Chapter 1 Design Policy

1-1 Introduction

This *Hydraulics Manual* provides policy for designing hydraulic features related to Washington State Department of Transportation (WSDOT) roadways including hydrology, culverts, open-channel flow, drainage collection and conveyance systems, water crossings, and pipe materials. These hydraulic features maintain safe driving conditions and protect the roadway from surface and subsurface water. The chapters contained in the *Hydraulics Manual* are also based on the Federal Highway Administration's (FHWA's) *Hydraulic Engineering Circulars* (HECs) and the American Association of State Highway and Transportation Officials (AAS*HTO) Drainage Manual*.

The *Hydraulics Manual* makes frequent references to WSDOT's *Highway Runoff Manual*, which provides WSDOT's requirements for managing stormwater discharges to protect water quality, beneficial uses of the state's waters, and the aquatic environment in general. The intent is to use the two manuals in tandem for complete analysis and design of stormwater facilities for roadway and other transportation infrastructure projects. Projects should consult WSDOT's *Design Manual* for general hydraulic design guidance. Design-build projects should also consult the *Design Manual* and the *Design-Build Manual*.

In addition to the guidance in the *Hydraulics Manual*, the designer should use good engineering judgment and be mindful of WSDOT's legal and ethical obligations concerning hydraulic issues. Drainage facilities must be designed to convey water across, along, or away from the highway in the most economical, efficient, and safe manner possible without damaging the highway or adjacent properties and without causing permit violations. Furthermore, care must be taken so that highway construction does not interfere with or damage any of these facilities.

This chapter explains WSDOT policy regarding hydraulic design and hydraulic reports. In Section 1-2, the roles and responsibilities of the Project Engineer's Office (PEO), Region Hydraulics Engineer (RHE), and WSDOT Headquarters (HQ) Hydraulics Section are defined. WSDOT has specific documentation requirements for a hydraulic report, which are specified in Section 1-3. Each hydraulic feature is designed based on specific design frequencies and, in some cases, a specific design tool or software. A summary of the design frequency and design tools or software for most hydraulic features contained in the *Hydraulics Manual* is provided in Section 1-4. Section 1-5 defines the process for reviewing and issuing concurrence of a hydraulic report.

1-2 Responsibility

The PEO is responsible for the preparation of correct and adequate drainage design. All drainage structure types, culverts, storm sewer, drainage, general pipe connections, and pipe locations must be verified and annotated by the PEO. Actual design work may be

performed by the PEO, by another WSDOT office, or by a private consulting engineer; however, in all cases, it is the PEO's responsibility to complete the design work and verify that a hydraulic report is prepared as described in Section 1-3. In addition, the hydraulic report shall follow the review process outlined in Section 1-5. The PEO is also responsible for initiating the application for hydraulic-related permits required by various local, state, and federal agencies.

While the PEO is responsible for preparation of hydraulic reports and plans, specifications, and estimates (PS&E) for all drainage facilities, assistance from the RHE and the State Hydraulics Office may be requested for any drainage facility design. The RHE and State Hydraulics Office offer technical assistance to PEOs and local programs for the items listed below:

1. Hydraulic design of drainage facilities (culverts, storm sewers, stormwater best management practices [BMPs], siphons, channel changes, etc.).
2. Hydraulic design of structures (culverts, headwalls, etc.).
3. Analysis of closed drainage basins and unusual or unique drainage conditions.
4. Upstream and downstream analysis to identify and evaluate potential impacts from the project on the hydraulic conveyance system near the project site. The analysis shall be divided into three sections:
    a. Review of resources
    b. Inspection of drainage conveyance systems in the site area
    c. Analysis of upstream effects
    d. Analysis of downstream effects

The roles and responsibilities of the RHE and State Hydraulics Office are outlined in Table 1-1. The State Hydraulics Office also takes primary responsibility for the following:

1. Design of habitat features and stream restoration elements.
2. Hydraulic analysis (one-dimensional [1D] and two-dimensional [2D]) and support for scour of water crossings.

1. Analysis of streambank erosion along roadways and river and stream lateral migration, and the design of countermeasures for scour and stream instability and environmental mitigation.
2. Floodplain studies, flood predictions, and special hydrological analysis (snowmelt estimates, storm frequency predictions, etc.).
3. Wind and wave analysis.
4. Technical support to local programs for hydraulic or bridge-related needs.
5. Providing the Washington State Attorney General's Office with technical assistance on hydraulic issues.
6. Updating information in the *Hydraulics Manual* periodically.

7. Providing technical information for the *Highway Runoff Manual* updates.
8. Maintaining WSDOT's Standard Plans; *Standard Specifications for Road, Bridge, and Municipal Construction* (Standard Specifications); and General Special Provisions involving drainage-related items.
9. Designing water supply and sewage disposal systems for safety rest areas. The PEO is responsible for contacting individual fire districts to collect local standards and forward the information to the State Hydraulics Office.
10. Reviewing and concurring with Type A hydraulic reports, unless otherwise delegated to the RHE by the State Hydraulics Office.
11. Providing the regions with technical assistance on hydraulic issues that are the primary responsibility of the PEO.
12. Providing basic hydrology and hydraulics training material to the regions. Either region or HQ personnel can perform the actual training. (See the State Hydraulics Office on the WSDOT Hydraulics Training web page for information on course availability.)

1-3 Hydraulic Reports

The hydraulic report is intended to serve as a complete documented record containing the engineering justification for all drainage and stormwater installations and modifications that occur as a result of the project. The primary use of a hydraulic report is to facilitate design review and to assist in PS&E preparation. The hydraulic report should be well written, show conditions before and after construction, and be defensible in a court of law. This section contains specific guidance for developing, submitting, and archiving a hydraulic report.

A *Fish Passage and Stream Restoration Design* (FPSRD) certificate number is required for all authors and co-authors of any portion of a fish passage and stream restoration design specialty report. See Table 1-1 for a list of specialty reports and other requirements. An FPSRD certificate number is given to those who have viewed all of the training modules and successfully passed the comprehensive exam. Additional information, training resources, and the point of contact for this training can be found on the WSDOT Hydraulics Training web page. As WSDOT updates the FPSRD training modules a re-certification number is also required. Any updates to this training will be posted on the WSDOT Hydraulics Training web page.

A *Highway Runoff Manual* certificate number is required for the stormwater designer who designs a new stormwater BMP on WSDOT right-of-way (ROW) or modifies an existing stormwater BMP on WSDOT ROW, or where a stormwater BMP is designed or modified and will be turned back to WSDOT ownership. The *Highway Runoff Manual* certificate number is given to those who have successfully passed the *Highway Runoff Manual* training course. See training information on the WSDOT Hydraulics Training web page.

A scour analysis is required for all WSDOT projects or WSDOT-managed infrastructure

associated with scour or that have a potential to be impacted by scour, such as water crossings, walls, roadway embankments, and other WSDOT infrastructure. A *WSDOT Scour Certification Record* (SCR) number is required for all stream team members that are conducting scour calculations, lateral migration, scour analysis, and reviews as part of or supporting specialty reports. See Table 1-1 for a list of specialty reports and other requirements. An SCR certificate number is given to those who have viewed all the WSDOT Scour Training Workshops and FHWA Bridge Scour Workshop Recordings; completed National Highway Institute (NHI) Course 135046, *Stream Stability and Scour at Highway Bridges*, *and* NHI Course 135048, *Countermeasures Design for Bridge Scour and Stream Instability*; and successfully passed the comprehensive exam. Additional information, training resources, and the point of contact for this training can be found on the WSDOT Hydraulics Training web page. As WSDOT updates the Scour Training modules a re-certification number is also required. Any updates to this training will be posted on the WSDOT Hydraulics Training web page.

The following training courses are required to obtain a scour certification:

- FHWA Bridge Scour Workshop Recordings
- NHI Course 135046, *Stream Stability and Scour at Highway Bridges*
- NHI Course 135048, *Countermeasures Design for Bridge Scour and Stream Instability*
- WSDOT 2023 Scour training

1-3.1 *Hydraulic Report Types*

There are three types of hydraulic reports: specialty report, Type A, and Type B. Table 1-1 provides guidance for selecting the report type; however, consult the RHE for final selection.

Table 1-1 Hydraulic Report Documentation

Report Type[a]	Description[b]	Concurrence[c]		PE Stamp
		RHE	State Hydraulics Section	
Specialty report[d]	Projects with any of the following components: • Culverts or buried structures greater than 48 inches in diameter or large-span culverts • Bridge drainage • Fish passage[e] • Bank protection • Large woody material (LWM)[e] • River structures (e.g., barbs, engineered log jams, levees)[e] • Channel realignment/modifications or restoration[e] • Any fills in floodplain or floodway • Pump stations • Hydraulic connectivity zones • Siphons • Bridges • Scour analysis (e.g., bridges, walls, roadway embankments, other WSDOT infrastructure)[f]		✓	✓[g]
A[d]	Projects with any of the following components: • Water quality treatment facility • Flow control facility • Storm sewer systems that discharge into a stormwater treatment or flow control facility • Create, modify, or remove any existing or new BMP (full or partial treatment BMP) • Fish passage stormwater treatment assessment for full or partial treatment[h] • Region facilities projects[i]	✓[i,j]		✓
B[c, d]	Projects without Type A components and with any of the following components: • Stormwater and non-fish passage culverts up to 48 inches in diameter[d] • Storm sewer systems that do not discharge into a stormwater treatment or flow control facility • Paving/safety restoration and preservation projects	✓		✓

Notes:

HQ = Washington State Department of Transportation Headquarters.
PE = Professional Engineer.
RHE = Region Hydraulics Engineer.

a. During scoping, all projects shall conduct a stormwater and hydraulic assessment per *Design Manual*, Chapter 800.
b. Projects listed are examples. Projects not listed may still require a specialty report based on direction from the RHE.
c. In no case may the PEO provide concurrence on its own design.
d. For design-build projects, HQ and the identified concurring RHE or State Hydraulics Office shall be involved in developing the scope, budget, schedule, and the Request for Proposal. The identified concurring hydraulic engineer shall verify that the Stormwater BMP Maintenance Plans and Preliminary and Final Hydraulic Design Report meet the Mandator Standards per the Request for Proposals 2.14 and 2.30, respectively.
e. Fish passage projects shall be designed by a stream design team consisting of a hydraulic engineer, geomorphologist/hydrologist, and biologist, who shall all co-author the specialty report and have received their

FPSRD certifications.

f. Scour certification is required for stream design engineers, hydraulic engineers, geomorphologists, or any other team members conducting and reviewing scour calculations and analysis.
g. The PE stamp shall be either by the State Hydraulics Office or by a licensed engineer approved by the State Hydraulics Office.
h. All fish passage projects shall complete a stormwater assessment for the feasibility of full or partial stormwater treatment BMPs. See *Highway Runoff Manual* for more information.
i. Facilities designed by the RHE will have concurrence from the State Hydraulics Office.
j. The State Hydraulics Office is delegating final review authority and concurrence for all Type A hydraulic reports to a person designated by the assistant regional administrator for development in each region.

1-3.2 *Preparing a Stormwater and Drainage Hydraulic Report*

The overall hydraulic design process is part of scoping, predesign, design, and construction. To allow the most efficient hydraulic report review and assessment, PEOs shall follow the hydraulic review process outlined in Section 1-5.

1-3.2.1 Hydraulic Report Content and Outline

The hydraulic report checklist identifies the required subject matter that the hydraulic report should contain. PEOs shall provide a well-organized report such that an engineer with no prior knowledge of the project could read and fully understand the hydraulic/hydrologic design decisions made for the design of the project. The report shall contain enough information to allow reproduction of the design in its entirety, but at the same time PEOs should be concise and avoid duplicate information that could create confusion. Because the software used for analysis will change over time, all assumptions and input parameters shall be clearly documented to allow the analysis to be reproduced in other software in the future, if needed.

In addition, a Type A hydraulic report outline has been developed as a starting point. Although use of the outline is not mandatory, organizing reports in the outline format may expedite the review process. Because some regions have modified the outline to meet specific regional needs or requirements, PEOs should contact their RHE to determine the correct outline before starting a report. Once the relevant outline is selected, PEOs shall read through the outline, determine which sections are applicable to the project, and delete those that are not. Either the RHE or the State Hydraulics Office can be contacted for assistance in preparing a Type A hydraulic report and for current updates to the hydraulic report outline.

The author should not copy sections of the *Hydraulics Manual* or *Highway Runoff Manual* into the hydraulic report because it would add redundant information to the report. Instead, authors should reference the relevant section and version in the hydraulic report narrative.

1-3.2.2 Deviations from the *Hydraulics Manual*

An author who deviates from the requirements in the *Hydraulics Manual* must clearly state why a deviation is necessary and document all the steps used in the analysis in a hydraulic deviation. Deviations from this manual require approval prior to submitting a hydraulic report for review. Requests for a deviation shall go through the RHE to the State Hydraulics Office engineering staff. A Hydraulic Deviation template is available on the WSDOT Hydraulics & hydrology website under the Tools, templates & links tab.

1-3.2.3 Design Tools and Software

The design tools and programs described in the *Hydraulics Manual* and in the *Highway Runoff Manual* shall be used whenever possible. To determine if software and/or a design tool is required, PEOs shall review Section 1-4 or check the expanded list on the State Hydraulics Office web page. If a PEO wishes to use a design tool or software other than those required, it must request concurrence during the 10 percent milestone timeline for the hydraulic report through the RHE.

1-3.2.4 Contract or Scope of Work for Hydraulic Support

Contact the RHE and/or State Hydraulics Office to review the contract or scope prior to hiring a consultant.

1-3.3 *Hydraulic Report Submittal and Archiving*

Hydraulic reports shall be submitted to the following offices.

1-3.3.1 Review Copies

PEOs shall submit a complete searchable electronic copy of the hydraulic report to the appropriate concurring authority (RHE and/or State Hydraulics Office; see Table 1-1) for review. To allow the most efficient hydraulic report review, PEOs shall follow the hydraulic review process outlined in Section 1-5. To allow the most efficient hydraulic report review, PEOs shall follow the hydraulic review process outlined in Section 1-5. Final concurrence of the hydraulic report will be issued once the report complies with the *Hydraulics Manual* and the *Highway Runoff Manual* and all reviewer comments are satisfactorily addressed.

1-3.3.2 Final Copies

Upon concurrence, PEOs shall submit a searchable electronic copy of the hydraulic report and the original concurrence letter shall be sent to the offices noted below. Electronic copies shall include the entire contents of the hydraulic report (including the appendices files) in a Portable Document Format (PDF) file.

1. Send one PDF to the Construction Office for reference during construction.
2. For water crossings documented in Final Hydraulic Design (FHD) reports, send one PDF to the Bridge Preservation Office.
3. For design-bid-build projects, the FHD report that received concurrence becomes the official record of copy. Along with the original concurrence letter, the PEO shall upload the FHD report to the Enterprise Content Management (ECM) application along with the Design Decision Package (DDP). If any stormwater or hydraulic change occurs that affects a hydraulic feature's intended function and this change occurs after the FHD report concurrence (e.g., during construction or final PS&E), the FHD report shall be updated in the ECM to include stormwater and hydraulic changes per Section 1-3.4 prior to construction project closeout. Changes require approval from either the State Hydraulics Office or RHE depending on the report type per Table 1-1.
4. For design-build projects, the FHD report shall be uploaded to the ECM application by the construction project office.

1-3.4 *Hydraulic Report Revisions and Supplements*

An approved hydraulic report may need to be revised because of design changes during the design phase or construction phase of the project. There are two ways to submit a change:

1. **Revision:** A revision is a correction to the existing report because of either an error or omitted design documentation. The PEO shall submit the revision along with a new title page that is stamped and signed by the PE with the same date as the revision or later.
2. **Supplement:** A supplement is a change that was not part of the original scope of work. The same approval process is required as with the original report; however, the supplement shall be a standalone document that references the original report. The supplement shall indicate what the existing design was and how the existing design has changed as well as describe why the change was necessary.

Either type of change shall be included in a submittal package with the changes clearly documented as well as supporting analysis and data including any revised plans, calculations, and other updates, as warranted, to support the change. The package shall be submitted to the concurring authority following the guidance in Section 1-3.3 and as shown on .

1-3.5 *Hydraulic Reports and Design-Build Projects*

Design-build projects present design and schedule challenges so PEOs shall coordinate the hydraulic design with both the RHE and State Hydraulics Office throughout the project. In addition to the guidance in the *Hydraulics Manual* and the *Highway Runoff Manual*, PEOs shall consult the *Design-Build Manual*.

Prior to the Request for Proposal phase of the project, a conceptual design hydraulic report(s) is prepared that serves as the basis of a bid and further development by the selected design-build contractor. Refer to the design-build Request for Proposal template for more information on required reporting.

1-3.6 *Developers and Utility Agreements*

Developers, state and local agencies, utilities, and others designing stormwater facilities within the WSDOT ROW shall assume the same responsibility as the PEO and prepare hydraulic reports in compliance with the policy outlined in Chapter 1. Developers, state and local agencies, utilities, and others discharging stormwater to the WSDOT ROW may need a permit. For more information on requirements and permits for discharging to the WSDOT ROW and/or building on the WSDOT ROW, consult the *Design Manual*, Utilities Manual, and Local Agency Guidelines manual.

1-3.7 *Upstream and Downstream Analysis*

Conducting an upstream and downstream analysis as part of a Type A or B or specialty report identifies, evaluates, and documents the impacts and risks, if any, that a project

will have on the drainage conveyance system, properties, and sensitive areas. All projects that propose to discharge stormwater from WSDOT ROW and meet the requirements below are required to provide an analysis as part of the hydraulic report; see the hydraulic report outline for more information. For projects that require a flood risk assessment see additional guidance in Chapter 7.

- Projects that add 5,000 square feet or more of new, impervious surface area
- Projects where known drainage or erosion problems indicate there may be impacts on either the upstream or downstream conveyance system, properties, or sensitive areas
- Projects that add less than 5,000 square feet of new, impervious surface and where the project is within 300 feet of a stream or if the project's stormwater discharges into a stream within 0.25 mile upstream or downstream of WSDOT's ROW
- Projects that alter existing hydrology or drainage

1-3.7.1 Upstream and Downstream Analysis for Type A and B Reports

At a minimum, the analysis must include the area of the project site to a point 0.25 mile downstream of the site and upstream to a point where any backwater conditions cease. The results of the analysis must be documented in the project hydraulic report. Potential impacts to be assessed in the report also include but are not limited to changes in flows for extreme events, changes in flood duration, water surface elevations (WSELs), bank erosion, channel erosion, and nutrient loading changes from the project site. The analysis is divided into three steps that follow sequentially:

1. Review of resources
2. Inspection of drainage conveyance systems in the site area
3. Analysis of upstream and downstream effects

1-3.7.2 Review of Resources

The PEO reviews available resources to assess the existing conditions of the drainage conveyance systems in the project vicinity. Resource data commonly include aerial photographs, area maps, floodplain maps, wetland inventories, stream surveys, habitat surveys, engineering reports concerning the entire drainage basin, the *Climate Impacts Vulnerability Assessment* statewide map, geographic information system (GIS) and light detecting and ranging (LiDAR) information, and any previously completed upstream or downstream analyses. All of this information shall encompass an area 0.25 mile downstream of the project site's discharge point from WSDOT's ROW and upstream to a point where any backwater conditions cease.

The background information is used to review and establish the existing conditions of the drainage conveyance system. This baseline information is used to determine whether the project will improve upon existing conditions, have no impact, or degrade existing conditions if no mitigating measures are implemented. The RHE and HQ Environmental Services Office staff will be able to provide most of this information. Other resource information sources include the Washington State Department of Ecology (Ecology), the Washington Department of Fish and Wildlife (WDFW), and local

agencies.

1-3.7.3 Inspection of Drainage Conveyance System

The PEO must inspect the conveyance system and identify any existing problems that might relate to stormwater runoff. The PEO will physically inspect (if possible) the drainage conveyance system at the project site and downstream from the WSDOT ROW for a distance of at least 0.25 mile and upstream to a point where any backwater conditions cease. The inspection shall include any problems or areas of concern that were noted during the resource review process or in conversations with local residents and the WSDOT Maintenance Office. The PEO shall also identify existing or potential conveyance capacity problems in the drainage system, existing or potential areas where flooding may occur, existing or potential areas of extensive channel destruction or erosion, and existing or potential areas of significant destruction of aquatic habitat (runoff treatment or flow control) that can be related to stormwater runoff. If areas of potential and existing impacts related to project site runoff are established, actions must be taken to minimize impacts to upstream and downstream resources.

1-3.7.4 Analysis of Upstream and Downstream Effects

This final step analyzes information gathered in the first two steps of the analysis. It is necessary to determine if the project will create any drainage conveyance problems downstream or make any existing problems worse. The PEO must analyze upstream and downstream effects to determine corrective or preventive actions that may be necessary. If the project is within a medium- or high-vulnerability location according to the *Climate Impacts Vulnerability Assessment* statewide map, the PEO must run extreme events (for example, the 100-year storm event) and evaluate the impacts and stability of the conveyance system. The PEO will perform a risk assessment based on the extreme events showing impacts to the conveyance system and to downstream properties and sensitive areas.

PEOs will consult the *Highway Runoff Manual* for further guidance on the design flow for runoff treatment and flow control BMP design. In some cases, analysis of effects may indicate that no corrective or preventive actions are necessary. If corrective or preventive actions are necessary, the following options must be considered:

- Design the on-site treatment and/or flow control facilities to provide a greater level of runoff control than stipulated in the minimum requirements in Chapter 3 of the *Highway Runoff Manual*.
- Take a protective action separate from meeting Minimum Requirements 5 and 6 in the *Highway Runoff Manual* for runoff treatment and flow control. In some situations, a project will have negative impacts even when the minimum requirements are met. Below are two examples:
    - Roadway runoff in a project's threshold discharge area (TDA) was sheet-flowing to the roadway side slopes in the pre-developed condition but is now being collected and conveyed to a stormwater detention pond in the post-developed condition. The detention pond's emergency overflow usually discharges to the same location as the riser structure and overflow structure but sometimes discharges to a different location. In both scenarios, even

though the detention pond will provide flow control for more frequent storm events (up to the 25-year for eastern Washington or 50-year for western Washington), the larger, less frequent storm events (100-year) may not have flow control. These scenarios need to be analyzed as part of the downstream analysis. Because the stormwater is now collected and conveyed to one or two discharge locations, there may be more flow at those discharge locations than in the pre-developed condition. If a situation is encountered where downstream impacts will result from the project, the corrective action must be applied to the project based on a practicability analysis.

- If a project is flow control exempt, the conveyance system downstream of the project site shall be inspected to ensure adequate capacity. The PEO shall also analyze and document any changes to the downstream conveyance system, properties, and sensitive areas. If there are any negative impacts, the PEO shall perform a risk analysis showing what would happen if no actions were taken to minimize the negative impacts.

1-3.8 *Existing Stormwater Drainage Conveyance System*

During the scoping phase, a stormwater and hydraulic assessment is done for the project. If the assessment identified any parts of the existing stormwater drainage conveyance system (culverts, storm sewers, catch basins, manholes, inlets, grates, and ditches) to be repaired or replaced by the project, a physical inspection of the entire existing stormwater drainage conveyance system within the project limits is required. There may be condition ratings for some of these existing stormwater features in Highway Activities Tracking System (HATS) or the Stormwater Features Inventory that may aid in determining the physical inspection requirements. Contact the State Hydraulics Office for culvert Level 1 and Level 2 inspection requirements and guidelines. See the 2020 AASHTO Culvert and Storm Drain System Inspection Guide for guidance on inspecting storm sewer, catch basins, manholes, inlets, grates, and ditches.

1-4 Storm Frequency Policy and Design Tools and Software

WSDOT policy regarding design storm frequency for hydraulic structures has been established so the PEO does not have to perform a risk analysis for each structure on each project. The design storm frequency is referred to in terms of mean recurrence interval (MRI) of precipitation. A more detailed discussion of MRI can be found in Chapter 2. New hydraulic structures shall also consider climate resilience for final design size by evaluating higher storm events. Consult the RHE and the State Hydraulics Office early for discussion and concurrence climate-resilient designs.

For design of hydraulic features, the PEO shall review Section 1-3.2.3 for required design tools and software. The PEO shall work with the RHE to verify that the required design tools and software are used for design of hydraulic features.

If the PEO wants to use a design tool or hydraulic software that has not been approved by the State Hydraulics Office, the PEO shall provide a side-by-side comparison analysis showing the differences between the approved design tool or approved software and

the proposed design tool or proposed software. The analysis shall be submitted to the RHE for review and approval. The approval of using an alternative design tool or alternative software shall be obtained before the intermediate hydraulic report can be submitted. Contact the RHE for additional guidance.

Table 1-2 presents a design reference chart and approved software.

Table 1-2 Design Reference

Type of Structure	MRI Chapter Reference	Approved Software
Gutters	5	Inlet spreadsheet
Storm sewer inlets on longitudinal slope	6 (MRI based on farthest downstream BMP or 10 year, whichever is greater)	Inlet spreadsheet
Storm sewer inlets on vertical curve sag/closed contour location	6 (MRI based on farthest downstream BMP or 50, whichever is greater)	Sag spreadsheet
Storm sewers	6[b] (MRI based on farthest downstream BMP or 25)	StormShed3G
Ditches	4	StormShed3G or FHWA Hydraulic Toolbox
Non-fish passage culverts[a]	3	HY-8, HEC-RAS, SRH-2D[C]
Temporary diversions[a]	3	StormShed3G, HY-8, HEC-RAS, SRH-2D[C]
Water crossings	7 (Table 7-1)	SRH-2D[C]
Stormwater BMP	See the *Highway Runoff Manual*	

Notes:

a. Coordinate with the Region Hydraulic Engineer to determine the appropriate software to use and potential reports required.

b. When tying into existing systems, the hydrologic methods used shall be the rational method.

c. Use the model checklist found on WSDOT's Hydraulics & hydrology website under the Tools, templates & links tab.

1-5 Hydraulic Report Review Schedule

Hydraulic reports developed for WSDOT must be reviewed and receive concurrence by the State Hydraulics Office or RHE (per Table 1-1) prior to the project advertisement date. The State Hydraulics Office has delegated concurrence authority to RHEs. PEOs shall contact the RHE to verify the hydraulic report review process.

To help facilitate an efficient design and review process, a hydraulic report review process has been developed. The review will consist of several checkpoints or milestones of the design as it is being developed, followed by a complete review of the report. The purpose of the milestones is to establish communication among the PEO, the RHE, and/or the State Hydraulics Office, and other internal and external stakeholders during the hydraulic design. Each prescribed milestone is considered complete when the corresponding checklist is completed, along with deliverables, and submitted to the RHE reviewer(s).

1-5.1 *Milestones and Scheduling*

WSDOT has developed the Project Management and Reporting System to track and manage projects. This system uses a master deliverable list (MDL) to identify major elements that occur during most projects. The MDL is intended to be a starting point for creating a work breakdown structure and identifies specific offices with which the PEO should communicate during project schedule development. The current MDL identifies three options for hydraulics (see Section 1-3):

- Type A report
- Type B report
- Specialty report

Regardless of the type of report, the milestones identified in

Table 1-3 apply. At the 10 percent milestone, all projects with hydraulic features shall develop an approved hydraulic schedule. At a minimum, the schedule shall include the milestones with agreed-upon dates by the PEO, the RHE, and the State Hydraulics Office. Additional guidance will be provided in future revisions to the *Hydraulics Manual*.

Table 1-3 Hydraulic Report Review Schedule

Percentage	Milestone	Project Alignment	Estimated Task Durations[a]	Date of Completion
0	Define project	Project definition complete MDL 320	TBD	TBD
10	Develop approved schedule	TBD	TBD	TBD
30	Design planning checklist complete	Design approved MDL 1685	TBD	TBD
60	Conceptual design complete	Complete prior to starting design	TBD	TBD
90	Draft hydraulic report submitted for review and concurrence	TBD	TBD	TBD
TBD	Revisions and supplements	Complete prior to hydraulic report archive	TBD	TBD
100	Hydraulic report concurrence	Complete prior to project design approval	TBD	TBD
CN	Hydraulic Report supplement	Complete prior to operationally complete	TBD	TBD

Notes:

MDL = master deliverable list.

PEO = Project Engineer's Office.

TBD = to be determined.

CN = construction phase of a project.

a. Allow additional time for projects submitted around major holidays.