WSDOT
Scour Workshop

Module 11
Scour Analysis Review

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WSDOT

Current Duties

- Oversee scour and floodplain designs statewide
- Oversee fish passage projects in Southwest, South Central, North Central, and Eastern Regions
- Help with policy updates and training
- Assist Eastern Washington with stormwater management, and drainage materials

Background and Experience

- 16 total years at WSDOT
  - 10 years in South Central Region
  - 6 years in HQ Hydraulics

Education

- B.S. Civil Engineering (WSU)

Personal Interests

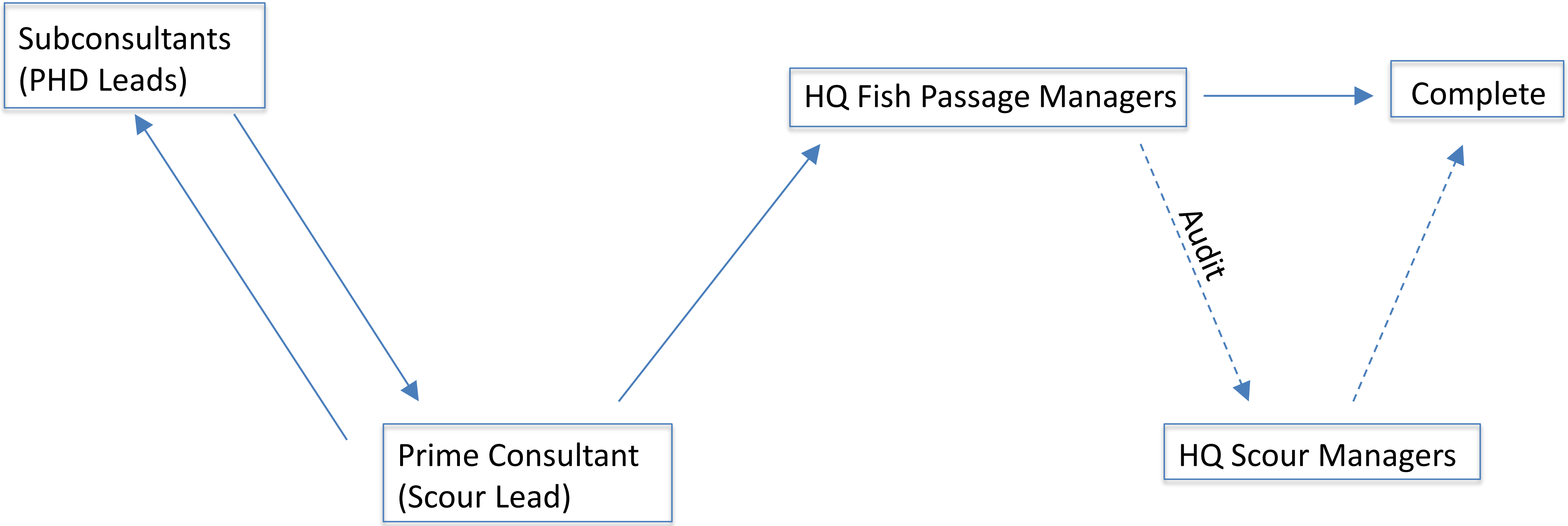
- Reading
- Video games
- Amateur poultryman
- Traveling

Roles and Responsibilities

WSDOT Scour Checklist

Section 1 - Basic WSDOT Expectations		
1.1	Understand scour guidelines from FHWA, which include HEC-18 and the September 2021 training materials (PDF slides and meeting recording)	☐
1.2	Understand current WSDOT scour guidelines from manuals, templates, sanctioned training, and scour Q&A meetings	☐
1.3	SRH-2D models should be reviewed for quality (using checklists) and finalized prior to scour computations	☐
1.4	Based on current WSDOT guidance, correctly determine the scour design and scour check floods	☐
1.5	Be sure to incorporate any items that resulted from Over-the-Shoulder (OTS) meetings	☐
1.6	Adhere to best practices and use good engineering judgement. Do results appear reasonable? Think through the assessment and reasonable levels of accuracy.	☐
Section 2 - Geotechnical Scour Considerations		
2.1	Understand the available geotechnical data and coordinate with WSDOT geotechnical staff, as needed	☐
2.2	Confirm that the non-cohesive (cohesionless) equations in HEC-18 apply to crossing-specific substrate, noting that non-cohesive soils typically have a D_{50} value of 0.2 mm or larger. Scour in cohesive soils will require a different approach.	☐
2.3	Check and verify that the median grain size (D_{50}) selected for the analysis is correct and defensible	☐
2.4	Designer to assess which sediment transport condition dominates scour at the crossing, which can be indicated incipient motion equations (e.g., Critical Velocity Index (CVI) in SMS) for each discharge rate. A live-bed determination will require confidence that the median grain size is consistently mobile in the upstream approach areas of the watershed, resulting in a reliable sediment supply into the crossing.	☐
Section 3 - Long-Term Degradation (LTD)		
3.1	Are the text, photos, and figures among Ch. 2 (Watershed and Site Assessment), Ch. 7.1 (Lateral Migration), Ch. 7.2 (Long-term Degradation), and live-bed vs. clear-water scour assumptions/findings in Ch 7.3 (Contraction Scour) congruent?	☐
3.2	Are the elevations, slopes (lines and values), and labeled features shown in the watershed-scale longitudinal profile (Ch. 2.7.4) the same as the longitudinal profile shown in Ch. 7.2 (Long-term Degradation)? If not, what is different and why?	☐
3.3	Are the "Assumed Base Level Control(s)," "Assumed Potential Equilibrium/Regrade Slope," "Average Slopes," "Proposed Profile," "(date) LiDAR," "WSDOT (date) Topographic Survey," and vertical dimension(s) of "Potential Degradation" properly displayed on the longitudinal profile in Ch. 7.2 (Long-term Degradation)? For example, the "Potential Degradation" dimension is drawn from the *proposed* crossing profile to the assumed potential equilibrium/regrade slope.	☐
3.4	Has the soil subsurface information been shown on longitudinal profile? Ideally this includes the boring location, soil unit layers (at least those at or near the proposed stream bed elevation, and erosion resistant layer[s]), and points or reaches where erosion resistant material (or other important bedform controls) were observed.	☐
3.5	Is the basis of the "Assumed Base Level Control" adequately described in the text of Ch. 7.2?	☐
3.6	Has an adequate length of stream reach been assessed to document or consider long-term degradation impacts associated with other crossings downstream and upstream of the subject crossing? Upstream and downstream infrastructure are to be identified in the watershed-scale profile, and those proximal and integral to the crossing and base level control should also appear on the LTD profile.	☐
3.7	Are the results/findings of the geotechnical scoping memorandum (boring locations, elevations, material properties) adequately/properly described and incorporated into Ch. 7.1 and Ch. 7.2?	☐
3.8	Is sediment supply change discussed (considering existing and proposed conditions)?	☐
3.9	If assumptions of base level control are made, are they adequately described in the text?	☐
3.10	Has degradation associated with any identified future conditions been addressed?	☐
3.11	Are there grade breaks through the system that aren't described in the text?	☐
3.12	Have potential risks associated with debris flows, dam failures, or maintained sediment traps been accounted for?	☐
3.13	Is the crossing subject to bed elevation changes due to headcutting from a downstream creek/stream/river/future replaced infrastructure?	☐
3.14	Within ravines, will the new design change the sediment supply and or wood loading from existing conditions?	☐
3.15	If wood is being proposed for steps, is natural recruitment likely/sustainable?	☐
3.16	Are assumptions for channel migration valid? Avulsion risks addressed? Are these factored into vertical change?	☐
Section 4 - General SMS Scour Procedures		
4.1	Determine if separate bridge scour coverages are needed for the various flood flows (more common for live-bed conditions, where flexibility on how SMS scour arcs are placed may be needed for differing flood flows)	☐
4.2	Are enough different return period flows modeled to ensure that the worse-case scour has been determined?	☐
4.3	Using the View Values feature in the SMS Bridge Scour Properties, check and verify that SMS is capturing and passing on the correct hydraulic result values to HTB, and that values appear reasonable.	☐
4.4	Ensure that you have removed or renamed old, outdated, or extraneous bridge scour coverages	☐
4.5	Ensure that you have removed or renamed old, outdated, or extraneous scatter sets, and that relevant scatter sets to rename are clearly identified	
4.6	Ensure that the correct result datasets are attached to each bridge scour scenario in the Bridge Scour Properties/Options dialog	☐
4.7	Check and verify that the selected median grain size (D_{50}) is showing up correctly in SMS	☐
4.8	Ensure that compressed SMS package files do not have broken or missing files or links when transmitted to others.	☐
Section 5 - Contraction Scour		
5.1	Contraction scour estimates should be computed for all flood flows, even if flow contraction is not evident	☐
5.2	Per direction from HEC-18 for live-bed conditions in course-bed sediments, as well as WSDOT direction, both live-bed and clear-water computations should be checked to consider differences and possibilities over the design life of the bridge structure.	☐
5.3	Especially given lateral migration potential, establish that main channel contraction scour governs, as opposed to overbank contraction scour (it is rare for overbank contraction scour depths for HEC-18 Case 1C to be deeper and govern)	☐
5.4	Although extremely uncommon for WSDOT work, verify that pressure-flow conditions do not exist. If they do, contact HQ for freeboard deviations. Additional computations would be required.	☐

HQ Review Process



Resources

WSDOT

- Hydraulic Design Report Template
- Scour Analysis and Scour Countermeasures FAQ
- Ten Topics for Successful Scour Analysis
- Bend Scour Template
- WSDOT Scour Training Workshop Modules
- WSDOT Hydraulics Manual

NHI

- 135046 Stream Stability and Scour at Highway Bridges (Instructor-led Training)
- 135048 Countermeasure Design for Bridge Scour and Stream Instability (Instructor-led Training)
- 135087 Scour at Highway Bridges: Concepts and Definitions (Web-based Training)
- 135086 Stream Stability Factors and Concepts (Web-based Training)
- 135093 Hydraulic Toolbox (Web-based Training)

FHWA

- HEC 18 Evaluating Scour at Bridges
- HEC 20 Stream Stability at Highway Structures
- HEC 23 Bridge Scour and Stream Instability Countermeasures Experience, Selection, and Design Guidance
- HDS 7 Hydraulic Design of Safe Bridges
- FHWA Bridge Scour Workshop recordings

Questions?