Stormwater Management Manual for Western Washington

Volume I
Minimum Technical Requirements
and Site Planning

Prepared by:
Washington State Department of Ecology
Water Quality Program

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Chapter 1 - Introduction

1.1 Objective

The objective of this manual is to provide guidance on the measures necessary to control the quantity and quality of stormwater produced by new development and redevelopment such that they comply with water quality standards and contribute to the protection of beneficial uses of the receiving waters. Application of appropriate minimum requirements and Best Management Practices (BMPs) identified in this manual are necessary but sometimes insufficient measures to achieve these objectives. (See Section 1.7, Effects of Urbanization).

Water quality standards include:

- Chapter 173-200 of the Washington Administrative Code (WAC), Water Quality Standards for Groundwaters of the State of Washington
- Chapter 173-201A WAC, Water Quality Standards for Surface Waters of the State of Washington
- Chapter 173-204 WAC, Sediment Management Standards

This manual identifies minimum requirements for development and redevelopment projects of all sizes and provides guidance concerning how to prepare and implement stormwater site plans. These requirements are, in turn, satisfied by the application of BMPs from Volumes II through V. Projects that follow this approach will apply reasonable, technology-based BMPs and water quality-based BMPs to reduce the adverse impacts of stormwater. This manual is applicable to all types of land development – including residential, commercial, industrial, and roads. Manuals with a more-specific focus, such as a Highway Runoff Manual, that have been determined to be equivalent to this manual, may provide more appropriate guidance to the intended audience.

Federal, state, and local permitting authorities with jurisdiction can require more stringent measures that are deemed necessary to meet locally established goals, state water quality standards, or other established natural resource or drainage objectives.

This manual can also help to identifying options for retrofitting BMPs in existing developments. Retrofitting stormwater BMPs into existing developed areas will be necessary in many cases to meet federal Clean Water Act and state Water Pollution Control Act (Chapter 90.48 RCW) requirements.

The Washington State Department of Ecology (Ecology) does not have guidance specifically for retrofit situations (not including redevelopment situations). Application of BMPs from this manual is encouraged.

However, there can be site constraints that make the strict application of these BMPs difficult.

1.2 Applicability to Western Washington

This stormwater manual applies to all of western Washington. This includes the area bounded on the south by the Columbia River, on the west by the Pacific Ocean, on the north by the Canadian border, and on the east by the Cascade Mountains crest. The manual also applies to those areas of Skamania and Cowlitz counties that lie east of the Cascade crest.

The Ecology stormwater manual was originally developed in response to a directive of the Puget Sound Water Quality Management Plan (PSWQA 1987 et. seq.). The Puget Sound Water Quality Authority (since replaced by the Puget Sound Partnership, PSP) recognized the need for overall guidance for stormwater quality improvement. It incorporated requirements in its plan to implement a cohesive, integrated stormwater management approach through the development and implementation of programs by local jurisdictions, and the development of rules, permits and guidance by Ecology.

The Puget Sound Water Quality Management Plan included a stormwater element (SW-2.1) requiring Ecology to develop a stormwater technical manual for use by local jurisdictions. This manual was originally developed to meet this requirement. Ecology has found that the concepts developed for the Puget Sound Basin are applicable throughout western Washington.

Information describing how this manual relates to the Puget Sound Water Quality Management Plan (now the Puget Sound Action Agenda) is included in Section 1.6.4.

1.3 Organization of this Manual

1.3.1 Overview of Manual Content

To accomplish the objective described in Section 1.1, the manual includes the following:

- *Minimum Requirements* that cover a range of issues, such as preparation of Stormwater Site Plans, pollution prevention during the construction phase of a project, control of potential pollutant sources, treatment of runoff, control of stormwater flow volumes, protection of wetlands, and long-term operation and maintenance. The Minimum Requirements applicable to a project vary depending on the type and size of the proposed project.
- *Best Management Practices (BMPs)* that can be used to meet the minimum requirements. BMPs are schedules of activities, prohibitions of practices, maintenance procedures, managerial practices, or

structural features that prevent or reduce pollutants or other adverse impacts to waters of Washington State. BMPs are divided into those for short-term control of stormwater from construction sites, and those addressing long-term management of stormwater at developed sites. Long-term BMPs are further subdivided into those covering management of the volume and timing of stormwater flows, prevention of pollution from potential sources, and treatment of runoff to remove sediment and other pollutants.

- *Guidance on how to prepare and implement Stormwater Site Plans*. The Stormwater Site Plan is a comprehensive report that describes existing site conditions, explains development plans, examines potential off-site effects, identifies applicable Minimum Requirements, and proposes stormwater controls for both the construction phase and long-term stormwater management. The project proponent submits the Stormwater Site Plan to state and local permitting authorities with jurisdiction, who use the plan to evaluate a proposed project for compliance with stormwater requirements.

1.3.2 Organization of this Manual

Volume I of this manual serves as an introduction and covers several key elements of developing the Stormwater Site Plan. The remaining volumes of this manual cover BMPs for specific aspects of stormwater management. Volumes II through V are organized as follows:

- Volume II covers BMPs for short-term stormwater management at construction sites.
- Volume III covers hydrologic analysis and BMPs to control flow volumes from developed sites.
- Volume IV addresses BMPs to minimize pollution generated by potential pollution sources at developed sites.
- Volume V presents BMPs to treat runoff that contains sediment or other pollutants from developed sites.

1.3.3 Organization of Volume I

Following this introduction, Volume I contains three additional chapters. Chapter 2 identifies the Minimum Requirements for stormwater management at all new development and redevelopment projects. Chapter 3 describes the Stormwater Site Plan, and provides step-by-step guidance on how to develop these plans. Chapter 4 describes the process for selecting BMPs for long-term management of stormwater flows and quality. Appendices are included to support these topics. Volume I also includes the Glossary for all five volumes of the stormwater manual.

1.4 How to Use this Manual

This manual has applications for a variety of users. Project proponents should start by reading Chapter 3 of Volume I. It explains how to complete stormwater site plans. Staff at all local governments and agencies with permitting jurisdiction may use this manual in reviewing Stormwater Site Plans, checking BMP designs, and providing technical advice to project proponents.

Other Federal, State, and local permits may refer to this manual or the BMPs contained in this manual. For example, the Industrial Stormwater General Permit and the Construction Stormwater General Permit refer to this manual. In those cases, affected permit-holders or applicants should use this manual for specific guidance on how to comply with those permit conditions.

1.5 Development of Best Management Practices for Stormwater Management

1.5.1 Best Management Practices (BMPs)

The method by which the manual controls the adverse impacts of development and redevelopment is through the application of Best Management Practices (BMP).

BMPs are defined as 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. The types of BMPs are source control, treatment, and flow control. BMPs that involve construction of engineered structures are often referred to as facilities in this manual. For instance, the BMPs referenced in the menus of Chapter 3 in Volume V are called treatment facilities.

The primary purpose of using BMPs is to protect beneficial uses of water resources through the reduction of pollutant loads and concentrations, through reduction of discharges (volumetric flow rates) causing stream channel erosion, and through reductions in deviations from natural hydrology. If it is found that, after the implementation of BMPs advocated in this manual, beneficial uses are still threatened or impaired, then additional controls may be required.

1.5.2 Source Control BMPs

Source control BMPs typically **prevent** pollution, or other adverse effects of stormwater, from occurring. Ecology further classifies source control BMPs as operational or structural. Examples of source control BMPs include methods as various as using mulches and covers on disturbed soil, putting roofs over outside storage areas, and berming areas to prevent stormwater run-on and pollutant runoff.

It is generally more cost-effective to use source controls to **prevent** pollutants from entering runoff, than to treat runoff to remove pollutants. However, since source controls cannot prevent all impacts, some combination of measures will always be needed.

1.5.3 Treatment BMPs

Treatment BMPs include facilities that remove pollutants by simple gravity settling of particulate pollutants, centrifugal separation, filtration, biological uptake, and media or soil adsorption. Treatment BMPs can accomplish significant levels of pollutant load reductions if properly designed and maintained.

1.5.4 Flow Control BMPs

Flow control BMPs typically control the volume rate, frequency, and flow duration of stormwater surface runoff. The need to provide flow control BMPs depends on whether a development site discharges to a stream system or wetland, either directly or indirectly. Stream channel erosion control can be accomplished by BMPs that detain runoff flows and also by those which physically stabilize eroding streambanks. Both types of measures may be necessary in urban watersheds. Only the former is covered in this manual.

Construction of a detention pond is the most common means of meeting flow control requirements. Construction of an infiltration facility is the preferred option but is feasible only where more porous soils are available.

The concept of detention is to collect runoff from a developed area and release it at a slower rate than it enters the collection system. The reduced release rate requires temporary storage of the excess amounts in a pond with release occurring over a few hours or days. The volume of storage needed is dependent on:

1. The size of the drainage area.
2. The extent of disturbance of the natural vegetation, topography, and soils and creation of effective impervious surfaces (surfaces that drain to a stormwater collection system).
3. How rapidly the water is allowed to leave the detention pond; i.e., the target release rates.

The 1992 Ecology manual focused primarily on controlling the peak flow release rates for recurrence intervals of concern – the 2, 10, and 100-year rates. This level of control did not adequately address the increased duration at which those high flows occur because of the increased volume of water from the developed condition as compared to the pre-developed conditions.

To protect stream channels from increased erosion, it is necessary to control the durations over which a stream channel experiences geomorphically significant flows such that the energy imparted to the stream channel does not increase significantly. Geomorphically significant flows are those that are capable of moving sediments. This target will translate into lower release rates and significantly larger detention ponds than the previous Ecology standard. The size of such a facility can be reduced by changing the extent to which a site is disturbed.

In regard to wetlands, the goal is to not alter the natural hydroperiod. This requires the control of input flows such that the wetland is within certain elevations at different times of the year and short-term elevation changes are within the desired limits. If the amount of surface water runoff draining to a wetland is increased because of land conversion from forested to impervious areas, it may be necessary to bypass some water around the wetland in the wet season. (Bypassed stormwater must still meet flow control and treatment requirements applicable to the receiving water.) If however, the wetland was fed by local ground water elevations during the dry season, the impervious surface additions and the bypassing practice may cause variations from the dry season elevations.

Because Ecology found it difficult to model water surface elevation changes, especially for riverine and slope wetlands, the new regulatory strategy is to simply try to match the pre-project surface and ground water inputs that drive the water surface elevations in wetlands. Estimates of what should be done to match inputs requires the use of a continuous runoff model. It remains to be seen whether the available continuous runoff models are sufficiently accurate to determine successful flow management strategies. Even if the modeling approaches are sufficient, it will be a challenge to simulate pre-project hydrology after significant development has occurred.

1.5.5 Construction Stormwater BMPs and On-site Stormwater Management BMPs

Construction stormwater BMPs can be source control, treatment, or flow control BMPs. Examples include stabilized construction entrances, silt fences, check dams, and sediment traps. Volume II contains construction stormwater BMPs.

On-site stormwater management BMPs can be either treatment or flow control BMPs. BMP’s in this category serve to infiltrate, disperse, and retain stormwater runoff on-site. Examples include bioretention, rain gardens, and permeable pavements in Chapter 5, of Volume V. Other examples include downspout infiltration, downspout dispersion, and perforated sub-out connections in Chapter 3, of Volume III.

1.6 Relationship of this Manual to Federal, State, and Local Regulatory Requirements

1.6.1 The Manual's Role as Technical Guidance

The *Stormwater Management Manual for Western Washington* is not a regulation. The Manual does not have any independent regulatory authority and it does not establish new environmental regulatory requirements. Its "Requirements" and BMP's become required through:

- Ordinances and rules established by local governments; and
- Permits and other authorizations issued by local, state, and federal authorities.

Current law and regulations require the design, construction, operation and maintenance of stormwater systems that prevent pollution of State waters. The Manual is a guidance document which provides local governments, State and Federal agencies, developers and project proponents with a stormwater management strategy to apply at the project level. If this strategy is implemented correctly, in most cases it should result in compliance with existing regulatory requirements for stormwater – including compliance with the Federal Clean Water Act, Federal Safe Drinking Water Act and State Water Pollution Control Act.

The Manual provides generic, technical guidance on measures to control the quantity and quality of stormwater runoff from new development and redevelopment projects. These measures are considered to be necessary to achieve compliance with State water quality standards and to contribute to the protection of the beneficial uses of the receiving waters (both surface and ground waters). Stormwater management techniques applied in accordance with this Manual are presumed to meet the technology-based treatment requirement of State law to provide all known available and reasonable methods of treatment, prevention and control (AKART; RCW 90.52.040, and RCW 90.48.010).

This technology-based treatment requirement does not excuse any discharge from the obligation to apply additional stormwater management practices as necessary to comply with State water quality standards. The State water quality standards include: Chapter 173-200 WAC, Water Quality Standards for Ground Waters of the State of Washington; Chapter 173-201A WAC, Water Quality Standards for Surface Waters of the State of Washington; and Chapter 173-204 WAC, Sediment Management Standards.

Following this Manual is not the only way to properly manage stormwater runoff. A municipality may adopt, or a project proponent may choose to implement other methods to protect water quality; but in those cases, they assume the responsibility of providing technical justification that the chosen methods will protect water quality (see Section 1.6.3, Presumptive versus Demonstrative Approaches to Protecting Water Quality below).

1.6.2 More Stringent Measures and Retrofitting

Federal, State, and local government agencies with jurisdiction can require more stringent measures that are deemed necessary to meet locally established goals, State water quality standards, or other established natural resource or drainage objectives. Water cleanup plans or Total Maximum Daily Loads (TMDLs) may identify more stringent measures needed to restore water quality in an impaired water body.

This Manual is not a retrofit manual, but it can be helpful in identifying options for retrofitting BMPs to existing development. Retrofitting stormwater BMPs into existing developed areas may be necessary to meet federal Clean Water Act and state Water Pollution Control Act (Chapter 90.48 RCW) requirements. The Puget Sound Action Agenda, described in Section 1.6.4, also includes prioritizing and implementing stormwater retrofits as one objective. In retrofit situations there frequently are site constraints that make the strict application of these BMPs difficult. In these instances, the BMPs presented here can be modified using best professional judgment to provide reasonable improvements in stormwater management.

1.6.3 Presumptive versus Demonstrative Approaches to Protecting Water Quality

Wherever a discharge permit or other water-quality-based project approval is required, project proponents may be required to document the technical basis for the design criteria used to design their stormwater management BMPs. This includes: how stormwater BMPs were selected; the pollutant removal performance expected from the selected BMPs; the scientific basis, technical studies, and(or) modeling which supports the performance claims for the selected BMPs; and an assessment of how the selected BMP will comply with State water quality standards and satisfy State AKART requirements and Federal technology-based treatment requirements.

The Manual is intended to provide project proponents, regulatory agencies and others with technically sound stormwater management practices which are *presumed* to protect water quality and instream habitat – and meet the stated environmental objectives of the regulations described in this chapter. Project proponents always have the option of not following the stormwater management practices in this Manual. However, if a project proponent chooses not to follow the practices in the Manual then the project proponent may be required to individually *demonstrate* that the project will not adversely impact water quality by collecting and providing appropriate supporting data to show that the alternative approach is protective of water quality and satisfies State and federal water quality laws.

Figure 1.6.1 graphically depicts the relation between the *presumptive approach* (the use of this Manual) and the *demonstrative approach* for achieving the environmental objectives of the standards. Both the presumptive and demonstrative approaches are based on best available science and result from existing Federal and State laws that require stormwater treatment systems to be properly designed, constructed, maintained and operated to:

1. Prevent pollution of state waters and protect water quality, including compliance with state water quality standards.
2. Satisfy state requirements for all known available and reasonable methods of prevention, control and treatment (AKART) of wastes prior to discharge to waters of the State.
3. Satisfy the federal technology based treatment requirements under 40 CFR part 125.3.

Under the demonstration approach, the timeline and expectations for providing technical justification of stormwater management practices will depend on the complexity of the individual project and the nature of the receiving environment. In each case, the project proponent may be asked to document to the satisfaction of the permitting agency or other approval authority that the practices they have selected will result in compliance with the water quality protection requirements of the permit or other local, State, or Federal water-quality-based project approval condition. This approach may be more cost effective for large, complex or unusual types of projects.

Project proponents that choose to follow the stormwater management approaches contained in Ecology approved stormwater technical manuals are presumed to have satisfied this demonstration requirement and do not need to provide technical justification to support the selection of BMPs for the project. Following the stormwater management practices in this Manual means adhering to the guidance provided for proper selection, design, construction, implementation, operation and maintenance of BMPs. Approved stormwater technical manuals include this Manual and other equivalent stormwater management guidance documents approved by Ecology. This approach will generally be more cost effective for typical development and redevelopment projects.

Ecology lists approved equivalent stormwater management manuals this website: http://www.ecy.wa.gov/programs/wq/stormwater/municipal/Phase1equivalentstormwatermanualsWestern.html.

The following sub-sections will explain the relationship of the manual to various programs, permits, and planning efforts.

Both the presumptive and demonstrative approaches are based on using best available science to protect water quality. See the glossary for definitions.

STANDARDS

Water Pollution Control Act

(Chapter 90.48 RCW)

Discharges to state waters shall not cause pollution, which is defined as an alteration of the physical, chemical or biological properties of State waters which would impair beneficial uses. Requires the use of AKART and BMPs approved by Ecology.

Federal Clean Water Act

Restore and maintain the chemical, physical, and biological integrity of the Nation's waters.

- State water quality standards (water-quality based treatment requirements)
- Federal technology-based treatment requirements
- NPDES permits
- 303(d) impaired water body list and water clean-up plans

Others

Endangered Species Act

- Properly functioning conditions

Hydraulics Code (HPA)

Safe Drinking Water Act (UIC)

Presumptive Approach

The Stormwater Management Manual for Western Washington provides a default set of stormwater practices based on current science which satisfy State and Federal stormwater requirements.

Considerations:

- More predictable, practices are approved across jurisdictions
- Costly studies, etc. are not required as they may be under the demonstration approach

Demonstrative Approach

Project sponsor and approval agency individually review and condition proposed projects to meet federal and state stormwater standards based on current science.

Considerations:

- Lacks predictability and can be very time consuming
- For large, complex projects may reduce costs and/or improve environmental protection

Hydrology

- When native vegetation is removed and replaced with impervious surfaces (roads or buildings) there is an increase in stormwater runoff and other drastic alterations to the natural hydrology.
- Increased flows lead to increased flooding and stream bank and stream bed erosion.
- Unless mitigated, adverse high flow impacts occur at even low levels of urban development: 4% to 10% total impervious area.
- Transportation infrastructure (including parking areas) represents between 50% and 75% of the impervious surface area within any single watershed.

Water Quality

- More than a third of the State's urban streams, creeks, and embayments are impaired due to stormwater runoff.
- Stormwater runoff from construction activities can contain large amounts of sediments and suspended solids which are harmful to fish and other aquatic life.
- Untreated stormwater from roads and urban areas can adversely impact water quality due to sediments, toxic metals, pesticides, herbicides, oils and greases, and possible human pathogens including fecal coliform bacteria.
- Untreated stormwater runoff from roads and urban areas can be toxic to aquatic life including fish.

SCIENCE

Figure 1.6.1 - Relation between environmental science and standards in stormwater regulations.

1.6.4 The Puget Sound Action Agenda

The Puget Sound Partnership's 2014/2015 Action Agenda lays out the work needed to protect and restore Puget Sound into the future. It is intended to drive investment and action. The Plan identifies three strategic initiatives to help prioritize near-term actions. "Prevention of pollution from urban stormwater runoff" is one of the strategic initiatives.

The Plan includes 29 strategies to achieve recovery targets, 106 sub-strategies to provide a narrower focus for the strategies and to develop near-term actions. The plan identifies about 150 regional and 150 local near-term actions. The strategy most aligned with this manual is to "Prevent, reduce, and control the sources of contaminants entering Puget Sound." Within that strategy, the sub-strategies and the near-term actions under these sub-strategies in which Ecology is identified as the "owner" of the action follows:

Sub-Strategy: Prevent problems from new development at the site and subdivision scale.

- NPDES Permits: Ecology will issue municipal stormwater permits for western Washington and provide financial assistance to permittees for implementation, particularly for code changes, stormwater system mapping, operations and maintenance, inspections and enforcement. This will require additional resources to Ecology for permit oversight, technical assistance, and enforcement. Ecology will provide incentives to NPDES permittees who, by interlocal agreement, lead or carry out regional or watershed scale NPDES implementation
- Stormwater Treatment Standards**:** Ecology will evaluate under which circumstances (i.e., for which pollutants, from which land uses) discharges to Puget Sound should be required to provide treatment beyond sediment removal (i.e., TSS removal) to help meet 2020 recovery targets.
- Stormwater management outside permitted areas: Ecology, in coordination with DOH, will identify two high priority shellfish growing areas degraded by urban stormwater discharges and work with local governments and other key parties to reduce these impacts to the areas.
- New development under earlier stormwater programs**:** Ecology will initiate a process to assess projected implications and impacts of current state law concerning the level of stormwater control from new development approved under earlier stormwater programs.

Sub-Strategy: Control Sources of Pollutants

- Compliance assurance program: Ecology and local governments will increase inspection, technical assistance, and enforcement programs for high-priority businesses and at construction sites.

Sub-Strategy: Provide focused stormwater-related education, training, and assistance.

- Low Impact Development training and certification: Ecology will provide focused training for local government staff on Low Impact Development project review, and inspections and approvals, as well as to local government staff and private sector on maintenance. Develop new professional certification for stormwater maintenance specialists. Provide business staff and contractors with training on source control, spill recognition, spill response, and erosion control.

The Action Agenda includes many other stormwater-related sub-strategies and near-term actions. The Action Agenda is available at the Puget Sound Partnership website.

1.6.5 Phase I - NPDES and State Waste Discharge Stormwater Permits for Municipalities

Certain municipalities and other entities are subject to permitting under the U.S. Environmental Protection Agency (EPA) Phase I Stormwater Regulations (40 CFR Part 122). In Western Washington, Ecology has issued joint NPDES and State Waste Discharge permits to regulate the discharges of stormwater from the municipal separate storm sewer systems operated by the following cities and counties:

- Clark County
- King County
- Pierce County
- Snohomish County
- City of Seattle
- City of Tacoma

The Washington Department of Transportation is also a Phase I Municipal Stormwater Permittee for its stormwater discharges within the jurisdictions of the above cities and counties.

These Phase I Municipal Stormwater Permittees must refer to Appendix 1 of their permit rather than relying on Chapter 2 of this volume to find the minimum requirements, thresholds, and definitions that their jurisdiction either must implement, or must adopt equivalent measures as determined by Ecology. The permits also direct these permittees to require site planning processes and BMP selection and design criteria from this manual, or an Ecology-approved equivalent manual. Municipal permittees which want to deviate from the site planning process and BMP selection and design criteria in this manual must demonstrate that their alternative will protect water quality, meet the federal statutory requirement to reduce pollutants to the maximum extent practicable (MEP), and satisfy the state requirement to apply all known, available, and reasonable methods of pollution control.

1.6.6 Phase II - NPDES and State Waste Discharge Stormwater Permits for Municipalities

The EPA adopted Phase II stormwater regulations in December 1999. Those rules identify additional municipalities as subject to NPDES municipal stormwater permitting requirements. Over 100 municipalities in Washington are subject to the requirements.

Ecology first issued a Western Washington Phase II Municipal Stormwater Permit in 2007. These Phase II Municipal Stormwater Permittees must refer to Appendix 1 of their permit rather than relying on Chapter 2 of this volume to find the minimum requirements, thresholds, and definitions that their jurisdiction either must implement, or must adopt equivalent measures approved by Ecology for a Phase II permittee. The permits also directs these permittees to require site planning processes and BMP selection and design criteria from this manual, or an Ecology approved equivalent manual. Municipal permittees which want to deviate from the site planning process and BMP selection and design criteria in this manual must demonstrate that their alternative will protect water quality, meet the federal statutory requirement to reduce pollutants to the maximum extent practicable (MEP), and satisfy the state requirement to apply all known, available, and reasonable methods of pollution control.

1.6.7 Municipalities Not Subject to the NPDES Stormwater Municipal Permits

Municipalities not subject to NPDES stormwater permits for municipalities are encouraged to adopt stormwater programs. This would include adoption of ordinances, minimum requirements, and BMPs equivalent to those in this manual. Any municipalities in areas where urban stormwater has been identified as a limiting factor to salmon recovery should have an equivalent stormwater manual. The *Salmon Habitat Limiting Factors Reports* available at the Washington State Conservation Commission's website provide information on these areas: http://www.scc.wa.gov/index.php/174-Salmon-Habitat-Limiting-Factors-Reports/View-category/Page-6.html.

1.6.8 Industrial Stormwater General Permit

Facilities covered under Ecology's Industrial Stormwater General Permit (i.e., NPDES and State Waste Discharge General Permit for Stormwater Discharges Associated With Industrial Activities) must manage stormwater in accordance with specific terms and conditions including: the development and implementation of an Industrial Stormwater Pollution Prevention Plan (Industrial SWPPP), monitoring, reporting, and ongoing adaptive management based on sampling and inspections.

The Industrial Stormwater General Permit (ISGP) requires Industrial SWPPPs to include certain mandatory Best Management Practices (BMPs), including those BMPs identified as "applicable" to specific industrial activities in Volume IV and V of the this manual. Facilities with new development or redevelopment must evaluate whether flow control BMPs are necessary. BMPs must be consistent with this manual, or other stormwater management guidance documents that are approved by Ecology and incorporated into the ISGP. Facilities may also use alternative BMPs if their Industrial SWPPP includes documentation that the BMPs selected are demonstrably equivalent to practices contained in stormwater technical manuals approved by Ecology, including the proper selection, implementation, and maintenance of all applicable and appropriate best management practices for on-site pollution control.

Ecology's Industrial Stormwater Webpage has a fill-in-the-blank Industrial SWPPP template for use by industrial facilities.

ISGP facilities are required to update their Industrial SWPPPs and perform corrective actions if stormwater monitoring results exceed "benchmark" or indicator values. Facilities that trigger corrective actions under the ISGP, or otherwise need to update their SWPPP, should consider:

1) "Recommended" operational and structural source control BMPs listed in Volume IV.
2) Treatment BMPs listed in Volume V.
3) Erosion and sediment control BMPs listed in Volume II (e.g., if turbidity, sediment, or associated pollutants need to be addressed).
4) Treatment BMPs that have been evaluated through Ecology's TAPE or C-TAPE program.
5) BMPs that are "demonstrably equivalent", as defined by the ISGP.

1.6.9 Construction Stormwater General Permit

Coverage under the CSWGP is generally required for any clearing, grading, or excavating if the project site discharges:

- Stormwater from the site into surface water(s) State, or
- Into storm drainage systems that discharge to a surface water(s) of the State.

And

- Disturbs one or more acres of land area, or
- Disturb less than one acre of land area, if the project or activity is part of a larger common plan of development or sale.

Any construction activity discharging stormwater that Ecology and/or the local permitting authority determines to be a significant contributor of pollutants to waters of the State may also require permit coverage, regardless of project size, at the discretion of the agency.

The permit requires application of stabilization and structural practices to reduce the potential for erosion and the discharge of sediments from the site. The stabilization and structural practices cited in the permit are similar to the minimum requirements for sedimentation and erosion control in Volume I of the SWMM.

The permit also requires construction sites within Western Washington to implement stormwater BMPs contained in stormwater management manuals published or approved by Ecology, or BMPs that are demonstrably equivalent. Volume II of this manual further describes the requirements and BMPs appropriate for managing construction site stormwater.

1.6.10 Endangered Species Act

With the listing of multiple species of salmon as threatened or endangered across much of Washington State, and the probability of more listings in the future, implementation of the requirements of the Endangered Species Act impacts urban stormwater management. Provisions of the Endangered Species Act can apply to stormwater management include the Section 4(d) rules, Section 7 consultations, and Section 10 Habitat Conservation Plans (HCP).

Under Section 4(d) of the statute, the federal government issues regulations to provide for the conservation of the species. A 4(d) rule may require new development and redevelopment to comply with specific requirements.

Under Section 7 of the statute, all federal agencies must insure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of any endangered or threatened species (or a species proposed for listing), nor result in the destruction or adverse modification of designated critical habitat. The responsibility for initially determining whether jeopardy is likely to occur rests with the "action" agency. If an action "may affect" a listed species, the "action" agency must consult with National Oceanic and Atmospheric Administration Fisheries Service (NOAA Fisheries), or the U.S. Fish and Wildlife Service (USFWS) depending on the species involved, to determine whether jeopardy is likely to occur.

Where NOAA Fisheries or USFWS believes that jeopardy would result, it must specify reasonable and prudent alternatives to the action that would avoid jeopardy if any such alternatives are available. If the "action" agency rejects these, the action cannot proceed.

Under Section 10 of the ESA, through voluntary agreements with the federal government that provide protections to an endangered species, a non-federal applicant may commit an "incidental take" of individuals of that species as long as it is incidental to an otherwise lawful activity (such as developing land or building a road). This provision of the ESA may help resolve conflicts between development pressures and endangered species protection. A "Habitat Conservation Plan" (HCP) is an example of this type of agreement. Under an HCP, the applicant's plan must:

- Outline the impact that will likely result from the taking;
- List steps the applicant will take to minimize and mitigate such impacts, and funding available to implement such steps; and
- Include alternative actions the applicant considered and reasons alternative acts are not being used.

The federal government may grant a permit if it finds that the taking will be incidental; the applicant will minimize and mitigate impacts of taking; and the applicant will ensure that adequate funding for the conservation plan will be provided. The USFWS and NOAA Fisheries may require additional measures as necessary or appropriate for purposes of the plan.

1.6.11 Section 401 Water Quality Certifications

For projects that require a fill or dredge permit under Section 404 of the Clean Water Act, Ecology must certify to the permitting agency, the U.S. Army Corps of Engineers, that the proposed project will not violate water quality standards. In order to make such a determination, Ecology may do a more specific review of the potential impacts of a stormwater discharge from the construction phase of the project and from the completed project. As a result of that review, Ecology may condition its certification to require:

- Application of the minimum requirements and BMPs in this manual; or
- Application of more stringent requirements.

1.6.12 Hydraulic Project Approvals (HPAs)

Under Chapter 77.55 RCW, the Hydraulics Act, the Washington State Department of Fish and Wildlife has the authority to require actions when stormwater discharges related to a project would change the natural flow or bed of state waters. The implementing mechanism is the issuance of a

Hydraulics Project Approval (HPA) permit. In exercising this authority, Fish and Wildlife may require:

- Compliance with the provisions of this manual; or
- Application of more stringent requirements that they determine are necessary to meet their statutory obligations to protect fish and wildlife.

1.6.13 Aquatic Lands Use Authorizations

The Department of Natural Resources (DNR), as the steward of public aquatic lands, may require a stormwater outfall to have a valid use authorization, and to avoid or mitigate resource impacts. Through its use authorizations, which are issued under authority of Chapter 79.105-79.140 RCW, and in accordance with Chapter 332-30 WAC, DNR may require:

- Compliance with the provisions of this manual; or
- Application of more stringent requirements that they determine are necessary to meet their statutory obligations to protect the quality of the state's aquatic lands.

1.6.14 Requirements Identified through Watershed/Basin Planning or Total Maximum Daily Loads

A number of the requirements of this manual can be superseded by the adoption of ordinances and rules to implement the recommendations of watershed plans or basin plans. Local governments may initiate their own watershed/ basin planning processes to identify more stringent or alternative requirements. They may also choose to develop a watershed plan in accordance with the Watershed Management Act (Chapter 90.82 RCW) that includes the optional elements of water quality and habitat. As long as the actions or requirements identified in those plans and implemented through local or state ordinances or rules comply with applicable state and federal statutes (e.g., the federal Clean Water Act and the Endangered Species Act), they can supersede the requirements in this manual. The decisions concerning whether such locally derived requirements comply with federal and state statutes rest with the regulatory agencies responsible for implementing those statutes.

A requirement of this manual can also be superseded or added to through the adoption of actions and requirements identified in a Total Maximum Daily Load (TMDL) that is approved by the EPA. However, it is likely that at least some TMDLs will require use of the BMPs in this manual.

1.6.15 Underground Injection Control Authorizations

To implement provisions of the federal Safe Drinking Water Act (see Federal UIC regulations, 40 CFR, Part 144), Ecology has adopted rules

(Chapter 173-218 WAC) for an underground injection control (UIC) program. For more information visit Ecology's home page for the UIC program at http://www.ecy.wa.gov/programs/wq/grndwtr/uic/ and "Guidance for UIC Wells that Manage Stormwater" at http://www.ecy.wa.gov/pubs/0510067.pdf.

According to WAC 173-218-030 UIC well is defined as "a well that is used to discharge fluids into the subsurface. A UIC well is one of the following: (1) A bored, drilled or driven shaft, or dug hole whose depth is greater than the largest surface dimension; (2) An improved sinkhole; or (3) A subsurface fluid distribution system (contains perforated pipe or similar structure)."

Depending upon the manner in which it is accomplished, the discharge of stormwater into the ground can be classified as a Class V injection well. For more information and for a listing on potential stormwater facilities that may have Class V classification refer to the memorandum available at http://www.ecy.wa.gov/programs/wq/stormwater/municipal/resources/EPAmemoinfiltrationclassvwells.pdf.

1.6.16 Other Local Government Requirements

Local governments have the option of applying more stringent requirements than those in this manual. They are not required to base those more stringent requirements on a watershed/basin plan or their obligations under a TMDL. Project proponents should always check with the local governmental agency with jurisdiction to determine the stormwater requirements that apply to their project.

1.7 Effects of Urbanization

1.7.1 Background Conditions

Prior to the Euro-American settlement, western Washington primarily was forested in alder, maple, fir, hemlock and cedar. The area's bountiful rainfall supported the forest and the many creeks, springs, ponds, lakes and wetlands. The forest system provided protection by intercepting rainfall in the canopy, reducing the possibility of erosion and the deposition of sediment in waterways. The trees and other vegetative cover evapotranspirated at least 40% of the rainfall. The forest duff layer absorbed large amounts of runoff releasing it slowly to the streams through shallow ground water flow.

1.7.2 Hydrologic Changes

As settlement occurs and the population grows, trees are logged and land is cleared for the addition of impervious surfaces such as rooftops, roads, parking lots, and sidewalks. Maintained landscapes that have much higher runoff characteristics typically replace the natural vegetation. The natural soil structure is also lost due to grading and compaction during construction. Roads are cut through slopes and low spots are filled. Drainage patterns are irrevocably altered. All of this results in drastic changes in the natural hydrology, including:

- Increased volumetric flow rates of runoff
- Increased volume of runoff
- Decreased time for runoff to reach a natural receiving water
- Reduced ground water recharge
- Increased frequency and duration of high stream flows and wetlands inundation during and after wet weather
- Reduced stream flows and wetlands water levels during the dry season
- Greater stream velocities

Figure 1.7.1 illustrates some of these hydrologic changes. As a consequence of these hydrology changes, stream channels are eroded by high flows and can lose summertime base flows. Increased flooding occurs. Streams lose their hydraulic complexity. Habitat is degraded and receiving water species composition is altered as explained below.

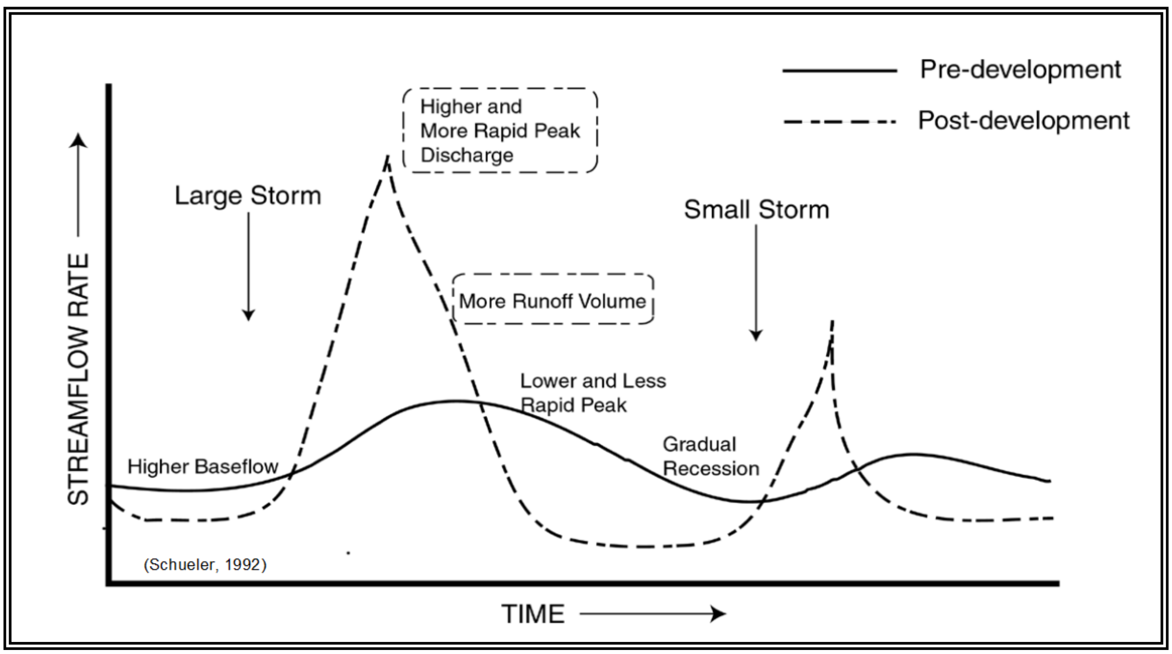

Figure 1.7.1 – Changes in Hydrology after Development

Figure 1.7.2 (Booth and Jackson, 1997) illustrates one observed relationship between the level of development in a basin (as measured by effective, not total, impervious area), the changes in the recurrence of modeled stream flows, and the resultant streambank instability and channel erosion. These data show that even a crude measure of stream degradation, “channel instability,” shows significant changes at relatively low levels of urban development. More sensitive measures, such as biological indicators (see Section 1.7.4), document degradation at even lower levels of human activity.

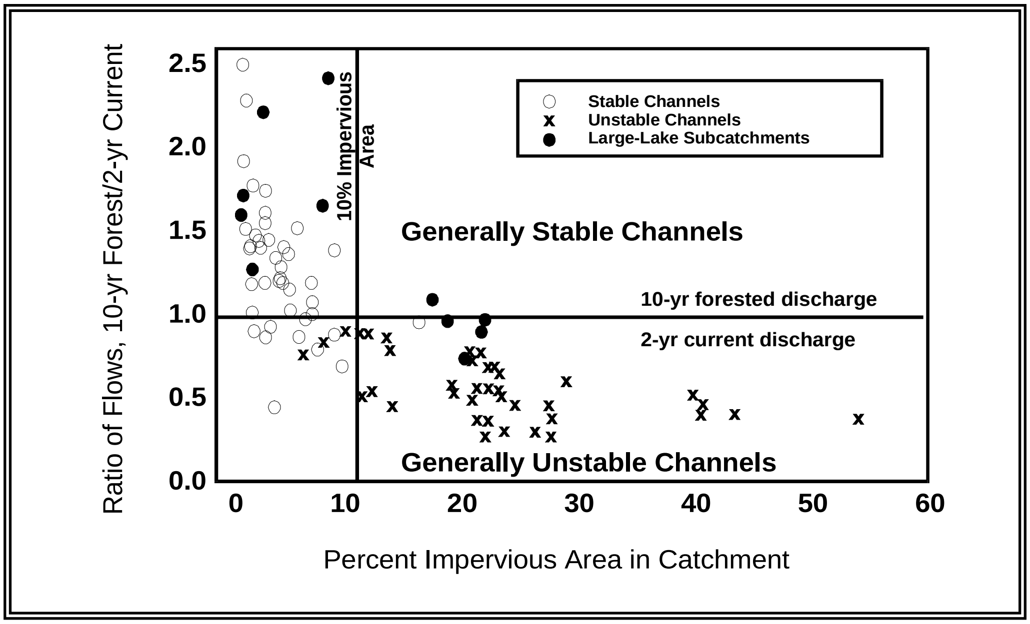

Figure 1.7.2 - Channel Stability and Land Use: Hylebos, East Lake Sammamish, Issaquah Basins

1.7.3 Water Quality Changes

Urbanization also causes an increase in the types and quantities of pollutants in surface and ground waters. Runoff from urban areas has been shown to contain many different types of pollutants, depending on the nature of the activities in those areas. Table 1.7.1, from an analysis of Oregon urban runoff water quality monitoring data collected from 1990 to 1996, shows mean concentrations for a limited number of pollutants from different land uses. (Strecker et al., 1997)

Table 1.7.1 Mean Concentrations of Selected Pollutants in Runoff from Different Land Uses

Land Use	TSS mg/l	Total Cu mg/l	Total Zn mg/l	Dissolved Cu mg/l	Total P mg/l
In-pipe Industry	194	0.053	0.629	0.009	0.633
Instream Industry	102	0.024	0.274	0.007	0.509
Transportation	169	0.035	0.236	0.008	0.376
Commercial	92	0.032	0.168	0.009	0.391
Residential	64	0.014	0.108	0.006	0.365
Open	58	0.004	0.025	0.004	0.166

Note: In-pipe industry means the samples were taken in stormwater pipes. Instream industry means the samples were taken in streams flowing through industrial areas. Samples for all other categories were taken within stormwater pipes.

The runoff from roads and highways is 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.

Regardless of the eventual land use conversion, the sediment load produced by a construction site can turn the receiving waters turbid and be deposited over the natural sediments of the receiving water.

The pollutants added by urbanization can be dissolved in the water column or can be attached to particulates that settle in streambeds, lakes, wetlands, or marine estuaries. A number of urban bays in Puget Sound have contaminated sediments due to pollutants associated with particulates in stormwater runoff.

Urbanization also tends to cause changes in water temperature. Heated stormwater from impervious surfaces and exposed treatment and detention ponds discharges to streams with less riparian vegetation for shade. Urbanization also reduces ground water recharge, which reduces sources of cool ground water inputs to streams. In winter, stream temperatures may lower due to loss of riparian cover. There is also concern that the replacement of warmer ground water inputs with colder surface runoff during colder periods may have biological impacts.

1.7.4 Biological Changes

The hydrologic and water quality changes result in changes to the biological systems that were supported by the natural hydrologic system. In particular, aquatic life is greatly affected by urbanization. Habitats are drastically altered when a stream changes its physical configuration and substrate due to increased flows. Natural riffles, pools, gravel bars and other areas are altered or destroyed. These and other alterations produce a habitat structure that is very different from the one in which the resident aquatic life evolved. For example, spawning areas, particularly those of salmonids, are lost. Fine sediments imbed stream gravels and suffocate salmon redds. The complex food web is destroyed and is replaced by a biological system that can tolerate the changes. However, that biological community is typically not as complex, is less desirable, and is unstable due to the ongoing rapid changes in the new hydrologic regime.

Significant and detectable changes in the biological community of Puget Sound lowland streams begin early in the urbanization process. May *et al.* (1997) reported changes in the 5-10% total impervious area range of a watershed. Figure 1.7.3 from May et al. (1997) shows the relationship observed between the Benthic Index of Biotic Integrity (B-IBI) developed by Kleindl (1995) and Karr (1991), and the extent of watershed urbanization as estimated by the percentage of total impervious area (% TIA). Also shown in the figure is the correlation between the abundance ratio of juvenile coho salmon to cutthroat trout (Lucchetti and Fuerstenberg 1993) and the extent of urbanization.

The biological communities in wetlands are also severely impacted and altered by the hydrological changes. Relatively small changes in the natural water elevation fluctuations can cause dramatic shifts in vegetative and animal species composition.

In addition, the toxic pollutants in the water column such as pesticides, soaps, and metals can have immediate and long-term lethal impacts. Toxic pollutants in sediments can yield similar impacts with the lesions and cancers in bottom fish of urban bays serving as a prime example.

A rise in water temperature can have direct lethal effects. It reduces the maximum available dissolved oxygen and may cause algae blooms that further reduce the amount of dissolved oxygen in the water.

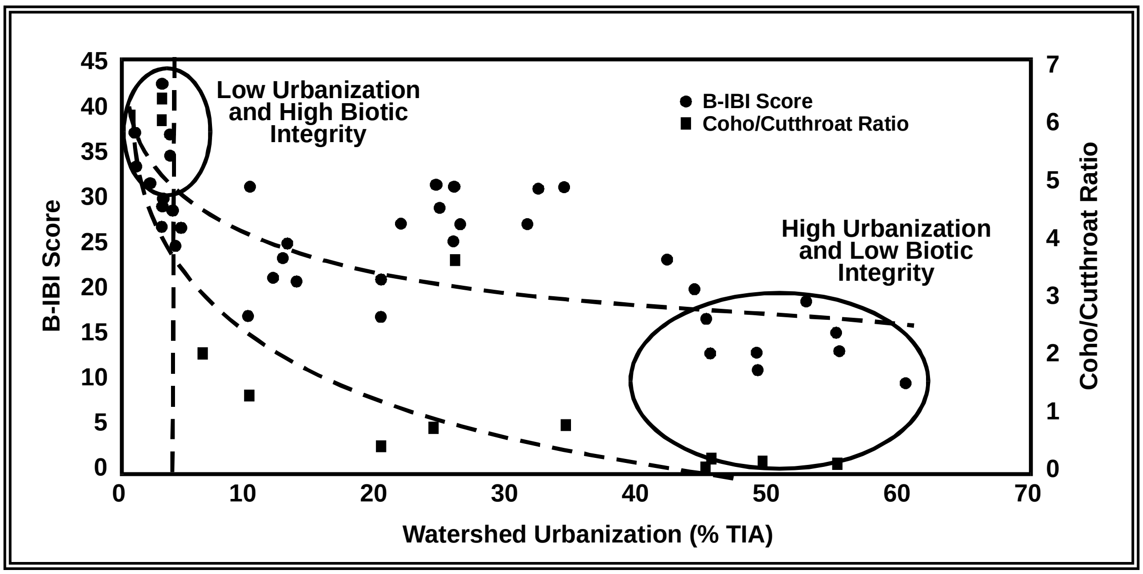

Figure 1.7.3 – Relationship between Basin Development and Biotic Integrity in Puget Sound Lowland Streams

1.7.5 The Role of Land Use and Lifestyles

The manual's scope is limited to managing the surface runoff generated by a new development or redevelopment project. The manual does not intend to delve deeply into site development standards or where development should be allowed. Those are land use decisions that should not be directed by this stormwater manual. The manual applies after the decision to develop a site has been made. The manual can provide site development strategies to reduce the pollutants generated and the hydrologic disruptions caused by development.

The engineered stormwater conveyance, treatment, and detention systems advocated by this and other stormwater manuals can reduce the impacts of development to water quality and hydrology. But they cannot replicate the natural hydrologic functions of the natural watershed that existed before development, nor can they remove sufficient pollutants to replicate the water quality of pre-development conditions. Ecology understands that despite the application of appropriate practices and technologies identified in this manual, some degradation of urban and suburban receiving waters will continue, and some beneficial uses will continue to be impaired or lost due to new development. This is because land development, as practiced today, is incompatible with the achievement of sustainable ecosystems. Unless development methods are adopted that cause significantly less disruption of the hydrologic cycle, the cycle of new development followed by beneficial use impairments will continue.

In recent years, researchers (May et al., 1997) and regulators (e.g., Issaquah Creek Basin and Nonpoint Action Plan, 1996) have speculated on the amount of natural land cover and soils that should be preserved in a watershed to retain sufficient hydrologic conditions to prevent stream channel degradation, maintain base flows, and contribute to achieving properly functioning conditions for salmonids. There is some agreement that preserving a high percentage (possibly 65 to 75%) of the land cover and soils in an undisturbed state is necessary. To achieve these high percentages in urban, urbanizing, and suburban watersheds, a dramatic reduction is necessary in the amount of impervious surfaces and artificially landscaped areas to accommodate our preferred housing, play, and work environments, and most significantly, our transportation choices.

Surfaces created to provide “car habitat” comprise the greatest portion of impervious areas in land development. Therefore, to make appreciable progress in reducing impervious surfaces in a watershed, we must reduce the density of our road systems, alter our road construction standards, reduce surface parking, and rely more on transportation systems that do not require such extensive impervious surfaces (rail, bicycles, walking).

Reducing the extent of impervious surfaces and increasing natural land cover in watersheds are also necessary to solve the water quality problems of sediment, temperature, toxicants, and bacteria. Changing public attitudes toward chemical use and preferred housing are also necessary to achieve healthy water ecosystems.

Until we are successful in applying land development techniques that result in matching the natural hydrologic functions and cycles of watersheds, management of the increased surface runoff is necessary to reduce the impact of the changes. Figure 1.7.3 illustrates that significant biological impacts in streams can occur at even low levels of development associated with rural areas where stormwater runoff has not been properly managed. Improving our stormwater detention, treatment, and source control management practices should help reduce the impacts of land development in urban and rural areas. We must also improve the operation and maintenance of our engineered systems so that they function as well as possible. This manual is Ecology's latest effort to apply updated knowledge in these areas.

The question yet to be answered is whether better management – including improved treatment and detention techniques – of the increased surface runoff from developed areas can work in combination with preservation of high percentages of natural vegetation and soils on a watershed scale to yield a minimally altered hydrologic and water quality regime that protects the water-related natural resources.

In summary, implementing improved engineering techniques and drastic changes in where and how land is developed and how people live and move across the land are necessary to achieve the goals in the federal Clean Water Act - to preserve, maintain, and restore the beneficial uses of our nation's waters.

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Chapter 2 - Minimum Requirements for New Development and Redevelopment

This chapter identifies the nine Minimum Requirements for stormwater management applicable to new development and redevelopment sites. The 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
6. Runoff Treatment
7. Flow Control
8. Wetlands Protection
9. Operation and Maintenance

Depending on the type and size of the proposed project, different combinations of these minimum requirements apply. In general, small sites are required to control erosion and sedimentation from construction activities and to apply simpler approaches to treatment and flow control of stormwater runoff from the developed site. Controlling flows from small sites is important because the cumulative effect of uncontrolled flows from many small sites can be as damaging as those from a single large site.

Large sites must provide erosion and sedimentation control during construction, permanent control of stormwater runoff from the developed site through selection of appropriate BMPs and facilities, and other measures to reduce and control the on-site and off-site impacts of the project. Sites being redeveloped must generally meet the same minimum requirements as new development for the new hard surfaces and pervious surfaces converted to lawn or landscaped areas. Redevelopment sites must also provide erosion control, source control, and on-site stormwater management for the portion of the site being redeveloped. In addition, if the redevelopment meets certain cost or space (as applied to roads) thresholds, updated stormwater management for the redeveloped pervious and hard surfaces must be provided. There may also be situations in which additional controls are required for sites, regardless of type or size, as a result of basin plans or special water quality concerns.

Development sites are to demonstrate compliance with these requirements through the preparation of Stormwater Site Plans (SSP). The plans are described in detail in Chapter 3. Two major components of these plans are a Construction Stormwater Pollution Prevention Plan (SWPPP) and a

Permanent Stormwater Control Plan (PSCP). The Construction SWPPP shall identify how the project intends to control pollution generated during the construction phase only, primarily erosion and sediment. The PSCP shall identify how the project intends to provide permanent BMPs for the control of pollution from stormwater runoff after construction has been completed. Sites must submit these plans for review by the local government if they add or replace 2,000 square feet or more of hard surface, or disturb 7,000 square feet or more of land.

Section 2.4 provides additional information on applicability of the Minimum Requirements to different types of sites.

2.1 Relationship to Municipal Stormwater Permits

Municipalities covered under the Phase I or Western Washington Phase II NPDES and State Waste Discharge Municipal Stormwater Permits should use Appendix 1 of those permits rather than the bold font statements of this chapter for determining their compliance requirements.

The State recommends that local governments not covered under the Phase I or Western Washington Phase II Municipal Stormwater Permits should adopt and use the bold font statements of the thresholds, definitions, minimum requirements, adjustment, and variance sections in this chapter. Use of the two optional guidance statements is also advisable. The statements in the supplemental guidance sections are for background, clarification, and implementation guidance.

2.2 Exemptions

Unless otherwise indicated in this Section, the practices described in this section are exempt from the Minimum Requirements, even if such practices meet the definition of new development or redevelopment.

Forest practices:

Forest practices regulated under Title 222 WAC, except for Class IV General forest practices that are conversions from timber land to other uses, are exempt from the provisions of the minimum requirements.

Commercial agriculture:

Commercial agriculture practices involving working the land for production are generally exempt. However, the conversion from timberland to agriculture, and the construction of impervious surfaces are not exempt.

Pavement Maintenance:

The following pavement maintenance practices are exempt: pothole and square cut patching, overlaying existing asphalt or concrete pavement with asphalt or concrete without expanding the area of coverage, shoulder grading, reshaping/regrading drainage systems, crack sealing, resurfacing with in-kind material without expanding the road prism, pavement preservation activities that do not expand the road prism, and vegetation maintenance.

The following pavement maintenance practices are not categorically exempt. The extent to which the manual applies is explained for each circumstance.

- Removing and replacing a paved surface to base course or lower, or repairing the pavement base: If impervious surfaces are not expanded, Minimum Requirements #1 - #5 apply.
- Extending the pavement edge without increasing the size of the road prism, or paving graveled shoulders: These are considered new impervious surfaces and are subject to the minimum requirements that are triggered when the thresholds identified for new or redevelopment projects are met.
- Resurfacing by upgrading from dirt to gravel, asphalt, or concrete; upgrading from gravel to asphalt, or concrete; or upgrading from a bituminous surface treatment ("chip seal") to asphalt or concrete: These are considered new impervious surfaces and are subject to the minimum requirements that are triggered when the thresholds identified for new or redevelopment projects are met.

Underground utility projects:

Underground utility projects that replace the ground surface with in-kind material or materials with similar runoff characteristics are only subject to Minimum Requirement #2, Construction Stormwater Pollution Prevention.

2.3 Definitions Related to Minimum Requirements

Terms that Ecology presented in this section of previous versions of the manual have been moved to the glossary. Refer to the Glossary in Appendix G of this volume for definitions of terms used throughout this manual.

2.4 Applicability of the Minimum Requirements

Not all of the Minimum Requirements apply to every development or redevelopment project. The applicability varies depending on the project type and size. This section identifies thresholds that determine the applicability of the Minimum Requirements to different projects. Use the flow charts in Figures 2.4.1 and 2.4.2 to determine which of the Minimum Requirements apply. The Minimum Requirements themselves are presented in Section 2.5.

Use the thresholds in Figures 2.4.1 and 2.4.2 at the time of application for a subdivision, plat, short plat, building permit, or other construction permit. The plat or short plat approval shall identify all stormwater BMPs that are required for each lot. For projects involving only land disturbing activities, (e.g., clearing or grading), the thresholds apply at the time of application for the permit allowing or authorizing that activity. Note the exemption in Section 2.2 for forest practices other than Class IV General.

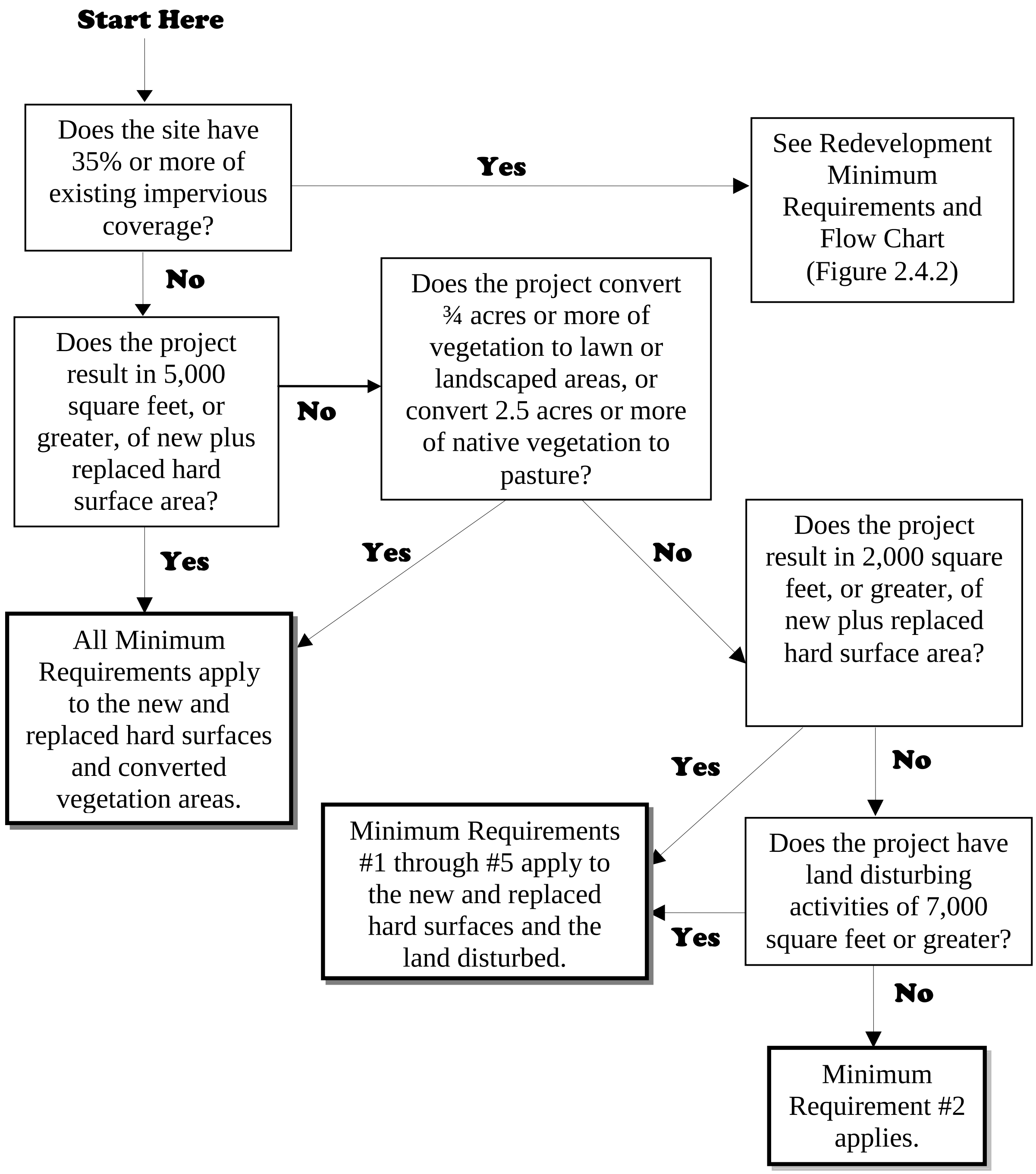

Figure 2.4.1 – Flow Chart for Determining Requirements for New Development

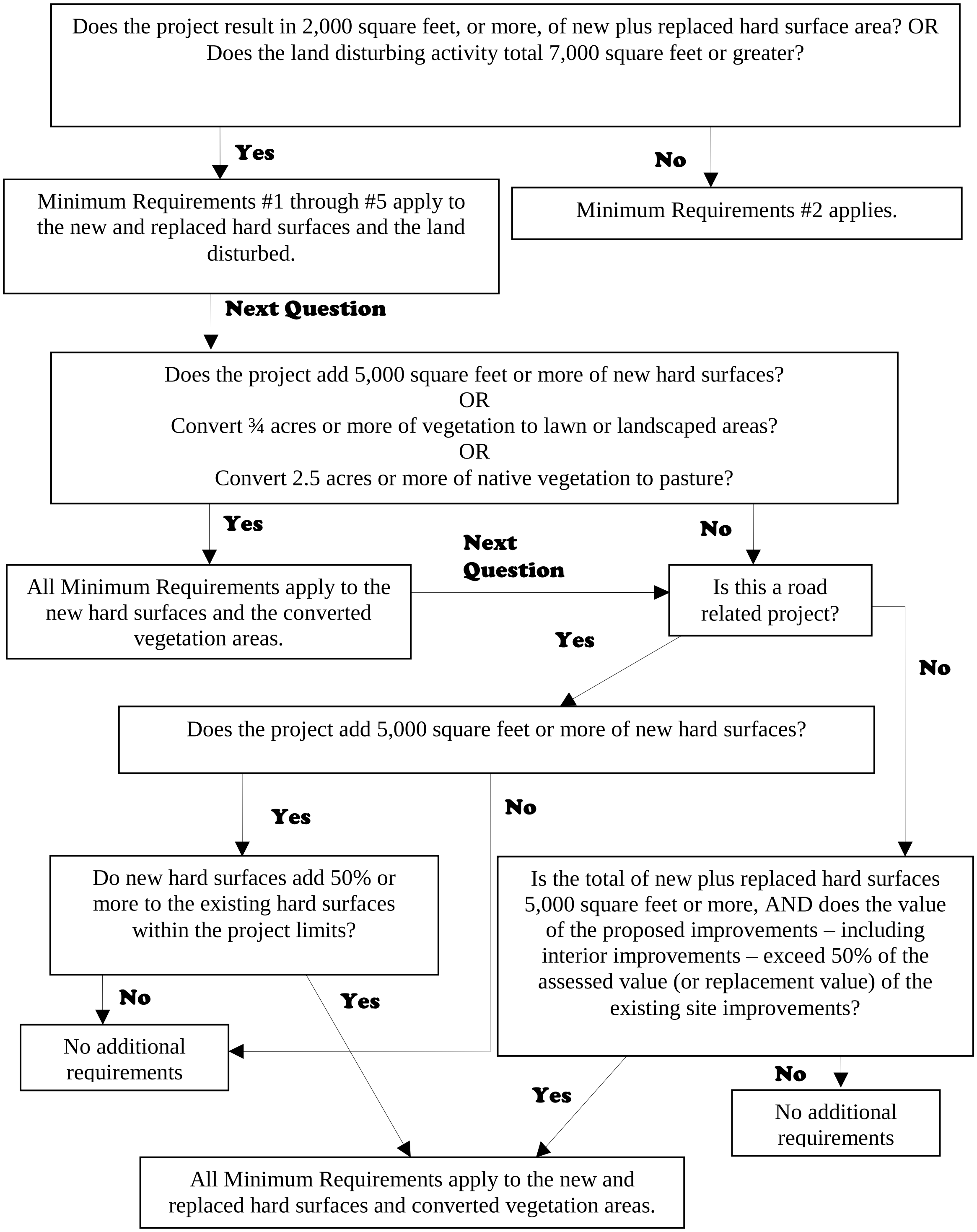

Figure 2.4.2 – Flow Chart for Determining Requirements for Redevelopment

2.4.1 New Development

All new development shall be required to comply with Minimum Requirement #2.

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

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

Supplemental Guidelines

For purposes of applying the above 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 corresponding complete land division application. Where local land use regulations restrict maximum hard (or impervious) surfaces to smaller amounts, those maxima may be used.

Regional stormwater facilities may be used as an alternative method of meeting Minimum Requirements 6, 7, and 8, through documented engineering reports detailing how the proposed facilities meet these requirements for the sites that drain to them. Such facilities must be operational prior to and must have capacity for new development.

Basin planning is encouraged and may be used to tailor Minimum Requirements: #5 On-site Stormwater Management, #6 Runoff Treatment, #7 Flow Control, and / or #8 Wetlands Protection. Basin planning may be used to support alternative treatment, flow control, and/or wetland protection through construction of regional stormwater facilities. Such facilities must be operational prior to and must have capacity for new development.

Where new development projects require improvements (e.g., frontage improvements) that are not within the same threshold discharge area, the local government may allow the Minimum Requirements to be met for an equivalent (flow and pollution characteristics) area that drains to the same receiving water.

2.4.2 Redevelopment

All redevelopment shall be required to comply with Minimum Requirement #2.

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

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

The local government may allow the Minimum Requirements to be met for an equivalent (flow and pollution characteristics) area within the same site. For public roads projects, the equivalent area does not have to be within the project limits, but must drain to the same receiving water.

<u>Additional Requirements for the Project Site</u>

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 all the Minimum Requirements if the new hard surfaces total 5,000 square feet or more and total 50% or more of the existing hard surfaces within the project limits. The project limits shall be defined by the length of the project and the width of the right–of-way.

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

A local government 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 the local government has adopted a plan and a schedule that fulfills those requirements in regional facilities.

A local government may grant a variance/exception to the application of the flow control requirements to replaced impervious surfaces if such application imposes a severe economic hardship. See Section 2.8 of this chapter.

Objective

Redevelopment projects have the same requirements as new development projects in order to minimize the impacts from new surfaces. To not discourage redevelopment projects, replaced surfaces aren't required to be brought up to new stormwater standards unless the noted cost or space thresholds are exceeded. As long as the replaced surfaces have similar pollution-generating potential, the amount of pollutants discharged shouldn't be significantly different. However, if the redevelopment project scope is sufficiently large that the cost or space criteria noted above are exceeded, it is reasonable to require the replaced surfaces to be brought up to current stormwater standards. This is consistent with other utility standards. When a structure or a property undergoes significant remodeling, local governments often require the site to be brought up to new building code requirements (e.g., on-site sewage disposal systems, fire systems).

Supplemental Guidelines

If runoff from new hard surfaces, converted vegetation areas, and replaced hard surfaces (if the applicable cost or space threshold has been exceeded) is not separated from runoff from other existing surfaces within the project site or the site, the guidance in Appendix III-B of Volume III for off-site inflow shall be used to size the detention facilities.

Local governments can select from various bases for identifying projects that must retrofit the replaced hard surfaces on the project site. Those can include:

- Exceeding 50% of the assessed value of the existing improvements;
- Exceeding 50% of the replacement value of the existing site improvements as determined by the Marshall Value System, or a similar valuation system; and
- Exceeding a certain dollar value of improvements; and
- Exceeding a certain ratio of the new hard surfaces to the total of replaced plus new hard surfaces.

A local government's thresholds for the application of stormwater controls to replaced hard surfaces must be at least as stringent as Ecology's thresholds. Local governments should be prepared to demonstrate that by comparing the number and types of historical projects that would have been regulated using the Ecology thresholds versus the local government's thresholds.

Local governments are allowed to institute a stop-loss provision on the application of stormwater requirements to replaced hard surfaces. A stop-loss provision is an upper limit on the extent to which a requirement is applied. For instance, there could be a maximum percentage of the estimated total project costs that are dedicated to meeting stormwater requirements. A project would not have to incur additional stormwater costs above that maximum though the standard redevelopment requirements will not be fully achieved. The allowance for a stop-loss provision pertains to the extent that treatment, flow control and wetlands protection requirements are imposed on replaced hard surfaces. It does not apply to meeting stormwater requirements for new hard surfaces.

Local governments can also establish criteria for allowing redevelopment projects to pay a fee in lieu of constructing water quality or flow control facilities on a redeveloped site. At a minimum, the fee should be the equivalent of an engineering estimate of the cost of meeting all applicable stormwater requirements for the project. The local government should use such funds for the implementation of stormwater control projects that would have similar benefits to the same receiving water as if the project had constructed its required improvements. Expenditure of such funds is subject to other state statutory requirements.

Ecology cautions local governments about the potential long-term consequences of allowing a fee-in-lieu of stormwater facilities. Sites that are allowed to pay a fee continue without stormwater controls. If it is determined, through future basin planning for instance, that controls on such sites are necessary to achieve water quality goals or legal requirements, the public may bear the costs for providing those controls.

Underground utility projects that replace the ground surface with in-kind material or materials with similar runoff characteristics should not be subject to redevelopment requirements except construction site erosion control.

Local governments are also encouraged to review all road projects for changes in elevations or drainage flowpath that could cause flooding, upland or stream erosion, or changes to discharges to wetlands. For example, adding curbs will result in redirecting flows and possibly causing new downstream impacts. The local government should set project-specific requirements to avoid or mitigate those impacts.

2.5 Minimum Requirements

This section describes the minimum requirements for stormwater management at development and redevelopment sites. Section 2.4 should be consulted to determine which requirements apply to any given project. Figures 2.4.1 and 2.4.2 should be consulted to determine whether the minimum requirements apply to new surfaces, replaced surfaces, or new and replaced surfaces. Volumes II through V of this manual present Best Management Practices (BMPs) for use in meeting the Minimum Requirements.

Throughout this chapter, requirements are written in bold and supplemental guidelines that serve as advice and other materials are not in bold.

2.5.1 Minimum Requirement #1: Preparation of Stormwater Site Plans

All projects meeting the thresholds in Section 2.4 shall prepare a Stormwater Site Plan for local government review. Stormwater Site Plans shall use site-appropriate development principles, as required and encouraged by local development codes, to retain native vegetation and minimize impervious surfaces to the extent feasible. Stormwater Site Plans shall be prepared in accordance with Chapter 3 of this volume.

Objective

The 2,000 square feet threshold for hard surfaces and 7,000 square foot threshold for land disturbance are chosen to capture most single family home construction and their equivalent. Note that the scope of the stormwater site plan only covers compliance with Minimum Requirements #2 through #5 if the thresholds of 5,000 square feet of hard surface or conversion of ¾ acre of vegetation to lawn or landscape, or conversion of 2.5 acres of vegetation to pasture are not exceeded.

Supplemental guidelines

Projects proposed by departments and agencies within the local government with jurisdiction must comply with this requirement. The local government shall determine the process for ensuring proper project review, inspection, and compliance by its own departments and agencies.

2.5.2 Minimum Requirement #2: Construction Stormwater Pollution Prevention (SWPP)

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 a Construction SWPP Plan (SWPPP) as part of the Stormwater Site Plan (see Section 2.5.1**).**

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 consider all of the 13 Elements of Construction Stormwater Pollution Prevention and develop controls for all elements that pertain to the project site.

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 of the SWPPP.

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 chapters 3 and 4 of Volume II.

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 the local permitting authority 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.**

Project Requirements - Construction SWPPP Elements

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 practicable.**

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 of sediment onto public 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 prevent it from discharging into systems tributary to waters of the State.**

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 stormwater retention or detention facilities as one of the first steps in grading. Assure that detention facilities function properly before constructing site improvements (e.g., impervious surfaces).**
- **If permanent infiltration ponds are used for flow control during construction, protect these facilities from siltation during the construction phase.**

Element 4: Install Sediment Controls

- **Design, install, and maintain effective erosion controls and sediment controls to minimize the discharge of pollutants.**
- **Construct sediment control BMPs (sediment ponds, traps, filters, etc.) as one of the first steps in grading. These BMPs shall be functional before other land disturbing activities take place.**
- **Minimize sediment discharges from the site. The design, installation and maintenance of erosion and sediment controls must address factors such as the amount, frequency, intensity and duration of precipitation, the nature of resulting stormwater runoff, and soil characteristics, including the range of soil particle sizes expected to be present on the site.**
- **Direct stormwater runoff from disturbed areas through a sediment pond or other appropriate sediment removal BMP, before the runoff leaves a construction site or before discharge to an infiltration facility. Runoff from fully stabilized areas may be discharged without a sediment removal BMP, but must meet the flow control performance standard in Element #3, bullet #1.**
- **Locate BMPs intended to trap sediment on-site in a manner to avoid interference with the movement of juvenile salmonids attempting to enter off-channel areas or drainages.**
- **Where feasible, design outlet structures that withdraw impounded stormwater from the surface to avoid discharging sediment that is still suspended lower in the water column.**

Element 5: Stabilize Soils

- **Stabilize exposed and unworked soils by application of effective BMPs that prevent 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 early on areas to be paved, and dust control.**
- **Control stormwater volume and velocity within the site to minimize soil erosion.**
- **Control stormwater discharges, including both peak flow rates and total stormwater volume, to minimize erosion at outlets and to minimize downstream channel and stream bank erosion.**
- **Soils must not remain exposed and unworked for more than the time periods set forth below to prevent erosion:**
    - **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, protected with sediment trapping measures, and where possible, be located 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.**

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 ground water away from slopes and disturbed areas with interceptor dikes, pipes and/or swales. Off-site stormwater should be managed separately from stormwater generated on the site.**
- **At the top of slopes, collect drainage in pipe slope drains or protected channels to prevent erosion.**
    - **Temporary pipe slope drains must handle the peak volumetric flow rate calculated using a 10-minute time step from a Type**

1A, 10-year, 24-hour frequency storm for the developed condition. Alternatively, the 10-year and 1-hour flow rate predicted by an approved continuous runoff model, increased by a factor of 1.6, may be used. The hydrologic analysis must use the existing land cover condition for predicting flow rates from tributary areas outside the project limits. For tributary areas on the project site, the analysis must use the temporary or permanent project land cover condition, whichever will produce the highest flow rates. If using the Western Washington Hydrology Model (WWHM) 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.**

Element 7: Protect Drain Inlets

- **Protect all storm drain inlets made operable during construction so that stormwater runoff shall 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 (unless a different standard is specified by the product manufacturer).**

Element 8: Stabilize Channels and Outlets

- **Design, construct, and stabilize all on-site conveyance channels to prevent erosion from the following expected peak flows:**
  - **Channels must handle the peak volumetric flow rate calculated using a 10-minute time step from a Type 1A, 10- year, 24-hour frequency storm for the developed condition. Alternatively, the 10-year, 1-hour flow rate indicated by an approved continuous runoff model, increased by a factor of 1.6, may be used. The hydrologic analysis must use the existing land cover condition for predicting flow rates from tributary areas outside the project limits. For tributary areas on the project site, the analysis must use the temporary or permanent project land cover condition, whichever will produce the highest flow rates. If using the Western Washington Hydrology Model (WWHM) to predict flows, bare soil areas should be modeled as "landscaped area.**
- **Provide stabilization, including armoring material, adequate to prevent erosion of outlets, adjacent stream banks, slopes and downstream reaches at the outlets of all conveyance systems.**

Element 9: Control Pollutants

- **Design, install, implement and maintain effective pollution prevention measures to minimize the discharge of pollutants.**
- **Handle and dispose of all pollutants, including waste materials and demolition debris that occur on-site in a manner that does not cause contamination of stormwater.**
- **Provide cover, containment, and protection from vandalism for all chemicals, liquid products, petroleum products, and other materials that have the potential to pose a threat to human health or the environment. On-site fueling tanks must include secondary containment. Secondary containment means placing tanks or containers within an impervious structure capable of containing 110% of the volume contained in the largest take 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, such as closed-loop recirculation or upland application, or to the sanitary sewer, with local sewer district approval.**
- **Apply fertilizers and pesticides in a manner and at application rates that will not result in loss of chemical to stormwater runoff. Follow manufacturers' label requirements for application rates and procedures.**
- **Use BMPs to prevent contamination of stormwater runoff by pH modifying sources. The sources for this contamination include, but are not limited to: bulk cement, cement kiln dust, fly ash, new concrete washing and curing waters, waste streams generated from concrete grinding and sawing, exposed aggregate processes, dewatering concrete vaults, concrete pumping and mixer washout waters.**
- **Adjust the pH of stormwater if necessary to prevent violations of 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 trucks onto the ground, or into storm drains, open ditches, streets, or streams. Do not dump excess concrete on-site, except in designated concrete washout areas. Concrete spillage or concrete discharge to surface waters of the State is prohibited.**

- **Obtain written approval from Ecology before using chemical treatment other than CO2 or dry ice to adjust pH.**

Element 10: Control De-Watering

- **Discharge foundation, vault, and trench de-watering water, which has similar characteristics to stormwater runoff at the site, into a controlled conveyance system before discharge to a sediment trap or sediment pond.**
- **Discharge clean, non-turbid de-watering water, such as well-point ground water, to systems tributary to, or directly into surface waters of the State, as specified in Element #8, provided the de-watering flow does not cause erosion or flooding of receiving waters. Do not route clean dewatering water through stormwater sediment ponds. Note that "surface waters of the State" may exist on a construction site as well as off site; for example, a creek running through a site.**
- **Handle highly turbid or otherwise contaminated dewatering water separately from stormwater.**
- **Other treatment or disposal options may include:**
  1. **Infiltration.**
  2. **Transport off-site in a vehicle, such as a vacuum flush truck, for legal disposal in a manner that does not pollute state waters.**
  3. **Ecology-approved on-site chemical treatment or other suitable treatment technologies.**
  4. **Sanitary or combined sewer discharge with local sewer district approval, if there is no other option.**
  5. **Use of a sedimentation bag that discharges to a ditch or swale for small volumes of localized dewatering.**

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.**

Element 12: Manage the Project

- **Phase development projects to the maximum degree practicable and take into account seasonal work limitations.**
- **Inspection and monitoring – Inspect, maintain and repair all BMPs as needed to assure continued performance of their intended function. Projects regulated under the Construction Stormwater General Permit must conduct site inspections and monitoring in accordance with Special Condition S4 of the Construction Stormwater General Permit.**
- **Maintaining an updated construction SWPPP – Maintain, update, and implement the SWPPP.**
- **Projects that disturb one or more acres must have site inspections conducted by a Certified Erosion and Sediment Control Lead (CESCL). Project sites disturbing less than one acre may have a CESCL or a person without CESCL certification conduct inspections. By the initiation of construction, the SWPPP must identify the CESCL or inspector, who must be present on-site or on-call at all times.**
- The CESCL or inspector (project sites less than one acre) must have the skills to 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 the 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 not 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 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 temporary stabilized, inactive sites to once every calendar month.

Element 13: Protect Low Impact Development BMPs

- **Protect all Bioretention and Rain Garden BMPs from sedimentation through installation and maintenance of erosion and sediment control BMPs on portions of the site that drain into the Bioretention and/or Rain Garden BMPs. Restore the BMPs to their fully functioning condition if they accumulate sediment during construction. Restoring the BMP must include removal of sediment and any sediment-laden Bioretention/rain garden soils, and replacing the removed soils with soils meeting the design specification.**
- **Prevent compacting Bioretention and rain garden BMPs by excluding construction equipment and foot traffic. Protect completed lawn and landscaped areas from compaction due to 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.**
- **Pavement fouled with sediments or no longer passing an initial infiltration test must be cleaned using procedures in accordance with this manual 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.**

Objective

To control erosion and prevent sediment and other pollutants from leaving the site during the construction phase of a project. To have fully functional stormwater facilities and BMP's for the developed site upon completion of construction.

Supplemental Guidelines

If a Construction SWPPP is found to be inadequate (with respect to erosion and sediment control requirements), then the Plan Approval Authority[1] within the Local Government should require that other BMPs be implemented, as appropriate.

The Plan Approval Authority may allow development of generic Construction SWPPP's that apply to commonly conducted public road activities, such as road surface replacement, that trigger this minimum requirement. They may also develop an abbreviated SWPPP format for project sites that will disturb less than 1 acre.

Based on the information provided and/or local weather conditions, the local permitting authority may expand or restrict the seasonal limitation on site disturbance. The local permitting authority shall take enforcement action - such as a notice of violation, administrative order, penalty, or stop-work order under 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; or
- If clearing and grading limits or erosion and sediment control measures shown in the approved plan are not maintained.

Coordination with Utilities and Other Contractors - 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.

Element #13, Protect Low Impact Development BMPs, is not yet included as a permit condition in the NPDES Construction Stormwater General Permit. That permit is not scheduled for reissuance until December, 2015. Until that permit is reissued with element #13 added as a permit condition, the element may be enforceable only through the requirements of local stormwater codes that may have been updated to include it. Municipal Stormwater Permittees must incorporate this element into local requirements per the timelines in their Municipal Stormwater Permit.

[1] The Plan Approval Authority is defined as that department within a local government that has been delegated authority to approve stormwater site plans.

2.5.3 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 this manual.

Objective

The intent of source control BMPs is to prevent stormwater from coming in contact with pollutants. They are a cost-effective means of reducing pollutants in stormwater, and, therefore, should be a first consideration in all projects.

Supplemental Guidelines

An adopted and implemented basin plan or a Total Maximum Daily Load (TMDL, also known as a Water Clean-up Plan) may be used to develop more stringent source control requirements that are tailored to a specific basin.

Source Control BMPs include Operational BMPs and Structural Source Control BMPs. See Volume IV for design details of these BMPs. For construction sites, see Volume II, Chapter 4.

Structural source control BMPs should be identified in the stormwater site plan and should be shown on all applicable plans submitted for local government review and approval.

2.5.4 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 downgradient properties. All outfalls require energy dissipation.

Objective

To preserve and utilize natural drainage systems to the fullest extent because of the multiple stormwater benefits these systems provide; and to prevent erosion at and downstream of the discharge location.

Supplemental Guidelines

Creating new drainage patterns results in more site disturbance and more potential for erosion and sedimentation during and after construction. Creating new discharge points can create significant stream channel erosion problems as the receiving water body typically must adjust to the new flows. Diversions can cause greater impacts than would otherwise occur by discharging runoff at the natural location.

Where no conveyance system exists at the adjacent downgradient property line and the discharge was previously unconcentrated flow or significantly lower concentrated flow, then measures must be taken to prevent downgradient impacts. Drainage easements from downstream property owners may be needed and should be obtained prior to approval of engineering plans.

The following discharge requirement is recommended:

Where no conveyance system exists at the abutting downstream property line and the natural (existing) discharge is unconcentrated, any runoff concentrated by the proposed project must be discharged as follows:

a) If the 100-year peak discharge is less than or equal to 0.2 cfs (0.3 cfs using 15 minute time steps) under existing conditions and will remain less than or equal to 0.2 cfs under developed conditions, then the concentrated runoff may be discharged onto a rock pad or to any other system that serves to disperse flows.

b) If the 100-year peak discharge is less than or equal to 0.5 cfs (0.75 cfs using 15 minute time steps) under existing conditions and will remain less than or equal to 0.5 cfs under developed conditions, then the concentrated runoff may be discharged through a dispersal trench or other dispersal system, provided the applicant can demonstrate that there will be no significant adverse impact to downhill properties or drainage systems.

c) If the 100-year peak discharge is greater than 0.5 cfs for either existing or developed conditions, or if a significant adverse impact to downgradient properties or drainage systems is likely, then a conveyance system must be provided to convey the concentrated runoff across the downstream properties to an acceptable discharge point (i.e., an enclosed drainage system or open drainage feature where concentrated runoff can be discharged without significant adverse impact).

Stormwater control or treatment structures should not be located within the expected 25-year water level elevations for salmonid-bearing waters. Such areas may provide off-channel habitat for juvenile salmonids and salmonid fry. Designs for outfall systems to protect against adverse impacts from concentrated runoff are included in Volume V, Chapter 4.

2.5.5 Minimum Requirement #5: On-site Stormwater Management

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

Projects qualifying as flow control exempt in accordance with Section 2.5.7 of this chapter do not have to achieve the LID performance standard, nor consider bioretention, rain gardens, permeable pavement, and full dispersion if using List #1 or List #2. However, those projects must implement BMP T5.13; BMPs T5.10A, B, or C; and BMP T5.11or T5.12, if feasible.

Project Thresholds

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

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

b. 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 7 of Volume V to achieve the LID Performance Standard.

Projects triggering Minimum Requirements #1 through #9, must meet the requirements in Table 2.5.1.

Table 2.5.1 On-site Stormwater Management Requirements for Projects Triggering Minimum Requirements #1 - #9

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

NOTE: This table refers to the Urban Growth Area (UGA) as designated under the Growth Management Act (GMA) (Chapter 36.70A RCW) of the State of Washington. If the Permittee is located in a county that is not subject to planning under the GMA, the city limits shall be used instead.

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 the Standard Flow Control Requirement section in 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.

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

For each surface, consider the BMP's 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 this manual; and**
2. **Competing Needs Criteria listed in Chapter 5 of Volume V of this manual.**

Lawn and landscaped areas:

- **Post-Construction Soil Quality and Depth in accordance with BMP T5.13 in Chapter 5 of Volume V**

Roofs:

1. **Full Dispersion in accordance with BMP T5.30 in Chapter 5 of Volume V, or Downspout Full Infiltration Systems in accordance with BMP T5.10A in Section 3.1.1 in Chapter 3 of Volume III**
2. **Rain Gardens in accordance with BMP T5.14A in Chapter 5 of Volume V, or Bioretention in accordance with Chapter 7 of Volume V. The rain garden or bioretention facility must have a minimum horizontal projected surface area below the overflow which is at least 5% of the area draining to it.**
3. **Downspout Dispersion Systems in accordance with BMP T5.10B in Section 3.1.2 in Chapter 3 of Volume III**
4. **Perforated Stub-out Connections in accordance with BMP T5.10C in Section 3.1.3 in Chapter 3 of Volume III**

Other Hard Surfaces:

1. **Full Dispersion in accordance with BMP T5.30 in Chapter 5 of Volume V**

2. Permeable pavement[1] in accordance with BMP T5.15 in Chapter 5 of Volume V, or Rain Gardens in accordance with BMP T5.14 in Chapter 5 of Volume V, or Bioretention in accordance with Chapter 7 of Volume V. The rain garden or bioretention facility must have a minimum horizontal projected surface area below the overflow which is at least 5% of the area draining to it.

3. Sheet Flow Dispersion in accordance with BMP T5.12, or Concentrated Flow Dispersion in accordance with BMP T5.11 in Chapter 5 of Volume V.

List #2: On-site Stormwater Management BMPs for Projects Triggering Minimum Requirements #1 through #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 this manual; and

2. Competing Needs Criteria listed in Chapter 5 of Volume V of this manual.

Lawn and landscaped areas:

- **Post-Construction Soil Quality and Depth in accordance with BMP T5.13 in Chapter 5 of Volume V.**

Roofs:

1. Full Dispersion in accordance with BMP T5.30 in Chapter 5 of Volume V, or Downspout Full Infiltration Systems in accordance with BMP T5.10A in Section 3.1.1 in Chapter 3 of Volume III

2. Bioretention (See Chapter 7 of Volume V) facilities that have a minimum horizontally projected surface area below the overflow which is at least 5% of the total surface area draining to it.

3. Downspout Dispersion Systems in accordance with BMP T5.10B in Section 3.1.2 in Chapter 3 of Volume III

4. Perforated Stub-out Connections in accordance with BMP T5.10C in Section 3.1.3 in Chapter 3 of Volume III

Other Hard Surfaces:

1. Full Dispersion in accordance with BMP T5.30 in Chapter 5 of Volume V

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

2. **Permeable pavement[1] in accordance with BMP T5.15 in chapter 5 of Volume V**
3. **Bioretention BMP's (See Chapter 7, Volume V of the SMMWW) 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 5 of Volume V.**

Objective

To use practices distributed across a development that reduce the amount of disruption of the natural hydrologic characteristics of the site.

Supplemental Guidelines

"Flooding or erosion impacts" include flooding of septic systems, crawl spaces, living areas, outbuildings, etc.; increased ice or algal growth on sidewalks/roadways; earth movement/settlement; erosion and other potential damage.

Recent research indicates that traditional development techniques in residential, commercial, and industrial land development cause gross disruption of the natural hydrologic cycle with severe impacts to water and water-related natural resources. Based upon gross level applications of continuous runoff modeling and assumptions concerning minimum flows needed to maintain beneficial uses, watersheds must retain the majority of their natural vegetation cover and soils, and developments must minimize their disruption of the natural hydrologic cycle in order to avoid significant natural resource degradation in lowland streams.

The BMPs described in Section 3.1 of Volume III, and Section 5.3.1 of Volume V are likely insufficient by themselves to prevent significant hydrologic disruptions and impacts to streams and their natural resources. Therefore, local governments should look for opportunities to change their local development codes to minimize impervious surfaces and retain native vegetation in all development situations. Most importantly, to maintain the beneficial uses of our lowland freshwater systems will require land use planning that targets retention of a majority of a creek's watershed in its natural condition, and retains most of the benefits of headwater areas, connected wetlands, riparian, and floodplain areas.

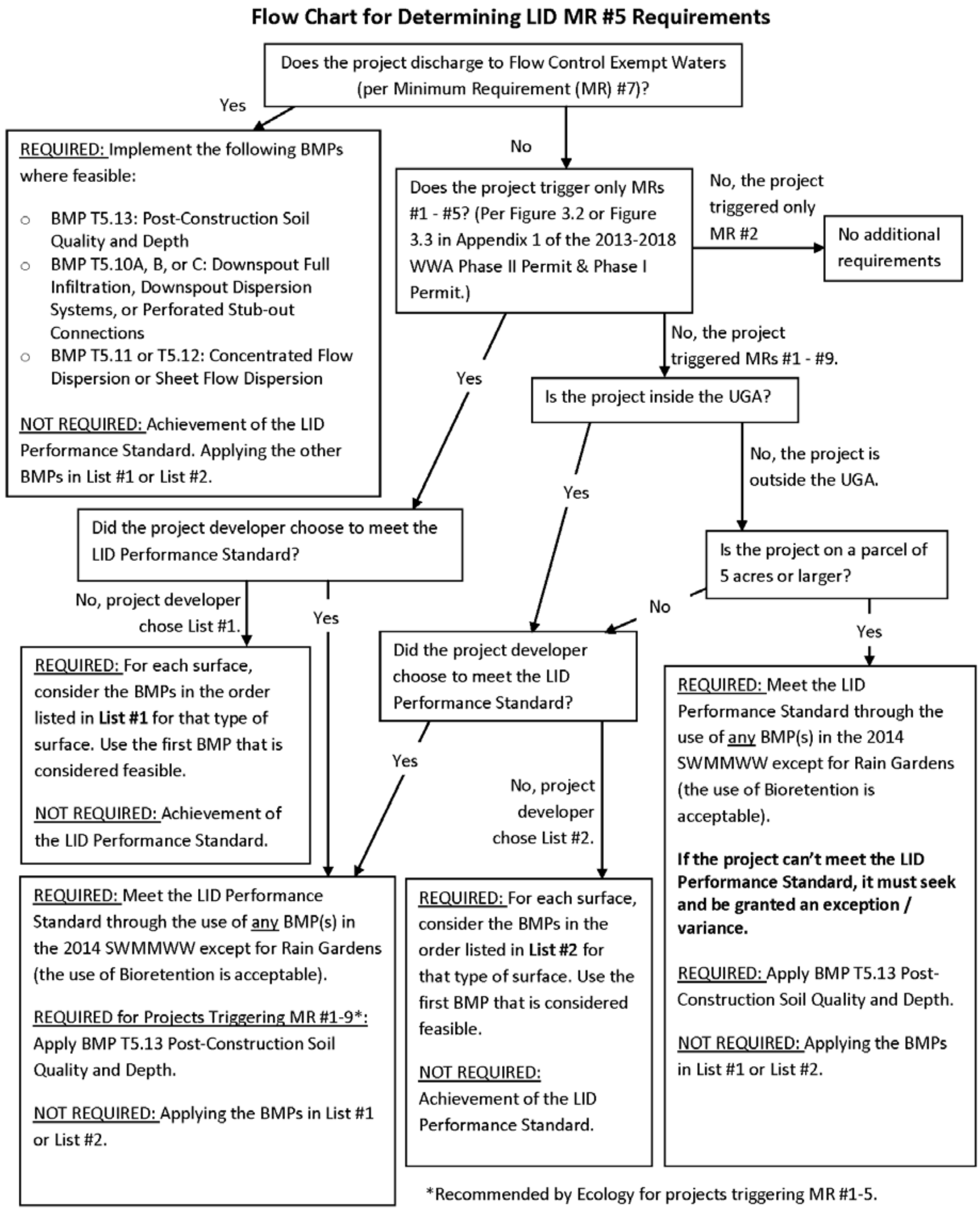

Figure 2.5.1 – Flow Chart for Determining LID MR #5 Requirements

2.5.6 Minimum Requirement #6: Runoff Treatment

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 2.4 of this chapter.

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.**

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 2.4 of this chapter) or the treatment threshold decisions of this minimum requirement.

Water Quality Design Storm Volume:

- **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 Chapter 2 of Volume III, for the 6-month, 24-hour storm. Alternatively, when using an approved continuous runoff 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 flow rate at or below which 91% of the runoff volume, as estimated by an approved continuous runoff 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 runoff 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 must be the full 2-year release rate from the detention facility.**

Treatment Facility Selection, Design, and Maintenance

Stormwater treatment facilities shall be:

- Selected in accordance with the process identified in Chapter 4 of Volume I, and Chapter 2 of Volume V,
- Designed in accordance with the design criteria in Volume V, and
- Maintained in accordance with the maintenance schedule in Volume V.

Additional Requirements

Direct discharge of untreated stormwater from pollution-generating hard surfaces to ground water 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 5, Volume V and Chapter 7, Volume V; or by infiltration through soils meeting the soil suitability criteria in Chapter 3 of Volume III.

Objective

The purpose of runoff treatment is to reduce pollutant loads and concentrations in stormwater runoff using physical, biological, and chemical removal mechanisms so that beneficial uses of receiving waters are maintained and, where applicable, restored. When site conditions are appropriate, infiltration can potentially be the most effective BMP for runoff treatment.

Supplemental Guidelines

See Volume V for more detailed guidance on selection, design, and maintenance of treatment facilities. The water quality design storm volume and flow rates are intended to capture and effectively treat about 90-95% of the annual runoff volume in western Washington. See Appendix I-B for background on their derivation.

Volume V includes performance goals for Basic, Enhanced, Phosphorus, and Oil Control treatment, and a menu of facility options for each treatment type. Treatment facilities that are selected from the appropriate menu and designed in accordance with their design criteria are presumed to meet the applicable performance goals.

An adopted and implemented basin plan, or a Total Maximum Daily Load (TMDL - also known as a Water Clean-up Plan) may be used to develop runoff treatment requirements that are tailored to a specific basin.

However, treatment requirements shall not be less than that achieved by facilities in the Basic Treatment Menu (see Volume V, Chapter 3).

Treatment facilities applied consistent with this manual are presumed to meet the requirement of state law to provide all known available and reasonable methods of treatment (RCW 90.52.040, RCW 90.48.010). This technology-based treatment requirement does not excuse any discharge from the obligation to apply whatever technology is necessary to comply with state water quality standards, Chapter 173-201A WAC; state ground water quality standards, Chapter 173-200 WAC; state sediment management standards, Chapter 173-204 WAC; and the underground injection control program, Chapter 173-218 WAC. Additional treatment to meet those standards may be required by federal, state, or local governments.

Infiltration through use of On-site Stormwater Management BMPs can provide both treatment of stormwater, through the ability of certain soils to remove pollutants, and volume control of stormwater, by decreasing the amount of water that runs off to surface water. Infiltration through engineered treatment facilities that utilize the natural soil profile can also be very effective at treating stormwater runoff, but pretreatment must be applied and soil conditions must be appropriate to achieve effective treatment while not impacting ground water resources. See Chapter 6 of Volume V for pretreatment design details.

Discharge of pollution-generating surfaces into a dry well, after pretreatment for solids reduction, can be acceptable if the soil conditions provide sufficient treatment capacity. Dry wells into gravelly soils are not likely to have sufficient treatment capability. They must be preceded by at least a basic treatment BMP. See Volume V, Chapters 2 and 7 for details.

Impervious surfaces that are "fully dispersed" in accordance with BMP T5.30 in Volume V are not considered effective impervious surfaces. Impervious surfaces that are "dispersed" in accordance with BMPs T5.10B, T5.11, and T5.12 in Section 5.3.1 of Volume V are still considered effective surfaces though they may be modeled as pervious surfaces if flow path lengths meet the specified minima. See Volume III, Appendix III-C for a more complete description of hydrologic representation of On-site Stormwater Management BMPs.

2.5.7 Minimum Requirement #7: Flow Control

Applicability

Projects must provide flow control to reduce the impacts of stormwater runoff from hard surfaces and land cover conversions. The requirement below applies to projects that discharge stormwater directly, or indirectly through a conveyance system, into a fresh waterbody.

Flow Control is not required for projects that discharge directly to, or indirectly to a water listed in Appendix I-E - Flow Control-Exempt Receiving Waters 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 BMP's are applied to route natural runoff volumes from the project site to any downstream Type 5 stream or category IV wetland:**
  - **Design of flow splitting devices or drainage BMP's 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, durations ranging from 50% of the 2-year to the 50-year peak flow.**
  - **Flow splitting devices or drainage BMP's 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) and extends to the ordinary high water line of the exempt receiving water; and**
- **The conveyance system between the project site and the exempt receiving water shall have sufficient hydraulic capacity to convey discharges from future build-out conditions (under current zoning) of the site, and the existing condition from non-project areas from which runoff is or will be collected; and**
- **Any erodible elements of the manmade conveyance system must be adequately stabilized to prevent erosion under the conditions noted above.**

If the discharge is to a stream that leads to a wetland, or to a wetland that has an outflow to a stream, both this requirement and Minimum Requirement #8 apply.

Local governments may petition Ecology to exempt projects in additional areas. A petition must justify the proposed exemption based upon a hydrologic analysis that demonstrates that the potential stormwater runoff from the exempted area will not significantly

increase the erosion forces on the stream channel nor have near field impacts.

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 2.4 of this chapter.

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

- **Projects in which the total of effective impervious surfaces is 10,000 square feet or more in a threshold discharge area, or**
- **Projects that convert ¾ acres or more of vegetation to lawn or landscape, or convert 2.5 acres or more of native vegetation to pasture in a threshold discharge area, and from which there is a surface discharge in a natural or man-made conveyance system from the site, or**
- **Projects that through a combination of effective hard surfaces and converted vegetation areas cause a 0.10 cubic feet per second increase in the 100-year flow frequency from a threshold discharge area as estimated using the Western Washington Hydrology Model or other approved model and one-hour time steps (or a 0.15 cfs increase using 15-minute time steps).** [2]

Standard Flow Control Requirement

The following requirement applies to the following counties:

Clallam	Jefferson	Pacific	Snohomish
Clark	King	Pierce	Thurston
Cowlitz	Kitsap	San Juan	Wahkiakum
Grays Harbor	Lewis	Skagit	Whatcom
Island	Mason	Skamania	

[2] The 0.10 cfs (one-hour time steps) or 0.15 cfs (15-minute time steps) increase should be a comparison of the post-project runoff to the existing condition runoff. For the purpose of applying this threshold, the existing condition is either the pre-project land cover, or the land cover that existed at the site as of a date when the local jurisdiction first adopted flow control requirements into code or rules.

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:

- **Reasonable, historic information is provided that indicates the site was prairie prior to settlement (modeled as "pasture" in the Western Washington Hydrology Model); or,**
- **The drainage area of the immediate stream and all subsequent downstream basins have had at least 40% total impervious area since 1985. In this case, the pre-developed condition to be matched shall be the existing land cover condition. The map in Appendix I-F depicts those areas which meet this criterion. 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.**

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

Western Washington Alternative Requirement

An alternative requirement may be established through application of watershed-scale hydrological modeling and supporting field observations. Possible reasons for an alternative flow control requirement include:

- **Establishment of a stream–specific threshold of significant bedload movement other than the assumed 50% of the 2-year peak flow;**
- **Zoning and Land Clearing Ordinance restrictions that, in combination with an alternative flow control standard, maintain or reduce the naturally occurring erosive forces on the stream channel; or**
- **A duration control standard is not necessary for protection, maintenance, or restoration of designated and existing beneficial uses or Clean Water Act compliance.**

Additional Requirement

Flow Control BMPs shall be selected, designed, and maintained according to Volume III or a local government manual deemed equivalent to this manual.

Objective

To prevent increases in the stream channel erosion rates that are characteristic of natural conditions (i.e., prior to disturbance by European settlement). The standard intends to maintain the total amount of time that a receiving stream exceeds an erosion-causing threshold based upon historic rainfall and natural land cover conditions. That threshold is assumed to be 50% of the 2-year peak flow. Maintaining the naturally occurring erosion rates within streams is vital, though by itself insufficient, to protect fish habitat and production.

Supplemental Guidelines

Reduction of flows through infiltration decreases stream channel erosion and helps to maintain base flow throughout the summer months. However, infiltration should follow the guidance in this manual to reduce the chance that ground water quality is threatened by such discharges.

Volume III includes a description of the Western Washington Hydrology Model. The model provides ways to represent On-site Stormwater Management BMPs described in Volumes III and V. Using those BMPs reduces the predicted runoff rates and volumes and thus also reduces the size of the required flow control facilities.

Application of sufficient types of On-site Stormwater Management BMPs can result in reducing the effective impervious area and the converted vegetation areas such that a flow control facility is not required. Application of "Full Dispersion", BMP T5.30, also results in eliminating the flow control facility requirement for those areas that are "fully dispersed."

See the guidelines in Appendix I-D for Minimum Requirement #8, and directions concerning use of the Western Washington Hydrology Model for information about the approach for protecting wetland hydrologic conditions.

Diversions of flow from perennial streams and from wetlands can be considered if significant existing (i.e., pre-project) flooding, stream stability, water quality, or aquatic habitat problems would be solved or significantly mitigated by bypassing stormwater runoff rather than providing stormwater detention and discharge to natural drainage features. Bypassing should not be considered as an alternative to applicable flow control or treatment if the flooding, stream stability, water quality or habitat problem to be solved would be caused by the project. In addition, the proposal should not exacerbate other water quality/quantity problems such as inadequate low flows or inadequate wetland water elevations. The existing problems and their solution or mitigation as a result of the direct discharge should be documented by a stormwater engineer or scientist after review of any available drainage reports, basin plans, or other relevant literature. The restrictions in this minimum requirement on conveyance systems that transfer water to an exempt receiving water are applicable in these situations. Approvals by all regulatory authorities with relevant permits applicable to the project are necessary.

Ecology hopes to publish guidance concerning basin studies to develop basin-specific flow control strategies intended to stabilize stream channels and provide flows intended to protect and restore beneficial uses such as fish resources. The recommendations made in basin plans should be consistent with the requirements and intent of the federal Clean Water Act, the State Water Pollution Control Act, and any other applicable natural resources statutes, such as the Federal Endangered Species Act.

2.5.8 Minimum Requirement #8: Wetlands Protection

Applicability

The requirements below apply only to projects whose stormwater discharges into a wetland, either directly or indirectly through a conveyance system.

Thresholds

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

Standard Requirement

Projects shall comply with Guide Sheets #1 through #3 in Appendix I-D. The hydrologic analysis shall use the existing land cover condition to determine the existing hydrologic conditions unless directed otherwise by a regulatory agency with jurisdiction.

Additional Requirements

Stormwater treatment and flow control facilities shall not be built within a natural vegetated buffer, except for:

- **Necessary conveyance systems as approved by the local government; or**
- **As allowed in wetlands approved for hydrologic modification and/or treatment in accordance with Guide Sheet 2 in Appendix I-D.**

An adopted and implemented basin plan, or a Total Maximum Daily Load (TMDL, also known as a Water Clean-up Plan) may be used to develop requirements for wetlands that are tailored to a specific basin.

Objective

To ensure that wetlands receive the same level of protection as any other waters of the state. Wetlands are extremely important natural resources which provide multiple stormwater benefits, including ground water recharge, flood control, and stream channel erosion protection. They are easily impacted by development unless careful planning and management are conducted. Wetlands can be severely degraded by stormwater discharges from urban development due to pollutants in the runoff and also due to disruption of natural hydrologic functioning of the wetland system. Changes in water levels and the frequency and duration of inundations are of particular concern.

Supplemental Guidelines

Appendix I-D Guidelines for Wetlands when Managing Stormwater shall be used for discharges to natural wetlands and wetlands constructed as mitigation. While it is always necessary to pre-treat stormwater prior to discharge to a wetland, there are limited circumstances where wetlands may be used for additional treatment and detention of stormwater. These situations are considered in Guide Sheet 2 of Appendix I-D.

Note that if selective runoff bypass is an alternative being considered to maintain the hydroperiod, the hydrologic analysis must consider the impacts of the bypassed flow. For instance, if the bypassed flow is eventually directed to a stream, the flow duration standard, Minimum Requirement #7, applies to the bypass.

2.5.9 Minimum Requirement #9: Operation and Maintenance

An operation and maintenance manual that is consistent with the provisions in Volume V shall be provided for proposed stormwater facilities and BMPs, and the party (or parties) responsible for maintenance and operation shall be identified. At private facilities, a copy of the operation and 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 public facilities, a copy of the operation and maintenance manual shall be retained in the appropriate department. A log of maintenance activity that indicates what actions were taken shall be kept and be available for inspection by the local government.

Objective

To ensure that stormwater control facilities are adequately maintained and operated properly.

Supplemental Guidelines

Inadequate maintenance is a common cause of failure for stormwater control facilities. The description of each BMP in Volumes II, III, and V includes a section on maintenance. Chapter 4 of Volume V includes a schedule of maintenance standards for drainage facilities. Local governments should consider more detailed requirements for maintenance logs, such as a record of where wastes were disposed.

2.6 Optional Guidance

The following guidance is offered as recommendations to local governments. Ecology considers their use to be in the best interest of the general public and the environment but will not make their implementation a requirement for manual equivalency.

2.6.1 Optional Guidance #1: Financial Liability

Performance bonding or other appropriate financial guarantees shall be required for all projects to ensure construction of drainage facilities in compliance with these standards. In addition, a project applicant shall post a two-year financial guarantee of the satisfactory performance and maintenance of any drainage facilities that are scheduled to be assumed by the local government for operation and maintenance.

Objective

To ensure that development projects have adequate financial resources to fully implement stormwater management plan requirements and that liability is not unduly incurred by local governments.

Supplemental Guidelines

The type of financial instrument required is less important than ensuring that there are adequate funds available in the event that non-compliance occurs.

2.6.2 Optional Guidance #2: Off Site Analysis and Mitigation

Development projects that discharge stormwater off-site shall submit an off-site analysis report that assesses the potential off-site water quality, erosion, slope stability, and drainage impacts associated with the project and that proposes appropriate mitigation of those impacts. An initial qualitative analysis shall extend downstream for the entire flow path from the project site to the receiving water or up to one mile, whichever is less. If a receiving water is within one-quarter mile, the analysis shall extend within the receiving water to one-quarter mile from the project site. The analysis shall extend one-quarter mile beyond any improvements proposed as mitigation. The analysis must extend upstream to a point where any backwater effects created by the project cease. Upon review of the qualitative analysis, the local project reviewer may require that a quantitative analysis be performed.

The existing or potential impacts to be evaluated and mitigated shall include:

- Conveyance system capacity problems;
- Localized flooding;
- Upland erosion impacts, including landslide hazards;
- Stream channel erosion at the outfall location;
- Violations of surface water quality standards as identified in a Basin Plan or a TMDL (Water Clean-up Plan); or violations of ground water standards in a wellhead protection area.

Objective

To identify and evaluate off-site water quality, erosion, slope stability, and drainage impacts that may be caused or aggravated by a proposed project, and to determine measures for preventing impacts and for not aggravating existing impacts. Aggravated shall mean increasing the frequency of occurrence and/or severity of a problem.

Supplemental Guidelines

Ecology highly recommends that local governments adopt similar off-site analysis requirements. Some of the most common and potentially destructive impacts of land development are erosion of downgradient properties, localized flooding, and slope failures. These are caused by increased surface water volumes and changed runoff patterns. Because these problems frequently do not have a related water quality impact, Ecology is not listing off-site analysis as a minimum requirement. However, taking the precautions of off-site analysis could prevent substantial property damage and public safety risks.

Projects should be required to initially submit, with the permit application, a qualitative analysis of each downstream system leaving a site. The analysis should accomplish four tasks:

Task 1 – Define and map the study area

> Submission of a site map showing property lines; a topographic map (at a minimum a USGS 1:24000 Quadrangle Topographic map) showing site boundaries, study area boundaries, downstream flowpath, and potential/existing problems.

Task 2 – Review all available information on the study area

> This should include all available basin plans, ground water management area plans, drainage studies, floodplain/floodway FEMA maps, wetlands inventory maps, Critical Areas maps, stream habitat reports, salmon distribution reports, etc.

Task 3 – Field inspect the study area

> The design engineer should physically inspect the existing on- and off-site drainage systems of the study area for each discharge location for

existing or potential problems and drainage features. An initial inspection and investigation should include:

- Investigate problems reported or observed during the resource review
- Locate existing/potential constrictions or capacity deficiencies in the drainage system
- Identify existing/potential flooding problems
- Identify existing/potential overtopping, scouring, bank sloughing, or sedimentation
- Identify significant destruction of aquatic habitat (e.g., siltation, stream incision)
- Collect qualitative data on features such as land use, impervious surface, topography, soils, presence of streams, wetlands
- Collect information on pipe sizes, channel characteristics, drainage structures
- Verify tributary drainage areas identified in task 1
- Contact the local government office with drainage review authority, neighboring property owners, and residents about drainage problems
- Note date and weather at time of inspection

Task 4 – Describe the drainage system, and its existing and predicted problems

For each drainage system component (e.g., pipe, culvert, bridges, outfalls, ponds, vaults) the following should be covered in the analysis: location, physical description, problems, and field observations.

All existing or potential problems (e.g., ponding water, erosion) identified in tasks 2 and 3 above should be described. The descriptions should be used to determine whether adequate mitigation can be identified, or whether more detailed quantitative analysis is necessary. The following information should be provided for each existing or potential problem:

- Magnitude of or damage caused by the problem
- General frequency and duration
- Return frequency of storm or flow when the problem occurs (may require quantitative analysis)
- Water elevation when the problem occurs
- Names and concerns of parties involved

- Current mitigation of the problem
- Possible cause of the problem
- Whether the project is likely to aggravate the problem or create a new one.

Upon review of this analysis, the local government may require mitigation measures deemed adequate for the problems, or a quantitative analysis, 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 analysis should repeat tasks 3 and 4 above, using quantitative field data including profiles and cross-sections.

The quantitative analysis should provide information on the severity and frequency of an existing problem or the likelihood of creating a new problem. It should evaluate proposed mitigation intended to avoid aggravation of the existing problem and to avoid creation of a new problem.

2.7 Adjustments

Adjustments to the Minimum Requirements may be granted prior to permit approval and construction. The drainage manual administrator may grant an adjustment provided that a written finding of fact is prepared, that addresses the following:

- **The adjustment provides substantially equivalent environmental protection.**
- **The objectives of safety, function, environmental protection and facility maintenance, based upon sound engineering, are met.**

2.8 Exceptions/Variances

Exceptions to the Minimum Requirements may be granted prior to permit approval and construction. The drainage manual administrator may grant an exception following legal public notice of an application for an exception, legal public notice of the administrator's decision on the application, and a written finding of fact that documents the administrator's decision to grant an exception.

The administrator may grant an exception to the minimum requirements if such application imposes a severe and unexpected economic hardship. To determine whether the application imposes a severe and unexpected economic hardship on the project applicant, the administrator must consider and document - with written findings of fact – the following:

- **The current (pre-project) use of the site, and**

- **How the application of the minimum requirement(s) restricts the proposed use of the site compared to the restrictions that existed prior to the adoption of the minimum requirements; and**
- **The possible remaining uses of the site if the exception were not granted; and**
- **The uses of the site that would have been allowed prior to the adoption of the minimum requirements; and**
- **A comparison of the estimated amount and percentage of value loss as a result of the minimum requirements versus the estimated amount and percentage of value loss as a result of requirements that existed prior to adoption of the minimum requirements; and**
- **The feasibility for the owner to alter the project to apply the minimum requirements.**

In addition, any exception must meet the following criteria:

- **The exception will not increase risk to the public health and welfare, nor be injurious to other properties in the vicinity and/or downstream, and to the quality of waters of the state; and**
- **The exception is the least possible exception that could be granted to comply with the intent of the Minimum Requirements.**

Supplemental Guidelines

The adjustment and exception provisions are an important element of the plan review and enforcement programs. They are intended to maintain a necessary flexible working relationship between local officials and applicants. Plan Approval Authorities should consider these requests judiciously, keeping in mind both the need of the applicant to maximize cost-effectiveness and the need to protect off-site properties and resources from damage.

Chapter 3 - Preparation of Stormwater Site Plans

The Stormwater Site Plan is the comprehensive report containing all of the technical information and analysis necessary for regulatory agencies to evaluate a proposed new development or redevelopment project for compliance with stormwater requirements. Contents of the Stormwater Site Plan will vary with the type and size of the project, and individual site characteristics.

The scope of the Stormwater Site Plan also varies depending on the applicability of Minimum Requirements (see Section 2.4).

This chapter describes the contents of a Stormwater Site Plan and provides a general procedure for how to prepare the plan. The specific BMPs and design methods and standards to be used are contained in Volumes II-V. The content of, and the procedures for preparing a Construction Stormwater Pollution Prevention Plan (Construction SWPPP) are covered in detail in Chapter 3 of Volume II. Guidelines for selecting treatment, flow control, and source control BMPs are given in Chapter 4 of this Volume, and Chapter 2 of Volume V.

The goal of this chapter is to provide a framework for uniformity in plan preparation. Such uniformity will promote predictability throughout the region and help secure prompt governmental review and approval. Properly drafted engineering plans and supporting documents will also facilitate the operation and maintenance of the proposed system long after its review and approval.

State law requires that engineering work be performed by or under the direction of a professional engineer licensed to practice in Washington State. Plans involving construction of treatment facilities or flow control facilities (detention ponds or infiltration basins), structural source control BMPs, or drainage conveyance systems generally involve engineering principles and should be prepared by or under the direction of a licensed engineer. Construction Stormwater Pollution Prevention Plans (SWPPPs) that involve engineering calculations must also be prepared by or under the direction of a licensed engineer.

3.1 Stormwater Site Plans: Step-By-Step

The steps involved in developing a Stormwater Site Plan are listed below.

1. Site Analysis: Collect and Analyze Information on Existing Conditions
2. Prepare Preliminary Development Layout
3. Perform Off-site Analysis (at local government's option)
4. Determine Applicable Minimum Requirements
5. Prepare a Permanent Stormwater Control Plan

6. Prepare a Construction Stormwater Pollution Prevention Plan
7. Complete the Stormwater Site Plan
8. Check Compliance with All Applicable Minimum Requirements

The level of detail needed for each step depends upon the project size as explained in the individual steps. A narrative description of each of these steps follows.

3.1.1 Step 1 – Site Analysis: Collect and Analyze Information on Existing Conditions

Site analysis results shall be submitted as part of an Existing Conditions Summary and a site map within the Stormwater Site Plan submittal (see Step 7). Part of the information in this step should be used to help prepare the Construction Stormwater Pollution Prevention Plan. The authorized project reviewer for the local government with jurisdiction may chose to waive certain components required in this section as appropriate.

Purpose of the Site Analysis: Low impact development site design is intended to complement the predevelopment conditions on the site. However, not all sites are appropriate for a complete LID project, as site conditions determine the feasibility of using LID techniques. The development context shall be established by an initial site analysis consistent with the requirements of this section.

The initial inventory and analysis process will provide baseline information necessary to design strategies that utilize areas most appropriate to evaporate, transpire, and infiltrate stormwater, and achieve the goal of minimizing the pre- development natural hydrologic conditions on the site.

The site analysis shall include, at a minimum, the following information for projects required to meet Minimum Requirements 1 – 5:

1. A survey prepared by a registered land surveyor (or other qualified professional) showing:
    - Existing public and private development, including utility infrastructure on and adjacent to the site if publicly available,
    - Minor hydrologic features, including seeps, springs, closed depression areas, drainage swales.
    - Major hydrologic features with a streams, wetland, and water body survey and classification report showing wetland and buffer boundaries consistent with the requirements of the jurisdiction.

      Note that site visits should be conducted during winter months and after significant precipitation events to identify undocumented surface seeps or other indicators of near surface ground water.
    - Flood hazard areas on or adjacent to the site, if present.

- Geologic Hazard areas and associated buffer requirements as defined by the local jurisdiction
- Aquifer and wellhead protection areas on or adjacent to the site, if present.
- Topographic features that may act as natural stormwater storage, infiltration or conveyance.

  Contours for the survey are as follows:

  - Up to 10 percent slopes, two-foot contours.
  - Over 10 percent to less than 20 percent slopes, five-foot contours.
  - Twenty percent or greater slopes, 10-foot contours.
  - Elevations shall be at 25-foot intervals.

2. A soils report prepared by a professional soil scientist certified by the Soil Science Society of America (or an equivalent national program), a locally licensed on-site sewage designer, or by other suitably trained persons working under the supervision of a professional engineer, geologist, hydrogeologist, or engineering geologist registered in the State of Washington. The report shall identify:

   a. 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).

   b. The results of saturated hydraulic conductivity (K_{sat}) testing to assess infiltration capability and the feasibility of rain gardens, bioretention, and permeable pavement. Testing should occur between December 1 and April 1. Use small-scale Pilot Infiltration Tests (PIT), or other small-scale test acceptable to the local jurisdiction. Grain size analyses may substitute for infiltration tests on sites with soils unconsolidated by glacial advance.

      Note: The certified soils professional or engineer can exercise discretion concerning K_{sat} testing if in their judgment information exists confirming that the site is unconsolidated outwash material (high infiltration rates) and there is adequate depth to ground water (1 foot minimum from bottom of a rain garden, bioretention, or permeable pavement installation).

   c. The results of testing for an hydraulic restriction layer (ground water, soil layer with less than 0.3 in/hr K_{sat}, bedrock, etc) under possible sites for a rain garden, bioretention facility, or permeable pavement. Testing with a monitoring well or an excavated pit must extend to a depth at least 1 foot below the estimated bottom elevation of a rain garden/bioretention excavation and at least 1 foot below the subgrade surface of a permeable pavement. This analysis should be performed in the winter season (December 21 through March 21). The optimum time to test for depth to ground water is usually late winter and shortly after an extended wet period. Site historic information and evidence of high ground water in the soils can also be used.

3. If there are native soil and vegetation protection areas proposed for the site, provide a survey of existing native vegetation cover by a licensed architect, arborist, qualified biologist or project proponent identifying any forest areas on the site and a plan to protect those areas. The preserved area should be placed in a separate tract or protected through recorded easements for individual lots.

The site analysis shall include, at a minimum, the following information for projects required to meet Minimum Requirements 1 – 9:

1. A survey prepared by a registered land surveyor or civil engineer showing:
    - Existing public and private development, including utility infrastructure on and adjacent to the site if publicly available,
    - Minor hydrologic features, including seeps, springs, closed depression areas, drainage swales.
    - Major hydrologic features with a streams, wetland, and water body survey and classification report showing wetland and buffer boundaries consistent with the requirements of the jurisdiction.

      Note that site visits should be conducted during winter months and after significant precipitation events to identify undocumented surface seeps or other indicators of near surface ground water.
    - Flood hazard areas on or adjacent to the site, if present.
    - Geologic Hazard areas and associated buffer requirements as defined by the local jurisdiction
    - Aquifer and wellhead protection areas on or adjacent to the site, if present.
    - Topographic features that may act as natural stormwater storage, infiltration or conveyance.

      Contours for the survey are as follows:

- o Up to 10 percent slopes, two-foot contours.
- o Over 10 percent to less than 20 percent slopes, five-foot contours.
- o Twenty percent or greater slopes, 10-foot contours.
- o Elevations shall be at 25-foot intervals.

2. A soils report prepared by a professional soil scientist certified by the Soil Science Society of America (or an equivalent national program), or by other suitably trained persons working under the supervision of a professional engineer, geologist, hydrogeologist, or engineering geologist registered in the State of Washington. The report shall identify:

   a. Underlying soils on the site utilizing soil surveys, soil test pits, or soil grain analyses (see http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm for soil survey information).

      Prepare detailed logs for each test pit or soil boring and a map showing the location of the test pits or borings. Logs must include depth of pit or boring, soil descriptions, depth to water (if present), and presence of stratification. Depth should extend to 5 feet below estimated bottom elevation of bioretention facilities and road subgrade. 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.

      Soil stratigraphy should be assessed for low permeability layers, highly permeable sand/gravel layers, depth to ground water, 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

   b. The results of saturated hydraulic conductivity (K_{sat}) testing to assess infiltration capability and the feasibility of bioretention, and permeable pavement. Use small-scale Pilot Infiltration Tests (PIT), or other small-scale test acceptable to the local jurisdiction. Grain size analyses may substitute for infiltration tests on sites with soils unconsolidated by glacial advance.

Placement of K_{sat} tests should be carefully considered to reduce cost. A few strategically placed soil test pits and saturated hydraulic conductivity test sites are generally adequate for initial site assessment and for smaller sites (e.g., less than an acre). On larger project sites, a more detailed soil assessment and additional K_{sat} testing may be necessary to direct placement of impervious surfaces such as structures away from soils that can most effectively infiltrate stormwater, and placement of permeable pavement roads, parking lots, driveways, walks, and bioretention/rain gardens over those soils. See Section 3.4 in Volume III of this manual for more details. The K_{sat} tests are also necessary as input to the runoff model to predict the benefits of LID BMPs which infiltrate.

Note: The certified soils professional or engineer can exercise discretion concerning K_{sat} testing if in their judgment information exists confirming that the site is unconsolidated outwash material (high infiltration rates) and there is adequate depth to ground water (1 foot minimum from bottom of a rain garden, bioretention, or permeable pavement installation).

c. The results of testing for an hydraulic restriction layer (ground water, soil layer with less than 0.3 in/hr K_{sat}, bedrock, etc) under possible sites for a bioretention facility, or permeable pavement. If the general site assessment cannot confirm that the seasonal high ground water or hydraulic restricting layer will be greater than 3 feet below the bottom of the bioretention, or greater than 1 foot below the bottom of the lowest gravel base course of permeable pavement, monitoring wells or excavated pits should be placed strategically to assess depth to ground water. This analysis should be performed during the wet season prior to construction. Monitoring with a continuously logging censor between Dec. 21 and Mar. 21 provides the most thorough information. Monitoring for lesser time periods can be accepted but increases risk. Site historical data regarding ground water levels can be used in lieu of field testing if the data are reliable and sufficient. Also, soil evidence of historical ground water elevations may be used.

Special considerations are necessary for highly permeable gravel areas. Signs of high ground water will likely not be present in gravelly soils lacking finer grain material such as sand and silt. Test pit and monitoring wells may not show high ground water levels during low precipitation years. Accordingly, sound professional judgment, considering these factors and water quality treatment needs, is required to design multiple and dispersed infiltration facilities on sites with gravel deposits.

   d. If on-site infiltration may result in shallow lateral flow (interflow), the conveyance and possible locations where that interflow may re-emerge should be assessed by a professional engineer, geologist, hydrogeologist, or engineering geologist registered in the State of Washington. This will likely require placement of ground water monitoring wells to determine existing ground water gradients and flow. In general, a minimum of three wells associated with three hydraulically connected surface or ground water features, are needed to determine the direction of flow and gradient.

3. If there are native soil and vegetation protection areas proposed for the site, provide a survey of existing native vegetation cover by a licensed architect, arborist, or qualified biologist identifying any forest areas on the site and a plan to protect those areas. The preserved area should be placed in a separate tract or protected through recorded easements for individual lots.

3.1.2 Step 2 – Prepare Preliminary Development Layout

Based upon the analysis of existing site conditions, locate the buildings, roads, parking lots, landscaping features, on-site stormwater management BMPs, and preliminary location of stormwater treatment and retention/detention facilities for the proposed development. Consider the following points when laying out the site:

- Fit development to the terrain to minimize land disturbance; Confine construction activities to the least area necessary, and away from critical areas.
- Preserve areas with natural vegetation (especially forested areas) as much as possible.
- On sites with a mix of soil types, locate impervious areas over less permeable soil (e.g., till), try to restrict development over more porous soils or take advantage of them by locating bioretention/rain gardens and permeable pavement over them. .
- Cluster buildings together.
- Minimize impervious areas.
- Maintain and utilize the natural drainage patterns.

The development layout designed here will be used for determining threshold discharge areas, for calculating whether size and flow rate thresholds under Minimum Requirements #6, #7, and #8 are exceeded (see Chapter 2), and for the drawings and maps required for the Stormwater Site Plan.

See Chapters 2 and 3 in the *LID Technical Guidance Manual for Puget Sound* (2012) for more detail on Preliminary Development Layout. Note that the *LID Technical Guidance Manual for Puget Sound* (2012) is for additional informational purposes only. You must follow the guidance within this manual if there are any discrepancies between this manual and the *LID Technical Guidance Manual for Puget Sound* (2012).

3.1.3 Step 3 – Perform an Off-site Analysis

Ecology recommends that local governments require an off-site analysis for projects that add 5,000 square feet or more of new hard surface, or that convert ¾ acres of vegetation to lawn or landscaped areas, or convert 2.5 acres of forested area to pasture.

The phased off-site analysis approach outlined in Optional Guidance #2 is recommended. This phased approach relies first on a qualitative analysis. If the qualitative analysis indicates a potential problem, the local government may require mitigation or a quantitative analysis. For more information, see Section 2.6.2.

3.1.4 Step 4 – Determine and Read the Applicable Minimum Requirements

Section 2.4 establishes project size thresholds for the application of Minimum Requirements to new development and redevelopment projects. Figures 2.4.1 and 2.4.2 provide the same thresholds in a flow chart format. Based on the preliminary layout, determine whether Minimum Requirements #1 through #5 apply to the project; or, whether Minimum Requirements #1 through #9 apply.

3.1.5 Step 5 – Prepare a Permanent Stormwater Control Plan

Select on-site stormwater control BMPs (all projects), and treatment and flow control facilities (projects subject to minimum requirements #1 through #9) that will serve the project site in its developed condition. The selection process for treatment and flow control facilities is presented in detail in Chapter 4 of this Volume, and Chapter 2 of Volume V.

A preliminary design of the On-site Stormwater Management BMPs and treatment/flow control facilities is necessary to determine how they will fit within and serve the preliminary development layout. After a preliminary design is developed, the designer may want to reconsider the site layout to reduce the need for construction of facilities, or the size of the facilities by reducing the amount of hard – especially impervious - surfaces created, and increasing the areas to be left undisturbed. After the designer is satisfied with the BMP and facilities selections, the information must be presented within a Permanent Stormwater Control Plan. The Permanent Stormwater Control Plan should contain the following sections:

Permanent Stormwater Control Plan – Existing Site Hydrology

If flow control facilities are proposed to comply with Minimum Requirement #7, provide a listing of assumptions and site parameters used in analyzing the pre-developed site hydrology. The acreage, soil types, and land covers used to determine the pre-developed flow characteristics, along with basin maps, graphics, and exhibits for each subbasin affected by the project should be included. The pre-developed condition to be matched shall be a forested land cover unless reasonable, historic information is provided that indicates the site was prairie prior to settlement.

Provide a topographic map, of sufficient scale and contour intervals to determine basin boundaries accurately, and showing:

- Delineation and acreage of areas contributing runoff to the site;
- Flow control facility location;
- Outfall;
- Overflow route; and
- All natural streams and drainage features.

The direction of flow, acreage of areas contributing drainage, and the limits of development should be indicated. Each basin within or flowing through the site should be named and model input parameters referenced.

Permanent Stormwater Control Plan – Developed Site Hydrology

All Projects:

Reporting totals of new hard surfaces, replaced hard surfaces, and converted pervious surfaces are necessary to determine which minimum requirements initially apply to the project.

Projects that apply only Minimum Requirements #1through #5:

Provide a scale drawing of the lot or lots, and any public-right-of-way that displays the location of On-site Stormwater Management BMPs and the areas served by them. 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 that includes On-site Stormwater Management BMPs.

Provide design details, figures, and maintenance instructions for each On-site Stormwater Management BMP. These documents must also 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.

Provide a written summary of the proposed project and how it complies with the applicable stormwater management requirements. If using List #1 or List #2 (necessary for threshold discharge areas of projects that have triggered Minimum Requirements #1 - #9, but do not exceed the thresholds in Minimum Requirements #6, #7) to comply with Minimum Requirement #5, provide written justification, including citation of site conditions identified in a soils report, for any On-site Stormwater Management BMPs that are determined to be “infeasible” for the project site.

If the applicant elects or must use the LID performance standard option of Minimum Requirement #5, they shall provide design details of all BMP’s that are used to help achieve the standard, and 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 documentation on site plans for the locations of the trees. 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.

Skip down to Section 3.1.6 - Step 6.

Projects that are subject to Minimum Requirements #1 through #9:

a. *Summary Section*

   By threshold discharge area, provide totals of new pollution-generating hard surfaces, replaced pollution-generating hard surfaces (where the replaced hard surfaces have been determined to be subject to requirements per Section 2.4.1 or 2.4.2), effective impervious surfaces, and converted vegetated areas to determine whether treatment (Minimum Requirement #6) and/or flow control facilities (Minimum Requirement #7) are necessary for those areas. See Chapter 4 of this Volume for more specific directions concerning treatment and flow control requirements, and selection of treatment and flow control facilities. For those threshold discharge areas that do not trigger Minimum Requirements #6, #7, or #8, follow the directions above for *Projects that apply only Minimum Requirements #1 through #5.* Otherwise, provide narrative, mathematical, and graphic presentations of computer model input parameters selected for each threshold discharge area of the developed site condition, including acreage, soil types, and land covers, road layout, and all drainage facilities.

   Developed threshold discharge areas and flow routing should be shown on a map and cross-referenced to computer input screens and printouts or calculation sheets.

   Any documents used to determine the developed site hydrology should be included. Whenever possible, maintain the same basin name as used for the pre-developed site hydrology. If the boundaries of a basin have been modified by the project, that should be clearly shown on a map and the name modified to indicate the change.

Final grade topographic maps shall be provided. Ecology recommends local governments also require finished floor elevations.

b. Permanent Stormwater Control Plan – Performance Standards and Goals

If treatment facilities are proposed, provide a listing of the water quality menus used (Chapter 3, Volume V). If flow control facilities are proposed, provide a confirmation of the flow control standard being achieved (e.g., the Ecology flow duration standard). Indicate whether using the mandatory list or the LID performance standard option for Minimum Requirement #5.

c. Permanent Stormwater Control Plan – Low Impact Development Features.

A description of the proposed project including:

1. Project narrative showing how the project will fulfill the requirement for on-site management of stormwater to the extent feasible.
2. Total area of Native Vegetation retained.
3. Provide a scale drawing of the lot or lots, and any public-right-of-way that displays the location of On-site Stormwater Management BMPs and the areas served by them. 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 that includes On-site Stormwater Management BMPs.
4. For projects using the list option for Minimum Requirement #5, an explanation and documentation, including citation of site conditions identified in a soils report, for any determination that an On-site Stormwater Management BMP was considered infeasible for the site.
5. Provide design details, figures, and maintenance instructions for each On-site Stormwater Management BMP. These documents must also 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.
6. A summary of proposed public or private ownership of On-site Stormwater Management BMPs and areas serving a stormwater function within the project site both during and after construction.
7. Areas of disturbed soils to be amended. (NOTE: All lawn and landscaped areas are to meet BMP T5.13. Use of compost is one way to meet the requirement).

8. Retained trees and newly planted trees for which impervious reduction credits are claimed.

d. Permanent Stormwater Control Plan – Flow Control System

Provide a drawing of the flow control facility and its appurtenances. This drawing must be accompanied by basic measurements necessary to calculate the storage volumes available from zero to the maximum head, all orifice/restrictor sizes and head relationships, control structure/restrictor placement, and placement on the site. Provide sufficient details on the drawings to show how the facility conforms with design criteria in Volume III for detention facilities or infiltration facilities. If distributed bioretention facilities and/or storage below permeable pavement are used to help meet the LID performance standard option of minimum requirement #5, and/or minimum requirement #7, drawings are necessary to confirm accurate representation in the runoff model. Identify locations and approximate size of all permeable pavement surfaces and bioretention facilities to be installed as part of this project, including those that will be installed on individual lots by subsequent contractors. Identify locations and species types for newly planted or retained trees for which impervious surface reduction credits are claimed. Supporting areas such as the flow paths for dispersion BMPs should also be shown."

Include computer printouts, calculations, equations, references, storage/volume tables, graphs as necessary to show results and methodology used to determine the storage facility volumes. Where the Western Washington Hydrology Model (WWHM), or other approved runoff model, is used, its documentation input and output files must be included.

e. Permanent Stormwater Control Plan – Water Quality System

Provide a drawing of the proposed treatment facilities, and any structural source control BMPs. The drawing must show overall measurements and dimensions, placement on the site, location of inflow, bypass, and discharge systems. If distributed bioretention facilities and/or infiltration below pollution-generating hard surfaces are used to help meet treatment requirements, drawings are necessary to confirm accurate representation in the runoff model. Identify locations and approximate dimensions of those facilities to be installed as part of this project, including those that will be installed on individual lots by subsequent contractors.

Include WWHM or other approved model printouts, calculations, equations, references, and graphs as necessary to show the facilities are designed consistent with the Volume V requirements and design criteria. If bioretention and/or infiltration through adequate soils (see Site Suitability Criteria in Section 3.3, Volume III) below pollution-generating hard surfaces will be used to help meet treatment requirements, the runoff model output files must include the volume of water that has been treated through those BMPs. The summation of those volumes and the volume treated through a centralized, conventional treatment system must meet or exceed 91% of the total stormwater runoff file. The total stormwater runoff file includes:

- Stormwater that has infiltrated through a bioretention facility and stormwater that has infiltrated through adequate soils below pollution-generating hard surfaces.
- Stormwater that passes through a properly sized treatment facility. Note that stormwater that is re-collected below a bioretention facility and routed to a centralized treatment facility should not be counted twice.
- Stormwater that does not receive treatment due to bypass of, or overflow from a treatment facility or a bioretention facility (if the overflow is not subsequently routed to a treatment facility).

f. Permanent Stormwater Control Plan – Conveyance System Analysis and Design

Present an analysis of any existing conveyance systems, and the analysis and design of the proposed stormwater conveyance system for the project. At a minimum, present an analysis of on-site hydrologic connectivity of surficial conveyance channels and/or pipes, and points of concentration. If the local government requires an off-site analysis, include the results of that analysis here. This information should be presented in a clear, concise manner that can be easily followed, checked, and verified. All pipes, culverts, catch basins, channels, swales, and other stormwater conveyance appurtenances must be clearly labeled and correspond directly to the engineering plans.

3.1.6 Step 6 – Prepare a Construction Stormwater Pollution Prevention Plan

The Construction SWPPP for projects adding or replacing 2,000 square feet of hard surface or more, or clearing 7,000 square feet or more, must contain sufficient information to satisfy the local government Plan Approval Authority that the potential pollution problems have been adequately addressed for the proposed project. Local governments may adopt a standard SWPPP format for use by projects less than 1 acre. An adequate Construction SWPPP includes a narrative and drawings. The narrative is a written statement to explain and justify the pollution prevention decisions made for a particular project. The narrative contains concise information concerning existing site conditions, construction schedules, and other pertinent items that are not contained on the drawings. The drawings and notes describe where and when the various

BMPs should be installed, the performance the BMPs are expected to achieve, and actions to be taken if the performance goals are not achieved.

The 13 Elements listed in Section 2.5.2 - Minimum Requirement #2 - must be considered in the development of the Construction SWPPP unless site conditions render the element unnecessary and the exemption from that element is clearly justified in the narrative of the Construction SWPPP. These elements are described in detail in Volume II, Chapter 3. They cover the general water quality protection strategies of limiting site impacts, preventing erosion and sedimentation, and managing activities and sources.

On construction sites that discharge to surface water, the primary consideration in the preparation of the Construction SWPPP is compliance with the State Water Quality Standards. The step-by-step procedure outlined in Volume II, Section 3.3 is recommended for the development of these Construction SWPPPs. A checklist is contained in Volume II, Section 3.3 that may be helpful in preparing and reviewing the Construction SWPPP.

On construction sites that infiltrate all stormwater runoff, the primary consideration in the preparation of the Construction SWPPP is the protection of the infiltration facilities from fine sediments during the construction phase and protection of ground water from other pollutants. Several of the other elements are very important at these sites as well, such as marking the clearing limits, establishing the construction access, and managing the project.

3.1.7 Step 7 – Complete the Stormwater Site Plan

The Stormwater Site Plan encompasses the entire submittal to the local government agency with drainage review authority. It includes the following documents

Project Overview

The project overview must provide a general description of the project, predeveloped and developed conditions of the site, site area and size of the improvements, and the pre- and post-developed stormwater runoff conditions. The overview should summarize difficult site parameters, the natural drainage system, and drainage to and from adjacent properties, including bypass flows.

A vicinity map should clearly locate the property, identify all roads bordering the site, show the route of stormwater off-site to the local natural receiving water, and show significant geographic features and sensitive/critical areas (streams, wetlands, lakes, steep slopes, etc.).

A site map, using a minimum USGS 1:2400 topographic map as a base, should display:

- Acreage and outlines of all drainage basins;
- Existing stormwater drainage to and from the site;
- Routes of existing, construction, and future flows at all discharge points; and
- The length of travel from the farthest upstream end of a proposed storm drainage system to any proposed flow control and treatment facility.

A soils map should show the soils within the project site as verified by field testing. It is the designer's responsibility to ensure that the soil types of the site are properly identified and correctly used in the hydrologic analysis.

Existing Conditions Summary

This is the summary described in Section 3.1.1 above. If the local government does not require a detailed off-site analysis, this summary should also describe:

- The natural receiving waters that the stormwater runoff either directly or eventually (after flowing through the downstream conveyance system) discharges to, and
- Any area-specific requirements established in local plans, ordinances, or regulations or in Water Clean-up Plans approved by Ecology.

Off-site Analysis Report

This is the report described under Section 3.1.3 above.

Permanent Stormwater Control Plan

This is the plan described in Section 3.1.5 above.

Construction Stormwater Pollution Prevention Plan

This is the plan described in Section 3.1.6 above.

Special Reports and Studies

Include any special reports and studies conducted to prepare the Stormwater Site Plan (e.g., a soils report that could include the results of soil sampling and testing, infiltration tests and/or soil gradation analyses, depth to ground water; wetlands delineation).

Other Permits

Include a list of other necessary permits and approvals as required by other regulatory agencies, if those permits or approvals include conditions that affect the drainage plan, or contain more restrictive drainage-related requirements.

Operation and Maintenance Manual

Submit an operations and maintenance manual for each flow control and treatment facility, including any distributed bioretention facilities that are used to help meet flow control and/or treatment requirements. . The manual should contain a description of the facility, what it does, and how it works. The manual must identify and describe the maintenance tasks, and the frequency of each task. The maintenance tasks and frequencies must meet the standards established in this manual or an equivalent manual adopted by the local government agency with jurisdiction.

Include a recommended format for a maintenance activity log that will indicate what actions will have been taken.

The manual must prominently indicate where it should be kept, and that it must be made available for inspection by the local government.

Declaration of Covenant for Privately Maintained Flow Control and Treatment Facilities

To ensure future maintenance and allow access for inspection by the local government, any flow control and treatment facilities for which the applicant identifies operation and maintenance to be the responsibility of a private party must have a declaration of covenant and grant of easement. After approval by the local government, the declaration of covenant and grant of easement must be signed and recorded at the appropriate records office of the local government.

Declaration of Covenant for Privately Maintained On-site Stormwater Management BMPs

To ensure future maintenance and allow access for inspection by the local government, any On-site Stormwater Management BMPs for which the applicant identifies operation and maintenance to be the responsibility of a private party must have a declaration of covenant and grant of easement. Design details, figures, and maintenance instructions for each On-site Stormwater Management BMP shall be attached. A map showing the location of newly planted and retained trees claimed as flow reduction credits shall also be attached. This applies to every lot within a subdivision on which an On-site Stormwater Management BMP is proposed. After approval by the local government, the declaration of covenant and grant of easement must be signed and recorded at the appropriate records office of the local government.

Bond Quantities Worksheet

If the local government adopts a requirement for a performance bond (or other financial guarantee) for proper construction and operation of construction site BMPs, and proper construction of permanent drainage facilities, the designer shall provide documentation to establish the appropriate bond amount.

3.1.8 Step 8 – Check Compliance with All Applicable Minimum Requirements

A Stormwater Site Plan as designed and implemented should specifically fulfill all Minimum Requirements applicable to the project. The Stormwater Site Plan should be reviewed to check that these requirements are satisfied.

3.2 Plans Required After Stormwater Site Plan Approval

This section includes the specifications and contents required of those plans submitted after the local government agency with jurisdiction has approved the original Stormwater Site Plan.

3.2.1 Stormwater Site Plan Changes

If the designer wishes to make changes or revisions to the originally approved stormwater site plan, the proposed revisions shall be submitted to the local government agency with review authority prior to construction. The submittals should include the following:

1. Substitute pages of the originally approved Stormwater Site Plan that include the proposed changes.
2. Revised drawings showing any structural changes.
3. Any other supporting information that explains and supports the reason for the change.

3.2.2 Final Corrected Plan Submittal

If the project included construction of conveyance systems, treatment facilities, flow control facilities, structural source control BMPs, bioretention facilities, permeable pavement, vegetated roofs, a rainwater harvest system, and/or newly planted or retained trees for which a flow reduction credit was taken, the applicant shall submit a final corrected plan ("as-builts") to the local government agency with jurisdiction when the project is completed. These should be engineering drawings that accurately represent the stormwater infrastructure of the project as constructed. These corrected drawings must be professionally drafted revisions that are stamped, signed, and dated by a licensed civil engineer registered in the state of Washington.

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Chapter 4 - BMP and Facility Selection Process for Permanent Stormwater Control Plans

4.1 Purpose

The purpose of this chapter is to provide guidance for selecting permanent BMPs and facilities for new development and redevelopment sites (including retrofitting of redevelopment sites). The task of selecting BMPs and facilities is necessary to complete the Permanent Stormwater Control Plan - one of the major components of a Stormwater Site Plan. The details for how to complete the other major component - a Construction Stormwater Pollution Prevention Plan - are included in Chapter 3 of Volume II of this manual.

The Department of Ecology's (Ecology) pollution control strategy is to emphasize pollution prevention first, through the application of source control BMPs. Then the application of appropriate on-site, treatment, and flow control facilities fulfills the statutory obligation to provide "all known available and reasonable methods by industries and others to prevent and control the pollution of the waters of the State of Washington." (RCW 90.48.010) This statutory requirement is generally known by an acronym – AKART.

The remainder of this chapter presents seven steps in selecting BMPs, Treatment Facilities, and Flow Control Facilities.

4.2 BMP and Facility Selection Process

Step I: Determine and Read the Applicable Minimum Requirements

Section 2.4 establishes project size thresholds for the application of Minimum Requirements to new development and redevelopment projects. Figures 2.4.1 and 2.4.2 provide the same thresholds in a flow chart format. Total new hard surfaces, replaced hard surfaces, and converted vegetation areas to determine which minimum requirements apply to the project.

Step II: Select Source Control BMPs

Note: If your project is a residential development, you may skip this step.

Refer to Volume IV. If the project involves construction of areas or facilities to conduct any of the activities described in Section 2.2 of Volume IV, the "applicable" structural source control BMPs described in that section must be constructed as part of the project. In addition, if the specific business enterprise that will occupy the site is known, the "applicable" operational source control BMPs must also be described. Structural source control BMPs should be identified in the stormwater site plan and should be shown on all applicable plans submitted for local government review and approval.

The project may have additional source control responsibilities as a result of area-specific pollution control plans (e.g., watershed or basin plans, water clean-up plans, ground water management plans, lakes management plans), ordinances, and regulations.

Step III: Determine Threshold Discharge Areas and Applicable Requirements for Treatment, Flow Control, and Wetlands Protection

Minimum Requirements #6 (Runoff Treatment) and #7 (Flow Control) have size thresholds that determine their applicability (see Sections 2.5.6 and 2.5.7). Minimum Requirement #8 (wetlands protection) uses the same size thresholds as those used in #6 and #7. Those thresholds determine whether certain areas (called "threshold discharge areas") of a project must use treatment and flow control facilities, designed by a professional engineer, or whether just Minimum Requirement #5 (On-Site Stormwater Management BMPs) applies (see Section 2.5.5).

Step 1: Read the definitions in Section 2.3 to become acquainted with the following terms: effective impervious surface, impervious surface, hard surface, pollution-generating impervious surface (PGIS), pollution-generating hard surface, pollution-generating pervious surface (PGPS), converted vegetation areas, and threshold discharge area.

Step 2: ***Outline the threshold discharge areas*** for your project site.

Step 3: Determine the amount of pollution-generating hard surfaces (including pollution-generating permeable pavements) and pollution-generating pervious surfaces (not including permeable pavements) in each threshold discharge area. Compare those totals to the project thresholds in Section 2.5.6 to determine where treatment facilities are necessary. Note that On-site Stormwater Management BMPs (Minimum Requirement #5) are always applicable.

Step 4: ***Compute the totals for effective impervious surface and converted vegetation areas in each threshold discharge area.*** Compare those totals to the project thresholds in Section 2.5.7 to determine if flow control facilities (Minimum Requirement #7 and #8) are needed. If neither threshold for flow control facilities (Minimum Requirement #7) is exceeded, proceed to Step 5. If one of the thresholds is exceeded, proceed to Step IV below.

Step 5: ***For each threshold discharge area, use an approved continuous runoff model (e.g., WWHM, MGS Flood) to determine whether there is an increase of 0.1 cfs in the 100-year return frequency flow.*** [Note: this is the threshold using 1-hour time steps. If using 15-minute time steps, the threshold is a 0.15 cfs increase.] ***)*** This requires a comparison to the 100-

year return frequency flow predicted for the existing (pre-project; not the historic) land cover condition of the same area. If the above threshold is exceeded, flow control – Minimum Requirements #7 and #8 – is potentially required. See the “Applicability” sections of those minimum requirements. Note that On-site Stormwater Management BMPs (Minimum Requirement #5) are always applicable.

This task requires properly representing the hard surfaces, and the converted vegetation areas in the runoff model. Hard surfaces include impervious surfaces, permeable pavements, and vegetated roofs. Impervious surface area totals are entered directly. Permeable pavements are entered as lawn/landscaping areas over the project soil type if they do not have any capability for storage in the gravel base (more typical of private walks, patios, and private residential driveways). Permeable pavements with storage capability should use the permeable pavement “element” in the model. An “element” is provided for vegetated roofs also. See Appendix III-C in Volume III, and the WWHM user’s manual for guidance concerning proper representation of LID BMPs in approved computer models.

Step IV: Select Flow Control BMPs and Facilities

A determination should have already been made whether Minimum Requirement #7, and/ or Minimum Requirement #8 apply to the project site. On-site Stormwater Management BMPs must be applied in accordance with Minimum Requirement #5. In addition, flow control facilities must be provided for discharges from those threshold discharge areas that exceed the thresholds outlined in Section 2.5.7. Use an approved continuous runoff model (e.g., the Western Washington Hydrology Model) and the details in Chapter 3 of Volume III to size and design the facilities.

The following describes a selection process for those facilities.

Step 1: Determine whether you can infiltrate.

There are two possible options for infiltration.

The first option is to infiltrate through rapidly draining soils that do not meet the site characterization and site suitability criteria for providing adequate treatment. See Chapter 3 of Volume III for design criteria for infiltration facilities intended to provide flow control without treatment. In this case, a treatment facility must be provided prior to discharge to the ground for infiltration. The treatment facility could be located off-line with a capacity to treat the water quality design flow rate or volume (See Volume V, Chapter 4) to the applicable performance goal (See Volume V, Chapter 3). Volumes or flow rates in excess of the design volume or flow rate would bypass untreated into the infiltration basin. (Note that wetpool treatment facilities are always designed to be on-line.) The infiltration facility must provide adequate volume such that the flow duration standard of Minimum Requirement #7, or the water surface elevation requirements of Minimum Requirement #8 will be achieved.

The second option is to infiltrate through soils that meet the site characterization and site suitability criteria in Chapter 3 of Volume III. The facility would be designed to meet the requirements for treatment and flow control. 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.

If infiltration facilities for flow control are planned, the flow control requirement has been met. Proceed to Step V. If infiltration facilities are not planned, proceed to Step 2.

Step 2: Use the Western Washington Hydrology Model to size a detention facility.

Refer to Chapter 2, of Volume III for an explanation of the use of the Western Washington Hydrology Model. Detailed guidance concerning proper use of the model is provided in a separate document. Ecology recommends attendance at WWHM training classes.

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

Step V: Select Treatment Facilities

Please refer to Chapter 2 of Volume V of this manual for step-by-step guidance to selection of treatment facilities.

Step VI: Review Selection of BMPs and Facilities

The list of on-site, treatment and flow control facilities, and the list of source control BMPs should be reviewed. The site designer may want to re-evaluate site layout to reduce the need for construction of facilities, or the size of the facilities by reducing the amount of impervious surfaces created, making more use of On-site Stormwater Management BMPs, and increasing the areas to be left undisturbed.

Step VII: Complete Development of Permanent Stormwater Control Plan

The design and location of the BMPs and facilities on the site must be determined using the detailed guidance in Volumes III, IV, and V. Operation and Maintenance manuals for each treatment and flow control facility are necessary. Please refer to Chapter 3 for guidance on the contents of the Stormwater Site Plan which includes the Permanent Stormwater Control Plan and the Erosion and Sediment Control Plan.

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Appendix I-A Guidance for Altering the Minimum Requirements through Basin Planning

Basin Planning Applied to Source Control

(Minimum Requirement #3)

Basin plans can identify potential sources of pollution and develop strategies to eliminate or control these sources to protect beneficial uses. A basin plan can include the following source control strategies:

1. Detection and correction of illicit discharges to storm sewer systems, including the use of dry weather sampling and dye-tracing techniques;
2. Identification of existing businesses, industries, utilities, and other activities that may store materials susceptible to spillage or leakage of pollutants into the storm sewer system or to the ground via wells, drains, or sumps;
3. Elimination or control of pollutant sources identified in (2);
4. Identification and control of future businesses, industries, utilities, and other activities which may store materials susceptible to spillage or leakage of pollutants into the storm sewer system; and
5. Training and public education

Basin Planning Applied to Runoff Treatment

(Minimum Requirement #6)

Basin plans can develop different runoff treatment requirements and performance standards to reduce pollutant concentrations or loads based on an evaluation of the beneficial uses to be protected within or downstream of a watershed. Consideration must be given to the antidegradation provisions of the Clean Water Act and implementing state water quality standards. The evaluation should include an analysis of existing and future conditions. Basin specific requirements and performance standards can be developed based on an evaluation of pollutant loads and modeling of receiving water conditions.

The Basic Treatment Level is viewed as a minimum technology-based requirement that must be applied regardless of the quality of the receiving waters. Additional levels of control beyond the Basic Treatment Level of Minimum Requirement #6 may be justified in order to control the impacts of future development.

Runoff treatment requirements and performance standards developed from a basin plan should apply to individual development sites. Regional treatment facilities can be considered an acceptable substitute for on-site treatment facilities if they can meet the identified treatment requirements and performance standards. A limitation to the use of regional treatment systems is that the conveyances used to transport the stormwater to the facility must not include waters of the state that have existing or attainable beneficial uses other than drainage.

The above text describes how Basin Planning can influence requirements for new and redevelopment. Basin Planning can also be used to identify prevention, structural retrofit, and redevelopment strategies for reducing the effects of existing development on the aquatic resources.

Basin Planning Applied to Flow Control

(Minimum Requirement #7)

Basin planning is well-suited to control stream channel erosion for both existing and future conditions. Flow control standards developed from a basin plan may include a combination of on-site, regional, and stream protection and rehabilitation measures. On-site standards are usually the primary mechanism to protect streams from the impacts of increased high flows in future conditions. Regional flow control facilities are used primarily to correct existing stream erosion problems. Basin plans can evaluate retrofitting opportunities, such as modified outlets for, and expansion of existing stormwater detention facilities.

In-stream protection and rehabilitation measures may be applied where stream channel erosion problems exist that will not be corrected by on-site or regional facilities. However, caution is urged in the application of such measures. If the causes of the stream channel erosion problems still exist, repairs to the physical expression of those problems may be short-lived. In some instances, it may be prudent to apply in-stream measures to reduce impacts until the basin hydrology is improved.

Another potential outcome of basin planning is the identification of a different flow control standard. Ecology's flow duration standard is based upon a generalization that the threshold of significant bedload movement in Western Washington streams occurs at 50% of the 2-year return stream flow. Through field observations and measurements, a local government may estimate a more appropriate threshold – higher or lower- for a specific stream. The alternative threshold can become the lower limit for the range of flows over which the duration standard applies. For instance, if the threshold is established at 70% of a 2-year return flow, the alternative standard would be to match the discharge durations of flows from the developed site to the range of pre-developed discharge rates from 70% of the 2-year peak flow up to the full 50-year peak flow. An alternative flow control standard must be compatible with maintaining and restoring the designated beneficial uses for that stream. If the existing stream condition is not compatible with the beneficial uses, it should not be used to determine an alternative flow control standard.

Basin Planning Applied to Wetlands and other Sensitive Areas

(Minimum Requirement #8)

Basin planning can be used to develop alternative protection standards for wetlands and other sensitive areas, such as landslide hazard areas, wellhead protection areas, and ground water quality management areas. These standards can include source control, runoff treatment, flow control, stage levels, and frequency and duration of inundations.

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Appendix I-B Rainfall Amounts and Statistics

Table B.1.24 Hour Rainfall Amounts and Comparisons for Selected USGS Stations								
	Station Name	**6 Month Storm Inches**	**6 Month % Rainfall Volume**	**2 Year Storm Inches**	**6 Month/ 2 year %**	**90% Rainfall Inches**	**95% Rainfall Inches**	**Mean Annual Precip. Inches**
1	Aberdeen	2.47	92.58%	3.43	72.0%	2.25	2.81	83.12
2	Anacortes	0.93	90.45%	1.37	67.9%	0.91	1.22	25.92
3	Appleton	1.39	89.04%	1.96	70.9%	1.45	1.80	32.71
4	Arlington	1.28	93.42%	1.74	73.6%	1.11	1.40	46.46
5	Bellingham	1.27	90.78%	1.79	70.9%	1.23	1.63	35.82
6	Bremerton	1.87	90.75%	2.61	71.6%	1.83	2.22	49.97
7	Cathlamet	2.13	92.52%	3.47	61.4%	1.89	2.59	78.97
8	Centralia	1.49	91.81%	2.09	71.3%	1.40	1.78	45.94
9	Chelan	0.62	84.50%	0.96	64.6%	0.76	1.00	10.44
10	Chimacum	1.20	89.63%	1.73	69.4%	1.22	1.52	29.45
11	Clearwater	3.46	92.88%	4.75	72.8%	3.04	3.94	125.25
12	CleElum	1.06	86.85%	1.66	63.9%	1.20	1.64	22.17
13	Colfax	0.80	90.52%	1.07	74.8%	0.80	0.99	19.78
14	Colville	0.71	90.46%	0.97	73.2%	0.69	0.86	18.31
15	Cushman Dam	3.31	91.26%	5.29	62.6%	3.18	4.25	100.82
16	Cushman PwrH	3.17	90.81%	4.42	71.7%	3.08	4.00	85.71
17	Darrington	2.90	91.19%	4.01	72.3%	2.73	3.42	82.90
18	Ellensburg	0.50	84.63%	0.79	63.3%	0.62	0.81	8.75
19	Elwha RS	2.14	90.49%	2.80	76.4%	2.11	2.53	55.87
20	Everett	1.10	93.14%	1.46	75.3%	1.00	1.22	36.80
21	Forks	3.47	92.50%	5.07	68.4%	3.13	4.00	117.83
22	Goldendale	0.84	86.92%	1.29	65.1%	0.98	1.25	17.57
23	Hartline	0.61	84.85%	0.96	63.5%	0.77	0.97	10.67
24	Kennewick	0.46	84.10%	0.71	64.8%	0.55	0.72	7.57
25	Lk. Wenatchee	2.20	85.87%	3.16	69.6%	2.58	3.16	42.72
26	Long Beach	2.32	93.09%	3.08	75.3%	2.04	2.55	80.89
27	Longview	1.41	92.02%	1.97	71.6%	1.29	1.67	45.62
28	McMillin	1.31	92.24%	1.82	72.0%	1.21	1.49	40.66
29	Monroe	1.38	92.90%	1.86	74.2%	1.26	1.53	48.16
30	Moses Lake	0.47	85.32%	0.70	67.1%	0.54	0.68	7.89
31	Oakville	1.81	92.86%	2.28	79.4%	1.62	1.98	57.35
32	Odessa	0.52	87.23%	0.76	68.4%	0.56	0.72	10.09
33	Olga	1.02	90.82%	1.52	67.1%	0.99	1.30	28.96
34	Olympia	1.74	91.13%	2.51	69.3%	1.65	2.19	50.68

Table B.1.24 Hour Rainfall Amounts and Comparisons for Selected USGS Stations								
	Station Name	**6 Month Storm Inches**	**6 Month % Rainfall Volume**	**2 Year Storm Inches**	**6 Month/ 2 year %**	**90% Rainfall Inches**	**95% Rainfall Inches**	**Mean Annual Precip. Inches**
35	Omak	0.66	85.89%	0.98	67.3%	0.79	0.98	11.97
36	Packwood	2.41	88.70%	3.52	68.5%	2.51	3.20	55.20
37	Pomeroy	0.75	89.29%	1.02	73.5%	0.78	0.98	16.04
38	Port Angeles	1.12	88.39%	1.66	67.5%	1.19	1.56	25.46
39	Port Townsend	0.77	90.56%	1.14	67.5%	0.76	0.95	19.13
40	Prosser	0.48	83.82%	0.74	64.9%	0.61	0.78	7.90
41	Quilcene	2.53	88.81%	3.40	74.4%	2.61	3.15	54.88
42	Quincy	0.53	82.12%	0.81	65.4%	0.68	0.90	8.07
43	Sea-Tac	1.32	91.13%	1.83	72.1%	1.27	1.63	38.10
44	Seattle JP	1.30	92.05%	1.74	74.7%	1.20	1.49	38.60
45	Sedro Woolley	1.50	92.07%	2.01	74.6%	1.41	1.80	46.97
46	Shelton	2.15	91.49%	3.13	68.7%	2.05	2.55	64.63
47	Smyrna	0.52	83.16%	0.76	68.4%	0.63	0.75	7.96
48	Spokane	0.68	89.54%	0.96	70.8%	0.70	0.88	16.04
49	Sunnyside	0.45	82.22%	0.73	61.6%	0.63	0.76	6.80
50	Tacoma	1.21	92.18%	1.61	75.2%	1.12	1.37	36.92
51	Toledo	1.36	92.73%	2.10	64.8%	1.25	1.68	50.18
52	Vancouver	1.35	91.32%	1.93	69.9%	1.28	1.62	38.87
53	Walla Walla	0.90	88.60%	1.23	73.2%	0.94	1.18	19.50
54	Waterville	0.67	84.43%	1.04	64.4%	0.81	1.05	11.47
55	Wauna	1.82	91.37%	2.50	72.8%	1.72	2.18	51.61
56	Wenatchee	0.58	81.97%	0.92	63.0%	0.80	1.04	8.93
57	Winthrop	0.75	85.36%	1.13	66.4%	0.94	1.13	14.28
58	Yakima	0.53	81.44%	0.85	62.4%	0.72	1.03	8.16

Table B.2 24 - Hour Rainfall Amounts and Statistics					
Station Name	Return 2-yr.	Freq 6-month	Knee-of-curve 24 hr. (in)	Mean Annual Storm (in)	Mean Annual Precip (in)
Aberdeen	3.32	2.53	2.81		83.1
Anacortes	1.33	0.99	1.20		25.9
Appleton	1.97	1.47	1.80		32.7
Arlington	1.79	1.35	1.40		46.5
Auburn	2.00	1.51		0.54	44.9
Battle Ground	2.12	1.60			52.0
Bellingham 3SSW -- F	1.70	1.27			35.0
Bellingham CAA AP	1.56	1.17	1.63		35.8
Benton City 2NW	0.79	0.53			8.0
Blaine 1ENE	1.89	1.42		0.46	39.9
Bremerton	2.31	1.74	2.22		50.0
Buckley 1NE	2.09	1.58			49.0
Burlington	1.75	1.31		0.40	35.0
Carnation 4NW	1.91	1.44		0.49	47.5
Cathlamet 6NE	3.84	2.93	2.59		79.0
Centralia 1W	2.10	1.59	1.78	0.44	47.6
Chelan	0.94	0.65	1.00		10.4
Colfax 1NW	1.18	0.86	0.99		19.8
Colville	1.02	0.74	0.86		18.3
Colville WB AP	1.01	0.73		0.35	17.4
Coupville 1S	1.08	0.79			21.0
Cushman Dam	4.61	3.52	4.25	1.23	99.7
Darrington RS	3.32	2.53	3.42	0.84	79.8
Duvall 3NE	1.99	1.50			50.0
Ellensburg	0.70	0.48	0.80	0.25	9.2
Ellensburg WB AP	0.72	0.51			12.0
Elwha RS	2.74	2.07	2.53		55.9
Everett Jr. Col.	1.48	1.11	1.22	0.41	34.4
Forks 1E	4.90	3.76	3.99		117.8
Goldendale	1.12	0.81	1.25		17.6
Goldendale 2E	1.31	0.95			18.0
Hartline	0.89	0.62	0.98		10.7
Hoquiam AP	2.85	2.17			71.0
Kennewick	0.71	0.48	0.71		7.6
Kent	1.87	1.40			36.0

Table B.2 24 - Hour Rainfall Amounts and Statistics					
Station Name	Return 2-yr.	Freq 6-month	Knee-of-curve 24 hr. (in)	Mean Annual Storm (in)	Mean Annual Precip (in)
Leavenworth	1.64	1.21			26.0
Long Beach Exp	2.99	2.28	2.54		80.0
Longview	2.20	1.66	1.67	0.48	48.1
Mazama 2W	1.59	1.17		0.41	22.7
McMillin Reservoir	1.81	1.36	1.49	0.46	40.0
Mill Creek	2.04	1.53			35.0
Monroe	1.91	1.44	1.52		48.2
Montesano 3NW	3.30	2.52		0.81	81.5
Moses Lake Devil Far	0.74	0.50	0.68		7.9
Mount Vernon 3WNW	1.60	1.20			32.0
Newport	1.41	1.05			29.0
Oakville	2.46	1.86	1.99		57.4
Odessa	0.80	0.55	0.72		10.1
Okanogan	0.90	0.63			12.0
Olga 2se	1.52	1.13	1.29		29.0
Olympia WB AP	2.62	1.98	2.18	0.62	51.1
Omak 2nw	0.99	0.70	0.98		12.0
Othello 5e	0.70	0.47			8.0
Packwood	2.92	2.21	3.16		55.2
Pomeroy	1.10	0.79	0.97		16.0
Port Angeles	1.69	1.26	1.56	0.42	24.2
Port Townsend	1.11	0.81	0.95	0.35	17.6
Prosser	0.74	0.49	0.78		7.9
Prosser 4NE	0.72	0.48			8.0
Pullman 2NW	1.17	0.86		0.41	22.3
Puyallup 2w Exp Stn	1.85	1.40			41.0
Quilcene 2SW	3.42	2.59	3.14		54.9
Quilcene Dam 5SW	3.84	2.92		0.77	69.4
Quincy 1S	0.77	0.52	0.90		8.1
Republic	1.04	0.76			17.0
Seattle Jackson Park	1.49	1.12	1.49		38.6
Seattle Tac WB AP	1.90	1.42	1.62	0.49	37.4
Seattle U. of W.	1.72	1.29			36.0
Sedro Wolley 1E	2.05	1.55	1.80		47.0
Sequim	1.11	0.80			16.0

Table B.2 24 - Hour Rainfall Amounts and Statistics					
Station Name	Return 2-yr.	Freq 6-month	Knee-of-curve 24 hr. (in)	Mean Annual Storm (in)	Mean Annual Precip (in)
Shelton	3.15	2.39	2.54		64.6
Smyrna	0.79	0.53	0.75		8.0
Spokane	1.11	0.80	0.88		16.0
Spokane WB AP	0.97	0.70		0.35	17.0
Sunnyside	0.76	0.50	0.76	0.30	7.4
Tacoma City Hall	1.70	1.28	1.37		36.9
Toledo	1.99	1.51	1.68		50.2
Vancouver 4NNE	2.01	1.51	1.62		38.9
Walla Walla CAA AP	1.19	0.87	1.17		19.5
Waterville	1.00	0.70	1.05		11.5
Wauna	2.15	1.63	2.18		51.6
Wenatchee	0.95	0.65	1.04		8.9
Winthrop 1WSW	1.19	0.85	1.13		14.3
Yakima WB AP	0.81	0.54	1.03	0.33	8.2

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Appendix I-C Basic Treatment Receiving Waters

1. **<u>All Salt Waterbodies</u>**

2. **<u>Rivers</u>**

Rivers	Basic Treatment Applies Below This Location
Baker	Anderson Creek
Bogachiel	Bear Creek
Cascade	Marblemount
Chehalis	Bunker Creek
Clearwater	Town of Clearwater
Columbia	Canadian Border
Cowlitz	Skate Creek
Elwha	Lake Mills
Green	Howard Hanson Dam
Hoh	South Fork Hoh River
Humptulips	West and East Fork Confluence
Kalama	Italian Creek
Lewis	Swift Reservoir
Muddy	Clear Creek
Nisqually	Alder Lake
Nooksack	Glacier Creek
South Fork Nooksack	Hutchinson Creek
North River	Raymond
Puyallup	Carbon River
Queets	Clearwater River
Quillayute	Bogachiel River
Quinault	Lake Quinault
Sauk	Clear Creek
Satsop	Middle and East Fork Confluence
Skagit	Cascade River
Skokomish	Vance Creek
Skykomish	Beckler River
Snohomish	Snoqualmie River
Snoqualmie	Middle and North Fork Confluence
Sol Duc	Beaver Creek
Stillaguamish	North and South Fork Confluence
North Fork Stillaguamish	Boulder River
South Fork Stillaguamish	Canyon Creek
Suiattle	Darrington
Tilton	Bear Canyon Creek
Toutle	North and South Fork Confluence
North Fork Toutle	Green River
Washougal	Washougal
White	Greenwater River
Wind	Carson
Wynoochee	Wishkah River Road Bridge

3. **<u>Lakes</u>** — **<u>County</u>**

Lakes	County
Washington	King
Sammamish	King
Union	King
Whatcom	Whatcom
Silver	Cowlitz

Note: Local governments may petition for the addition of more waters to this list. The initial criteria for this list are rivers whose mean annual flow exceeds 1,000 cfs, and lakes whose surface area exceeds 300 acres. Additional waters do not have to meet these criteria, but should have sufficient background dilution capacity to accommodate dissolved metals additions from build-out conditions in the watershed under the latest Comprehensive Land Use Plan and zoning regulations.

Appendix I-D Guidelines for Wetlands when Managing Stormwater

This Appendix provides guidelines on the management of stormwater, from development and redevelopment projects, to avoid or minimize changes to wetland functions and values.

This appendix consists of seven sections:

Information Needed to Apply the Guidelines–This section contains a list of basic data needed for each of the guide sheets to perform basic analyses.

Definitions– Refer to this section for the meaning of terms throughout this appendix.

Scope and Principles

Purpose

Wetlands are important features in the landscape that provide numerous beneficial functions and values for people, fish, and wildlife. Some of these include protecting and improving water quality, providing fish and wildlife habitats, storing floodwaters, and maintaining surface water flow during dry periods.

Development, redevelopment, and stormwater management projects may decrease the functions and values of wetlands by:

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

This can happen even if the wetland is not formally used for stormwater management purposes.

These guidelines intend to prevent decreasing the functions and values of wetlands by avoiding alterations to the structural, hydrologic, and water quality characteristics of existing wetlands to the extent possible during development, redevelopment and stormwater management projects.

Regulatory Requirements

Following these guidelines does not fulfill requirements for assessment and permitting. Every development and redevelopment project should follow the stipulations of the State Environmental Policy Act and contact the local permitting authority. Other state and federal agencies may also have jurisdiction over projects affecting wetlands such as the Washington State Departments of Ecology, Fisheries, and Wildlife; the U.S. Environmental Protection Agency; and the U.S. Army Corps of Engineers.

These guidelines do not address actions needed to enhance or restore degraded wetlands.

Guideline Basis

These guidelines were principally from the results of the Puget Sound Wetlands and Stormwater Management Research Program, as set forth in Sections 2 and 3 of the program's summary publication, *Wetlands and Urbanization, Implications for the Future* (Horner et al. 1997).

Washington State Wetland Rating System

The wetlands in Washington State differ widely in their functions and values. Washington State's wetland rating systems categorizes wetlands into four categories based on their sensitivity to disturbance, their rarity, our ability to replace them, and the functions they provide.

The rating system, however, does not replace a full assessment of wetland functions that may be necessary to plan and monitor a project of compensatory mitigation.

For more information on the wetlands rating system go to: http://www.ecy.wa.gov/programs/sea/wetlands/ratingsystems/index.html.

Guide Sheet 1: Criteria that excludes wetlands from serving as a treatment or flow control BMP/facility

The following types of wetlands are not suitable as a treatment or flow control BMPs/facilities. Engineering structural or hydrologic changes within the wetland itself to improve stormwater flows and water quality are not allowed. Do not increase or decrease the water regime in these wetlands beyond the limits set in Guide Sheet 3. Provide these wetlands with the maximum protection from urban impacts (see Guide Sheet 3, Wetland Protection Guidelines):

1. The wetland is currently a Category I wetland because of special conditions (forested, bog, estuarine, Natural Heritage, coastal lagoon).

2. The wetland provides a high level of many functions. These are Category I and II wetlands as determined by the Washington State Wetland Rating System of Western Washington.
3. The wetland provides habitat for threatened or endangered species. Determining whether or not the conserved species will be affected by the proposed project requires a careful analysis in relation to the anticipated habitat changes. Consult with the appropriate agencies with jurisdiction over the specific threatened or endangered species on the site.

If a wetland type listed above needs to be included in a stormwater system then this activity is considered an impact. It will be treated as any other impact, and will need to be mitigated according to the rules for wetland mitigation. Project proponents will have to demonstrate that they have done everything to avoid and minimize impacts before proceeding to compensatory mitigation.

The wetlands listed above cannot receive flows from a stormwater system unless the criteria in Guide Sheets 3B and 3C are met.

Guide Sheet 2: Criteria for including wetlands as a treatment or flow control BMP/facility

A wetland can be physically or hydrologically altered to meet the requirements of a treatment or flow control BMP/facility if ALL of the following criteria are met:

Modifications that alter the structure of a wetland or its soils will require permits. Existing functions and values that are lost would have to be compensated/replaced.

1. It is classified in Category IV in the "Washington State Wetland Rating System of Western Washington," or a Category III wetland with a habitat score of 19 points or less.
2. You can demonstrate that there will be "no net loss" of functions and values of the wetland as a result of the structural or hydrologic modifications done to provide control of runoff and water quality. This includes the impacts from the machinery used for the construction. Heavy equipment can often damage the soil structure of a wetland. However, the functions and values of degraded wetlands may sometimes be increased by such alterations and thus would be self-mitigating. Functions and values that are not replaced on site will have to be mitigated elsewhere.
    a. Modifications that alter the structure of a wetland or its soils will require permits. Check with the agency(ies) issuing the permits for the modification(s) to determine which method to use to establish "no net loss."

   b. A wetland will usually sustain fewer impacts if the required storage capacity can be met through a modification of the outlet rather than through raising the existing overflow.

3. The wetland does not contain a breeding population of any native amphibian species.

4. The hydrologic functions of the wetland can be improved as outlined in questions 3,4,5 of Chart 4 and questions 2,3,4 of Chart 5 in the "Guide for Selecting Mitigation Sites Using a Watershed Approach," (available here: http://www.ecy.wa.gov/biblio/0906032.html); or the wetland is part of a priority restoration plan that achieves restoration goals identified in a Shoreline Master Program or other local or regional watershed plan.

5. The wetland lies in the natural routing of the runoff, and the discharge follows the natural routing.

Guide Sheet 3: Wetland protection guidelines

This guide sheet provides information on ways to protect wetlands from changes to their ecological structure and functions that result from human alterations of the landscape. It also recommends management actions that can avoid or minimize deleterious changes to wetlands.

Although, this guide sheet is intended primarily for the protection of the wetlands listed in Guide Sheet 1; this guidance still should be applied, as practical, for wetlands listed in Guide Sheet 2 when they are modified to meet stormwater requirements.

Guide Sheet 3A: General guidelines for protecting functions and values of wetlands

1. Consult regulations issued under federal and state laws that govern the discharge of pollutants. Wetlands are classified as "Waters of the United States" and "Waters of the State" in Washington.

2. Maintain the wetland buffer required by local 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 exotic plant species during any work in a wetland.

5. Take measures to avoid general urban impacts (e.g., littering and vegetation destruction). Examples are protecting existing buffer zones; discouraging access, especially by vehicles, by plantings outside the wetland; and encouragement of stewardship by a homeowners' association.

6. Fences can be useful to restrict dogs and pedestrian access, but they also interfere with wildlife movements. Their use should be very

carefully evaluated on the basis of the relative importance of intrusive impacts versus wildlife presence. Fences should generally not be installed when wildlife would be restricted and intrusion is relatively minor. They generally should be used when wildlife passage is not a major issue and the potential for intrusive impacts is high. When wildlife movements and intrusion are both issues, the circumstances will have to be weighed to make a decision about fencing.

7. If the wetland inlet will be modified for the stormwater management project, use a diffuse flow method, (eg. BMPC206 Level Spreader Swale, Volume II, and BMP T5.10B Downspout Dispersion Systems, Volume III) to discharge water into the wetland in order to prevent flow channelization.

Guide Sheet 3B: Protecting wetlands from impacts of changes in water flows

Protecting wetland plant and animal communities depends on maintaining the existing wetland's hydroperiod. This means maintaining the annual fluctuations in water depth and its timing as closely as possible. The risk of impacts to functions and values increases as the changes in water regime deviate more from the existing conditions. These changes often result from development.

Hydrologic modeling is useful to measure or estimate the aspects of the hydroperiod under existing pre-project and anticipated post-project conditions. Post-project estimates of the water regime in a watershed and wetland hydroperiod must include the cumulative effect of all anticipated watershed and wetland modifications. Perform this assessment with the aid of a qualified hydrologist.

Provisions in these guidelines pertain to the full anticipated build-out of the wetland's watershed as well as changes resulting from an individual development.

Unfortunately, attempts to modify and use the standard hydrologic models for describing the flow and fluctuations of water in a stormwater pond have failed to adequately model the hydrodynamics in wetlands. It is difficult, to estimate if stormwater discharges to a wetland will meet the criteria for protection developed by the Puget Sound Wetland and Stormwater Research Program. The criteria developed by that program apply only to depressional wetlands. They are not applicable to riverine, slope, or lake-fringe wetlands. Ecology does not have any hydrologic models available to characterize the hydrodynamics in these types of wetlands.

As a result, it is difficult to predict the direct impacts of changes in water flows resulting from a development. In the absence of hydrologic models that characterize all types of wetlands, criteria have to be set using information that is readily available. These criteria are based on risk to the resource rather than an actual understanding of impacts.

The following criteria will provide some protection for the valuable wetland types listed in Guide Sheet 1, but we cannot determine if they result in the complete protection of a wetland's functions and values. The risk to wetland functions will increase as the water volumes into the wetland diverge from the pre-project conditions. The risk will be decreased if the divergence is smaller.

Use the Western Washington Hydrology Model (WWHM), or other models approved by Ecology, 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 criterion below. WWHM 2012 will have the capability to compare these results with the criterion.

Criterion 1: total volume of water into a wetland during a single precipitation event should not be more than 20% higher or lower than the pre-project volumes.

Modeling algorithm for Criterion 1

1. Daily Volumes can be calculated for each day over 50 years for Pre- and Post-project scenarios. Volumes are to be calculated at the inflow to the wetland or the upslope edge where surface runoff, interflow, and ground water are assumed to enter.
2. Calculate the average of Daily Volume for each day for Pre- and Post-project scenarios. There will be 365 values for the Pre-project scenario and 365 for the Post-project.

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

   - If you use 50 years of precipitation data, there will be 50 values for April 1. Calculate the average of the 50, April 1, Daily Volumes for Pre- and Post-project scenarios.
   - Compare the average Daily Volumes for Pre- versus Post-project scenarios for each day. The average Post-project Daily Volume for April 1 must be within +/- 20% of the Pre-project Daily Volume for April 1.
3. Check compliance with the 20% criterion for each day of year. Criterion 1 is met/passed if none of the 365 post-project daily volumes varies by more than 20% from the pre-project daily volume for that day.

Criterion 2: Total volume of water into a wetland on a monthly basis should not be more than 15% higher or lower than the pre-project volumes.

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

Modeling algorithm for Criterion 2

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

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

   - If you use 50 years of precipitation data, there will be 50 values for the month of April Calculate the average of the 50, April, Monthly Volumes for Pre- and Post-project scenarios.
   - Compare the Monthly Volumes for Pre- versus Post-project scenarios. Post- project Monthly Volume for April must be within +/- 15% of the Pre- project Monthly Volume for April.
3. Check compliance with the 15% criterion for each calendar month of year. Criterion 2 is met/passed if none of the post- project Monthly Volume varies by more than 15% from the pre- project Monthly Volume for every month.

WWHM Modeling Assumption and Approach

Assumption - Flow components feeding the wetland under both Pre- and Post-project scenarios are assumed to be the sum of the surface, interflow, and ground water flows from the project site.

Approach - Assign the wetland a point of compliance #1 (POC) number such as POC1 downstream of the project area**.**

- Pre-project scenario - Connect all flow components to the wetland/POC1
  - ➢ **Pre-project Total Flows to POC1 = Surface + Interflow + Ground water**
- Post-project scenario - Identify flows to the wetland/POC1.
  a) Impervious surfaces send flows to wetland via (1)- surface flow.

- ✓ WWHM sub-flows to POC1 = Surface flow (+ Interflow default set in WWHM)

b) Pervious surfaces send flows to wetland via (1)- surface, (2)- interflow, and (3)- ground.

- ✓ WWHM sub-flows to POC1 = Surface + Interflow + Ground water

c) Infiltrating facilities send flows to wetland via ground water, and surface overflows.

(1) Ground water - Connect infiltrated water (Outlet 2) to ground water component of the area between facility and wetland. Use Lateral Basin downstream of the infiltrating facility and connect Outlet 2 to the ground water component of the Lateral Basin. If this area is the same area modeled in Step (b) above, use the Lateral Basin element in Step (b).

- ✓ WWHM sub-flows to POC1 = infiltrated flows

(2) Surface Overflow – Connect the surface flow (Outlet 1) to wetland/POC1

- ✓ WWHM sub-flows to POC1 = facility surface flows (Outlet 1)
- ➢ **Post-project Total Flows to POC1 = Sum of flows in (a), (b), and (c).**

If it is expected that the limits stated above could be exceeded, consider the following strategies to reduce the volume of surface flows:

- Reducing of the level of development by reducing the amount of impervious surface and/or increasing the retention of natural forest cover.
- Increasing infiltration through the use of LID BMPs and LID principles.
- Increasing storage capacity for surface runoff.
- Using selective runoff bypass around the wetland. Bypassed flow must still comply with other applicable stormwater requirements.

Monitoring – Modifications that alter the structure of a wetland or its soils will require permits. Conduct monitoring as required by local, state, or federal permits.

Guide Sheet 3C: Guidelines for protecting wetlands from pollutants

Protecting a wetland from pollutants generated by a development should include the following measures:

1. Use effective erosion control at construction sites in the wetland's drainage catchment. Refer to Volume II this manual and local jurisdiction requirements.
2. Institute a program of source control BMPs and minimize the pollutants that will enter storm runoff that drains to the wetland.
3. For wetlands the meet the criteria in Guide Sheet 1, provide a water quality control facility consisting of one or more treatment BMPs to treat runoff entering the wetland.

   If the wetland is a Category I wetland because of special conditions (forested, bog, estuarine, Natural Heritage, costal lagoon), the facility should include a BMP with the most advanced ability to control nutrients.

Guide Sheet 4: Jurisdictional planning for wetlands and stormwater management

Local jurisdictions should plan and manage their resources to protect the overall function and values of wetlands, including their role in storm drainage systems.

Advanced planning can help local jurisdictions to take advantage of the most options for managing stormwater in newly developing areas.

The comprehensive planning steps, below, are based on two principles for effective environmental management:

1. The best management policies for the protection of wetlands are those that prevent or minimize impacts at their point of origin.
2. The best management strategies are self-perpetuating, that is they do not require periodic infusions of capital and labor.

The Department of Ecology, the Puget Sound Partnership, and other groups are actively developing new tools for watershed planning that will address many of the steps outlined below. We suggest you review information that has already been developed in the region of your concern. This may significantly reduce your efforts. A good place to start is: http://www.ecy.wa.gov/watershed/index.html

Comprehensive Planning Steps

1. Define the landscape unit you will be using for your planning effort. See the definition of landscape unit in the Definitions section.
2. Begin the plan for the landscape unit with attention to the following general principles:
   a. Formulate the plan based on clearly articulated community goals. Carefully identify conflicts and choices between retaining and protecting desired resources and community growth.

b. Map and assess the suitability of different areas for urban uses.

c. There are several tools available for identifying such areas. For more information visit http://www.ecy.wa.gov/mitigation/landscapeplan.html. When appropriate, the assessment can also highlight outstanding local or regional resources that the community determines should be protected. For example, a fish run, scenic area, recreational area, threatened species habitat, farmland.

3. Maximize natural water storage and infiltration opportunities within the landscape unit and outside of existing wetlands, especially:

   a. Promote the conservation of forest cover. Develop on deforested land. This affects the water flows in a basin less than building on land that requires removing forest cover. Loss of forest cover increases peak runoff requiring expensive structural solutions.

   b. Maintain natural storage reservoirs and drainage corridors, including depressions, areas of permeable soils, swales, and intermittent streams. Implement policies and regulations to discourage the clearing, filling, and channelization of these features. Use existing drainage networks in preference to pipes, culverts, and engineered ditches as long as the flows and volumes of water in them are not increased.

4. Establish and maintain buffers surrounding wetlands and in riparian zones. Also, maintain interconnections among wetlands and other natural habitats to allow for wildlife movements.

5. Implement measures to avoid general impacts on wetlands and other water bodies (e.g., littering, vegetation destruction, human and pet intrusion harmful to wildlife).

   In wetlands that are relatively unaffected by human activities, plan so the quantity or stormwater flows match the pre-project hydroperiod and hydrodynamics. In wetlands whose water flows have been disturbed, consider ways of reducing the existing changes to flows. This involves not only management of high volumes and rates of flow during the wet season, but also preventing water supply depletion during the dry season. The latter may require augmenting flows if urbanization reduces existing surface or ground water inflows. Refer to *Guide Sheet 3: Wetland Protection Guidelines*, for details on implementing these guidelines.

6. Assess alternatives for controlling the quantities of runoff as follows:

   a. Analyze proposed development actions in terms of changes to quantity of runoff.

   b. For existing development or redevelopment, assess possible alternative solutions to adding flow controls by:

(1) Protecting health, safety, and property from flooding by removing buildings from the flood plain.

(2) Preventing stream channel erosion by stabilizing the eroding bed and/or bank area with bioengineering techniques, preferably, by using structural reinforcements that are consistent with the protection of aquatic habitats and beneficial uses of the stream (refer to Chapter 173-201A of the Washington Administrative Code (WAC) for the definition of beneficial uses).

c. For new development or redevelopment, assess different regulatory alternatives or incentives for changing common practices in land use including: density controls, clearing limits, impervious surface limits, transfer of development rights, purchase of conservation areas, etc.

d. If the alternatives considered in Step 6 above cannot solve an existing or potential problem, perform an analysis of the contributing drainage catchment to assess possible alternative solutions that can be applied on-site or on a regional scale. The most appropriate solution or combination of alternatives should be selected with regard to the specific opportunities and constraints existing in the drainage catchment. For new development or redevelopment, on-site facilities that should be assessed include, in approximate order of preference:

(1) LID BMPs and LID principles

(2) Infiltration basins or trenches.

(3) Detention ponds.

(4) Below-ground vault or tank storage.

(5) Parking lot detention.

Regional facilities that should be assessed for solving problems associated with new development, redevelopment, or existing development include:

(1) LID BMPs and LID principles

(2) Infiltration basins or trenches.

(3) Detention ponds.

(4) Constructed wetlands.

(5) Bypassing a portion of the flow to an acceptable receiving water body, with treatment as required to protect water quality and other special precautions as necessary to prevent downstream impacts.

e. Consider physically altering an existing wetland for controlling water quantities only if upland alternatives are inadequate to solve the existing or potential problem. Refer to the criteria in Guide Sheet 1 and 2 to evaluate if wetlands can be altered.

7. Place strong emphasis on water resource protection during construction of new development. Establish effective erosion control programs to reduce the sediment loadings to receiving waters to the maximum extent possible. No preexisting wetland or other water body should ever be used for the sedimentation of solids in construction-phase runoff.

8. Characterize alternatives for the control of runoff water quality as follows:

   a. Analyze the contributing drainage catchment basin to assess possible alternative solutions that can be applied on-site or on a regional scale. The best alternatives are those that minimize changes to water quality resulting from development. Consider both source control BMPs, treatment BMPs, and LID BMPs as alternative solutions before considering use of existing wetlands.

   b. Consider altering an existing wetland for water quality control only if upland alternatives are inadequate to solve the existing or potential problem.

      Using wetlands for polishing is subject to analysis on a case-by-case basis and may be allowed only if the following conditions are met:

      (1) The restoration or enhancement of a previously degraded wetland is required.

      (2) Both improving water quality and the upgrading of other wetland functions need to be accomplished.

      (3) All legally adopted water quality standards for wetlands are observed.

      (4) Appropriate source control and treatment BMPs are applied in the contributing catchment on the basis of the analysis in Step 9a.

      If these circumstances apply, refer to *Guide Sheet 2: Criteria for Including Wetlands as a Treatment or Flow Control BMP/Facility*

9. Stimulate public awareness of and interest in wetlands and other water resources in order to encourage protective attitudes in the community. This program should include:

   a. Education regarding the use of fertilizers and pesticides, automobile maintenance, the care of animals and the importance of retaining buffers to prevent water pollution.

b. Descriptive signboards adjacent to wetlands informing residents of the wetland type, its functions, the protective measures taken, etc.

c. If beavers are present in a wetland, educate residents about their ecological role and value and take steps to avoid human interference with beavers.

Monitoring

Design and carry out a program to monitor water quality if bogs and other Category I wetlands will be subject to pollutant loadings from new developments. Such wetlands are at risk if they have contributing catchments with either of the following characteristics:

1. More than 20 percent of the catchment area is committed to commercial, industrial, and/or multiple family residential land uses.
2. The combination of all urban land uses (including single family residential) exceeds 30 percent of the catchment area.

The monitoring program should include the following tasks:

1. Perform pre-project baseline sampling by collecting water quality grab samples in an open water pool of the wetland for at least one year, allocated through the year as follows:

   - November 1-March 31--4 samples
   - April 1- May 31--1 sample
   - June 1- August 31--2 samples
   - September 1- October 31--1 sample

   If the wetland is dry during any period, reallocate the sample(s) scheduled then to another time when the wetland is no longer dry.

   Analyze samples for pH; dissolved oxygen (DO); conductivity (Cond); total suspended solids (TSS); total phosphorus (TP); nitrate + nitrite-nitrogen (N); fecal coliforms (FC); and total copper (Cu), lead (Pb), and zinc (Zn). Find the median and range of each water quality variable.

2. Considering the baseline results, set water quality goals to be maintained in the post-project period. Example goals are:

   - pH--no more than “x” percent (e.g., 10%) increase (relative to baseline) in annual median and maximum or decrease in annual minimum.;
   - Do--no more than “x” percent decrease in annual median and minimum concentrations.
   - Other variables--no more than “x” percent increase in annual median and maximum concentrations.
   - No increase in violations of the Washington Administrative Code (WAC) water quality criteria.

Repeat the sampling on the same schedule for at least one year after all development is complete. Compare the results to the set goals.

Information Needed to Apply the Guidelines

Each guide sheet requires collecting specific information. The following sections list the basic data needed for applying the Guide Sheets. As a start, obtain the relevant soil survey; the National Wetland Inventory for the watershed, topographic and land use maps, and the results of any local wetland inventory.

Data Needed for Guide Sheet 1: Criteria for Excluding Wetlands as Part of a Stormwater System

1. Wetland category Ecology's "Washington State Wetland Rating System for Western Washington," available on-line at http://www.ecy.wa.gov/biblio/sea.html.
2. Rare, threatened, or endangered species inhabiting the wetland.
3. Presence or absence of a breeding population of native amphibians. If amphibians are found in the wetland assume they are native unless you can demonstrate the only species present are non-native.

Data Needed for Guide Sheet 2: Criteria for Including Wetlands as Part of a Stormwater System

1. Hydrologic modeling of the existing flows and predicted flows into the wetland.
2. A characterization of the changes to water quality coming into the wetland from the development.
3. Presence of breeding populations of native amphibian species.
4. Presence of fish species.

Data Needed for Guide Sheet 3B: Protecting wetlands from impacts of changes in water flows

The WWHM user manual will have a modeling procedure for estimating water flows to wetlands. Follow the modeling procedure in WWHM user manual to estimate flows and determine compliance with the wetland Criteria 1 and 2. The information needed to model water flows to a wetland in WWHM includes the following:

1. Location of the development project
2. Land use characteristics before and after development.
   a) Soil Type
   b) Surface Vegetation
   c) Land slope
   d) Land area (acres)
3. Land use characteristics between the development project area and the wetland.

Data Needed for Guide Sheet 4: Jurisdictional Planning for Wetlands and Stormwater Management

1. Wetland boundary delineated using the latest Federal Manuals http://www.ecy.wa.gov/programs/sea/wetlands/delineation.html
2. A map of the contributing watershed to the wetland or other landscape unit, and an estimate of its area.
3. A definition of environmental and development goals for the landscape unit subject to planning and management.
4. Existing management and monitoring plans.
5. Existing and projected land use in the landscape unit in the categories commercial, industrial, multi-family residential, single-family residential, agricultural, various categories of undeveloped, and areas subject to active logging or construction (expressed as percentages of the total watershed area).
6. Surface drainage network throughout the landscape unit.
7. Soil conditions, including soil types, infiltration rates, and elevation of water table as it changes seasonally, and the presence of any restrictive layers,
8. Ground water recharge and discharge points.

Definitions

The following terms are applicable only to this appendix (Appendix I-D).

Baseline sampling	Sampling performed to define the existing environmental and biological conditions present before any modification occurs.
Bioengineering	Bioengineering for streams and wetlands --The use of living and nonliving plant materials in combination with naturea and synthetic support materials for slope stabilization, erosion reduction, and vegetative establishment.
Buffer	The area (either upland, open water, or another wetland) that surrounds a wetland and that reduces adverse impacts to it from adjacent development.
Constructed wetland	A wetland intentionally created from a non-wetland site.
Degraded wetland	A wetland whose functions and values have been reduced as a result of human activities
Enhancement	The manipulation of the physical, chemical, or biological characteristics of a wetland site to heighten, intensify or improve specific function(s) or to change

	the growth stage or composition of the vegetation present. Enhancement is undertaken for specified purposes such as water quality improvement, flood water retention or wildlife habitat. Activities typically consist of planting vegetation, controlling non-native or invasive species, modifying site elevations or the proportion of open water to influence hydroperiods, or some combination of these. Enhancement results in a change in some wetland functions and can lead to a decline in other wetland functions, but does not result in a gain in wetland acres.
Estuarine wetland	Generally, a vegetated wetland where the salinity of the surface or port waters is greater than 0.5 parts per thousand.
Functions	The ecological (physical, chemical, and biological) processes or attributes of a wetland. Functions are often defined in terms of the processes that provide value to society, but they can be defined on processes that are not value based. Wetland functions include food chain support, provision of ecosystem diversity and fish and wildlife habitat, flood flow alteration, ground water recharge and discharge, water quality improvement, and soil stabilization.
Hydrodynamics	The science involving the energy and forces acting on water or other liquids and the resulting impact on the motion of the liquid.
Hydroperiod	The seasonal occurrence of flooding and/or soil saturation; encompasses the depth, frequency, duration, and seasonal pattern of inundation.
Invasive plant species	Opportunistic plant species (either native or non-native) that colonize disturbed ecosystems and come to dominate the plant community in ways that are seen by us as reducing the values provided by the previous plant community. Most often, opportunistic plants are considered invasive if they reduce the value of an area as habitat for valuable species.
Landscape unit	An area of land that has a specified boundary used for planning purposes that defines an area of interrelated physical, chemical, and biological processes. A watershed or drainage basin is a common type of landscape unit. A ground water aquifer is another type of landscape unit.

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.
On-site	An action (here, for stormwater management purposes) taken within the property boundaries of the site to which the action applies.
Polishing	Additional treatment of a waste stream that has already received one or more stages of treatment by other means. This is also called advance treatment. The conditions present across a landscape after a specific stormwater management project (e.g., raising the outlet, building and outlet control structure) are placed in the wetland or a land use change that occurs in the landscape unit that will potentially affect the wetland.
Post-project	The conditions present across a landscape after a specific stormwater management project (e.g., raising the outlet, building an outlet control structure) are placed in the wetland or a land use change that occurs in the landscape unit that will potentially affect the wetland.
Pre-project	The conditions present across a landscape before a specific stormwater management project (e.g., raising the outlet, building an outlet control structure) are placed in the wetland or a land use change occurs in the landscape unit that will potentially affect the wetland.
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.
Redevelopment	Conversion of an existing development to another land use, or addition of a material improvement to an existing development.
Regional	An action (here, for stormwater management purposes) that involves more than one discrete property.
Re-establishment	Actions performed to reestablish wetland functional characteristics and processes that have been lost by alterations, activities, or catastrophic events in an area that no longer meets the definition of a wetland.

Structure	The physical components of an ecosystem, both the abiotic (physical and chemical) and biotic (living).
Values	Wetland processes or attributes that are valuable or beneficial to society (also see Functions). Wetland values include support of commercial and sport fish and wildlife species, protection of life and property from flooding, recreation, education, and aesthetic enhancement of human communities.
Wetlands	Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas. Wetlands do not include those artificial wetlands intentionally created from nonwetland sites, including, but not limited to, irrigation and drainage ditches, grass-lined swales, canals, detention facilities, wastewater treatment facilities, farm ponds, and landscape amenities, or those wetlands created after July 1, 1990, that were unintentionally created as a result of the construction of a road, street, or highway. Wetlands may include those artificial wetlands intentionally created from nonwetland areas to mitigate the conversion of wetlands. (Waterbodies not included in the definition of wetlands as well as those mentioned in the definition are still waters of the state.)

Appendix I-E Flow Control-Exempt Surface Waters

Stormwater discharges, that are otherwise subject to Minimum Requirement #7 – Flow Control, to waters on this list must meet the following restrictions to be exempt from Minimum Requirement #7.

- 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 BMP's are applied to route natural runoff volumes from the project site to any downstream Type 5 stream or category IV wetland:
    - Design of flow splitting devices or drainage BMP's 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, durations ranging from 50% of the 2-year to the 50-year peak flow.
    - Flow splitting devices or drainage BMP's 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) and extends to the ordinary high water mark of the exempt receiving water; and
- The conveyance system between the project site and the exempt receiving water shall have a hydraulic capacity sufficient 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.

Exempt Surface Waters List.

Water Body	**Upstream Point/Reach for Exemption** (if applicable)
Alder Lake	
Baker Lake	
Baker River	Baker River/Baker Lake downstream of the confluence with Noisy Creek
Bogachiel River	0.4 miles downstream of Dowans Creek
Calawah River	Downstream of confluence with South Fork Calawah River
Capital Lake / Deschutes River	Downstream of Tumwater Falls
Carbon River	Downstream of confluence with South Prairie Creek
Cascade River	Downstream of Found Creek
Cedar River	Downstream of confluence with Taylor Creek
Chehalis River	1,500 feet downstream of confluence with Stowe Creek
Chehalis River, South Fork	1,000 feet upstream of confluence with Lake Creek
Cispus River	Downstream of confluence with Cat Creek
Clearwater River	Downstream of confluence with Christmas Creek
Coal Creek Slough	Boundary of Consolidated Diking and Irrigation District #1 to confluence with the Columbia River.
Columbia River	Downstream of Canadian border
Consolidated Diking and Irrigations District #1	Waters that lie within the area bounded by the Columbia River on the south, the Cowlitz River on the east, Ditch No. 10 to the west, and Ditch No. 6 to the north.
Consolidated Diking and Irrigation District #3	Ditches served by these pump stations: Tam O'Shanter #1 and #2, Coweeman, Baker Way, Elk's
Coweman River	Downstream of confluence with Gobble Creek
Cowlitz River	Downstream of confluence of Ohanapecosh River and Clear Fork Cowlitz River
Crescent Lake	
Dickey River	Downstream of confluence with Coal Creek
Dosewallips River	Downstream of confluence with Rocky Brook
Dungeness River	Downstream of confluence with Gray Wolf River
Duwamish / Green River	Downstream River Mile 6 (S. Boeing Access Road)
Elwha River	Downstream of confluence with Goldie River
Erdahl Ditch in Fife	Downstream of pump station
First Creek in Tacoma	
Grays River	Downstream of confluence with Hull Creek
Green River (WRIA 26 – Cowlitz)	3.5 miles upstream of Devils Creek
Hoh River	1.2 miles downstream of Jackson Creek
Humptulips River	Downstream of confluence with West and East Forks
Johns Creek	Downstream of Interstate-405 East Right-of-way
Kalama River	2.0 miles downstream of Jacks Creek
Lacamas Lake	
Lake Cushman	
Lake Quinault	
Lake River (Clark County)	
Lake Shannon	
Lake Sammamish	
Lake Union & Union Bay	King County
Lake Washington, Montlake Cut, Ship Canal, & Salmon Bay	

Water Body	**Upstream Point/Reach for Exemption** (if applicable)
Lake Whatcom	
Lewis River	Downstream of confluence with Quartz Creek
Lewis River, East Fork	Downstream of confluence with Big Tree Creek
Lightning Creek	Downstream of confluence with Three Fools Creek
Little White Salmon River	Downstream of confluence with Lava Creek
Mayfield Lake	
Mercer Slough	
Muddy River	Downstream of confluence with Clear Creek
Naselle River	Downstream of confluence with Johnson Creek
Newaukum River	Downstream of confluence with South Fork Newaukum River
Nisqually River	Downstream of confluence with Big Creek
Nooksack River	Downstream of confluence of North Fork and Middle Forks
Nooksack River, North Fork	Downstream of confluence with Glacier Creek, at USGS gauge 12205000
Nooksack River, South Fork	0.1 miles upstream of confluence with Skookum Creek
North River	Downstream of confluence with Vesta Creek
Ohanapecosh River	Downstream of confluence with Summit Creek
Puyallup River	Half-mile downstream of confluence with Kellog Creek
Queets River	Downstream of confluence with Tshletshy Creek
Quillayute River	Downstream of Bogachiel River
Quinault River	Downstream of confluence with North Fork Quinault River
Riffe Lake	
Round Lake	
Ruby Creek	Ruby Creek at SR-20 crossing downstream of Granite and Canyon Creeks
Sammamish River	Downstream of Lake Sammamish
Satsop River	Downstream of confluence of Middle and East Forks
Satsop River, East Fork	Downstream of confluence with Decker Creek
Sauk River	Downstream of confluence of South Fork and North Fork
Sauk River, North Fork	North Fork Sauk River at Bedal Campground
Silver Lake	Cowlitz County
Skagit River	Downstream of Canadian border
Skokomish River	Downstream of confluence of North and South Fork
Skokomish River, South Fork	Downstream of confluence with Vance Creek
Skokomish River, North Fork	Downstream of confluence with McTaggert Creek
Skookumchuck River	1 mile upstream of Bucoda at SR 507 mile post 11.0
Skykomish River	Downstream of South Fork
Skykomish River, South Fork	Downstream of confluence of Tye and Foss Rivers
Snohomish River	Down stream of confluence of Snoqualmie and Skykomish Rivers
Snohomish River Estuary	
Snoqualmie River	Downstream of confluence of the Middle Fork
Snoqualmie River, Middle Fork	Downstream of confluence with Rainy Creek
Sol Duc River	Downstream of confluence of North and South Fork Soleduck River
Stillaguamish River	Downstream of confluence of North and South Fork
Stillaguamish River, North Fork	7.7 highway miles west of Darrington on SR530, downstream of confluence with French Creek.
Stillaguamish River, South Fork	Downstream of confluence of Cranberry Creek and South Fork
Suiattle River	Downstream of confluence with Milk Creek
Sultan River	0.4 miles upstream of SR2
Swift Creek Reservoir	
Thunder Creek	Downstream of the confluence with Neve Creek

Water Body	**Upstream Point/Reach for Exemption** (if applicable)
Tilton River	Downstream of confluence with North Fork Tilton River
Toutle River	North and South Fork Confluence
Toutle River, North Fork	Downstream of confluence with Hoffstadt Creek
Toutle River, South Fork	Downstream of confluence with Thirteen Creek
Union Bay	
Vancouver Lake	
White River	Downstream of confluence with Huckleberry Creek
Willapa River	Downstream of confluence with Mill Creek
Wind River	Downstream of confluence with Cold Creek
Wynochee Lake	
Wynoochee River	Downstream of confluence with Schafer Creek

Appendix I-F Basins with 40% or more total impervious area as of 1985

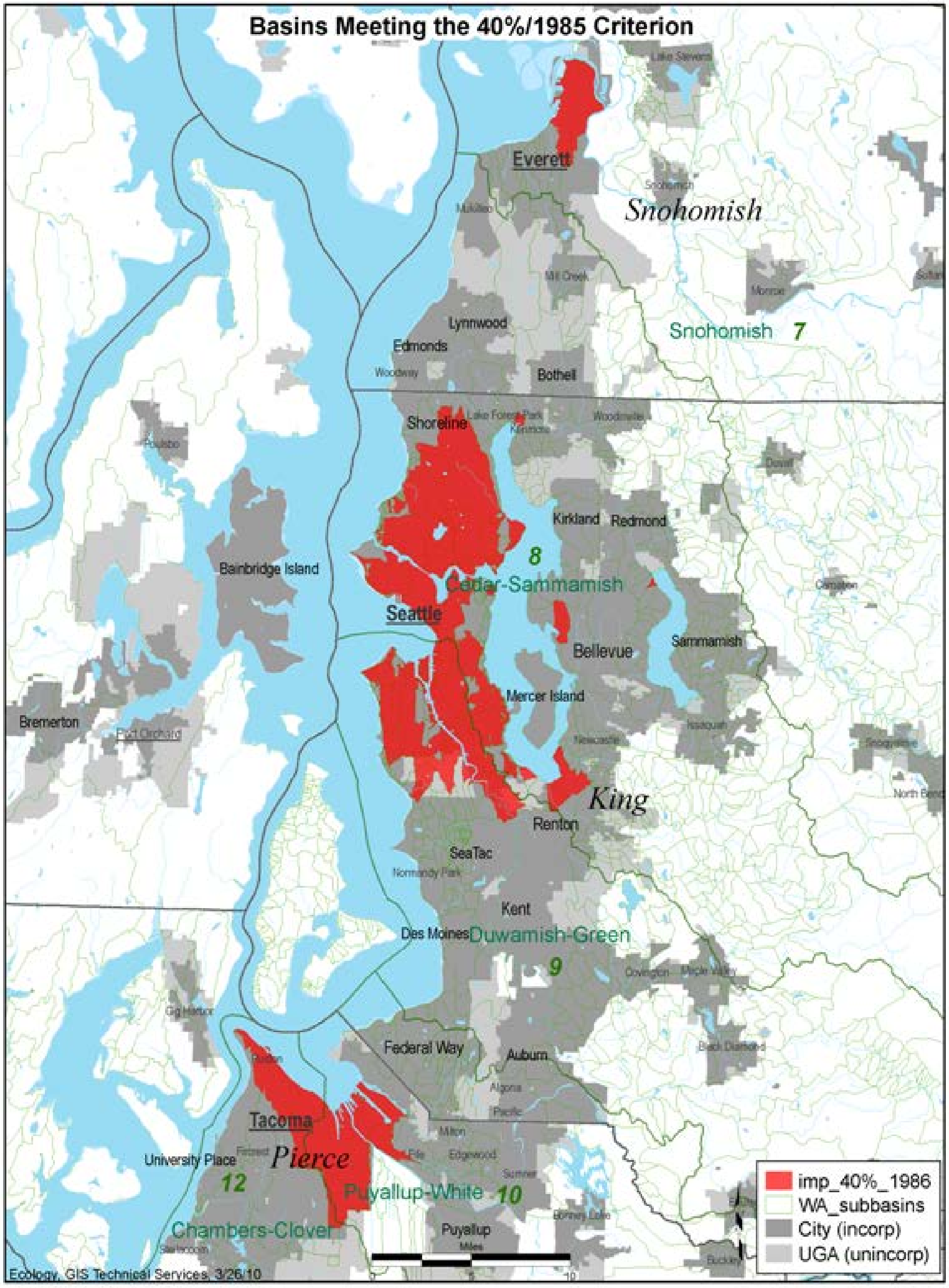

Figure F.1 – Basins with 40% total impervious area as of 1985

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Appendix G Glossary and Notations

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/Variances.

Adsorption The adhesion of a substance to the surface of a solid or liquid; often used to extract pollutants by causing them to be attached to such adsorbents as activated carbon or silica gel. Hydrophobic, or water-repulsing adsorbents, are used to extract oil from waterways when oil spills occur. Heavy metals such as zinc and lead often adsorb onto sediment particles.

Aeration The process of being supplied or impregnated with air. In waste treatment, the process used to foster biological and chemical purification. In soils, the process by which air in the soil is replenished by air from the atmosphere. In a well aerated soil, the soil air is similar in composition to the atmosphere above the soil. Poorly aerated soils usually contain a much higher percentage of carbon dioxide and a correspondingly lower percentage of oxygen.

Aerobic Living or active only in the presence of free (dissolved or molecular) oxygen.

Aerobic bacteria Bacteria that require the presence of free oxygen for their metabolic processes.

Aggressive plant species	Opportunistic species of inferior biological value that tend to out-compete more desirable forms and become dominant; applied to native species in this manual.
Algae	Primitive plants, many microscopic, containing chlorophyll and forming the base of the food chain in aquatic environments. Some species may create a nuisance when environmental conditions are suitable for prolific growth.
Algal bloom	Proliferation of living algae on the surface of lakes, streams or ponds; often stimulated by phosphate over-enrichment. Algal blooms reduce the oxygen available to other aquatic organisms.
American Public Works Association (APWA)	The Washington State Chapter of the American Public Works Association.
Anadromous	Fish that grow to maturity in the ocean and return to rivers for spawning.
Anaerobic	Living or active in the absence of oxygen.
Anaerobic bacteria	Bacteria that do not require the presence of free or dissolved oxygen for metabolism.
Annual flood	The highest peak discharge on average which can be expected in any given year.
Antecedent moisture conditions	The degree of wetness of a watershed or within the soil at the beginning of a storm.
Anti-seep collar	A device constructed around a pipe or other conduit and placed through a dam, levee, or dike for the purpose of reducing seepage losses and piping failures.
Anti-vortex device	A facility placed at the entrance to a pipe conduit structure such as a drop inlet spillway or hood inlet spillway to prevent air from entering the structure when the pipe is flowing full.
Applicable BMPs	As used in Volume IV, applicable BMPs are those source control BMPs that are expected to be required by local governments at new development and redevelopment sites. Applicable BMPs will also be required if they are incorporated into NPDES permits, or they are included by local governments in a stormwater program for existing facilities.
Applicant	The person who has applied for a development permit or approval.
Appurtenances	Machinery, appliances, or auxiliary structures attached to a main structure, but not considered an integral part thereof, for the purpose of enabling it to function.
Aquifer	A geologic stratum containing ground water that can be withdrawn and used for human purposes.

Arterial	A road or street primarily for through traffic. The term generally includes roads or streets considered collectors. It does not include local access roads which are generally limited to providing access to abutting property. See also RCW 35.78.010, RCW 36.86.070, and RCW 47.05.021.
As-built drawings	Engineering plans which have been revised to reflect all changes to the plans which occurred during construction.
As-graded	The extent of surface conditions on completion of grading.
BSBL	See Building set back line.
Background	A description of pollutant levels arising from natural sources, and not because of man's immediate activities.
Backwater	Water upstream from an obstruction which is deeper than it would normally be without the obstruction.
Baffle	A device to check, deflect, or regulate flow.
Bankfull discharge	A flow condition where streamflow completely fills the stream channel up to the top of the bank. In undisturbed watersheds, the discharge conditions occur on average every 1.5 to 2 years and controls the shape and form of natural channels.
Base flood	A flood having a one percent chance of being equaled or exceeded in any given year. This is also referred to as the 100-year flood.
Base flood elevation	The water surface elevation of the base flood. It shall be referenced to the National Geodetic Vertical Datum of 1929 (NGVD).
Baseline sample	A sample collected during dry-weather flow (i.e., it does not consist of runoff from a specific precipitation event).
Basin plan	A plan that assesses, evaluates, and proposes solutions to existing and potential future impacts to the beneficial uses of, and the physical, chemical, and biological properties of waters of the state within a basin. Basins typically range in size from 1 to 50 square miles. A plan should include but not be limited to recommendations for: • Stormwater requirements for new development and redevelopment; • Capital improvement projects; • Land Use management through identification and protection of critical areas, comprehensive land use and transportation plans, zoning regulations, site development standards, and conservation areas; • Source control activities including public education and involvement, and business programs; • Other targeted stormwater programs and activities, such as maintenance, inspections and enforcement;

- Monitoring; and
- An implementation schedule and funding strategy.

A plan that is "adopted and implemented" must have the following characteristics:

- It must be adopted by legislative or regulatory action of jurisdictions with responsibilities under the plan;
- Ordinances, regulations, programs, and procedures recommended by the plan should be in effect or on schedule to be in effect; and,
- An implementation schedule and funding strategy that are in progress.

Bearing capacity The maximum load that a material can support before failing.

Bedrock The more or less solid rock in place either on or beneath the surface of the earth. It may be soft, medium, or hard and have a smooth or irregular surface.

Bench A relatively level step excavated into earth material on which fill is to be placed.

Berm A constructed barrier of compacted earth, rock, or gravel. In a stormwater facility, a berm may serve as a vertical divider typically built up from the bottom.

Best management practice (BMP) The schedules of activities, prohibitions of practices, maintenance procedures, and structural and/or managerial practices, that when used singly or in combination, prevent or reduce the release of pollutants and other adverse impacts to waters of Washington State.

Biochemical oxygen demand (BOD) An indirect measure of the concentration of biologically degradable materials present in organic wastes. The amount of free oxygen utilized by aerobic organisms when allowed to attack the organic material in an aerobically maintained environment at a specified temperature (20°C) for a specific time period (5 days), and thus stated as BOD5. It is expressed in milligrams of oxygen utilized per liter of liquid waste volume (mg/l) or in milligrams of oxygen per kilogram of waste solution (mg/kg = ppm = parts per million parts). Also called biological oxygen demand.

Biodegradable Capable of being readily broken down by biological means, especially by microbial action. Microbial action includes the combined effect of bacteria, fungus, flagellates, amoebae, ciliates, and nematodes. Degradation can be rapid or may take many years depending upon such factors as available oxygen and moisture.

Bioengineering The combination of biological, mechanical, and ecological concepts (and methods) to control erosion and stabilize soil through the use of vegetation or in combination with construction materials.

Biofilter A designed treatment facility using a combined soil and vegetation system for filtration, infiltration, adsorption, and biological uptake of pollutants in stormwater when runoff flows over and through. Vegetation growing in these facilities acts as both a physical filter which causes gravity settling of particulates by regulating velocity of flow, and also as a biological sink when direct uptake of dissolved pollutants occurs. The former mechanism is probably the most important in western Washington where the period of major runoff coincides with the period of lowest biological activity.

Biofiltration The process of reducing pollutant concentrations in water by filtering the polluted water through biological materials.

Biological control A method of controlling pest organisms by means of introduced or naturally occurring predatory organisms, sterilization, the use of inhibiting hormones, or other means, rather than by mechanical or chemical means.

Biological magnification The increasing concentration of a substance along succeeding steps in a food chain. Also called biomagnification.

Bioretention BMP Engineered facilities that store and treat stormwater by passing it through a specified soil profile, and either retain or detain the treated stormwater for flow attenuation. Refer to Chapter 7 of Volume V for Bioretention BMP types and design specifications.

Biosolids Municipal sewage sludge that is a primarily organic, semisolid product resulting from the wastewater treatment process, that can be beneficially recycled and meets all applicable requirements under Chapter 173-308 WAC. Biosolids includes a material derived from biosolids, and septic tank sludge, also known as septage, that can be beneficially recycled and meets all applicable requirements under Chaper 173-308 WAC. For the purposes of Chapter 173-308 WAC, semisolid products include biosolids or products derived from biosolids ranging in character from mostly liquid to fully dried solids.

Bollard A post (may or may not be removable) used to prevent vehicular access.

Bond A surety bond, cash deposit or escrow account, assignment of savings, irrevocable letter of credit or other means acceptable to or required by the manager to guarantee that work is completed in compliance with the project's drainage plan and in compliance with all local government requirements.

Borrow area A source of earth fill material used in the construction of embankments or other earth fill structures.

Buffer The zone contiguous with a sensitive area that is required for the continued maintenance, function, and structural stability of the sensitive area. The critical functions of a riparian buffer (those

	associated with an aquatic system) include shading, input of organic debris and coarse sediments, uptake of nutrients, stabilization of banks, interception of fine sediments, overflow during high water events, protection from disturbance by humans and domestic animals, maintenance of wildlife habitat, and room for variation of aquatic system boundaries over time due to hydrologic or climatic effects. The critical functions of terrestrial buffers include protection of slope stability, attenuation of surface water flows from stormwater runoff and precipitation, and erosion control.
Building setback line (BSBL)	A line measured parallel to a property, easement, drainage facility, or buffer boundary, that delineates the area (defined by the distance of separation) where buildings or other obstructions are prohibited (including decks, patios, outbuildings, or overhangs beyond 18 inches). Wooden or chain link fences and landscaping are allowable within a building setback line. In this manual the minimum building setback line shall be 5 feet.
CIP	See Capital Improvement Project.
Capital Improvement Project or Program (CIP)	A project prioritized and scheduled as a part of an overall construction program or, the actual construction program.
Catch basin	A chamber or well, usually built at the curb line of a street, for the admission of surface water to a sewer or subdrain, having at its base a sediment sump designed to retain grit and detritus below the point of overflow.
Catchline	The point where a severe slope intercepts a different, more gentle slope.
Catchment	Surface drainage area.
Cation Exchange Capacity (CEC)	The amount of exchangeable cations that a soil can absorb. Units are milli-equivalents per 100 g of soil, typically abbreviated simply as meq. Soil found to have a CEC of 5 meq at pH 7 will have CEC < 5 meq when pH < 7..
CESCL	See Certified Erosion and Sediment Control Lead
Certified Erosion and Sediment Control Lead (CESCL)	An individual who has current certification through an approved erosion and sediment control training program that meets the minimum training standards established by Ecology (see BMP C160 of Volume II). A CESCL is knowledgeable in the principles and practices of erosion and sediment control. The CESCL must have the skills to assess site conditions and construction activities that could impact the quality of stormwater and, the effectiveness of erosion and sediment control measures used to control the quality of stormwater discharges. Certification is obtained through an Ecology approved erosion and sediment control course. Course listings are provided online at Ecology's website.

Channel	A feature that conveys surface water and is open to the air.
Channel, constructed	Channels or ditches constructed (or reconstructed natural channels) to convey surface water.
Channel, natural	Streams, creeks, or swales that convey surface/ground water and have existed long enough to establish a stable route and/or biological community.
Channel stabilization	Erosion prevention and stabilization of velocity distribution in a channel using vegetation, jetties, drops, revetments, and/or other measures.
Channel storage	Water temporarily stored in channels while enroute to an outlet.
Channelization	Alteration of a stream channel by widening, deepening, straightening, cleaning, or paving certain areas to change flow characteristics.
Check dam	Small dam constructed in a gully or other small watercourse to decrease the streamflow velocity, minimize channel scour, and promote deposition of sediment.
Chemical oxygen demand (COD)	A measure of the amount of oxygen required to oxidize organic and oxidizable inorganic compounds in water. The COD test, like the BOD test, is used to determine the degree of pollution in water.
Civil engineer	A professional engineer licensed in the State of Washington in Civil Engineering.
Civil engineering	The application of the knowledge of the forces of nature, principles of mechanics and the properties of materials to the evaluation, design and construction of civil works for the beneficial uses of mankind.
Clay lens	A naturally occurring, localized area of clay which acts as an impermeable layer to runoff infiltration.
Clearing	The destruction and removal of vegetation by manual, mechanical, or chemical methods.
Closed depression	An area which is low-lying and either has no, or such a limited, surface water outlet that during storm events the area acts as a retention basin.
Cohesion	The capacity of a soil to resist shearing stress, exclusive of functional resistance.
Coliform bacteria	Microorganisms common in the intestinal tracts of man and other warm-blooded animals; all the aerobic and facultative anaerobic, gram-negative, nonspore-forming, rod-shaped bacteria which ferment lactose with gas formation within 48 hours at 35°C. Used as an indicator of bacterial pollution.
Commercial agriculture	Those activities conducted on lands defined in RCW 84.34.020(2), and activities involved in the production of crops or livestock for commercial trade. An activity ceases to be considered commercial

agriculture when the area on which it is conducted is proposed for conversion to a nonagricultural use or has lain idle for more than five (5) years, unless the idle land is registered in a federal or state soils conservation program, or unless the activity is maintenance of irrigation ditches, laterals, canals, or drainage ditches related to an existing and ongoing agricultural activity.

Common Plan of Development or Sale A site where multiple separate and distinct construction activities may be taking place at different times on different schedules and/or by different contractors, but still under a single plan. Examples include: 1) phase projects and projects with multiple filings or lots, even if the separate phases or filings/lots will be constructed under separate contract or by separate owners (e.g., a development where lots are sold to separate builders); 2) a development plan that may be phased over multiple years, but is still under a consistent plan for long-term development; 3) projects in a contiguous area that may be unrelated but still under the same contract, such as construction of a building extension and a new parking lot at the same facility; and 4) linear projects such as roads, pipelines, or utilities. If the project is part of a common plan of development or sale, the disturbed area of the entire plan must be used in determine permit requirements.

Compaction The densification, settlement, or packing of soil in such a way that permeability of the soil is reduced. Compaction effectively shifts the performance of a hydrologic group to a lower permeability hydrologic group. For example, a group B hydrologic soil can be compacted and be effectively converted to a group C hydrologic soil in the way it performs in regard to runoff.

Compaction may also refer to the densification of a fill by mechanical means.

Compensatory storage New excavated storage volume equivalent to the flood storage capacity eliminated by filling or grading within the flood fringe. Equivalent shall mean that the storage removed shall be replaced by equal volume between corresponding one-foot contour intervals that are hydraulically connected to the floodway through their entire depth.

Compost Organic material 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 createdon 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 catch-basins 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.

Discharge Point The location where a discharge leaves the Permittee's MS4 through the Permittee's MS4 facilities/BMPs designed to infiltrate.

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 review An evaluation by Plan Approving Authority staff of a proposed project's compliance with the drainage requirements in this manual or its technical equivalent.

Drainage, Soil As a natural condition of the soil, soil drainage refers to the frequency and duration of periods when the soil is free of saturation; for example, in well-drained soils the water is removed readily but not rapidly; in poorly drained soils the root zone is waterlogged for long periods unless artificially drained, and the roots of ordinary crop plants cannot get enough oxygen; in excessively drained soils the water is removed so completely that most crop plants suffer from lack of water. Strictly speaking, excessively drained soils are a result of excessive runoff due to steep slopes or low available water-holding capacity due to small amounts of silt and clay in the soil material. The following classes are used to express soil drainage:

Well drained - Excess water drains away rapidly and no mottling occurs within 36 inches of the surface.

- Moderately well drained - Water is removed from the soil somewhat slowly, resulting in small but significant periods of wetness. Mottling occurs between 18 and 36 inches.
- Somewhat poorly drained - Water is removed from the soil slowly enough to keep it wet for significant periods but not all of the time. Mottling occurs between 8 and 18 inches.
- Poorly drained - Water is removed so slowly that the soil is wet for a large part of the time. Mottling occurs between 0 and 8 inches.

- Very poorly drained - Water is removed so slowly that the water table remains at or near the surface for the greater part of the time. There may also be periods of surface ponding. The soil has a black to gray surface layer with mottles up to the surface.

Drawdown — Lowering of the water surface (in open channel flow), water table or piezometric surface (in ground water flow) resulting from a withdrawal of water.

Drop-inlet spillway — Overall structure in which the water drops through a vertical riser connected to a discharge conduit.

Drop spillway — Overall structure in which the water drops over a vertical wall onto an apron at a lower elevation.

Drop structure — A structure for dropping water to a lower level and dissipating its surplus energy; a fall. A drop may be vertical or inclined.

Dry weather flow — The combination of ground water seepage and allowed non-stormwater flows found in storm sewers during dry weather. Also that flow in streams during the dry season.

EIS — See Environmental Impact Statement.

ESC — Erosion and Sediment Control (Plan).

Earth material — Any rock, natural soil or fill and/or any combination thereof. Earth material shall not be considered topsoil used for landscape purposes. Topsoil used for landscaped purposes shall comply with ASTM D 5268 specifications. Engineered soil/landscape systems are also defined independently.

Easement — The legal right to use a parcel of land for a particular purpose. It does not include fee ownership, but may restrict the owners use of the land.

Effective Impervious Surface — Those impervious surfaces that are connected via sheet flow or discrete conveyance to a drainage system. Impervious surfaces are considered ineffective if: 1) the runoff is dispersed through at least one hundred feet of native vegetation in accordance with BMP T5.30 – “Full Dispersion” as described in Chapter 5 of Volume V; 2) residential roof runoff is infiltrated in accordance with Downspout Full Infiltration Systems in BMP 5.10A Volume III; or 3) approved continuous runoff modeling methods indicate that the entire runoff file is infiltrated.

Embankment — A structure of earth, gravel, or similar material raised to form a pond bank or foundation for a road.

Emergent plants — Aquatic plants that are rooted in the sediment but whose leaves are at or above the water surface. These wetland plants often have high habitat value for wildlife and waterfowl, and can aid in pollutant uptake.

Emergency spillway — A vegetated earth channel used to safely convey flood discharges in excess of the capacity of the principal spillway.

Emerging technology Treatment technologies that have not been evaluated with approved protocols, but for which preliminary data indicate that they may provide a necessary function(s) in a stormwater treatment system. Emerging technologies need additional evaluation to define design criteria to achieve, or to contribute to achieving, state performance goals, and to define the limits of their use.

Energy dissipater Any means by which the total energy of flowing water is reduced. In stormwater design, they are usually mechanisms that reduce velocity prior to, or at, discharge from an outfall in order to prevent erosion. They include rock splash pads, drop manholes, concrete stilling basins or baffles, and check dams.

Energy gradient The slope of the specific energy line (i.e., the sum of the potential and velocity heads).

Engineered soil/ landscape system This is a self-sustaining soil and plant system that simultaneously supports plant growth, soil microbes, water infiltration, nutrient and pollutant adsorption, sediment and pollutant biofiltration, water interflow, and pollution decomposition. The system shall be protected from compaction and erosion. The system shall be planted and/or mulched as part of the installation.

The engineered soil/plant system shall have the following characteristics:

a. Be protected from compaction and erosion.

b. Have a plant system to support a sustained soil quality.

c. Possess permeability characteristics of not less than 6.0, 2.0, and 0.6 inches/hour for hydrologic soil groups A, B, and C, respectively (per ASTM D 3385). D is less than 0.6 inches/hour.

d. Possess minimum percent organic matter of 12, 14, 16, and 18 percent (dry-weight basis) for hydrologic soil groups A, B, C, and D, respectively (per ASTM D 2974).

Engineering geology The application of geologic knowledge and principles in the investigation and evaluation of naturally occurring rock and soil for use in the design of civil works.

Engineering plan A plan prepared and stamped by a professional civil engineer.

Enhancement To raise value, desirability, or attractiveness of an environment associated with surface water.

Environmental Impact Statement (EIS) A document that discusses the likely significant adverse impacts of a proposal, ways to lessen the impacts, and alternatives to the proposal. They are required by the national and state environmental policy acts when projects are determined to have significant environmental impact.

Erodible granular soils Soil materials that are easily eroded and transported by running water, typically fine or medium grained sand with minor gravel, silt, or clay content. Such soils are commonly described as Everett or Indianola series soil types in the SCS classification. Also included are any soils showing examples of existing severe stream channel incision as indicated by unvegetated streambanks standing over two feet high above the base of the channel.

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

Erosion The wearing away of the land surface by running water, wind, ice, or other geological agents, including such processes as gravitational creep. Also, detachment and movement of soil or rock fragments by water, wind, ice, or gravity. The following terms are used to describe different types of water erosion:

Accelerated erosion - Erosion much more rapid than normal or geologic erosion, primarily as a result of the influence of the activities of man or, in some cases, of the animals or natural catastrophes that expose bare surfaces (e.g., fires).

- Geological erosion - The normal or natural erosion caused by geological processes acting over long geologic periods and resulting in the wearing-away of mountains, the building up of floodplains, coastal plains, etc. Synonymous with natural erosion.
- Gully erosion - The erosion process whereby water accumulates in narrow channels and, over short periods, removes the soil from this narrow area to considerable depths, ranging from 1 to 2 feet to as much as 75 to 100 feet.
- Natural erosion - Wearing away of the earth's surface by water, ice, or other natural agents under natural environmental conditions of climate, vegetation, etc., undisturbed by man. Synonymous with geological erosion.
- Normal erosion - The gradual erosion of land used by man which does not greatly exceed natural erosion.
- Rill erosion - An erosion process in which numerous small channels only several inches deep are formed; occurs mainly on recently disturbed and exposed soils. See Rill.
- Sheet erosion - The removal of a fairly uniform layer of soil from the land surface by runoff.
- Splash erosion - The spattering of small soil particles caused by the impact of raindrops on wet soils. The loosened and spattered

particles may or may not be subsequently removed by surface runoff.

Erosion classes (soil survey)	A grouping of erosion conditions based on the degree of erosion or on characteristic patterns. Applied to accelerated erosion, not to normal, natural, or geological erosion. Four erosion classes are recognized for water erosion and three for wind erosion.
Erosion and sedimentation control	Any temporary or permanent measures taken to reduce erosion; control siltation and sedimentation; and ensure that sediment-laden water does not leave the site.
Erosion and sediment control facility	A type of drainage facility designed to hold water for a period of time to allow sediment contained in the surface and stormwater runoff directed to the facility to settle out so as to improve the quality of the runoff.
Escarpment	A steep face or a ridge of high land.
Estuarine wetland	Generally, an eelgrass bed; salt marsh; or rocky, sandflat, or mudflat intertidal area where fresh and salt water mix. (Specifically, a tidal wetland with salinity greater than 0.5 parts per thousand, usually semi-enclosed by land but with partially obstructed or sporadic access to the open ocean).
Estuary	An area where fresh water meets salt water, or where the tide meets the river current (e.g., bays, mouths of rivers, salt marshes, and lagoons). Estuaries serve as nurseries and spawning and feeding grounds for large groups of marine life and provide shelter and food for birds and wildlife.
Eutrophication	Refers to the process where nutrient over-enrichment of water leads to excessive growth of aquatic plants, especially algae.
Evapotranspiration	The collective term for the processes of evaporation and plant transpiration by which water is returned to the atmosphere.
Excavation	The mechanical removal of earth material.
Exception	Relief from the application of a Minimum Requirement to a project.
Exfiltration	The downward movement of runoff through the bottom of an infiltration BMP into the soil layer or the downward movement of water through soil.
FIRM	See Flood Insurance Rate Map.
Fertilizer	Any material or mixture used to supply one or more of the essential plant nutrient elements.
Fill	A deposit of earth material placed by artificial means.
Filter fabric	A woven or nonwoven, water-permeable material generally made of synthetic products such as polypropylene and used in stormwater

management and erosion and sediment control applications to trap sediment or prevent the clogging of aggregates by fine soil particles.

Filter fabric fence — A temporary sediment barrier consisting of a filter fabric stretched across and attached to supporting posts and entrenched. The filter fence is constructed of stakes and synthetic filter fabric with a rigid wire fence backing where necessary for support. Also commonly referred to in the Washington Department of Transportation standard specifications as "construction geotextile for temporary silt fences."

Filter strip — A grassy area with gentle slopes that treats stormwater runoff from adjacent paved areas before it concentrates into a discrete channel.

Flocculation — The process by which suspended colloidal or very fine particles are assembled into larger masses or floccules which eventually settle out of suspension. This process occurs naturally but can also be caused through the use of such chemicals as alum.

Flood — An overflow or inundation that comes from a river or any other source, including (but not limited to) streams, tides, wave action, storm drains, or excess rainfall. Any relatively high stream flow overtopping the natural or artificial banks in any reach of a stream.

Flood control — Methods or facilities for reducing flood flows and the extent of flooding.

Flood control project — A structural system installed to protect land and improvements from floods by the construction of dikes, river embankments, channels, or dams.

Flood frequency — The frequency with which the flood of interest may be expected to occur at a site in any average interval of years. Frequency analysis defines the "n-year flood" as being the flood that will, over a long period of time, be equaled or exceeded on the average once every "n" years.

Flood fringe — That portion of the floodplain outside of the floodway which is covered by floodwaters during the base flood; it is generally associated with slower moving or standing water rather than rapidly flowing water.

Flood hazard areas — Those areas subject to inundation by the base flood. Includes, but is not limited to streams, lakes, wetlands, and closed depressions.

Flood Insurance Rate Map (FIRM) — The official map on which the Federal Emergency Management Agency has delineated many areas of flood hazard, floodway, and the risk premium zones.

Flood Insurance Study — The official report provided by the Federal Emergency Management Agency that includes flood profiles and the FIRM.

Flood peak — The highest value of the stage or discharge attained by a flood; thus, peak stage or peak discharge.

Floodplain	The total area subject to inundation by a flood including the flood fringe and floodway.
Flood-proofing	Adaptations that ensure a structure is substantially impermeable to the passage of water below the flood protection elevation that resists hydrostatic and hydrodynamic loads and effects of buoyancy.
Flood protection elevation	The base flood elevation or higher as defined by the local government.
Flood protection facility	Any levee, berm, wall, enclosure, raise bank, revetment, constructed bank stabilization, or armoring, that is commonly recognized by the community as providing significant protection to a property from inundation by flood waters.
Flood routing	An analytical technique used to compute the effects of system storage dynamics on the shape and movement of flow represented by a hydrograph.
Flood stage	The stage at which overflow of the natural banks of a stream begins.
Floodway	The channel of the river or stream and those portions of the adjoining floodplains that are reasonably required to carry and discharge the base flood flow. The portions of the adjoining floodplains which are considered to be "reasonably required" is defined by flood hazard regulations.
Flow control BMP (or facility)	A drainage facility designed to mitigate the impacts of increased surface and stormwater runoff flow rates generated by development. Flow control facilities are designed either to hold water for a considerable length of time and then release it by evaporation, plant transpiration, and/or infiltration into the ground, or to hold runoff for a short period of time, releasing it to the conveyance system at a controlled rate.
Flow duration	The aggregate time that peak flows are at or above a particular flow rate of interest. For example, the amount of time that peak flows are at or above 50% of the 2-year peak flow rate for a period of record.
Flow frequency	The inverse of the probability that the flow will be equaled or exceeded in any given year (the exceedance probability). For example, if the exceedance probability is 0.01 or 1 in 100, that flow is referred to as the 100-year flow.
Flow path	The route that stormwater runoff follows between two points of interest.
Forebay	An easily maintained, extra storage area provided near an inlet of a BMP to trap incoming sediments before they accumulate in a pond or wetland BMP.
Forest practice	Any activity conducted on or directly pertaining to forest land and relating to growing, harvesting, or processing timber, including but not limited to:

a. Road and trail construction.

b. Harvesting, final and intermediate.

c. Precommercial thinning.

d. Reforestation.

e. Fertilization.

f. Prevention and suppression of diseases and insects.

g. Salvage of trees.

h. Brush control.

Forested communities (wetlands) In general terms, communities (wetlands) characterized by woody vegetation that is greater than or equal to 6 meters in height; in this manual the term applies to such communities (wetlands) that represent a significant amount of tree cover consisting of species that offer wildlife habitat and other values and advance the performance of wetland functions overall.

Freeboard The vertical distance between the highest designed water surface elevation and the elevation of the crest of the facility. For example, in pond design, freeboard is the vertical distance between the emergency overflow water surface and the top of the pond embankment.

Frequently flooded areas The 100-year floodplain designations of the Federal Emergency Management Agency and the National Flood Insurance Program or as defined by the local government.

Frost-heave The upward movement of soil surface due to the expansion of water stored between particles in the first few feet of the soil profile as it freezes. May cause surface fracturing of asphalt or concrete.

Frequency of storm (design storm frequency) The anticipated period in years that will elapse, based on average probability of storms in the design region, before a storm of a given intensity and/or total volume will recur; thus a 10-year storm can be expected to occur on the average once every 10 years. Sewers designed to handle flows that occur under such storm conditions would be expected to be surcharged by any storms of greater amount or intensity.

Fully controlled limited access highway A highway where the right of owner or occupants of abutting land or other persons to access, light, air, or view in connection with the highway is controlled to give preference to through traffic by providing access connections with selected public roads only, and by prohibiting crossings or direct private driveway connections at grade. (See WAC 468-58-010)

Function(s) The ecological (physical, chemical, and biological) processes or attributes of a wetland without regard for their importance to society (see also values). Wetland functions include food chain support, provision of ecosystem diversity and fish and wildlife habitat, floodflow alteration, ground water recharge and discharge, water quality improvement, and soil stabilization.

Gabion A rectangular or cylindrical wire mesh cage (a chicken wire basket) filled with rock and used as a protecting agent, revetment, etc., against erosion. Soft gabions, often used in streambank stabilization, are made of geotextiles filled with dirt, in between which cuttings are placed.

Gage or gauge Device for registering precipitation, water level, discharge, velocity, pressure, temperature, etc. Also, a measure of the thickness of metal; e.g., diameter of wire, wall thickness of steel pipe.

Gaging station A selected section of a stream channel equipped with a gage, recorder, or other facilities for determining stream discharge.

Geologist A person who has earned a degree in geology from an accredited college or university or who has equivalent educational training and has at least five years of experience as a practicing geologist or four years of experience and at least two years post-graduate study, research or teaching. The practical experience shall include at least three years work in applied geology and landslide evaluation, in close association with qualified practicing geologists or geotechnical professional/civil engineers.

Geologically hazardous areas Areas that because of their susceptibility to erosion, sliding, earthquake, or other geological events, are not suited to the siting of commercial, residential, or industrial development consistent with public health or safety concerns.

Geometrics The mathematical relationships between points, lines, angles, and surfaces used to measure and identify areas of land.

Geotechnical professional civil engineer A practicing, geotechnical/civil engineer licensed as a professional Civil Engineer with the State of Washington who has at least four years of professional employment as a geotechnical engineer in responsible charge, including experience with landslide evaluation.

Grade The slope of a road, channel, or natural ground. The finished surface of a canal bed, roadbed, top of embankment, or bottom of excavation; any surface prepared for the support of construction such as paving or the laying of a conduit.

(To) Grade To finish the surface of a canal bed, roadbed, top of embankment or bottom of excavation.

Gradient terrace An earth embankment or a ridge-and-channel constructed with suitable spacing and an acceptable grade to reduce erosion damage by intercepting surface runoff and conducting it to a stable outlet at a stable nonerosive velocity.

Grassed waterway A natural or constructed waterway, usually broad and shallow, covered with erosion-resistant grasses, used to conduct surface water from an area at a reduced flow rate. See also biofilter.

Ground water	Water in a saturated zone or stratum beneath the land surface or a surface waterbody.
Ground water recharge	Inflow to a ground water reservoir.
Ground water table	The free surface of the ground water, that surface subject to atmospheric pressure under the ground, generally rising and falling with the season, the rate of withdrawal, the rate of restoration, and other conditions. It is seldom static.
Gully	A channel caused by the concentrated flow of surface and stormwater runoff over unprotected erodible land.
Habitat	The specific area or environment in which a particular type of plant or animal lives. An organism's habitat must provide all of the basic requirements for life and should be protected from harmful biological, chemical, and physical alterations.
Hardpan	A cemented or compacted and often clay-like layer of soil that is impenetrable by roots. Also known as glacial till.
Hard Surface	An impervious surface, a permeable pavement, or a vegetated roof.
Harmful pollutant	A substance that has adverse effects to an organism including immediate death, chronic poisoning, impaired reproduction, cancer or other effects.
Head (hydraulics)	The height of water above any plane of reference. The energy, either kinetic or potential, possessed by each unit weight of a liquid, expressed as the vertical height through which a unit weight would have to fall to release the average energy possessed. Used in various compound terms such as pressure head, velocity head, and head loss.
Head loss	Energy loss due to friction, eddies, changes in velocity, or direction of flow.
Heavy metals	Metals of high specific gravity, present in municipal and industrial wastes, that pose long-term environmental hazards. Such metals include cadmium, chromium, cobalt, copper, lead, mercury, nickel, and zinc.
High-use site	High-use sites are those that typically generate high concentrations of oil due to high traffic turnover or the frequent transfer of oil. High-use sites include: • An area of a commercial or industrial site subject to an expected average daily traffic (ADT) count equal to or greater than 100 vehicles per 1,000 square feet of gross building area; • An area of a commercial or industrial site subject to petroleum storage and transfer in excess of 1,500 gallons per year, not including routinely delivered heating oil;

- An area of a commercial or industrial site subject to parking, storage or maintenance of 25 or more vehicles that are over 10 tons gross weight (trucks, buses, trains, heavy equipment, etc.);
- A road intersection with a measured ADT count of 25,000 vehicles or more on the main roadway and 15,000 vehicles or more on any intersecting roadway, excluding projects proposing primarily pedestrian or bicycle use improvements.

Highway A main public road connecting towns and cities.

Hog fuel Wood-based mulch.

Horton overland flow A runoff process whereby the rainfall rate exceeds the infiltration rate, so that the precipitation that does not infiltrate flows downhill over the soil surface.

HSPF **Hydrological Simulation Program-Fortran.** A continuous simulation hydrologic model that transforms an uninterrupted rainfall record into a concurrent series of runoff or flow data by means of a set of mathematical algotrithms 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 permeability coefficient

Hydraulic gradient Slope of the potential head relative to a fixed datum.

Hydrodynamics Means the dynamic energy, force, or motion of fluids as affected by the physical forces acting upon those fluids.

Hydrograph A graph of runoff rate, inflow rate or discharge rate, past a specific point over time.

Hydrologic cycle The circuit of water movement from the atmosphere to the earth and return to the atmosphere through various stages or processes as precipitation, interception, runoff, infiltration, percolation, storage, evaporation, and transpiration.

Hydrologic Soil Groups A soil characteristic classification system defined by the U.S. Soil Conservation Service in which a soil may be categorized into one of four soil groups (A, B, C, or D) based upon infiltration rate and other properties.

<u>Type A:</u> Low runoff potential. Soils having high infiltration rates, even when thoroughly wetted, and consisting chiefly of deep, well drained to excessively drained sands or gravels. These soils have a high rate of water transmission.

<u>Type B:</u> Moderately low runoff potential. Soils having moderate infiltration rates when thoroughly wetted, and consisting chiefly of

moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission.

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.

Impact basin A device used to dissipate the energy of flowing water. Generally constructed of concrete in the form of a partially depressed or partially submerged vessel, it may utilize baffles to dissipate velocities.

Impervious A surface which cannot be easily penetrated. For instance, rain does not readily penetrate paved surfaces.

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

Impoundment A natural or man-made containment for surface water.

Improvement Streets (with or without curbs or gutters), sidewalks, crosswalks, parking lots, water mains, sanitary and storm sewers, drainage facilities, street trees and other appropriate items.

Industrial activities Material handling, transportation, or storage; manufacturing; maintenance; treatment; or disposal. Areas with industrial activities include plant yards, access roads and rail lines used by carriers of raw materials, manufactured products, waste material, or by-products; material handling sites; refuse sites; sites used for the application or disposal of process waste waters; sites used for the storage and maintenance of material handling equipment; sites used for residual treatment, storage, or disposal; shipping and receiving areas; manufacturing buildings; storage areas for raw materials, and intermediate and finished products; and areas where industrial activity has taken place in the past and significant materials remain and are exposed to stormwater.

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. 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.
Landslide	Episodic downslope movement of a mass of soil or rock that includes but is not limited to rockfalls, slumps, mudflows, and earthflows. For the purpose of these rules, snow avalanches are considered to be a special case of landsliding.
Landslide hazard areas	Those areas subject to a severe risk of landslide.
Leachable materials	Those substances that, when exposed to rainfall, measurably alter the physical or chemical characteristics of the rainfall runoff. Examples

include erodible soils, uncovered process wastes, manure, fertilizers, oil substances, ashes, kiln dust, and garbage dumpster leakage.

Leachate Liquid that has percolated through soil and contains substances in solution or suspension.

Leaching Removal of the more soluble materials from the soil by percolating waters.

Legume A member of the legume or pulse family, Leguminosae, one of the most important and widely distributed plant families. The fruit is a "legume" or pod. Includes many valuable food and forage species, such as peas, beans, clovers, alfalfas, sweet clovers, and vetches. Practically all legumes are nitrogen-fixing plants.

Level pool routing The basic technique of storage routing used for sizing and analyzing detention storage and determining water levels for ponding water bodies. The level pool routing technique is based on the continuity equation: Inflow – Outflow = Change in storage.

Level spreader A temporary ESC device used to spread out stormwater runoff uniformly over the ground surface as sheet flow (i.e., not through channels). The purpose of level spreaders is to prevent concentrated, erosive flows from occurring, and to enhance infiltration.

LID See Low Impact Development

Local government Any county, city, town, or special purpose district having its own incorporated government for local affairs.

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 permeability liner A layer of compacted till, compacted clay, concrete, or a geomembrane.

Lowest floor The lowest enclosed area (including basement) of a structure. An area used solely for parking of vehicles, building access, or storage, in an area other than a basement area, is not considered a building's lowest floor, provided that the enclosed area meets all of the structural requirements of the flood hazard standards.

MDNS A Mitigated Determination of Nonsignificance (See DNS and Mitigation).

Maintenance Repair and maintenance includes activities conducted on currently serviceable structures, facilities, and equipment that involves no expansion or use beyond that previously existing and results in no significant adverse hydrologic impact. It includes those usual activities taken to prevent a decline, lapse, or cessation in the use of structures and systems. Those usual activities may include replacement of dysfunctioning facilities, including cases where environmental permits require replacing an existing structure with a different type structure, as long as the functioning characteristics of the original structure are not changed. One example is the replacement of a collapsed, fish blocking, round culvert with a new box culvert under the same span, or width, of roadway. In regard to stormwater facilities, maintenance includes assessment to ensure ongoing proper operation, removal of built-up pollutants (i.e., sediments), replacement of failed or failing treatment media, and other actions taken to correct defects as identified in the maintenance standards of Chapter 4, Volume V. See also Pavement Maintenance exemptions in Section 2.2 of Volume I.

Manning's equation An equation used to predict the velocity of water flow in an open channel or pipelines:

$$V = \frac{1.486R^{2/3}S^{1/2}}{n}$$

where:

V is the mean velocity of flow in feet per second

R is the hydraulic radius in feet

S is the slope of the energy gradient or, for assumed uniform flow, the slope of the channel in feet per foot; and

n is Manning's roughness coefficient or retardance factor of the channel lining.

Mass wasting The movement of large volumes of earth material downslope.

Master drainage plan A comprehensive drainage control plan intended to prevent significant adverse impacts to the natural and manmade drainage system, both on and off-site.

Mean annual water level fluctuation
Derived as follows:

(1) Measure the maximum water level (e.g., with a crest stage gage, Reinelt and Horner 1990) and the existing water level at the time of the site visit (e.g., with a staff gage) on at least eight occasions spread through a year.

(2) Take the difference of the maximum and existing water level on each occasion and divide by the number of occasions.

Mean depth
Average depth; cross-sectional area of a stream or channel divided by its surface or top width.

Mean velocity
The average velocity of a stream flowing in a channel or conduit at a given cross-section or in a given reach. It is equal to the discharge divided by the cross-sectional area of the reach.

Measuring weir
A shaped notch through which water flows are measured. Common shapes are rectangular, trapezoidal, and triangular.

Mechanical analysis
The analytical procedure by which soil particles are separated to determine the particle size distribution.

Mechanical practices
Soil and water conservation practices that primarily change the surface of the land or that store, convey, regulate, or dispose of runoff water without excessive erosion.

Metals
Elements, such as mercury, lead, nickel, zinc and cadmium, which are of environmental concern because they do not degrade over time. Although many are necessary nutrients, they are sometimes magnified in the food chain, and they can be toxic to life in high enough concentrations. They are also referred to as heavy metals.

Microbes
The lower trophic levels of the soil food web. They are normally considered to include bacteria, fungi, flagellates, amoebae, ciliates, and nematodes. These in turn support the higher trophic levels, such as mites and earthworms. Together they are the basic life forms that are necessary for plant growth. Soil microbes also function to bioremediate pollutants such as petroleum, nutrients, and pathogens.

Mitigation
Means, in the following order of preference:

a. Avoiding the impact altogether by not taking a certain action or part of an action;

b. Minimizing impacts by limiting the degree or magnitude of the action and its implementation, by using appropriate technology, or by taking affirmative steps to avoid or reduce impacts;

c. Rectifying the impact by repairing, rehabilitating or restoring the affected environment;

d. Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; and

e. Compensating for the impact by replacing, enhancing, or providing substitute resources or environments.

Modification, modified (wetland) A wetland whose physical, hydrological, or water quality characteristics have been purposefully altered for a management purpose, such as by dredging, filling, forebay construction, and inlet or outlet control.

Monitor To systematically and repeatedly measure something in order to track changes.

Monitoring The collection of data by various methods for the purposes of understanding natural systems and features, evaluating the impacts of development proposals on such systems, and assessing the performance of mitigation measures imposed as conditions of development.

Mulch A layer of organic material or aggregate applied to the surface of soil. Its purpose is any or all of the following:

- To conserve soil moisture or temperature
- To improve the fertility and health of the soil
- To reduce weed growth
- To hold fertilizer, seed, and soil in place
- To enhance the visual appeal of the area.

Types of mulches used in this manual include: Chipped site vegetation, compost, hydromulch, wood-based or wood straw, wood strand, straw, and aggregate.

NGPE See Native Growth Protection Easement.

NGVD National Geodetic Vertical Datum.

NPDES The National Pollutant Discharge Elimination System as established by the Federal Clean Water Act.

National Pollutant Discharge Elimination System (NPDES) The part of the federal Clean Water Act, which requires point source dischargers to obtain permits. These permits are referred to as NPDES permits and, in Washington State, are administered by the Washington State Department of Ecology.

Native Growth Protection Easement (NGPE) An easement granted for the protection of native vegetation within a sensitive area or its associated buffer. The NGPE shall be recorded on the appropriate documents of title and filed with the County Records Division.

Native vegetation Vegetation comprised of plant species, other than noxious weeds, that are indigenous to the coastal region of the Pacific Northwest and which reasonably could have been expected to naturally occur on the site. Examples include trees such as Douglas fir, Western Hemlock, Western Red Cedar, Alder, Big-leaf Maple, and Vine Maple; shrubs such as willow, elderberry, salmonberry and salal; and herbaceous plants such as sword fern, foam flower, and fireweed.

Natural location	Means the location of those channels, swales, and other non-manmade conveyance systems as defined by the first documented topographic contours existing for the subject property, either from maps or photographs, or such other means as appropriate. In the case of outwash soils with relatively flat terrain, no natural location of surface discharge may exist.
New development	Land disturbing activities, including Class IV -general forest practices that are conversions from timber land to other uses; structural development, including construction or installation of a building or other structure; creation of hard surfaces; and subdivision, short subdivision and binding site plans, as defined and applied in Chapter 58.17 RCW. Projects meeting the definition of redevelopment shall not be considered new development.
Nitrate (NO_3)	A form of nitrogen which is an essential nutrient to plants. It can cause algal blooms in water if all other nutrients are present in sufficient quantities. It is a product of bacterial oxidation of other forms of nitrogen, from the atmosphere during electrical storms and from fertilizer manufacturing.
Nitrification	The biochemical oxidation process by which ammonia is changed first to nitrites and then to nitrates by bacterial action, consuming oxygen in the water.
Nitrogen, Available	Usually ammonium, nitrite, and nitrate ions, and certain simple amines available for plant growth. A small fraction of organic or total nitrogen in the soil is available at any time.
Nonpoint source pollution	Pollution that enters a waterbody from diffuse origins on the watershed and does not result from discernible, confined, or discrete conveyances.
Normal depth	The depth of uniform flow. This is a unique depth of flow for any combination of channel characteristics and flow conditions. Normal depth is calculated using Manning's Equation.
NRCS Method	A single-event hydrologic analysis technique for estimating runoff based on the Curve Number method. The Curve Numbers are published by NRCS in *Technical Release No. 55: Urban Hydrology for Small Watersheds, 1986*. With the change in name to the Natural Resource Conservation Service, the method may be referred to as the NRCS Method.
Nutrients	Essential chemicals needed by plants or animals for growth. Excessive amounts of nutrients can lead to degradation of water quality and algal blooms. Some nutrients can be toxic at high concentrations.

Off-line facilities — Water quality treatment facilities to which stormwater runoff is restricted to some maximum flow rate or volume by a flow-splitter.

Off-site — Any area lying upstream of the site that drains onto the site and any area lying downstream of the site to which the site drains.

Off-system storage — Facilities for holding or retaining excess flows over and above the carrying capacity of the stormwater conveyance system, in chambers, tanks, lagoons, ponds, or other basins that are not a part of the subsurface sewer system.

Oil/water separator — A vault, usually underground, designed to provide a quiescent environment to separate oil from water.

On-line facilities — Water quality treatment facilities which receive all of the stormwater runoff from a drainage area. Flows above the water quality design flow rate or volume are passed through at a lower percent removal efficiency.

On-site — The entire property that includes the proposed development.

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

Operational BMPs — Operational BMPs are a type of Source Control BMP. They are schedules of activities, prohibition of practices, and other managerial practices to prevent or reduce pollutants from entering stormwater. Operational BMPs include formation of a pollution prevention team, good housekeeping, preventive maintenance procedures, spill prevention and clean-up, employee training, inspections of pollutant sources and BMPs, and record keeping. They can also include process changes, raw material/product changes, and recycling wastes.

Ordinary high water mark — The term ordinary high water mark means the line on the shore established by the fluctuations of water and indicated by physical characteristics such as a clear, natural line impressed on the bank; shelving; changes in the character of soil destruction on terrestrial vegetation, or the presence of litter and debris; or other appropriate means that consider the characteristics of the surrounding area.

The ordinary high water mark will be found by examining the bed and banks of a stream and ascertaining where the presence and action of waters are so common and usual, and so long maintained in all ordinary years, as to mark upon the soil a character distinct from that of the abutting upland, in respect to vegetation. In any area where the ordinary high water mark cannot be found, the line of mean high water shall substitute. In any area where neither can be found, the channel bank shall be substituted. In braided channels and alluvial fans, the ordinary high water mark or substitute shall be measured so as to include the entire stream feature.

Organic matter Organic matter as decomposed animal or vegetable matter. It is measured by ASTM D 2974. Organic matter is an important reservoir of carbon and a dynamic component of soil and the carbon cycle. It improves soil and plant efficiency by improving soil physical properties including drainage, aeration, and other structural characteristics. It contains the nutrients, microbes, and higher-form soil food web organisms necessary for plant growth. The maturity of organic matter is a measure of its beneficial properties. Raw organic matter can release water-soluble nutrients (similar to chemical fertilizer). Beneficial organic matter has undergone a humification process either naturally in the environment or through a composting process.

Orifice An opening with closed perimeter, usually sharp-edged, and of regular form in a plate, wall, or partition through which water may flow, generally used for the purpose of measurement or control of water.

Outfall A point source as defined by 40 CFR 122.2 at the point where a discharge leaves the Permittee's MS4 and enters a surface receiving waterbody or surface receiving waters. Outfall does not include pipes, tunnels, or other conveyances which connect segments of the same stream or other surface waters and are used to convey primarily surface waters (i.e., culverts).

Outlet Point of water disposal from a stream, river, lake, tidewater, or artificial drain.

Outlet channel A waterway constructed or altered primarily to carry water from man-made structures, such as terraces, tile lines, and diversions.

Outwash soils Soils formed from highly permeable sands and gravels.

Overflow A pipeline or conduit device, together with an outlet pipe, that provides for the discharge of portions of combined sewer flows into receiving waters or other points of disposal, after a regular device has allowed the portion of the flow which can be handled by interceptor sewer lines and pumping and treatment facilities to be carried by and to such water pollution control structures.

Overflow rate Detention basin release rate divided by the surface area of the basin. It can be thought of as an average flow rate through the basin.

Overtopping To flow over the limits of a containment or conveyance element.

Partially controlled limited access highway A highway where the right of owner or occupants of abutting land or other persons to access, light, air, or view in connection with the highway is controlled to give preference to through traffic to a degree that, in addition to access connections with selected public roads, there may be some crossings and some private driveway connections at grade. (See WAC 468-58-010)

Particle Size	The effective diameter of a particle as measured by sedimentation, sieving, or micrometric methods.
Peak discharge	The maximum instantaneous rate of flow during a storm, usually in reference to a specific design storm event.
Peak-shaving	Controlling post-development peak discharge rates to pre-development levels by providing temporary detention in a BMP.
Percolation	The movement of water through soil.
Percolation rate	The rate, often expressed in minutes/inch, at which clear water, maintained at a relatively constant depth, will seep out of a standardized test hole that has been previously saturated. The term percolation rate is often used synonymously with infiltration rate (short-term infiltration rate).
Permanent Stormwater Control (PSC) Plan	A plan which includes permanent BMPs for the control of pollution from stormwater runoff after construction and/or land disturbing activity has been completed
Permeable pavement	Pervious concrete, porous asphalt, permeable pavers or other forms of pervious or porous paving material intended to allow passage of water through the pavement section. It often includes an aggregate base that provides structural support and acts as a stormwater reservoir.
Permeable soils	Soil materials with a sufficiently rapid infiltration rate so as to greatly reduce or eliminate surface and stormwater runoff. These soils are generally classified as SCS hydrologic soil types A and B.
Person	Any individual, partnership, corporation, association, organization, cooperative, public or municipal corporation, agency of the state, or local government unit, however designated.
Perviousness	Related to the size and continuity of void spaces in soils; related to a soil's infiltration rate.
Pervious Surface	A surface material that allows stormwater to infiltrate into the ground. Examples include lawn, landscape, pasture, native vegetation areas, and permeable pavements.
Pesticide	A general term used to describe any substance - usually chemical - used to destroy or control organisms; includes herbicides, insecticides, algicides, fungicides, and others. Many of these substances are manufactured and are not naturally found in the environment. Others, such as pyrethrum, are natural toxins that are extracted from plants and animals.
pH	A measure of the alkalinity or acidity of a substance which is conducted by measuring the concentration of hydrogen ions in the substance. A pH of 7.0 indicates neutral water. A 6.5 reading is slightly acid.
Physiographic	Characteristics of the natural physical environment (including hills).

Plan Approval Authority The Plan Approval Authority is defined as that department within a local government that has been delegated authority to approve stormwater site plans.

Planned unit development (PUD) A special classification authorized in some zoning ordinances, where a unit of land under control of a single developer may be used for a variety of uses and densities, subject to review and approval by the local governing body. The locations of the zones are usually decided on a case-by-case basis.

Plat A map or representation of a subdivision showing the division of a tract or parcel of land into lots, blocks, streets, or other divisions and dedications.

Plunge pool A device used to dissipate the energy of flowing water that may be constructed or made by the action of flowing. These facilities may be protected by various lining materials.

Point discharge The release of collected and/or concentrated surface and stormwater runoff from a pipe, culvert, or channel.

Point of compliance The location at which compliance with a discharge performance standard or a receiving water quality standard is measured.

Pollution Contamination or other alteration of the physical, chemical, or biological properties, of waters of the state, including change in temperature, taste, color, turbidity, or odor of the waters, or such discharge of any liquid, gaseous, solid, radioactive or other substance into any waters of the state as will or is likely to create a nuisance or render such waters harmful, detrimental or injurious to the public health, safety or welfare, or to domestic, commercial, industrial, agricultural, recreational, or other legitimate beneficial uses, or to livestock, wild animals, birds, fish or other aquatic life.

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

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

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

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

Prediction — For the purposes of this document an expected outcome based on the results of hydrologic modeling and/or the judgment of a trained professional civil engineer or geologist.

Pretreatment — The removal of material such as solids, grit, grease, and scum from flows prior to physical, biological, or physical treatment processes to improve treatability. Pretreatment may include screening, grit removal, settling, oil/water separation, or application of a Basic Treatment BMP prior to infiltration.

Priority peat systems — Unique, irreplaceable fens that can exhibit water pH in a wide range from highly acidic to alkaline, including fens typified by Sphagnum species, Ledum groenlandicum (Labrador tea), Drosera rotundifolia (sundew), and Vaccinium oxycoccos (bog cranberry); marl fens; estuarine peat deposits; and other moss peat systems with relatively diverse, undisturbed flora and fauna. Bog is the common name for peat systems having the Sphagnum association described, but this term applies strictly only to systems that receive water income from precipitation exclusively.

Professional civil engineer — A person registered with the state of Washington as a professional engineer in civil engineering.

Project — Any proposed action to alter or develop a site. The proposed action of a permit application or an approval, which requires drainage review.

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

Properly Functioning Soil System (PFSS) — Equivalent to engineered soil/landscape system. This can also be a natural system that has not been disturbed or modified.

Puget Sound basin — Puget Sound south of Admiralty Inlet (including Hood Canal and Saratoga Passage); the waters north to the Canadian border, including portions of the Strait of Georgia; the Strait of Juan de Fuca south of the Canadian border; and all the lands draining into these waters as mapped in Water Resources Inventory Areas numbers 1 through 19, set forth in WAC 173-500-040.

R/D — See Retention/detention facility.

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

Rare, threatened, or endangered species	Plant or animal species that are regional relatively uncommon, are nearing endangered status, or whose existence is in immediate jeopardy and is usually restricted to highly specific habitats. Threatened and endangered species are officially listed by federal and state authorities, whereas rare species are unofficial species of concern that fit the above definitions.
Rational method	A means of computing storm drainage flow rates (Q) by use of the formula Q = CIA, where C is a coefficient describing the physical drainage area, I is the rainfall intensity and A is the area. This method is no longer used in the technical manual.
Reach	A length of channel with uniform characteristics.
Receiving Waterbody or Receiving Waters	Naturally and/or reconstructed naturally occurring surface water bodies, such as creeks, streams, rivers, lakes, wetlands, estuaries, and marine waters, or groundwater, to which a MS4 discharges.
Recharge	The addition of water to the zone of saturation (i.e., an aquifer).
Recommended BMPs	As used in Volume IV, recommended BMPs are those BMPs that are not expected to be mandatory by local governments at new development and redevelopment sites. However, they may improve pollutant control efficiency, and may provide a more comprehensive and environmentally effective stormwater management program.
Redevelopment	On a site that is already substantially developed (i.e., has 35% or more of existing hard surface coverage), the creation or addition of hard surfaces; the expansion of a building footprint or addition or replacement of a structure; structural development including construction, installation or expansion of a building or other structure; replacement of hard surface that is not part of a routine maintenance activity; and land disturbing activities.
Regional	An action (here, for stormwater management purposes) that involves more than one discrete property.
Regional detention facility	A stormwater quantity control structure designed to correct existing surface water runoff problems of a basin or subbasin. The area downstream has been previously identified as having existing or predicted significant and regional flooding and/or erosion problems. This term is also used when a detention facility is sited to detain stormwater runoff from a number of new developments or areas within a catchment.
Release rate	The computed peak rate of surface and stormwater runoff from a site.
Replaced hard surface	For structures, the removal and replacement of hard surfaces down to the foundation. For other hard surfaces, the removal down to bare soil

or base course and replacement.

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

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.

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.

Rodenticide A substance used to destroy rodents.

Runoff Water originating from rainfall and other precipitation that is found in drainage facilities, rivers, streams, springs, seeps, ponds, lakes and wetlands as well as shallow ground water. As applied in this manual, it

	also means the portion of rainfall or other precipitation that becomes surface flow and interflow.
SCS	Soil Conservation Service (now the Natural Resources Conservation Service), U.S. Department of Agriculture
SCS Method	See NRCS Method.
NRCS Method	A single-event hydrologic analysis technique for estimating runoff based on the Curve Number method. The Curve Numbers are published by NRCS in *Technical Release No. 55: Urban Hydrology for Small Watersheds, 1986*. With the change in name to the Natural Resource Conservation Service, the method may be referred to as the NRCS Method.
SEPA	See State Environmental Policy Act.
Salmonid	A member of the fish family Salmonidae. Chinook, Coho, chum, sockeye and pink salmon; cutthroat, brook, brown, rainbow, and steelhead trout; Dolly Varden, kokanee, and char are examples of salmonid species.
Sand filter	A man-made depression or basin with a layer of sand that treats stormwater as it percolates through the sand and is discharged via a central collector pipe.
Saturation point	In soils, the point at which a soil or an aquifer will no longer absorb any amount of water without losing an equal amount.
Scour	Erosion of channel banks due to excessive velocity of the flow of surface and stormwater runoff.
Sediment	Fragmented material that originates from weathering and erosion of rocks or unconsolidated deposits, and is transported by, suspended in, or deposited by water.
Sedimentation	The depositing or formation of sediment.
Sensitive emergent vegetation communities	Assemblages of erect, rooted, herbaceous vegetation, excluding mosses and lichens, at least some of whose members have relatively narrow ranges of environmental requirements, such as hydroperiod, nutrition, temperature, and light. Examples include fen species such as sundew and, as well as a number of species of Carex (sedges).
Sensitive life stages	Stages during which organisms have limited mobility or alternatives in securing the necessities of life, especially including reproduction, rearing, and migration periods.
Sensitive scrub-shrub vegetation communities	Assemblages of woody vegetation less than 6 meters in height, at least some of whose members have relatively narrow ranges of environmental requirements, such as hydroperiod, nutrition, temperature, and light. Examples include fen species such as Labrador tea, bog laurel, and cranberry.

Settleable solids	Those suspended solids in stormwater that separate by settling when the stormwater is held in a quiescent condition for a specified time.
Sheet erosion	The relatively uniform removal of soil from an area without the development of conspicuous water channels.
Sheet flow	Runoff that flows over the ground surface as a thin, even layer, not concentrated in a channel.
Shoreline development	The proposed project as regulated by the Shoreline Management Act. Usually the construction over water or within a shoreline zone (generally 200 feet landward of the water) of structures such as buildings, piers, bulkheads, and breakwaters, including environmental alterations such as dredging and filling, or any project which interferes with public navigational rights on the surface waters.
Short circuiting	The passage of runoff through a BMP in less than the design treatment time.
Siltation	The process by which a river, lake, or other waterbody becomes clogged with sediment. Silt can clog gravel beds and prevent successful salmon spawning.
Site	The area defined by the legal boundaries of a parcel or parcels of land that is (are) subject to new development or redevelopment. For road projects, the length of the project site and the right-of-way boundaries define the site.
Slope	Degree of deviation of a surface from the horizontal; measured as a numerical ratio, percent, or in degrees. Expressed as a ratio, the first number is the horizontal distance (run) and the second is the vertical distance (rise), as 2:1. A 2:1 slope is a 50 percent slope. Expressed in degrees, the slope is the angle from the horizontal plane, with a 90° slope being vertical (maximum) and 45° being a 1:1 or 100 percent slope.
Sloughing	The sliding of overlying material. It is the same effect as caving, but it usually occurs when the bank or an underlying stratum is saturated or scoured.
Soil	The unconsolidated mineral and organic material on the immediate surface of the earth that serves as a natural medium for the growth of land plants. See also topsoil, engineered soil/landscape system, and properly functioning soil system.
Soil group, hydrologic	A classification of soils by the Soil Conservation Service into four runoff potential groups. The groups range from A soils, which are very permeable and produce little or no runoff, to D soils, which are not very permeable and produce much more runoff.
Soil horizon	A layer of soil, approximately parallel to the surface, which has distinct characteristics produced by soil-forming factors.

Soil profile	A vertical section of the soil from the surface through all horizons, including C horizons.
Soil structure	The relation of particles or groups of particles which impart to the whole soil a characteristic manner of breaking; some types are crumb structure, block structure, platy structure, and columnar structure.
Soil permeability	The ease with which gases, liquids, or plant roots penetrate or pass through a layer of soil.
Soil stabilization	The use of measures such as rock lining, vegetation or other engineering structures to prevent the movement of soil when loads are applied to the soil.
Soil Texture Class	The relative proportion, by weight, of particle sizes, based on the USDA system, of individual soil grains less than 2 mm equivalent diameter in a mass of soil. The basic texture classes in the approximate order of increasing proportions of fine particles include: sand, loamy sand, sandy loam, loam, silt loam, silt, clay loam, sandy clay, silty clay, and clay.
Sorption	The physical or chemical binding of pollutants to sediment or organic particles.
Source control BMP	A structure or operation that is intended to prevent pollutants from coming into contact with stormwater through physical separation of areas or careful management of activities that are sources of pollutants. This manual separates source control BMPs into two types. *Structural Source Control BMPs* are physical, structural, or mechanical devices or facilities that are intended to prevent pollutants from entering stormwater. *Operational BMPs* are non-structural practices that prevent or reduce pollutants from entering stormwater. See Volume IV for details.
Spill control device	A Tee section or turn down elbow designed to retain a limited volume of pollutant that floats on water, such as oil or antifreeze. Spill control devices are passive and must be cleaned-out for the spilled pollutant to actually be removed.
Spillway	A passage such as a paved apron or channel for surplus water over or around a dam or similar obstruction. An open or closed channel, or both, used to convey excess water from a reservoir. It may contain gates, either manually or automatically controlled, to regulate the discharge of excess water.
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 This manual, as prepared by Ecology, 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

(Stormwater Manual)	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 regulatory agencies to evaluate a proposed new development or redevelopment project for compliance with stormwater requirements. Contents of the Stormwater Site Plan will vary with the type and size of the project, and individual site characteristics. It includes a Construction Stormwater Pollution Prevention Plan (Construction SWPPP) and a Permanent Stormwater Control Plan (PSC Plan). Guidance on preparing a Stormwater Site Plan is contained in Chapter 3 of Volume I.
Stream gaging	The quantitative determination of stream flow using gages, current meters, weirs, or other measuring instruments at selected locations. See Gaging station.
Streambanks	The usual boundaries, not the flood boundaries, of a stream channel. Right and left banks are named facing downstream.
Streams	Those areas where surface waters flow sufficiently to produce a defined channel or bed. A defined channel or bed is an area that demonstrates clear evidence of the passage of water and includes, but is not limited to, indicated by hydraulically sorted sediments or the removal of vegetative litter or loosely rooted vegetation by the action of moving water. The channel or bed need not contain water year-round. This definition is not meant to include irrigation ditches, canals, stormwater runoff devices or other entirely artificial watercourses unless they are used to convey streams naturally occurring prior to construction. Those topographic features that resemble streams but have no defined channels (i.e., swales) shall be considered streams when hydrologic and hydraulic analyses done pursuant to a development proposal predict formation of a defined channel after development.
Structure	A catchbasin or manhole in reference to a storm drainage system.
Structural source control BMPs	Physical, structural, or mechanical devices or facilities that are intended to prevent pollutants from entering stormwater. Structural source control BMPs typically include: • Enclosing and/or covering the pollutant source (building or other enclosure, a roof over storage and working areas, temporary tarp, etc.). • Segregating the pollutant source to prevent run-on of stormwater, and to direct only contaminated stormwater to appropriate treatment BMPs.

Stub-out	A short length of pipe provided for future connection to a storm drainage system.
Subbasin	A drainage area that drains to a water-course or waterbody named and noted on common maps and which is contained within a basin.
Subcatchment	A subdivision of a drainage basin (generally determined by topography and pipe network configuration).
Subdrain	A pervious backfilled trench containing stone or a pipe for intercepting ground water or seepage.
Subgrade	A layer soil used as the underlying base for a BMP.
Subsoil	The B horizons of soils with distinct profiles. In soils with weak profile development, the subsoil can be defined as the soil below the plowed soil (or its equivalent of surface soil), in which roots normally grow. Although a common term, it cannot be defined accurately. It has been carried over from early days when "soil" was conceived only as the plowed soil and that under it as the "subsoil."
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	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 flowpath). The examples in Figure G.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.

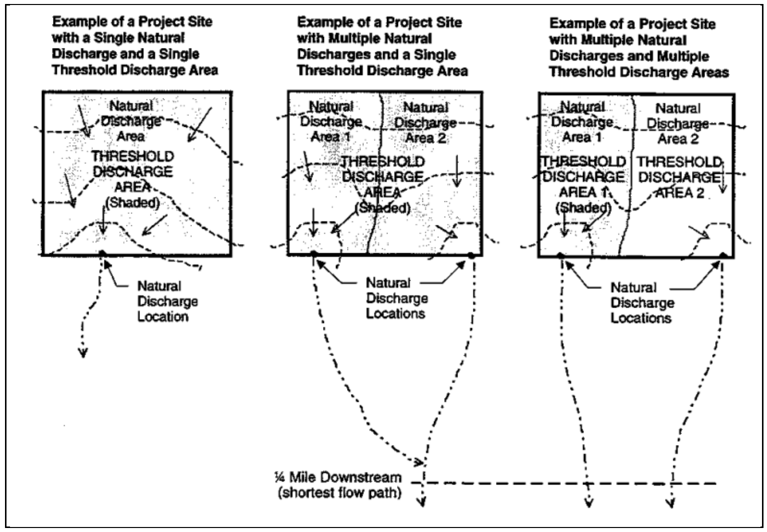

Figure G.1 – Threshold Discharge Areas

Tightline A continuous length of pipe that conveys water from one point to another (typically down a steep slope) with no inlets or collection points in between.

Tile, Drain Pipe made of burned clay, concrete, or similar material, in short lengths, usually laid with open joints to collect and carry excess water from the soil.

Tile drainage Land drainage by means of a series of tile lines laid at a specified depth and grade.

Till A layer of poorly sorted soil deposited by glacial action that generally has very low infiltration rates.

Time of concentration The time period necessary for surface runoff to reach the outlet of a subbasin from the hydraulically most remote point in the tributary drainage area.

Topography General term to include characteristics of the ground surface such as plains, hills, mountains, degree of relief, steepness of slopes, and other physiographic features.

Topsoil The upper portion of a soil, usually dark colored and rich in organic material. It is more or less equivalent to the upper portion of an A horizon in an ABC soil.

Total dissolved solids The dissolved salt loading in surface and subsurface waters.

Total Petroleum Hydrocarbons (TPH) TPH-Gx: The qualitative and quantitative method (extended) for volatile (“gasoline”) petroleum products in water; and TPH-Dx: The qualitative and quantitative method (extended) for semi-volatile (“diesel”) petroleum products in water.

Total solids The solids in water, sewage, or other liquids, including the dissolved, filterable, and nonfilterable solids. The residue left when the moisture is evaporated and the remainder is dried at a specified temperature, usually 130°C.

Total suspended solids That portion of the solids carried by stormwater that can be captured on a standard glass filter.

Total Maximum Daily Load (TMDL) – Water Cleanup Plan A calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, and an allocation of that amount to the pollutant's sources. A TMDL (also known as a Water Cleanup Plan) is the sum of the allowable loads of a single pollutant from all contributing point and nonpoint sources. The calculation must include a margin of safety to ensure that the waterbody can be used for the purposes the State has designated. The calculation must also account for seasonable variation in water quality. Water quality standards are set by states, territories, and tribes. They identify the uses for each waterbody, for example, drinking water supply, contact recreation (swimming), and aquatic like support (fishing), and the scientific criteria to support that use. The Clean Water Act, section 303, establishes the water quality standards and TMDL programs.

Toxic Poisonous, carcinogenic, or otherwise directly harmful to life.

Tract A legally created parcel of property designated for special nonresidential and noncommercial uses.

Trash rack A structural device used to prevent debris from entering a spillway or other hydraulic structure.

Travel time The estimated time for surface water to flow between two points of interest.

Treatment BMP or Facility A BMP that is intended to remove pollutants from stormwater. A few examples of treatment BMPs are Wetponds, oil/water separators, biofiltration swales, and constructed wetlands.

Treatment liner A layer of soil that is designed to slow the rate of infiltration and provide sufficient pollutant removal so as to protect ground water quality.

Treatment train A combination of two or more treatment facilities connected in series.

Turbidity Dispersion or scattering of light in a liquid, caused by suspended solids and other factors; commonly used as a measure of suspended solids in a liquid.

Underdrain Plastic pipes with holes drilled through the top, installed on the bottom of an infiltration BMP, which are used to collect and remove excess runoff.

Undisturbed buffer A zone where development activity shall not occur, including logging, and/or the construction of utility trenches, roads, and/or surface and stormwater facilities.

Undisturbed low gradient uplands	Forested land, sufficiently large and flat to infiltrate surface and storm runoff without allowing the concentration of water on the surface of the ground.
Unstable slopes	Those sloping areas of land which have in the past exhibited, are currently exhibiting, or will likely in the future exhibit, mass movement of earth.
Unusual biological community types	Assemblages of interacting organisms that are relatively uncommon regionally.
Urbanized area	Areas designated and identified by the U.S. Bureau of Census according to the following criteria: an incorporated place and densely settled surrounding area that together have a maximum population of 50,000.
U.S. EPA	The United States Environmental Protection Agency.
Values	Wetland processes or attributes that are valuable or beneficial to society (also see Functions). Wetland values include support of commercial and sport fish and wildlife species, protection of life and property from flooding, recreation, education, and aesthetic enhancement of human communities.
Variance	See Exception.
Vegetation	All organic plant life growing on the surface of the earth.
Vehicular Use	Regular use of an impervious or pervious surface by motor vehicles. The following are subject to regular vehicular use: roads, un-vegetated road shoulders, bike lanes within the traveled lane of a roadway, driveways, parking lots, unrestricted access fire lanes, vehicular equipment storage yards, and airport runways. The following are not considered subject to regular vehicular use: paved bicycle pathways separated from and not subject to drainage from roads for motor vehicles, restricted access fire lanes, and infrequently used maintenance access roads.
Waterbody	Surface waters including rivers, streams, lakes, marine waters, estuaries, and wetlands.
Water Cleanup Plan	See Total Maximum Daily Load
Water quality	A term used to describe the chemical, physical, and biological characteristics off water, usually in respect to its suitability for a particular purpose.
Water quality design storm	The 24-hour rainfall amount with a 6-month return frequency. Commonly referred to as the 6-month, 24-hour storm.
Water quality standards	Minimum requirements of purity of water for various uses; for example, water for agricultural use in irrigation systems should not exceed specific levels of sodium bicarbonate, pH, total dissolved

salts, etc. In Washington, the Department of Ecology sets water quality standards.

Watershed A geographic region within which water drains into a particular river, stream, or body of water. Watersheds can be as large as those identified and numbered by the State of Washington Water Resource Inventory Areas (WRIAs) as defined in Chapter 173-500 WAC.

Water table The upper surface or top of the saturated portion of the soil or bedrock layer, indicates the uppermost extent of ground water.

Weir Device for measuring or regulating the flow of water.

Weir notch The opening in a weir for the passage of water.

Wetlands Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas. Wetlands do not include those artificial wetlands intentionally created from non-wetland sites, including, but not limited to, irrigation and drainage ditches, grass-lined swales, canals, detention facilities, wastewater treatment facilities, farm ponds, and landscape amenities, or those wetlands created after July 1, 1990, that were unintentionally created as a result of the construction of a road, street, or highway. Wetlands may include those artificial wetlands intentionally created from non-wetland areas to mitigate the conversion of wetlands.

Wetland edge Delineation of the wetland edge shall be based on the U.S. Army Corps of Engineers Wetlands Delineation Manual, Technical Report Y-87-1, U.S. Army Engineers Waterways Experiment Station, Vicksburg, Miss. (1987)

Wetponds and wetvaults Drainage facilities for water quality treatment that contain permanent pools of water that are filled during the initial runoff from a storm event. They are designed to optimize water quality by providing retention time in order to settle out particles of fine sediment to which pollutants such as heavy metals absorb, and to allow biologic activity to occur that metabolizes nutrients and organic pollutants.

Wetpool A pond or constructed wetland that stores runoff temporarily and whose normal discharge location is elevated so as to maintain a permanent pool of water between storm events.

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.