HYDRAULIC DESIGN PROCESS

MODULE 4 - HEATHER PITTMAN. P.E.

SEE APPENDICES FOR ATTACHMENTS
Heather Pittman, P.E.

Fish Passage Design Manager
Headquarter Hydraulics
WSDOT

Current duties: Oversee and manage fish passage projects in the Olympic Region and assist in updating fish passage policy.

Background & Experience: Heather started at WSDOT after graduating college in 2008 as a Transportation Engineer 1 in the Mount Baker Area. After several stormwater designs, she was able to move to the Headquarters Hydraulics office in 2013 through an in-training opportunity to learn how to do stream design and eventually became a fish passage design manager. As part of the Headquarters Hydraulics Office, Heather has designed several fish passage corrections, assisted with materials acceptance and placement during construction, reviewed hydraulic design reports, and worked with permitting agencies and the Tribes to find fish passage solutions that meet everyone’s needs.

Education: Michigan State University, May 2008, BS in Civil Engineering

Personal interests: Heather lives in Lacey with her husband, son and cat. She enjoys playing games, going for walks, and knitting.

Hydraulic Design Process

This module will inform Fish Passage designers, inspectors, engineers, biologists, geologists and other practitioners on the process of the hydraulic design starting with initial site visits and ending with final Plans, Specifications and Estimates. The model will also cover how the Hydraulic Design fits in at each stage of the overall design process.
Fish Passage and Stream Restoration Training
Hydraulic Design Process

Heather Pittman, PE
Fish Passage Design Manager - Olympic Region

Abbreviations

- SR = State Route
- MP = Mile Post
- WDFW = Washington Department of Fish and Wildlife
- PHD = Preliminary Hydraulic Design
- FHD = Final Hydraulic Design
- PEO = Project Engineering Office
- ESO = Environmental Services Office
- HQ = Headquarters
- LWM = Large Woody Material

Overview

- PHD Process & Importance
- FHD Process & Importance
- Describe interaction between:
  - Hydraulics, Tribe(s) and WDFW
  - Hydraulics & PEO
  - Hydraulics, Geotech and Bridge
- End product goal: a fish passable crossing that requires little to no long-term maintenance
Overview
Hydraulic Design Deliverables
- Field Report Form
- PHD
  - HQ Hydraulics Draft
  - Internal Review Draft
  - External Review Draft
  - Final
- Preliminary Scour
- LWM Layout
- Final Scour
- Seasonal Flow Analysis
- FHD
- Final model

Main Goals of PHD Process
- Determine & Document:
  - Bankfull Width
  - Minimum Hydraulic Opening
  - Preliminary Channel Geometry
  - Preliminary Channel Shape
  - LWM Layout
  - Sediment
- Achieve agreement on the above

PHD Team
- HQ Hydraulics
- Hydraulic Design Team
- Survey Team
- HQ Environmental Services Office (ESO)
- WSDOT PEO
- WSDOT Review Team
- WDFW
- Tribe(s)
**PHD Team**

- HQ Hydraulics
- Hydraulic Design Team
- Survey Team
- HQ Environmental Services Office (ESO)
- WSDOT PEO
- WSDOT Review Team
- WDFW
- Tribe(s)

- Fish passage design policy
- Management of the hydraulic design & internal review process
- Coordinate with region/external partners on design elements
- Fill the role of the hydraulic designer when consultant not on board (Site Visit 1)

**PHD Team**

- HQ Hydraulics
- Hydraulic Design Team
- Survey Team
- HQ Environmental Services Office (ESO)
- WSDOT PEO
- WSDOT Review Team
- WDFW
- Tribe(s)

- Either HQ Hydraulics/ESO staff or Consultants
- Gather all field information (Site Visit 2)
- Author Field Report Form
- Author PHD
- Facilitate on site meeting (Site Visit 3)
- Respond to comments

**PHD Team**

- HQ Hydraulics
- Hydraulic Design Team
- Survey Team
- HQ Environmental Services Office (ESO)
- WSDOT PEO
- WSDOT Review Team
- WDFW
- Tribe(s)

- Either a region or a consultant
- Responsible for
  - Establish Control
  - Existing Surface (including bathymetry)
  - Coordinate with Hydraulic Engineer to define critical features and survey limits
PHD Team

- HQ Hydraulics
- Hydraulic Design Team
- Survey Team
- HQ Environmental Services Office (ESO)
- WSDOT PEO
- WSDOT Review Team
- WDFW
- Tribe(s)

- Establishes Program Priorities
- Answers barrier/biological questions
- PHD Author (if internal)
- Part of review process

PHD Team

- HQ Hydraulics
- Hydraulic Design Team
- Survey Team
- HQ Environmental Services Office (ESO)
- WSDOT PEO
- WSDOT Review Team
- WDFW
- Tribe(s)

- Identifies roadway constraints
- Facilitates communication between groups
- Organizes coordination meetings
- Looks at project constructability
- Takes the project through the design phase if internal

PHD Team

- HQ Hydraulics
- Hydraulic Design Team
- Survey Team
- HQ Environmental Services Office (ESO)
- WSDOT PEO
- WSDOT Review Team
- WDFW
- Tribe(s)

- PEO
- Bridge and Structures
- Geotech
- Region Environmental
- Assistant State Design Engineer
- HQ ESO
- HQ Hydraulics
**PHD Team**

- HQ Hydraulics
- Hydraulic Design Team
- Survey Team
- HQ Environmental Services Office (ESO)
- WSDOT PEO
- WSDOT Review Team
- WDFW
- Tribe(s)

- Provides concurrence on bankfull width and reference reach
- Reviews PHD for compliance with Water Crossing Design Guidelines and WAC
- Early involvement helps prevent issues receiving HPA

---

**PHD Team**

- HQ Hydraulics
- Hydraulic Design Team
- Survey Team
- HQ Environmental Services Office (ESO)
- WSDOT PEO
- WSDOT Review Team
- WDFW
- Tribe(s)

- Provides agreement on bankfull width and reference reach
- Reviews PHD and provides feedback

---

**Importance of Teamwork**

- Great number of team players
- Early coordination and communication
- Open and honest communication
- Need to build trust for future projects
Day 1  Fish Passage and Stream Restoration Training
Hydraulic Survey

- Establish Control
- Existing Surface (including bathymetry)
- Process data into InRoads Surface
- Notify Fish Passage Design Manager of completion
- Hydraulic Designer to confirm survey

Modeling/PHD Draft

- PHD Template to be followed
- Design decisions to be documented
- Constraints to be brought up with HQ Hydraulics
- Plans need to follow Plans Prep/Checklist

Design Constraints

- Slope Ratio
- Velocity Ratio
- Discontinuity between upstream and downstream reaches
- Channel Realignment
- Freeboard Concerns
- Geometric Constraints
- Sediment Size
Site Visit 2

Who:
- Hydraulic Design Team

Purpose:
- Conduct stream assessment
- Determine project constraints

Deliverable:
- Field Report

Field Report Form

- All fields filled out in detail
- Include photos
- Review Process
  - HQ Hydraulics
  - PEO
  - WDFW
  - Tribes
**Site Visit 3**

Who:
- Project Team

Purpose:
- Agreement on bankfull width & reference reach
- Discuss project constraints

Deliverable:
- Field Report Update
  or PHD Update

**Draft PHD**
**Review Process**

WSDOT Preliminary Hydraulic Design (PHD) Report Review Process

**Final PHD – Now What?**

**Design-Build**
- 2.30 of RFP (HQ Hyd Author)
- Use minimums from PHD as requirements in RFP
- PHD updated by Design-Build to reflect changes

**Design-Bid-Build**
- PEO begins working toward 30% design or continues working on design with Hydraulic Design Team
Kickoff With PEO

- Hydraulic Design
  Team meets with
  PEO
- Cover roles and
  responsibilities
- Talk through project
  constraints

Main Goals of FHD Process

- Document final hydraulic
design decisions
- Reflect any hydraulic
design changes
- LWM final design
documentation
- Final scour calculations
- Final hydraulic model
documentation

Project Design Team

- WSDOT PEO
- HQ Hydraulics
- Hydraulic Design Team
- Region Environmental
- Landscape
- WSDOT Bridge Office
- WSDOT Geotechnical Office
- HQ ESO
- WDFW
- Tribe(s)
Project Design Team

- WSDOT PEO
- HQ Hydraulics
- Hydraulic Design Team
- Region Environmental
- Landscape
- WSDOT Bridge Office
- WSDOT Geotechnical Office
- HQ ESO
- WDFW
- Tribe(s)

- Project Coordination
- Leader for Plans, Specials and Estimate
- Permit Packages
- Wall Site Data
- Bridge Site Data
Project Design Team

- WSDOT PEO
- HQ Hydraulics
- Hydraulic Design Team
- Region Environmental
- Landscape
- WSDOT Bridge Office
- WSDOT Geotechnical Office
- HQ ESO
- WDFW
- Tribe(s)

- Provide Special Provisions for Stream Materials
- Review Stream Plans
- Compute stream bypass flows
- Determine Scour Elevation
- LWM Layout and Calculations
- FHD

---

Project Design Team

- WSDOT PEO
- HQ Hydraulics
- Hydraulic Design Team
- Region Environmental
- Landscape
- WSDOT Bridge Office
- WSDOT Geotechnical Office
- HQ ESO
- WDFW
- Tribe(s)

- Assist PEO with Permit Package
- Apply for Project Permits
- Provide feedback

---

Project Design Team

- WSDOT PEO
- HQ Hydraulics
- Hydraulic Design Team
- Region Environmental
- Landscape
- WSDOT Bridge Office
- WSDOT Geotechnical Office
- HQ ESO
- WDFW
- Tribe(s)

- Create the planting plans and special provisions
- Coordinate with HQ Hydraulics on any bioengineering countermeasures
Project Design Team

- WSDOT PEO
- HQ Hydraulics
- Hydraulic Design Team
- Region Environmental
- Landscape
- WSDOT Bridge Office
- WSDOT Geotechnical Office
- HQ ESO
- WDFW
- Tribe(s)

- Structural Design
- Wall Design
- Foundation Design

---

Project Design Team

- WSDOT PEO
- HQ Hydraulics
- Hydraulic Design Team
- Region Environmental
- WSDOT Bridge Office
- WSDOT Geotechnical Office
- HQ ESO
- WDFW
- Tribe(s)

- Project Feedback and Support
- FHD Author (Internal Only)
- Coordination for nearby system barriers

---

Project Design Team

- WSDOT PEO
- HQ Hydraulics
- Hydraulic Design Team
- Region Environmental
- WSDOT Bridge Office
- WSDOT Geotechnical Office
- HQ ESO
- WDFW
- Tribe(s)

- Project Feedback and Support
- Issue HPA

---
Project Design Team

- WSDOT PEO
- HQ Hydraulics
- Hydraulic Design Team
- Region Environmental
- WSDOT Bridge Office
- WSDOT Geotechnical Office
- HQ ESO
- WDFW
- Tribe(s)

30% to 60% Design

- Update InRoads Surface with structure
- Update Plans, Estimate, Special Provisions
- Determine stream bypass flows

Preliminary Bridge Plan

Hydraulics

- WSE
- Freeboard
- Scour Risk
- Early Borings
- Migration Risk

Geotechnical

- Prelim Foundation Info
- Liquefaction
- Landslides
- Early Borings End Slopes
- Soil Improvements

Bridge

Preliminary Bridge Plan
**Seasonal Flow Analysis**

- Either MGS Flood Seasonal Flow Statistics or Gage Data (if available)
- Flow Requirements (Minimum)
  - Design Flow: 50% Exceedance Flow
  - Contingency Flow: 10% Exceedance Flow

**60% to 90% Design**

- Updated InRoads Surface
- Update hydraulics model
- Assist PEO with JARPA
- Work with WDFW/Tribes on LWM design

**Bridge Design**

- Preliminary Scour/Final Scour
- Hydraulics
- Geotechnical
- Final Bridge Layout

- Soil Borings
- Foundation Design
- Final Structure Type/Location
- Bridge

Day 1  Fish Passage and Stream Restoration Training
90% to 100% Design

- Complete FHD (prior to 100% Design Turn in)
- Update Special Provisions
- Review updated Plans

PHD & FHD Differences

FHD covers everything in PHD plus:
- Any design changes
- Final hydraulic model
- Final LWM layout
- Final total scour calculations
- Updated plans

Deliverables (unless otherwise specified):
- FHD
- Hydraulic Model

Beyond 100% Design

- Update Special Provisions
- Review updated Plans
- Address any Region review comments
Questions?