Chapter 1 Design Policy

1-1 Introduction

This *Hydraulics Manual* provides the guidance for designing hydraulic features related to the Washington State Department of Transportation's (WSDOT's) transportation design including hydrology, culverts, open-channel flow, drainage collection and conveyance systems, fish passage, 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 based on the Federal Highway Administration's (FHWA's) Hydraulic Engineering Circulars (HECs) that are located at www.fhwa.dot.gov/bridge/hydpub.htm.

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* (2018b) for general hydraulic design guidance. Design-build projects should also consult the *Design Manual*.

In addition to the guidance in the *Hydraulics Manual*, the Project Engineer's Office (PEO) should use good engineering judgment and be mindful of the legal and ethical obligations of WSDOT concerning hydraulic issues. Drainage facilities must be designed to convey the 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 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 PEO, Region Hydraulics Engineer (RHE), and the WSDOT Headquarters (HQ) Hydraulics Section are defined. WSDOT has specific documentation requirements for the 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 recommended 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. 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 the preparation of hydraulic reports and plans, specifications, and estimates (PS&E) for all drainage facilities except bridges, assistance from the RHE and the HQ Hydraulics Section may be requested for any drainage facility design. The RHE and HQ Hydraulics Section offer technical assistance to PEOs, WSDOT consultants, 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, fish ladders, etc.).
3. Hydraulic support for bridge scour, bridge foundations, water surface profiles, and analysis of floodwaters through bridges.
4. Analysis of streambank erosion along roadways and river migration and the design of channel stabilization countermeasures and environmental mitigation.
5. Floodplain studies, flood predictions, and special hydrological analysis (snowmelt estimates, storm frequency predictions, etc.).
6. Analysis of closed drainage basins and unusual or unique drainage conditions.
7. Downstream analysis to identify and evaluate impacts from the project on the hydraulic conveyance system downstream of the project site. The analysis shall be broken into three sections:
    a. Review of resources
    b. Inspection of drainage conveyance systems in the site area
    c. Analysis of downstream effects
8. Wind and wave analysis on open-water structures.
9. Technical support to local programs for hydraulic or bridge-related needs.
10. Providing the Washington State Attorney General's Office with technical assistance on hydraulic issues.

The roles and responsibilities of the RHE and the HQ Hydraulics Section are outlined in Figure 1-1. The HQ Hydraulics Section also takes primary responsibility for the following:

Updating information in the *Hydraulics Manual* periodically.

1. Providing technical information for the *Highway Runoff Manual* updates.
2. Maintaining WSDOT's *Standard Plans for Road, Bridge, and Municipal Constuction* (*Standard Plans*; 2018c); *Standard Specifications for Road, Bridge, and Municipal Construction* (*Standard Specifications*; 2018d); and General Special Provisions involving drainage-related items.
3. 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 HQ Hydraulics Section.
4. Reviewing and concurring with Type A hydraulic reports, unless otherwise delegated to the RHE by the HQ Hydraulics Section.
5. Providing the regions with technical assistance on hydraulic issues that are the primary responsibility of the PEO.
6. Providing basic hydrology and hydraulics training material to the regions. Either region or HQ personnel can perform the actual training. (See the HQ Hydraulics Section web page for information on course availability: www.wsdot.wa.gov/design/hydraulics/training.htm.)

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 *Highway Runoff Manual* certificate number is required for the stormwater designer that 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. The link to the training course is www.wsdot.wa.gov/Design/Hydraulics/Training.htm.

1-3.1 *Hydraulic Report Types*

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

Figure 1-1 Hydraulic Report Selection Table

Report Type	Description	Concurrence[1]		PE Stamp
		RHE	HQ Hydraulics Section	
Specialty Report[2]	Projects with any of the following components: • Culverts greater than 48 inches in diameter or large-span culverts[2] • Bridge • Fish Passage • Bank Protection • Large woody material • River structures (e.g., barbs, engineered logjams, levees) • Channel realignment/modifications or restoration • Any fills in floodplain or floodway • Pump stations • Hydraulic connectivity zones • Siphons		X	X[3]
A[2]	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[6] • Region facilities projects[5]	X[4][5]		X
B[2]	Projects without Type A components and with any of the following components: • Culverts up to 48 inches in diameter[2] • Storm sewer systems with 10 or less catch basins/manholes that do not discharge into a treatment or flow control facility • Paving/Safety Restoration and Preservation Projects	X		X

Notes:

HQ = Washington State Department of Transportation Headquarters

PE = Professional Engineer

RHE = Region Hydraulics Engineer

[1]In no case may the Project Engineer's Office provide concurrence on their own design.

[2]For design-build projects, the identified concurring RHE or HQ Hydraulics Section engineer shall be involved in developing the scope and the Request for Proposal. The identified concurring hydraulics engineer shall have rejection authority as per the Request for Proposal.

[3]The PE stamp shall be either by the HQ Hydraulics Section or by a licensed engineer approved by the HQ Hydraulics Section.

[4]The HQ Hydraulics Section 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.

[5]Facilities designed by the RHE will have concurrence from the HQ Hydraulics Section.

[6]All fish passage projects shall complete a stormwater assessment for the feasibility of full or partial stormwater treatment BMP's. See HRM for more information.

1-3.2 *Preparing a Hydraulic Report*

This section provides guidance for developing a hydraulic report.

1-3.2.1 Hydraulic Report Content and Outline

The hydraulic report checklist identifies the required subject matter that the hydraulic report should contain (see Appendix 1A). 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 designs made in 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 hydraulic report outline has been developed as a starting point (see Appendix 1B). Although use of the outline is not mandatory, organizing reports in the outline format may expedite the review process. Since 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, it is recommended that PEOs read through the outline, determine which sections are applicable to the project, and delete those that are not. Either the RHE or the HQ Hydraulics Section can be contacted for assistance in preparing a hydraulic report.

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

1-3.2.2 Deviations to the Hydraulics Manual

If the author deviates from the requirements in the *Hydraulics Manual*, they must clearly state why a deviation is necessary and document all the steps used in the analysis in the written portion of the hydraulic report. Deviations from either manual require approval prior to submitting a hydraulic report for review. Requests for a deviation shall go through the RHE to the HQ Hydraulics Section engineering staff.

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 utilized whenever possible. To determine if software and/or a design tool is recommended, PEOs shall review Section 1-4 or check the expanded list on the HQ Hydraulics Section web page: www.wsdot.wa.gov/design/hydraulics/programdownloads.htm. If a PEO wishes to use a design tool or software other than those recommended, they must request concurrence by the 10 percent milestone for the hydraulic report through the RHE (see Appendix 1A).

1-3.2.4 Contract or Scope of Work

PEOs should use caution when referencing the hydraulic report outline in contracts or scopes of work for consultants. Never contract or scope a consultant to only finish or complete the hydraulic report outline. The consultant should use the hydraulic report outline to develop the report in accordance with the *Hydraulics Manual*; the hydraulic report shall address all of the applicable minimum requirements in the *Highway Runoff Manual*. Contact the RHE and/or HQ Hydraulics Section 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 electronic and/or hard copy, depending on the reviewer's preference, of the hydraulic report to the appropriate concurring authority (RHE and/or HQ Hydraulics Section; see Figure 1-1) for review. To allow the most efficient hydraulic report review, PEOs shall follow the hydraulic review process outlined in Section 1-5 and shown in Figure 1-2. 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.

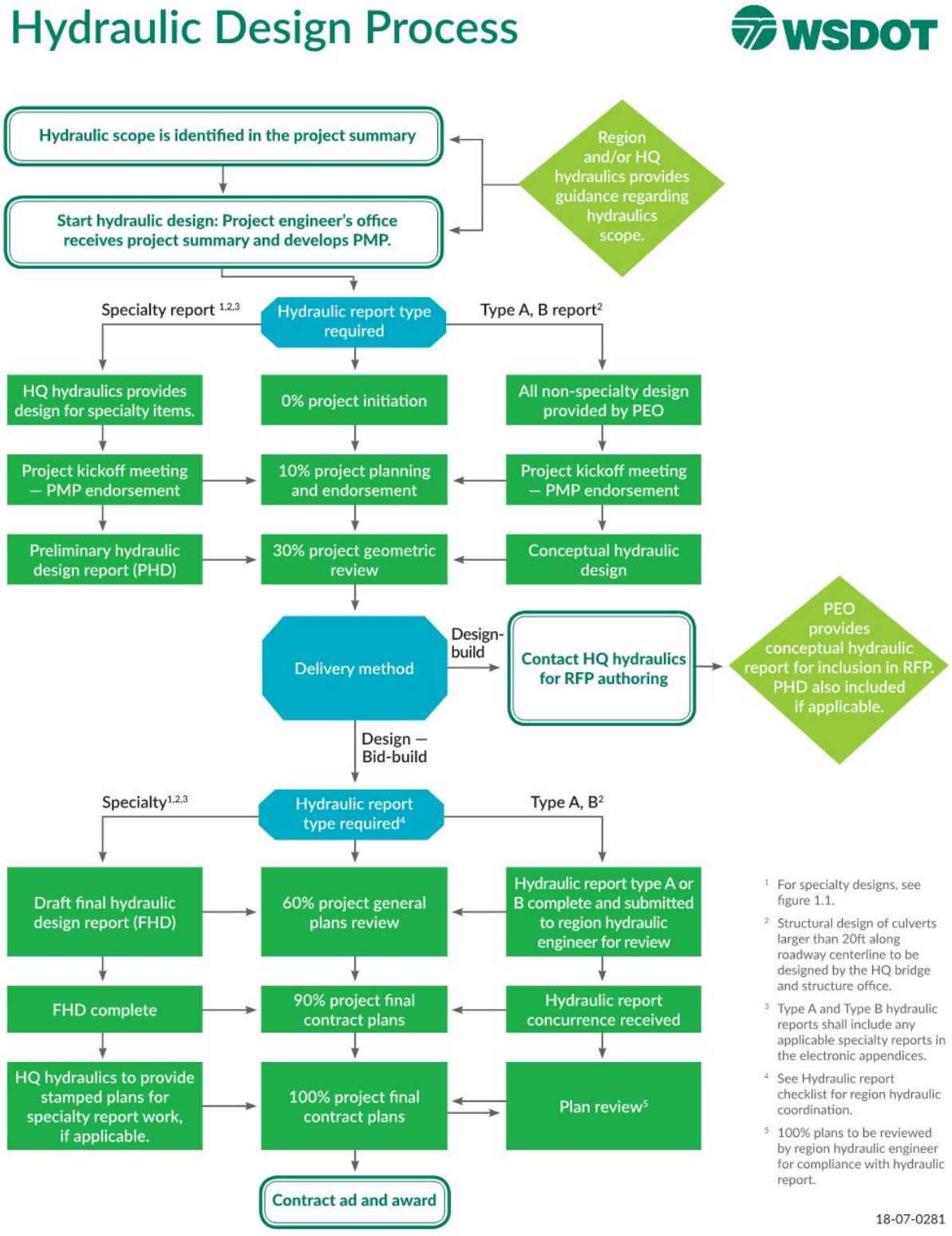
1-3.3.2 Final Copies

Upon concurrence, two hard copies and a searchable electronic copy of the hydraulic report and the original approval 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 PDF format.

1. Send one PDF or a hard copy to the Construction Office (whichever they prefer) for reference during construction.
2. Send one PDF and one hard copy to the RHE to be kept in a secure location as the record of copy for 10 years and then follow the state retention schedule.
3. Send one PDF to the HQ Hydraulics Section. The HQ Hydraulics Section will retain this copy for at least 10 years and then follow the state retention schedule.
4. Archive the original concurrence letter and original hydraulics report with the design documentation package.

The 10-year report retention period begins after construction is complete. However, WSDOT employees are directed to preserve electronic, paper, and other evidence as soon as they are aware of an incident that may reasonably result in an injury, claim, or legal action involving the department per WSDOT Secretary's Executive Order E 1041 (wsdot.wa.gov/docs/operatingrulesprocedures/1041.pdf). In some instances, this may extend beyond the 10-year retention period.

Figure 1-2 Hydraulic Design Process



1-3.4 *Hydraulic Report Revisions and Supplements*

At times, a hydraulic report may need to be revised due to design changes within a proposed project. There are two ways to submit a change:

1. **Revision.** A revision is a correction to the existing report either due to 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 stand-alone 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 Figure 1-1.

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

Design-build projects present design and schedule challenges so PEOs should coordinate the hydraulic design with both the RHE and the HQ Hydraulics Section throughout the project. In addition to the guidance in the *Hydraulics Manual* and the *Highway Runoff Manual*, PEOs shall also consult the *Design-Build Manual* (WSDOT 2018f).

Prior to the Request for Proposal phase of the project, a conceptual design hydraulic report 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 *Utilities Manual* (WSDOT 2018e), the *Development Services Manual* (WSDOT 2016), and the *Local Agency Guidelines* manual (WSDOT 2018a).

1-3.7 *Downstream Analysis*

A downstream analysis identifies and evaluates the impacts and risks, if any, a project will have on the drainage conveyance system, properties, and sensitive areas that are downstream of the project site. All projects that propose to discharge stormwater from WSDOT ROW and meet the requirements below are required to provide a downstream analysis as part of the hydraulic report, see the hydraulic report outline in Appendix 1B.

- 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 the 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 downstream of WSDOT's ROW.
- Projects that alter existing drainage.

1-3.7.1 Downstream Analysis 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, bank erosion, channel erosion, and nutrient loading changes from the project site. The analysis is divided into three parts that follow sequentially:

1. Review of resources.
2. Inspection of drainage conveyance systems in the site area.
3. Analysis of 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 includes 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 (WSDOT 2011), geographic information system (GIS) and LiDAR information, and any previously completed 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.

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 downstream 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 WSDOT ROW for a distance of at least 0.25-mile. 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 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 downstream resources.

1-3.7.4 Analysis of Downstream Effects

This final step analyzes information gathered in the first two steps of the downstream 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 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 Map (WSDOT 2011), 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 shall perform a risk assessment based on the extreme events showing impacts to the conveyance system and to downstream properties and sensitive areas.

PEOs shall 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 downstream 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 Nos. 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; for example, a site where the project discharges runoff into a small, closed-basin wetland even though a detention pond was installed to comply with Minimum Requirement 6. The total volume of runoff draining into the wetland will change, possibly affecting habitat and plant species in the area. If a situation is encountered where there will be downstream impacts resulting 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.

1-4 Storm Frequency Policy and Recommended Software/Design Tools

It is not practical to design hydraulic structures for the largest possible flow since this would result in unreasonably large and costly structures. Therefore, specific storm frequencies have been selected for various types of hydraulic structures. Selected storm frequencies for design purposes have considered the potential degree of damage to the roadway and adjacent property, potential hazard and inconvenience to the public, the number of users on the roadway, and the initial construction cost of the hydraulic structure.

The way in which these factors interrelate can be quite complex. WSDOT policy regarding design storm frequency for typical 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. Figure 1-3 lists the MRIs to be used for the design of new hydraulic structures. Based on past experience, these will give acceptable results in most cases. A more detailed discussion of MRI can be found in Chapter 2. New hydraulic structures shall also consider climate resiliency for final design size.

Occasionally, the cost of damages may be so great or the need to preserve the level of services using the roadway during higher storm events may be so important that a higher MRI is appropriate. As this is a departure from conventional design, it must go to the RHE and the HQ Hydraulics Section early for discussion and concurrence. Good engineering judgment must be used to recognize these instances, and the design should be modified accordingly. In high-risk areas, a statistical risk analysis (benefit/cost) may be needed to arrive at the most suitable frequency. This must go to the RHE and the HQ Hydraulics Section early for discussion and concurrence.

Figure 1-3 lists hydrology and hydraulic methods and approved software and design tools. A more detailed discussion of these hydrologic methods can be found in Chapter 2. Copies of the software or design tools can be found on the HQ Hydraulics Section web page: www.wsdot.wa.gov/design/hydraulics/programdownloads.htm.

PEOs proposing to use software that has not been approved need to perform a side-by-side comparison with an approved one. This should be done early in the schedule. Contact the RHE for additional guidance.

Figure 1-3 Design Frequencies, Hydrologic Methods, and Modeling Tools

Type of Structure	MRI[1] (Years)	Hydrologic Method	Hydraulic Design Tools and Software[2]
Gutters	10	Rational	Inlet spreadsheet
Storm Sewer Inlets • On longitudinal slope • Vertical curve sag/closed contour location	10 50	Rational	Inlet spreadsheet Sag spreadsheet
Storm Sewers[3][4] • Laterals • Trunk Lines	25 25	SBUH/SCS Curve Number Method Rational	StormShed3G or Storm sewer spreadsheet[5]
Ditches[4][6]	10	SBUH/SCS or Rational	StormShed3G or Manning's
Standard Culverts • Design for HW/D ratio[7] • Check for high flow damage	25 100	Published flow records Flood reports (flood insurance study) USGS regression Rational SBUH/SCS Curve Number Method	HY-8 or HEC-RAS
Bottomless Culverts[8] • Design for HW depth	100	Same as standard culverts (except Rational Method)	HY-8, HEC-RAS, or SRH-2D[9]
Temporary Bypass Pipes • Design for HW depth	2[7][8][9]	Published Flow records SBUH/SCS Continuous Simulation	StormShed3G, HY-8, HEC-RAS, or Manning's
Bridges/Fish Passage Culverts • Conveyance design and foundation scour • Check for high flow damage	100 500	Same as standard culverts (except Rational Method)	HEC-RAS (1D) or SRH-2D[9]
Stormwater BMP	See the *Highway Runoff Manual*		

Notes:

BMP = best management practice
HEC-RAS = Hydrologic Engineering Center's River Analysis System
HW/D = headwater/diameter
MRI = mean recurrence interval
SBUH/SCS = Santa Barbara Urban hydrograph/Soil Conservation Service
SRH-2D = Sedimentation and River Hydraulics – 2D Model
USGS = U.S. Geological Survey
WSDOT = Washington State Department of Transportation

[1]See the *Highway Runoff Manual* for further guidance on selecting design storms.

[2]If a different method or software is selected, the reason for not using the standard WSDOT method shall be explained and approved as part of the 10 percent submittal. The following web link contains a detailed description of all current programs and design tools recommended by WSDOT: www.wsdot.wa.gov/design/hydraulics/programdownloads.htm.

[3]When tying into existing system, the hydrologic methods used shall be the Rational Method.

[4]Storm sewers and ditches shall be designed to the same design frequency as the farthest downstream BMP.

[5]Must obtain prior approval from Region Hydraulics Engineer to use this method for designing storm sewers.

[6]More design guidance for roadside ditches can be found Chapter 4.

[7]For temporary culvert design, see Chapter 3.

[8]For non-fish bearing watercourses.

[9]In Federal Emergency Management Agency (FEMA) floodplains, use the same modeling methodology as FEMA for that floodplain.

1-5 Hydraulic Report Review Schedule

Hydraulic reports developed for WSDOT must be reviewed and receive concurrence by the HQ Hydraulics Section or RHE (per Figure 1-1) prior to the project advertisement date. The HQ Hydraulics Section has delegated concurrence authority to all HQ Hydraulics Section engineers and to some 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 between the PEO, the RHE and/or the HQ Hydraulics Section, and other internal and external stakeholders during the hydraulic design. Each prescribed milestone is considered complete when the corresponding checklist (see Appendix 1A) 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 utilizes 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 the PEO should communicate with during project schedule development. The current MDL identifies three options for hydraulics (see Section 1-3):

1. Type A report
2. Type B report
3. Specialty report

Regardless of the type of report, the milestones identified in Figure 1-4 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 HQ Hydraulics Section. Figure 1-4 should be used as a starting place. For Primavera users, a template that includes the milestones is available on the HQ Hydraulics Section web page: www.wsdot.wa.gov/design/hydraulics/default.htm. Additional guidance will be provided in future revisions to the *Hydraulics Manual*.

Figure 1-4 Hydraulic Report Review Schedule

Percent	Milestone	Project Alignment	Estimated Task Durations[1]	Date of Completion
0	Define project	Project definition complete MDL No. 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	Estimate six weeks for PEO to write and compile report contents. Once report is completed, allow eight weeks for region review, comments, and resolution of comments by PEO.	TBD
TBD	Revisions and supplements	Complete prior to hydraulic report archive	TBD	TBD
100	Hydraulic report archived	Complete prior to project design approval	TBD	TBD

Notes:
MDL = master deliverable list
PEO = Project Engineer's Office
TBD = to be determined
[1]Allow additional time for projects submitted around major holidays.

1-6 Appendices

Appendix 1A Hydraulic Report Checklist

Appendix 1B Hydraulic Report Outline

Appendix 1A Hydraulic Report Checklist

Please see the following link for the Hydraulic Report Checklist:

www.wsdot.wa.gov/design/hydraulics/default.htm

Note that an updated checklist is planned. Contact the RHE for the current checklist.

Appendix 1B Hydraulic Report Outline

Please see the following link for the Hydraulic Report Outline:

www.wsdot.wa.gov/design/hydraulics/default.htm