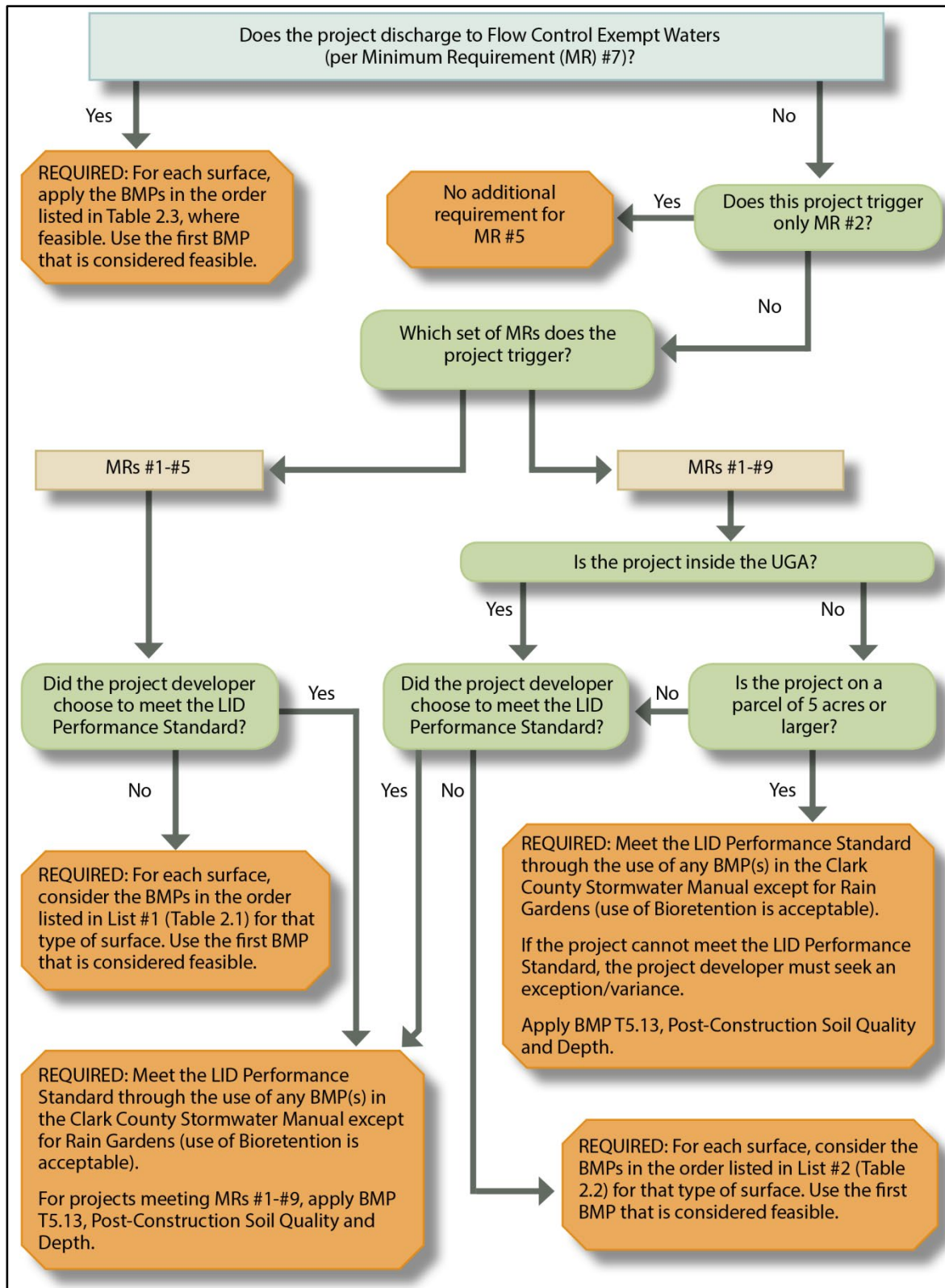


Figure 2.1: Flow Chart for Determining LID Minimum Requirement #5 Requirements

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.				
<p>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.</p> <p>Use the first BMP that is considered feasible. No other On-site Stormwater Management BMP is necessary for that surface.</p>				
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.				
<p>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.</p> <p>Use the first BMP that is considered feasible. No other On-site Stormwater Management BMP is necessary for that surface.</p>				
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 that discharge to a flow control exempt water body per Minimum Requirement #7

Implement the following BMPs where feasible.				
<p>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.</p> <p>Use the first BMP that is considered feasible. No other On-site Stormwater Management BMP is necessary for that surface.</p>				
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 for Engineered Stormwater Plans

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 Stormwater Site Plan Short Form, follow the instructions in the in [Appendix 1-I](#) to document the results.

2.3.1 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.

2.3.2 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~~ **10 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 2.3.3 through 2.3.5:

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.

2.3.3 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

2.3.4 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, [at depths](#), 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 and Not Meeting LID Performance Standard

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.

For proposed permeable pavement locations, perform an infiltration test for every 5,000 sq. ft. of permeable pavement.

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 also 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

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 feet 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	$CF_m = 0.9 \text{ to } 1$

Total correction factor (CF_T) = $CF_v \times CF_m$

2.3.5 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 and available field information describing water table elevations within 500 feet of the site indicate 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 <https://dahp.wa.gov/project-review/preservation-laws>.
 - Federal Superfund (general information at: <https://www.epa.gov/superfund>) 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 Clark County rights-of-way.
- Critical areas code provides protection of tree species.

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](#).

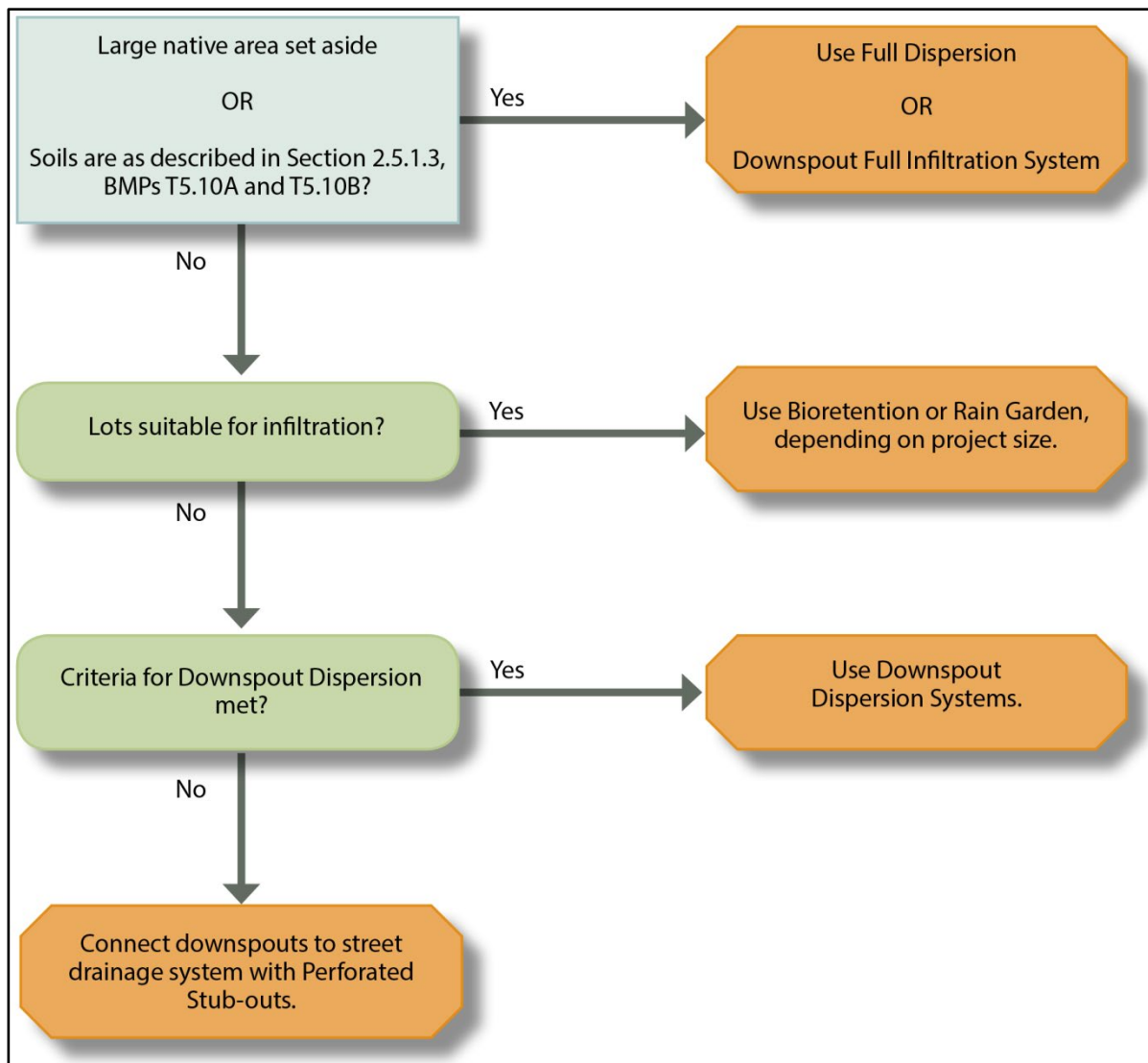


Figure 2.2: Roof Downspout Selection Process

2.5.1.3 Roof Downspout BMP Applications, Limitations, and Infeasibility Criteria

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 consisting of coarse sand to medium sand, loam, or cobbles

and gravels are present in the infiltration zone. If other soils are present in the infiltration zone consider a rain garden or bioretention facility instead. 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.
- It cannot meet the setback requirements in [Section 2.5.1.4](#).

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.
- 200 feet from the top of any slope over 40%.
- Not on slopes steeper than 15% unless information from a geotechnical engineer is provided stating that slope stability will not be compromised.

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.
- 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 (BMP T5.30B) 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.
 - 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.
- The following surfaces will be considered “fully dispersed per BMP T5.30A or BMP T5.30B if they 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 for BMP T5.30A and vegetated flow paths of 300 feet or more through pasture or cropland for BMP T5.30B; 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 $\frac{3}{4}$ -inch to $1\frac{1}{2}$ -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 or 300-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 for BMP T5.30A and 5% for BMP T5.30B 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 for BMP T5.30A and vegetated flow paths of 300 feet or more through pasture or cropland for BMP T5.30B; or, 2) disperse driveway runoff along with the road runoff in accordance with the roadway dispersion BMP section above.

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% for BMP T5.30A and 5% for BMP T5.30B.

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, not including Shorelines, Floodplains, or Critical Aquifer Recharge Areas (CARAs) per CCC Subtitle 40.4.
- 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 Geologic Hazard Area 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 [Geologic Hazard Area](#) ~~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.I4A: 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.I4B: 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 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](#).

- 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 $\frac{3}{4}$ acres of pervious surface, where the minimum vertical separation of one foot to seasonal high water table, bedrock or other impervious layer cannot be achieved below the facility.
- 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) $\frac{3}{4}$ acres or more of pervious surface; and 2) cannot reasonably be broken down into amounts smaller than indicated in (1), where the minimum vertical separation of three feet to seasonal high water table, bedrock or other impervious layer cannot be achieved below the facility.
- 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 redevelopment sites, or where there is insufficient space within the existing Clark County right-of-way on Clark County 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 $\frac{3}{4}$ 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 BMP T5.I5

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:

- Run-on from pervious surfaces is not allowed, except from minor or incidental pervious areas that cannot be directed elsewhere. Those areas must be fully stabilized before discharging runoff to the pervious pavement.
- 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\(b\)\(14\)](#) or in the [Washington Department of Ecology Industrial Stormwater General Permit](#).
- 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:

- Cation Exchange Capacity ≥ 5 milliequivalents CEC/100 g dry soil (USEPA Method 9091)
- Organic Content $> 1\%$
- 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)
- [BMP T5.41 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*.

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~~ [metals](#) treatment, and basic treatment.

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 off-site 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 Metals Treatment is Required
6. Select a Basic Treatment Facility

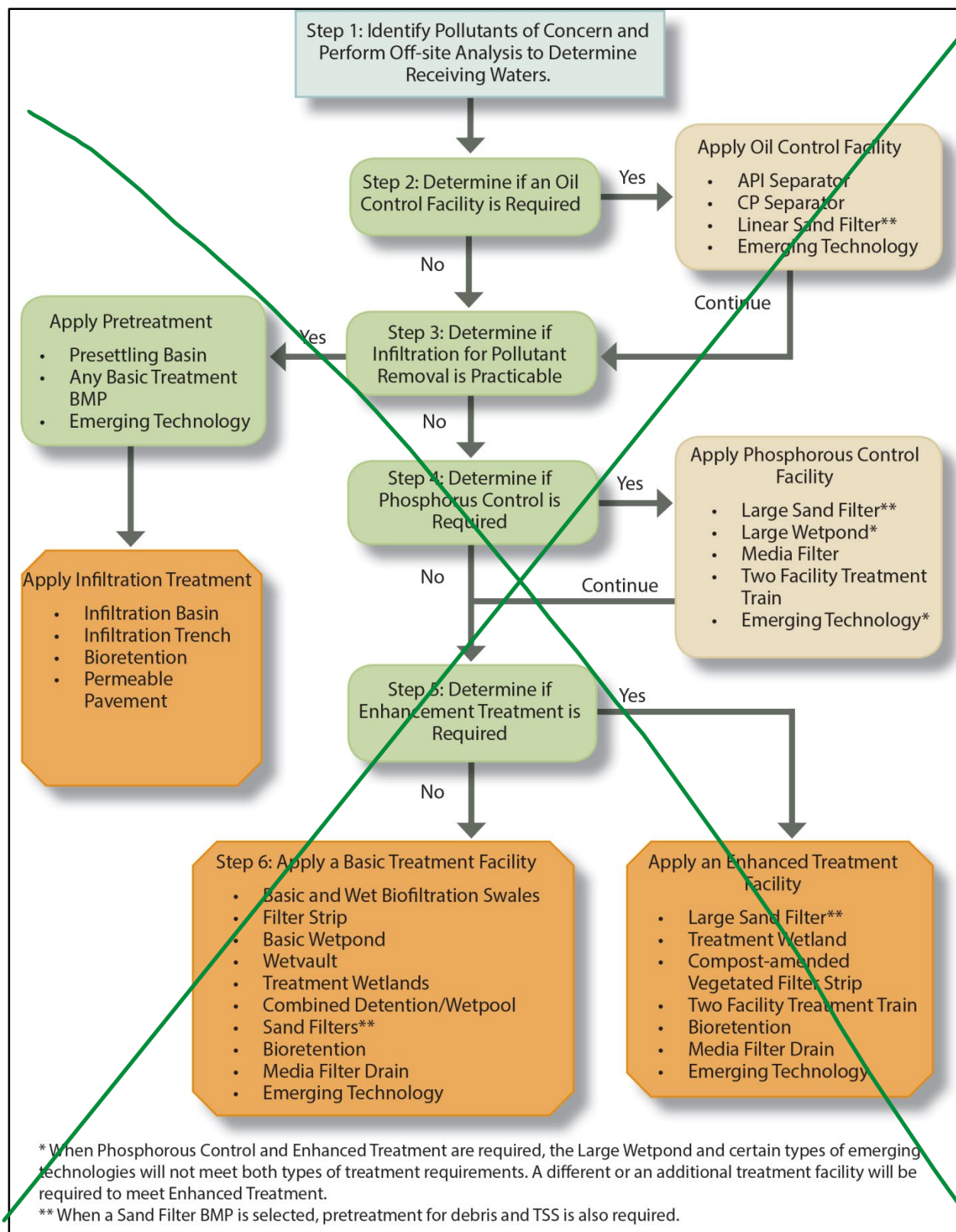
After selecting any BMP in the Step-by-Step Process, refer to the selection criteria in [Book 2, Section 3.1](#), which may affect the design and placement of the facility.

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 Off-site Analysis described in [Chapter 5](#). Clark County will verify the identification of the receiving water from the Off-site 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.



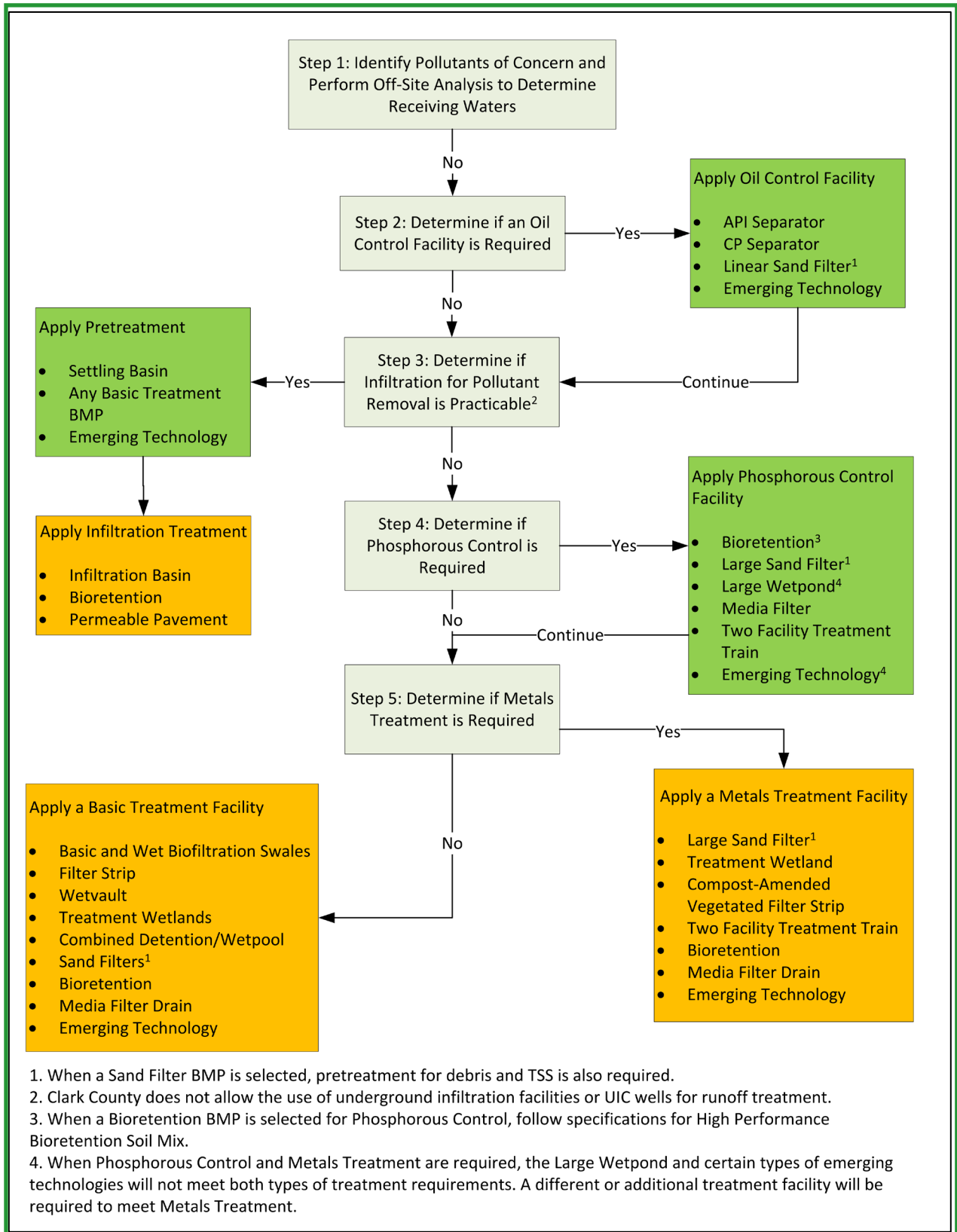


Figure 3.1: Treatment Facility Selection Flow Chart

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 (<https://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](#). Due to the risk of clogging, Clark County does not allow the use of underground infiltration facilities or UIC wells for runoff treatment.

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 metals](#) 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~~ and on any land draining either directly or through a tributary to Vancouver Lake or to Lake River 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 Lacamas Lake ~~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 Metals](#) Treatment requirement (see Step 5). In that event, apply a facility or a treatment train that is listed in both the [Enhanced Metals](#) 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 Metals Treatment is Required

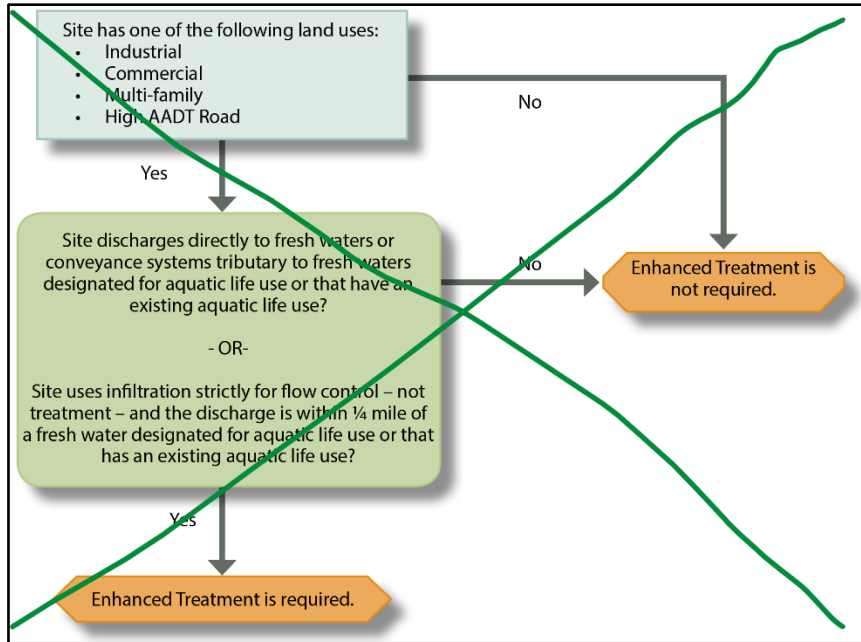
Except where specified under Step 6, enhanced Metals Treatment to reduce dissolved metals is required for the following project sites that 1) discharge directly to fresh waters or conveyance systems tributary to fresh waters designated for aquatic life use or that have an existing aquatic life use; or 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:

- Sites subject to ~~F~~ industrial project sites activities
- Commercial project sites
- Multi-family residential project sites
- High ~~A~~ADT 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 ~~F~~ Roads with an AADT of 7,500 or greater~~
 - Outside of Urban Growth Management Areas:
 - Roads with an ~~A~~ADT of 15,000 or greater ~~unless discharging to a 4th 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).~~
- Light rail elevated and non-elevated guideways/tracks
- Other projects sites that are anticipated to generate high pollutant loading, including:
 - Parking areas as follows:
 - On-street parking on streets with an expected ADT of $\geq 7,500$ or greater
 - All on-street parking areas in commercial and industrial areas
 - Parking areas with an expected trip count of ≥ 40 vehicles per 1,000 sf of gross building area
 - Parking areas with ≥ 100 expected trip ends per day
 - Fueling stations
 - Transit center bus stops

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 Metals Treatment requirements. For developments with a mix of land use types, the Enhanced Metals Treatment requirement shall apply when the

runoff from the areas subject to the [Enhanced Metals](#) Treatment requirement comprises 50% or more of the total runoff within a threshold discharge area.

If the project must apply [Enhanced Metals](#) Treatment, select and apply an appropriate [Enhanced Metals](#) Treatment facility. Please refer to the [Enhanced Metals](#) 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.



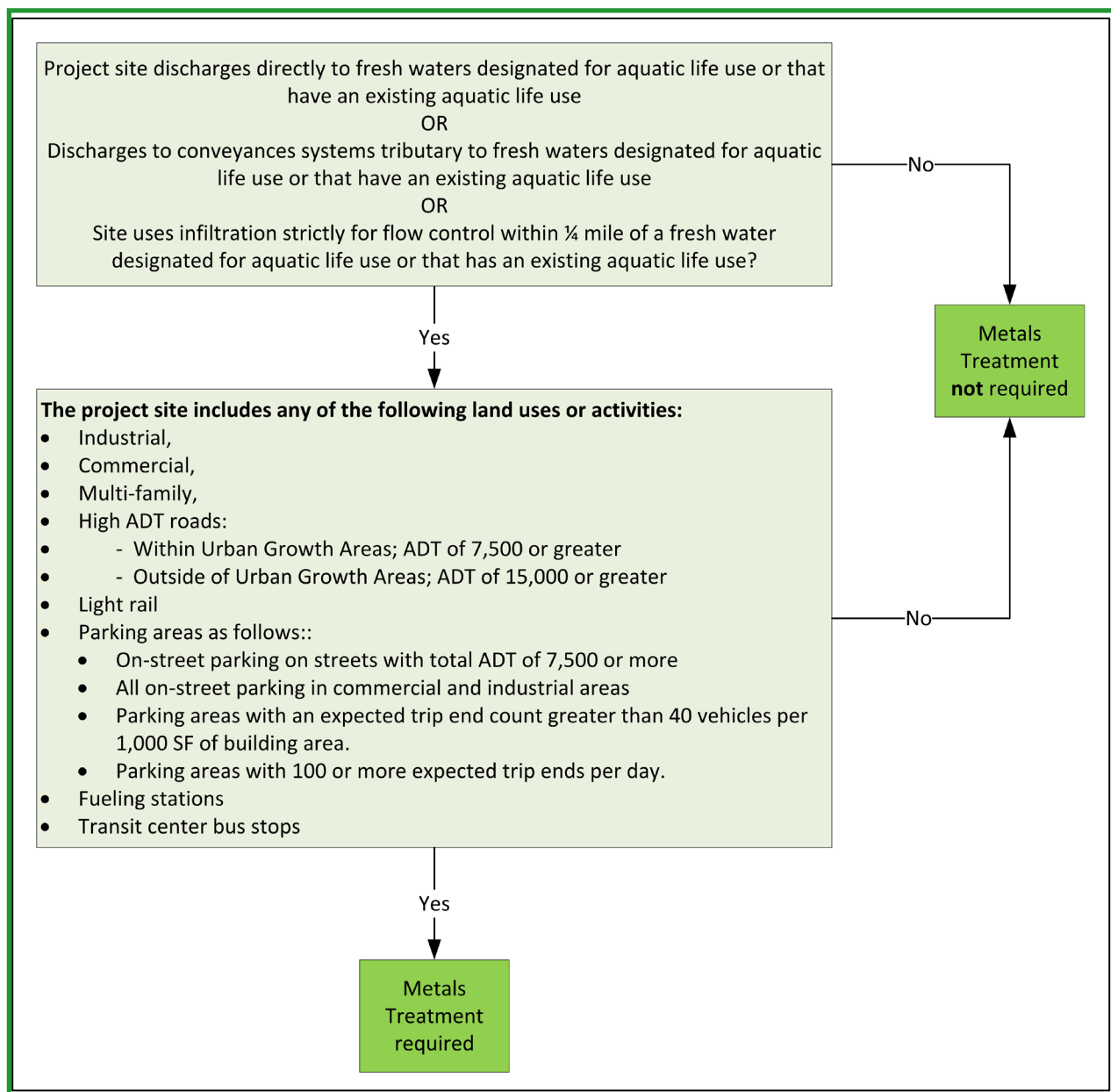


Figure 3.2: Enhanced Metals Treatment Flow Chart

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

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

If Enhanced Metals 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
 - 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 Metals](#) 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:
 - Columbia River
 - Lewis River
 - 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.~~

If Phosphorous Treatment BMPs or Metals Treatment BMPs are not provided, Basic Treatment BMPs are required. 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~~ Metals 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 is 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 Metals](#), 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](#))
- Proprietary BMPs:
 - [Filterra® System \(BMP T12.20\)](#)
 - [Filterra® Bioscape™ \(BMP T12.20\)](#)

- Emerging Technology (see [Section 3.4.7](#))

Note: The linear sand filter is used in the Basic, [Enhanced Metals](#), 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 Technology (see [Section 3.4.7](#))

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 the site soils meet minimum soil criteria for treatment 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 metals](#) treatment requirement too.

- Proprietary BMPs:
 - [Filtterra® System \(BMP T12.20\)](#)
 - [Filtterra® Bioscape™ \(BMP T12.20\)](#)
 - [FloGard Perk Filter® \(BMP T12.11\)](#)
 - [StormFilter using Phosphosorb media® \(BMP T12.10\)](#)
- 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
- Proprietary BMPs:
 - [Filtterra® System \(BMP T12.20\)](#)
 - [Filtterra® Bioscape™ \(BMP T12.20\)](#)
 - [FloGard Perk Filter® \(BMP T12.11\)](#)
- Emerging Technology (see [Section 3.4.7](#))

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 Metals** Treatment Menu

Performance Goal

The **Enhanced Metals** 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 metals** 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](#))
- Proprietary BMPs:

- [Filtterra® System](#)
- [Filtterra® Boxless™](#)
- 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 Metals](#) 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.
- Emerging Technology (see [Section 3.4.7](#))

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 metals](#) treatment use by Ecology. See "Emerging Technologies" on page 146 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](#))

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.

- Stormwater Treatment Wetland ([BMP T10.30](#))
- Combined Detention and Wetpool Facilities ([BMP B6.40](#))
- Bioretention ([BMP T5.14B](#))

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](#))
- Proprietary BMPs:
 - [Filtterra® System \(BMP T12.20\)](#)

- [Filterra® Bioscape™ \(BMP T12.20\)](#)
- [StormFilter® \(using ZPG Media\) \(BMP T12.10\)](#)
- [FloGard Perk Filter® \(BMP T12.11\)](#)
- Emerging Technology (see [Section 3.4.7](#))

Where media filters are used as the second BMP in a treatment train, consider whether the flow rate to the filter vault is high enough to ensure activation of the filters. Consult with the manufacturer for requirements.

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 metals](#) runoff treatment facilities.

Presetting 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. Note that pretreatment may also be provided by any Basic Treatment BMP, including Proprietary BMPs approved for Basic Treatment.

3.3.3.1 Purpose and Description

A Presetting 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 Presetting Basin may not be discharged directly to a receiving water; it must be further treated by a basic or [enhanced metals](#) runoff treatment BMP.

- All facilities shall be a minimum of 20 feet from any structure, property line, and any critical area buffer.
- 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.

- [BMP T6.10](#): Presettling Basin
- Any Basic Treatment BMP (see [Basic Treatment Menu](#), above)

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. Expedient 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).

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 or 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~~ Metals 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 D6.40](#) 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 D6.40](#).

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 D6.40](#) 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 D6.40](#): Combined Detention and Wetpool

3.4.6 Proprietary BMPs

As of the printing of this manual, the following proprietary BMPs are accepted by Clark County for applicable treatment uses:

- StormFilter® using ZPG Media is accepted for Basic Treatment.
- Filterra® System and Filterra® Bioscape™ are accepted for Oil Treatment, Basic Treatment, [Enhanced Metals](#) Treatment, and Phosphorous Treatment.
- Perk Filter® is accepted for Basic Treatment and Phosphorous Treatment.
- StormFilter® using Phosphosorb for basic treatment and phosphorus treatment.

Consult a BMPs [GULD](#) and manufacturer for design, specifications, and installation criteria.

Proprietary BMPs that have not been accepted by Clark County or that may emerge after the printing of this manual are known as Emerging Technologies. Section 3.4.7, below, discusses the use of Emerging Technologies in Clark County.

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 approval 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 and acceptance of the BMP by the permitting municipality.

3.4.7.2 Using Emerging Technology BMPs in Clark County

Clark County accepts several Proprietary BMPs as listed in [Section 3.4.6](#) of this manual.

For Emerging Technologies arising after the publication of this manual, the Responsible Official maintains a list of BMPs 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.

Approved emerging technologies and approval procedure are included in the implementation procedures documents on the Clark County Stormwater Manual web page.

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Chapter 4 Flow Control

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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 1.5.7.2](#) to determine if flow control facilities are required.
5. 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.

6. 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.

The Applicant shall evaluate infiltration first. Infiltration is the preferred approach to meeting Minimum Requirement #7. 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.

All UIC wells receiving runoff from pollutant generating surfaces are required to have basic treatment. All underground infiltration BMPs receiving runoff from surfaces other than pollutant generating must have a pretreatment BMP.

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 groundwater 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 Stormwater Management Manual for Western Washington (2019), Chapter I-4, 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 prohibits the use of Deep UIC wells, as defined in the Stormwater Management Manual for Western Washington, Section I-4.15.

Clark County Code 40.410 CARA

The county's Critical Aquifer Recharge Area (CARA) regulation, CCC 40.410, allows Class V stormwater injection wells that meet Clark County Stormwater Manual requirements.

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.
 - a. 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.

- b. 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.
- c. 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 ft² gross building area (trip generation).
 - Road intersections with an ADT of $\geq 25,000$ on the main roadway and $\geq 15,000$ 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 ft² 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 groundwater 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 groundwater 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 and 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.

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.

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	
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

Please see [Section 1.5.7](#) for the standard requirements for meeting Minimum Requirement 7 using detention.

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 <https://ecology.wa.gov/Water-Shorelines/Water-supply/Dams>.
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 Off-site Analysis

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5.1 Introduction

5.1.1 Purpose

This chapter provides requirements for off-site analysis and mitigation. These requirements are in addition to the minimum requirements identified in [Chapter 1](#). The off-site analysis is a field investigation of downstream impacts on water quality and surface water conditions resulting from a development, redevelopment, or other land-disturbing activity.

5.1.2 How to Use this Chapter

An off-site 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 on-site drainage facilities, the County may require a qualitative analysis further downstream, mitigation measures, or a quantitative analysis.

Existing off-site 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 Off-site 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 on-site and off-site basin upstream and downstream for the site shall be provided. The basin map shall be to a defined scale and must show the receiving water body. 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.

The project engineer shall make a finding on the downstream conveyance suitability to accept flows from the proposed project based on 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.
4. Historic groundwater flooding based 1996 infrared flood photos.

The design engineer shall physically inspect the existing on-site and off-site 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 on-site 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 $\frac{1}{4}$ 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 off-site 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 on-site 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 off-site 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

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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, Chapter II-1 of the Stormwater Management Manual for Western Washington (Ecology, 2019).

6.1.2 How to Use this Chapter

Clark County allows development and redevelopment projects to meet Minimum Requirement #2 by either using the standards of this Chapter or a SWPPP created to meet requirements of the Ecology Construction Stormwater General Permit.

Chapter 6 addresses preparing for and implementing a Construction Stormwater Pollution Prevention Plans (SWPPP). Use this chapter to develop a SWPPP and select BMPs to control erosion, sediment, and other pollutants during construction. Submit the Construction SWPPP according to the submittal requirements in [Sections 1.8](#). Projects disturbing less than 1 acre of land may use the Abbreviated Construction SWPPP in [Appendix 1-J](#) in lieu of using the instructions in this Chapter.

- [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.
- Alternately, the BMPs listed in 2019 SWMMW Volume II, Chapter 3 may be used to complete a SWPPP.

Optional: Applicants with large and engineered projects that will disturb less than one acre of land may prepare the Abbreviated Construction SWPPP in [Appendix 1-J](#) in lieu of using the instructions in this Chapter.

Applicants with projects that qualify for a Small Project submittal in accordance with [Section 1.7](#) should use the Stormwater Site Plan 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 2019 *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.

6.3 Stormwater Pollution Prevention Plan Development

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.

Use Sections 6.3, 6.4, and 6.5 if the project is not developing a SWPPP to meet requirements of the CSWGP.

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 off-site 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 off-site 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.

1. 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://www.nrcs.usda.gov/wps/portal/nrcs/surveylist/soils/survey/state/?stateId=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. Book 2 Appendix 2-A 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 infiltration or detention BMPs as one of the first steps in grading. Such facilities must function properly before constructing site improvements (e.g. impervious surfaces).
- If permanent infiltration BMPs 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 $\frac{1}{2}$ 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 must 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 BMP C241 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 rates in Element #3: Control Flow Rates.
- 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.
- Provide and maintain natural buffers around surface waters, direct stormwater to vegetated areas to increase sediment removal and maximize stormwater infiltration, unless infeasible.
- 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. Applicable BMPs include, but are not limited to: temporary and permanent seeding, sodding, mulching, plastic covering, erosion control fabrics and matting, soil application of polyacrylamide (PAM), the early application of gravel base on areas to be paved, and dust control.
- 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 off-site stormwater (run-on) or groundwater away from slopes and disturbed areas. Manage off-site 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 be sized to convey the flow rate calculated by one of the following methods:

Single Event Hydrograph Method: The peak volumetric flow rate calculated using 10-minute time step from a Type 1A, 10-year, 24-hour frequency storm.

OR

Continuous Simulation Method: The 10-year peak flow rate as determined by an approved continuous flow model with a 15-minute time step.

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 all 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 flow rate calculated by one of the following methods:
 - Single Event Hydrograph Method: The peak volumetric flow rate calculated using a 10-minute time step from a Type A, 10-year, 24-hour frequency storm.

OR

- Continuous Simulation Method: The 10-year peak flow rate as determined by an approved continuous flow model with a 15-minute time step.

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. The project proponent must:

- 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.
- Discharge wheel wash or tire bath wastewater to a separate on-site treatment system that prevents discharge to surface water, 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: recycled concrete stockpiles, 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 off-site or in designated concrete washout areas only. Do not wash out concrete truck drums or concrete handling equipment onto the ground, or into storm drains, open ditches, streets, or streams. Washout of small concrete handling equipment may be disposed of in a formed area awaiting concrete where it will not contaminate surface water or groundwater. Do not dump excess concrete on site, except in designated concrete washout areas. Concrete spillage or concrete discharge directly to groundwater or surface waters of the State is prohibited. Do not wash out to areas awaiting infiltration BMPs.
- Obtain written approval from the Department of Ecology before using chemical treatment other than CO₂ or dry ice, or food grade vinegar to adjust pH.
- Uncontaminated water from water-only based shaft drilling for construction of building, road, and bridge foundations may be infiltrated provided the wastewater

is managed in a way that prohibits discharge to surface waters. Prior to infiltration, water from water-only based shaft drilling that comes into contact with curing concrete must be neutralized until pH is in the range of 6.5 to 8.5 su.

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 CO₂
- [BMP C253](#): pH Control for High pH Water
- See [Book 3](#) – Source Control

6.4.10 Element #10: Control Dewatering

- 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 BMP C240 Sediment Trap or BMP C241 Sediment Pond.
- Discharge clean, non-turbid dewatering 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 dewatering 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 pond BMPs. 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 dewatering treatment or disposal options may include:
 - Infiltration.
 - Transport off-site 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.
- Phase development projects where feasible in order to prevent soil erosion and transporting of sediment from the site during construction. Revegetate exposed areas and maintain that vegetation as an integral part of the clearing activities for any phase.
- 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 must ensure all BMPs are inspected, maintained, and repaired as needed to assure continued performance of their intended function.
- 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:

- Reviewing the SWPPP for compliance with the 13 construction SWPPP elements and making appropriate revisions within 7 days of the inspection.
- 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.
- 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:
 - Site conditions including existing vegetative coverage, slope, soil type, and proximity to receiving waters.
 - Limit activities and the extent of disturbed areas.
 - Proposed erosion and sediment control measures.
 - 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:

- Routine maintenance and necessary repair of erosion and sediment control BMPs.
- 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.
- 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

The primary purpose of On-Site Stormwater Management is to reduce the disruption of the natural site hydrology by infiltrating rainfall. BMPs used to meet Minimum Requirement #5. On-Site Stormwater Management (LID) are permeable facilities susceptible to clogging.

- Protect all LID BMPs, including bioretention facilities, rain gardens and permeable pavements, 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.

- Maintain the infiltration capacity of LID BMPs by protecting against compaction 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.
- Permeable pavement fouled with sediments or no longer passing an initial infiltration test 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 6.1](#) 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 9](#).

[Table 6.2](#) 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 9](#).

Table 6.1 Source Control BMPs by SWPPP Element

		<div>Element Name</div> <div>Preserve Vegetation / Mark Clearing Limits</div> <div>Establish Construction Access</div> <div>Stabilize Soils</div> <div>Protect Slopes</div> <div>Stabilize Channels and Outlets</div> <div>Control Pollutants</div> <div>Maintain BMPs</div> <div>Manage the Project</div> <div>Protect Low Impact Development BMPs</div>									
▼ 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 6.2 Runoff Conveyance and Treatment BMPs by SWPPP Element

▼ BMP	Element No. ►	<div> <div>Element Name</div> <div>Control Flow Rates</div> <div>Install Sediment Controls</div> <div>Protect Slopes</div> <div>Protect Drain Inlets</div> <div>Stabilize Channels and Outlets</div> <div>Control Pollutants</div> <div>Control Dewatering</div> <div>Protect Low Impact Development BMPs</div> </div>							
		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.

Book | References

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Book I Appendices

Appendix 1-A	Glossary
Appendix 1-B	Basin Plans
Appendix 1-C	Infiltration Tests
Appendix 1-D	Prairie Map
Appendix 1-E	LID Feasibility Checklist
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Appendix I-A

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.

Administrator The local government official(s) authorized to make decisions in regard to Adjustments and Exceptions/Variations.

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.

ADT Average Daily Traffic

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.
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. Ecology-approved models are listed in the Additional Resources pages for the on-line 2019 SWMMWW.
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	<p>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:</p> <ul style="list-style-type: none"> • 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

	<p>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.</p>
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	<p>Engineered vegetated <u>stormwater</u> facilities that <u>provide Runoff Treatment store and treat stormwater</u> by passing it <u>stormwater</u> through a specified soil profile (<u>Bioretention Soil Mix, or BSM</u>), and <u>typically</u> either retain or detain the treated stormwater for f <u>Flow attenuation Control</u>. <u>Bioretention facilities include a variety of plant material including trees, shrubs, grasses, and/or other herbaceous plants adapted to the local climate and soil moisture conditions. Bioretention is typically implemented as an LID practice, and as such is typically sited to receive stormwater runoff from a small contributing area.</u> Refer to Book 1, Chapter 3; and Book 2, Chapter 1 for Bioretention BMP types and design specifications.</p>
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, below.
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 , below.
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 Book 2). 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.
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	<p>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:</p> <p>Well drained - Excess water drains away rapidly and no mottling occurs within 36 inches of the surface.</p> <ul style="list-style-type: none"> • 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 fully dispersed through at least one hundred feet of native vegetation in accordance with 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) all runoff from the impervious surfaces is infiltrated (i.e. 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	<p>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.</p> <p>The engineered soil/plant system shall have the following characteristics:</p> <ol style="list-style-type: none"> Be protected from compaction and erosion. Have a plant system to support a sustained soil quality. 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. 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 flocules 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: <ul style="list-style-type: none"> 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 is licensed by the state of Washington to practice geology,
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:

	<ul style="list-style-type: none"> • 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.

Type A: 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.

Type B: 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.

Type C: 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	<p>A non-vegetated surface area <u>that-which</u> 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.</p> <ul style="list-style-type: none"> • <u>For purposes of determining whether the thresholds for application of Minimum Requirements are exceeded, Θ 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/ <u>or</u> detention facilities BMPs shall be considered impervious surfaces for purposes of runoff modeling.</u> • <u>When an underdrain (not intended to infiltrate) is used below an artificial turf surface, that surface shall be considered (and modeled) as impervious surface.</u>
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.
Indirect discharge	A stormwater discharge to the MS4 through a man-made-conveyance not owned or operated by Clark County.
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 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, <u>Leguminosae</u> , 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: $\text{Inflow} - \text{Outflow} = \text{Change in storage}$.
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 Book 4. See also Pavement Maintenance Exemptions in Book 1, Chapter 1.

Manning's equation	<p>An equation used to predict the velocity of water flow in an open channel or pipelines:</p> $V = \frac{1.486R^{2/3}S^{1/2}}{n}$ <p>where:</p> <p>V is the mean velocity of flow in feet per second</p> <p>R is the hydraulic radius in feet</p> <p>S is the slope of the energy gradient or, for assumed uniform flow, the slope of the channel in feet per foot; and</p> <p>n is Manning's roughness coefficient or retardance factor of the channel lining.</p>
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	<p>Derived as follows:</p> <ol style="list-style-type: none"> (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	<p>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.</p>
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.
<u>New hard surface</u>	<p><u>A surface that is:</u></p> <ul style="list-style-type: none"> • <u>Upgraded from dirt to gravel, a bituminous surface treatment (“chip seal”), asphalt, concrete, permeable pavement, a structure with a vegetated roof, or an impervious structure; or</u> • <u>Upgraded from gravel to chip seal, asphalt, concrete, permeable pavement, a structure with a vegetated roof, or an impervious structure; or</u> • <u>Upgraded from chip seal to asphalt, concrete, permeable pavement, a structure with a vegetated roof, or an impervious structure.</u> <p><u>Note that if asphalt or concrete has been overlaid by a chip seal, the existing condition should be considered as asphalt or concrete.</u></p>
Nitrate (NO₃)	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.
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 <i>Technical Release No. 55: Urban Hydrology for Small Watersheds, 1986</i> . 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	<u>Development and mitigation techniques that serve to infiltrate, disperse, and retain stormwater runoff on a project site.</u> 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	<p>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.</p> <p>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.</p>
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 (as defined in this manual) ; 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 artificial turf or any pervious non-impervious surface subject to vehicular use (as defined in this manual) , 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, <i>Ledum groenlandicum</i> (Labrador tea), <i>Drosera rotundifolia</i> (sundew), and <i>Vaccinium oxycoccos</i> (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; or to The proposed action of a permit application or an approval, which <u>that</u> requires drainage review.
Project site	That portion of a property, properties, or <u>and</u> 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	<p>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.</p> <p>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.</p>
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 <u>(i.e. exposing the top of)</u> the foundation and replaced . For other hard surfaces, the removal down to <u>(i.e. exposing the top of)</u> bare soil or base course and replacement.
Replaced impervious surface	For structures, the removal <u>down to (i.e. exposing the top of) the foundation</u> and replacement of impervious surfaces down to the foundation . For other impervious surfaces, the removal down to <u>(i.e. exposing the top of)</u> 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 <i>Technical Release No. 55: Urban Hydrology for Small Watersheds, 1986</i> . 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 <i>Salmonidae</i> . 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 <i>Carex</i> (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. <u>A site may include multiple parcels and/or sections of right-of-way, if multiple parcels and/or sections of right-of-way are subject to the new development or redevelopment project.</u>
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 <u>topsoil</u> , <u>engineered soil/landscape system</u> , and <u>properly functioning soil system</u> .
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. <i>Structural source control BMPs</i> are physical, structural, or mechanical devices or facilities that are intended to prevent pollutants from entering stormwater. <i>Operational BMPs</i> are non-structural practices that prevent or reduce pollutants from entering stormwater. See Book 3 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

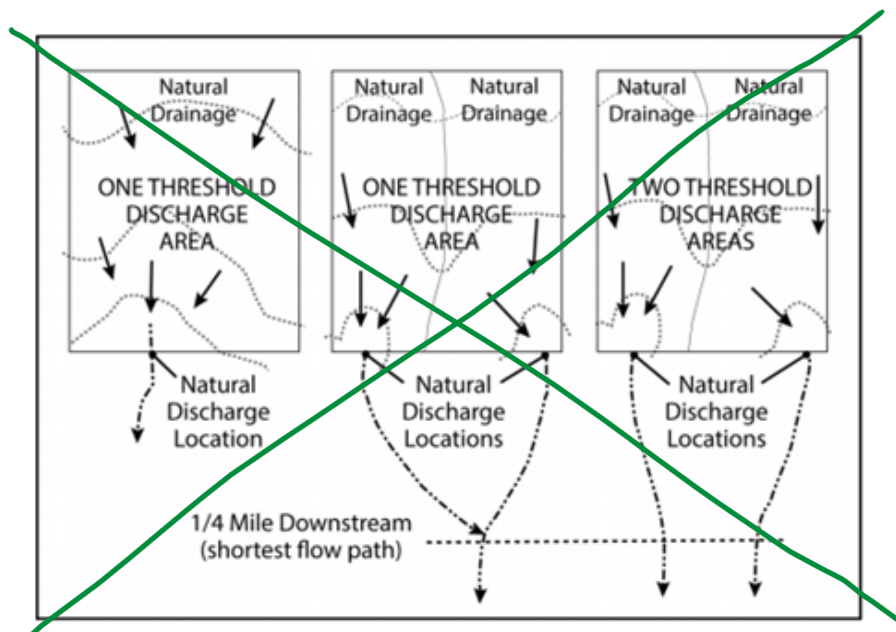
A constructed component of a stormwater drainage system, designed or constructed to perform a particular function, or multiple functions. Stormwater facilities include, but are not limited to, pipes, swales, ditches, culverts, street gutters, detention ponds, retention ponds,

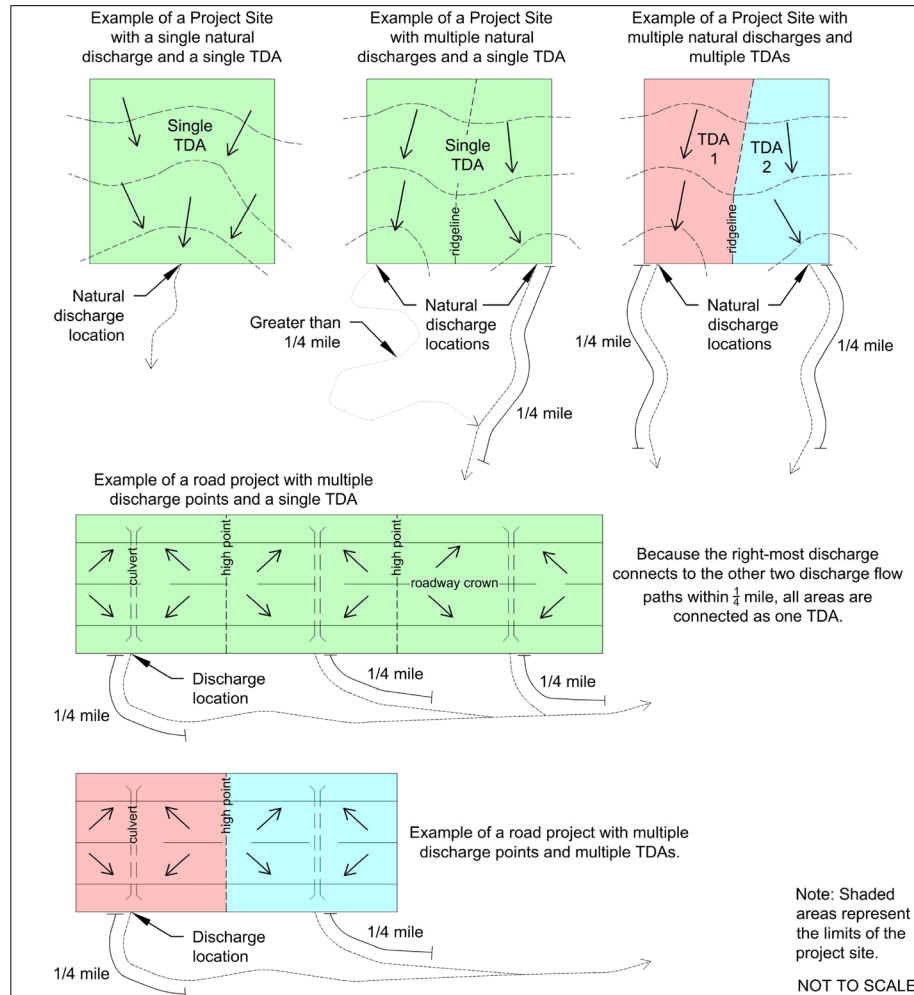
	constructed wetlands, infiltration devices, catch basins, oil/water separators, and biofiltration swales.
Stormwater Management Manual for Western Washington (SMMWW)	A manual, prepared by Ecology, that contains BMPs to prevent, control or treat pollution in stormwater and reduce other stormwater-related 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.
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: <ul style="list-style-type: none"> • Enclosing and/or covering the pollutant source (building or other enclosure, a roof over storage and working areas, temporary tarp, etc.).

	<ul style="list-style-type: none"> • 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.





(Figure courtesy Department of Ecology)

If the project site does not currently discharge at the natural location and is such that it is impractical (as determined by Clark County) to return the discharge to the natural location, then the TDA delineation would be based on the discharge(s) at the existing location(s). An example of this case is a site in an ultra urban environment, where fully built-out conveyance systems exist and are not in the natural (i.e. historic) locations.

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 life 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	<p>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, railway lines, including light rail elevated and non-elevated guideways/tracks, and airport runways and other surfaces intended for movement and/or storage of aircraft.</p> <p>The following are not considered subject to regular vehicular use: sidewalks not subject to drainage from roads for motor vehicles, 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.</p>
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 of 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 I-B

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 I-C

Infiltration Tests

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 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 1 shows the test configuration and relevant parameters.

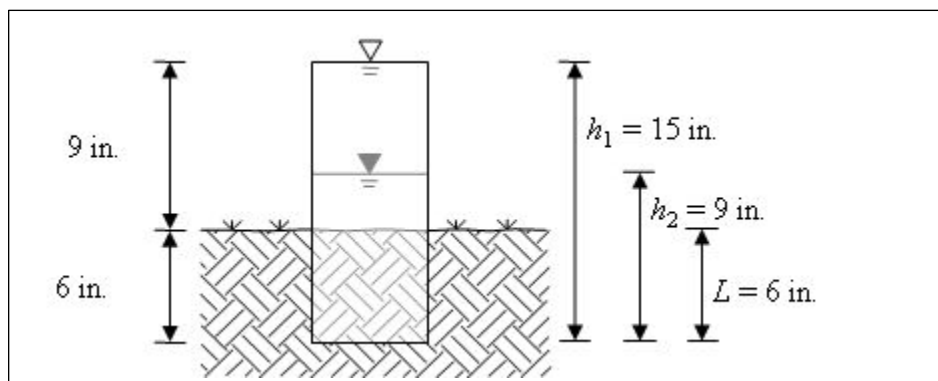


Figure 3: Single-Ring Falling Head Infiltration Test Procedure

(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 1. The coefficient of permeability obtained from Equation 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

$$k = (L/t) * \ln(h_1/h_2)$$

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 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 1. However, the test configuration, standpipe length, embedment depth, and other parameters may be modified by an experienced geotechnical professional, provided that Equation 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 2 shows the auger borehole test configuration and relevant parameters.

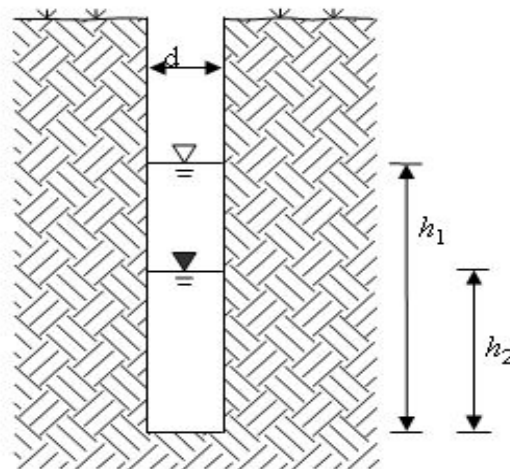


Figure 21: Single-Ring Falling Head Infiltration Test Procedure (Auger Borehole Method)

(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 2 (Lambe and Whitman 1969).

Equation 2 applies only for coefficient of permeability calculations using the auger borehole method. The value obtained from Equation 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)

h₁ = initial head (in)

h₂ = 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 3

$$\log_{10}(\text{COP}) = -1.57 + 1.90D_{10} + 0.015D_{60} - 0.013D_{90} - 2.08f_{\text{fines}}$$

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 4

$$K_{equiv} = \frac{d}{\sum \frac{d_i}{K_i}}$$

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 4 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 4.

Equation 4 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 4. Using the layer with the lowest COP is advised for designing bioretention facilities or permeable pavements. The harmonic mean given by Equation 4 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 I-D

Prairie Map



Appendix I-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 2.1) ☐ List #2 (Table 2.2) ☐ BMPs in (Table 2.3)

Section 2: Surfaces

☐ Roofs ☐ Hard surface 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 Surfaces	
	YES	NO	YES	NO
Feasibility Criteria and Setbacks				
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	
	YES	NO	YES	NO
Applicability and Setbacks				
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?				

Determination: Is this BMP feasible?

ROOF DOWNSPOUT FULL INFILTRATION BMPs T5.10A and T5.10B	Roof			
<u>Feasibility Criteria and Setbacks</u>	YES	NO		
Note: this BMP is not applicable to surfaces other than roofs.				
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?				
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RAIN GARDEN BMP T5.14A and BIORETENTION BMP T5.14B	Roof		Other Hard Surfaces	
	YES	NO	YES	NO
Infeasibility Criteria and Setbacks				
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?				
<i>[End soil / groundwater contamination sub-list.]</i>				
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 indicate 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?				
<i>The following require professional technical evaluation.</i>				
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 Surfaces	
<u>Feasibility Criteria and Setbacks</u>	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?				
<i>[End soil / groundwater contamination sub-list.]</i>				

Appendix I-E – LID Feasibility Checklist

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?				
If the area for permeable pavement would be a pollution-generating hard surface (e.g. roads, driveways, parking lots) does the soil underneath the proposed location <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?				
If 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?				

DOWNSPOUT DISPERSION BMP T5.10C	Roof			
<u>Setbacks</u>	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: The Responsible Official may consider reducing 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 Surfaces	
	YES	NO	YES	NO
Setbacks				
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?				

Appendix I-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 through 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

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

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 I-G

Legal Form Examples

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Inspection and Maintenance Example

COVENANT RUNNING WITH THE LAND

Grantor (owner): _____

Grantee: Clark County

Abbreviated Legal Description: _____

Assessor's Property Tax

Parcel/Account No(s): _____

Subdivision/Site Plan

Review Case No.: _____

A **Covenant** to Clark County, State of Washington, hereinafter "County," entered into in conjunction with the (Subdivision /Short Plat/Site Plan) Review # _____, of certain real property as more particularly described in Exhibit A, hereinafter "Site," whereby the owner(s) of said real property on behalf of themselves and all their heirs, assigns and successors in interest into whose ownership said property may pass, together hereinafter referred to as "Grantor," covenant to the County that it will have access to the stormwater facilities as shown on an expanded portion of the plat of _____, attached hereto and incorporated herein by reference as Exhibit B, hereinafter "Facilities."

Grantor herein covenants to Clark County and agrees 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. That it is the sole and exclusive owner of the Site.

2. This Covenant has three purposes: to ensure that the Facilities are inspected, maintained, and repaired, as necessary, by the parties identified in the Final Stormwater Plan for the Site as responsible for long-term maintenance; to ensure that the County is allowed access to the Facilities as shown on Exhibit B for both routine and emergency inspection of the Facilities for compliance with the Clark County Stormwater Manual, and Chapters 13.26A and 40.386, Clark County Code, as they may be amended and in effect at the time, or as they have been superseded; and to provide access to the County for emergency maintenance or repairs to prevent flooding or pollution of other properties.
3. If the parties responsible for long-term maintenance fail to maintain the Facilities to applicable 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 Clark County Stormwater Manual as in effect at the time, or requirements that have superseded that Manual. If these actions are not performed in a timely manner, the County may access the Facilities, perform necessary maintenance and repair, and bill the parties responsible for the maintenance in accordance with Title 32 CCC.
4. Nothing in this Covenant shall be construed to provide for public use of or entry into the 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.
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 the Site 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 Site 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 Site is annexed into a City, the enforcement and modification of the Covenant shall be transferred to the annexing jurisdiction upon the effective date of the annexation, after which Clark county shall not be required to review or sent to any modification or to be involved in any enforcement of the Covenant.

IN WITNESS WHEREOF, the parties hereto have caused this Covenant to be executed the day and year indicated below.

Dated this _____ day of _____, 20____. GRANTOR

GRANTOR

Entity name: _____

Entity name: _____

By: _____

By: _____

Print name _____

Print name _____

Print title _____

Print title _____

APPROVED AS TO FORM ONLY:

ANTHONY F. GOLIK, Prosecuting Attorney By:

Deputy Prosecuting Attorney

STATE OF WASHINGTON)

:SS

COUNTY OF CLARK)

I hereby certify that I know or have satisfactory evidence that _____
signed this instrument, and acknowledged it to be _____ free and voluntary act for the
uses and purposes mention in this instrument.

Dated: _____

Notary's Signature My

Appointment Expires:

Fencing Waiver Hold Harmless Example

RECORDING REQUESTED BY

AND WHEN RECORDED RETURN TO:

Public Works – Development Engineering
1300 Franklin Street

Post Office Box 9810
Vancouver, Washington 98660

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 _____ on certain real property described herein below whereby the owner _____ of said real property, hereinafter "Owner," on behalf on 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 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 their heirs, assigns and successors-in-interest into whose ownership the below described property might pass as follows, it being specified 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. Owner is seeking or has been granted permit approval for this 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 and other damages by any person because of the lack of fencing that the County would otherwise require.
4. Owner agrees to maintain the facility in compliance with the engineer approved plan attached as Exhibit "B".
5. Owner hereby assumes full responsibility for any injuries or damages suffered by any person or its property 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 indemnify 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 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 "____" and recorded prior to final plat or occupancy (for commercial site plans) approval by the County.
7. If any provisions of this Covenant or the application of any provisions to any person or circumstance is declared invalid, then the rest of the Covenant, or the application of the provisions 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.
8. This Covenant and all of its provisions shall be binding upon the Owner and any and all their heirs, assigns and successors-in-interests into whose ownerships 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 _____, 20 _____

OWNER:

BY: _____

NAME: _____

TITLE: _____

Approved as to form:

Chris Horne
Chief Civil Deputy Prosecuting Attorney

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 use and purpose mention in this instrument.

Dated: _____

By:

Notary's Signature

My Appointment Expires:

Single Family Residential Stormwater
COVENANT RUNNING WITH THE LAND

Grantor(owner):

—

Grantee:

Clark County

Abbreviated Legal Description

(SE 1/4, S10, T4N, R1E):

—

Assessor's Property Tax

Parcel/Account No.:

—

Review Case No.:

—

A **Covenant** to Clark County, State of Washington, hereinafter "County", entered into in conjunction with review # _____ of certain real property as more particularly described in exhibit A, hereinafter "Site", whereby Grantor of said real property on behalf of all heirs, assigns and successors in interest into whose ownership the Site may pass, makes this covenant to the Grantee concerning the storm water facility shown in exhibit B. Both exhibits are incorporated herein by reference

Grantor covenants to Clark County on behalf of all persons or entities currently having ownership interest in the Site and all heirs, assigns and successors in interest into whose ownership the Site may pass, as follows, it being specifically agreed that this covenant runs with the land:

1. Grantor is the sole and exclusive owner of the Site and/or has authority to bind all persons or entities that have a known interest in the Site.
2. Grantor or any subsequent possessor of the Site will be responsible for inspection, maintenance of the full dispersion area as required by the Clark County Storm Water

Initials (_____)

SFR stormwater covenant

(Revised 11/2018)

Manual and Chapter 13.26A. of the Clark County Code.

3. Grantor or any subsequent possessor of the Site will ensure the County is allowed, with reasonable notice, access to the facilities for routine and emergency inspections regarding compliance with the Clark County Storm Water Manual and Chapter 13.26A of the Clark County Code.
4. Grantor or any subsequent possessor of the Site will ensure the County is allowed access with or without reasonable notice to the facilities for emergency maintenance and/or repair to prevent flooding or pollution of the Site or other properties.
5. The site must be maintained in native vegetation for full dispersion into native vegetation. If the Site is not maintained in accord with BMP T5.30A in the Clark County Storm Water Manual and Chapter 13.26A and this covenant, Clark County may enter the Site to perform the required maintenance and/or repair and bill the Property Owner pursuant to CCC 32.04.060.
6. Nothing in this covenant shall be construed to provide for public use of or entry onto the Site or into the facilities, except for representatives of Clark County authorized to make reasonable entry to administer this covenant.
7. This covenant and all of its provisions shall be binding upon Grantor and all heirs, assigns and successors in interest into whose ownership the Site may pass, and any obligations made herein by Grantor shall be enforceable against all heirs, assigns and successors in interest into whose ownership the Site may pass.
8. The provisions of this covenant are enforceable in law or equity by Clark County and its successors. In the event the Site is annexed into a City, the enforcement and modification of the covenant shall be transferred to the annexing jurisdiction upon the effective date of the annexation, after which Clark County shall not be required to review or consent to any modification or to be involved in any enforcement of the covenant.

ACKNOWLEDGEMENT OF CORPORATION

STATE OF WASHINGTON
COUNTY OF _____

On this _____ day of _____, 20____, before me appeared
_____ and _____, to me
known to be the President and Secretary, respectively, of _____,
the corporation that executed the foregoing instrument and acknowledged the said instrument to be
the free and voluntary act of and deed of said corporation, for the uses and purposes therein
mentioned, and on oath stated that _____ was authorized to execute the
instrument and that the seal affixed is the corporate seal of said corporation.

Witness my hand and seal the day and year first above written.

Notary Public in and for the State of WA,
My commission expires:

(Revised 11/2018)

Initials (_____)

SFR stormwater covenant

COVENANT RUNNING WITH THE LAND

Grantor (Owner): _____

Grantee: Clark County

Abbreviated Legal Description: _____

**Assessor's Property Tax
Parcel/Account No(s):** _____

**Subdivision/Site Plan
Review Case No.:** _____

A **Covenant** to Clark County, State of Washington, hereinafter "County," entered into in conjunction with the (Subdivision /Short Plat/Site Plan) Review #_____, of certain real property as more particularly described in Exhibit A, hereinafter "Site," whereby the owner(s) of said real property on behalf of themselves and all their heirs, assigns and successors in interest into whose ownership said property may pass, together hereinafter referred to as "Grantor," covenant to the County that it will have access to the stormwater facilities as shown on an expanded portion of the plat of _____, attached hereto as Exhibit B, hereinafter "Facilities" along with the instructions provided in the Operations and Maintenance Manual shown in Exhibit C. All exhibits are incorporated herein by reference.

Grantor herein covenants to Clark County and agrees 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. That it is the sole and exclusive owner of the Site.
2. This Covenant has three purposes: to ensure that the Facilities are inspected, maintained, and repaired, as necessary, by the parties identified in the Final Stormwater Plan for the Site as responsible for long-term maintenance; to ensure that the County is allowed access to the Facilities as shown on Exhibit B for both routine and emergency inspection of the Facilities for compliance with the Clark County Stormwater Manual, Chapters

- 13.26A, 40.385 and 40.386, Clark County Code, as they may be amended and in effect at the time, or as they have been superseded; and to provide access to the County for emergency maintenance or repairs to prevent flooding or pollution of other properties.
3. If the parties responsible for long-term maintenance fail to maintain the Facilities to applicable 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 Clark County Stormwater Manual as in effect at the time, or requirements that have superseded that Manual. If these actions are not performed in a timely manner, the County may access the Facilities, perform necessary maintenance and repair, and bill the parties responsible for the maintenance in accordance with Title 32 CCC.
 4. Nothing in this Covenant shall be construed to provide for public use of or entry into the 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.
 5. Grantor takes on the responsibilities discussed in Chapters 1.9.3.1 through 1.9.3.5 of the Clark County Storm Water Manual, along with the instructions provided in the Operations and Maintenance Manual prepared by the project engineer in accordance with the Clark County Storm Water Manual, attached hereto as “Exhibit C”.
 6. 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 the Site 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 Site may pass.
 7. The provisions of this Covenant are enforceable in law or equity by Clark County and its successors; provided, however, that in the event the Site is annexed into a City, the enforcement and modification of the Covenant shall be transferred to the annexing jurisdiction upon the effective date of the annexation, after which Clark County shall not be required to review or consent to any modification or to be involved in any enforcement of the Covenant.

COUNTY OF CLARK)

I hereby certify that I know or have satisfactory evidence that _____
signed this instrument, and acknowledged it to be _____ free and voluntary act for
the uses and purposes mention in this instrument.

Dated: _____

Notary's Signature My

Appointment Expires:

Acknowledgment of Corporation

STATE OF WASHINGTON COUNTY

OF _____

On this _____ day of _____, before me, the undersigned, a Notary Public in and for the State of Washington, duly commissioned and sworn, personally appeared _____ and

_____, to me known to be the _____ President and _____ Secretary, respectively, of

_____, the corporation that executed the foregoing instrument and acknowledged the said instrument to be the free and voluntary act of and deed of said corporation, for the uses and purposes therein mentioned, and on oath stated that _____ authorized to execute the said instrument and that the seal affixed is the corporate seal of said corporation.

Witness my hand and seal the day and year first above written.

.

Notary Public residing at _____

Printed Name: _____

My Commission Expires:

State of Washington

County of _____

On this _____ [date], before me personally came
_____ [owner or operator] to me known, who, being by me duly
sworn, did depose and say that she/he resides at _____
[address], that she/he is _____ [title] of
_____ [corporation], the corporation described in and which
executed the above instrument; that she/he knows the seal of said corporation; that the seal
affixed to such instrument is such corporate seal; that it was so affixed by order of the board
of directors of said corporation; and that she/he signed her/his name thereto by like order.

Notary Public residing at _____

Printed Name: _____

My Commission Expires:

REFERENCE:

[Statutory Authority: Chapter 90.76 RCW. 90-24-017, § 173-360-493, filed 11/28/90, effective
12/29/90.]

Guidance for Stormwater Plat Language

Glossary of terms

Stormwater Facilities: any stormwater infrastructure.

Stormwater Treatment and Flow Control Facilities: a subset of grouped stormwater infrastructure designed for flow control and/or treatment. These are facilities designed to meet Minimum Requirements 6 and 7 in the Clark County Stormwater Manual.

Maintenance Easement, *when granted to multiple lot owners or HOA*, provides for access for long-term operation including inspection, maintenance and repair.

Maintenance Easement, *when granted to Clark County*, provides for county access to public infrastructure outside the public right-of-way for long-term operation including inspection, maintenance and repair.

Inspection Easement: granted to Clark County. Applies only to privately operated treatment and flow control facilities located in private maintenance easements or private tracts. The county is granted an inspection easement to regularly inspect for proper function. Routine long-term operation and maintenance obligations remain with the private party named as stormwater tract owner or named in the corresponding maintenance easement note. The easement also grants county access to perform permit-compliance or emergency repairs or maintenance, to be billed to the stormwater tract owner.

Dedicated to and *Conveyed to* are terms used when donating a tract of land to a specific entity for ownership. The tract owner is responsible for long-term maintenance and operation of the specified stormwater infrastructure.

Granted to is the term used when allowing specified parties access within an easement on private property.

General Rules

Tracts

- Tracts containing stormwater treatment/flow control structures: each such stormwater tract needs to be assigned ownership, typically either Clark County or a subdivision homeowner's association. Generally, if an HOA has been formed, a stormwater tract should not have ownership described as multiple lot owners; rather, ownership should be in the name of the HOA. In the absence of an HOA, a stormwater tract may be owned jointly and severally by multiple lot owners. An individual should generally not be the named owner.

Platted Easements

- All maintenance easements must in some fashion state the purpose of the easement, the responsible party and, where applicable, that the county has access for inspection purposes.
- The terms “private easement” and “public easement” are to be avoided.
- Easements containing stormwater treatment/flow control structures:
 - all such portions or assemblages of infrastructure that are not on county property or county right-of-way are to be privately owned and maintained. The easement will be granted to the party or parties responsible for maintenance and operation of the infrastructure. Additionally, an inspection easement must be granted to Clark County.
- Easements containing stormwater conveyance:
 - no easement is required for stormwater infrastructure serving only one lot and located on that lot. That infrastructure will be the responsibility of the lot owner.
 - an easement **is** required for stormwater infrastructure serving two or more lots. The easement needs to name the responsible party or parties, either an HOA or specific lot owners.
 - if a stormwater conveyance system does not either originate from public infrastructure, or connect both upstream and downstream with public infrastructure, there will be no easement granted to Clark County.
 - When a stormwater conveyance system that will be the responsibility of Clark County is placed on or across private property, a 20 foot wide easement (for access, maintenance, inspection and repair) is required (or alternate width if allowed by code). A note must appear that states a maintenance easement is granted to Clark County.

Specific language for Side Notes

- *STORMWATER NOTES, GENERAL (required on all plats)*

All stormwater facilities outside of county right-of-way and not located on county property shall be privately owned and maintained unless otherwise noted.

All private stormwater facilities serving only a single lot shall be the responsibility of the individual lot owner.

- *WHEN THERE IS PRIVATE STORMWATER INFRASTRUCTURE SERVING MULTIPLE LOTS*

A stormwater maintenance easement is granted to .*

- *WHEN PRIVATE TREATMENT AND/OR FLOW CONTROL FACILITIES ARE LOCATED IN AN EASEMENT*

A stormwater maintenance easement is granted to Clark County.

. * Also an inspection easement is granted to

○ *WHEN TREATMENT AND/OR FLOW CONTROL FACILITIES ARE LOCATED IN
A TRACT OF LAND SET ASIDE FOR STORMWATER PURPOSES*

IF TRACT IS TO BE COUNTY OWNED:

Stormwater Tract “ ” is dedicated to Clark County.

IF TRACT IS TO BE OWNED BY AN HOA OR SPECIFIC LOT OWNERS:

Stormwater Tract “ ” is dedicated to * An inspection easement is granted to Clark County.

Map Easement Notes

Easement notes on the map itself may be shortened to state only a stormwater easement exists along with its width, but only when there is also a reference to a clarifying plat note.

Example:

→ ← 20' stormwater easement. See note 3.

Referencing the following plat note:

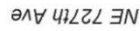
3. *A stormwater maintenance easement is granted to the H.O.A. Also an inspection easement is granted to Clark County.*

Please see attached sample plat for more examples.

*homeowners association or specified lot owners.

1. ALL STORMWATER FACILITIES OUTSIDE OF COUNTY RIGHT-OF-WAY AND LOCATED ON COUNTY PROPERTY SHALL BE PRIVATELY OWNED AND MAINTAINED UNLESS OTHERWISE NOTED.
2. ALL PRIVATE STORMWATER FACILITIES SERVING ONLY A SINGLE LOT SHALL BE THE RESPONSIBILITY OF THE INDIVIDUAL LOT OWNER.
3. A STORMWATER MAINTENANCE EASEMENT IS GRANTED TO THE H.O.A.
4. A STORMWATER MAINTENANCE EASEMENT IS GRANTED TO THE H.O.A. ALSO AN INSPECTION EASEMENT IS GRANTED TO CLARK COUNTY.
5. STORM TRACT "A" IS DEDICATED TO CLARK COUNTY.
6. STORM TRACT "B" IS DEDICATED TO THE HOMEOWNERS ASSOCIATION. ALSO AN INSPECTION EASEMENT IS GRANTED TO CLARK COUNTY.
7. TRACT "C" IS DEDICATED TO THE HOMEOWNERS ASSOCIATION FOR USE AS PRIVATE ROADWAYS. ACCESS EASEMENTS ARE GRANTED TO LOTS 21 THROUGH 50 TO THE HOMEOWNERS ASSOCIATION. ALSO AN INSPECTION EASEMENT TO STORM TRACT "B" IS GRANTED TO CLARK COUNTY ACROSS TRACT "C".

AUTIDOR'S CERIFICATE



NE 946th Street





Appendix I-H:

Wetland Protection Guidelines

I-H.I Scope and Principles for Wetland Protection

Purpose

These guidelines are intended to prevent diminishment of the functions and values of wetlands by avoiding alterations to the structural, hydrologic, and water quality characteristics of existing wetlands to the extent feasible during new development, redevelopment, and stormwater management projects.

New development, redevelopment, and stormwater management projects may decrease the function and value of a wetland by:

- Increasing the amount of water flow discharged to a wetland.
- Decreasing the amount of water flow discharged to a wetland.
- Increasing the amount of pollutants discharged to a wetland.

These decreases to wetland functions can happen even if the wetland is not physically altered for development or stormwater management purposes.

Wetland Rating System

A wetland identified as a receiving water of a project needs to be rated using the *Washington State Wetland Rating System for Western Washington: 2014 Update* ([Hruby, 2014](#)) to determine its category and habitat score.

Wetlands in Washington State differ widely in their functions and values. The Washington State Wetland Rating System categorizes wetlands into four categories (I, II, III and IV) based on their sensitivity to disturbance, their rarity, our ability to replace them, and the functions they provide. Category I is the highest rated wetland and the most sensitive to disturbance and Category IV wetlands are the lowest rated, based on relatively low functions and values.

This Appendix uses categories and habitat scores for wetlands to determine the level of protection necessary to reduce the risk of loss of wetland functions and values.

The rating system does not replace a full assessment of wetland functions that may be necessary if wetlands are impacted and mitigation permits are required.

For more information on the wetlands rating system refer to the following webpage:

<https://ecology.wa.gov/Water-Shorelines/Wetlands/Tools-resources/Rating-systems>

Regulatory Authority

Wetlands are Waters of the State as defined under [Chapter 90.48 RCW](#), Surface Waters of the State under Chapter 173-201A WAC, and may be Waters of the U.S. according to the 2015 Clean Water Rule and regulated under the Clean Water Act. This Appendix does not include guidance for wetland delineation, assessment, permitting, or restoration.

Clark County Code Chapter ~~40.440~~ 40.450 regulates development projects within wetland and wetland buffers. Other state and federal agencies may also have jurisdiction over projects affecting wetlands, in particular, the U.S. Army Corps of Engineers.

Wetland Protection Levels

The level of protection required for existing wetlands is based on the wetland category, habitat score, and the wetland characteristics.

The levels of wetland protection outlined in this Appendix include:

- [I-H.2 General Protection](#)
- [I-H.3 Protection from Pollutants](#)
- [I-H.4 Wetland Hydroperiod Protection](#)

Information needs

The following information is needed to assess the impacts and risks to wetlands, and to determine the necessary protection level.

1. Size, boundary, and characteristics of the proposed project site, wetland contributing drainage area, and the wetland and its buffer.
2. Following Ecology's *Wetland Rating System for Western Washington: 2014 Update* ([Hruby, 2014](#)) determine:
 - a. Wetland type.
 - b. Wetland category.
 - c. Wetland habitat score.
3. Presence of rare, endangered, threatened, or sensitive species.
4. Presence of breeding populations of native amphibian species.
5. Use an approved continuous flow simulation model.
 - a. If the TDA Thresholds for Book 1, Section 1.5.7.2 MR #7 Flow Control are triggered, the project proponent may also need wetland field monitoring data if access to the wetland is legally available (See [I-H.5 Wetland Hydroperiod Data Collection and Evaluation Procedures](#)).

I-H.2 General Protection

All wetlands (Categories I, II, III and IV) must receive the following general protection:

1. Consult regulations issued under federal and state laws that regulate the discharge of pollutants to surface waters, including the Construction Stormwater General NPDES Permit.
2. Maintain the wetland buffer required by county and/or state and federal regulations.
3. Retain areas of native vegetation connecting the wetland and its buffer with nearby wetlands and other contiguous areas of native vegetation.
4. Avoid compaction of soil and introduction of invasive plant or animal species in the wetland and its buffer.
5. Take measures to avoid general physical impacts (e.g., littering and vegetation destruction). Examples are protecting existing buffer zones; discouraging access, especially by vehicles, by planting outside the wetland, and encouragement of stewardship and signage by landowners.
6. Any stormwater management practices, such as Runoff Treatment or Flow Control BMP implementation, must be done outside of the wetland buffer boundary, except limited circumstances where the wetland and/or buffer may be used for additional Runoff Treatment and/or Flow Control of stormwater (See [1-H.6 Compensatory Mitigation of Wetlands](#))
7. Discharge from a BMP or project site should be dispersed using a method to diffuse the flow before entering the wetland buffer.
8. Consider fences to restrict human access, but make sure it doesn't interfere with wildlife movement. They should be used when wildlife passage is not a major issue and the potential for intrusive impacts is high. When wildlife movement and intrusion are both issues, the circumstances will have to be weighed to make a decision about fencing. Check with the local and/or state agencies to determine if fencing would be allowed.

I-H.3 Protection from Pollutants

All wetlands (Categories I, II, III and IV) must receive the following protection from pollutants:

1. Provide Construction Stormwater BMPs as directed in [Book 1, Section 1.5.2 MR #2 Construction Stormwater Pollution Prevention Plan \(SWPPP\)](#) to prevent sediment and other pollutants from entering the wetland.
2. Provide Source Control BMPs as directed in Book 1, Section 1.5.3 [MR #3 Source Control of Pollution](#).
3. Provide On-Site Stormwater Management and use LID principles as much as practicable for the site, as directed in Book 1, Section 1.5.5 [MR #5 On-Site Stormwater Management](#). LID principles and practices will help meet other wetland hydroperiod protection criteria and provide additional habitat.
4. Provide Runoff Treatment BMPs as directed in Book 1, Section 1.5.6 [MR #6: Runoff Treatment](#) to treat runoff prior to entering the wetland and its buffer.

Note: If the thresholds for [MR #6 Runoff Treatment](#) are not met for a TDA, then it is not required to provide Runoff Treatment BMPs for that TDA to comply with [MR #8 Wetlands Protection](#).

If the wetland is a special characteristic wetland (such as mature or old growth forest wetlands, bogs, or wetlands of high conservation value), implement Runoff Treatment BMPs with the most advanced ability to control nutrient loads. Consider using Runoff Treatment BMPs with infiltration and active biological filtration.

I-H.4 Wetland Hydroperiod Protection

Protection of many wetland functions and values depends on maintaining the existing wetland's hydroperiod. This means maintaining the annual fluctuations in water depth and its timing as closely as possible. If a project triggers the requirements for Flow Control BMPs per the TDA Thresholds in [MR #7 Flow Control](#), the project must apply the following Wetland Hydroperiod Protection.

The Wetland Hydroperiod Protection is separated into two methods (Methods 1 and 2) that are dependent on the wetland category, and whether the project proponent has legal access to the wetland.

The first method requires a minimum one year of monitoring followed by continuous simulation modeling of the wetland stage (called Method 1). Method 1 shall be applied to the wetlands listed below.

- Category I or II depressional or riverine impounding (including special characteristics Category I or II) wetlands that the project proponent owns, or the project proponent has legal access to – for purposes of conducting monitoring in the wetland.

Method 1 takes into account wetland specific information and field data; therefore, it allows more detailed evaluation of effects of stormwater on wetland functions. In cases where the project proponent neither owns nor has legal access to the Category I or II wetlands receiving stormwater from a proposed project, Method 2 shall be used.

Method 2 uses a site discharge volume model to evaluate hydrologic changes in a wetland, with no additional wetland monitoring requirement. Method 2 shall be applied to the wetlands listed below.

- Category I or II wetlands that are off-site or the project proponent doesn't have legal access to conduct monitoring in the wetland,
- Category I or II riverine, slope or lake-fringe wetlands,
- Category III and IV wetlands with habitat score greater than 5,
- Category III and IV wetlands that provide habitat for rare, threatened, endangered or sensitive species,
- Category III and IV wetlands that contain a breeding population of any native amphibian species.
 - If the wetland has permanent or seasonal ponding or inundation, assume that it has a breeding population of native amphibians.
 - For seasonal ponding, if the wetland has surface ponding after May 1 of a normal water year or drier, assume that it has a breeding population of native amphibians.
 - See the Wetland Rating System for guidance on identifying field indicators.
 - Recent aerial images of surface water in the wetland during normal water year or drier year can also indicate presence of permanent or seasonal ponding.

Method 1: 1-yr Wetland Monitoring and Wetland Stage Modeling

Method 1 criteria and analysis is based on the presumption that a wetland has limited water level fluctuation and water holding capacity. The risk to the wetland will be minimal if the frequency and

duration of water level fluctuation (WLF) in the wetland and the WLF timing post project remain as similar to pre-project levels as possible. Therefore, the criteria sets limits on the frequency and duration of stage excursions (greater WLF than the pre-project level), as well as on overall WLF after development. The criteria were developed based on studies in *Wetlands and Urbanization, Implications for the Future* (Azous and Horner, 1997).

One water year (October 1 through September 30) of field monitoring will characterize the existing WLF and water holding capacity of the wetland, and it will be used to calculate the allowable WLF by the proposed development.

A hydrologic assessment to measure or estimate elements of the hydroperiod under pre-project and post-project conditions should be performed with the aid of a qualified scientist or wetland specialist.

Criteria for Method 1

The project proponent must meet the following six Method 1 criteria in order to comply with the Wetland Hydroperiod Protection requirements.

Criteria 1. Mean Monthly WLF Limit

- If the pre-project (monitored) mean monthly WLF for a given calendar month is < 15cm (0.49ft, 5.91inch), the post-project mean WLF of the wetland for that calendar month may increase to no more than 20 cm (0.66ft, 7.87inch).
- If the pre-project (monitored) mean monthly WLF for a given calendar month is \geq 15 cm (0.49ft, 5.91inch), the post-project mean monthly WLF of the wetland for that calendar month may increase by up to, but no more than, 5 cm (0.16ft, 1.97inch).
- Without one year of monitoring data, assume the pre-project mean monthly WLF for any month is \geq 15 cm (0.49ft, 5.91inch), and the post-project mean monthly WLF of the wetland for that calendar month may increase by up to, but no more than, 5 cm (0.16ft, 1.97inch).

Criteria 2. Mean Annual WLF Limit

- If the pre-project (monitored) mean annual WLF is < 15cm (0.49ft), the post-project mean annual WLF of the wetland may increase to no more than 20 cm (0.66ft, 7.87inch).
- If the pre-project (monitored) mean annual WLF is \geq 15 cm (0.49ft, 5.91inch), the post-project mean annual WLF of the wetland may increase by up to, but no more than, 5 cm (0.16ft, 1.97inch).
- Without one year of monitoring data, assume the pre-project mean annual WLF is \geq 15 cm (0.49ft, 5.91inch), and the post-project mean annual WLF of the wetland may increase by up to, but no more than, 5 cm (0.16ft, 1.97inch).

Criteria 3. Frequency of Stage Excursions

- The frequency of stage excursions of 15 cm (0.49ft, 5.91inch) above or below the pre-project stage must not exceed an annual average of six.

Criteria 4. Durations of Stage Excursions

- The duration of stage excursions of 15 cm (0.49ft, 5.91inch) above or below the pre-project stage must not exceed 3 days per excursion.

AND

- *For a Wetland that Provides Habitat for Native Amphibians:* The stage excursions above or below the pre-project stage must not exceed 8 cm (0.26ft, 3.15inch) for more than 1 day in any 30-day period between January 1 and May 31. The hydroperiod limits characterize wetlands inhabited by breeding native amphibians and apply to breeding zones during the period of January 1 through May 31. If these limits are exceeded, then amphibian breeding success is likely to decline.

OR

- *For a Peat Wetland:* The duration of stage excursions in the post-project scenario cannot be above the pre-project stage for more than 1 day in any year, and applies to all zones over the entire year. If this limit is exceeded, then characteristic bog or fen wetland vegetation is likely to decline.

Criteria 5. Total Dry Period Change

- The total dry period (when pools dry down to the soil surface everywhere in the wetland) must not increase or decrease by more than two weeks in any year between the pre-project and post-project scenarios.

Criteria 6. Perennial to Ephemeral or Seasonal Avoidance

- Alterations to watershed and wetland hydrology that may cause perennial wetlands to become ephemeral or seasonal post-project must be avoided.
- If modeled wetland stage indicates that the wetland is perennial, the dry period at the post-project scenario should not exceed 1 day in any year.

Additional guidance, as well as an excel template to assist with the calculations to verify compliance with Method 1 is provided in [I-H.5 Wetland Hydroperiod Data Collection and Evaluation Procedures](#).

Method 2: Site Discharge Modeling

An alternative way to predict the risk to the wetland hydroperiod from stormwater discharges is to assess the changes in total volume of flows into a wetland that result from the development project. The size of the wetland and its capacity are not known or needed to utilize Method 2. The risk to wetland functions will be assumed to increase as the total discharge volumes from the site into the wetland diverge from the pre-project conditions. The risk will be decreased if the divergence is smaller.

As stormwater generated at the project site passes through the wetland buffer, total discharge volumes from the site to the wetland are to be calculated at the outflow of the wetland buffer. The existing or required length and area of wetland buffer per local and/or state regulations around the wetland should be included as an element in the model under both pre-project (existing) and post-project scenarios.

Criteria for Method 2

The project proponent must ensure both of the following Method 2 criteria are met to comply with Wetland Hydroperiod Protection.

Criteria 1. Mean Daily Total Discharge Volumes from the Site

Total volume of water into a wetland on daily basis should not be more than 20% higher or lower than the pre-project volumes.

- Calculate the average of the total discharge volumes from the site for each day over the period of precipitation record in the approved model for pre- and post-project scenarios. There will be 365 (366 for a leap year) average daily values for the pre-project scenario and 365 (366 for a leap year) for the post-project. No day can exceed 20% change in volume.

Criteria 2. Mean Monthly Total Discharge Volumes from the Site

Total volume of water into a wetland on a monthly basis should not be more than:

- 20 45% higher or lower than the pre-project volumes for the months of October, November, and December.
- 15% higher or lower than the pre-project volumes for all remaining months (January through September).
- Calculate the average of the monthly total discharge volumes from the site for each calendar month over the period of precipitation record in the approved model for pre- and post-project scenarios. ~~No month can exceed 15% change in volume.~~

Summer Months Allowable Exception for Criteria 2: The exception for summer months (July, August, and September) may be an option for projects that are not able to meet the monthly basis criteria above. To utilize this exception, additional information about the wetland is necessary. It is important to note that this information may not be available, as it goes beyond what is required to complete the standard method 2 analysis. If that is the case, then the exception will not be an option for the project being analyzed.

If the only months that fail the monthly basis criteria above are July, August, and/or September, then complete the following for the failing month(s):

- Obtain information about the wetland size consistent with what is described in the Contour Data or Water Storage Capacity section of I-H.5 Wetland Hydroperiod Protection Data Collection and Evaluation Procedures.
- Determine the size of the entire contributing basin to the wetland.
- Determine the size of the pre-project area that has been contributing to the wetland

- Calculate the ratio of the project area to the contributing basin area and multiply by the 15 cm Mean Monthly WLF Limit. The calculated value represents the Mean Monthly WLF limit for the project being analyzed.
- Using the information about the wetland size and the monthly volume changes for the months that failed criteria 2, calculate the WLF for each specific month.
- Compare the two values. If the limit is not surpassed by the monthly change then the month passes. If it does not pass, then the month still fails.
- Repeat these steps for all months that failed the original criteria 2 analysis.

The guidance for implementing Method 2 and assessing the criteria above in the respective model is provided in I-H.5 Wetland Hydroperiod Data Collection and Evaluation Procedures.

Limitations

Method 2 may not result in complete protection of wetland functions and values as these criteria are based on risk to the resource rather than an actual understanding of the impacts. When applicable, Ecology recommends application of the Wetland Hydroperiod Protection with wetland-specific monitoring as described in Method 1.

I-H.5 Wetland Hydroperiod Data Collection and Evaluation Procedures

Method I

Field Monitoring and Data Collection

Field monitoring data of the wetland must be collected to determine the existing pre-project hydroperiod, which will then be compared to model outputs to verify compliance with the Hydroperiod Protection Criteria. Without one year of hydroperiod monitoring, the minimum allowable WLF change can be used (see Criteria for Method 1 in [I-H.4 Wetland Hydroperiod Protection](#) and [Steps to Verify Compliance with the Method 1 Hydroperiod Protection Criteria](#) below).

An Ecology approved continuous simulation model will be needed for data analysis. Relevant historic monitoring information can also inform the pre-project condition of the wetland. The following lists describe the minimum required wetland specific information in order to implement the Method 1 Wetland Hydroperiod Protection guidance.

1. Contour Data or Water Storage Capacity

Bathymetry, or wetland contours, is indicative of the water storage capacity of the wetland that will be used in the model simulation.

If possible, the bathymetry of the wetland should be surveyed. LIDAR data or GIS analysis may also be used to provide approximate wetland contours.

In the absence of bathymetry data, approximate the bathymetry using the permanent ponding area and assume that the storage will occur on top of that area. This resulting storage area will be lower than the actual area, providing a more protective model.

2. Hydroperiod Monitoring

Collect at least one year of water levels using either a crest stage gage or continuous water level loggers with one hour time steps in the wetland. Water levels should be collected at least monthly over a year.

Using the measurements of crest and instantaneous stage during a series of time intervals over a year, calculate water level fluctuation (WLF) between measurements.

Average base stage = (Instantaneous stage at the beginning of interval + Instantaneous stage at the end of interval)/2

3. Flow Monitoring

The goal of this monitoring is to construct a relationship in the model to simulate how flows will be released from the wetland for each given stage. A simplified monitoring approach may be appropriate for a simple wetland flow regime. For instance, where a well-defined outlet controls the outflows from a wetland, instantaneous monitoring of the outflow for the typical range of flows may be sufficient. In this simple case, a velocity and cross-section and stage monitoring at the outlet can be sufficient to create the relationship for the model. These measurements may be performed in

conjunction with the hydroperiod monitoring described above. Additional field visits timed with precipitation or dry periods may be necessary to ensure that the outflow relationship covers the range of modeled flows.

Ecology acknowledges that it can be challenging to determine the location(s) of flows to and from wetlands. In some cases, there will be a clear channel that is the source of the inflows and outflows, while in others, the water may disperse over a wide area. An alternative would be to gather nearly continuous (every 15 minute) rainfall data along with wetland stage data (hydroperiod monitoring) and adjust the storage and discharge rate within the model using these data. If the flow data or estimation in the model are not available, assume there is no surface outflow for the wetland (closed depression).

Chapter 8 of *Wetlands and Urbanization, Implications for the Future* ([Azous and Horner, 1997](#)) indicates that a complete wetland water balance includes precipitation, evapotranspiration, surface inflow, surface outflow, groundwater exchange, and change in wetland storage using a tipping-bucket gage and continuous flow measurements. The wetland assessment as part of this Method 1 needs to consider the more protective approach to develop that relationship. A scientist (e.g. wetland scientist or hydrologist) may determine that the groundwater flow is a significant characteristic of the outflow of the system. In this case the project proponent may need to determine the groundwater regime of the system.

Model Construction and Simulation

The project proponent should develop a stage-storage-discharge (SSD) table that represents the volume of water that ponds in the wetland and the flow rate of water that discharges from the wetland at a given stage.

Having a reliable SSD table that represents the wetland is essential to evaluate the effects of development in the model. Wetland bathymetry and contour data by field measurement or using equations to represent the volume-area-depth relations of wetlands and wetland flow monitoring data are critical to develop the SSD table for the wetland.

In the absence of actual wetland flow monitoring data, it may be possible to develop an SSD table for the wetland by combining the model simulated flows with the field data obtained on the wetland WLF (hydroperiod monitoring) data. This would require an iterative modeling process. The modeling iterations would involve manually changing the discharge rates in the SSD table until the resulting simulated WLF approach WLF from the field monitoring data. The project proponent or modeler should provide the details of how this estimated in its hydrologic assessment report, so that it can be reviewed by the local jurisdiction.

With an SSD table, the following are necessary for the model simulation to evaluate the discharge of development in the model and determine compliance with the Method 1 Wetland Hydroperiod Protection criteria.

- Pre-project condition land uses and associated acreage for the entire contributing area that drains to the wetland.
- Post-project condition land uses and associated acreage for the entire contributing area that drains to the wetland.

- Percentage of developing project area compared to total acreage of contributing area that drains to the wetland.

Pre-Project Simulation

1. Identify existing impervious and pervious surfaces that discharge to the wetland and use the model elements to represent the land use and associated acreage for all hydrologically contributing areas to the wetland.
2. Add the wetland buffer using the lateral flow soil basin or include it as part of the contributing area land use.
3. Connect the runoff from the contributing basin(s) including interflow and groundwater to the SSD table that represents the wetland.
4. Set the outflow of the wetland as the Point of Compliance (POC).

Post-Project Simulation

1. Identify anticipated impervious and pervious surfaces that discharge to the wetland and use the model elements to represent the land use and associated acreage for all hydrologically contributing areas to the wetland.
2. Identify any Flow Control BMPs in the contributing area draining to the wetland and use the appropriate model elements to represent these facilities.
3. Add the wetland buffer using the lateral flow soil basin or include it as part of the contributing area land use.
4. Connect the runoff from the contributing basin(s) (including the buffer) including interflow and groundwater to the same SSD table that was used in the pre-project scenario.
5. Connect flows from any Flow Control BMP elements through the downstream element(s) to SSD table that represents the wetland.
6. Connect any infiltration from Flow Control BMP elements to groundwater of SSD table (if applicable).
7. Set the outflow of the wetland as the POC.

The order of the steps above depends on the type of elements and their intended function and could change to be more representative of the contributing flow pathways to the wetland.

Once the model simulations are done for post and pre-project scenarios, export the SSD table stage data for the full period of record: daily, monthly and yearly average, and Max and Min stage.

These model outputs, together with monitored WLF, are to be used to verify compliance with the Method 1 Hydroperiod Protection Criteria in [I-H.4 Wetland Hydroperiod Protection](#).

Steps to Verify Compliance with the Method 1 Hydroperiod Protection Criteria

Ecology has provided an excel template to assist with the calculations in the steps below. The excel template may be downloaded from the interactive online version of the 2019 SWMMWW.

1) Calculate the Existing WLF of Wetland using Monitored Water Levels

Using the measurements of crest and instantaneous stage during a series of time intervals over a year, calculate water level fluctuation (WLF) between measurements.

Calculate mean annual and mean monthly WLF as the arithmetic averages of a year and each month for which data are available.

$$\text{Water level fluctuation (WLF)} = \text{Crest stage} - \text{Average base stage}$$

2) Estimate the WLF by Continuous Simulation of Stages in the Model

Using modeled daily, monthly and yearly stages (average, max and min) for the full period of record, calculate daily, monthly or annual WLF as follows:

$$\text{WLF} = \text{Max stage} - \text{average stage}$$

3) Calculate Allowable WLF change

Allowable WLF change by the proposed project is determined by two factors: Monitored WLF of the wetland, and the size of the proposed project relative to the wetland's contributing basin area.

Allowable WLF change for the proposed project is calculated as follows:

- If monitored WLF is < 15 cm (0.49 ft, 5.91 inch),
 - Allowable WLF change for the wetland (A) = 20 cm (0.66 ft, 7.87 inch) – monitored WLF
 - **Allowable WLF change for the proposed project** = A / percentage of development by proposed project in the contributing basin area.
- If monitored WLF for a given calendar month is ≥ 15 cm (0.49 ft, 5.91 inch),
 - Allowable WLF of the wetland (A) for that calendar month may increase by up to, but no more than, 5 cm (0.16 ft, 1.97 inch).
 - **Allowable WLF change for the proposed project** = 5 cm / percentage of development by proposed project in the contributing basin area.

For example, if the project develops 10 acres of a 100-acre basin (10 %), the project can cause no more than 10 % of total allowable WLF change in the wetland. If the total allowable WLF change for the wetland is 10 cm (0.32 ft, 3.94 inch), the allowable WLF change for the proposed site is 1.0 cm (0.032 ft, 0.394 inch).

4) Verify Compliance with the Criteria

Compare each modeled daily, monthly or annual WLF with the calculated allowable WLF (factored by percentage of development by proposed project in the contributing basin area). If any of the modeled WLF difference between pre-project and post-project scenarios exceeds the calculated allowable WLF change for the proposed project, it means the proposed project does not comply with Method 1 Wetland Hydroperiod Protection.

For criteria about durations and frequencies, assess individual modeled stage outputs to verify compliance.

Method 2

Model Construction and Simulation

When modeling, include the wetland buffer as the final element in both pre- and post-project scenarios, downstream of the project area including any Flow Control BMPs. The point of compliance (POC) should be assigned to capture the total (surface, interflow, and ground water) volume leaving the wetland buffer for both the pre-project and the post-project scenarios.

Pre-project simulation

1. Identify existing impervious and pervious surfaces that discharge to the wetland and use the model elements to represent these land areas.
2. Identify the wetland buffer area and use the lateral flow soil basin to represent the wetland buffer.
3. Connect the model elements to the wetland buffer ensuring that impervious land areas are connected to surface flows and that for any other model elements all flows (surface, interflow, and ground water) are connected.
4. Set the wetland buffer element as the most downstream element.
5. Set the POC at the outflow of the wetland buffer element including surface runoff, interflow, and ground water.

Post-project simulation

1. Identify anticipated post-project impervious and pervious surfaces that discharge to the wetland and use the model elements to represent these land areas.
2. Identify any Flow Control BMPs and use the appropriate the model elements to represent these facilities.
3. Identify the wetland buffer area and use the lateral flow soil basin to represent the wetland buffer.
4. Connect the model elements to the wetland buffer ensuring that impervious land areas are connected to surface flows and that for any other model elements all flows (surface, interflow, and ground water) are connected.
5. Connect any Flow Control BMP elements to the wetland buffer ensuring that surface flows are connected to surface water and any infiltration is connected to ground water.
6. Set the wetland buffer element as the most downstream element.
7. Set the POC at the outflow of the wetland buffer element including surface runoff, interflow, and ground water.

Once the model simulations are done for post and pre-project scenarios, verify compliance with the Method 2 Hydroperiod Protection Criteria.

Strategies to meet the Wetland Hydroperiod Protection Criteria

Consider the following strategies to minimize impacts on the wetland hydroperiod and to meet the criteria. The list is in order of preference:

- Increasing the retention of natural pervious cover.
- Reducing the level of development.
- Reducing the total amount of impervious surfaces.
- Increasing infiltration using on-site LID techniques.
- Increasing or maintaining larger wetland buffer zones.
- Increasing infiltration and/or storage capacity of Flow Control BMPs.

I-H.6 Compensatory Mitigation of Wetlands

It is always necessary to treat stormwater prior to discharge to a wetland and its buffer. Any required Runoff Treatment BMPs including the outlet structure must be provided outside of the wetland and its buffer boundaries. If outflow from a BMP or project site is concentrated, flow should be diffused prior to discharge into the buffer.

Compensatory Mitigation Required

When project proponents alter a wetland(s) as part of a Runoff Treatment and/or Flow Control BMP system, they must demonstrate that they have done everything possible to avoid and minimize impacts. Remaining impacts to wetland area and/or functions must be compensated according to Clark County Code Chapter ~~40.440~~ 40.450, state and federal regulations.

Compensatory Mitigation Not Required

Treated stormwater may be beneficial to wetlands that have been heavily disturbed by human activities and can improve wetland hydrologic functions. In these cases, when all of the solid bullet criteria below are met, hydrologic alteration of the wetland to meet the requirements of a Flow Control BMP/facility is allowed without compensatory mitigation. This alteration will be considered a hydrologic functional restoration activity.

- The wetland is rated Category III or IV.
- The wetland has a habitat score of 5 or less.
- The wetland does not provide habitat for rare, threatened or endangered species.
- The wetland does not contain a breeding population of any native amphibians.
- The hydrologic functions of the wetland can be improved by modification. Generally, this means that constraints exist within the wetland (or surrounding area) that have altered natural hydrologic processes. The constraints are described in Charts 4 & 5 in *Selecting Wetland Mitigation Sites Using a Watershed Approach* (Hruby et al., 2009).

Proponents must identify and address at least one of the following common constraints to document improvement of hydrologic functions:

- Surface water flows have been diverted away from the wetland by prior development. Surface/subsurface water flows could be directed to the site to augment hydrologic inputs.
- Ditches that artificially drain water from the wetland could be filled or plugged to retain water.
- Drain tiles that artificially drain water from the wetland could be broken or removed to retain water.
- Artificially placed fill that decreases surface water storage capacity could be removed to increase surface water storage capacity.
- Dikes or berms that prevent overbank flooding could be breached or removed.
- Outlet culvert that is lower than the surrounding topographic depression could have its invert elevation raised to increase surface water storage

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.
- The wetland lies in the natural route of water and the discharge follows the natural routing.
- Successful demonstration that no net loss of wetland function and value occurs as a result of the structural or hydrologic modifications.
 - This includes the impacts from the machinery used for the construction. Heavy equipment can damage the soil structure of a wetland.
 - When the functions and values of a degraded wetland are improved by project alterations, the project proponent must specify which project activities would thus be self-mitigating.
 - Check with the agency(ies) issuing the permits for the modification(s) to determine which method(s) and/or analyses to use to determine no net loss of wetland functions and values.
 - Functions and values that are not replaced on site will have to be compensated for elsewhere.

I-H.7 Jurisdictional Planning for Wetland Protection from Stormwater

Ecology recommends that local jurisdictions plan and manage their resources to protect overall wetland functions and values, including their role in stormwater management. See 2019 SWMMWW Appendix I-C for guidance.

I-H.8 Wetland Protection Definitions

The following terms are applicable only to this Appendix.

Buffer

The area (either upland, open water, or another wetland) that surrounds a wetland or watercourse and that reduces adverse impacts to the ecosystem functions and values from adjacent development.

Compensatory mitigation

The stage of the mitigation sequence where impacts to wetland functions are offset (i.e., compensated for) through creation (establishment), restoration (re-establishment, rehabilitation), or enhancement of other wetlands. Because regulatory requirements and policies tend to focus on compensatory mitigation, the term “mitigation” is often used to refer to compensation, which is just one part of the overall mitigation sequence.

Constructed wetland

A wetland intentionally created from a non-wetland site for the purpose of water treatment.

Degraded wetland

A wetland (community) whose functions and values have been reduced as a result of human activities. For example, a wetland 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.

Depressional wetland

Depressional wetlands occur in topographic depressions where the elevation of the surface within the wetland is lower than in the surrounding landscape. These wetlands often pond water at the surface but they can also be saturated without surface ponding.

Ephemeral wetland

Wetlands that temporarily hold water in the spring and early summer or after heavy rains. Periodically, these wetlands dry up, often in mid to late summer.

Estuarine wetland

Wetlands where salt tolerant plant species are dominant and the water regime is influenced by tidal action. The wetlands are usually partially enclosed by land with open, or partially obstructed access to open saline water. Salinity is greater than 0.5 ppt.

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; it encompasses the depth, frequency, duration, and seasonal pattern of inundation.

Invasive species

Nonnative organisms whose introduction causes or is likely to cause economic or environmental harm or harm to human, animal or plant health.

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.

Lake Fringe Wetlands

Lake Fringe wetlands are on the water side of the Ordinary High Water Mark (OHWM) of lakes where the area of open water next to a vegetated wetland is larger than 20 ac (8 ha), and more than 6.6 ft deep (2 m) over 30% of the open water areas.

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.

Peat Wetland

Unique, irreplaceable bogs and fens that can exhibit water pH in a wide range from highly acidic to alkaline, including fens typified by *Sphagnum* species, *Rhododendron 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.

Perennial Wetland

Wetlands where at least a portion of their area has permanent surface water (i.e., flooded or inundated throughout the year), in a normal water year or wetter.

Polishing

Additional treatment of a waste stream that has already received one or more stages of treatment by other means.

Rare, threatened, endangered, or sensitive species

Plant or animal species that are relatively uncommon regionally, are nearing endangered status, or whose existence is in jeopardy and is usually restricted to highly specific habitats.

Threatened, endangered or sensitive species are listed by federal or state authorities, whereas rare species are unofficial species of concern that fit the above definitions.

Regional

An action (here, for stormwater management purposes) that involves more than one discrete property.

Rehabilitation

The manipulation of the physical, chemical, or biological characteristics of a site with the goal of repairing natural or historic hydrologic functions and processes of a degraded wetland.

Rehabilitation results in a gain in wetland function but does not result in a gain in wetland area.

Riverine impounding wetland

Riverine impounded wetlands retain surface water significantly longer than the duration of the flood event. Riverine impounded wetlands tend to hold water for more than a week after a flood event. These wetlands are found in a topographic depression on the valley floor, or in areas where natural or human made barriers to downstream flow occur.

Riverine wetlands

Riverine wetlands occur in valleys associated with stream or river channels. They lie in the active floodplain of a river and have important hydrologic links to the water dynamics of the river or stream. The distinguishing characteristic of riverine wetlands in Washington is that they are frequently flooded by overbank flow from the stream or river.

Seasonal wetland

A wetland that has water above the soil surface for a period of time (usually between two months to less than one year) during and/or after the wettest season but in typical years dries to or below the soil surface in warmer, drier weather.

Slope Wetlands

Slope wetlands occur on slopes where groundwater surfaces and begins running along the surface, or immediately below the surface. Water in these wetlands flows only in one direction

(down the slope) and the gradient is steep enough that the water is not impounded. The downhill side of the wetland is always the point of lowest elevation in the wetland.

Stage excursion

A post-project departure, either higher or lower, from the water depth existing under a given set of conditions in the pre-development state.

Water Level Fluctuation (WLF)

This is a defining characteristic of a wetland. Water level fluctuation (WLF) during a monitoring interval is as follows:

Average base stage = (Instantaneous stage at beginning of interval + Instantaneous stage at end of interval)/2

Wetland 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 also be defined based 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.

Wetland structure

The physical components of a wetland, both the abiotic (physical and chemical) and biotic (living).

Wetland values

Wetland processes or attributes that are valuable or beneficial to society (also see Wetland 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 BMPs, 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.)

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Appendix I-I

Stormwater Site Plan Short Form

Stormwater Site Plan Short Form

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

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

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

Section I — Submittal Requirements

The following submittals are required:

- Project Overview (Section 2)
- Existing Conditions Summary (Section 3)
- Soils Assessment (see Section 4)
- Minimum Requirements Narrative (Section 5)
- Erosion and Sediment Control Plan (Section 6)
- Maps, Plans and Drawings (see Section 7)
- LID Feasibility Checklist, if required (Section 8)

Section 2 — Project Overview

County Permit

Building Permit Number(s): _____

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

Applicant Info

Name: _____

Address: _____

Phone Number: _____ E-mail: _____

Property Owner Info

Name: _____

Address: _____

Phone Number: _____ E-mail: _____

Property Info

Project Address: _____

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

Other Permits

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

Project Description

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

Current site condition and use: _____

Proposed site condition and use: _____

Project Impacts

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

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

Definitions of terms are shown on the following page.

Threshold Discharge Area ID _____	Square Feet
New hard surfaces	
• Roof	
• Driveway and parking area	
• Paved patio and other paved areas	
Replaced hard surfaces	
• Roof	
• Driveway and parking area	
• Paved patio and other paved areas	
Total New + Replaced Hard Surfaces	

Definitions

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

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

- For purposes of determining whether the thresholds for application of Minimum Requirements are exceeded, open, uncovered retention or detention BMPs shall not be considered as impervious surfaces. Open, uncovered retention or detention BMPs shall be considered impervious surfaces for the purposes of runoff modeling.
- When an underdrain (not intended to infiltrate) is used below an artificial turf surface, that surface shall be considered (and modeled) as impervious surface.

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

Pollution-generating Hard Surface (PGHS) – ~~Hard surfaces that are significant source of pollutants in stormwater runoff, such as those subject to vehicular traffic and industrial activities. Surfaces include roads, driveways, parking areas, most metal roofs, and areas that receive direct rainfall or run on and which are used to store erodible stockpiles, wastes, or chemicals.~~ Those impervious surfaces considered to be a significant source of pollutants in stormwater runoff. Such surfaces include those which are subject to: vehicular use (as further defined in this section); 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, nonleachable 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.

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

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

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

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

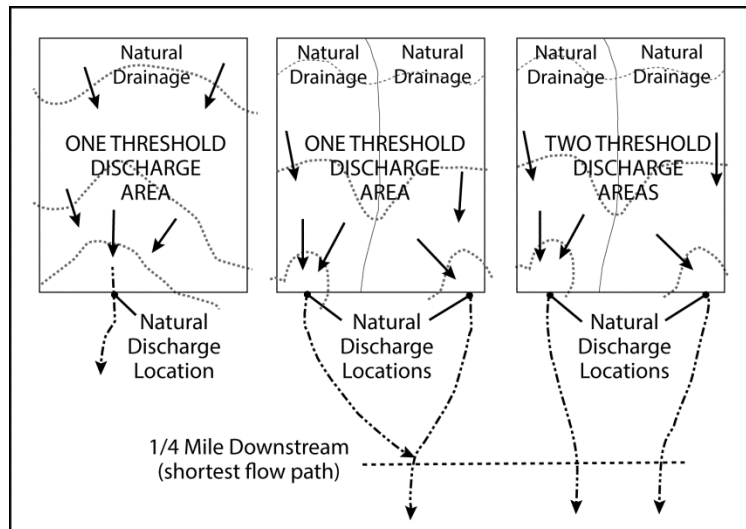



Figure 22: Threshold Discharge Area

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.

- | | | | |
|--------------------------------------|----------------------------------|----------------------------------|--------------------------------------|
| <input type="checkbox"/> Forest | <input type="checkbox"/> Prairie | <input type="checkbox"/> Pasture | <input type="checkbox"/> Pavement |
| <input type="checkbox"/> Landscaping | <input type="checkbox"/> Brush | <input type="checkbox"/> Trees | <input type="checkbox"/> Other _____ |


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

- | | | | |
|---|---------------------------------|--------------------------------------|--------------------------------------|
| <input type="checkbox"/> Overland | <input type="checkbox"/> Gutter | <input type="checkbox"/> Catch Basin | <input type="checkbox"/> Ditch/Swale |
| <input type="checkbox"/> Storm Sewer Pipe | <input type="checkbox"/> Stream | <input type="checkbox"/> 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)?

- | | | | |
|---|--------------------------------------|--|--|
| <input type="checkbox"/> Streams ⁶ | <input type="checkbox"/> Lakes/Ponds | <input type="checkbox"/> Wetlands ⁶ | <input type="checkbox"/> Steep Slopes/Geohazard ⁶ |
| <input type="checkbox"/> Floodplain | <input type="checkbox"/> Springs | <input type="checkbox"/> Habitat ⁶ | <input type="checkbox"/> Critical Aquifer Recharge Area |

- Existing utilities

⁶ If the site is on a critical area, Clark County may require additional information, engineering, or other permits.

☐ 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):

☐ Streams⁷ ☐ Lakes ☐ Wetlands⁷ ☐ Steep Slopes/Geohazards⁷
☐ Residential Areas ☐ Roads ☐ Ditches, pipes, culverts
☐ Other _____

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

⁷ If the site is adjacent to a critical area, Clark County may require additional information, engineering, or other permits.

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

Section 4 — Soils Assessment

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

If needed to design an LID BMP, obtain a Soils Assessment of the site performed by a qualified professional. Ask the qualified professional to fill out items 1 – 3, below, and attach a written report to this form.

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

I. Soil Description

A soil description is required for all sites.

- ☐ Soils on the site are described by a qualified professional in accordance with CCSM Book 1, Section 2.3.1.2, Soil Description.
- ☐ A Soils Report is attached.
- ☐ The project does not require depth to groundwater or infiltration rate testing to verify LID BMP feasibility.

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

2. Infiltration Rate Testing

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

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

- ☐ Infiltration rate testing N/A
- ☐ Infiltration rate testing conducted by a qualified professional in accordance with CCSM Book 1, Section 2.3.1.4, Infiltration Rate.
- ☐ Infiltration testing method, logs, results, and rates are attached or described in the Soils Report.

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

3. Groundwater Depth Assessment

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

- ☐ Ground depth water assessment N/A
- ☐ Groundwater depth assessment conducted by a qualified professional in accordance with CCSM Book 1, Section 2.3.1.5, Groundwater Assessment.
- ☐ Groundwater depth assessment attached or included with the Soils Report.

Section 5 — Minimum Requirements Discussion and Narrative

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

Generally, small projects must:

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

Minimum Requirements are discussed below.

Instructions

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

Minimum Requirement #1 — Preparation of a Stormwater Site Plan

Minimum Requirement

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

Documentation

☐ Stormwater Site Plan Short Form (this form)

Attachments (when required)

- ☐ Soils Assessment (see Section 4); ☐ N/A
- Groundwater Assessment: ☐ Attached ☐ N/A
- ☐ Erosion and Sediment Control Plan (see Section 6)
- ☐ LID Infeasibility Checklist, if required (see Section 8)

Drawings (see Section 7)

- ☐ Vicinity Map
- ☐ Existing Site Map
- ☐ Site Plan
- ☐ BMP Drawings
- ☐ Erosion and Sediment Control Site Plan

Minimum Requirement #2 — Erosion and Sediment Control during Construction

Minimum Requirement

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

Documentation

- ☐ Erosion and Sediment Control Plan (Section 6 of this form) completed
- ☐ Erosion and Sediment Control Site Plan included with required drawings (see Section 7)

Minimum Requirement #3 — Source Control of Pollution

Minimum Requirement

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

Description

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

Commercial Site Activities

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

- ☐ Manufacturing
- ☐ Transportation and Communication Business
- ☐ Retail and Wholesale Business
- ☐ Service Business
- ☐ Public Agency

Documentation

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

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

Minimum Requirement #4 — Preserve Natural Drainage Systems and Outfalls

Minimum Requirement

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

Documentation

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

Minimum Requirement #5 — On-site Stormwater Management

Minimum Requirement

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

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

Description

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

Documentation

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

Results of the Selection Process:

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

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

☐ Roofs will be constructed.

BMP Selected for Roofs: _____

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

BMP Selected for Other Hard Surfaces: _____

Selection

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

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

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

Lawn and Landscaped Areas

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

Roofs

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

1. Full Dispersion BMP T5.30A and BMP T5.30B or Downspout Full Infiltration BMP T5.10A and BMP T5.10B.
2. Rain Garden BMP T5.14A.
3. Downspout Dispersion BMP T5.10C.
4. Perforated Stub-out Connection BMP T5.10D

Other Hard Surfaces Such as Driveways, Parking Areas and Patios

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

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

Flow charts on the following pages illustrate the selection process.

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

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

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

Figure 2: BMP Selection Process for Roofs

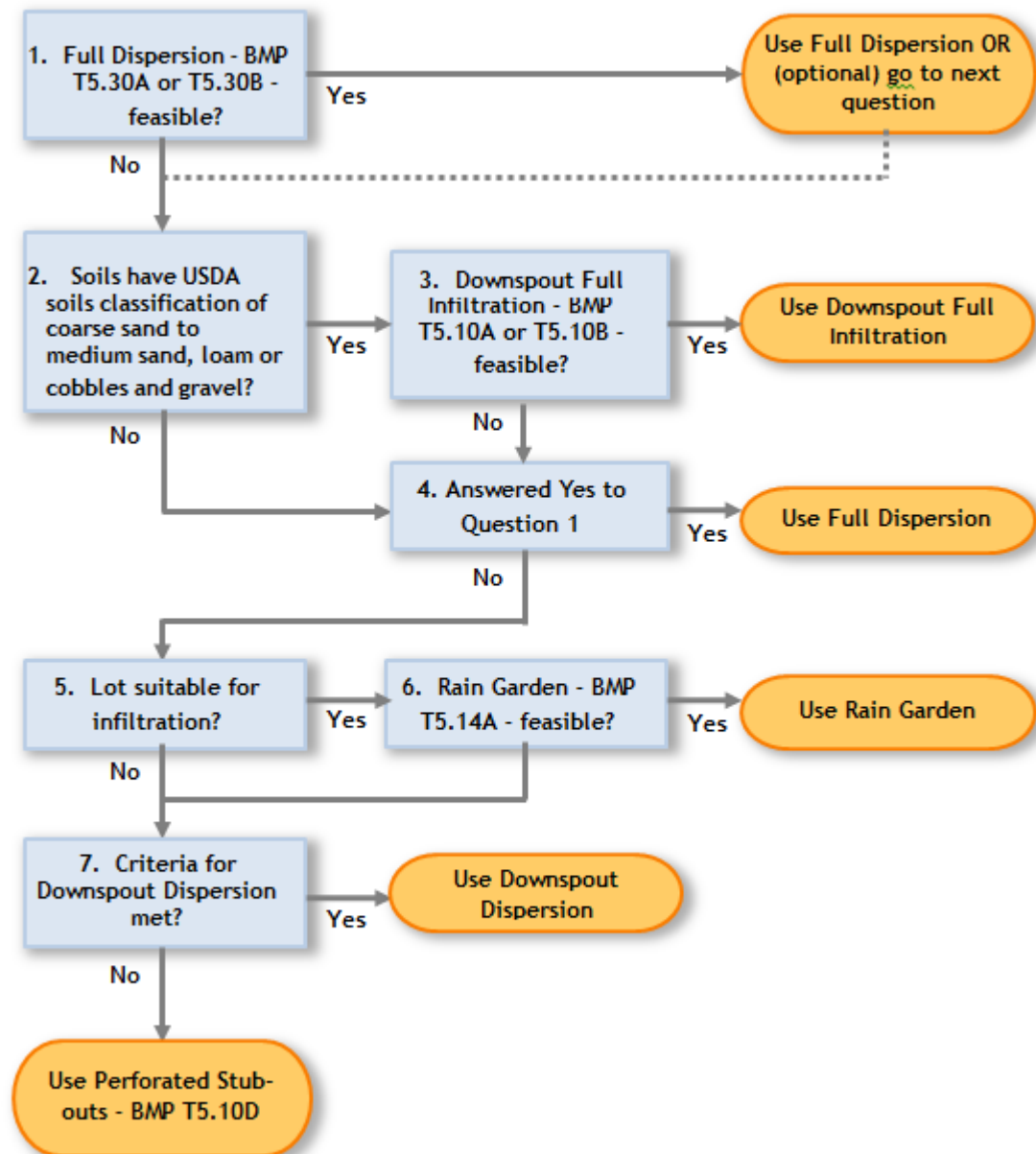
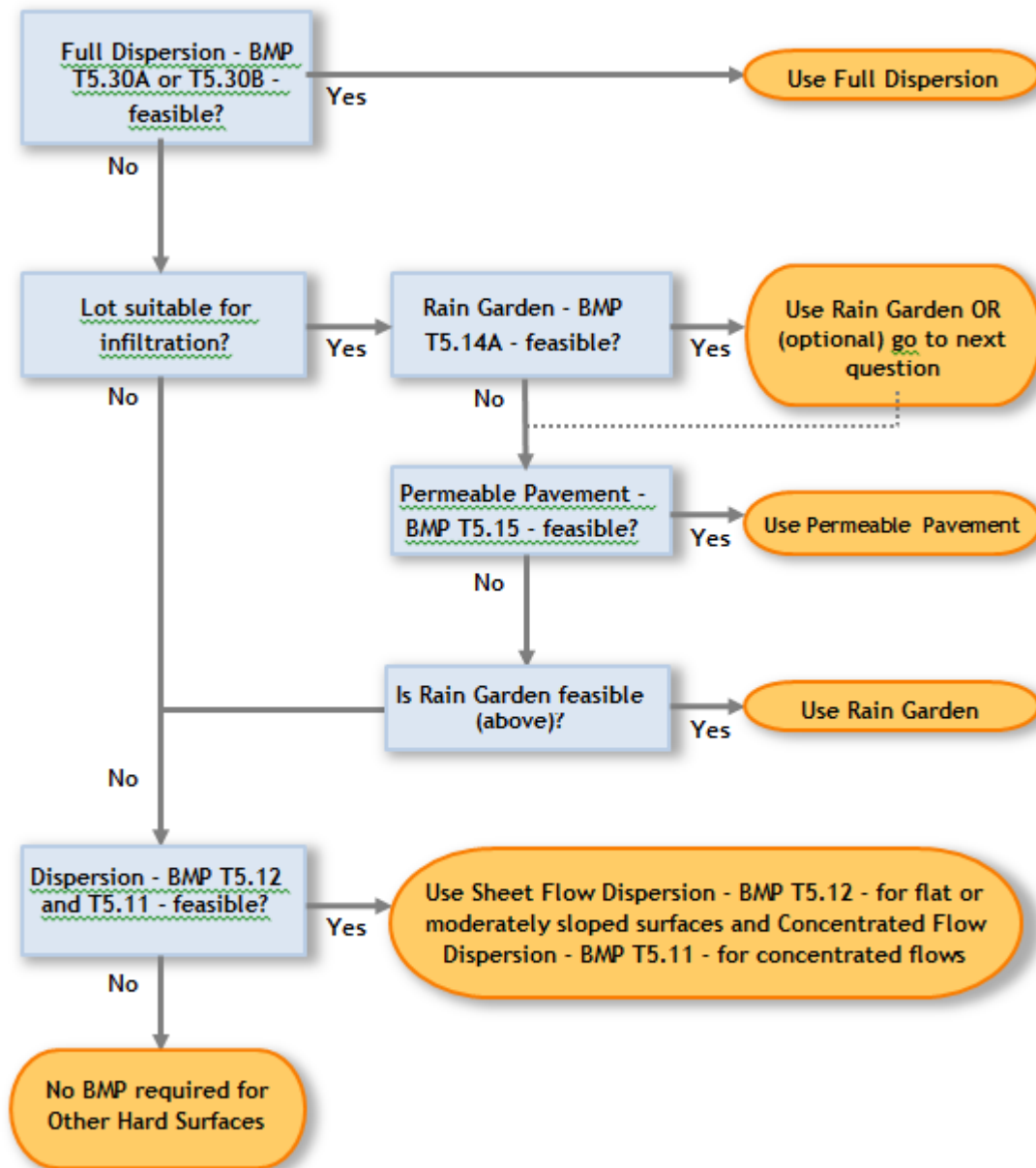


Figure 3: BMP Selection Process for Other Hard Surfaces



Section 6 — Erosion and Sediment Control During Construction

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

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

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

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

Instructions

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

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

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

Erosion and Sediment Control Narrative

Element #1 – Preserve Vegetation and Mark Clearing Limits

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

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

- ☐ C101 Preserving Native Vegetation
- ☐ C102 Buffer Zones
- ☐ C103 High Visibility Plastic Fence
- ☐ C233 Silt Fence

OR ☐ Element is N/A: _____

Element #2 – Establish Construction Access



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

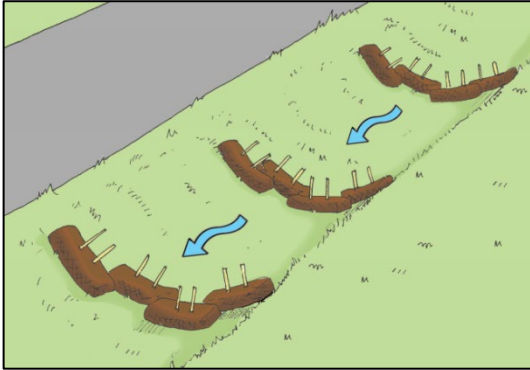
If sediment is tracked offsite, sweep or shovel it from the paved surface immediately.

The BMP being proposed to meet this element is:

- ☐ C105 Stabilized Construction Entrance

OR ☐ Element is N/A: _____

Element #3 – Control Flow Rates



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

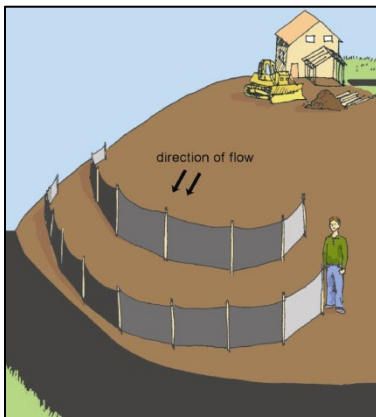
The BMP(s) being proposed to meet this element are:

☐ C207 Check Dams

☐ C235 Wattles

OR ☐ Element is N/A: _____

Element #4 – Install Sediment Controls



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

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

☐ C231 Brush Barrier

☐ C233 Silt Fence

☐ C234 Vegetated Strip

☐ C235 Wattles

☐ C233-A Bio-Filter Bags Sediment Barrier (for use only with Single Family Residential)

OR ☐ Element is N/A: _____

Element #5 – Stabilize Soils



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

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

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

- ☐ C121 Mulching
- ☐ C123 Plastic Covering
- ☐ C125 Compost

OR ☐ Element is N/A: _____

Element #6 – Protect Slopes

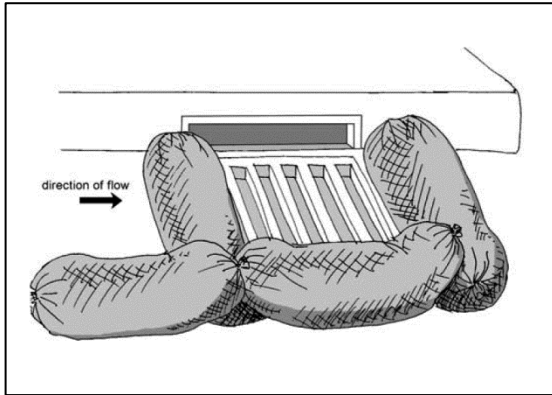
Protect slopes by diverting water away from the top of the slope and establishing vegetation on slopes.

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

- ☐ C203 Water Bars
- ☐ C207 Check Dams
- ☐ C208 Triangular Silt Dike

OR ☐ Element is N/A: _____

Element #7 – Protect Drain Inlets



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

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

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

☐ C220 Storm Drain Inlet Protection

OR ☐ Element is N/A: _____

Element #8 – Stabilize Channels and Outlets

Stabilize all temporary and permanent conveyance channels and their outlets.

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

☐ C207 Check Dams

☐ C209 Outlet Protection

OR ☐ Element is N/A: _____

Element #9 – Control Pollutants

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

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

☐ C150 Materials on Hand

☐ C151 Concrete Handling

OR ☐ Element is N/A: _____

Element #10 – Control Dewatering

If dewatering is needed, assess the condition of the pumped water. Clean, non-turbid dewatering water, such as groundwater, can be discharged to the stormwater system as long as it does not cause downstream erosion or flooding. Dirty or contaminated dewatering water must be filtered or may be discharged to the local sanitary sewer, if permitted.

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

☐ C203 Water Bars

OR ☐ Element is N/A: _____

Element #11 – Maintain BMPs

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

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

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

☐ C150 Materials on Hand

☐ C160 Certified Erosion and Sediment Control Lead

OR ☐ Element is N/A: _____

Element #12 – Manage the Project

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

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

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

☐ C160 Certified Erosion and Sediment Control Lead

OR ☐ Element is N/A: _____

Element #13 – Protect Low Impact Development BMPs

Protect LID BMPs from compaction, erosion, and sedimentation.

Bioretention and Rain Gardens

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

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

Permeable Pavement

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

Other LID BMPs

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

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


- ☐ C102 Buffer Zone
- ☐ C103 High Visibility Plastic Fence
- ☐ C207 Check Dams
- ☐ C208 Triangular Silt Dike
- ☐ C231 Brush Barrier

(list continues on following page)





- ☐ C233 Silt Fence
- ☐ C234 Vegetated Strip

OR ☐ Element is N/A: _____



Section 7 — Maps, Plans, and Drawings

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

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

1.  **Vicinity Map** — Mark the site on a vicinity map showing the nearest cross-streets; include a North arrow. See Figure 4 for an example.
2. **Existing Site Map** — See Figure 5 for an example. Show the following items:
 -  Address, parcel number, and street names
 - North arrow
 - Parcel boundaries with dimensions or scale
 -  Elevation contours
 - Existing site drainage patterns
 - Include natural and constructed drainages
 - Identify the primary discharge point or points from the site
 - Identify any storm drainage systems receiving site runoff (e.g. roadside ditch)
 - Boundaries of water bodies
 -  Boundaries of Critical Areas, if any, including:
 - Critical Aquifer Recharge Areas (CCC 40.410)
 - Flood Hazard Areas (CCC 40.420)
 - Geologic Hazard Areas (CCC 40.430)
 - Habitat Conservation Areas (CCC 40.440)
 - Wetland Protection Areas (CCC 40.450)
 - Shoreline Master Program Areas (CCC 40.460)
 - Boundaries of existing vegetation (e.g. trees, grassy areas, pastures, native vegetation)
 - Locations of water wells and septic system drain fields on the parcel or within 100 feet of the parcel boundary
 - Locations and dimensions of all existing improvements, including underground utilities

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

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

4. **BMP Drawings** — See Figure 7 for an example. If Downspout Drywell, Downspout Infiltration Trench, Rain Garden, or Permeable Pavement are proposed, submit a drawing for each BMP showing a

plan view (bird's-eye view) and a profile view (cross-section) of the facility. Include the following details:

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

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



- Address, Parcel Number, and Street names
- North Arrow
- Boundaries of existing vegetation (e.g. trees, pasture, fields, etc.)
- Critical areas and associated buffers (e.g. wetlands, steep slopes, streams, etc.).
- Delineate areas that are to be cleared and graded.
- Cut and fill slopes, indicating top and bottom of slope catch lines.
- Locations where upstream run-on enters the site and where runoff leaves the site.
- Existing surface water flow direction(s).
- Final grade contours and proposed surface water flow direction and surface water conveyance systems (e.g. pipes, catch basins, ditches, etc.).
- Show grades, dimensions, and direction of flow in all (existing and proposed) ditches, swales, culverts, and pipes.
- Identify and locate all ESC BMPs to be used during and after construction.

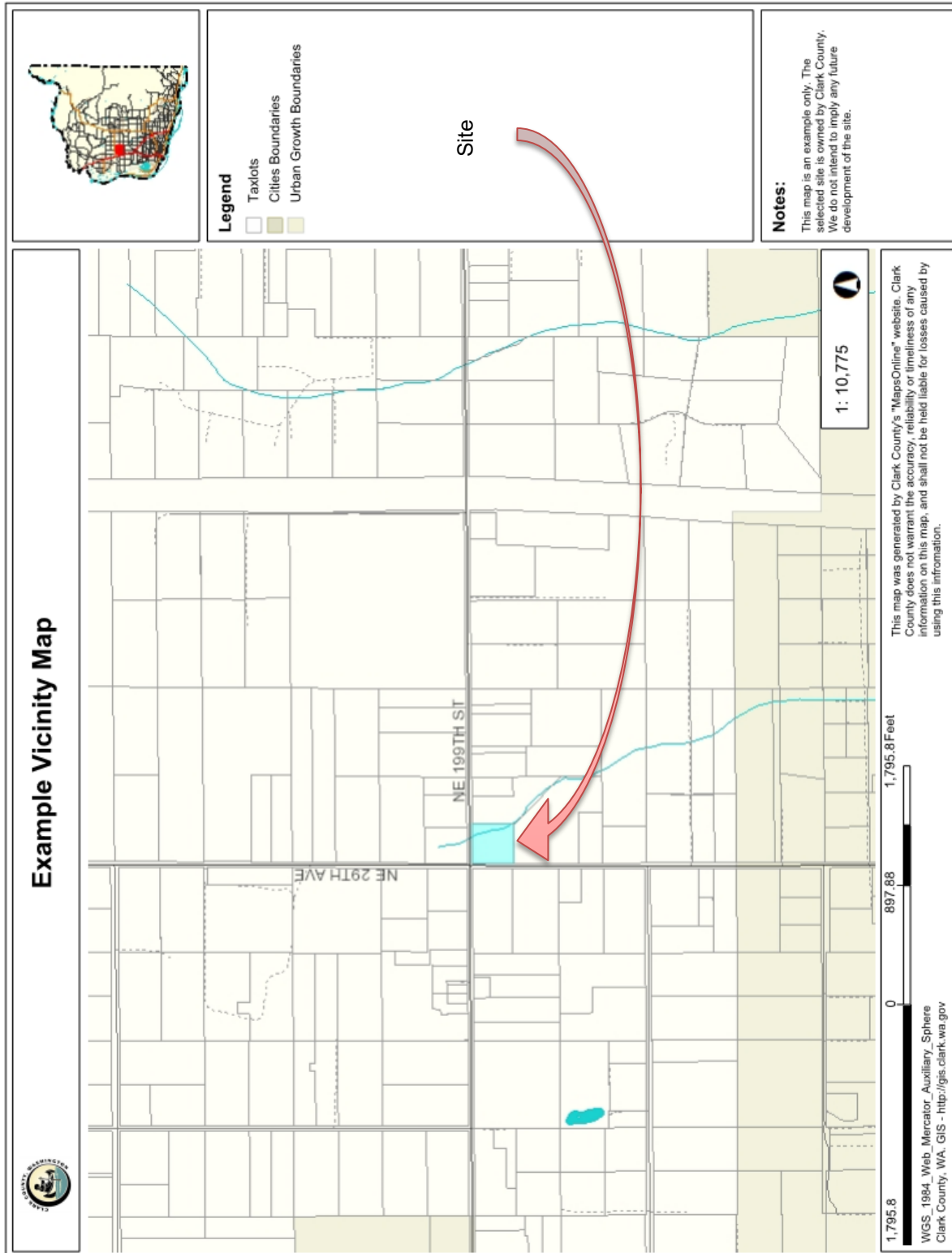


Figure 6: Example Vicinity Map

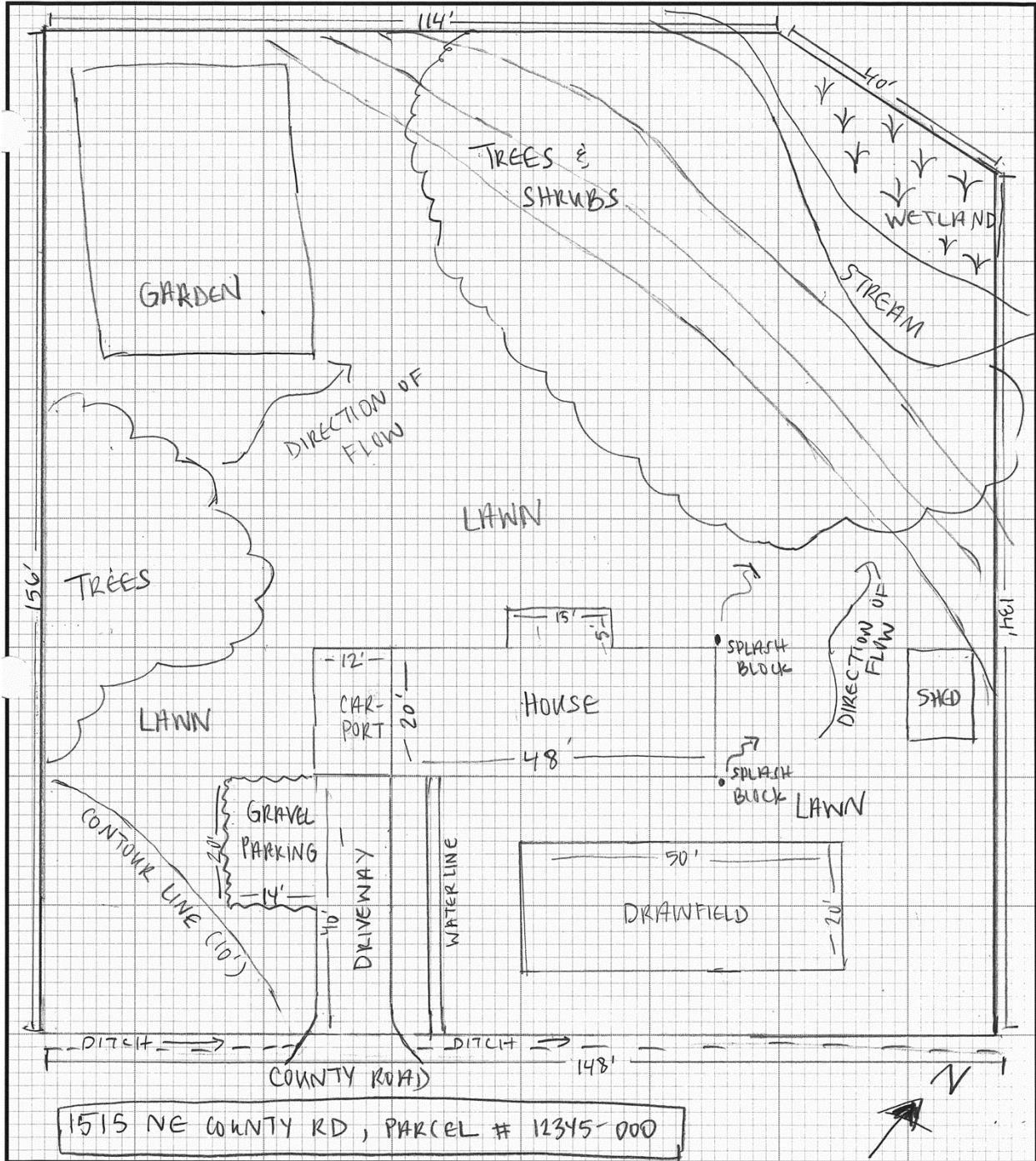


Figure 7: Example Existing Site Map

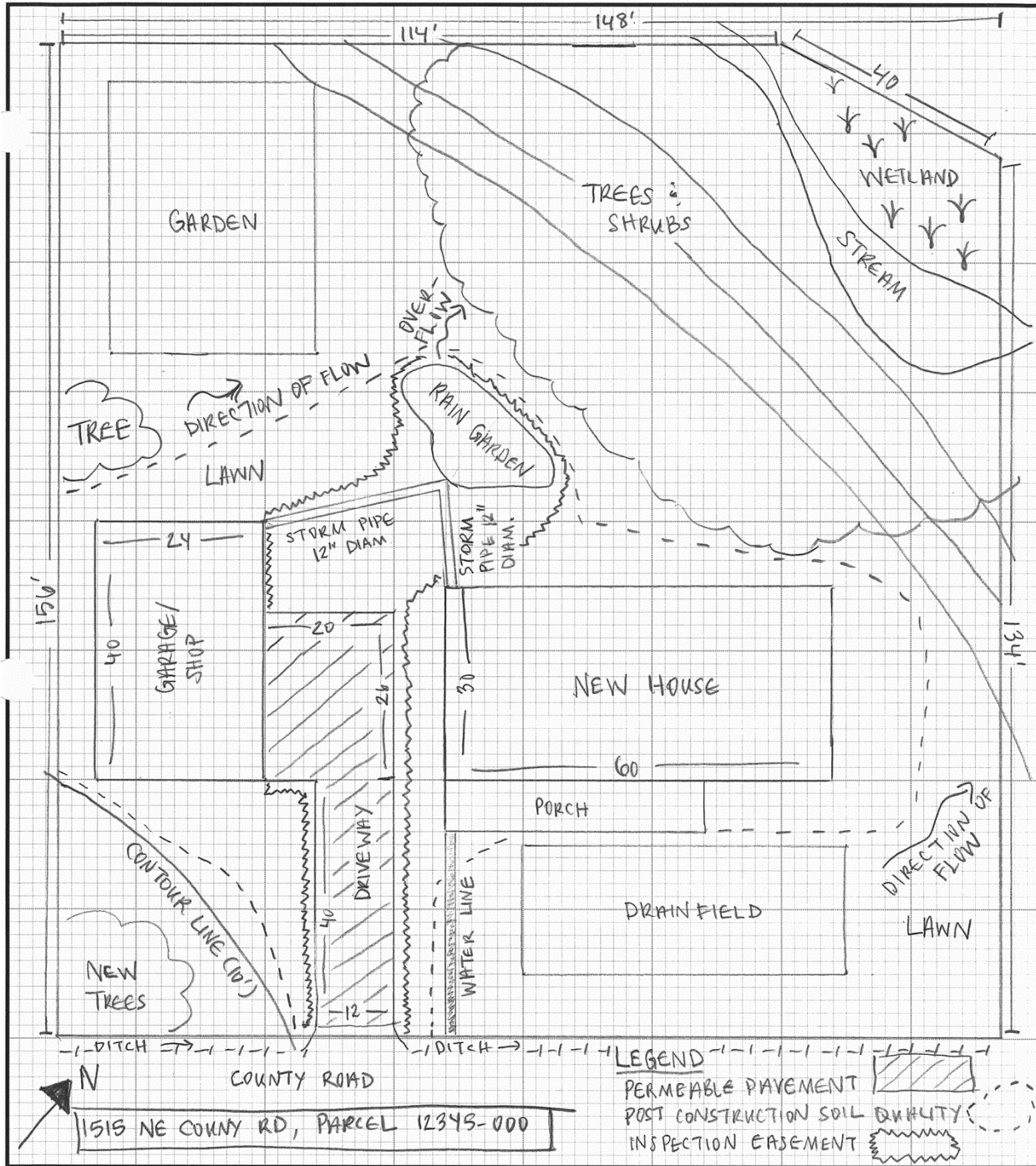


Figure 8: Example Site Plan

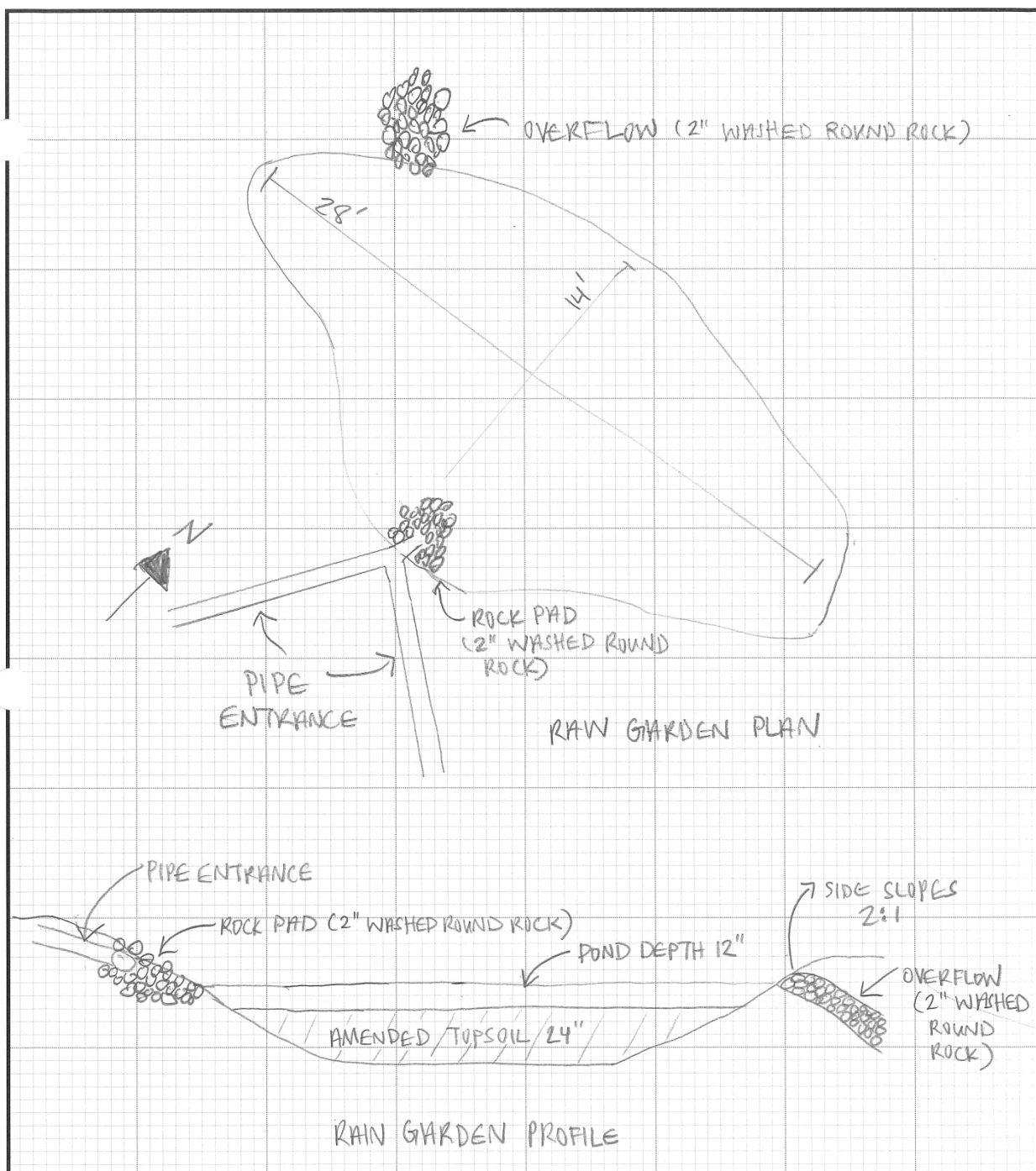


Figure 9: Example BMP Plan and Profile Drawing

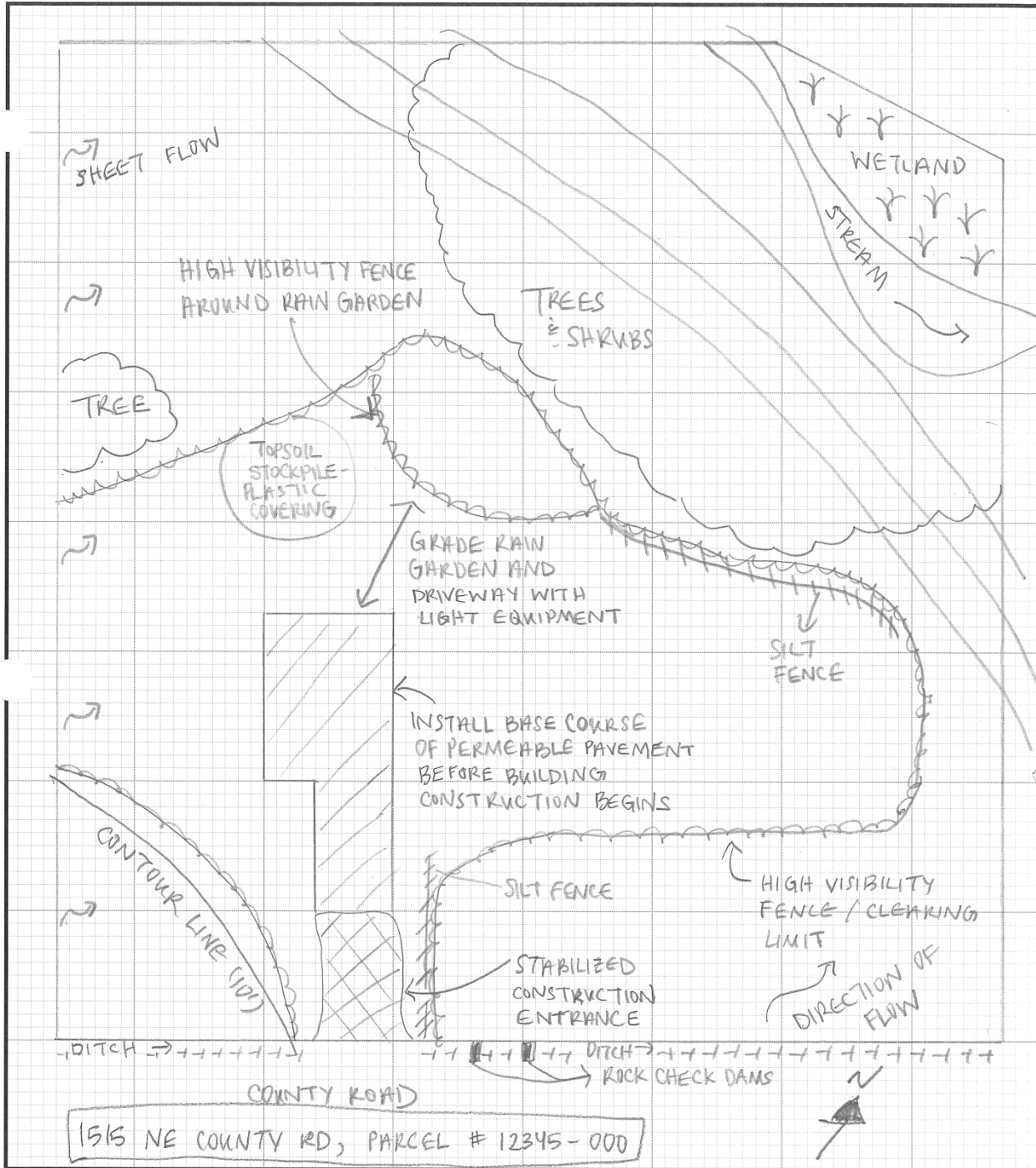
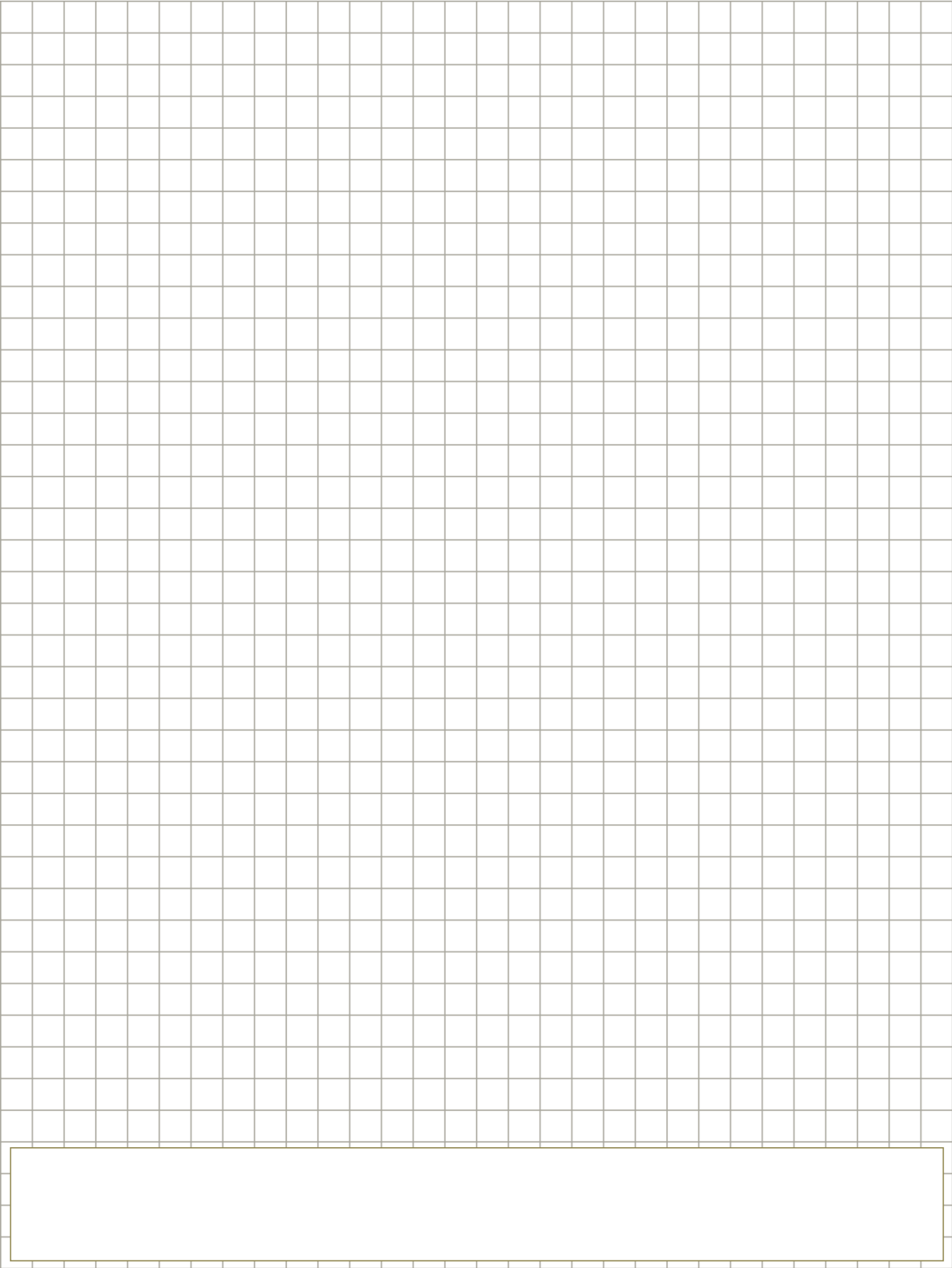


Figure 10: Example Sediment and Erosion Control Site Plan



Section 8 — LID Feasibility Checklist

Preface

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

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

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

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

LID Infeasibility due to Competing Needs

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

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

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

LID Feasibility Checklist

Project Title and Case Number: _____

Applicant: _____

Date: _____

TDA #: _____

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

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

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

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

Section 1: Surfaces

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

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

Section 2: Feasibility Criteria

For each type of surface selected in 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 for any question, then the BMP is not feasible in the TDA and is not required in accordance with Minimum Requirement #5. If No answers are given to all questions, then the BMP is feasible in the TDA and must be implemented in accordance with Minimum Requirement #5.** When feasibility of the BMP has been determined, then select the appropriate box in the Determination section.*

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

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

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

DISPERSION TO PASTURE OR CROPLAND BMP T5.30B	Roof		Other Hard Surfaces	
	YES	NO	YES	NO
Applicability and Setbacks				
Is the project site 22,000 square feet or less?				
Will the project protect and maintain less than 75% of the site or TDA as pasture or cropland or be covered in more than 15% impervious surfaces?				
Does use of the pasture or cropland for purposes other than plant growth (e.g. unpaved roads, equipment storage, animal pens, haystacks, wheel lines, campsites, trails, etc.) take up more than 10% of the area to be used for dispersion?				
Does the site prohibit a minimum dispersion flow path through pasture or cropland of 300 feet?				
Is the only area available for the required length of the BMP's flowpath on a slope greater than 5%?				
Is the only area available to place the dispersion device or required flowpath less than 10 feet from any structure, property line, or sensitive area?				
Is the only location available for the discharge less than 100 feet upgradient of a septic system?				
Is the only area available for the required length of the BMP's flowpath above an erosion hazard or toward a landslide hazard area?				
Is the only area available to place the dispersion device (not the flowpath) located in a critical area or critical area buffer?				

Is the only area available to place the dispersion device (not the flowpath) located on a slope greater than 20% or within 50 feet of a geohazard as defined in CCC 40.430?				
Are crops other than grass, grain, row crops (including berries, nursery stock, and orchards) grown in the proposed flowpath?				
Is the pasture/cropland under different ownership than the project site?				
If the crop or pasture land is predominantly covered in soils with an infiltration rate greater than 4 inches per hour, was the pasture or cropland cleared after November 2009?				
Does a professional geotechnical evaluation recommend dispersion not be used due to reasonable concerns about erosion, slope failure or down gradient flooding?				
Are there Competing Needs (see Section 8 Preface)? If so, attach a narrative justifying the use of Competing Needs criteria.				
Determination: Is this BMP feasible?				

ROOF DOWNSPOUT FULL INFILTRATION BMPs T5.10A and T5.10B		Roof			
Feasibility Criteria and Setbacks		YES	NO		
Note: this BMP is not applicable to other hard surfaces					
Is the proposed location on a slope of 25% (4:1) or greater and cannot reasonably be located elsewhere?					
Is the proposed location less than 10 feet from any small on-site sewage disposal drainfield, including reserve areas and grey water reuse systems, and cannot reasonably be located elsewhere?					
Is the proposed location less than 100 feet upgradient of a septic system unless topography clearly prohibits subsurface flows from intersecting the drainfield and cannot reasonably be located elsewhere?					
Is the proposed location less than 10 feet from any structure, property line, or sensitive area and cannot reasonably be located elsewhere?					
Has a qualified professional determined that soils in the infiltration zone at the location of the roof downspout infiltration BMP do not fall within USDA textural classes of coarse sands to medium sands, loam, or cobbles and gravels?					
Is there less than 3 feet of permeable soil from the proposed finished ground elevation at the drywell or trench location to the seasonal high groundwater table?					
Is there less than 1 foot of soil from the proposed bottom elevation of the roof downspout control to the groundwater elevation?					
Is the proposed location less than 50 feet from the top of any slope greater than 40% and cannot reasonably be located elsewhere? [Note: at the applicant's request, the Responsible Official may reduce this setback to 15 feet based on a geotechnical evaluation. If requested, submit a geotechnical report with this checklist for County review.]					
Is the proposed location less than 10 feet from an underground storage tank and its connecting pipes that is used to store petroleum products, chemicals, or liquid hazardous wastes in which 10% or more of the storage volume of the tank and connecting pipes is beneath the ground and cannot reasonably be located elsewhere?					
Is the proposed location less than 100 feet from a closed or active landfill and cannot reasonably be located elsewhere?					
Are there Competing Needs (see Section 8 Preface)? If so, attach a narrative justifying the use of Competing Needs criteria.					
Determination: Is this BMP feasible?					

RAIN GARDEN BMP T5.14A	Roof		Other Hard Surfaces	
Infeasibility Criteria and Setbacks	YES	NO	YES	NO
Can the site not reasonably be designed to locate the BMP on slopes less than 8%?				
Is the land for the BMP within an area designated as an erosion hazard or landslide hazard by the geotechnical report or county critical areas mapping?				
Is the BMP less than 50 feet from the top of slopes greater than 20% and with more than 10 feet of vertical relief and cannot reasonably be located elsewhere?				
<i>[End soil / groundwater contamination sub-list.]</i>				
Is the BMP less than 100 feet from a landfill (active or closed) and cannot reasonably be located elsewhere?				
Is the BMP less than 100 feet from a drinking water well or a spring used for drinking water and cannot reasonably be located elsewhere?				
Is the BMP less than 10 feet from any small on-site sewage disposal drain field, including reserve areas, and grey water reuse systems and cannot reasonably be located elsewhere? For setbacks from a "large on-site sewage disposal system," see Chapter 246-272B WAC.				
Is the BMP less than 10 feet from an underground storage tank and its connecting pipes that is used to store petroleum products, chemicals, or liquid hazardous wastes in which 10% or more of the storage volume of the tank and connecting pipes is beneath the ground and when the capacity of the tank and pipe system is less than 1100 gallons and cannot reasonably be located elsewhere?				
Does field testing indicate that soils have a measured (a.k.a. initial) native soil coefficient of permeability less than 0.3 inches per hour?				
Is the minimum vertical separation of one foot to seasonal high water table, bedrock or other impervious layer unable to be achieved below the rain garden?				
Is the BMP less than 100 feet from an underground storage tank and its connecting pipes that is used to store petroleum products, chemicals, or liquid hazardous wastes in which 10% or more of the storage volume of the tank and connecting pipes is underground and when the capacity of the tank and pipe system is greater than 1100 gallons and cannot reasonably be located elsewhere?				
Are there Competing Needs (see Section 8 Preface)? If so, attach a narrative justifying the use of Competing Needs criteria.				
The following require professional technical evaluation.				
Does a professional geotechnical evaluation recommend infiltration not be used due to reasonable concerns about erosion, slope failure or down gradient flooding?				
Does the site have groundwater that drains into an erosion hazard or landslide hazard area?				
Is the only area available for siting the BMP threatening the safety or reliability of pre-existing underground utilities, pre-existing underground storage tanks, pre-existing structures and basements, or pre-existing road or parking lot surfaces?				
Would infiltrating water threaten existing below grade basements?				
Would infiltrating water threaten shoreline structures such as bulkheads?				
Is the only area available for siting the BMP one that does not allow for a safe overflow pathway to a natural drainageway, the municipal separate storm sewer system or to a private storm sewer system?				

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

SHEET FLOW DISPERSION BMP T5.12 and CONCENTRATED FLOW DISPERSION BMP T5.11	Roof		Other Hard Surfaces	
Feasibility Criteria			YES	NO
Is the only area available for the BMP less than 10 feet from any structure, property line, or sensitive area?				
Is the only area available to place the dispersion device (not the flowpath) located on a slope greater than 20% or within 50 feet of a geohazard as defined by CCC 40.430?				
Is the only area available for the required length of the BMP's flowpath on a slope greater than 20%				
Is the only location available for the discharge location less than 100 feet upgradient of a septic system drainfield on the site?				
Is the only area available to place the dispersion device (not the flowpath) located in a critical area or critical area buffer?				
Is the only area available for the required length of the BMP's flowpath above an erosion hazard or toward a landslide hazard area?				
Does a professional geotechnical evaluation recommend dispersion not be used due to reasonable concerns about erosion, slope failure or down gradient flooding?				
Are there Competing Needs (see Section 8 Preface)? If so, attach a narrative justifying the use of Competing Needs criteria.				
Determination: Is this BMP feasible?				

PERMEABLE PAVEMENT BMP T5.15	Roof		Other Hard Surfaces	
Feasibility Criteria and Setbacks	YES	NO	YES	NO

Is the 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?				
<i>[End soil / groundwater contamination sub-list.]</i>				
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?				
Is measured coefficient of permeability in the area for permeable pavement less than 0.3 inches per hour?				
If the area for permeable pavement would be a pollution-generating hard surface (e.g., roads, driveways, parking lots) does the soil underneath the proposed location fail to meet all of the following criteria:				
- At least one foot depth of soil with the following characteristics:				
- Cation Exchange Capacity > 5%				
- Organic Content > 1%				
- Measured coefficient of permeability < 12 inches/hour				
Is the area for permeable pavement less than 50 feet from the top of a slope greater than 20% with more than 10 feet of vertical relief?				
Is the area for permeable pavement less than 100 feet from an active or closed landfill?				
Is the area for permeable pavement less than 100 feet from a drinking water well or a spring used for drinking water?				
Is the area for permeable pavement less than 10 feet from on-site sewage drainage?				
Is the area to be paved less than 10 feet from an underground storage tank and its connecting pipes that is used to store petroleum products, chemicals, or liquid hazardous wastes in which 10% or more of the storage volume of the tank and connecting pipes is beneath the ground?				
Are there Competing Needs (see Section 8 Preface)? If so, attach a narrative justifying the use of Competing Needs criteria.				
<i>The following require professional technical evaluation.</i>				
Does a professional geotechnical evaluation recommend infiltration not be used due to reasonable concerns about erosion, slope failure or down gradient flooding?				
Does the site have groundwater that drains into an erosion hazard or landslide hazard area?				
Would infiltrating and ponded water below new permeable pavement area compromise adjacent impervious pavement?				
Is the only area available for siting the BMP threatening the safety or reliability of pre-existing underground utilities, pre-existing underground storage tanks, pre-existing structures and basements, or pre-existing road or parking lot surfaces?				
Would infiltrating water threaten existing below grade basements?				
Would infiltrating water threaten shoreline structures such as bulkheads?				
Is the area for permeable pavement downslope of steep, erosion prone areas that are likely to deliver sediment?				

Is the area for permeable pavement over fill soils that can become unstable when saturated?				
Determination: Is this BMP feasible?				

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Section 9 — On-Site BMP Design Criteria and Drawings

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

BMP T5.I3: 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.

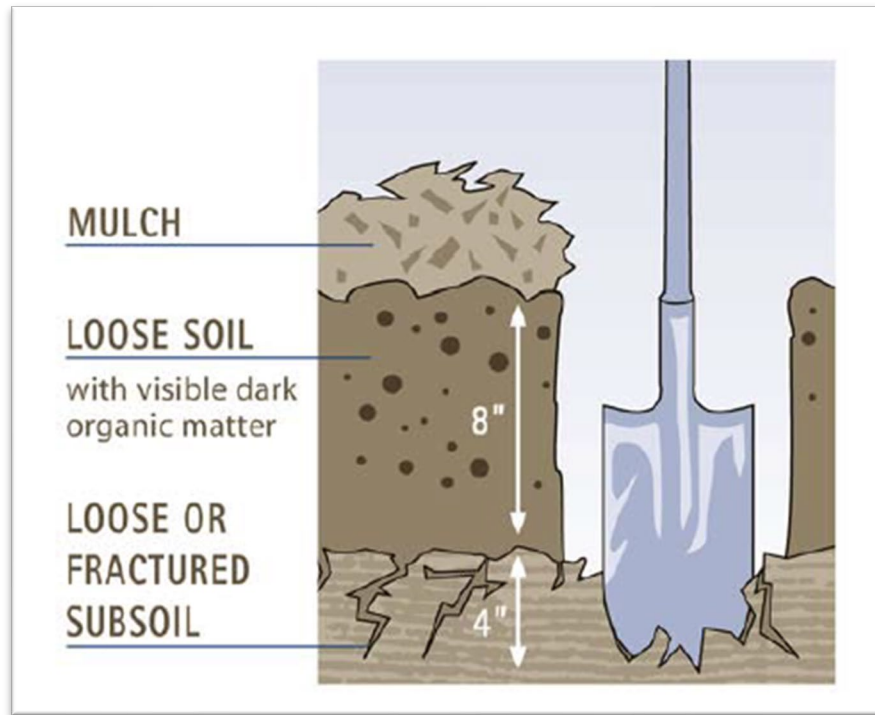


Figure 11: Typical Planting Bed Cross-section

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

exceeding the contaminant limits identified in Table 220-B, Testing Parameters, in WAC 173-350-220.

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

Maintenance

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

BMP T5.30A: Full Dispersion

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

Purpose and Definition

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



Figure 12: Native Vegetation in Clark County

Applications, Limitations and Setbacks

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

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

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

Setbacks

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

Infeasibility Criteria

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

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

Design Criteria

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

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

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

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

Roof Downspouts

- Roof surfaces are considered to be "fully dispersed" only if they are within a threshold discharge area that is or will be more than 65% forested (or native vegetative cover) and less than 10% impervious AND if they either:

- Comply with the Downspout Dispersion requirements of BMP T5.10C, but with vegetated flow paths of 100 feet or more through the native vegetation preserved area or,
- Disperse the roof runoff along with the road runoff in accordance with the roadway dispersion BMP section (below).

Driveway Dispersion

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

Roadway Dispersion

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

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

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

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

Cleared Area Dispersion

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

Native Vegetation Landscape Specifications

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

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

5. Existing impervious surface and any underlying base course (e.g., crushed rock, gravel) must be completely removed from the conversion area(s).
6. 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.
7. 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.
8. 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.

9. 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.

10. Plantings must be watered consistently once per week during the dry season for the first two years.
11. 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 13: 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.
- The length used for dispersion shall be 300 feet or greater.
- The preserved area is not required to be placed in a separate tract or recorded easement.
- The Applications, Limitations and Setbacks for BMP T5.30A shall also apply to this BMP. Where conflicts between the requirements in BMP T5.30 and the requirements in this BMP occur, the requirements for this BMP shall apply.

Setbacks

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

Infeasibility Criteria

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

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

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

Design Criteria

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

BMP T5.10A: Downspout Full Infiltration – Drywells

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

Applications, Limitations and Setbacks

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

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

Setbacks

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

Infeasibility Criteria

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

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

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

Design Criteria

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

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

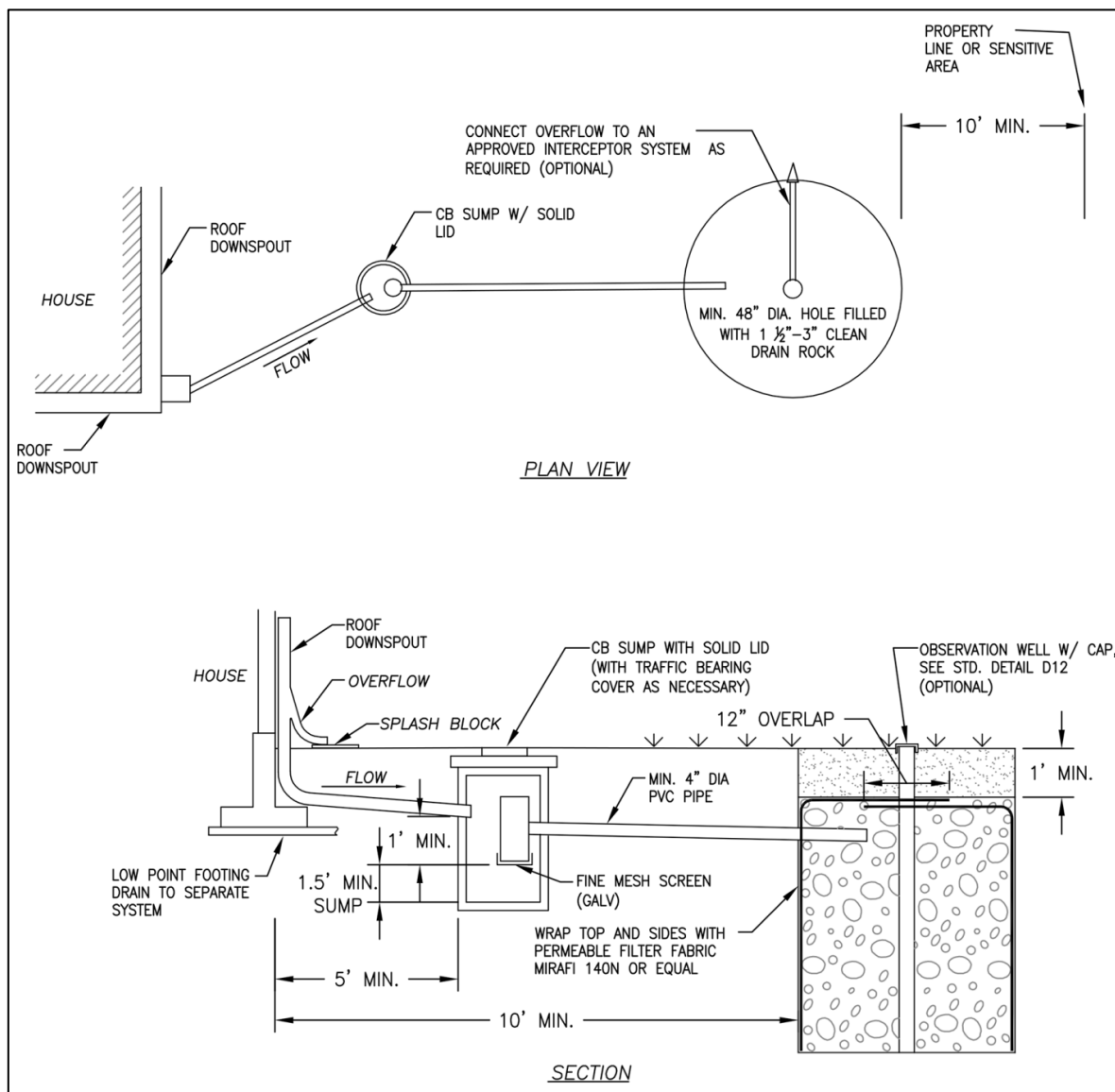


Figure 14: Typical Downspout Infiltration Drywell

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

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

Downspout Full Infiltration Trenches are underground trenches filled with rock and containing perforated pipe that are designed to infiltrate runoff from roof downspout drains into the soil.

Alternatives to rock-filled trenches, such as preformed chambers, are acceptable if equivalent storage volume is provided.

Applications, Limitations and Setbacks

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

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

Setbacks

- See BMP T5.10A for setback information.

Infeasibility Criteria

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

- A qualified professional determines that soils in the infiltration zone at the location of the drywell do not fall within USDA textural classes of coarse sands to medium sands, loam, or cobbles and gravels.
- Less than one foot exists between the bottom of the infiltration trench to the groundwater elevation.
- The facility is less than 100 feet from closed or active landfills.
- The facility is less than 10 feet from a sewage disposal drainfield, including reserve areas and grey water reuse systems.
- The facility is less than 100 feet upgradient from any septic system unless site topography clearly prohibits subsurface flows from intersecting the drainfield.
- The facility is less than 10 feet from an underground storage tank and its connecting pipes that is used to store petroleum products, chemical, or liquid hazardous wastes in which 10% or more of the storage volume of the tank and connecting pipes is beneath the ground.
- The facility is less than 10 feet from any structure, property line, or sensitive area (except slopes over 40%). However, if the roof downspout infiltration system is a common system shared by

two or more adjacent residential lots and contained within an easement given to owners of all residential properties draining to the system, then the setback from the property line(s) shared by the adjacent lots may be waived.

- The facility is less than 50 feet from the top of any slope over 40%. This setback may be reduced to 15 feet based on a geotechnical evaluation.

Design Criteria

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

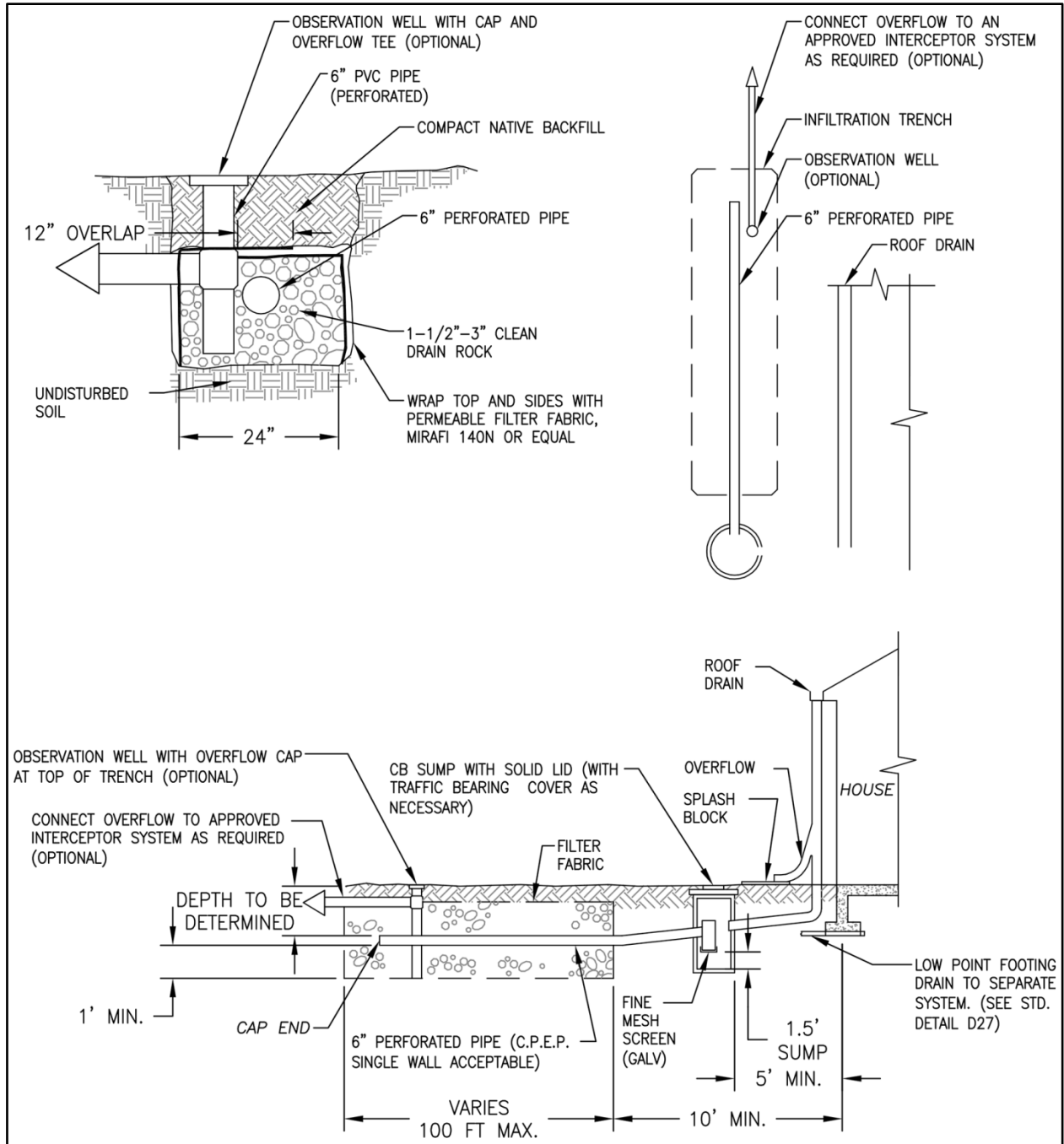


Figure 15: Typical Downspout Infiltration Trench

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

BMP T5.14A: Rain Gardens

Purpose and Description

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

Applications, Limitations and Setbacks

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

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

Setbacks

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

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

- Imported compost shall not be used if the site is within 1/4 mile of a phosphorous-sensitive water body.
- An underdrain shall not be used if drainage would be routed to a phosphorous-sensitive waterbody.

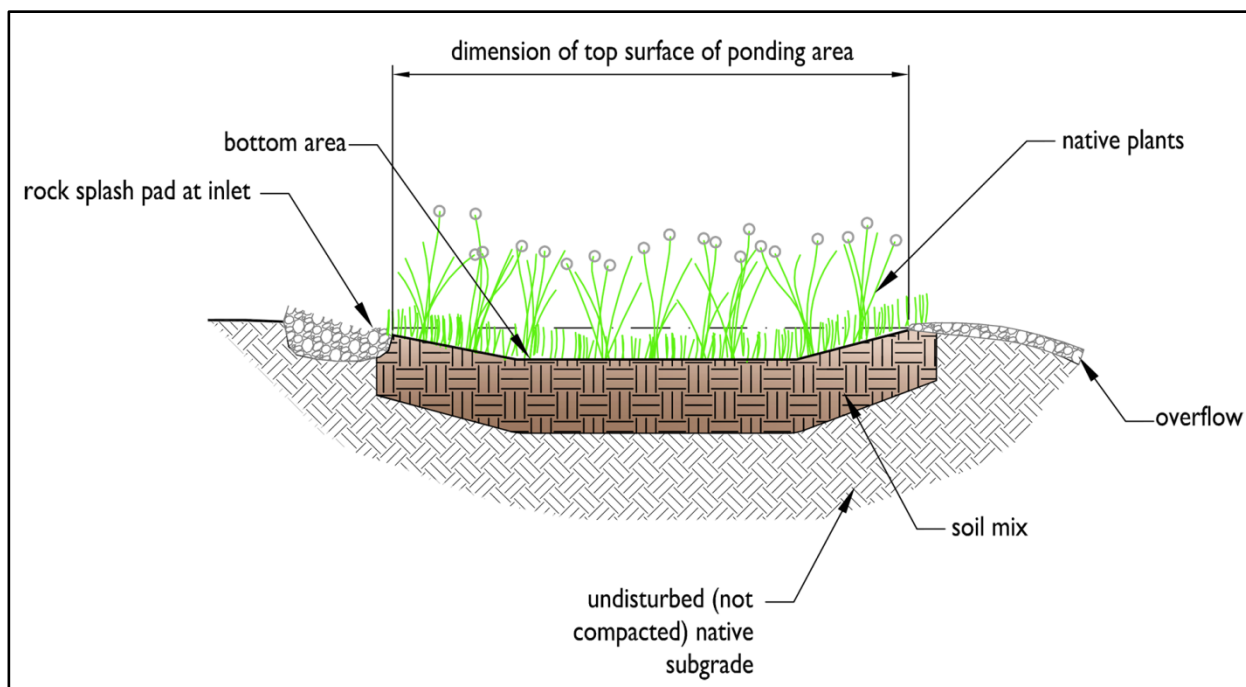


Figure 16: Schematic of Typical Rain Garden

(Source: redrawn from Oregon State University Extension)

Infeasibility

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

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

contaminated, and contaminated soils are still in place within 10 horizontal feet of the infiltration area.

- The BMP would be within any area where it would be prohibited by an approved cleanup plan under the state Model Toxics Control Act or Federal Superfund Law, or an environmental covenant under Chapter 64.70 RCW.
- Where the minimum vertical separation of one foot to seasonal high water table, bedrock or other impervious layer cannot be achieved below a Rain Garden.
- Where field testing indicates that soils have a measured (a.k.a. initial) native soil coefficient of permeability less than 0.3 inches per hour. [Note: an LID infiltration BMP may still be feasible with the use of an underdrain to help meet Minimum Requirements #6 or #7, depending on soil and filtration media characteristics.]
- Where the site cannot reasonably be designed to avoid placing the rain garden within setbacks given above.
- Where a professional evaluation demonstrates that any condition below is met:
 - Where a professional geotechnical evaluation recommend infiltration not be used due to reasonable concerns about erosion, slope failure or down gradient flooding.
 - Where the site has groundwater that drains into an erosion hazard or landslide hazard area.
 - Where the only area available for siting the BMP threaten the safety or reliability of pre-existing underground utilities, pre-existing underground storage tanks, pre-existing structures and basements, or pre-existing road or parking lot surfaces.
 - Where infiltrating water would threaten existing below grade basements.
 - Where infiltrating water would threaten shoreline structures such as bulkheads.
 - Where the only area available for siting the BMP is one that does not allow for a safe overflow pathway to the municipal separate storm sewer system or to a private storm sewer system.
 - Where the site is a redevelopment project that lacks usable space.
 - Where the site is a public road project that lacks sufficient space within existing public right-of-way.

Design Criteria

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

Site Considerations

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

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

Pond Area

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

Sizing Requirement and Procedure

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

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

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

- a. Include all types of surfaces draining to the rain garden including, but not limited to, roofs, driveways, patios, landscaping, and lawn.
13. At the location where the rain garden will be installed, find the infiltration rate of the soil following instructions in Book 1, Section 2.3.1.4. (Note: the *Rain Garden Handbook*, cited above, describes a different procedure for determining soil infiltration rate which is not accepted by Clark County.)
14. Determine the mean annual rainfall at the site (see map at Figure 15).
15. Use Table 1, below, and the information from steps 2 and 3, to determine the sizing factor.
16. Multiply the contributing area and the sizing factor to find the top surface area of the pond (see Figure 14 for an illustration of the top surface of the ponding area).

Table 0.1: Rain Garden Sizing Factors

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

⁸ At these low drainage rates, the maximum ponding depth is 6 inches. A 12-inch pond will not drain down quickly enough.

⁹ If meeting Minimum Requirement #5, a rain garden is not required if the infiltration rate is less than 0.30 inches/hour.

MEAN ANNUAL PRECIPITATION FOR CLARK COUNTY

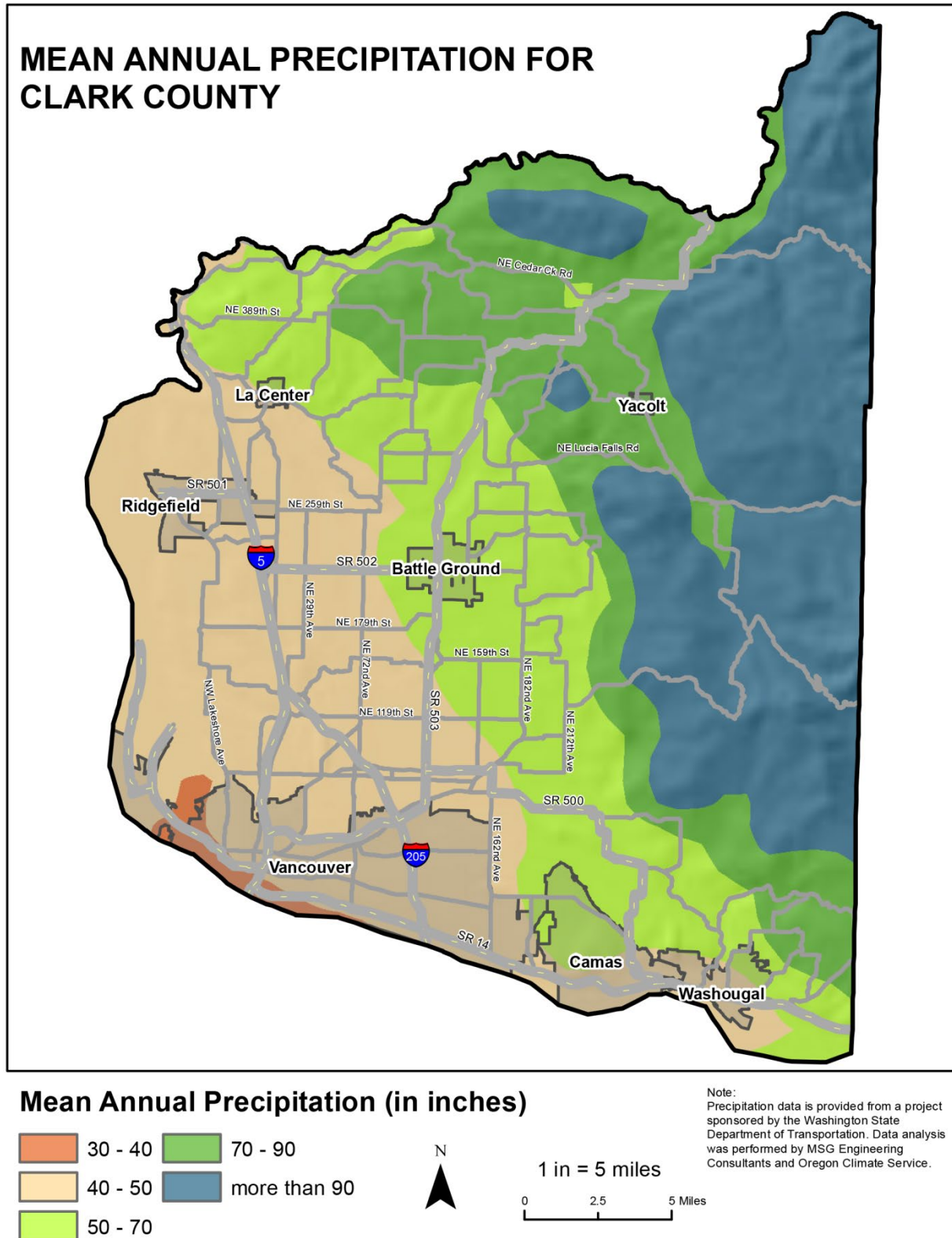


Figure 17: Mean Annual Precipitation in Clark County

Flow Entrances

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

Overflow

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

Soil Mix

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

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

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

Method 1: Excavate and Replace Soil

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

Use this method if:

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

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

Method 2: Excavate and Amend Topsoil with Compost

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

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

Method 3: Amend Topsoil in Place

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

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

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

Compost

Compost used to amend soils should have the following characteristics:

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

Planting

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

- The plants must be sited according to sun, soil, wind, and moisture requirements of the plant.
- At a minimum, the sizes of herbaceous, shrub, groundcover, and accent plants shall be 1-gallon container and tree sizes shall be 1-inch caliper, 5-foot height, 10-gallon container.
- 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.
- The design plans must specify that vegetation coverage of selected plants will achieve 90% coverage within 2 years or additional plantings will be provided until this coverage is met.
- At a minimum, provisions must be made for supplemental irrigation during the first two growing seasons following installation.

Table 0.2: Plant List for Rain Garden*

Moist to Wet Soil Conditions (Facility Bottom to Bottom of Overflow)					
Type	Botanical Name	Common Name	O.C. Spacing	Allowed ROW**	Light Requirements
Herbaceous	<i>Carex obnupta</i>	Slough Sedge	18"	N	Full Sun/Part Shade
Herbaceous	<i>Deschampsia cespitosa</i>	Tufted Hair Grass	18"	N	Full Sun
Herbaceous	<i>Juncus patens</i>	Spreading Rush	18"	Y	Full Sun
Shrub	<i>Cornus sericea</i> 'Kelseyii'	Kelsey Dogwood	24"	Y	Full Sun/Part Shade
Shrub	<i>Spiraea betulifolia</i>	Birch-leaf Spiraea	24"	N	Full Sun/Part Shade
Shrub	<i>Spiraea densiflora</i>	Sub-alpine Spiraea	24"	Y	Full Sun/Part Shade
Shrub	<i>Spiraea japonica</i>	Japanese spirea cultivars	24"	Y	Full Sun
Groundcover	<i>Rubus calycinoides</i> & <i>pentalobus</i>	Creeping Bramble	12"	N	Full Sun/Part Shade
Accent	<i>Camassia leichtinii</i>	Great Camas	12"	N	Full Sun/Part Shade
Accent	<i>Camassia quamash</i>	Common Camas	12"	N	Full Sun/Part Shade
Tree	<i>Celtis occidentalis</i>	Hackberry	50'	N	Full Sun
Tree	<i>Frangula purshiana</i>	Cascara	30'	N	Full Sun
Tree	<i>Nyssa sylvatica</i>	Black tupelo	50'	Y	Full Sun
Tree	<i>Quercus bicolor</i>	Swamp White Oak	45'	Y	Full Sun
Tree	<i>Quercus shumardii</i>	Shumard Oak	70'	Y	Full Sun

Dry Soil Conditions (Overflow and Above)					
Type	Botanical Name	Common Name	O.C. Spacing	Allowed ROW**	Light Requirements
Herbaceous	<i>Deschampsia cespitosa</i>	Tufted Hair Grass	18"	N	Full Sun
Herbaceous	<i>Helictotrichon sempervirens</i>	Blue Oat Grass	18"	N	Full Sun

Shrub	<i>Euonymus japonicus</i> 'Microphyllus'	Box Euonymus	24"	N	Full Sun
Shrub	<i>Mahonia aquifolium</i> 'Compacta'	Compact Oregon Grape	24"	Y	Part Shade/Shade
Shrub	<i>Spiraea betulifolia</i>	Birch-leaf Spirea	24"	N	Full Sun/Part Shade
Shrub	<i>Spiraea densiflora</i>	Sub-alpine Spirea	24"	Y	Full Sun/Part Shade
Shrub	<i>Spiraea japonica</i>	Japanese spirea cultivars	24"	Y	Full Sun
Groundcover	<i>Arctostaphylos uva-ursi</i>	Kinnikinnick	12"	Y	Full Sun
Groundcover	<i>Fragaria chiloensis</i>	Coastal Strawberry	12"	Y	Full Sun
Groundcover	<i>Mahonia repens</i>	Creeping Oregon Grape	12"	N	Part Shade/Shade
Tree	<i>Celtis occidentalis</i>	Hackberry	50'	N	Full Sun
Tree	<i>Frangula purshiana</i>	Cascara	30'	N	Full Sun
Tree	<i>Quercus bicolor</i>	Swamp White Oak	45'	Y	Full Sun
Tree	<i>Quercus shumardii</i>	Shumard Oak	70'	Y	Full Sun
<p>Selected plants shall not include any plants from the State of Washington Noxious Weed Board: https://www.nwcb.wa.gov/ and local Clark County Noxious Weed List: https://www.clark.wa.gov/public-works/vegetation-management.</p> <p>Also please refer to the State of Washington quarantine list for plants prohibited for sale: https://www.nwcb.wa.gov/noxious-weed-quarantine-list</p>					
<p>*Adapted from Portland Bureau of Environmental Services 2014 Stormwater Management Manual, Appendix F.4., Planting Templates and Plant Lists</p> <p>** Plant species allowed in Clark County street Rights-of-Way</p>					

Mulch Layer

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

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

General Construction Criteria

- Do not install media or excavate rain garden during soil saturation periods.
- Excavation and soil placement should be done from equipment operating adjacent to the facility – no heavy equipment should be operated in the facility to avoid compacting soils
- If equipment must be operated within the facility for excavation, use lightweight, low ground pressure equipment and scarify the base to reduce compaction upon completion. Do not use equipment on top of rain garden soil mix.
- Do not use fully excavated rain garden for erosion and sedimentation control during construction
- Scarify sides and bottom to roughen where equipment may have compacted soil.
- Clogged soil and silt shall be removed during excavation to finished bottom grade prior to installing rain garden soil mix
- Ensure the rain garden is protected from erosion and sedimentation until all contributory areas are fully stabilized.
- If sedimentation occurs within the rain garden, excavate the area a minimum of 12 inches below final grade to remove sediment and replace media, mulch, and plants as necessary.

BMP T5.15: Permeable Pavement

Purpose and Description

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

The following are the general categories of permeable paving systems:

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

Applications, Limitations and Setbacks

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

Limitations

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

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

Setbacks

The following setbacks are required for permeable pavements:

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

Infeasibility Criteria

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

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

- The proposed BMP is located in an area where surface soils have been found to be contaminated, and contaminated soils are still in place within 10 horizontal feet of the infiltration area.
 - The BMP would be within any area where it would be prohibited by an approved cleanup plan under the state Model Toxics Control Act or Federal Superfund Law, or an environmental covenant under Chapter 64.70 RCW.
- Where the site cannot be designed to have a porous asphalt surface at less than 5% slope, or a pervious concrete surface at less than 10% slope, or a permeable interlocking concrete pavement surface (where appropriate) at less than 12% slope. Grid systems upper slope limit can range from 6 to 12%; check with manufacturer and local supplier.
- Where the native soils below a pollution-generating permeable pavement (e.g., road or parking lot) do not meet the soil suitability criteria for providing treatment (Book 1, Section 3.1.5.3).
- Where seasonal high groundwater or an underlying impermeable/low permeable layer would create saturated conditions within one foot of the bottom of the lowest gravel base course.
- Where underlying soils are unsuitable for supporting traffic loads when saturated. Soils meeting a California Bearing Ratio of 5% are considered suitable for residential access roads.
- Where measured coefficient of permeability is less than 0.3 inches per hour. In these instances, unless other infeasibility restrictions apply, roads and parking lots may be built with an underdrain, preferably elevated within the base course, if flow control benefits are desired.
- Where replacing existing impervious surfaces, unless the existing surface is a non-pollution generating surface over a soil with a coefficient of permeability of four inches per hour or greater.
- At sites defined as “high-use sites” as defined in Book 1, Appendix 1-A.
- In areas with “industrial activity” as identified in 40 CFR 122.26(b)(14).
- Where the risk of concentrated pollutant spills is more likely such as gas stations, truck stops, and industrial chemical storage sites.
- Where routine, heavy applications of sand occur in frequent snow zones to maintain traction during weeks of snow and ice accumulation. Most lowland western Washington areas do not fit this criterion.
- Where the surface(s) to be paved are within setbacks given in Section 3.9.4.
- Where a professional evaluation demonstrates any condition listed below is met:
 - Where professional geotechnical evaluation recommends infiltration not be used due to reasonable concerns about erosion, slope failure, or down gradient flooding.
 - Where the site has groundwater that drains into an erosion hazard or landslide hazard area.
 - Where infiltrating and ponded water below new permeable pavement area would compromise adjacent impervious pavements.

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



Figure 18: Permeable pavement application

(Source: Vancouver McCord's Toyota)

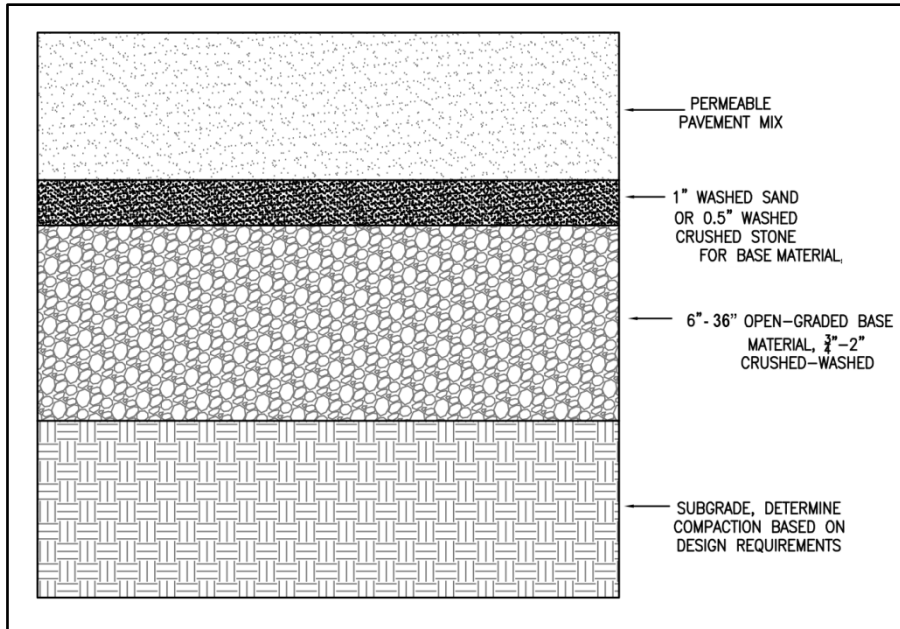


Figure 19: Permeable Pavement typical section

(Source: redrawn from City of Portland)

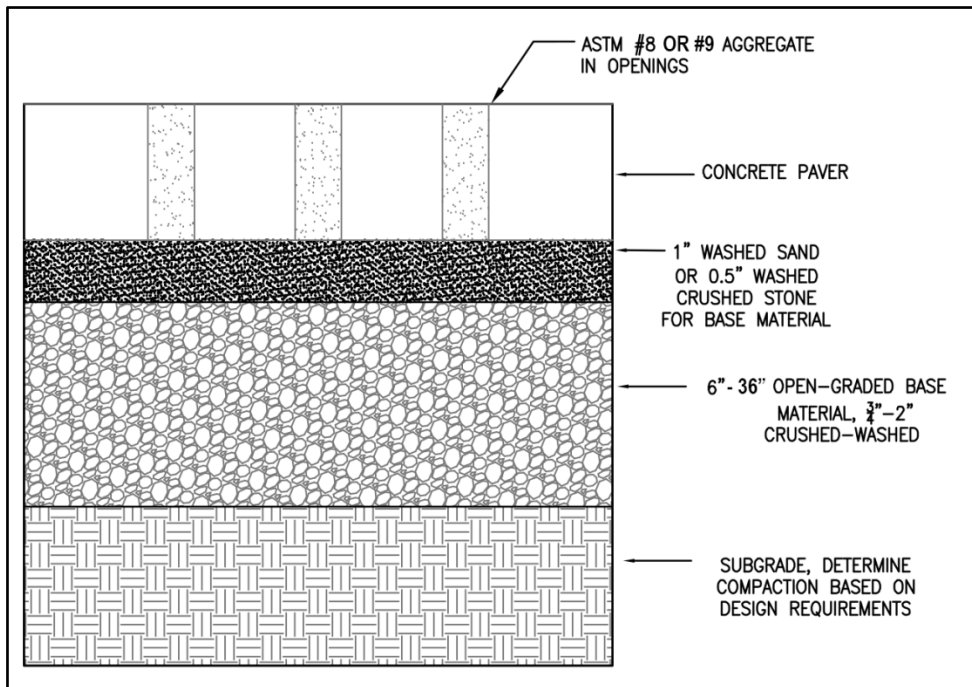


Figure 20: Permeable Pavement typical section of pavers

(Source: redrawn from City of Portland)

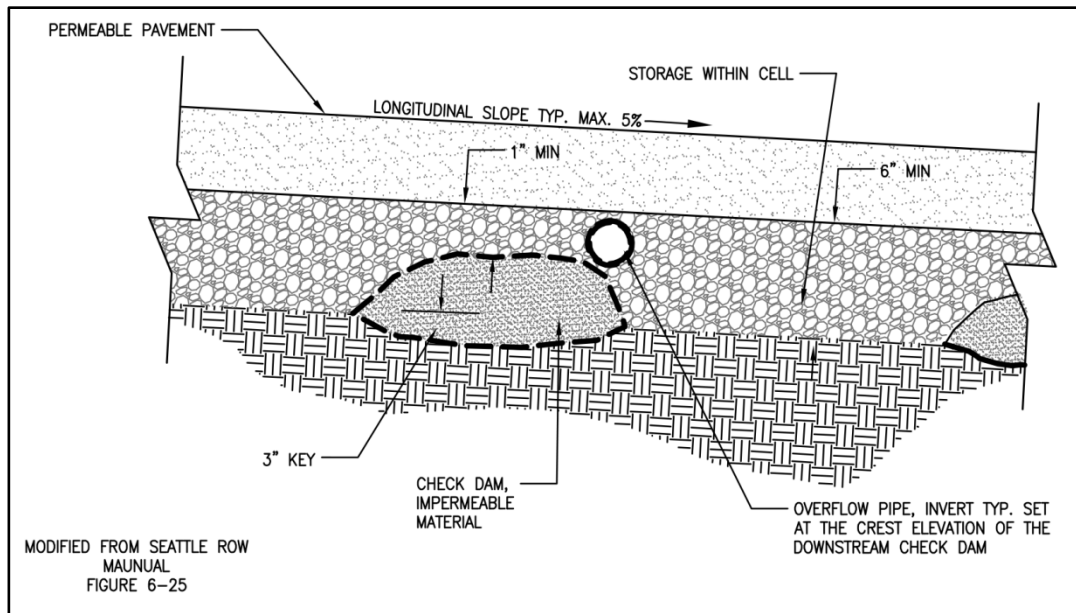


Figure 21: Permeable Pavement check dam for sloped pavement

(Source: modified from SMMWW)

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

Design Criteria

Estimation of Long-Term Infiltration Rates

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

Contributing Area

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

Subgrade

- The subgrade should be compacted to the minimum extent necessary for structural stability, including the following recommendations:

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

Separation or Bottom Filter Layer (Recommended but Optional)

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

Wearing Layer

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

Geotextile

- For all permeable pavement systems, geotextile material must line the sides to prevent soil intrusion if concrete curbs or other types of impermeable liners do not extend to the full depth of the base material. The geotextile material should follow the manufacturer’s specifications and recommendations of the project geotechnical engineer for the particular subgrade soil and aggregate base being used.
- Geotextiles are not allowed between the permeable pavement system and subgrade because of their tendency to clog.

- Geogrids can also be used for subgrade reinforcement at the recommendation of a geotechnical engineer.

Membrane Liners and Barriers

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

Storage Reservoir/Aggregate Base

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

Drainage conveyance

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

Membrane Liners and Barriers

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

Underdrain (Optional)

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

Permeable interlocking concrete pavements (PICP) Seed Mix

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

Table 0.3: PCIP Seed Mix

Botanical Name	Common Name	% By Weight
<i>Festuca rubra</i> 'Chewings'	Chewings fescue	25.00%

<i>Lolium perenne</i>	perennial rye grass	75.00%
TOTAL		100.00%

Quality Control and Acceptance Testing

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

BMP T5.10C: Downspout Dispersion

Purpose and Description

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

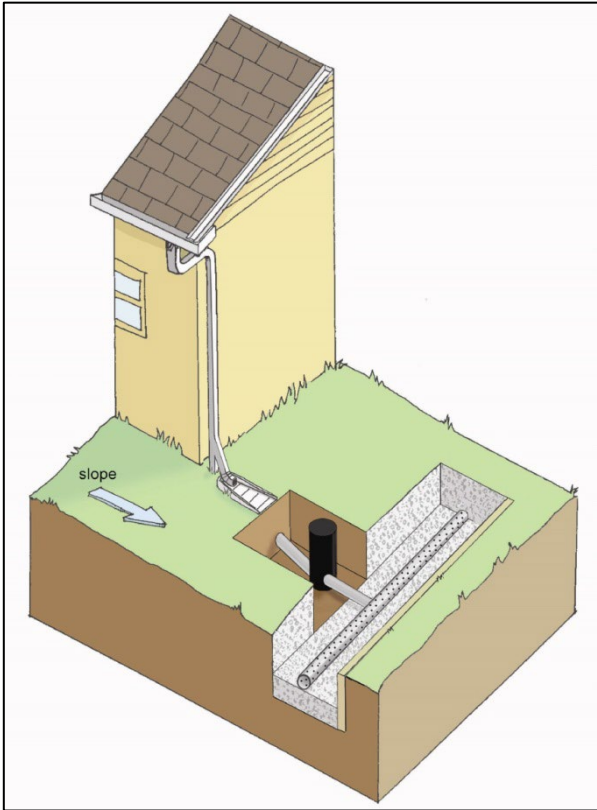


Figure 22: Illustration of Downspout Dispersion Trench

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.

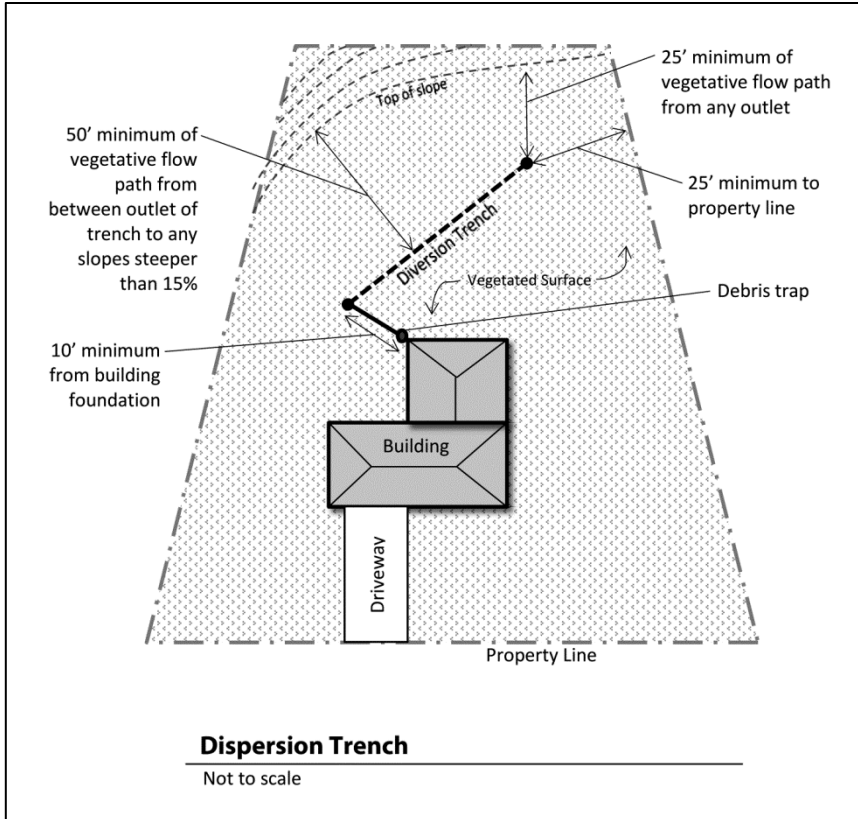


Figure 23: Typical Dispersion Trench Site Plan

(Source: Clark County)

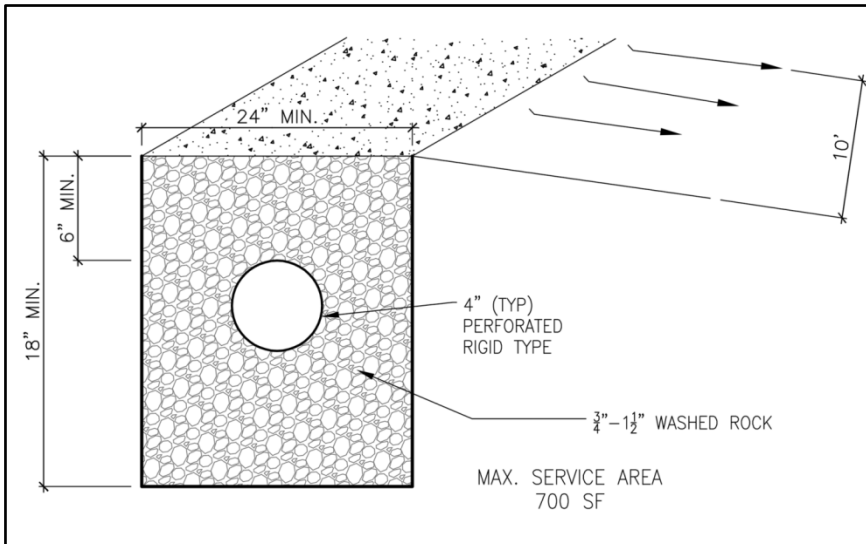


Figure 24: Downspout Dispersion Trench Cross-Section

(Source: modified from Department of Ecology)

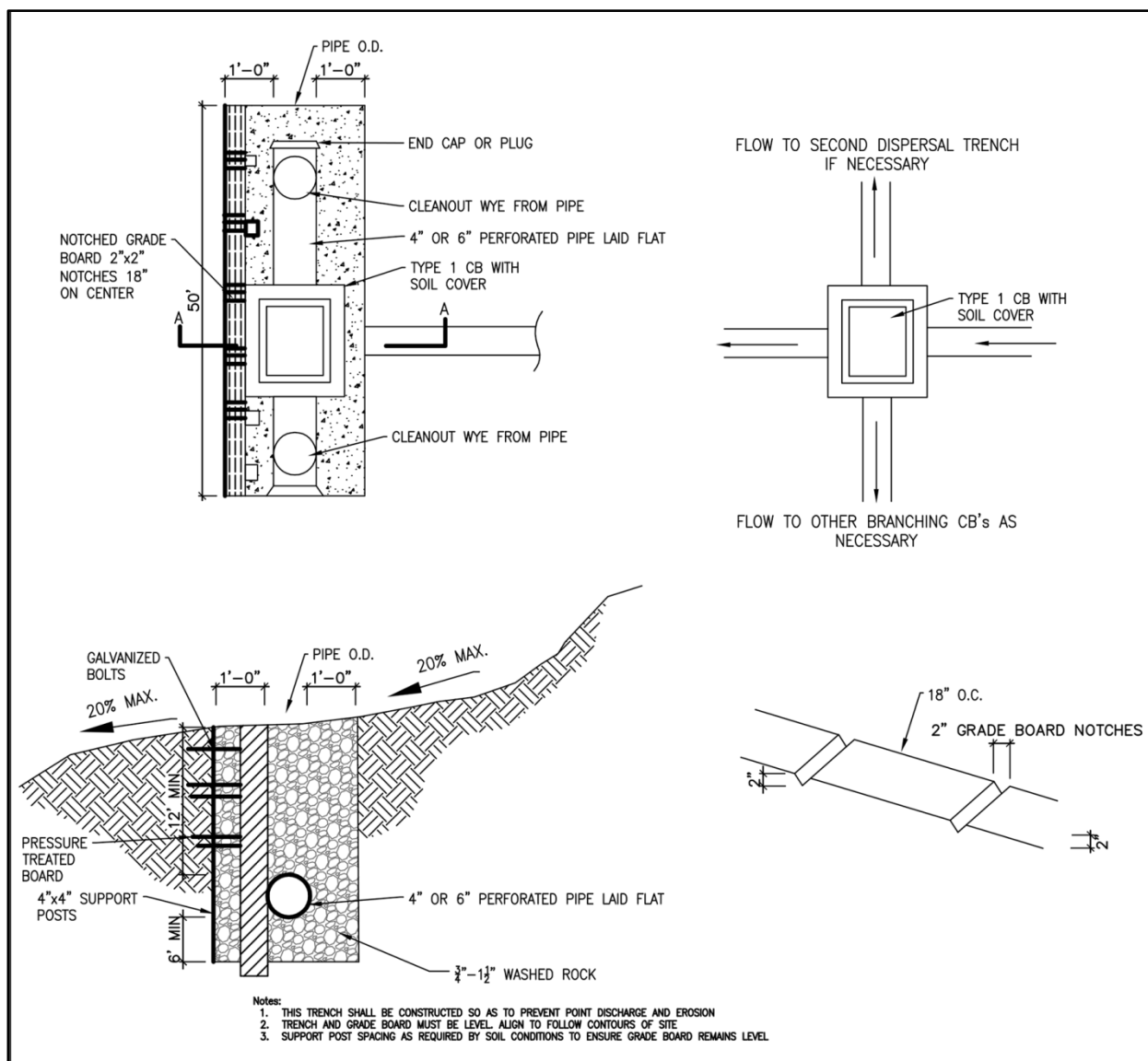


Figure 25: Dispersion Trench with Notched Grade Board

(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.

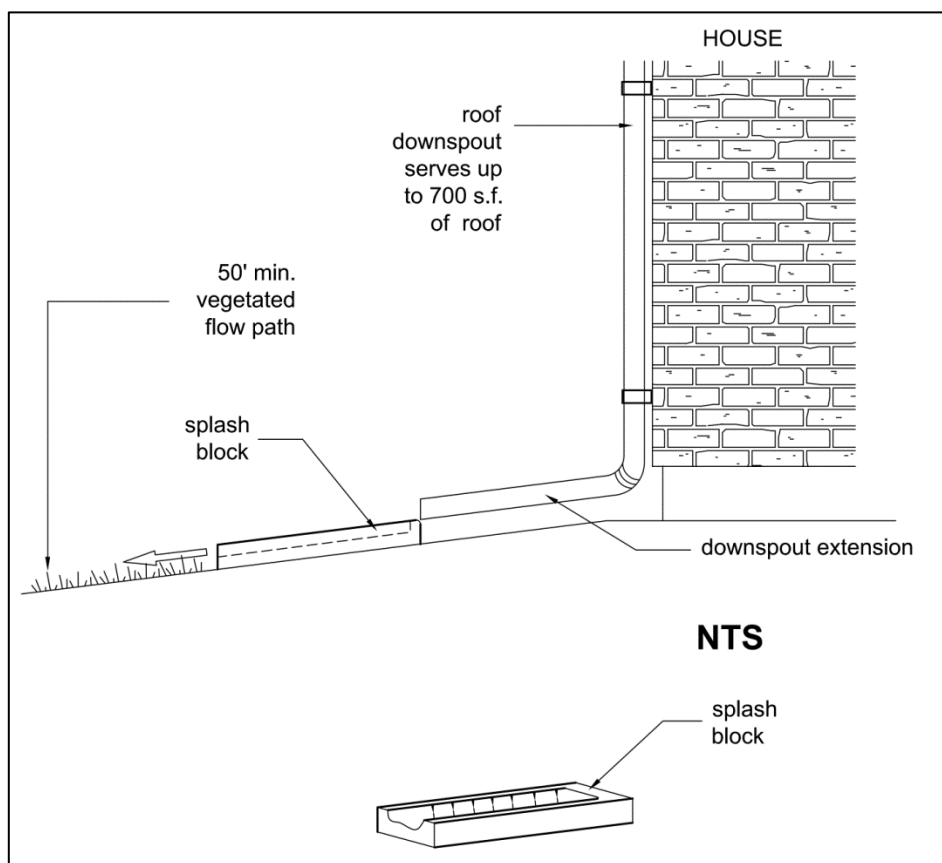


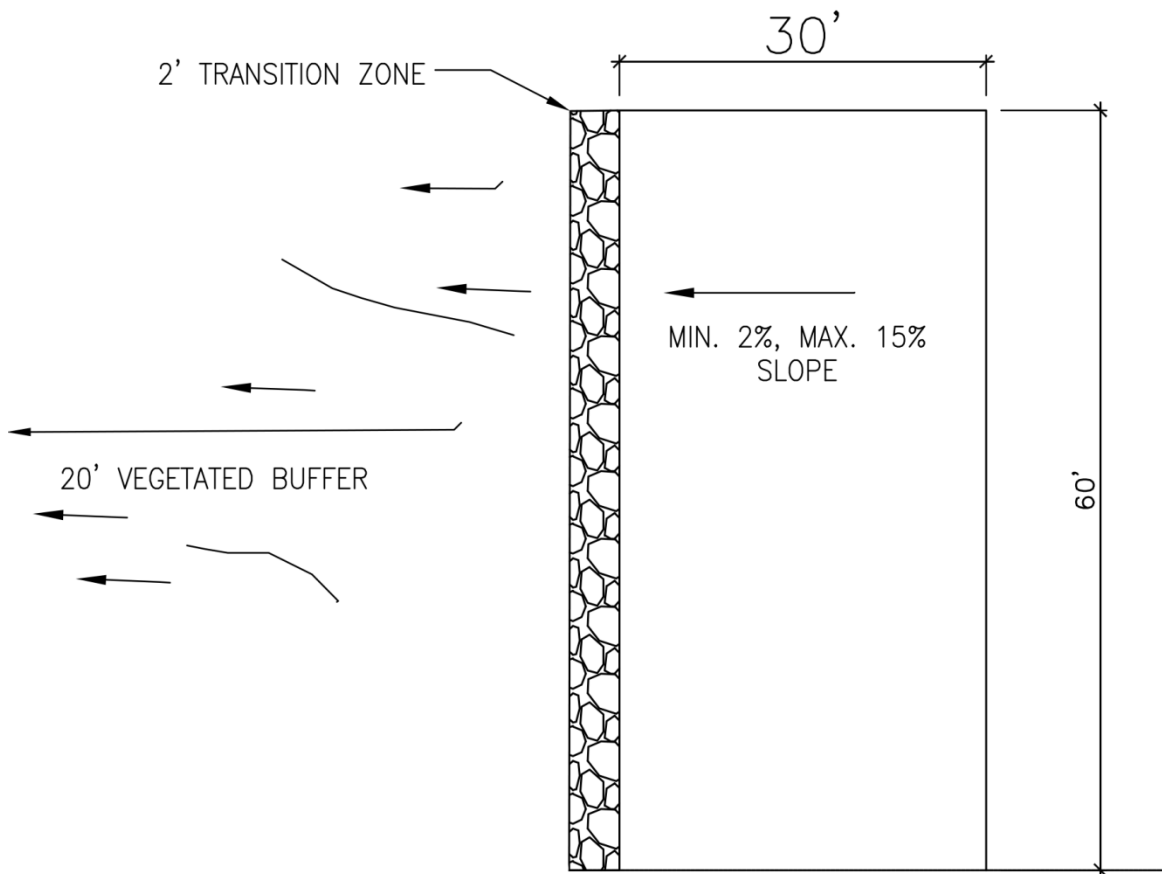
Figure 26: Typical Splashblock

(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.



Notes:

1. 10' MIN. VEGETATED FLOW PATH FOR EACH 20' OF IMPERVIOUS SURFACE DISPERSED
2. IF MINIMUM REQUIREMENT #7 APPLIES, USE 25' MIN. FLOWPATH FOR EACH 20' IMPERVIOUS SURFACE DISPERSED TO OBTAIN MODELING CREDIT

Figure 27: Sheet Flow Dispersion for Flat and Moderate Sloped Surfaces

(Source: Clark County)

Applications, Limitations and Setbacks

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

concentration of flows can be avoided.

Setbacks

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

Infeasibility

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

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

Design Criteria

- A 2 foot-wide transition zone shall be maintained (to discourage channeling between the edge of the impervious surface and the downslope vegetation). This transition zone may consist of an extension of subgrade material (crushed rock), modular pavement, drain rock, or other material approved by Clark County.
- The sheet flow dispersion area must abut the entire edge of the impervious area being treated by the BMP.
- A 10 foot vegetated flow path must be provided for each 20 feet of impervious surface. For each additional 20 feet of impervious surface or fraction thereof, an additional 10 feet of vegetated flow path must be provided. For example, if a driveway is 30 feet wide and 60 feet long provide a 20-foot wide by 60-foot long vegetated buffer, with a 2-foot by 60-foot transition zone. See Figure 25.
- No erosion or flooding of downstream properties shall result.

- Runoff discharge toward landslide hazard areas must be evaluated by a geotechnical engineer or a qualified geologist.
- Sheet flow dispersion shall not be allowed on or above slopes greater than 20%, or above erosion hazard areas, without evaluation by a geotechnical engineer or qualified geologist and approval by Clark County.
- For sites with septic systems, the discharge area shall be at least 10 feet below the elevation of the drainfield primary and reserve areas. Clark County may waive this requirement during plan approval if site topography clearly prohibits flows from intersecting the drainfield.

BMP T5.11: Concentrated Flow Dispersion

Purpose and Description

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

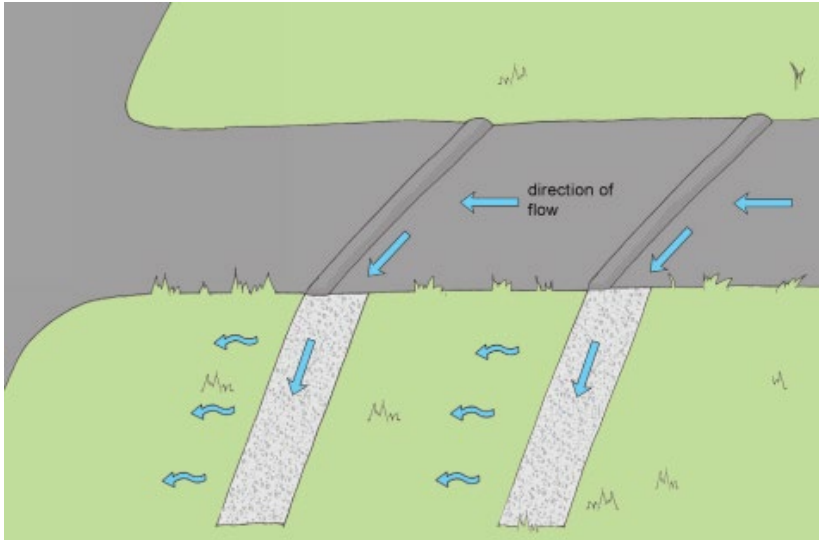


Figure 28: Illustration of Driveway Dispersion Using Berms and Dispersion Trenches

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.

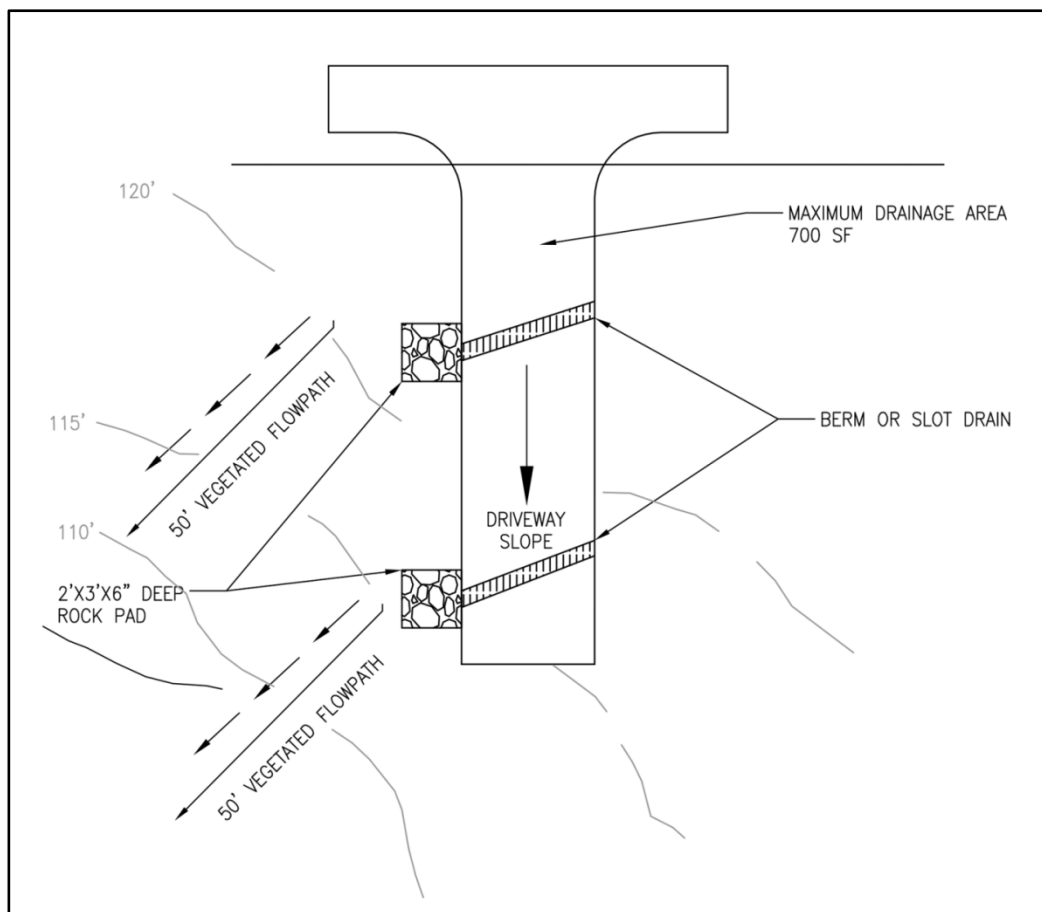


Figure 29: Concentrated Flow Dispersion Using Rock Pad

(Source: Clark County)

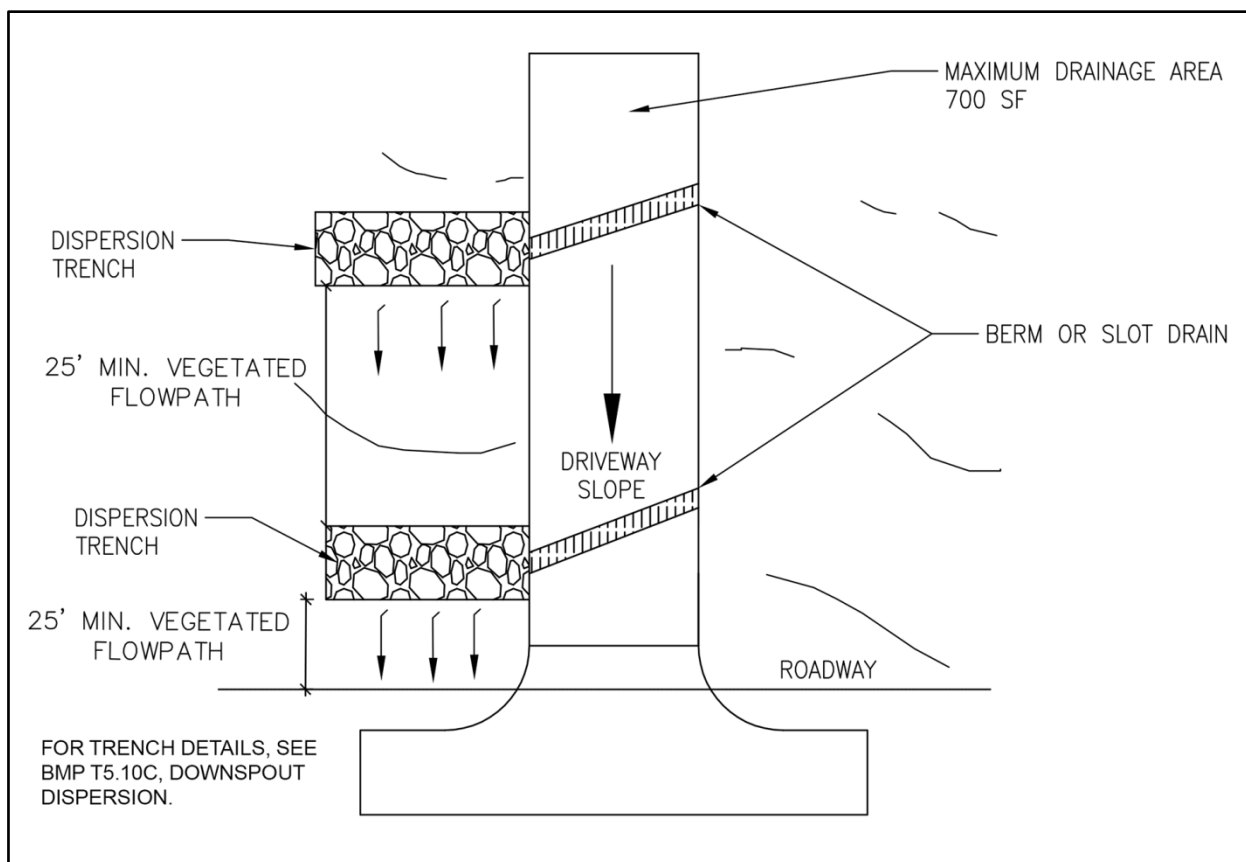


Figure 30: Concentrated Flow Dispersion Using Dispersion Trench

(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.

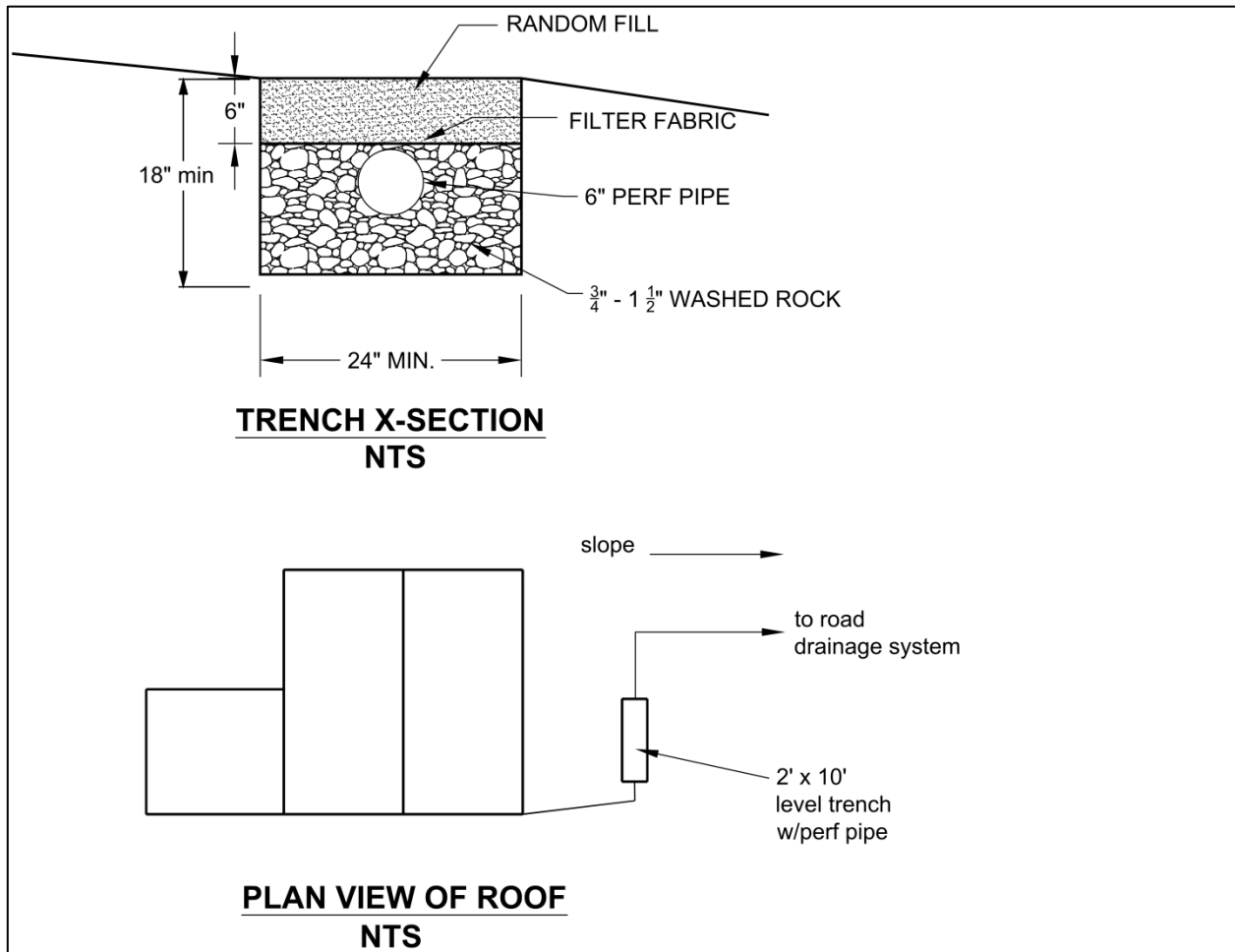


Figure 31: Typical Perforated Stub-out Connection

(Source: King County Surface Water Design Manual 2009)

Applications, Limitations and Setbacks

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

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

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

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

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

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

Setbacks

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

Infeasibility

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

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

Design Criteria

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

Section 10 — Erosion and Sediment Control BMPs

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

BMP C101: Preserving Natural Vegetation

Purpose and Description

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

Conditions of Use

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

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

Design Criteria

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

For Trees to be Preserved

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

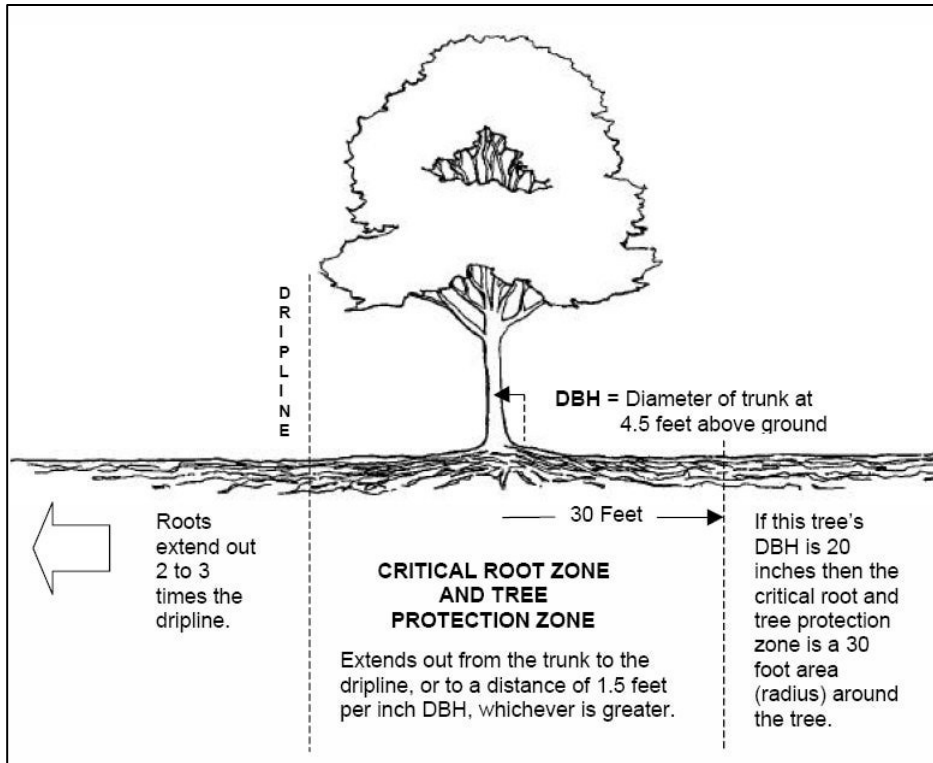


Figure 32: Illustration of Tree's Critical Root Zone

(Source: Athens/Clark County, Georgia)

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

Maintenance Standards

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

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

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

BMP C102: Buffer Zones

Purpose and Description

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

Conditions of Use

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

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

Design Criteria

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

Maintenance Standards

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

BMP C103: High Visibility Fence

Purpose and Description

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

Conditions of Use

Appropriate for all sites.

Design Criteria

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

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

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

Fences shall not be wired or stapled to trees.

Maintenance Standards

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

BMP C105: Stabilized Construction Entrance / Exit

Purpose and Description

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

Conditions of Use

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

Design Criteria

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



Figure 33: Small-scale Construction Entrance

Maintenance Standards

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

BMP C121: Mulching

Purpose and Description

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

Conditions of Use

As a temporary cover measure, mulch should be used:

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

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

Design Criteria

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

The following materials are allowed as mulch.

Chipped Site Vegetation

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

Straw

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

Coarse Compost

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

- Minimum Percent passing 3” sieve openings 100%
- Minimum Percent passing 1” sieve openings 90%
- Minimum Percent passing $\frac{3}{4}$ ” sieve openings 70%
- Minimum Percent passing $\frac{1}{4}$ ” sieve openings 40%.

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

Hog Fuel

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

Wood Strand Mulch

- A minimum of 95-percent of the wood strand shall have lengths between 2 and 10-inches, with a width and thickness between $\frac{1}{16}$ and $\frac{3}{8}$ -inches.
- The mulch shall not contain resin, tannin, or other compounds in quantities that would be detrimental to plant life.
- Sawdust or wood shavings shall not be used as mulch

Maintenance Standards

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

BMP C123: Plastic Covering

Purpose and Description

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



Figure 34: 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 convey clean rainwater away from bare soil and disturbed areas. Do not mix clean runoff from a plastic covered slope with dirty runoff from a project.

Design Criteria

Plastic slope cover must be installed as follows:

1. Run plastic up and down slope, not across slope.
 2. Plastic may be installed perpendicular to a slope if the slope length is less than 10 feet.
 3. Minimum of 8-inch overlap at seams.
 4. On long or wide slopes, or slopes subject to wind, tape all seams.
 5. Place plastic into a small (12-inch wide by 6-inch deep) slot trench at the top of the slope and backfill with soil to keep water from flowing underneath.
 6. Place sand filled burlap or geotextile bags every 3 to 6 feet along seams and tie them together with twine to hold them in place.
 7. Inspect plastic for rips, tears, and open seams regularly and repair immediately. This prevents high velocity runoff from contacting bare soil which causes extreme erosion.
 8. Sandbags may be lowered into place tied to ropes. However, all sandbags must be staked in place.
- Plastic sheeting shall have a minimum thickness of 0.06 millimeters.
 - If erosion at the toe of a slope is likely, a gravel berm, riprap, or other suitable protection shall be installed at the toe of the slope in order to reduce the velocity of runoff.

Maintenance Standards

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

BMP C150: Materials on Hand

Purpose and Description

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

Conditions of Use

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

Design Criteria

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

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

Maintenance Standards

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

BMP C151: Concrete Handling

Purpose and Description

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

Conditions of Use

Any time concrete is used, utilize these management practices.

Design Criteria

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

Maintenance Standards

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

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

Purpose and Description

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

Conditions of Use

The CESCL shall:

- Have a current certificate proving attendance in an erosion and sediment control training course that meets the minimum ESC training and certification requirements established by Ecology (see details below). Ecology will maintain a list of ESC training and certification providers at: <https://ecology.wa.gov/Regulations-Permits/Permits-certifications/Certified-erosion-sediment-control>.

OR

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

Specifications

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

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

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

•

BMP C203: Water Bars

Purpose and Description

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

Conditions of Use

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

Design Criteria

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

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

Guideline for Spacing:

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

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

Maintenance Standards

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

- Immediately remove sediment from the flow area and repair the dike.
-

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

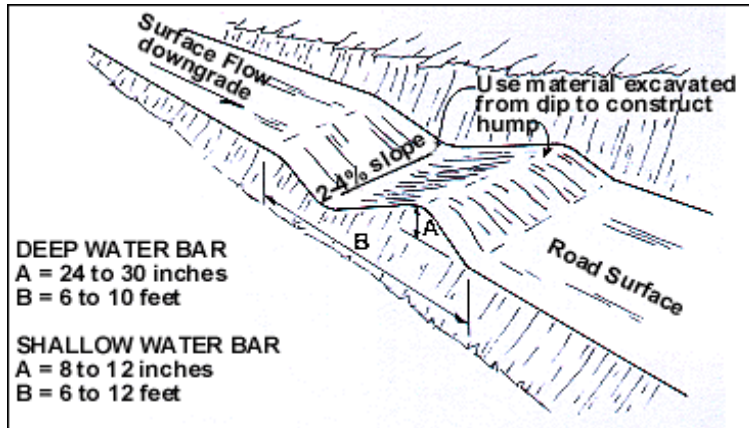


Figure 35: Water Bar

(Source: SMMWW)

BMP C207: Check Dams

Purpose and Description

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

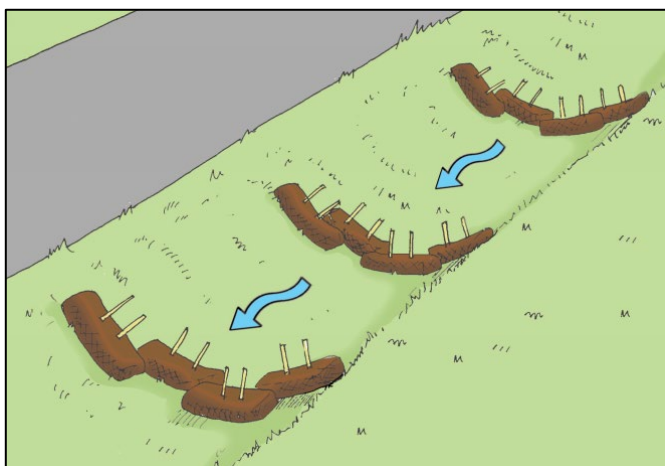


Figure 36: Illustration of Check Dams

Conditions of Use

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

Design Criteria

Materials

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

Placement

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

Shape and Size

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

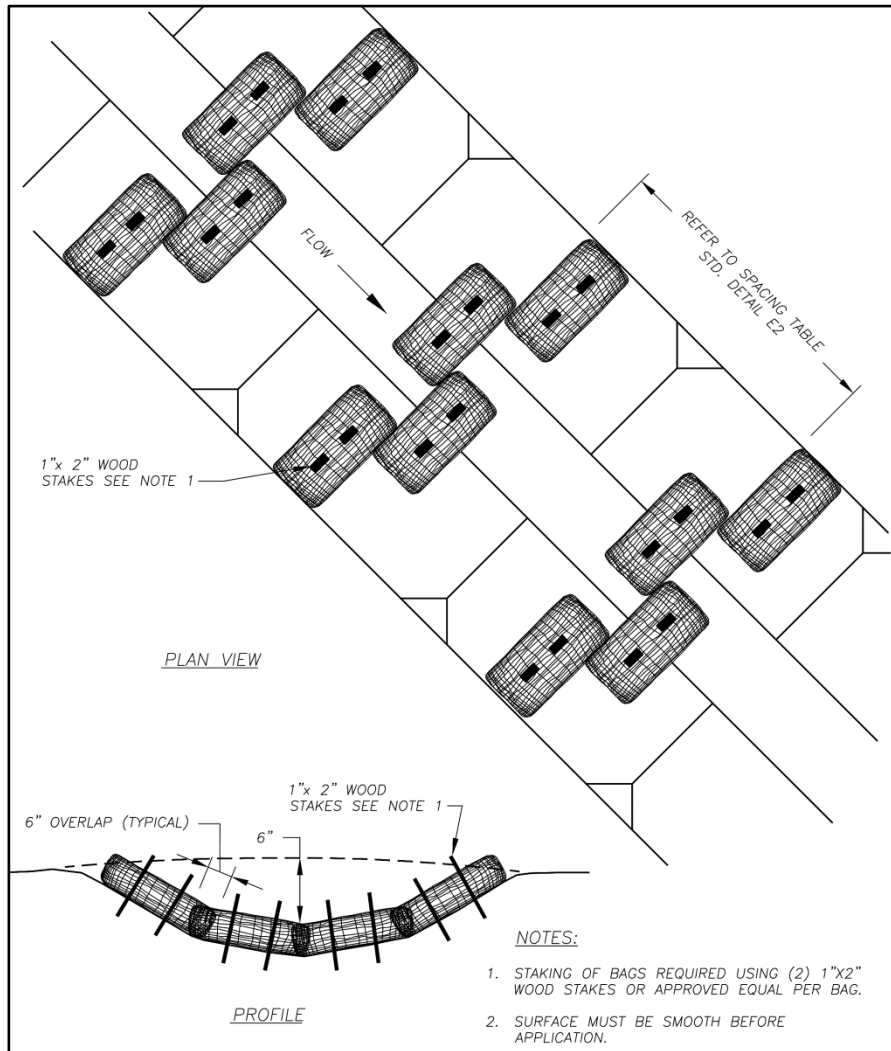


Figure 37: Check Dam using Bio-filter Bags

(Source: Clark County)

Installation

- Before installing check dams impound and bypass upstream water flow away from the work area. Options for bypassing include pumps, siphons, or temporary channels.

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

Removal

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

Maintenance Standards

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

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

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

Purpose and Description

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

Conditions of Use

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

TSDs have been used to build temporary:

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

Design Criteria

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

Dimensions

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

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

Installation

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

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

Placement

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

Removal

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

Maintenance Standards

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

BMP C209: Outlet Protection

Purpose and Description

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

Conditions of Use

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

Design Criteria

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

Maintenance Standards

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

BMP C220: Storm Drain Inlet Protection

Purpose and Description

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

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.

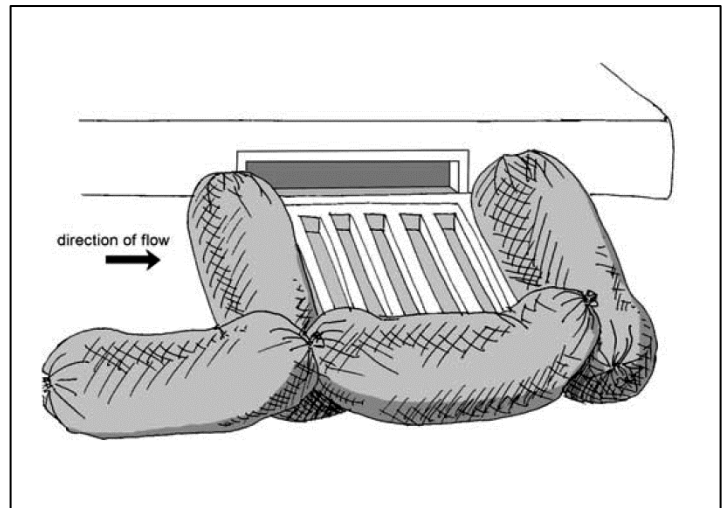


Figure 55: Illustration of Storm Drain Inlet Protection

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

Design Criteria

Bio-filter Bag Inlet Protection

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

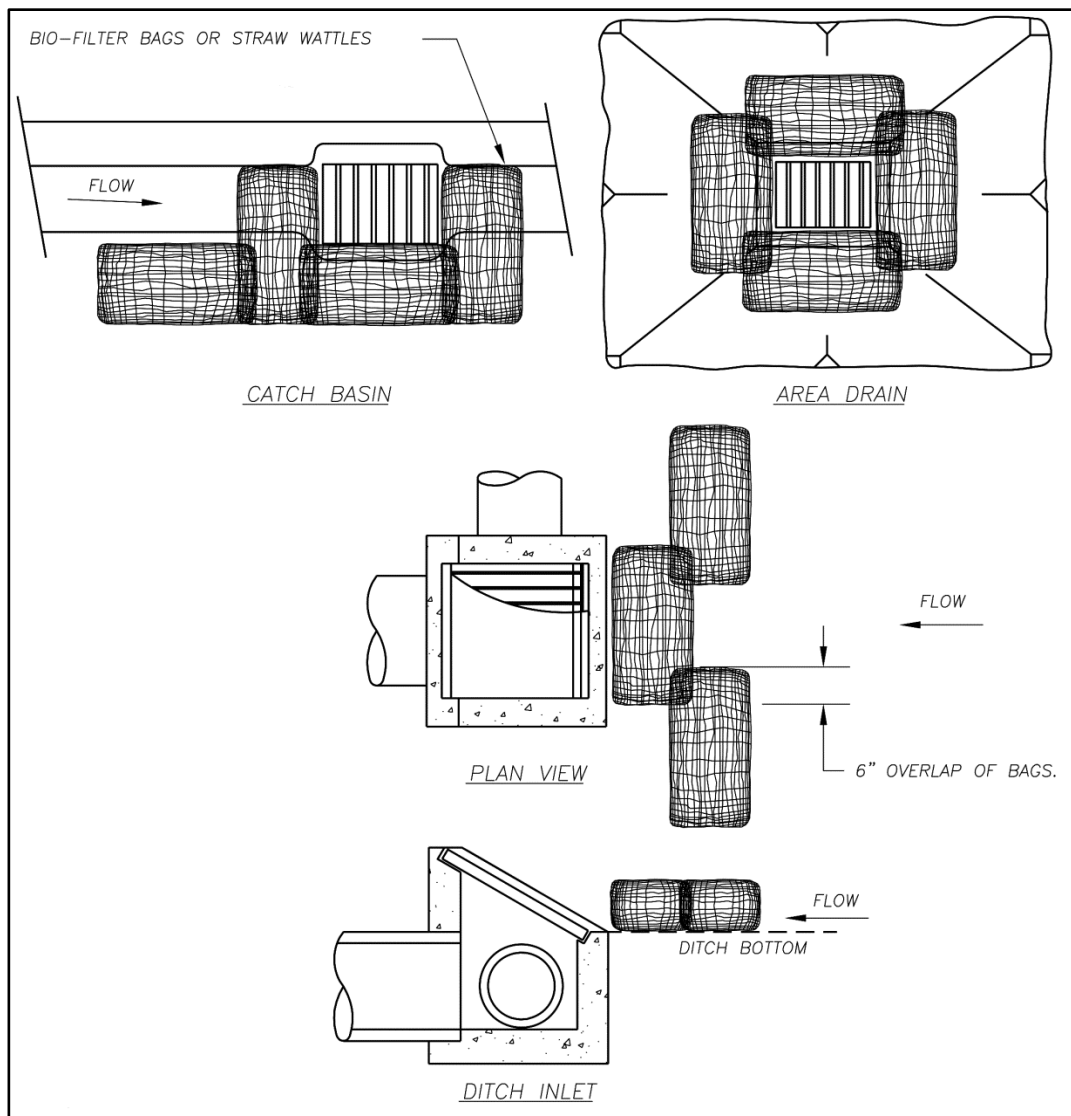


Figure 39: Inlet Protection with Bio-filter Bags

(Source: Clark County)

Catchbasin Filters

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

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

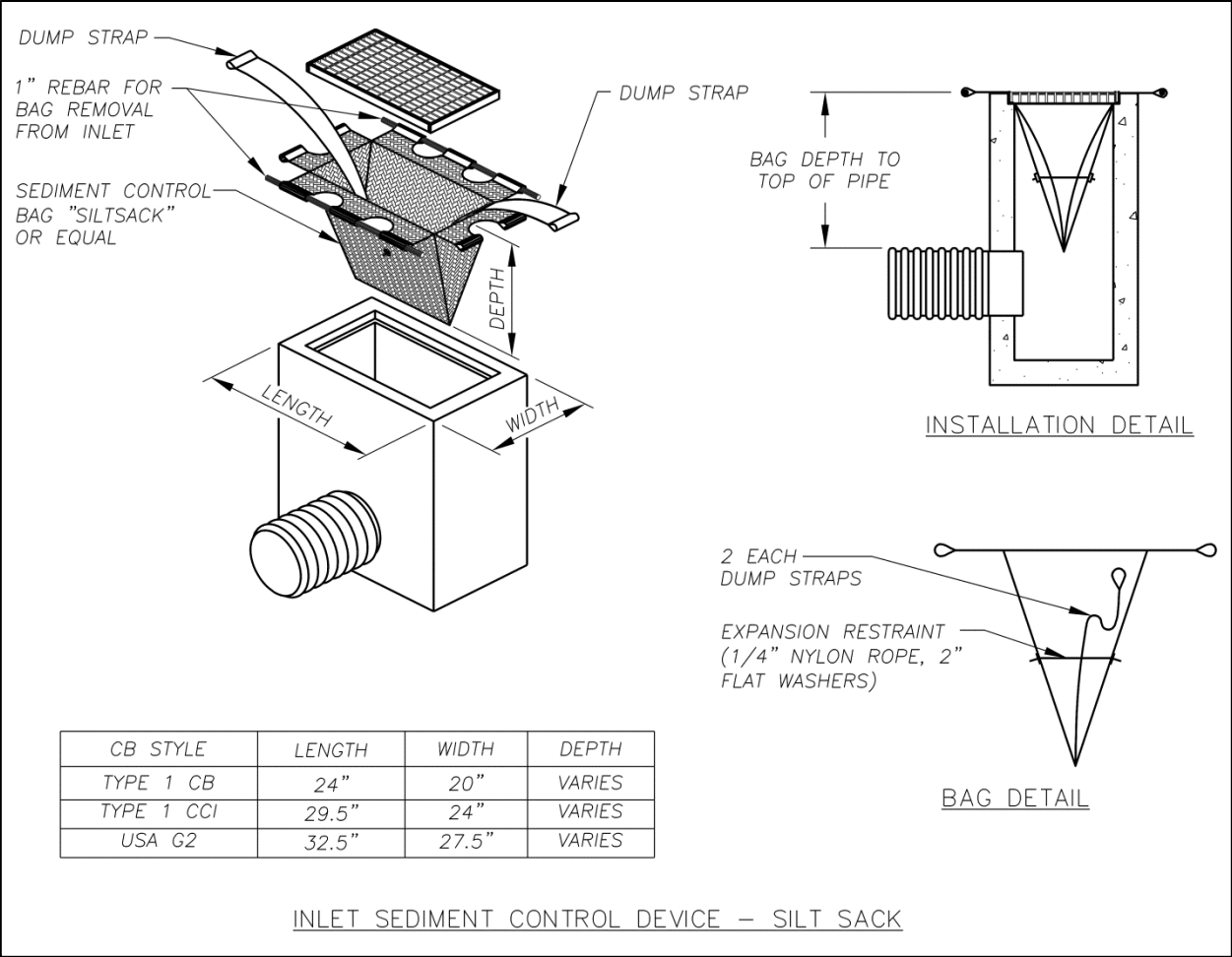


Figure 40: Silt Sack Detail

(Source: Clark County)

BMP C23I: Brush Barrier

Purpose and Description

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

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

Conditions of Use

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

Design Criteria

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

Maintenance Standards

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

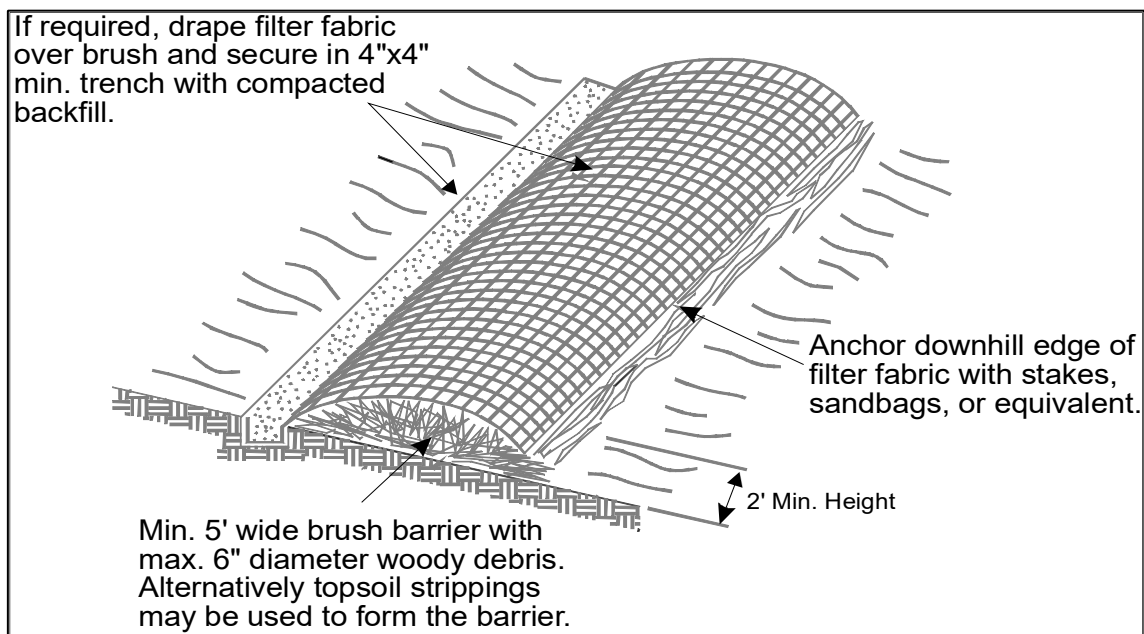


Figure 41: Brush Barrier

(Source: WA State Dept. of Ecology)

BMP C233: Silt Fence

Purpose and Description

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

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.

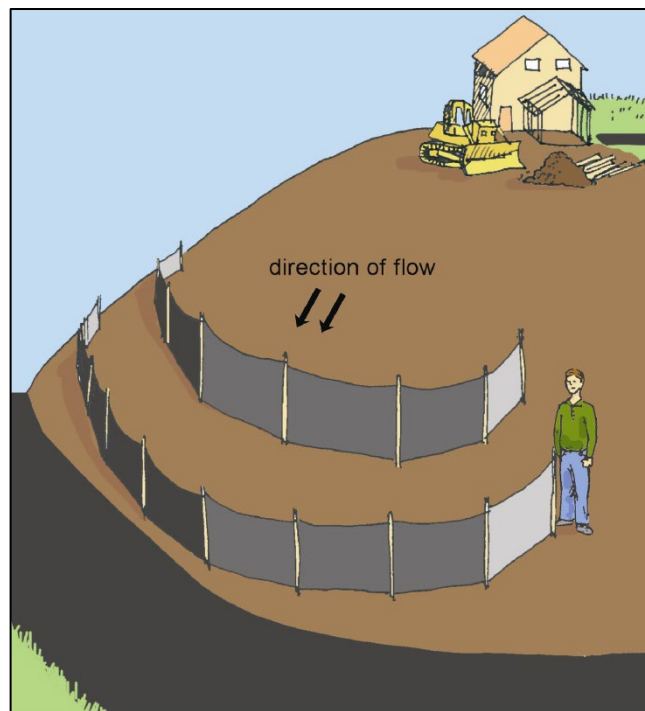


Figure 59: Illustration of Silt Fence

Design Criteria

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

be overlapped, provided that the overlap is long enough and that the adjacent fence sections are close enough together to prevent silt laden water from escaping through the fence at the overlap.

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

Maintenance Standards

- Repair any damage immediately.
- Intercept and convey all evident concentrated flows uphill of the silt fence to a sediment pond.
- Check the uphill side of the fence for signs of the fence clogging and acting as a barrier to flow and then causing channelization of flows parallel to the fence. If this occurs, replace the fence or remove the trapped sediment.

- Remove sediment deposits when the deposit reaches approximately one-third the height of the silt fence, or install a second silt fence.
- Replace filter fabric that has deteriorated due to ultraviolet breakdown.

BMP C234: Vegetated Strip

Purpose and Description

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

Conditions of Use

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

Table 0.4: Contributing Drainage Area for Vegetated Strips

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

Design Criteria

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

Maintenance Standards

- Any areas damaged by erosion or construction activity shall be seeded immediately and protected by mulch.
- If more than 5 feet of the original vegetated strip width has had vegetation removed or is being eroded, sod must be installed.

- If there are indications that concentrated flows are traveling across the buffer, surface water controls must be installed to reduce the flows entering the buffer, or additional perimeter protection must be installed.

BMP C235: Wattles

Purpose and Description

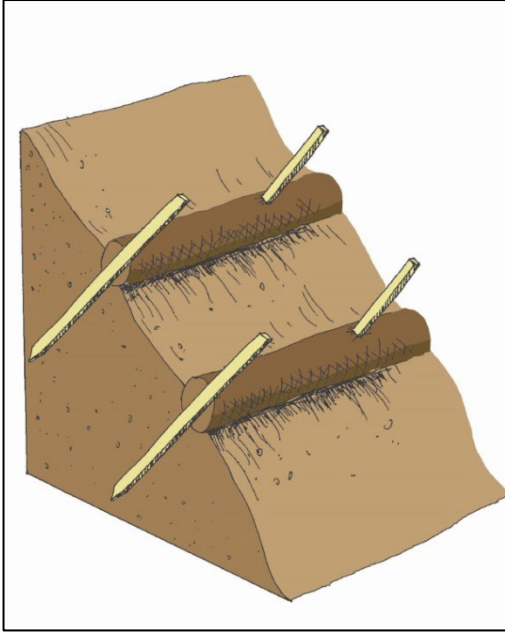


Figure 60: Illustration of Wattles

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.

Conditions of Use

Use wattles:

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

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

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

Design Criteria

- Install wattles perpendicular to the flow direction and parallel to the slope contour.
- Dig narrow trenches across the slope on contour to a depth of 3 to 5 inches on clay soils and soils with gradual slopes. On loose soils, steep slopes, and areas with high rainfall, dig trenches to a depth of 5 to 7 inches, or 1/2 to 2/3 of the thickness of the wattle.
- Start building trenches and installing wattles from the base of the slope and work up. Spread excavated material evenly along the uphill slope and compact using hand tamping or other methods.

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

Maintenance Standards

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

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

Purpose and Description

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

Conditions of Use

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

Design Criteria

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

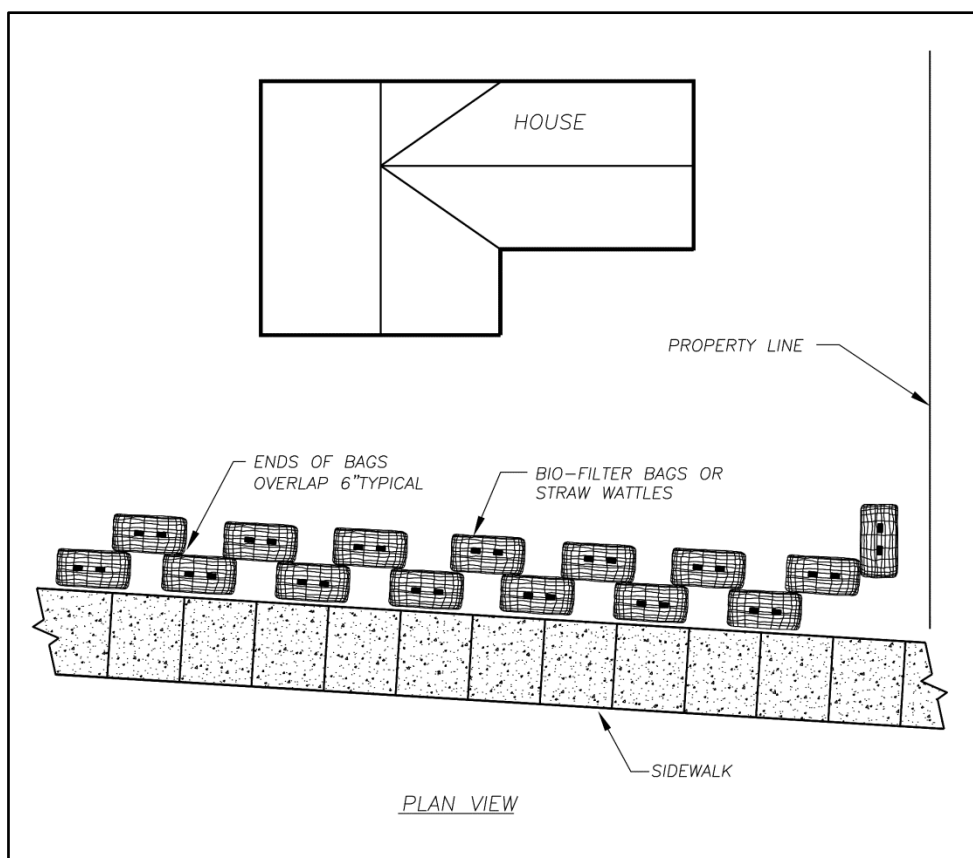


Figure 44: Bio-filter Bags Sediment Barrier

(Source: Clark County)

Appendix I- J

Abbreviated Construction Stormwater Pollution Prevention Plan (SWPPP)

Abbreviated Construction Stormwater Pollution Prevention Plan (SWPPP)

The Abbreviated Construction SWPPP is a form designed to fulfil Minimum Requirement #2 of the *Clark County Stormwater Manual*. This form may be revised by the Responsible Official.

6.6.4 Table of Contents

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The Abbreviated Construction SWPPP may be used for projects that are required to submit a Construction SWPPP under Minimum Requirement #2 and that disturb less than 1 acre. See the *Clark County Stormwater Manual* (CCSM), Section 1.8.4 to confirm eligibility to use this form.

Section I — Submittal Requirements

The Abbreviated Construction SWPPP (SWPPP) shall be prepared and stamped by a licensed engineer in the state of Washington or, if preparation of the SWPPP does not involve the practice of engineering, by a person who holds a valid Certified Erosion and Sediment Control Lead (CESCL) certification.

Submittal timing differs based on the type of permit or application and should be discussed with the Responsible Official. In all cases, the SWPPP shall be submitted prior to any land-disturbing activity.

The following submittals are required:

- Completed Abbreviated Construction SWPPP form (Section 2 – 3)
- Erosion and Sediment Control Site Plan (see Section 4)
- Standard details of Best Management Practices (BMPs), when required (see Section 3E)
- Engineering drawings and calculations of BMPs, when required (see Section 3E)

Purpose

Release of sediment, mud, and muddy stormwater from construction sites is prohibited. The SWPPP describes how erosion, sediment, and stormwater will be controlled during construction. The document lists and shows all erosion and sediment control (ESC) best management practices (BMPs) selected for the site. The SWPPP must be updated if conditions or plans change or if the ESC BMPs are found to be ineffective.

Section 2 — Project Overview

County Permit

Development Case or Building Permit Number(s): _____

Property Info

Project Address: _____

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

Applicant Info

Name: _____

Address: _____

Phone Number: _____ E-mail: _____

Property Owner Info

Name: _____

Address: _____

Phone Number: _____ E-mail: _____

Erosion Control Inspector / CESCL

Designate an erosion control inspector who has the skills to assess the site conditions and construction activities that could impact stormwater quality and the effectiveness of ESC BMPs. The inspector must be on-site or on-call at all times. If construction is carried out by a licensed contractor, then the inspector must be a Certified Erosion and Sediment Control Lead (CESCL).

☐ Inspector identified below will be on-site or on-call at all times.

Name: _____ CESCL # (if needed): _____

Address: _____

Phone Number: _____ Emergency Phone: _____

Section 3 — Project Narrative

The information required in this section is the project narrative. It describes the site and briefly summarizes the planned improvements.

Complete Sections A – E, below.

Note: From October 1 thru April 30, clearing, grading, and other soil disturbing activities shall only be permitted by special authorization from the Responsible Official.

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 or acres)	
Total Volume of Cuts (cubic yards)	
Total Volume of Fill (cubic yards)	

Brief Project Description:

B. Existing Site Conditions


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

6. Describe the existing site conditions.

- | | | | |
|--------------------------------------|----------------------------------|----------------------------------|-----------------------------------|
| <input type="checkbox"/> Forest | <input type="checkbox"/> Prairie | <input type="checkbox"/> Pasture | <input type="checkbox"/> Pavement |
| <input type="checkbox"/> Landscaping | <input type="checkbox"/> Brush | <input type="checkbox"/> Trees | <input type="checkbox"/> Other |

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

- | | | | |
|--|---------------------------------------|--------------------------------------|--------------------------------------|
| <input type="checkbox"/> Overland | <input type="checkbox"/> Gutter | <input type="checkbox"/> Catch Basin | <input type="checkbox"/> Ditch/Swale |
| <input type="checkbox"/> Storm sewer pipes | <input type="checkbox"/> Stream/Creek | <input type="checkbox"/> Other | |

2.  Are sensitive and/or critical areas present on the site?

- | | | | |
|-------------------------------------|--------------------------------------|-----------------------------------|---|
| <input type="checkbox"/> Streams | <input type="checkbox"/> Lakes/Ponds | <input type="checkbox"/> Wetlands | <input type="checkbox"/> Steep Slopes/Geohazard |
| <input type="checkbox"/> Floodplain | <input type="checkbox"/> Springs | <input type="checkbox"/> Habitat | <input type="checkbox"/> Critical Aquifer Recharge Area |

3. Existing utilities and underground objects?

- | | | | |
|-------------------------------------|---|--|--------------------------------|
| <input type="checkbox"/> Storm | <input type="checkbox"/> Water | <input type="checkbox"/> Sewer | <input type="checkbox"/> Other |
| <input type="checkbox"/> Fuel tanks | <input type="checkbox"/> Septic systems | <input type="checkbox"/> Groundwater wells | |

C. Adjacent Areas

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

- | | | | |
|--|--------------------------------|---|--|
| <input type="checkbox"/> Streams | <input type="checkbox"/> Lakes | <input type="checkbox"/> Wetlands | <input type="checkbox"/> Steep Slopes/Geohazards |
| <input type="checkbox"/> Residential Areas | <input type="checkbox"/> Roads | <input type="checkbox"/> Ditches, pipes, culverts | |
| <input type="checkbox"/> Other | _____ | | |
-
-

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

9. Describe the downstream drainage path leading from the site to adjacent property, drainage system, or water body. If water is held on-site, describe it:

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 soils information to be submitted before allowing construction on these sites. Permanent infiltration facilities shall not be used during construction unless approved in writing by the Responsible Official.

10. Does the project propose construction on or near slopes 15% or greater?

☐ Yes ☐ No

11. Does the project propose to infiltrate construction stormwater?

☐ Yes ☐ No

☐ If yes, obtain and attach approval letter from the Responsible Official.

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.

Instructions for using and installing each BMP are given in CCSM Book 2, Chapter 8 2. An index of standard details of many BMPs is given on the Clark County Public Works web site.

Instructions

1. Review the 13 elements of a construction SWPPP, below.
2. Select at least one BMP for each element (review BMP descriptions in CCSM Book 2, Chapter 8 2, if needed).
3. For any BMP you select, follow the instructions in the table for including the BMP in the Abbreviated Construction SWPPP.
 - a. If instructed to draw the BMP on the site plan, see Section 4 for instructions.
 - b. If instructed to submit the standard detail, find the BMP's standard detail using the Clark County Public Works web site, and then print and submit the detail.
 - c. If instructed to submit a detailed drawing and/or calculations, then have an engineer provide a detailed drawing of the proposed BMP in plan and profile views with dimensions and calculations described in the design criteria.
4. If the element does not apply to the project, check "N/A" and describe why. Section

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:

Check to Select	If Selected		
	Draw Location(s) on Site Plan	Submit Standard Detail	Submit Detailed Drawing*
<input type="checkbox"/> C101 Preserving Native Vegetation	x		
<input type="checkbox"/> C102 Buffer Zones	x		
<input type="checkbox"/> C103 High Visibility Fence	x		

<input type="checkbox"/> C233 Silt Fence	x	x	
* Requires Engineering			

OR ☐ Element is N/A: _____

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:

Check to Select	If Selected		
	Draw Location(s) on Site Plan	Submit Standard Detail	Submit Detailed Drawing/Calcs*
<input type="checkbox"/> C105 Stabilized Construction Entrance	x	x	
<input type="checkbox"/> C106 Wheel Wash	x		
<input type="checkbox"/> C107 Construction Road/Parking Area Stabilization	x		
* Requires Engineering			

OR ☐ Element is N/A: _____

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:

Check to Select	If Selected		
	Draw Location(s) on Site Plan	Submit Standard Detail	Submit Detailed Drawing/Calcs*
<input type="checkbox"/> C240 Sediment Trap	x		x
<input type="checkbox"/> C203 Water Bar	x		
<input type="checkbox"/> C207 Check Dams	x	x	
<input type="checkbox"/> C235 Wattles	x	x	
* Requires Engineering			

OR ☐ Element is N/A: _____

Element #4 – Install Sediment Controls

Prior to leaving a construction site, runoff from disturbed areas must pass through a sediment removal device. Sediment barriers are used to slow sheet flow of stormwater and allow the sediment to settle out behind the barrier. Install/construct the sediment control BMP before site grading.

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

Check to Select	If Selected		
	Draw Location(s) on Site Plan	Submit Standard Detail	Submit Detailed Drawing/Calcs*
<input type="checkbox"/> C231 Brush Barrier	x		
<input checked="" type="checkbox"/> C232 Gravel Filter Berm	x	x	x
<input type="checkbox"/> C233 Silt Fence	x	x	
<input type="checkbox"/> C234 Vegetated Strip	x		
<input type="checkbox"/> C235 Wattles	x	x	
<input type="checkbox"/> C240 Sediment Trap	x		x
* Requires Engineering			

OR ☐ Element is N/A: _____

Element #5 – Stabilize Soils

Stabilize exposed and unworked soils by applying BMPs that protect the soils from raindrop impact, flowing water, and wind.

During the wet season 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:

Check to Select	If Selected		
	Draw Location(s) on Site Plan	Submit Standard Detail	Submit Detailed Drawing/Calcs*
<input type="checkbox"/> C120 Temporary and Permanent Seeding	x		
<input type="checkbox"/> C121 Mulching	x		
<input type="checkbox"/> C122 Nets and Blankets	x		
<input type="checkbox"/> C123 Plastic Covering	x	x	
<input type="checkbox"/> C124 Sodding	x		
<input type="checkbox"/> C125 Compost	x		
<input type="checkbox"/> C126 Topsoiling	x		
<input type="checkbox"/> C131 Gradient Terraces	x		
<input type="checkbox"/> C130 Surface Roughening	x		
<input type="checkbox"/> C140 Dust Control	x		
* Requires Engineering			

OR ☐ Element is N/A: _____

Element #6 – Protect Slopes

Protect slopes by diverting water away from 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:

Check to Select	If Selected		
	Draw Location(s) on Site Plan	Submit Standard Detail	Submit Detailed Drawing/Calcs*
<input type="checkbox"/> C200 Interceptor Dike and Swale	x		x
<input type="checkbox"/> C201 Grass-Lined Channels	x		x
<input type="checkbox"/> C203 Water Bars	x		
<input type="checkbox"/> C204 Pipe Slope Drains	x		x
<input type="checkbox"/> C206 Level Spreader	x		
<input type="checkbox"/> C207 Check Dams	x	x	
<input type="checkbox"/> C208 Triangular Silt Dike	x		
* Requires Engineering			

OR ☐ Element is N/A: _____

Element #7 – Protect Drain Inlets

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

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

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

Check to Select	If Selected		
	Draw Location(s) on Site Plan	Submit Standard Detail	Submit Detailed Drawing/Calcs*
<input type="checkbox"/> C220 Storm Drain Inlet Protection	x		
* Requires Engineering			

OR ☐ Element is N/A: _____

Element #8 – Stabilize Channels and Outlets

Stabilize all temporary and permanent conveyance channels and their outlets.

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

Check to Select	If Selected		
	Draw Location(s) on Site Plan	Submit Standard Detail	Submit Detailed Drawing/Calcs*
<input type="checkbox"/> C122 Nets and Blankets	x		
<input type="checkbox"/> C202 Channel Lining	x		
<input type="checkbox"/> C207 Check Dams	x	x	
<input type="checkbox"/> C209 Outlet Protection	x		
* Requires Engineering			

OR ☐ Element is N/A: _____

Element #9 – Control Pollutants

Handle and dispose of all pollutants, including demolition debris and other solid wastes, to keep them out of rain and 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:

Check to Select	If Selected		
	Draw Location(s) on Site Plan	Submit Standard Detail	Submit Detailed Drawing/Calcs*
<input type="checkbox"/> C150 Materials on Hand	x		
<input type="checkbox"/> C151 Concrete Handling	x		
<input type="checkbox"/> C152 Sawcutting and Surface Pollution Prevention	x		
<input type="checkbox"/> C153 Materials, Delivery, Storage, and Containment	x		
<input type="checkbox"/> C154 Concrete Washout Area	x		x
* Requires Engineering			

OR ☐ Element is N/A: _____

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 downstream conveyances or 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:

Check to Select	If Selected		
	Draw Location(s) on Site Plan	Submit Standard Detail	Submit Detailed Drawing/Calcs*
<input type="checkbox"/> C203 Water Bars	x		
<input type="checkbox"/> C236 Vegetative Filtration	x		
* Requires Engineering			

OR ☐ Element is N/A: _____

Element #11 – Maintain BMPs

Maintain and repair ESC BMPs as needed. Inspect all BMPs at least weekly and after every storm event. Keep an inspection log on site and available for review by the County inspector at all times.

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:

Check to Select	If Selected		
	Draw Location(s) on Site Plan	Submit Standard Detail	Submit Detailed Drawing/Calcs*
<input type="checkbox"/> C150 Materials on Hand	x		
<input type="checkbox"/> C160 Certified Erosion and Sediment Control Lead			
* Requires Engineering			

OR ☐ Element is N/A: _____

Element #12 – Manage the Project

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

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

The erosion control inspector is responsible for:

- Ensuring that the erosion and sediment control BMPs are appropriate for the site and are functioning.
- Updating the Abbreviated Construction SWPPP when site conditions warrant.
- Maintaining the inspection log on site.

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

Check to Select	If Selected		
	Draw Location(s) on Site Plan	Submit Standard Detail	Submit Schedule
<input type="checkbox"/> C160 Certified Erosion and Sediment Control Lead			
<input type="checkbox"/> C162 Scheduling			x
* Requires Engineering			

OR ☐ Element is N/A: _____

Element #13 – Protect Low Impact Development BMPs

Protect LID BMPs from compaction, erosion, and sedimentation.

Bioretention and Rain Gardens

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

Protect all bioretention and rain gardens from sedimentation through installation and maintenance of erosion and sediment control BMPs on portions of the site that drain into them.

If they accumulate sediment during construction, restore the BMPs to their fully functioning condition. Restoration must include removal of sediment and any sediment-laden bioretention/rain garden soils, and replacing the removed soils with soils meeting the design specification.

Permeable Pavement

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 test must be cleaned using procedures from CCSM Book 4 or the manufacturer's procedures.

Other LID BMPs

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

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

Check to Select	If Selected		
	Draw Location(s) on Site Plan	Submit Standard Detail	Submit Detailed Drawing/Calcs*
<input type="checkbox"/> C102 Buffer Zone	x		
<input type="checkbox"/> C103 High Visibility Fence	x		
<input type="checkbox"/> C200 Interceptor Dike and Swale	x		x
<input type="checkbox"/> C201 Grass-Lined Channels	x		x
<input type="checkbox"/> C207 Check Dams	x	x	
<input type="checkbox"/> C208 Triangular Silt Dike	x		
<input type="checkbox"/> C231 Brush Barrier	x		
<input type="checkbox"/> C233 Silt Fence	x	x	
<input type="checkbox"/> C234 Vegetated Strip	x		
* Requires Engineering			

OR ☐ Element is N/A: _____

F. Construction Sequencing/Phasing

12. The standard construction sequence is as follows:

- Mark clearing/grading limits.
- Install initial erosion control practices (construction entrance, silt fence, catch basin inserts).
- 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 (buildings, driveways, landscaping, permanent stormwater control facilities (if required), etc.).

- 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.

The Development Inspector or Building Inspector Assigned to the site will tell you at which points in the sequence an erosion control inspection is required.

List any changes from the standard construction sequence outlined above.

Construction phasing: If construction is going to occur in separate phases, describe:

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.


Section 4 — Erosion and Sediment Control Site Plan




The erosion and sediment control site plan is a drawing which shows the location of the proposed BMPs.

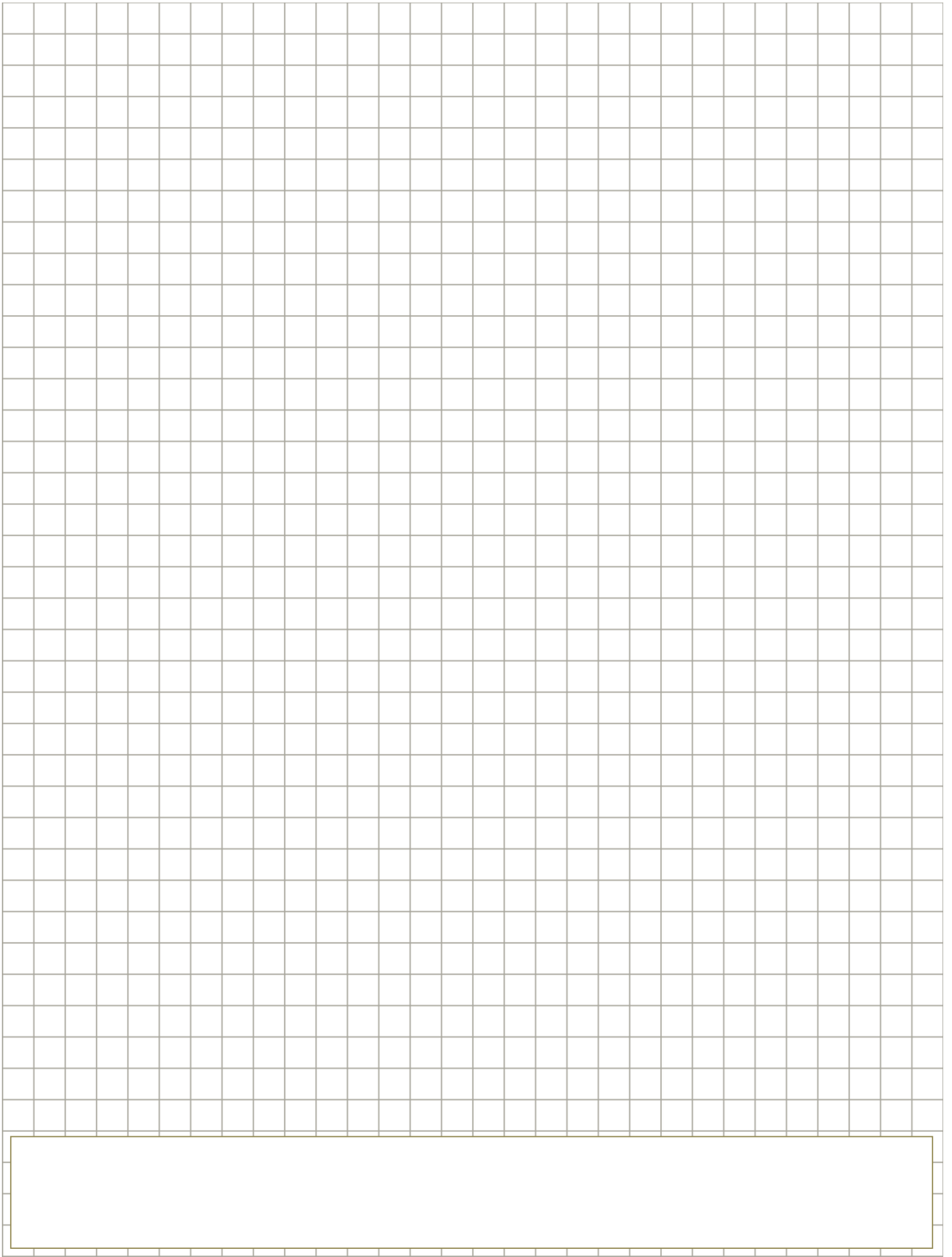
Submit an erosion and sediment control site plan on 8½ x 11 or 11 x 17 paper.

For projects meeting Minimum Requirements #1 - #5, the site plan may be either drawn by hand or drafted electronically. Blank graph paper is provided below. For projects meeting Minimum Requirements #1 - #9, the plan must be drafted electronically.

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 listed items on

the site plan. The  icon means that information may be found using Clark County Maps Online

-  Address, Parcel Number, and Street names
- North Arrow
- Boundaries of existing vegetation (e.g. tree lines, grass, pasture, fields, etc.)
-  On-site or adjacent critical areas and associated buffers (e.g. wetlands, steep slopes, streams, etc.)
-  Existing and proposed contours
- Areas that are to be cleared and graded
- Cut and fill slopes, indicating top and bottom of slope catch lines
- Locations where upstream run-on enters the site and locations where runoff leaves the site
- 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.)
- Grades, dimensions, and direction of flow in all (existing and proposed) ditches, swales, culverts, and pipes
- 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



Appendix I-K

Public Works Property Conveyance Policy Statement

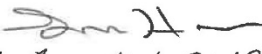
The attached two-page policy is for Conveyance of Open Space, Critical Areas, Undeveloped Remnant Lands, and Stormwater Tracts to Clark County Public Works.



CLARK COUNTY DEPARTMENT OF PUBLIC WORKS

POLICY STATEMENT

Conveyance of Open Space, Critical Areas, Undevelopable Remnant Lands, and Stormwater Tracts

Approved by: 
Effective Date: *August 1, 2019*
Revision Date:
File Name:

Purpose:

To define a legally sound and consistent policy for accepting or denying proposed conveyance of open-space tracts, critical-areas tracts, oversized stormwater tracts, or remnant tracts of undevelopable land to Clark County by development project proponents.

Intent

This policy provides Clark County control over conveyance of lands that the County would not otherwise seek to own, and that require significant maintenance risk expenditures from county revenues.

Responsibilities & Affected Parties of Clark County Public Works

This policy primarily affects staff in several Public Works divisions, including Clean Water, Development Engineering and Parks, as well as the Real Property Services section within the Engineering & Construction division. Responsibility for maintaining this policy rests with the Clean Water Division Manager, the Engineering and Construction Division Manager, the Real Property Services Manager, the Development Engineering Manager, the Parks Manager and the Legacy Lands Manager, under direction of the Public Works Director.

Final Authority

The final authority regarding this policy rests with the County Manager. The authority to accept conveyances of real property rests with the Public Works Director. The Public Works Director will inform the County Manager regarding any real property accepted under this policy. The policy supports and clarifies the provisions in Article III, Section 2.33A.090 of Clark County Code Chapter 2.33A Property Management with regard to acceptance of conveyances of real property.

Background

Land development regularly results in a variety of "left-over" undeveloped land areas. These may take the form of undevelopable critical areas, remnant land slivers not large enough to accommodate additional building lots, and other unusable areas.

Developers traditionally have disposed of these areas by conveying them to Clark County. In some cases entire tracts are dedicated as open space or wetlands. In others, remnant slivers are tacked onto stormwater tracts and dedicated as part of the stormwater facilities.

Legacy Lands, Clean Water and Parks have generally been recipients of these dedications, and in some cases there are valid reasons to accept or even desire conveyance of such tracts to Clark County. However, in many cases these areas represent poor-quality habitat or disconnected islands of land with little value for habitat or to the public. Historically, such conveyances have been accepted as a matter of course, with no input from the divisions that are ultimately responsible for ongoing maintenance and with little regard for the true cost of accepting them.

In many cases, unwanted conveyance of property to Clark County results in significant maintenance costs in response to public complaints about vegetation growth, fire hazards, tree fall, and use of the areas by homeless individuals.

County maintenance of these unused county lands is limited due to funding constraints and statutory limitations on the use of Clean Water fee revenue and Legacy Lands maintenance funding. Because these dedicated tracts are often not stormwater facilities, it is difficult to justify spending Clean Water stormwater fee dollars to maintain them. In the case of Legacy Lands, maintenance/management spending is limited by state code to land acquired with conservation futures revenues and in an amount not to exceed 25% of the prior year's conservation futures property tax revenue. This amount

is insufficient to properly manage the inventory of valuable and purposefully acquired legacy properties. It is also questionable whether such funds may be spent on lands acquired without a commitment of conservation futures funds. In the case of Parks, costs to maintain such parcels are included in the general fund appropriations.

Provisions

1) Conveyance of Open-space, critical area, and remnant tracts

If an applicant desires to convey unused property to Clark County, the following provisions will be considered before any decision is made.

Acceptance or denial of open-space, critical area, and remnant tract dedications will be at the discretion of the County, as represented by the Clean Water Manager, Legacy Lands Manager, Parks Manager, and Real Property Services Manager, with approval of the Public Works Director. Public Works will obtain final approval from the County Manager prior to acceptance of any proposed conveyance of open space, critical areas, or remnant tracts.

The preferred approach is to establish acceptance or non-acceptance of proposed conveyances during preliminary approval. With prior consent from Public Works, the decision may be deferred to final plat review. In either case, review must include an opportunity for comment by the above-listed managers or their designees. No tract conveyances may be accepted without approval from the responsible manager(s) with the concurrence of the Public Works Director. The County shall not issue Park Impact Fee credits for such conveyances, and such conveyances do not relieve the landowner of the obligation to fully comply with all critical areas mitigation requirements for the subdivision.

Criteria for Acceptance

Tracts will be evaluated on a case-by-case basis and acceptance is at the discretion of the above-listed managers. Community Development staff should be consulted during evaluation of proposed critical areas dedications. Parcels most likely to be accepted include:

- Lands within or adjacent to planned or existing county greenways or trail systems
- Lands identified as priority acquisitions under Parks master plans or Legacy Lands acquisition plans
- Lands consisting primarily of identified habitat or wetlands and associated buffers
- Lands that establish habitat connectivity between two or more larger parcels of protected habitat
- Lands required to be set aside as undevelopable under Clark County code

2) Conveyance of Stormwater tracts

If an applicant desires to convey stormwater tracts to Clark County, the following provisions will be considered before any decision is made.

- All provisions in the current Clark County Stormwater Manual pertaining to Clark County acceptance of stormwater facilities must be met.
- Stormwater tracts to be conveyed to Clark County must incorporate all treatment and flow control practices within the tract (whether above or below ground). Outfalls and associated pipes are not required to be within the conveyed tract, but an easement must be provided to allow Clark County access to this infrastructure for inspection and maintenance.
- Any additional land included in the tract that is unneeded for stormwater treatment and flow control or access may not exceed 25% of the functional stormwater facility area.
- For all storm facilities requiring fencing, the fencing shall conform to the boundary of the storm tract. Additional land area outside the fenced portion of the tract may not be conveyed to Clark County.

3) Split parcels

In no case may a single tract to be conveyed to Clark County be split into geographically separate areas. Each separate contiguous area must be a separate legal tract.