CHAPTER 2

Stormwater Planning and Design Integration

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Chapter 2. Stormwater Planning and Design Integration

2-1 Introduction

This chapter provides guidelines for integrating the planning and design of stormwater-related project elements into the context of the Washington State Department of Transportation (WSDOT) project development process. How the process applies to a specific project depends on the type, size, and complexity of the project and individual WSDOT regional business practices.

2-2 Stormwater Management Objectives

Originally, the only function of highway stormwater management was to maintain safe driving conditions using engineering techniques designed to prevent stormwater from ponding on road surfaces. While maintaining safe driving conditions continues to be essential for any functional highway drainage system, WSDOT also acknowledges the state's vital interest in protecting and preserving natural resources and other environmental assets, as well as its citizens' health and safety. These interests have become integrated with other vital interests entrusted to the department, including the cost-effective delivery and operation of transportation systems and services that meet public needs. Thus stormwater management for WSDOT transportation facilities has two main objectives: (1) protect the functions of the transportation facility, and (2) protect ecosystem functions and the beneficial uses of receiving waters.

2-3 Project Development Overview

The integration of stormwater planning and design into WSDOT's project development process is shown in Table 2-1. While the process consists of the distinct phases described below, in practice the phases actually overlap and some design modifications may occur during the *Construction phase*.

- The initial phase of project development entails creation of the project scope (referred to as scoping). The project S*coping and Programming phase* consists of determining a project description, schedule, and cost estimate. During the project scoping phase, Project Summary documents are produced and used to program the project. The environmental section of the Project Summary establishes the initial environmental classification and level of documentation for the project.
- After the project is programmed, it is further developed through the *Design and Environmental Review phase*. During this phase, much of the design work and environmental analysis and documentation requirements for a

project are completed and work on permit applications often begins. A Design Documentation Package (DDP) that compiles the project's design considerations and conclusions is also produced during this phase. Once the DDP is reviewed and approved, it becomes the project design.

- The process continues through the development of project environmental permits, plans, specifications, and estimates (the *Environmental Permitting and PS&E phase*), which leads to production of contract documents for construction. Region or Headquarters environmental staff should be consulted at each stage of the project design to review the permits and approvals that may be required. By following the *Highway Runoff Manual* minimum requirements (see Chapter 3) and selecting BMPs (see Chapter 5 and Appendix 6A) that are suggested for the specific highway setting, the design team plays a critical role in project development by avoiding costly design changes and delays in obtaining permits and keeping the project in compliance during construction, operation, and maintenance of the system.

Table 2-1. Stormwater planning and design in the project development process.

Scoping* → *and Programming ↓	***Design Approval/ Environmental Documentation*** → ↓	***Environmental Permitting and PS&E*** ↓
Preliminary identification of water quality and hydrologic impacts and potential mitigation BMPs ↓	Formal documentation of stormwater-related environmental impacts Selection of stormwater mitigation BMPs: type, size, and location ↓	Final design of stormwater BMPs: working plans Obtain environmental permits ↓
Project Summary supported by design file documentation: ▪ Stormwater scoping package ▪ Environmental Review Summary ↓	Design report and environmental permit applications supported by design file documentation: ▪ Required environmental documentation (such as SEPA, NEPA, and ESA Biological Assessments) ▪ Hydraulic Report ↓	Plans, Specifications, and Estimates package: ▪ TESC plan ▪ Provisions for SPCC plan ▪ Stormwater-related plans; General and Special Provisions ↓
BMP cost allocation	Preliminary BMP cost estimate Environmental commitments that arise from the DDP (such as use of experimental BMPs triggering costly and lengthy monitoring requirements through the demonstrative approach)	BMP cost estimate Environmental commitments become permit requirements

The level of effort invested during each phase of development and the extent to which the phases overlap for a specific project varies depending on the type, size, and complexity of that project. The project's design may also undergo modifications during the construction process. For further description and instruction related to the *Scoping and Programming*, *Design and Environmental Review*, *Environmental Permitting, and PS&E* phases, refer to the *Environmental Procedures Manual* and the *Design Manual*.

2-3.1 Development Team

Assessment and documentation of stormwater impacts and mitigation measures begin during project scoping. The scoping and design teams must involve appropriate participants (listed in alphabetical order in Table 2-2) as part of the scoping process. Project type, size, and complexity are key factors in determining who must be consulted for development of the stormwater strategy for a project.

Table 2-2. Key contacts for development of project stormwater strategy.

Contact	Roles	Activities
Air and Noise	Performs air quality and noise analyses.	Conducts air and noise testing; determines wall locations.
Biologist	Performs biological analyses.	Delineates wetlands; prepares wetland reports, biological assessments, and mitigation recommendations.
Bridge and Structures Office	Structural design.	Assesses condition of existing structures; designs new structures; prepares PS&E for structures; coordinates backwater studies and pier placement.
Construction Offices	Manages project construction.	Contributes to design considerations; provides constructibility reviews.
Consultant Liaison	Consultant administration.	Issues request for proposal; assists in development of scopes of work; selects consultant; manages contract.
Developer Services	Coordinates development activity.	Provides information and contacts for other development activity in the area.
Geotechnical and Materials Laboratory	Determines geotechnical requirements; obtains data; provides analyses.	Provides scope and cost estimate of geotechnical work; reviews existing records and maps; performs soil borings; installs piezometers; conducts pH and resistivity testing. Assesses sources of materials and makes surfacing recommendations.
Local Programs Office and Local Agencies	Various	Provides funding and design criteria; develops maintenance agreements.
Maintenance	Provides recommendations.	Provides information on existing conditions; gives input on maintenance requirements of completed project.
Planning Office	Determines future plans for route location.	Determines route development plans; develops proposals.
Plans Office/Plan Review Office	Ensures compliance with plan standards.	Assists with preparation of Special Provisions and plans; provides final plan reviews.

Contact	Roles	Activities
Program Management (including program development)	Manages current biennial program; develops future biennial programs.	Manages set-up design and construction funding and assists with below-the-line costs; manages project definition process.
Project Design Office	Project management.	Participates in all aspects of project management and design.
Railroads	Manages design conflicts.	Identifies facilities, relocation requirements, and design considerations.
Real Estate Services	Real estate management.	Determines ownership; estimates property costs; procures rights of way, easements, rights of entry, and access management.
Regional Transit Authorities	Various	Coordinates regional issues, basin plans, construction projects, and route development.
Region and HQ Hydraulics	Provides assistance with hydraulic elements of design; provides approval or concurrence.	Determines hydraulic requirements; manages design, review, and approval of hydraulic and TESC design elements; assists with construction monitoring.
Region Environmental/ HQ Environmental Services	Performs analyses of environmental impacts and alternatives; assures compliance with environmental laws and regulations.	Prepares environmental (NEPA/SEPA) documents; coordinates with resource and permitting agencies; assists with public involvement; obtains environmental permits.
Resource Agency (various)	Reviews reports; issues permits.	Provides endangered species list; approves biological assessments; issues permits that establish conditions for design and construction.
Right of Way Research and HQ Photogrammetry	Maintains as-built and right of way/access records.	Provides information regarding project location for inclusion in plans; provides aerial photos, survey, and photogrammetry development.
Roadside and Site Development Section	Provides landscape design plans.	Prepares landscaping plans, specifications, and estimates, including planting and irrigation work; inspects construction; manages plant establishment period until sign-off by regulators.
Safety Office	Applies safety standards.	Assists with designs and provisions for stormwater features to meet regulations and codes.
State Design Engineer	Approves design.	Reviews and approves overall design.
Survey	Collects survey information.	Compiles field data; performs surveys; stakes right of way; verifies existing conditions.
Traffic	Traffic analysis and design.	Collects traffic data; develops traffic models; reviews channelization plans/work zone traffic control plans.
Tribal Organizations	Various	May provide funding and comments on project.
Utilities	Manages existing and new utilities.	Determines utility requirements; prepares franchise inventory listing; reviews clear zone inventory; obtains utility as-built plans for inclusion on plan sheets; prepares relocation plan and utility agreements.

2-3.2 Site Assessment

Stormwater facility design is a major element for many projects, and it requires significant advance data gathering and assessment to identify alternatives and develop accurate schedules and cost estimates. Data are needed to assess the project site in order to (1) determine project alignment alternatives, (2) assess impacts, (3) determine minimum requirements, and (4) develop conceptual stormwater management alternatives.

Characterizing the site and adjacent areas allows for a determination of the limiting factors controlling local hydrology. These limiting factors can then become the focus of the project's stormwater management strategies.

A three-dimensional picture of site hydrology will emerge during the site assessment. This picture will include natural and altered flow paths to the site from upstream areas and from the site to downstream areas. Natural drainage must be preserved (see Minimum Requirement 4, Section 3-3.4). The design team must identify all off-site flows coming to the site, including streams, seeps, and stormwater discharges. The transportation facility must allow for passage of all off-site flows; however, every effort should be made to keep off-site flows separate (via bypass) from the highway runoff. This may not be possible for flows that are currently permitted to discharge to WSDOT conveyance and treatment facilities.

Runoff from WSDOT rights of way must not adversely affect downstream receiving waters and properties. Existing drainage impacts on downstream waters and properties must be identified during scoping and must be either corrected as part of the project or recommended for a later retrofit. Drainage impacts are identified using multiple sources of information (see Section 2-3.2.1) and site visits during storms. Section 4-7 in the *Hydraulics Manual* provides guidelines on performing and documenting a downstream analysis. The preliminary downstream analysis is used for scoping purposes; however, a more detailed analysis may be needed during the project design phase. The final downstream analysis is included in the Hydraulic Report.

The scoping phase is the time to begin identifying natural areas within or adjacent to the project boundary that can be conserved. Conserving these areas helps to minimize project impacts. Some of these areas may be used as part of the project's stormwater management approach if they are appropriate areas for dispersion and infiltration. (See Chapters 4 and 5 for information regarding dispersion and infiltration.)

Conservation areas and their functions must be permanently protected under conservation easements or other locally acceptable means. If the conservation area falls within the right of way, it needs to be appropriately labeled on the right of way plan. If the conservation area is outside the right of way, then WSDOT needs to purchase a conservation easement or obtain another similar real estate protection instrument.

2-3.2.1 Information Sources

As a starting point, the following data and resources are generally necessary for site assessments:

- Project vicinity map and site map
- Land cover types and areas (aerial photographs)
- Topography (USGS quadrangle maps and other survey maps)
- Watershed or drainage basin boundaries
- Receiving waters
- Wetlands
- Stream flow data
- Ditches and open-channel drainage
- Enclosed drainage
- Floodplains
- Utilities
- Total maximum daily loads (TMDLs)
- Water cleanup plans
- Clean Water Act Section 303(d) list of impaired waters
- Drainage patterns and drainage areas
- Basin plan data (basin-specific needs)
- Soil types, depth, and slope (Natural Resources Conservation Service soil surveys)
- Existing stormwater outfalls (outfall inventory and site reconnaissance)
- Land use types and associated pollutants
- Groundwater data (including depth to seasonal high water table)
- Soil infiltration rates
- Vegetation surveys
- Land surveys
- Hazardous materials or wastes
- Average daily traffic (ADT)

- Roadway geometry (profiles/superelevations)
- Geotechnical evaluation (see Section 2-3.2.2)

The contacts in Table 2-2 can help in collecting this information. In addition, WSDOT's *GIS Workbench* (an ArcView geographic information system tool to provide staff with access to comprehensive, current, and detailed environmental and natural resource management data) can be used to gather some of these data and can provide maps to help with project assessment, selection of stormwater management alternatives, and maintenance applications.

2-3.2.2 Geotechnical Evaluations

Understanding the soils, geology, geologic hazards, and groundwater conditions at the project site is essential to optimizing stormwater design for a project. Contact the Region Materials Engineer (RME) and staff from the HQ Geotechnical Services Division as early as possible in the scoping phase for inclusion on the scoping and design team.

Infiltration is the preferred method for flow control of stormwater runoff. Chapters 4 and 5 provide direction on how to apply optimal infiltration for stormwater management on transportation projects. However, the extent to which infiltration can be used needs to be assessed during the scoping phase because of its direct impact on stormwater alternatives and costs. The degree to which runoff can be infiltrated depends on the project location and context. Limiting factors include soil characteristics, depth to groundwater, and designated aquifer protection areas.

The RME evaluates the geotechnical feasibility of stormwater facilities that may be needed for the project. With assistance from the HQ Geotechnical Engineer, as needed, the RME gathers all available geotechnical data pertinent to the assessment of the geotechnical feasibility of the proposed stormwater facilities. Some subsurface exploration may be required at this stage, depending on the adequacy of the geotechnical data available to assess feasibility. Refer to the *Design Manual* for additional details.

The scoping office develops the stormwater facility conceptual design using input from the RME and the HQ Geotechnical Engineer. Based on this design and investigation effort, fatal flaws in the proposed stormwater plan are identified as well as potential design and construction problems that could affect project costs or the project schedule. Critical issues to be considered include the following:

- Depth to water table (including any seasonal variations)
- Presence of soft or otherwise unstable soils
- Presence in soils of shallow bedrock or boulders that could adversely affect constructibility
- Presence of existing adjacent facilities that could be adversely affected by construction of the stormwater facilities

- Presence of geologic hazards such as earthquake faults, abandoned mines, landslides, steep slopes, or rockfall
- Adequacy of drainage gradient to ensure functionality of the system
- Potential effects of the proposed facilities on future corridor needs
- Maintainability of the proposed facilities
- Potential impacts on adjacent wetlands and other environmentally sensitive areas
- Presence of hazardous materials in the area
- Whether or not the proposed stormwater plan will meet the requirements of resource agencies
- Infiltration capacity (infiltration and percolation rates for project sites)

To characterize the seasonal variation of the groundwater table, it may be desirable to install piezometers at potential infiltration sites during scoping. One year of monitoring is desirable. At a minimum, one full rainy season is necessary to acquire the data needed to make a determination of site suitability.

2-3.2.3 Right of Way

Once the stormwater requirements for the project are understood, the general hydrologic site characteristics are known (including approximate groundwater table elevations), and the stormwater design alternatives are determined, the area necessary for stormwater facilities can be estimated. Refer to Chapters 4 and 5 to estimate the required area for each facility. Examine the proposed layout of the project, and determine the most suitable sites available to locate the stormwater facilities. Determine where facilities are proposed outside existing right of way and establish estimates for right of way acquisition areas and costs.

2-3.2.4 Utilities

The project design office must contact the Region Utilities Office to obtain information about whether existing utilities have franchises or easements within the project limits. Whenever proposed stormwater facilities conflict with an existing utility's right of way and facilities, a utility agreement is required. WSDOT may be responsible for the relocation costs, the utility owner may be responsible for the costs, or the costs may be shared. Further information about utility elements is available in the *Utilities Manual*.

2-3.3 Maintenance Review

Once a list of permanent stormwater BMPs is determined based on the site assessment, the designer must contact the Region Maintenance Office to discuss treatment options available

for use. Overall maintenance costs must be considered when selecting BMPs. The project design office must consult with the region maintenance staff regarding the proposed drainage alternatives and evaluate maintenance needs, including personnel, equipment, and long-term costs through the BMP's expected life cycle. Review the general maintenance requirements in Section 5-3.7.1 and the maintenance guidelines in Section 5.5. Maintenance concurrence must be obtained prior to the final selection of the treatment BMP and documented in the Hydraulic Report.

2-3.4 Documentation

Thorough documentation of stormwater-related environmental impacts and tracking of stormwater design commitments is a required element of the State Environmental Policy Act (SEPA) and National Environmental Policy Act (NEPA), as well as other environmental laws, and environmental permit applications. To aid in the accurate exchange of stormwater information from the design team to workgroups preparing environmental documentation and permit applications, a Stormwater Design NEPA/SEPA Documentation Checklist and accompanying Stormwater Design Documentation Spreadsheet should be prepared for each project. The Checklist and Spreadsheet are available separately at:
www.wsdot.wa.gov/Environment/WaterQuality/Runoff/HighwayRunoffManual.htm.
For a general list of documents required to be preserved in the Design Documentation Package and the Project File, see the Design Documentation Checklist at:
www.wsdot.wa.gov/design/projectdev/

2-3.4.1 Stormwater Scoping Package

Stormwater documentation during the scoping phase of project development is referred to here as the *stormwater scoping package*. This package contains the information used to preliminarily determine project stormwater impacts and the initial selection of stormwater BMPs. It is the source of stormwater information needed to complete the Project Summary documents. This package must include a brief summary report that contains the following:

- Identification of the project program
- Brief project description
- Synopsis of data gathered during the site assessment
- Basin and subbasin identification
- Threshold discharge area delineations indicating flow paths and outfalls to receiving waters
- Area determinations
- Applicable minimum requirements

- Other applicable regulatory requirements related to stormwater (such as Endangered Species Act requirements)
- Design criteria required for flow control and runoff treatment
- Known problems and commitments
- Retrofit recommendations
- Design alternatives and assumptions for flow control and runoff treatment
- Cost estimates

The stormwater scoping package is critical to the efficient continuation of project development and must be retained and easily retrievable. Once the project is programmed and assigned to a project office, the file and report become the starting point for the design phase. The stormwater scoping package must be kept and stored by the Region Program Management Office or scoping office. The package must remain with the overall project scoping file to ensure the project office to which the project is assigned for design receives the preliminary stormwater information.

2-3.4.2 Project Summary

As described in Section 2-3, the product of scoping is the *Project Summary,* which is developed and approved before the project is funded for design and construction and consists of the *Project Definition*, *Environmental Review Summary*, and *Design Decisions Summary*. All of these documents require stormwater-related information, as outlined in Table 2-3. The Project Summary is prepared to document results of the scoping process and define the overall scope of the proposed solution in terms of the work and material involved. This includes the level of environmental documentation and extent of permitting work and mitigation, as well as cost estimate and performance outcome and benefit/cost ratio for the project. This documentation is also used to link the project to the *Washington State Highway System Plan* and the *Capital Improvement and Preservation Program* (CIPP).

2-3.4.3 Environmental Documentation

For any project funded by the Legislature, environmental documentation begins after the Project Summary is approved and ends with the approval of any documents that must be completed for compliance with SEPA and NEPA, as well as other environmental laws, including, but not limited to, the Endangered Species Act and Section 6(f) of the Land and Water Conservation Fund Act. Environmental documents are drafted after analyzing environmental issues, comparing alternatives, developing mitigation measures, consulting with resource agencies about required permits, and making a determination about the significance of any remaining unmitigated environmental impacts. Much of the stormwater-related design information needed for permit applications can be obtained from the Project Summary and environmental documentation. Refer to the *Environmental Procedures Manual* for specific instructions on preparing environmental documents.

Table 2-3. Stormwater-related information needed for the Project Summary.

Project Definition (PD)	▪ Cost estimate and variance for preliminary engineering, right of way, and construction ▪ Right of way needs for stormwater facilities ▪ Preliminary environmental review: required environmental documentation, permits, and environmental commitments ▪ Design decisions regarding stormwater ▪ Public input regarding stormwater ▪ Project commitments for stormwater made to and by others ▪ Potential impacts of stormwater facilities on utilities ▪ Specialized workforce expertise required for geotechnical, biological, geomorphic, and other evaluations ▪ Other stormwater-related issues
Environmental Review Summary (ERS) and Environmental Classification Summary (ECS)	▪ Required permits and approvals related to stormwater ▪ Critical or sensitive areas as designated by Growth Management Act ordinances ▪ Floodplains or floodways within (or affecting) the project site ▪ Rivers and streams: crossing structures and types ▪ Water quality/stormwater: impacts and mitigation ▪ Previous environmental commitments made in project site related to stormwater ▪ Long-term maintenance commitments related to stormwater and necessary for project
Design Decisions Summary (DDS)	▪ Roadway geometrics data affected by stormwater facilities ▪ Roadside character classification and treatment level: effect on stormwater facility design (forest, open, rural, semiurban, urban) ▪ Hydraulic decisions regarding stormwater facilities

2-3.4.4 Hydraulic Report

The Hydraulic Report is intended to serve as a complete document record containing the engineering justification for all drainage modifications that occur as a result of project construction, including documentation of the analysis and design for the postconstruction stormwater management system. Refer to the *Hydraulics Manual* for additional details.

2-3.4.5 Construction Planning

During the design phase, key stormwater documents are produced to meet stormwater site planning requirements associated with Minimum Requirement 1 (see Section 3-3-1).

All projects require spill prevention, control, and countermeasures (SPCC) plans, which are prepared by the contractor after the project contract is awarded. The WSDOT Hazardous Materials Program (www.wsdot.wa.gov/environment/hazmat/default.htm) and Section

1-07.15(1) in the *Standard Specifications for Road, Bridge, and Municipal Construction* (*Standard Specifications*) provide more information regarding SPCC plan expectations. To ensure plan implementation, develop provisions of the SPCC plan during the PS&E phase.

For soil-disturbing projects, WSDOT must also prepare temporary erosion and sediment control (TESC) plans (see Chapter 6).

2-3.4.6 Contract Plan Sheets

Infiltration, dispersion, and conservation areas, as well as other drainage and environmental elements, need to be identified on the contract plan sheet. Development of the contract plan sheets is defined in Division 4 of the *Plans Preparation Manual*.

2-3.4.7 Plans, Specifications, and Estimates (PS&E)

For the PS&E phase of a project, a set of Plans, Specifications, and Estimates is prepared. These documents translate the stormwater management elements of the design into a contract document format for project advertisement, bidding, award, and construction.

2-3.4.8 Underground Injection Control Wells

Drywells and infiltration trenches that contain perforated pipe are considered injection wells and require registration per the Washington State Department of Ecology's (Ecology's) Underground Injection Control (UIC) Program. Registration information is available at:
www.ecy.wa.gov/programs/wq/grndwtr/uic/registration/reg_info.html

For further guidelines, consult region environmental staff or HQ Environmental Services Office staff.

2-4 Developer Projects

WSDOT must provide for the passage of existing off-site flows through its right of way to maintain natural drainage paths. If a private developer's project discharges off-site flow to WSDOT right of way, the developer needs to comply with state and local requirements, assuming all costs and liabilities associated with the design, construction, maintenance, and operation of the developer's stormwater management facilities. The developer must also demonstrate that WSDOT conveyance systems have adequate capacity to convey the developer's flows per *Hydraulics Manual* conveyance design standards. WSDOT will not concur with designs or allow discharges that do not comply with these requirements. WSDOT requires discharge water be managed, at a minimum, in accordance with the provisions of the *Highway Runoff Manual,* Ecology stormwater management manuals, or an Ecology-approved local equivalent manual used by the local government with primary jurisdiction over the project.

For details regarding the WSDOT requirements and the process for review and concurrence of private project drainage design, refer to the *Development Services Manual* and the *Utilities Manual*.

2-5 Stormwater Facility Design Approach

2-5.1 Context Sensitive Design

It is important to recognize the watershed context of a project to understand how transportation facilities, in combination with other development, can affect the natural hydrology of watersheds and the water quality of receiving waters. This understanding can guide the planner and designer in choosing stormwater management solutions that more successfully achieve the objective of protecting Washington's ecosystems.

Context sensitive design (CSD), also known as *context sensitive solutions* and *thinking beyond the pavement*, is an approach to transportation planning that broadens the focus of the project development process to look beyond the basic transportation issues and develop projects that are integrated with the unique context(s) within the project setting. This approach considers the elements of mobility, safety, environment, community, and aesthetics from the beginning to the end of the project development process. The CSD also involves a collaborative project development process that obligates participants to understand the impacts and trade-offs associated with project decisions. Further discussion of and guidance on the context sensitive design/context sensitive solutions approach can be found at:
www.wsdot.wa.gov/biz/csd/

2-5.2 Stormwater Facility Design Strategy

Stormwater management facilities (runoff treatment and flow control) can be utilized to mitigate both the hydrologic impacts and the water quality impacts of a development project by applying the following fundamental strategy:

> *Maintain the preproject[1] hydrologic and water quality functions of the project site as it undergoes development.*

This strategy is accomplished through the following steps:

Step 1 Avoid and minimize impacts on hydrology and water quality.

Step 2 Compensate for altered hydrology and water quality by mimicking natural processes.

[1] The term *preproject* refers to the actual conditions of the project site before the project is built.

Step 3 Compensate for altered hydrology and water quality by using end-of-pipe solutions.

Steps 1 and 2 can be achieved by minimizing impervious cover; conserving or restoring natural areas; mimicking natural drainage patterns (for example, using sheet flow, dispersion, infiltration, or open channels); disconnecting drainage structures to avoid concentrating runoff; and using many small redundant facilities to treat, detain, and infiltrate stormwater. This approach to site design reduces reliance on the use of structural management techniques. Step 3 refers to the use of traditional engineering structural approaches (for example, detention ponds) to the extent that Steps 1 and 2 are not feasible.

The methods listed for achieving Steps 1 and 2 above are commonly referred to as low-impact development (LID) approaches. By using the project site's terrain, vegetation, and soil features to promote infiltration, the landscape can retain more of its natural hydrologic function. Low-impact development methods will not be feasible in all project settings, depending on the physical characteristics of the site, the adjacent development, and the availability and cost of additional right of way (if needed). However, the designer must always investigate the feasibility of using low-impact development methods. Low-impact development methods require understanding of soil characteristics, infiltration rates, water tables, native vegetation, and other site features. For this reason, it is important to gain the participation of design support services and others from the beginning through the end of the project development process.

2-6 Special Design Considerations

2-6.1 Critical and Sensitive Areas

The Washington Growth Management Act (RCW 36.70A), combined with Article 11 of the Washington State Constitution, requires local jurisdictions to adopt ordinances that classify, designate, and regulate land use in order to protect *critical areas*. Critical areas are defined as wetlands, floodplains, aquifer recharge areas, geologically hazardous areas, and those areas necessary for fish and wildlife conservation.

2-6.1.1 Wetlands

Altering land cover and natural drainage patterns may increase or decrease stormwater input into surrounding wetlands. Land use changes and stormwater management practices usually alter hydrology within a watershed. Hydrologic changes have more immediate and greater effects on the composition of vegetation and amphibian communities than do other environmental changes, including water quality degradation.

Wetland ecosystems can be highly effective managers of stormwater runoff; they can remove pollutants and also attenuate flows and recharge groundwater. Minimum Requirement 7 (see Section 3-3.7) addresses wetland protection. While natural wetlands for the most part may

not be used as pollution control facilities in place of runoff treatment BMPs, Ecology's SMMEW allows the use of lower-quality wetlands as runoff treatment BMPs if requirements for hydrologic modification are met. For detailed guidance on this issue for eastern Washington projects, refer to *Use of Existing Wetlands to Provide Runoff Treatment* (Section 2.2.5, page 2-26) and *Application to Wetlands and Lakes* (Section 2.2.6, page 2-33) in Ecology's SMMEW and the *Eastern Washington Wetland Rating Form* at:
www.wsdot.wa.gov/NR/rdonlyres/41520679-F96D-47A9-9B70-3EE8BBEC391F/0/WetlandRatingForm_EasternWA.doc

For western Washington projects that may potentially alter the wetland hydroperiod, refer to *Guide Sheet 2B* in Appendix I-D of Ecology's SMMWW to review the recommended allowable limits for altering the hydroperiod of wetlands. Additional information on wetland hydroperiods is provided in Section 4-6 of this manual.

Region or Headquarters hydraulics and environmental staff can provide further assistance on hydroperiod modeling. For guidelines on wetland creation or restoration as mitigation for direct wetland impacts, contact the region's wetland biologist or consult the following website: www.wsdot.wa.gov/Environment/Biology/Wetlands/guidelines.htm

2-6.1.2 Floodplains

Hydrologic storage that is displaced by roadway fill or other structures may result in increased stream flows, channel erosion, downstream flooding, and decreased infiltration and summer base flows. Projects may be required to mitigate loss of hydrologic storage by creating new hydrologic storage elsewhere in the watershed.

A decision to locate structural detention facilities in floodplains depends on the flow control benefits that can be realized. If a detention facility can be placed so that it is functional through at least the 10-year flood elevation, it will accomplish most of its function by controlling peaks during smaller, more frequent events that cumulatively cause more damage. Stormwater facilities that are located outside the 2-year, 10-year, and 25-year flood elevations do not compromise any flood storage during those floods. If it is not possible to locate stormwater facilities anywhere but within the 100-year floodplain, and if flood storage is an issue, consult with the Region Hydraulics Office to identify alternative mitigation opportunities.

2-6.1.3 Aquifers and Wellhead Protection Areas

To ensure highway improvement projects protect drinking water wells, WSDOT has entered into an agreement (www.wsdot.wa.gov/NR/rdonlyres/426DEF64-3BE9-4965-8414-441B878F0D46/0/SCAScreeningCriteria.pdf) with the State Department of Health (DOH). This agreement includes the following screening criteria to determine the conditions under which a highway project will not be considered a potential source of contamination to drinking water wells according to DOH:

1. Road location and construction setbacks are maintained such that the drinking water source intake structure is not in danger of physical damage.

2. All concentrated flows of untreated roadway runoff are directed via impervious channel or pipe and discharged outside the *Sanitary Control Area* (SCA).

3. If roadside vegetation management practices are identified as a potential source of contamination, the water purveyor will provide the location of the SCA to the appropriate WSDOT Maintenance Office for inclusion in the *Integrated Vegetated Management Plan* for that section of highway as necessary to protect the wellhead.

4. WSDOT complies with all National Pollutant Discharge Elimination System permits, as required per Section 402 of the federal *Water Pollution Control Act*.

5. WSDOT provides the well purveyor with contact information to be used in the event of any problems or questions that may arise.

The project design team must gather and document information on all drinking water wells along the project corridor. Refer to the local critical areas ordinances for details on aquifer and wellhead protection areas applicable to the project site. To locate wells in the project site, check Ecology's website for listed well logs: apps.ecy.wa.gov/welllog/. This website contains a database of wells constructed and registered since the 1930s and wells managed by Ecology since 1971. The WSDOT *GIS Workbench* can also provide a preliminary assessment of wellhead and aquifer protection areas in the vicinity of a given project. Recognize that some wells may not be registered and can only be identified through field investigations. Contact region environmental staff early in the project design phase if there are wells located within the radius of concern.

County health departments set well protection buffers (*Sanitary Control Areas*), presuming that the well protection buffer width will adequately protect wells from contamination. When highway projects encroach into well SCAs, however, WSDOT must document how the project will avoid impacting the well and water supply.

When a road project is expected to intersect a public water supply well's SCA, contact the water purveyor to confirm the location of the well and its SCA. If the project intersects the SCA, a licensed professional engineer, using the screening criteria listed above, needs to establish the conditions under which a highway project will not be considered a potential source of contamination to drinking water wells. Then, the engineer needs to attest to the well purveyor in writing, on WSDOT letterhead, that the screening criteria's conditions are satisfied. It is expected that the purveyor will identify and sign SCA-restrictive covenants and/or WSDOT will check for such covenants filed with the County Auditor's Office.

If a disagreement arises between the water purveyor and WSDOT region staff regarding the potential impacts of the project to a public water supply well that cannot be resolved, elevate the issue to HQ Environmental Services Office (ESO) Stormwater

and Watersheds Program staff. Likewise, contact HQ ESO Stormwater and Watersheds Program staff to evaluate mitigation options if it is not possible to meet the screening criteria.

Projects that include large cuts or compaction of soil over shallow aquifers could potentially intercept groundwater flows and restrict the quantity of water reaching a well. Groundwater quantity issues are not covered by the State Department of Health agreement; thus, potential groundwater quantity impacts must be analyzed as a hydrogeologic issue in consultation with the HQ Materials Laboratory and the HQ Hydraulics Office.

2-6.1.4 Streams and Riparian Areas

To prevent direct impacts on stream channels and stream ecosystems, avoid encroachment into riparian areas. Removing riparian vegetation may directly result in channel instability and streambank erosion; loss of aquatic and wildlife habitat; loss of spawning gravels; increased sedimentation; increased water temperatures; decreased dissolved oxygen concentrations; and other water quality impacts. When a highway-widening project is located parallel to a stream, stormwater facility placement must occur away from the stream to the extent practicable and measures must be taken to preserve or enhance riparian buffers.

2-6.2 Endangered Species

Projects with a federal nexus (those with federal funding, permit, or approval) must go through consultation according to Section 7 of the federal Endangered Species Act (ESA). A biological evaluation or biological assessment must be prepared whenever it is suspected that ESA-listed species inhabit the vicinity of a project.

The design team works with a WSDOT region biologist to develop the required ESA documentation. The information needed to complete the biological evaluation or biological assessment can be obtained from existing documents and resources for the given conceptual project design alternatives. Ideally, the majority of the final information will be gathered during the scoping phase of project development. The scoping team must contact the biologist early in the scoping process to request assistance in determining ESA-related issues and how these issues and needs affect project design and cost considerations.

Information necessary to complete a biological evaluation or biological assessment for stormwater-related impacts is compiled in the ESA Stormwater Design NEPA/SEPA Documentation Checklist available at:
www.wsdot.wa.gov/Environment/Biology/BA/default.htm

2-6.3 Contaminated and Hazardous Waste Sites

If a project contains a contaminated or hazardous waste site, or if it is suspected that such a site exists within the project limits, contact Headquarters Hazardous Materials Program staff

for further direction. Refer to the *Environmental Procedures Manual*, Section 447.05, Technical Guidance, for further information.

2-6.4 Airports

Special consideration must be given to the design of stormwater facilities for projects located near airports. Roadside features, including standing water (such as wet ponds) and certain types of vegetation, can attract birds both directly and indirectly. The presence of large numbers of birds near airports creates hazards for airport operations and must be avoided. Before planning and designing facilities for a project near an airport, contact WSDOT Aviation, the airport, and the Federal Aviation Administration for wildlife management manuals and other site-specific criteria.

2-6.5 Bridges

Because the over-water portion of the bridge surface captures only the portion of rainfall that otherwise would fall directly into the receiving water body, that portion of the bridge makes no contribution to the increased rate of discharge associated with surface runoff to the water body. This reasoning assumes that the conveyance system is constructed to prevent any localized erosion between the bridge surface and the outfall to the water body. While this fact may simplify needs for flow control, bridges present challenges associated with pollutant removal from runoff generated by their surfaces.

Bridges are typically so close to receiving waters that it is often difficult to find sufficient area in which to site a treatment solution. In the past, bridges were constructed with small bridge drains that discharged the runoff directly into the receiving waters by way of downspouts. This practice is no longer allowed, thus creating the challenge of incorporating runoff collection, conveyance, and treatment facilities into the project design.

Use of suspended pipe systems to convey bridge runoff must be avoided whenever possible because these systems have a tendency to become plugged with debris and are difficult to clean. The preferred method of conveyance is to hold the runoff on the bridge surface and intercept it at the ends of the bridge with larger inlets. This method requires adequate shoulder width to accommodate flows so that they do not spread farther into the travel way than allowed (see Chapter 5 of the *Hydraulics Manual* for allowable spread widths). In cases where a closed system must be used, it is recommended that bridge drain openings and pipe diameters be larger and that 90º bends be avoided to ensure the system's operational integrity. Early coordination with the HQ Bridge and Structures Office is essential if a closed system is being considered.

2-6.6 Ferry Terminals

A ferry dock consists of the bridge (trestle and span), piers, and some of the holding area (parking facility). The terminal is the dock and all associated upland facilities. Requirements and consideration for the terminal's upland facilities are the same as for park-and-ride lots, rest areas, and maintenance yards (where similarities exist) as described in Section 2-6.7. Requirements and considerations that apply to bridges also apply to the trestle, span, and other over-water portions (see Section 2-6.5).

2-6.7 Maintenance Yards, Park-and-Ride Lots, and Rest Areas

The Ecology stormwater management manuals for western (SMMWW) and eastern (SMMEW) Washington provide more specific stormwater BMP information related to parking lots and commercial and industrial land uses. Stormwater facility design must give consideration to the use of methods that emphasizes conservation and the use of on-site natural features to protect water quality and more closely mimic predevelopment hydrology. In addition to approaches in contained Ecology's stormwater management manuals, refer to Chapter 5 for other applicable BMPs.

2-7 How Stormwater Management Applies to a Project

2-7.1 HRM Minimum Requirements and Exemptions

Chapter 3 contains the manual's minimum requirements for stormwater management: Section 3-2 aids in determining the applicable minimum requirements and Section 3-3 provides further detailed direction regarding their application. Even when projects do not trigger a particular minimum requirement (such as flow control), the intent of the minimum requirement should still be considered in project design.

Section 3-2 provides information on projects that are exempt from the minimum requirements. Sections 3-3.5 and 3-3.6 provide specific information on limited exemptions from runoff treatment (Minimum Requirement 5) and flow control (Minimum Requirement 6), respectively.

2-7.2 Local Requirements

Section 1-1.5 explains the conditions under which local requirements apply to stormwater management on WSDOT projects. By state statute, WSDOT projects on state right of way are not subject to local permits, except for *shoreline* permits required by the local shoreline master program and permits required by *critical* or *sensitive areas* ordinances promulgated under the Growth Management Act (see Section 2-6.1).

Permitting staff in the Region Environmental Office must be consulted as to the individual permits required for a project. If the project will result in a new stormwater discharge to a municipal storm sewer system, a permit may be required by that jurisdiction's stormwater utility. Local agencies may have special design requirements for projects in which a portion of the local system will be replaced and turned over to the local jurisdiction for operation and maintenance.

The above information is intended to specify the local permits that may be applicable to WSDOT projects; it is not intended to preclude the need to work with local authorities to address concerns they may have regarding the potential impacts of a project. Additional information on applicable statutes, regulations, and environmental permitting can be found in the *Environmental Procedures Manual.*

2-7.3 Watershed and Basin Plans

Incorporating watershed and basin planning and local requirements into stormwater management is addressed in Minimum Requirement 8 (see Section 3-3.8). Project planners and designers need to familiarize themselves with the planning efforts for the watersheds and local jurisdictions in which the project is located and identify any specific requirements, recommendations, and opportunities that relate to stormwater management. Watershed plans may also identify priority mitigation needs within the watershed that may present off-site opportunities to mitigate project impacts. Local plans may have identified specific stormwater-related needs and/or contain useful analyses.

Statewide organized watershed planning efforts occur under two state laws: the Watershed Planning Act (2514 Planning) and the Salmon Recovery Act (2496 Planning). Each uses *water resource inventory areas* (WRIAs) as its basic geographic unit.

Basin planning conducted by local governments focuses on drainage basins at a sub-WRIA scale. Unfortunately, there are no uniform state standards defining an adequate basin plan. As stated in Minimum Requirement 8 (see Section 3-3.8), standards developed from basin plans cannot modify any minimum requirement until the basin plan is formally adopted and implemented by the local governments within the basin and has received approval or concurrence from Ecology.

Entities with basin planning responsibilities for an area where transportation projects are planned must be contacted as early as possible in the project planning process. Such groups include *lead entities* under the Salmon Recovery Act and *watershed planning units* under the Watershed Planning Act as well as city and county public works departments responsible for basin planning. There may be shared funding opportunities for local priority mitigation projects, which could significantly reduce project mitigation costs. Also, such entities may have data and analyses that can be used in the project planning process.

- Information on activities under the Watershed Planning Act, including a map of Washington's water resource inventory areas, is available at: www.ecy.wa.gov/watershed/index.html
- Information on activities under the Salmon Recovery Act is available at: wdfw.wa.gov/recovery.htm
- Watershed data, reports, and other related information is available at: www.ecy.wa.gov/programs/eap/wrias/index.html

Contact the Region Environmental Office or the HQ ESO Stormwater and Watersheds Program to arrange meetings and help coordinate watershed-related efforts.

2-7.3.1 Watershed-Based Approach

The Stormwater and Watersheds Program staff of the HQ Environmental Services Office has developed a project screening and watershed characterization process to identify alternatives to managing stormwater impacts within the right of way. The objectives in pursuing the watershed-based approach are to improve environmental benefits and reduce costs compared to standard runoff treatment and flow control facilities constructed within the right of way. Factors to consider with watershed-based options include the following:

1. *Have all source controls been included?* Source control may be the most cost-effective practice to control pollutants. This is the first step in the investigation of alternative treatment options.
2. *What size watershed scale is appropriate for this alternative mitigation approach?* While the smallest subbasin may be appropriate for healthy watersheds, a larger watershed scale may be more appropriate in highly degraded watersheds depending on the nature of the impairment(s).
3. *Can stormwater management be coordinated with habitat mitigation?* Stream restoration, floodplain restoration, riparian replanting, or other practices could provide both habitat mitigation and stormwater management.
4. *Has a regional facility been evaluated?* If on-site stormwater facilities are not feasible, combining several project stormwater treatment/control needs into one regional facility may be a more cost-effective option.
5. *Are there legal or regulatory constraints to off-site stormwater management?*

For information on the activities of WSDOT's Watershed Program, including the watershed-based mitigation method, see: www.wsdot.wa.gov/environment/watershed/default.htm

2-7.4 Engineering and Economic Feasibility

For some projects, practical limitations may present obstacles to fully meeting certain requirements, particularly runoff treatment and flow control, within the project right of way.

Limitations may be infrastructural, geographical, geotechnical, hydraulic, environmental, or benefit/cost-related. For these projects, the planning and design team must make a formal assessment of the project and identify constraints on meeting the minimum requirements. This assessment is referred to as *engineering and economic feasibility* (EEF).

The Engineering and Economic Feasibility Evaluation Checklist, included in Appendix 2A, is an evaluation based on 18 project- and site-specific criteria that assesses the practical limitations of constructing stormwater facilities within or adjacent to a project's right of way. The assessment must be performed as early as possible in project development. If the assessment reveals that stormwater requirements for a project cannot be met because it is not practicable to do so, an explanation must be provided in the project's Hydraulic Report. The explanation must include the reasons why the requirements cannot be met for the site and the amount of stormwater treatment/control that can be provided. Whenever an EEF assessment shows that meeting the HRM's minimum requirements for a project is not feasible within the project's right of way, in whole or in part, the project team must consult with the Region Environmental Office or the HQ ESO Stormwater and Watersheds Program regarding whether alternative mitigation opportunities have been identified for the project site.

If on-site options are unavailable and opportunities to create off-site runoff treatment and/or flow control capacity cannot be identified or are not chosen, the project needs to pursue the *demonstrative approach* to propose a treatment option for the stormwater discharge (see Sections 1-1.3 and 5-3.5.3). Such a proposal may involve using off-site or watershed-based options to create runoff treatment and flow control capacity to meet regulatory requirements (see Section 2-7.3). The *demonstrative approach* requires demonstrating that the project will not adversely affect water quality by providing appropriate supporting data showing that the alternative approach satisfies state and federal water quality laws. The timeline and expectations for providing technical justification depend on the complexity of the individual project and the nature of the receiving water environment. Thus, this approach may be more cost-effective for large, complex, or unusual types of projects. In developing alternate treatment and control options, it is important to consider and document the site limitations using the Engineering and Economic Feasibility Evaluation Checklist (see Appendix 2A).

2-7.5 Stormwater Retrofit

Stormwater retrofit provides treatment/control improvements for existing and/or replaced impervious surfaces where existing treatment/controls do not exist or are substandard. The decision to apply current *Highway Runoff Manual* standards for runoff treatment and flow control to existing impervious surfaces within the project limits should occur during project scoping. Section 3-4 provides guidelines for assessing (1) whether project-driven stormwater retrofit obligations can be met off-site by retrofitting an equivalent area of state highway in targeted environmental priority locations, and (2) whether it is cost-effective to provide stormwater management retrofits beyond what is called for under these requirements.

Stormwater retrofit may also be accomplished as a stand-alone programmed project (I-4 Subprogram). Those responsible for scoping a highway project need to contact the Region or

HQ Program Management Office to learn whether any such programmed retrofit actions apply to their project.

The extent and type of any stormwater retrofit activity needs to be documented in the Hydraulic Report and the Stormwater Design Documentation Spreadsheet available at:
www.wsdot.wa.gov/Environment/WaterQuality/Runoff/HighwayRunoffManual.htm

APPENDIX 2A

Engineering and Economic Feasibility for Construction of Stormwater Management Facilities

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Appendix 2A.
Engineering and Economic Feasibility for Construction of Stormwater Management Facilities

Stormwater runoff from highways should be treated and controlled adjacent to or within the right of way (ROW) when transportation improvement projects are constructed. However, various site-specific factors (for example, lack of land availability; engineering constraints; health and safety issues associated with operations and maintenance activities; or other obstacles) could make constructing stormwater management facilities within or adjacent to the highway right of way (called *in-ROW treatment*) difficult, if not impossible.

This appendix presents a method to assist in determining when site-specific factors could make constructing stormwater management facilities within or adjacent to the highway right of way infeasible. Using the Engineering and Economic Feasibility (EEF) Evaluation Checklist (see Section 2A-2) to document the critical site-specific limiting factors is required if the project deviates from prescribed stormwater management design criteria, such as those contained in the *Highway Runoff Manual* (HRM) or the Washington State Department of Ecology's (Ecology's) stormwater management manuals for eastern (SMMEW) and western (SMMWW) Washington. This documentation is necessary, in addition to the analysis required to seek compliance through the *demonstrative approach.* The *demonstrative approach* requires approval of a site-specific stormwater management proposal and supporting data to show that the alternative approach protects water quality and satisfies state and federal water quality laws (see Sections 1-1.3 and 5-3.5.3). Such a proposal may involve using off-site or watershed-based options to create runoff treatment and flow control capacity to meet regulatory requirements (see Section 2-7.3).

2A-1 General Criteria: Engineering and Economic Feasibility (EEF) of Constructing Stormwater Control Facilities

The following four general criteria should be considered by the designer in the siting and selection of stormwater best management practices (BMPs). These criteria affect the feasibility of stormwater BMPs and are further explained in the EEF Checklist in Section 2A-2.

- **Physical site limitations.** In many cases, the amount of available right of way determines which types of stormwater controls are feasible for the project. When additional right of way can be acquired at market value, or when eminent domain condemnations can be demonstrably justified, then project proponents should explore these options to acquire additional land for stormwater control facilities. Historically, condemning land specifically for wetland mitigation (also triggered by the federal Clean Water Act) has been extremely difficult; hence, this option for stormwater control facilities will likely encounter the same difficulties.

Additional site constraints could include geographic limitations, steep slopes, soil instability, proximity to water bodies, presence of significant cultural resources, and shallow water tables.

- **Treatment effectiveness.** Generally, BMPs with the highest pollutant-removal efficiencies should be considered first. These practices may require more land area, thus affecting space limitations.
- **Costs and associated environmental benefits.** Generally, the most cost-effective method of meeting environmental requirements should be chosen.
- **Legal and policy issues.** Washington State Department of Transportation (WSDOT) and Ecology stormwater requirements and design criteria, local ordinances, Endangered Species Act concerns, and tort liability issues must also be considered when selecting appropriate BMPs. If watershed-based stormwater management options are considered, legal and policy issues discouraging this approach may need to be overcome.

When identifying on-site treatment and control options, it is important to consider the site limitations preventing construction of stormwater control and treatment facilities. For physical or economic reasons, it may not be feasible to construct full-scale stormwater control facilities on-site.

2A-2 Engineering and Economic Feasibility (EEF) Evaluation Checklist

The following checklist is intended for use by WSDOT staff during the design stage to determine whether construction of stormwater control facilities is feasible within the immediate highway right of way. Factors that limit the feasibility of constructing in-ROW stormwater controls are listed, along with questions to help transportation project planners and designers determine the feasibility of constructing in-ROW stormwater treatment and control systems based on site conditions.

2A-2.1 Collect Project Site Data to Identify Limiting Factors

Project information such as boundaries, soil conditions, presence of slopes, proximity of water bodies, and other project data must be collected to determine in-ROW treatment and control feasibility. Preliminary estimates of runoff treatment and flow control needs for the project must also be made. At a minimum, this analysis should include the anticipated new and existing total impervious areas within the right of way; topographic characteristics; existing land use and land cover adjacent to the right of way; and whether on-site soil characteristics can accommodate infiltration.

The following list contains the information needed to complete a full EEF analysis for constructing stormwater control facilities within a specific highway right of way. It should be noted that, in many cases, not all of the information listed below is needed to make a feasibility determination. Once a fatal flaw is identified in the checklist that makes it infeasible to construct in-ROW stormwater control facilities, then the EEF analysis is

effectively completed, thus negating the need for additional information to evaluate in-ROW feasibility.

- Conceptual-level stormwater design: Is infiltration possible based on soil characteristics?
- Amount of right of way currently available or that can be reasonably acquired via purchase or condemnation.
- Location(s) of critical public infrastructure(s) relative to the established or acquirable right of way.
- Location(s) of protected cultural resources, historic sites, parklands, or wildlife and waterfowl refuges (Department of Transportation Act of 1966 §4[f] properties) relative to the established or acquirable right of way.
- Location(s) on or adjacent to the established or acquirable right of way that are designated as sensitive by a federal, state, local, or tribal government. These areas include, but are not limited to:
  - Water bodies designated as "impaired" under the provision of Section 303(d) of the federal Clean Water Act enacted by Public Law 92-500.
  - Designated "critical water resources" as defined in 33 CFR Part 330, Nationwide Permit Program.
  - Sole source aquifers as defined under the Safe Drinking Water Act, Public Law
    93-523.
  - Wellhead protection zones as defined under WAC 246-290, Public Water Supplies.
  - "Critical habitat" as defined in Section 3 of the Endangered Species Act of 1973.
  - Areas identified in local critical area ordinances or in an approved basin plan.
- Location(s) of established structure(s) on or adjacent to the established or acquirable right of way.
- Slopes and location(s) of unstable slopes on or adjacent to the established or acquirable right of way.
- Available hydraulic head.
- Depth of the mean annual high groundwater table and information on local groundwater flooding.
- Presence and location of hazardous or dangerous materials on or adjacent to the established or acquirable right of way.

- Existence and location(s) of well-established riparian tree canopies or vegetative buffers on the established or acquirable right of way.
- Presence and distribution of 100-year floodplains on or adjacent to the established or acquirable right of way.
- For bridge projects: Can the bridge structure be drained to land by gravity feed?
- Estimated cost for constructing and maintaining the conceptual stormwater control facilities for the drainage area.

2A-2.2 Infrastructure Limitations to Construction Feasibility

The density of the built environment adjacent to the established right of way may limit the amount of land available for acquisition to construct stormwater treatment and control systems. Once project limits, right of way, and stormwater runoff treatment and flow control needs are defined, a determination on whether it is feasible to construct stormwater management systems on-site can be made. Generally, wet vaults should be avoided when other BMP options are viable because of high construction and maintenance costs.

The following questions should be considered when determining whether infrastructure or right of way limits the feasibility of designing and constructing stormwater BMPs within or adjacent to the right of way (in-ROW treatment). Each element evaluates potential fatal flaws that would preclude the feasibility of constructing stormwater management facilities within the anticipated right of way of the project being scoped.

2A-2.2.1. Can a multipurpose runoff treatment system, such as an extended wet/detention pond or pond/constructed wetland or floodplain restoration project be constructed within the anticipated right of way to treat the estimated water quality and flow impacts of the project? (YES/NO)

*EEF implications: This is to reinforce that facilities designed and constructed to treat larger areas result in lower unit volume treatment costs, which will affect the benefit/ cost ratio, which can affect overall feasibility. If **YES**, go to* Section 2A-2.3. *If **NO**, proceed to Section 2A-2.2.2.*

2A-2.2.2. Can runoff treatment BMPs be designed to fit within the anticipated right of way? (YES/NO)

Consider these BMPs (in order of preference):

- Infiltration or exfiltration via ponds, trenches, depressions, groundwater contactors, or drain fields
- Compost-amended vegetated filter strips
- Ecology embankments
- Wet/detention ponds

- Biofiltration swales and filter strips
- Constructed wetlands
- Vaults and tanks (use requires preauthorization; see Section 5-3.6.1)

*EEF implications: If **YES**, proceed to Section 2A-2.2.3. If **NO**, go to* Section 2A-2.2.4. *In many instances, it may be possible to fit in-ROW BMPs for runoff treatment only, since some runoff treatment BMPs can be engineered to fit within highly constrained land parcels (such as compost-amended filter strips and ecology embankments), whereas flow control BMPs tend to require more land.*

2A-2.2.3. Can flow control BMPs be designed to fit within the anticipated right of way? (YES/NO)

Consider these BMPs (in order of preference):

- Low-impact development (LID) methods such as minimizing clearing and compaction; retaining mature stands of vegetation and soil horizons; soil enhancements; routing runoff to closed vegetated depressions (bioretention); compost-amended vegetated buffer strips; porous pavement shoulders and gore areas; and dispersion
- Floodplain restoration projects designed to increase stormwater storage
- Infiltration or exfiltration
- Dispersion BMPs
- Wet/detention ponds
- Extended detention (dry) ponds
- Vaults and tanks (use requires preauthorization; see Section 5-3.6.1).

*EEF implications: If **YES**, go to* Section 2A-2.3*; it has been established that there is enough land area within the anticipated right of way to construct BMPs. Other constraining factors, such as geotechnical, geographic, and environmental, may also limit the feasibility of constructing in-ROW BMPs and need to be examined to complete the EEF analysis. If **NO**, proceed to Section 2A-2.2.4.*

2A-2.2.4. If BMPs cannot be accommodated on-site, is it feasible to purchase adjoining properties to allow the construction of one of the above BMP designs?

In order to answer this question, the following associated questions need to be answered.

2A-2.2.4.1 Are there critical publicly owned infrastructure(s) or facilities, such as schools, fire stations, police facilities, or major utility lines, that would need to be

relocated to facilitate construction of in-ROW stormwater control facilities? (YES/NO)

*EEF implications: If **YES**, it is generally not feasible to construct in-ROW stormwater control facilities due to the existence of critical public infrastructure(s). Identification of the location and nature of the critical public infrastructure(s) needs to be well documented to regulatory agencies, to justify not constructing in-ROW stormwater control facilities. Consider using off-site or watershed-based options (see Sections 1-1.3 and 2-7.3) to create additional capacity in the receiving water so that the project will meet water quality standards. If **NO**, proceed to Section 2A-2.2.4.2.*

2A-2.2.4.2 Will the designated stormwater management area for constructing a stormwater management facility trespass on or disturb designated historic building sites, structures, archaeological sites, or other significant cultural resources? (YES/NO)

Note: Any projects involving disturbance of ground surfaces not previously disturbed should be reviewed for cultural resource study needs (such as site file searches at the Washington State Office of Archaeology and Historic Preservation, on-site surveys, and subsurface testing). Federal involvement (such as funding, permits, and lands) requires compliance with Section 106 of the National Historic Preservation Act and implementation of regulations in 36 CFR 800.

*EEF implications: If **YES**, it is not feasible to construct in-ROW stormwater control facilities due to the existence of statutorily protected cultural resources at the site. At this point, the EEF analysis is complete. Identification of the location and nature of the critical public infrastructure(s) needs to be well documented to resource agencies, to justify not constructing in-ROW stormwater control facilities. Other options to create capacity should be identified to maintain or restore the water quality, eliminate the hydrology impacts of the project, and comply with the antidegradation clause of the federal Clean Water Act. Consider using off-site or watershed-based options (see Sections 1-1.3 and 2-7.3) to create additional capacity in the receiving water so that the project will meet water quality standards. If **NO**, proceed to Section 2A-2.2.4.3.*

2A-2.2.4.3 Is the land needed to site and construct the stormwater management facility available at a reasonable cost without significant displacement or other impacts? In other words, is the needed additional land available for purchase from a willing seller at market value, at a cost acceptable to the project budget, or by eminent domain condemnation procedures? (If the required land lies within an area with expensive privately owned structures and buildings, the cost of acquisition and relocation may greatly exceed market rates for the land itself.) (YES/NO)

*EEF implications: This query evaluates whether it is feasible to purchase additional right of way to accommodate construction of in-ROW stormwater control facilities. If **YES**, proceed to* Section 2A-2.3*, since additional land can be practicably purchased, and project offices should continue with the EEF analysis to investigate whether there are other factors limiting feasibility. If **NO**, it is not feasible to construct stormwater control facilities within the right of way, and other options to create capacity should be identified to meet regulatory requirements. Consider using off-site or watershed-based options (see Sections 1-1.3 and 2-7.3) to create additional capacity in the receiving water so that the project will meet water quality standards.*

2A-2.3 Geographic and Geotechnical Limitations to Construction Feasibility

A project's topography and/or proximity to wetlands, sensitive water bodies, shorelines, riverfront areas, or steep slopes may physically or structurally preclude construction of BMPs on-site within required engineering standards. In situ geotechnical conditions can also limit the feasibility of constructing BMPs within the right of way (for example, the project is on unstable slopes, high shrink/swell soils, or karst topography). The following questions should be considered when determining whether geography or geotechnical limits affect the feasibility of designing stormwater BMPs on-site:

2A-2.3.1 Is the project located adjacent to or on a water body, wetland, riparian buffer, or other natural aquatic feature that would physically preclude the construction of any in-ROW BMP? Examples of water bodies that could geographically limit a WSDOT project include lakes, rivers, streams (including intermittent streams), wetlands, sloughs, wet meadows, natural ponds, sounds, and seas. (YES/NO)

*EEF implications: If **YES**, it is not feasible to construct in-ROW stormwater control facilities because of geographic limitations. Project offices should review project plans to evaluate whether it is feasible to reconfigure drainage and BMP designs to accommodate as much stormwater treatment/control as can practicably fit within the right of way. Other options to create capacity should be identified to maintain or restore the water quality and hydrology baselines impacted by the project and to comply with the antidegradation clause of the federal Clean Water Act and Washington State Water Pollution Law (RCW 90.48). Consider using off-site or watershed-based options (see Sections 1-1.3 and 2-7.3) to create additional capacity in the receiving water so that the project will meet water quality standards. If **NO**, proceed to Section 2A-2.3.2.*

2A-2.3.2 Do extremely steep slopes (steeper than 2H:1V) exist at the proposed BMP location?

*EEF implications: If **YES**, it is not feasible to construct in-ROW stormwater control facilities because of geographic limitations. Project offices should review project plans to evaluate whether or not it is feasible to reconfigure drainage and BMP*

*designs to accommodate as much stormwater treatment/control as can practicably fit within the right of way. Other options to create capacity should be identified to maintain or restore the water quality and hydrology baselines impacted by the project and to comply with the antidegradation clause of the federal Clean Water Act and Washington State Water Pollution Law (RCW 90.48). Consider using off-site or watershed-based options (see Sections 1-1.3 and 2-7.3) to create additional capacity in the receiving water so that the project will meet water quality standards. If **NO**, proceed to Section 2A-2.3.3.*

2A-2.3.3 Does the land needed for construction of runoff treatment or flow control facilities lie within 50 feet of any slope greater than 15%? (YES/NO)

*EEF implications: This is a setback specification encoded in Ecology's new stormwater manuals and reflected in the Highway Runoff Manual. If **NO**, proceed to* Section 2A-2.4.1. *If **YES**, consult with a geotechnical engineer to determine whether there is a risk of slope failure because of slope and soil characteristics. If there is an unacceptable risk of slope failure, it is not feasible to construct in-ROW stormwater control facilities on the designated BMP site. Other options to create capacity should be identified to maintain or restore the water quality and hydrology baselines impacted by the project and to comply with the antidegradation clause of the federal Clean Water Act and State Water Pollution Law (RCW 90.48). Consider using off-site or watershed-based options (see Sections 1-1.3 and 2-7.3) to create additional capacity in the receiving water so that the project will meet water quality standards.*

2A-2.4 Hydraulic Limitations to Construction Feasibility

Hydraulic limitations can include the lack of hydraulic head necessary to effectively operate stormwater control facilities or areas with very shallow water tables such as floodplains or seasonal wetlands. Alternatives such as spill control devices and frequent cleaning of road or bridge surfaces with high-efficiency vacuum sweepers should be considered in these areas in lieu of standard treatment facilities.

2A-2.4.1 Will BMP construction involve excavating to below annual high groundwater levels? (YES/NO)

*EEF implications: If **YES**, consideration should be given to altering the stormwater system design to use other BMP options. If other BMP options are also found not to be feasible, it is not feasible to construct in-ROW BMPs and the EEF analysis is complete. If **NO**, proceed to Section 2A-2.4.2.*

2A-2.4.2 Will construction of an infiltration BMP result in localized groundwater flooding (such as basement inundation) or will it be located less than 20 feet from any upslope foundation or less than 100 feet from any downslope foundation? (YES/NO)

*EEF implications: If **YES**, consider other BMPs or use impermeable barriers to protect existing foundations if found to be feasible. If **NO**, proceed to Section 2A-2.4.3.*

2A-2.4.3 Is there adequate hydraulic head (dependent on the type of BMP, but generally greater than 3 feet) available to effectively operate the BMP? (YES/NO)

*EEF implications: If **NO**, consideration should be given to altering the design to use other BMP options. If other BMP options are also found not to be feasible, it is not feasible to construct in-ROW stormwater control systems. If **YES**, proceed to Section 2A-2.4.4.*

2A-2.4.4 Specifically for bridge projects, is it feasible from an engineering perspective to convey stormwater to on-land stormwater control facilities by gravity feed and have a flowpath of less than 2,000 feet to shore? (YES/NO)

*EEF implications: If **NO**, the inability to drain bridge structures by gravity feed, whether because of expansion joints, grated sections, or the lack of grade, makes it not feasible to convey stormwater to land for treatment. Project offices should evaluate whether it is possible to alter project design to accommodate gravity drainage to land. If not, other options to create capacity should be identified to maintain or restore the water quality and hydrology baselines impacted by the project and to comply with the antidegradation clause of the federal Clean Water Act and State Water Pollution Law (RCW 90.48). Consider using off-site or watershed-based options (see Sections 1-1.3 and 2-7.3) to create additional capacity in the receiving water so that the project will meet water quality standards. If **YES**, proceed to Section 2A-2.5.*

2A-2.5 Environmental or Health Risk Limitations to Construction Feasibility

Areas with intensive historic levels of industrial or commercial activity may have significant levels of soil, water, or fill contamination, which would prevent highway construction work from being conducted in a safe manner (as specified in the Washington Industrial Safety and Health Act or federal Occupational Safety and Health Administration regulations), or may be the subject of overriding Resource Conservation and Recovery Act (RCRA), state Model Toxics Control Act (MTCA), or Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) regulations. Such significant safety, health, and environmental limitations would generally preclude construction of stormwater facilities on a particular site.

2A-2.5.1 Does the proposed stormwater management area contain significant quantities of contaminated soils or materials to designate it as a hazardous or dangerous waste area or require a cleanup action as defined by RCRA or MTCA regulations? (YES/NO)

*EEF implications: If **YES**, go to* Section 2A-2.6 *to evaluate benefit-to-cost ratios, incorporating estimated costs for remediation of hazardous or dangerous materials into the analysis. Construction of stormwater facilities in areas with hazardous or dangerous wastes is generally not feasible without putting a worker's health in jeopardy and may result in releases of acutely toxic substances to surface waters during the construction phase and impacts to groundwater in the operations phase. If **NO**, proceed to Section 2A-2.5.2.*

2A-2.5.2 Will the construction of stormwater control facilities require the removal of well-established riparian tree canopies (generally trees over 100 feet tall) or vegetative buffers? (YES/NO)

*EEF implications: If **YES**, the benefit/cost (B/C) analysis will determine feasibility if no other limiting factors are found, so go to* Section 2A-2.6. W*ell-established tree canopies can sequester significant amounts of air and water pollutants, provide long-term water storage, and provide shading that buffers temporal in-stream temperature increases. Project offices should reevaluate drainage and BMP designs to investigate whether stormwater control facilities can be reconfigured or moved to avoid or minimize the removal of established tree canopies.*

*If avoidance and minimization are not possible, other options to create capacity should be identified to maintain or restore the water quality and hydrology baselines affected by the project and to comply with the antidegradation clause of the federal Clean Water Act and State Water Pollution Law (RCW 90.48). Consider using off-site or watershed-based options (see Sections 1-1.3 and 2-7.3) to create additional capacity in the receiving water so that the project will meet water quality standards. If **NO**, proceed to Section 2A-2.5.3.*

2A-2.5.3 Will the construction of stormwater control facilities require the removal of critical habitat for listed endangered and threatened species? (YES/NO)

*EEF implications: If **YES**, it is not feasible to construct in-ROW stormwater control facilities due to environmental limitations. Removal of critical habitat would (at a minimum) result in a Section 7 consultation for the project or would likely result in a take of an endangered or threatened species, making it not feasible to construct in-ROW stormwater control facilities. Project offices should reevaluate drainage and BMP designs to investigate whether stormwater control facilities could be reconfigured or moved to avoid or minimize the removal of critical habitat. If avoidance and minimization are not possible, other options to create capacity should be identified to maintain or restore the water quality and hydrology baselines impacted by the project and to comply with the antidegradation clause of the federal Clean Water Act and State Water Pollution Law (RCW 90.48). Consider using off-site or watershed-based options (see Sections 1-1.3 and 2-7.3) to create additional capacity in the receiving water so*

*that the project will meet water quality standards. If **NO**, proceed to Section 2A-2.5.4.*

2A-2.5.4 Is the established or acquirable right of way for stormwater control facilities located within a 100-year floodplain? (YES/NO)

*EEF implications: If **YES**, the established or available land is within a 100-year floodplain and it is not feasible to construct functional stormwater control facilities within the right of way. Project offices should reevaluate drainage and BMP designs to investigate whether stormwater control facilities could be reconfigured or moved to avoid or minimize the 100-year floodplain. If avoidance and minimization are not possible, other options to create capacity should be identified to maintain or restore the water quality and hydrology baselines impacted by the project and to comply with the antidegradation clause of the federal Clean Water Act and State Water Pollution Law (RCW 90.48). Consider using off-site or watershed-based options (see Sections 1-1.3 and 2-7.3) to create additional capacity in the receiving water so that the project will meet water quality standards. If **NO**, proceed to Section 2A-2.6.*

2A-2.6 Cost Limitations to Construction Feasibility

In 2003 WSDOT performed an environmental mitigation cost analysis. Critical factors found to affect stormwater management costs included the location and setting of the specific projects relative to neighborhoods, streams, and wetlands. In addition, projects with poor soil conditions or high water tables generally had considerably higher costs for treating stormwater within the right of way. In discussions with the authors of the cost analysis, it was determined that project delivery would be impeded when stormwater costs exceeded a range of $5 to $7 per square foot of contributing impervious surface. Using a range of values allows project offices some flexibility to determine cost/benefit feasibility based on the project's setting.

2A-2.6.1 Within individual drainages, will the incremental cost for constructing in-ROW stormwater control facilities be more than $5 to $7 per square foot of contributing impervious surface? (YES/NO)

*EEF implications: If **YES**, it is generally not feasible to construct in-ROW stormwater control facilities. Project offices should investigate how project designs can be altered to accommodate more cost-efficient BMPs. Projects within highly urbanized areas or those that may impact significant areas of wetlands or floodplains should generally use the $7 per square foot criterion, while those projects in more rural areas should generally use the $5 per square foot criterion for evaluating benefit/cost feasibility. If **NO**, it is feasible to construct stormwater control facilities within or adjacent to the highway right of way.*