HYDRAULIC DESIGN REPORT TEMPLATE

MODULE 11 - HEATHER PITTMAN, P.E.

SEE APPENDICES FOR ATTACHMENTS

Heather Pittman, PE

WSDOT

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.

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Heather Pittman, PE

WSDOT

Hydraulic Design Report Template

This module will inform Fish Passage designers, inspectors, engineers, biologists, geologists and other practitioners on how to take information from previous modules and integrate it into the preliminary and final hydraulic design report. Each section of the hydraulic design report template will be covered along with expectations of those sections and previous lessons learned.

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WSDOT

Fish Passage and Stream Restoration Training

Hydraulic Design Report Template

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
- QC = Quality Control

WSDOT 2

Overview

- Brief overview of the goals & audience
- Brief overview of template history
- Expectations of each section of the PHD/FHD
- Examples of what is expected

WSDOT 3

Main Goals of PHD Process

- Bankfull Width
- Minimum Hydraulic Opening
- Preliminary Channel Geometry
- Preliminary Channel Shape
- LWM Layout
- Sediment
- Achieve agreement on the above with Tribes, Resource Agencies

WSDOT 4

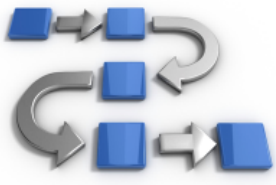
Document Audience

- Audience
  - Biologists
  - Hydraulic Engineers
  - Habitat Engineers
  - Highway Engineers
  - Geotechnical Engineers
  - Structural Engineers
  - Permitting staff
  - Contractors

WSDOT 5

A Brief History

- PHD began as a memo in 2013 called a PBOD "Preliminary Basis of Design"
- Around 2015 made change from memo form to report form
- Name change from PBOD to PHD late 2017/early 2018
- Minor template updates periodically adding additional information
- Major Template Update 2020



WSDOT 6

Writing the PHD/FHD

- All design decisions documented
- All constraints documented
- Clear how the guidance and requirements are met
- Any recommendations/ requirements clear
- If no structure recommended or obvious, both a bridge and culvert LWM design included
- How does the design help the species expected to use it?

WSDOT 7

Writing the PHD/FHD

- Newest Template to be followed
- All Table of Contents updated
- All map figures have scale bar and north arrow
- Table/Figure numbers updated
- No bookmark errors
- Footers updated
- "Draft" Watermark
- All Figures legible and of a high enough resolution

WSDOT 8

Writing the PHD/FHD

- Template general instructions
- Template section instructions

General Template Notes (Delete before turning in PHD):

The Table/Figure numbers in this document are fields. If any new Tables/Figures are added, it is recommended to follow the same format so updating is easier. The Table and Figure numbers in the titles can be updated automatically by:

1. *Ctrl + a*
2. *F9*

Anything with a yellow highlight is both PHD and FHD. Green is PHD only. Pink is FHD only. Italics with highlights are instruction s that are to be deleted prior to turning in PHD.

Please do not modify the document without talking with HQ Hydraulics first. The purpose of the template is to maintain consistency state wide for fish passage projects and make the review of the document easier for the Tribes and WDFW. Changes made to the document may warrant a template update.

Each stream crossing should have a separate design document for it, unless approved by HQ Hydraulics.

Rounding to the nearest 10th is the level of accuracy desired for all elevations, ratios, velocities, etc.

WSDOT 9

Cover Page

- Title correct
- Names updated
- Lower corner title updated
- Cover photo shows water in creek channel

Washington State Department of Transportation

SR X MP XX.XX NAME OF CREEK Creek (WDFW ID):
Preliminary (or "Final" if this is final) Hydraulic Design Report

Photograph of the creek should include the inlet or outlet WITH water flowing in the creek. If there is no water in the creek at the time of the site visit and no photo is available, please contact HQ Hydraulics.

ENGINEER OF RECORD
TITLE
COMPANY/OFFICE

LIST OF CONTRIBUTING ENGINEERS, GEOMORPHOLOGISTS, AND BIOLOGISTS WITH TITLES & COMPANY/OFFICE

SR XX MP XX.XX NAME Creek
Preliminary Hydraulic Design Report
MONTH YEAR

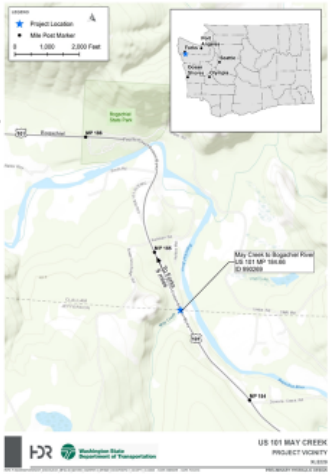
WSDOT 10

Cover Page

WSDOT 11

Introduction

- Fill in the yellow highlights
- Explain what design strategy was used and why
- Structural Dimensions
- Vicinity Map showing the:
  - North Arrow
  - Project Location
  - Location in state
  - Distance to nearest city/town
- Any design deviations
- Whether a structure type is recommended



WSDOT 12

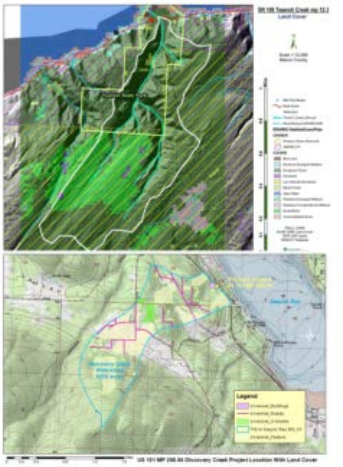
Watershed & Site Assessment

- Covers background info:
  - Watershed & Landcover
  - Geology & Soils
  - Floodplains
  - Site Descriptions
  - Fish presence & Wildlife
  - Site Assessment
  - Geomorphology

WSDOT 13

Watershed & Landcover

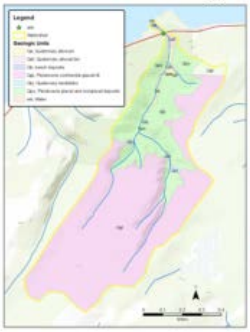
- Size and location of watershed
- Major tributaries
- Topography
- Land Cover
- Prevailing land uses
- Include a watershed/ landcover map

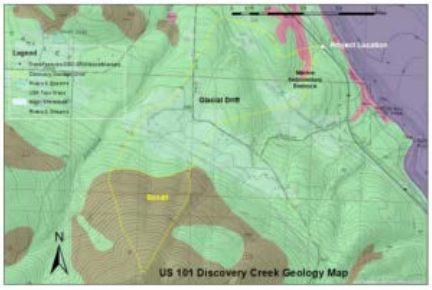


WSDOT 14

Geology & Soils

- Soils (if relevant) and geology
- Sources for any information gathered





WSDOT 15

Floodplains

- Mapped Floodplain?
- History of flooding (Extents/Frequency)
- Cite sources of information

Figure 7. November 6, 2006 Photo showing flooding just west of the project site (Right). Photo location highlighted (left) (Courtesy of King County)

WSDOT 16

Site Description

- Barrier status and impact to fish life
- Is the crossing a failing structure or CED
- Maintenance/Repair history
- Total length of habitat gain

WSDOT 17

Fish Presence in Project Area

- Species identified
- Sources
  - Spawner Surveys
  - WDFW Fish Passage Database
  - RSFS data
  - Scoping Reports
  - Scoping bios

WSDOT 18

Wildlife Connectivity

- HQ Hydraulics does not make the decision to increase structure size
- Section was added because it can impact minimum opening/channel design

PHD Documentation

- Indicate the route priority
- If any design decision has been made, state here

WSDOT 19

Site Assessment

- Data Collection
- Existing Conditions
- Fish Habitat Character/Quality
- Geomorphology

WSDOT 20

Data Collection

- Date of site visit(s) and survey
- People/agencies on site visit
- Survey extents
- Field report summarized
- Field report referenced in Appendix B
- Reference to bankfull widths in 2.8.2

WSDOT 21

Existing Conditions

- Structure description
- As-builts
- Stream conditions
- Signs of maintenance activity
- Impact on fish life
- Photographs!

WSDOT 22

Existing Conditions

- Structure description
- As-builts
- Stream conditions
- Signs of maintenance activity
- Impact on fish life
- Photographs!

WSDOT 22

Existing Conditions

- Structure description
- As-builts
- Stream conditions
- Signs of maintenance activity
- Impact on fish life
- Photographs!

WSDOT 22

Existing Conditions

Figure 18 Record Drawing for Existing Minter Creek Crossing – Plan View.

Existing Conditions

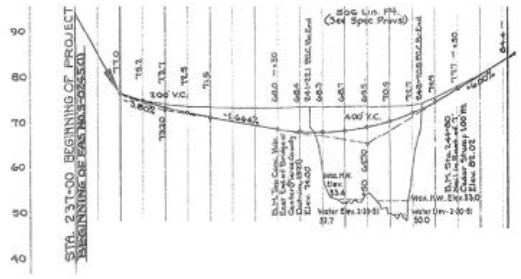


Figure 19 Record Drawing for Existing Minter Creek Crossing – Fill Plan.

Fish Habitat Character & Quality

- Describe habitat character and quality
- Highlight any important features for rearing and spawning
- Which species/lifestages likely to use
- Describe Hankin & Reeves channel type, wetlands, estuary function, tidal influence, etc

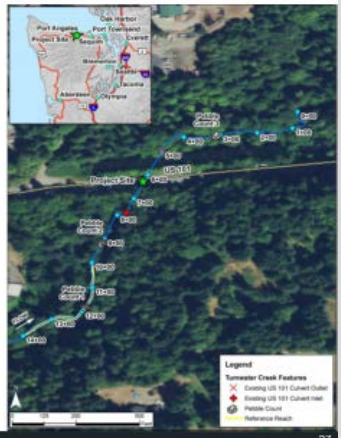
Geomorphology

- Reference Reach
- Channel Geometry
- Sediment
- Vertical Stability
- Channel Migration
- Riparian Conditions

WSDOT 26

Reference Reach Selection

- Explain why reach is appropriate
- Clearly identify location
- Include photographs of reference reach



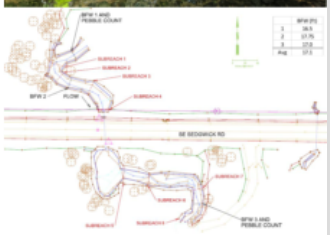
WSDOT 27

Reference Reach Selection

WSDOT 28

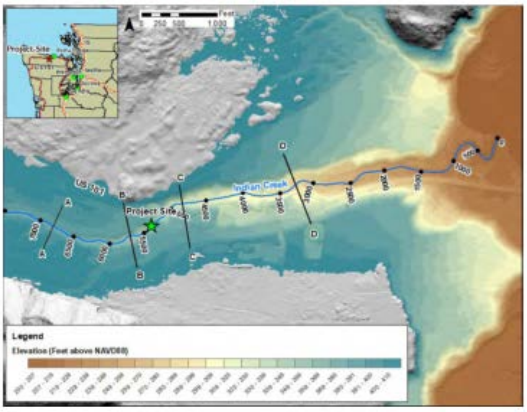
Channel Geometry

- Describe channel planform and cross section
- Reference reach slope and slope to be used for design
- Bankfull width and any agreements
- Photographs of bankfull
- Identify bankfull locations
- Survey sections



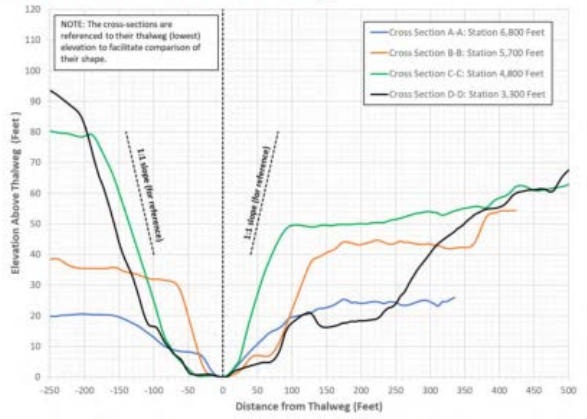
WSDOT 29

Channel Geometry



WSDOT 30

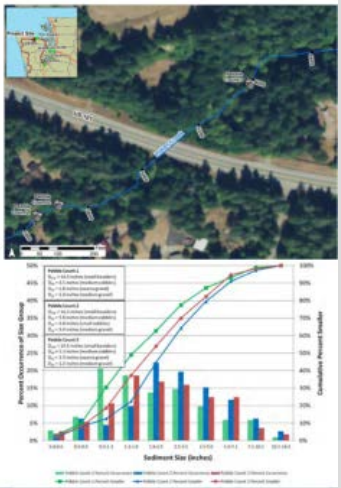
Channel Geometry



WSDOT 31

Sediment

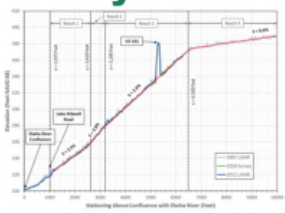
- Location and method of sediment sample
- Sediment distribution
- Any boulders/large cobbles described
- Photographs of sediment or boulders

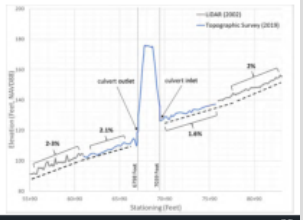


WSDOT 32

Vertical Channel Stability

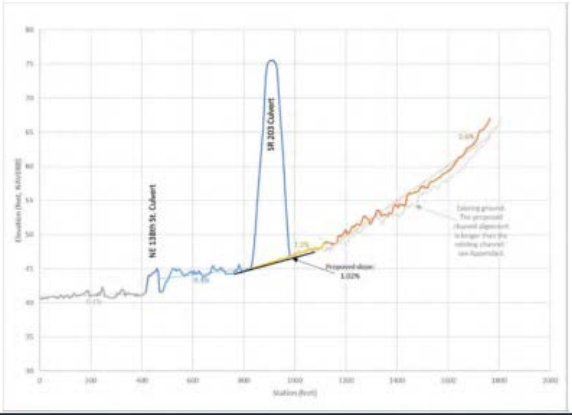
- Long profile included
- Sediment supply in watershed discussed
- Potential for aggradation/degradation qualified
- Location & Description of grade controls





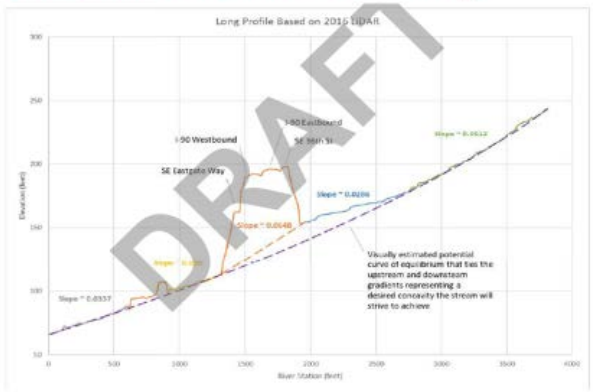
WSDOT 33

Vertical Channel Stability



WSDOT 34

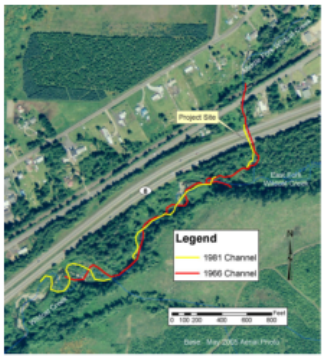
Vertical Channel Stability



WSDOT 35

Channel Migration

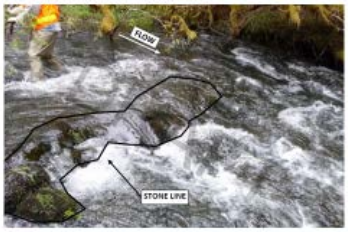
- Channel migration zone described (if applicable)
- Sinuosity described
- Channel erosion related to migration described
- Level of risk associated with migration (low or med/high)
- Floodplain flow paths explained



WSDOT 36

Riparian Conditions, Large Wood, Other Habitat Features

- Vegetation described
- Large wood described and quantified
- Other channel forming features described



WSDOT 37

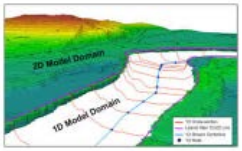
Hydrology & Peak Flow Estimates

- Describe methodology
- Reason selected methodology appropriate
- Flows to be used
- Level of accuracy or uncertainty captured
- Summer low flow conditions known?
- Do not include the High and Low fish passage design flows

WSDOT 38

Hydraulic Analysis and Design

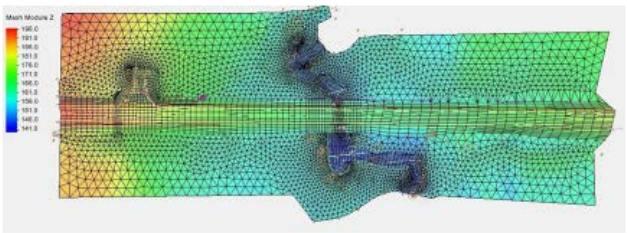
- Documentation of Hydraulic Analysis and Design
- Much of the Hydraulic Analysis portion covered in the Modeling with SRH 2D Module



WSDOT 39

Model Development

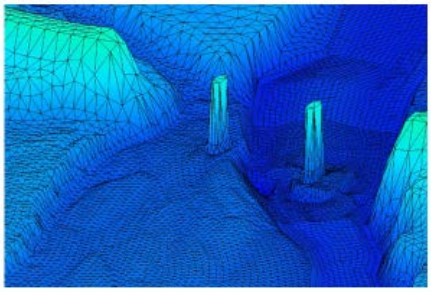
- Section should contain enough information to recreate the model



WSDOT 40

Topographic and Bathymetric Data

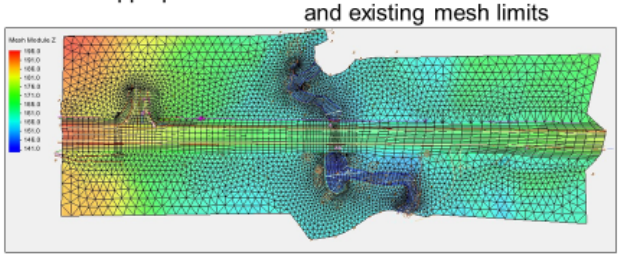
- Where was data obtained from
- When was data collected
- What is the datum
- Key topographic features and structural controls described



WSDOT 41

Model Extent and Computational Mesh

- Domain limits
- Reasoning for limits
- Limits appropriate
- Total area mesh covers/min number of elements
- Figures showing proposed and existing mesh limits



WSDOT 42

Materials/Roughness

- How was each manning's determined
- Figure(s) showing location of manning's areas

WSDOT 43

Boundary Conditions

- Describe boundary conditions
- Geometric data for culverts
- Any other conditions i.e. pressure flow
- Discharge values
- Figure showing BCs, culverts, pressure boundaries, etc
- Table or screenshot of HY-8 input
- All data needed to recreate conditions

WSDOT 44

Model Run Controls / Assumptions

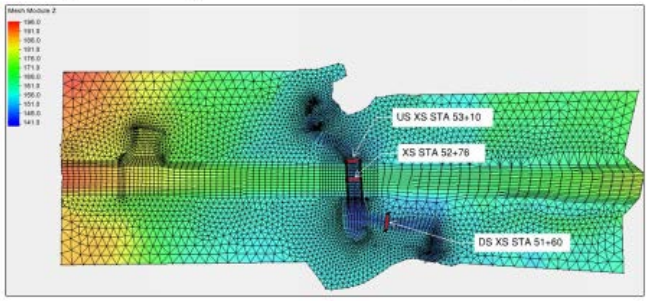
Model Run Controls
- Start Time
- Time Step
- End Time
- Initial Condition
- Flow (if defaults not used)

Model Assumptions
- Assumptions
- Limitations
- Or state none

WSDOT 45

Existing Conditions Model Results

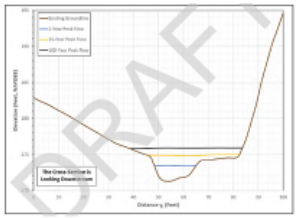
- Figure showing cross section locations and alignment



WSDOT 46

Existing Conditions Model Results

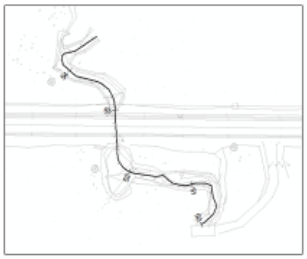
- Cross sections need to show
  - 2-year
  - 100-year
  - 500-year
- Should be taken at representative locations
- Can also be included in appendix



WSDOT 47

Existing Conditions Model Results

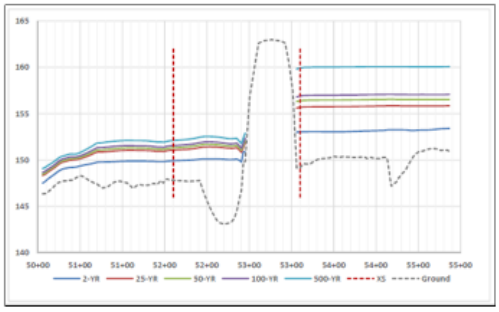
- Alignment with Stationing
- Average Hydraulic Results for Existing conditions



WSDOT 48

Existing Conditions Model Results

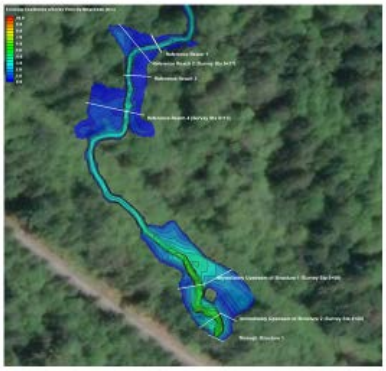
- Longitudinal profile with
  - 2-year
  - 100-year
  - 500-year



WSDOT 49

Existing Conditions Model Results

- Existing conditions velocity map with 100-year flow & cross section locations
- Whether overtopping occurs
- Table with cross section information



	Q100 Average Velocities (ft/s)		
	LOB*	Main Ch.	ROB*
Reference Reach 1	1.7	4.3	1.4
Reference Reach 2	1.3	4.6	0.3
Reference Reach 3	1.5	4.5	0.0
Reference Reach 4	0.6	2.7	1.0
Immediately Upstream of Structure 1	0.3	0.7	0.1
Immediately Upstream of Structure 2	0.5	0.7	0.3
Through Structure 1	0.6	2.2	0.8

*LOB/ROB locations determined from Existing Conditions Q2 extent

WSDOT 50

Natural Conditions Model Results

- Required to determine FUR
- All the same requirements as Existing Conditions Model plus 2080 Projected*
- This model requires some assumptions on historical conditions

WSDOT 51

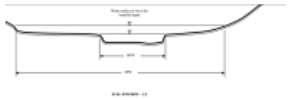
Channel Design

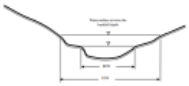
- Floodplain Utilization Ratio
- Channel Planform & Shape
- Channel Alignment
- Channel Gradient
- Design Methodology

WSDOT 52

Floodplain Utilization Ratio

- Explain how FUR Calculated
- Clearly state value
- State whether system is confined or unconfined

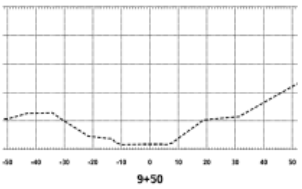


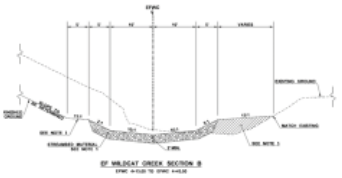


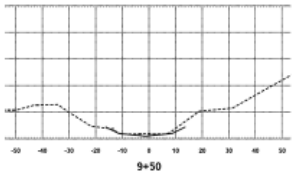
WSDOT 53

Channel Planform & Shape

- How was channel shape determined
- Channel shape should have low flow benches or an explanation on why they do not
- Performance expectation of channel section



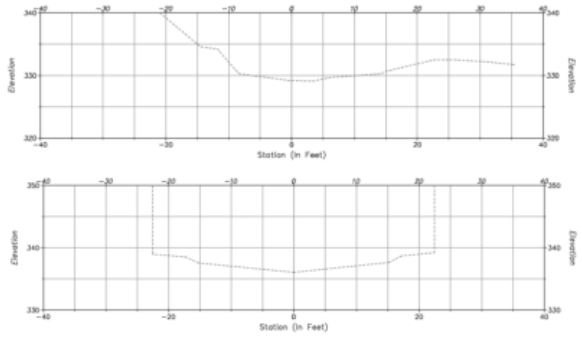




WSDOT 54

Channel Planform & Shape

- Proposed cross section shown along side reference reach (if possible)



WSDOT 55

Channel Alignment

- Grading limits discussed
- Any constraints restated and any design impacts stated
- Is the channel sinuosity similar to what would be expected?
- Can sharp bends in and out of structure be eliminated?

WSDOT 56

Channel Gradient

- Slope ratio identified
- If not within 25% of reference reach, reason given
- Long-term degradation expected?
- Long-term aggradation expected?
- Is there a reason to constrain degradation?

WSDOT 57

Design Methodology

- Methodology clearly identified
- Reason for method explained
- See WSDOT Hydraulics Manual Chapter 7 for more information

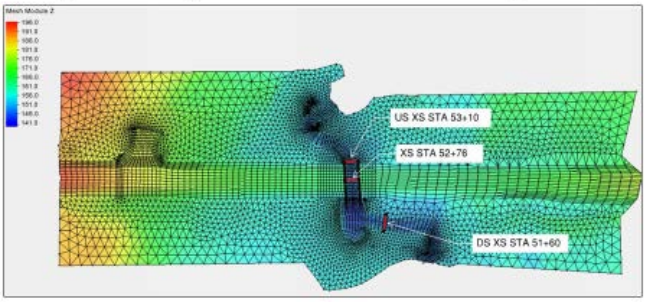
- FUR < 3
  - Stream Simulation
  - Confined Bridge

- FUR >3
  - Unconfined Bridge

WSDOT 58

Future Conditions Model Results

- Figure showing cross section locations and alignment



WSDOT 59

Future Conditions Model Results

- Cross sections need to show
  - 2-year
  - 100-year
  - 500-year
  - 100-year 2080 projected
- Should be taken at representative locations
- Can also be included in appendix
- All the other same elements as Existing Conditions
- Need to show floodplain velocities

WSDOT 60

Water Crossing Design

- Structure Type
- Minimum Hydraulic Opening
- Freeboard
- Bed Material
- Channel Complexity

WSDOT 61

Structure Type

- Whether or not a structure type is recommended or assumed
  - High risk for long term degradation
  - High risk for aggradation
  - High risk for lateral migration
  - Extremely deep fill
  - Other reasons

WSDOT 62

Minimum Hydraulic Opening Width and Length

- Opening size rational explained appropriately
- Factor of safety or velocity ratio stated
- Climate Resilience was addressed
- Velocity tables updated
- Are there any length limitations on the recommendations?

WSDOT 63

Freeboard

- Minimum requirement clear
- Additional recommendations clear
- If freeboard is not able to be met, clearly stated why

WSDOT 64

Bed Material

- Methodology chosen to determine size (if not pebble count, why)
- Describe when D50 and D84 are mobile
- Table comparing existing and proposed
- Are we within 25% of D50, if not, why
- Combination of WSDOT standard items that yields desired mix
- Minimum of 30% streambed sediment
- Ratios should be constructable

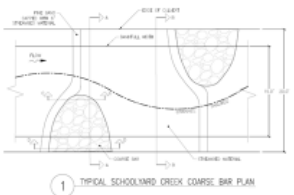
Particle	Observed Material Diameter (inches)	Proposed Material Diameter (inches)
D_{15}	0.4	0.02
D_{50}	0.8	1.0
D_{84}	1.4	2.0
D_{95}	2.4	2.5

Table 8 Comparison of observed and proposed streambed material

WSDOT 65

Channel Complexity

- Describe channel planform expected
- Recommendations for non-LWM Structures for complexity
- Any low flow considerations
- Fish stranding risks
- Clearly state how fish will use the habitat
- Pre-approval obtained for anything not in the HM or other WSDOT guidance



1 TYPICAL SCHOOLYARD CREEK COARSE BAR PLAN

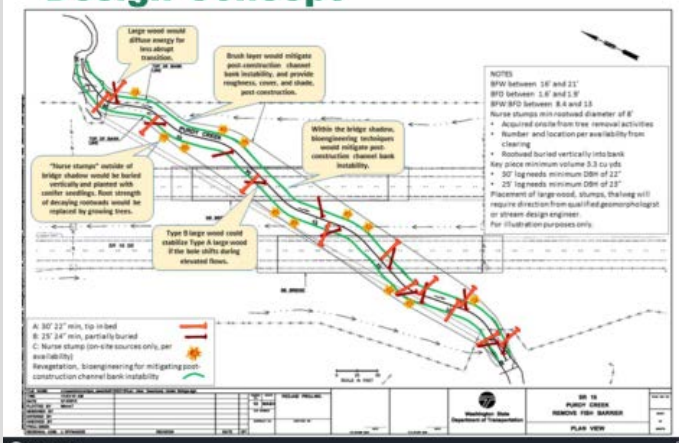
WSDOT 66

Channel Complexity

- How key pieces/volume compare to Fox & Bolton
- What flows is the mobile wood mobile at
- Anchoring anticipated?
- Any special considerations for LWM/Structural interactions
- If structure type unknown, then two scenarios to be shown

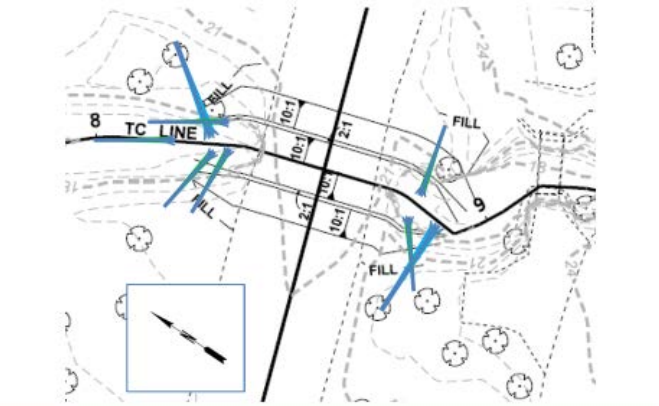
WSDOT 67

Design Concept



WSDOT 68

Design Concept



WSDOT 69

Floodplain Changes/Storage

Floodplain Changes

- Any changes to the floodplain noted in this section

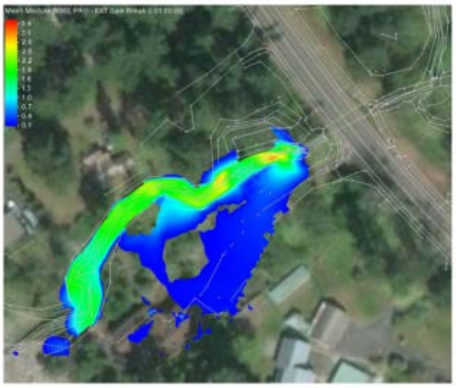
Floodplain Storage

- Quantify changes
- Any risks to infrastructure noted

WSDOT 70

Water Surface Elevations

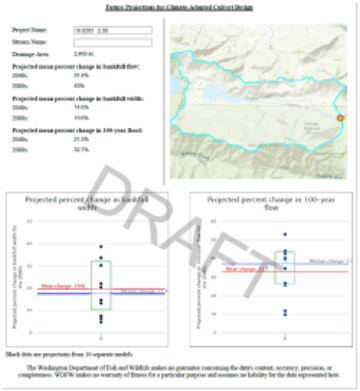
- WSE Changes noted
- Any risks explained in relation to WSE impacts
- Graphic depicting changes



WSDOT 71

Climate Resilience

- Recap of any changes made to the design as a result of climate resilience
- Explanation as to why Climate Resilience was not incorporated in cases where it is not practicable
- If no changes were necessary, note that
- Fill in the yellow highlights



WSDOT 72

Scour Analysis

- Different between PHD & FHD
- Green Highlights PHD only
- Pink Highlights FHD

For this section, what's included in the PHD vs FHD is different. As described in the instructions, green highlights are PHD only and Pink will be PHD only. Non-italics in this section are not instructions, but template language. If PHD, delete the Pink Highlights. If FHD, delete the Green Highlights.

Total Scour will be computed during later phases of the project utilizing the 100-year, 500-year and projected 2080 100-year flow events. The structure will be designed to account for the potential scour at the projected 2080 100-year flow events. For this phase of the project, the risk for lateral migration and potential for degradation are evaluated on a conceptual level. This information is considered preliminary and is not to be taken as a final recommendation in either case.

Utilizing the results of the hydraulic analysis and considering the potential for lateral channel migration, scour calculations were performed following the procedures outlined in *Evaluating Scour at Bridges* HEC No. 18 (Arneson et al. 2012). Scour components considered in the analysis include:

1. Long-term aggradation/degradation
2. General scour (i.e., contraction scour)
3. Local scour

In addition to the three scour components above, potential lateral migration of a channel must be assessed when evaluating total scour at highway infrastructure.

WSDOT 73

Lateral Migration

- PHD
  - Low risk or med/high risk?
  - Dependent on structure?
- FHD
  - Any countermeasures?
  - Risk to structure itself
  - If countermeasures only needed if structure not designed to scour, state
  - Discuss for each abutment/pier

WSDOT 74

Long-term Aggradation/ Degradation

- PHD
  - Describe risk
  - Conceptual level (3-5ft)
  - Sediment Tree relevance
  - If additional info necessary to determine
- FHD
  - Describe risk
  - Quantify

WSDOT 75

Other Scour

- All quantified at FHD
- Contraction Scour
- Abutment Scour
- Local Scour
- Bend Scour
- Scour summarized in table with final elevations and where those elevations are

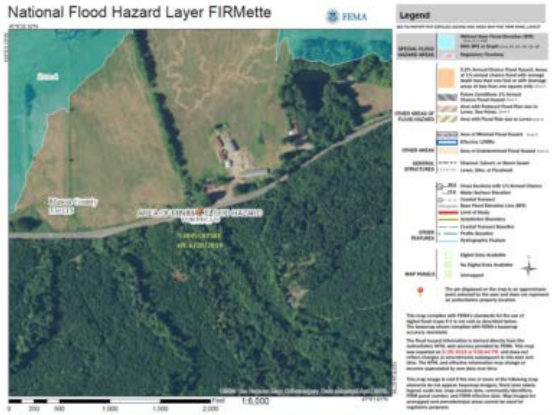
WSDOT 76

References

Update the Reference List.

WSDOT 77

Appendix A – FEMA Floodplain Map



WSDOT 78

Appendix B – Hydraulic Field Report Form

- Attach most recent version of report
- Reference it in the existing conditions
- Info in report should match field report

WSDOT Hydraulics Section — Hydraulics Field Report

Project Number:	
Project Name:	Date:
Project Office:	Time of Arrival:
Stream Name:	Time of Departure:
WSPAR ID Number: / Purpose of Site Visit	Prepared By:
State Route/MP: / Weather:	

Meeting Location:

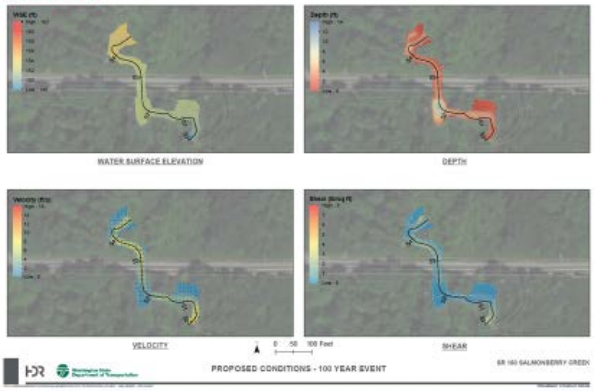
Attendance List:

Name	Organization	Role

Bankfull Width:
Describe measurements, locations, known history, summarize on site discussion
Reference Reach:
Describe location, known history, summarize on site discussion, appropriateness, bankfull measurement
Data Collection:
Describe who was involved, extents collection occurred within
Observations:
Describe site conditions, channel geomorphology, habitat type and location, flow splits, LWM location and quantity, etc.
Pebble Counts/Sediment Sampling:
Describe location of sediment sampling and pebble counts if available
Photos:
Any relevant photographs listed above

WSDOT 79

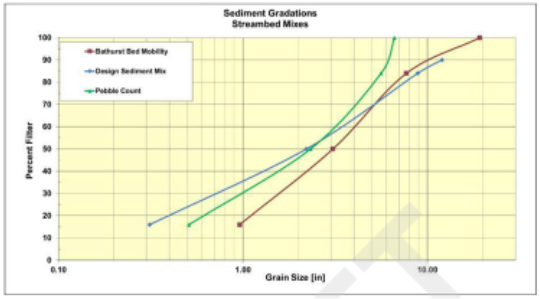
Appendix C – SRH 2D Model Results



WSDOT 80

Appendix D – Streambed Material Calculation

- Backup of sediment mobility calculations
- Graph showing the Pebble Counts vs Proposed Mix

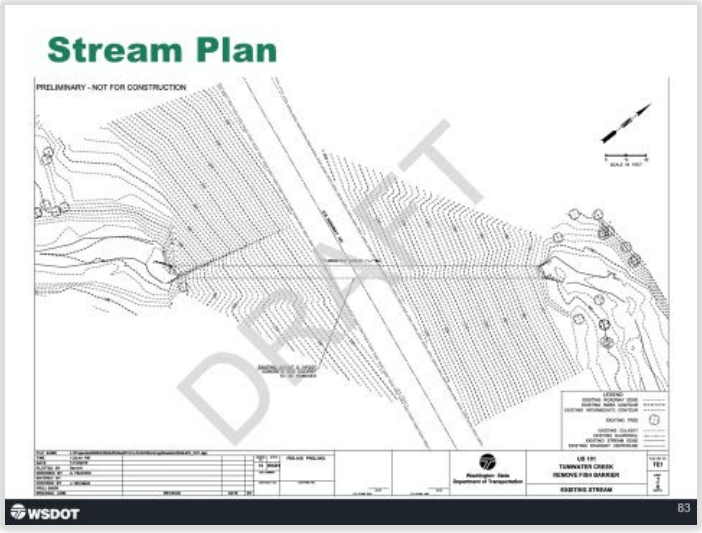


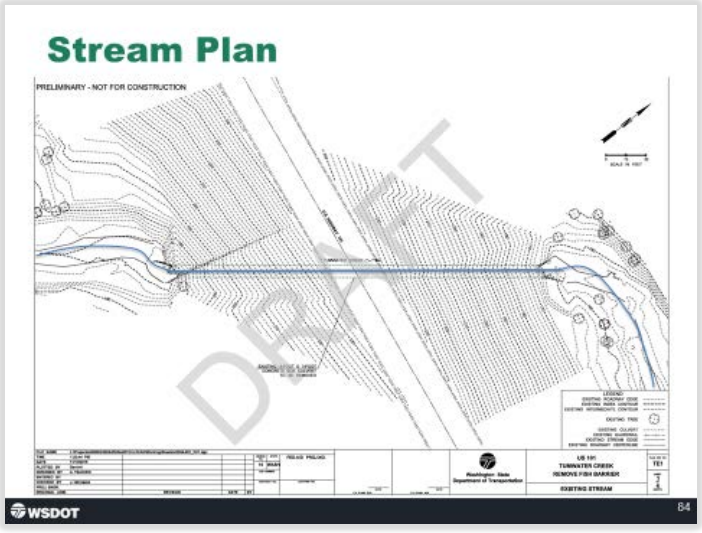
WSDOT 81

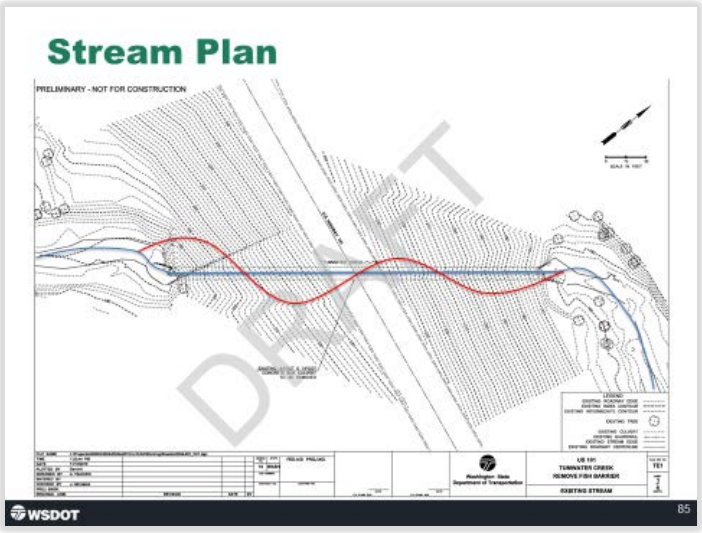
Appendix E – Stream Plan, Profile, & Detail Sheets

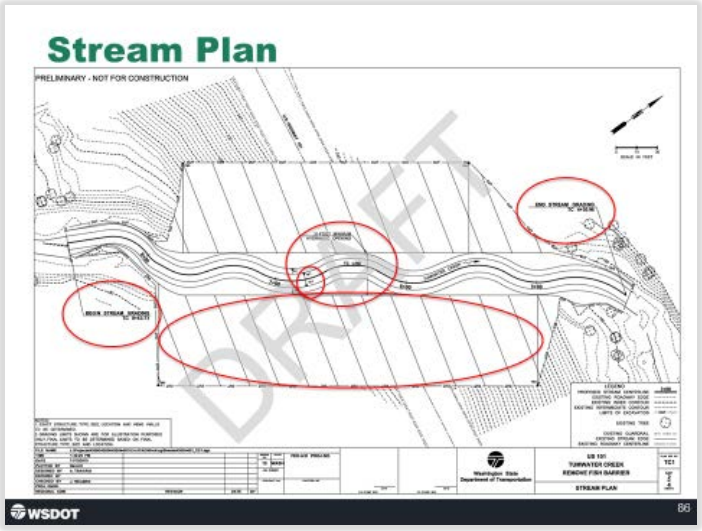
- All elements in checklist
- Clearly depict what is required
- Clearly depict what the minimums are
- Clearly depict what is not required
- These are not rough drafts

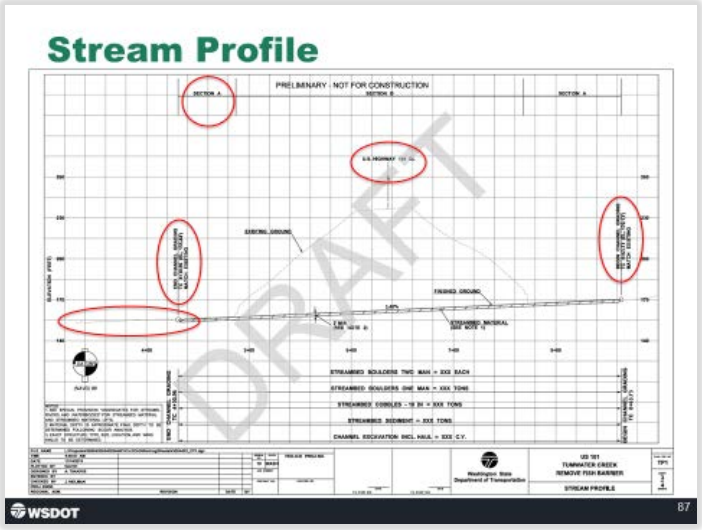
WSDOT 82

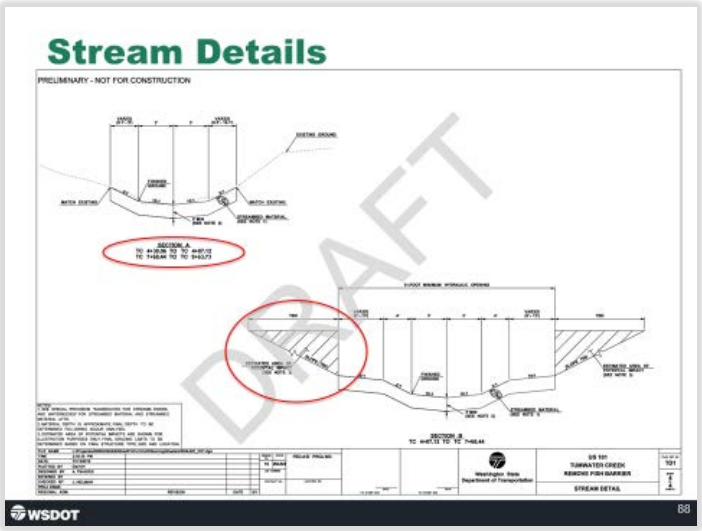

Stream Plan
PRELIMINARY - NOT FOR CONSTRUCTION
DRAFT
WSDOT
83


Stream Plan
PRELIMINARY - NOT FOR CONSTRUCTION
DRAFT
WSDOT
84

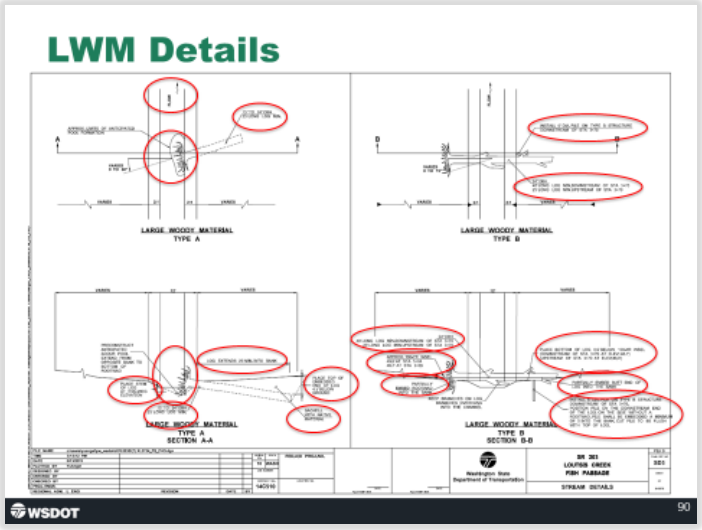

Stream Plan
PRELIMINARY - NOT FOR CONSTRUCTION
DRAFT
WSDOT
85

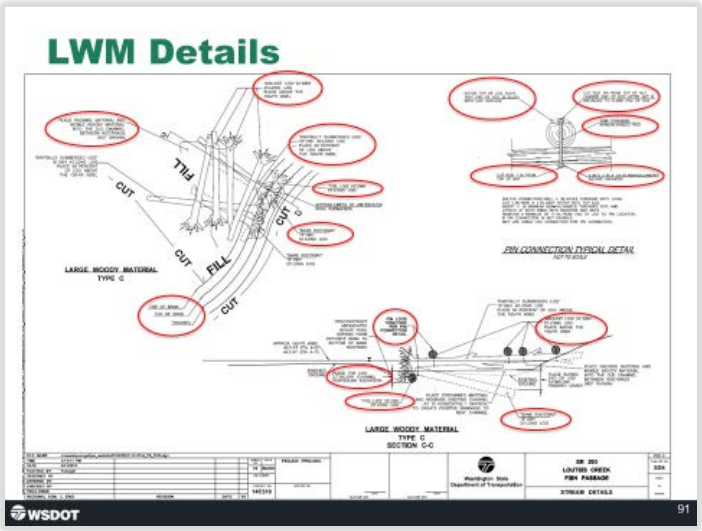

Stream Plan
PRELIMINARY - NOT FOR CONSTRUCTION
DRAFT
WSDOT
86


Stream Profile
PRELIMINARY - NOT FOR CONSTRUCTION
DRAFT
WSDOT
87


Stream Details
PRELIMINARY - NOT FOR CONSTRUCTION
DRAFT
WSDOT
88


Stream Plan with LWM
PRELIMINARY
NOT FOR CONSTRUCTION
30% REVIEW
LEGEND
WSDOT
89


LWM Details
LARGE WOODY MATERIAL
TYPE A
LARGE WOODY MATERIAL
TYPE B
LARGE WOODY MATERIAL
TYPE A
SECTION A-A
LARGE WOODY MATERIAL
TYPE B
SECTION B-B
WSDOT
90


LWM Details
FILL
CUT
CUT
FILL
CUT
CUT
LARGE WOODY MATERIAL
TYPE C
PIN CONNECTION TYPICAL DETAIL
LARGE WOODY MATERIAL
TYPE C
SECTION C-C
WSDOT
91

QC of PHD

- Author needs to:
  - Make sure all checklist elements addressed
  - Verify all appendices are attached and readable
  - PHD has been reviewed by a peer or company QC process
  - Any design deviations have already been discussed with HQ Hydraulics

WSDOT 92

Summary

- Summarizes all design elements
  - Values
  - Location in Report
- Check bookmarks
- Enter all values

Stream Crossing Category	Elements	Values	Report Location
Habitat Gain	Total Length		
Bankfull Width	Average BFW		2.8.2 Channel Geometry
	Reference reach found?	Y/N	2.8.1 Reference Reach Selection
Channel Slope/Gradient	Existing Crossing		2.8.4 Vertical Channel Stability
	Reference Reach		2.8.2 Channel Geometry
Countersink	Proposed		4.4.2 Channel Planform and Shape
	Proposed		4.7.3 Freeboard
Scour	Added for climate resiliency		4.7.3 Freeboard
	Analysis		8 Scour Analysis
	Streambank protection/stabilization		8 Scour Analysis
Channel Geometry	Existing		2.8.2 Channel Geometry
	Proposed		4.4.2 Channel Planform and Shape
Floodplain Continuity	FEMA mapped floodplain	Y/N	6 Floodplain Changes
	Lateral Migration	Y/N	2.8.5 Channel Migration
	Floodplain changes?	Y/N	6 Floodplain Changes
Freeboard	Required Above 100 yr		4.7.3 Freeboard
	Added for climate resiliency		4.7.3 Freeboard
	Additional Recommended		4.7.3 Freeboard
Maintenance Clearance	Proposed		4.7.3 Freeboard
Substrate	Existing		2.8.3 Sediment
	Proposed		5.1 Bed Material
Hydraulic Opening	Proposed		4.7.2 Minimum Hydraulic Opening Width and Length
	Added for climate resiliency	Y/N	4.7.2 Minimum Hydraulic Opening Width and Length
Channel Complexity	LWM	Y/N	5.2 Channel Complexity
	Meander Bars	Y/N	5.2 Channel Complexity
	Boulder Clusters	Y/N	5.2 Channel Complexity
	Mobile Wood	Y/N	5.2 Channel Complexity
Crossing length	Existing		2.7.2 Existing Conditions
	Proposed		4.7.2 Minimum Hydraulic Opening Width and Length
Floodplain Utilization Ratio (FUR)	Floodplain Width		4.2 Existing Conditions Model Results
	Average FUR Upstream and DS		4.2 Existing Conditions Model Results
Hydrology/Design Flows	Existing	See Link	3 Hydrology and Peak Flow Estimates
	Climate resiliency	See Link	3 Hydrology and Peak Flow Estimates
Channel Morphology	Existing		2.8.2 Channel Geometry
	Proposed		5.2 Channel Complexity
Channel Degradation	Potential?	Y/N	8.2 Long-term Aggradation/Degradation of the River Bed
	Allowed?	Y/N	8.2 Long-term Aggradation/Degradation of the River Bed
Structure Type	Recommendation	Y/N	4.7.1 Structure Type
	Type		4.7.1 Structure Type

WSDOT 93