PHD/FHD Process Workshop

<u>PHD/FHD Template Version 2021-12</u>
Julie Heilman, PE – *State Hydraulic Engineer, WSDOT*
Heather Pittman, PE – *Olympic Region Fish Passage Design Manager, WSDOT*
Shaun Bevan, PE – *Senior Water Resources Engineer, HDR*

<u>Fish Passage Tracking Spreadsheet</u>
Gabe Ng – *Northwest Region Fish Passage Design Manager, Jacobs*

<u>WDFW Fish Passage Coordination Process Improvement</u>
Cade Roler – *Olympic Region Tribal Liaison, WSDOT*
Eliza McGovern – *Northwest Region Tribal Liaison, WSDOT*

January 18, 2022

Agenda

PHD/FHD Template

- Expectations
- History and Comments
- Specific Changes
- Q&A

WDFW Fish Passage Complexity Determination

- Evaluating projects based on anticipated complexity
- Level of review from WDFW based on complexity
- Overview of design elements impacting complexity
- Collaboration process to determine complexity
- Q&A

Tracking Spreadsheet

- Review of Consultant Schedules
- Q&A

Introductions

Julie Heilman, PE

State Hydraulic Engineer

WSDOT

Heather Pittman, PE

Olympic Region Fish Passage Design Manager

WSDOT

Shaun Bevan, PE

Senior Water Resources Engineer

HDR

Gabe Ng, PE

Northwest Region Fish Passage Design Manager

Jacobs

Cade Roler

Olympic Region Tribal Liaison

WSDOT

Eliza McGovern

Northwest Region Tribal Liaison

WSDOT

PHD/FHD Template

Julie Heilman, PE	Heather Pittman, PE	Shaun Bevan, PE
State Hydraulic Engineer	*Olympic Region Fish Passage Design Manager*	*Senior Water Resources Engineer*
WSDOT	WSDOT	HDR

- Workshop Goals:
  - Focus on changes from previous template
  - Minimal discussion on items that have not changed

Expectations

- Use template as it is written
  - Approval from HQ Hydraulics required for any modifications to template
  - Respond to all prompts
- Use checklist while writing and performing QC
- Use alongside updated Hydraulics Manual

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 highlighting is both PHD and FHD. Green highlighting is PHD only. Pink highlighting is FHD only. Italics with highlights are instructions that are to be deleted prior to turning in PHD.

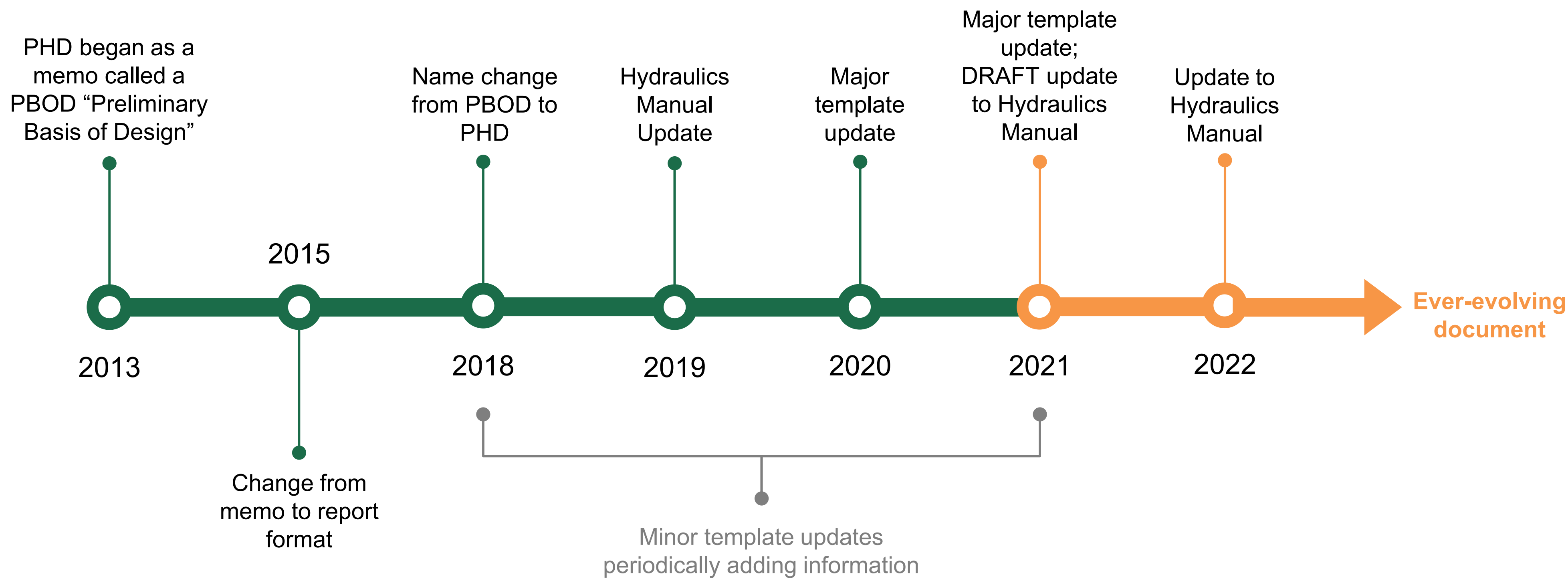
Please do not modify the document without talking with HQ Hydraulics first. The purpose of the template is to maintain consistency statewide for fish passage projects and to make the review of the document easier for the tribes and WDFW. Changes made to the document may warrant a template update.

The following are general directions for template use:

- *All prompts shall be acknowledged with the level of detail that is appropriate to convey the rationale.*
- *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.*
- *All plan view figures should have a north arrow and scale bar.*
- *Use one space after a period at the end of a sentence, not two.*
- *All figures, tables, and their captions/titles should be left-justified.*
- *When creating the PDF make sure it is created with PDF bookmarks of the headings so that readers can quickly jump to specific sections within the document.*
- *All pages should have a "draft" watermark until the PHD or FHD is considered final.*
- *Please do not manually modify template text styles—use Body Text 1 for body text, List Bullet for bulleted lists, List Number for numbered lists, Table Title for table titles, Caption, Figure for figure captions, etc.*
- *Please make sure to cross reference all figures and tables in the narrative of the report, preferably above (and near) where the figure/table appears. Use auto cross referencing and cross reference only the figure/table number (i.e., not the full caption or title).*

[Page 1 of 2021 Template]

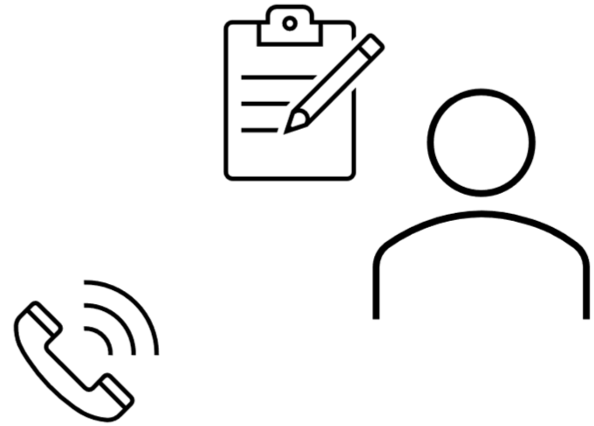
Template History

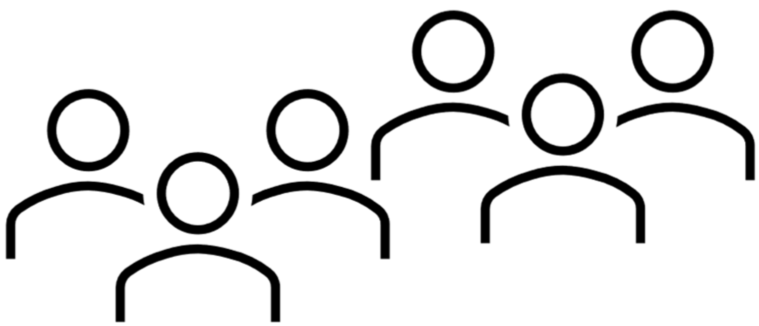


*Hydraulics Manual also being updated periodically – should be consulted during PHD / FHD development

Collected Comments

- Received comments from consultant firms
- Received comments from regions
  - More than 300 comments
- Not all comments addressed in template
- Template is ever evolving





PREVIOUS TEMPLATE 08/2020


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 X.XX NAME Creek
Preliminary Hydraulic Design Report
MONTH YEAR

NEW TEMPLATE 12/2021


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

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ENGINEER OF RECORD, TITLE
Certification FPT##-#####
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LIST OF CONTRIBUTING ENGINEERS, GEOMORPHOLOGISTS, AND BIOLOGISTS
WITH TITLES, COMPANY/OFFICE

Choose an item.
Hydraulics Report Template v2021-12

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

Significant Changes

- Rearranging of sections
  - Combined relevant sections
  - Moved sections
  - Better flow and readability
- Section 4 Water Crossing Design
  - Breaks design out from modeling / results
  - Minimum Hydraulic Opening section detailed and expanded
- Additional Appendices

2020 > 2021 Template Summary

Section Number	2020 Template Section
1	Introduction
2	Watershed and Site Assessment
3	Hydrology and Peak Flow Estimates
4	Hydraulic Analysis and Design
5	Streambed Design
6	Floodplain Changes
7	Climate Resilience
8	Scour Analysis

Section Number	2021 Template Section
1	Introduction
2	Watershed and Site Assessment
3	Hydrology and Peak Flow Estimates
4	Water Crossing Design
5	Hydraulic Analysis
6	Floodplain Evaluation
7	Scour Analysis
8	Scour Countermeasures

1 Introduction

Section Number	2020 Template Section
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2	Watershed and Site Assessment
3	Hydrology and Peak Flow Estimates
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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

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

Choose an item.

Hydraulics Report Template v2021-12

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

General

- Flow arrows on all figures
- PDF needs bookmarks

Cover Page

- FPT number for all authors
- Submittal type

1 Introduction

- Minimal narrative changes

2 Watershed and Site Assessment

Section Number	2020 Template Section
1	Introduction
2	**Watershed and Site Assessment**
3	Hydrology and Peak Flow Estimates
4	Hydraulic Analysis and Design
5	Streambed Design
6	Floodplain Changes
7	Climate Resilience
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Section Number	2021 Template Section
1	Introduction
2	**Watershed and Site Assessment**
3	Hydrology and Peak Flow Estimates
4	Water Crossing Design
5	Hydraulic Analysis
6	Floodplain Evaluation
7	Scour Analysis
8	Scour Countermeasures

2 Watershed and Site Assessment

- Slight rearrangement of existing section to flow better
  - i.e., *Site Description* moved to beginning of section, *Riparian Conditions* moved from end to middle of section, etc.
- Soils <u>always</u> included
- Floodplains section removed
- FUR moved from design section to this section
- Minor narrative changes and a few new figures

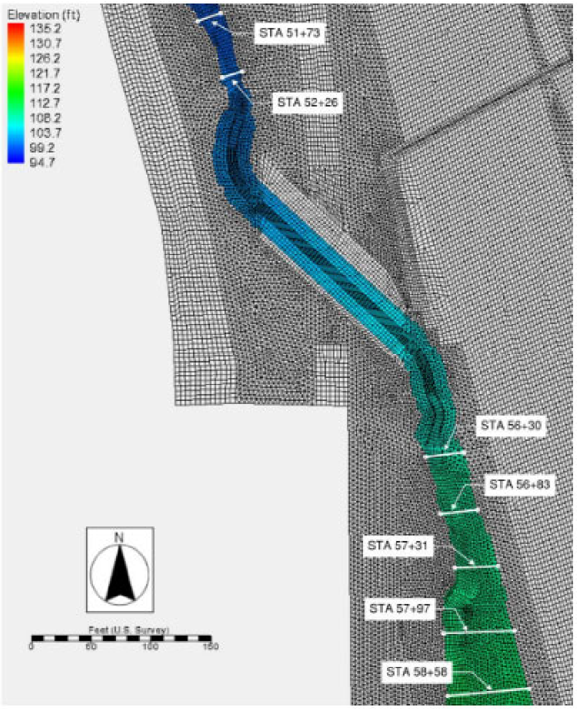

Figure 9: FUR locations

Table 4: FUR determination

Station	FPW (ft)	FUR	Confined/unconfined	Included in average FUR determination
US XX+XX	X.X	X.X	Confined/Unconfined	Yes/No
US XX+XX	X.X	X.X	Confined/Unconfined	Yes/No
US XX+XX (reference reach)	X.X	X.X	Confined/Unconfined	Yes/No
DS XX+XX	X.X	X.X	Confined/Unconfined	Yes/No
DS XX+XX	X.X	X.X	Confined/Unconfined	Yes/No
DS XX+XX	X.X	X.X	Confined/Unconfined	Yes/No
Average	**X.X**	**X.X**	Confined/Unconfined	Yes/No

3 Hydrology and Peak Flow Estimates

Section Number	2020 Template Section
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3 Hydrology and Peak Flow Estimates

- *Climate Resilience* folded into section
  - Climate Resilience assessment is a requirement for DOT but not for injunction or WAC
  - Concerns or issues with climate resilience requires communication with HQ Hydraulics
- Approved method for hydrology *must* be used (see Hydraulics Manual)
- Minor narrative changes

3 Hydrology and Peak Flow Estimates

Description of hydrology, peak flow estimates, and methodology used to determine peak flows (stream gages, USGS regression equations, StreamStats, MGSFlood, etc.). The appropriateness of the method needs to be described here. Include accuracy/uncertainty calculations if possible. Include any field verification or validation of the modeled flows to support accuracy of hydrology (rust lines on structures, scour lines, OHWM, BFW, observed high flow debris, photos from documented events, conversations with adjacent landowners, etc.). If low summer flow conditions are known, also discuss those here (can be helpful to know whether the stream has been observed dry in the summers). Do not include the high and low fish passage design flows described in Appendix G of the WCDG.

If modeling other flow inputs (tributaries, confluences, etc.) provide hydrology information and methodology for that flow used within the model. Add discussion here or within Section 5.1 for which flow combinations were run and why they were selected to determine the freeboard, scour, etc. (e.g., concurrent 100-year flows, 100-year flow within project stream and low flow in another, etc.)

WSDOT recognizes climate resilience as a component of the integrity of its structures, and approaches the design of bridges and buried structures through a risk-based assessment beyond the design criteria. The largest risk to bridges and buried structures will come from increases in flow and/or sea level rise. The goal of fish passage projects is to maintain natural channel processes through the life of the structure and to maintain passability for all expected life stages and species in a system.

WSDOT evaluates crossings using the mean percent change in 100-year flood flows from the WDFW Future Projections for Climate-Adapted Culvert Design program. All sites consider the projected 2080 percent increase throughout the design of the structure. Appendix G contains the projected increase information for the project site. The design flow for the crossing is X cubic feet per second (cfs) at the 100-year storm event. The projected increase for the 2080 100-year flow is X percent, yielding a projected 2080 100-year flow of X cfs.

Table 6: Peak flows for NAME Creek at SR X *(present all methods explored, bold method selected and clearly state in narrative which method was selected for design)*

Mean recurrence interval (MRI) (years)	USGS regression equation (Region 3) (cfs)	MGSFlood (cfs)
2	39	30
10	69	71
25	85	98
50	99	112
100	111	130
500		
Projected 2080 100		

4 Water Crossing Design

Section Number	2020 Template Section
1	Introduction
2	Watershed and Site Assessment
3	Hydrology and Peak Flow Estimates
4	**Hydraulic** Analysis and **Design**
5	**Streambed Design**
6	Floodplain Changes
7	Climate Resilience
8	Scour Analysis

Section Number	2021 Template Section
1	Introduction
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3	Hydrology and Peak Flow Estimates
4	**Water Crossing Design**
5	Hydraulic Analysis
6	Floodplain Evaluation
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4 Water Crossing Design

- Moves all design discussion into one section
  - *Channel Design, Water Crossing Design, Design Methodology,* and *Streambed Design* sections
- "New" Minimum Hydraulic Opening Section 4.2
- A few additional figures required
- Additional narratives added

4 Water Crossing Design

OLD

4 Hydraulic Analysis and Design

4.1 Model Development

4.1.1 *Topographic and Bathymetric Data*

4.1.2 *Model Extent and Computational Mesh*

4.1.3 *Materials/Roughness*

4.1.4 *Boundary Conditions*

4.1.5 *Model Run Controls*

4.1.6 *Model Assumptions and Limitations*

4.2 Existing Conditions Model Results

4.3 Natural Conditions (if applicable, sections and requirements are the same as above)

4.4 Channel Design

4.4.1 *Floodplain Utilization Ratio*

4.4.2 *Channel Planform and Shape*

4.4.3 *Channel Alignment*

4.4.4 *Channel Gradient*

4.5 Design Methodology

4.6 Future Conditions – Proposed X Foot Minimum Hydraulic Opening

4.7 Water Crossing Design

4.7.1 *Structure Type*

4.7.2 *Minimum Hydraulic Opening Width and Length*

4.7.3 *Freeboard*

5 Streambed Design

5.1 Bed Material

5.2 Channel Complexity

5.2.1 *Design Concept*

5.2.2 *Stability Analysis (FHD ONLY)*

NEW

4 Water Crossing Design

4.1 Channel Design

4.1.1 Channel Planform and Shape

4.1.2 Channel Alignment

4.1.3 Channel Gradient

4.2 Minimum Hydraulic Opening

4.2.1 Design Methodology

4.2.2 Hydraulic Width

4.2.3 Vertical Clearance

4.2.4 Hydraulic Length

4.2.5 Future Corridor Plans

4.2.6 Structure Type

4.3 Streambed Design

4.3.1 Bed Material

4.3.2 Channel Complexity

4.3.2.1 Design Concept

4.3.2.2 Stability Analysis

4 Water Crossing Design

OLD

Moved to 5 Hydraulic Analysis (4.1–4.3)

Moved to 2 Watershed and Site Assessment (4.4.1)

Moved to 5 Hydraulic Analysis (4.6)

NEW

4 Water Crossing Design

OLD

4 Hydraulic Analysis and Design

4.1 Model Development

4.1.1 Topographic and Bathymetric Data

4.1.2 Model Extent and Computational Mesh

4.1.3 Materials/Roughness

4.1.4 Boundary Conditions

4.1.5 Model Run Controls

4.1.6 Model Assumptions and Limitations

4.2 Existing Conditions Model Results

4.3 Natural Conditions (if applicable, sections and requirements are the same as above)

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4.7 Water Crossing Design

4.7.1 Structure Type

4.7.2 Minimum Hydraulic Opening Width and Length

4.7.3 Freeboard

5 Streambed Design

5.1 Bed Material

5.2 Channel Complexity

5.2.1 Design Concept

5.2.2 Stability Analysis (FHD ONLY)

NEW

4 Water Crossing Design

4.1 Channel Design

4.1.1 Channel Planform and Shape

4.1.2 Channel Alignment

4.1.3 Channel Gradient

4.2 Minimum Hydraulic Opening

4.2.1 Design Methodology

4.2.2 Hydraulic Width

4.2.3 Vertical Clearance

4.2.4 Hydraulic Length

4.2.5 Future Corridor Plans

4.2.6 Structure Type

4.3 Streambed Design

4.3.1 Bed Material

4.3.2 Channel Complexity

4.3.2.1 Design Concept

4.3.2.2 Stability Analysis

4.1 Channel Design

- Primarily same as last template version
- FUR removed from this section
- Details of meander belt analysis included

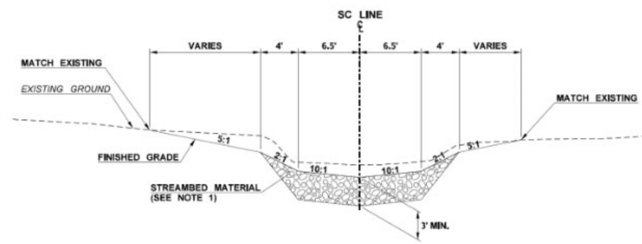


Figure 12: Design cross section ***(include typical 2-year and 100-year WSEs on this figure)***

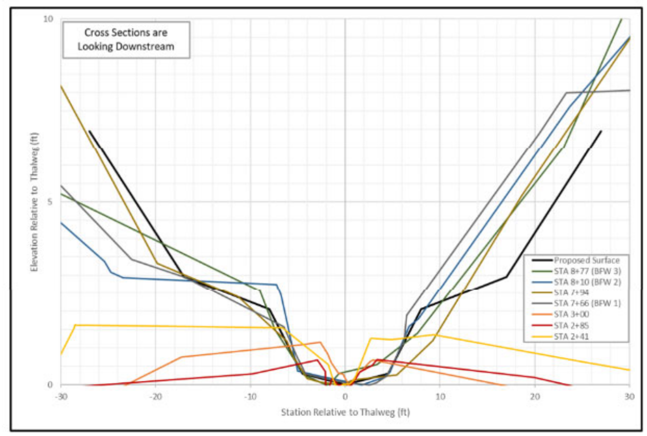


Figure 13: Proposed cross section superimposed with existing survey cross sections
(Used to determine bankfull width or within reference reach [this figure should illustrate that the proposed channel shape matches the reference reach, unless you are purposely not matching the reference reach shape]. Okay to include other sections not used for (such as STA 3+00, 2+85, and 2+41 in the example figure) but add explanation in the narrative that they were not within the reference reach and were not used in determining an appropriate design channel shape.)

SR X MP XX Name Creek: Preliminary Hydraulic Design Report Page 24

4 Water Crossing Design

OLD

NEW

OLD

4 Water Crossing Design

NEW

4 Water Crossing Design

OLD

NEW

4 Water Crossing Design

OLD

4 Hydraulic Analysis and Design

4.1 Model Development
4.1.1 *Topographic and Bathymetric Data*
4.1.2 *Model Extent and Computational Mesh*
4.1.3 *Materials/Roughness*
4.1.4 *Boundary Conditions*
4.1.5 *Model Run Controls*
4.1.6 *Model Assumptions and Limitations*
4.2 Existing Conditions Model Results
4.3 Natural Conditions (if applicable, sections and requirements are the same as above)
4.4 Channel Design
4.4.1 *Floodplain Utilization Ratio*
4.4.2 ***Channel Planform and Shape***
4.4.3 ***Channel Alignment***
4.4.4 ***Channel Gradient***
4.5 Design Methodology
4.6 Future Conditions – Proposed X Foot Minimum Hydraulic Opening
4.7 Water Crossing Design
4.7.1 ***Structure Type***
4.7.2 ***Minimum Hydraulic Opening Width and Length***
4.7.3 ***Freeboard***

5 Streambed Design

5.1 Bed Material
5.2 Channel Complexity
5.2.1 ***Design Concept***
5.2.2 ***Stability Analysis (FHD ONLY)***

NEW

4 Water Crossing Design

4.1 Channel Design
4.1.1 Channel Planform and Shape
4.1.2 Channel Alignment
4.1.3 Channel Gradient
4.2 Minimum Hydraulic Opening
4.2.1 Design Methodology
4.2.2 Hydraulic Width
4.2.3 Vertical Clearance
4.2.4 Hydraulic Length
4.2.5 Future Corridor Plans
4.2.6 Structure Type
4.3 Streambed Design
4.3.1 Bed Material
4.3.2 Channel Complexity
4.3.2.1 Design Concept
4.3.2.2 Stability Analysis

4.2 Minimum Hydraulic Opening

Table 9: Vertical clearance summary

Parameter	Downstream face of structure	Upstream face of structure
Station		
Thalweg elevation (ft)		
Highest streambed ground elevation within hydraulic width (ft)		
100-year WSE (ft)		
2080 100-year WSE (ft)		
Required freeboard (ft)	1, 2, 3, or more if aggradation risk	1, 2, 3, or more if aggradation risk
Recommended/Required maintenance clearance (ft)	Typically 6 or 10	Typically 6 or 10
Required minimum low chord, 100-year WSE + freeboard (ft)		
Required minimum low chord, 2080 100-year WSE + freeboard (ft) *if discussion in section states not practical to meet freeboard at 2080 100-year flow delete this row.*		
Recommended/Required minimum low chord, highest streambed ground elevation within hydraulic width + maintenance clearance (ft)		
Required minimum low chord (ft) *select highest of above REQUIRED low chords*		
Recommended minimum low chord (ft) *select highest of all the above RECOMMENDED and REQUIRED low chords; delete row if all the above are required*		

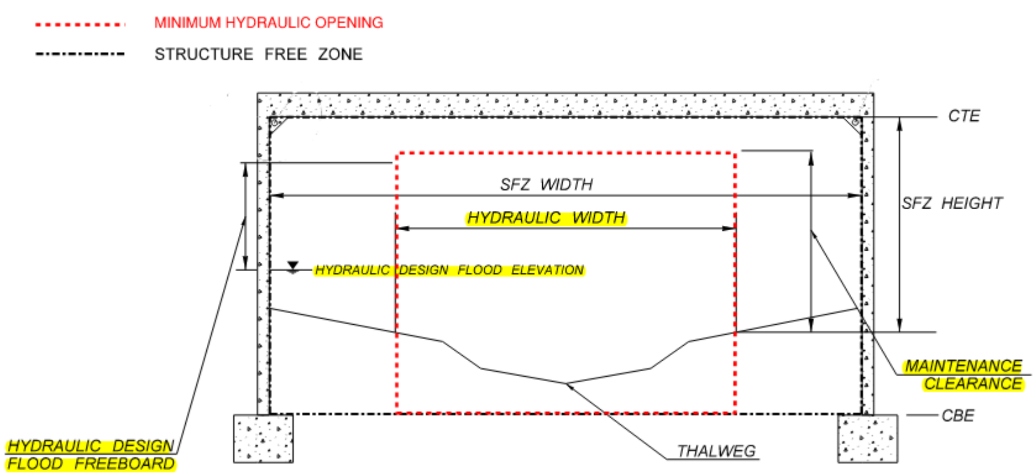
$$W_{HYO} = 1.2 * W_{bf} + 2 \text{ feet}$$

$$W_{HYO} = 1.3 * W_{bf}$$

Where

W_{HYO} = width of hydraulic opening

W_{bf} = BFW



4.2 Minimum Hydraulic Opening

4.2	**Minimum Hydraulic Opening**
4.2.1	***Design Methodology***
4.2.2	***Hydraulic Width***
4.2.3	***Vertical Clearance***
4.2.4	***Hydraulic Length***
4.2.5	***Future Corridor Plans***
4.2.6	***Structure Type***

$$W_{HYO} = 1.2 * W_{bf} + 2\text{ feet}$$

$$W_{HYO} = 1.3 * W_{bf}$$

Where

W_{HYO} = width of hydraulic opening

W_{bf} = BFW

Table 9: Vertical clearance summary

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Recommended/Required minimum low chord, highest streambed ground elevation within hydraulic width + maintenance clearance (ft)		
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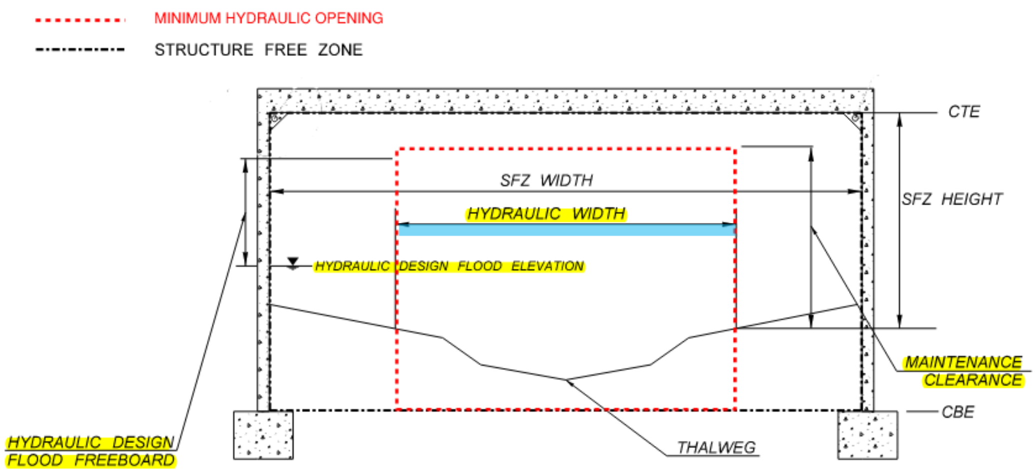

4.2 Minimum Hydraulic Opening

Table 9: Vertical clearance summary

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Recommended minimum low chord (ft) *select highest of all the above RECOMMENDED and REQUIRED low chords; delete row if all the above are required*		

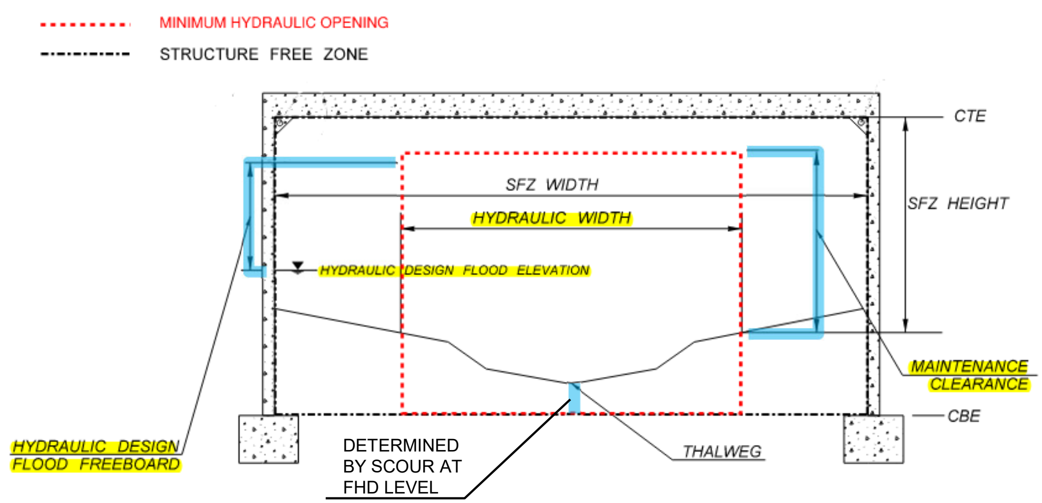
$$W_{HYO} = 1.2*W_{bf} + 2\text{ feet}$$

$$W_{HYO} = 1.3*W_{bf}$$

Where

W_{HYO} = width of hydraulic opening

W_{bf} = BFW



4.2 Minimum Hydraulic Opening

- No significant changes
- Reordered

Table 9: Vertical clearance summary

Parameter	Downstream face of structure	Upstream face of structure
Station		
Thalweg elevation (ft)		
Highest streambed ground elevation within hydraulic width (ft)		
100-year WSE (ft)		
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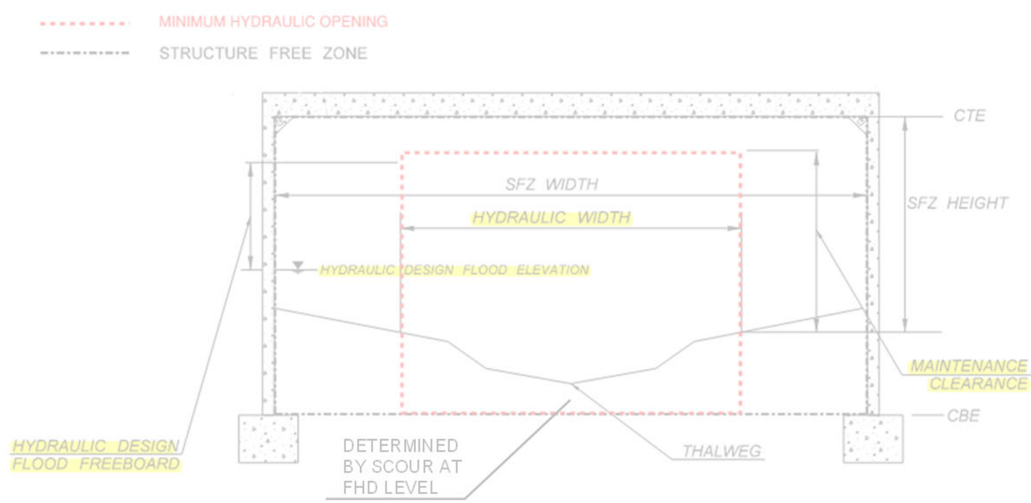
Required minimum low chord (ft) *select highest of above REQUIRED low chords*		
Recommended minimum low chord (ft) *select highest of all the above RECOMMENDED and REQUIRED low chords; delete row if all the above are required*		

$$W_{HYO} = 1.2 * W_{bf} + 2 \text{ feet}$$

$$W_{HYO} = 1.3 * W_{bf}$$

Where
W_{HYO} = width of hydraulic opening
W_{bf} = BFW



4 Water Crossing Design

OLD

NEW

4.3 Streambed Design

- Meander bar description
- Specific LWM targets for the project
- Add LWM quantity calculations as appendix for PHD and FHD

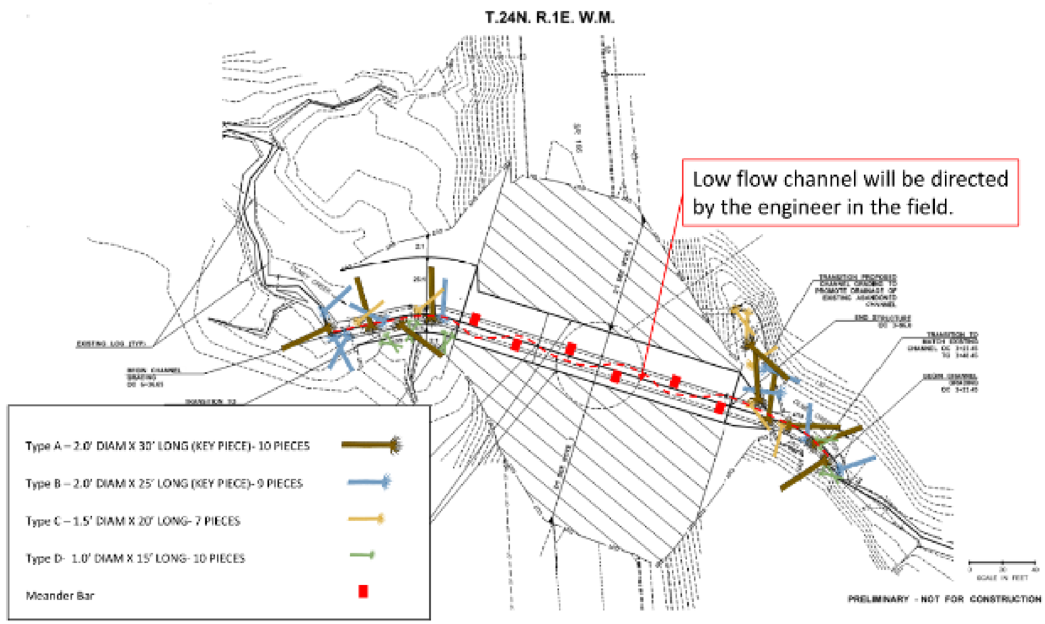


Figure 15: Conceptual layout of habitat complexity *(provide 2 figures if structure type is not known)*

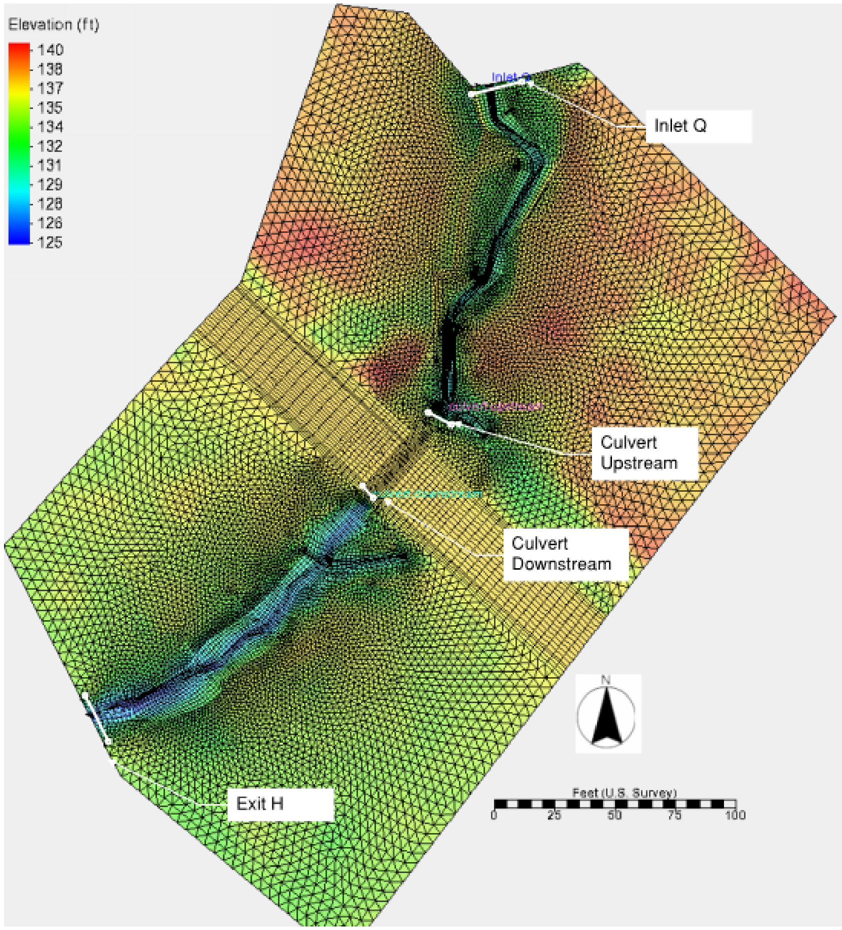
Table 10: Comparison of observed and proposed streambed material

Sediment size	Observed diameter for design (in)	Proposed diameter (in)	Meander bar diameter (in) *(if applicable)*
D_{16}			
D_{50}			
D_{84}			
D_{95}			
D_{100}			

5 Hydraulic Analysis

Section Number	2020 Template Section
1	Introduction
2	Watershed and Site Assessment
3	Hydrology and Peak Flow Estimates
4	**Hydraulic Analysis** and Design
5	Streambed Design
6	Floodplain Changes
7	Climate Resilience
8	Scour Analysis

Section Number	2021 Template Section
1	Introduction
2	Watershed and Site Assessment
3	Hydrology and Peak Flow Estimates
4	Water Crossing Design
5	**Hydraulic Analysis**
6	Floodplain Evaluation
7	Scour Analysis
8	Scour Countermeasures



5 Hydraulic Analysis

- Breaks out model development and results to section separate from design
- Provides additional instructions for adequate section completion
- *Section 5.1.5 Model Run Controls*
  - Reference Appendix I: SRH-2D Model Stability and Continuity

6 Floodplain Evaluation

Section Number	2020 Template Section
1	Introduction
2	Watershed and Site Assessment
3	Hydrology and Peak Flow Estimates
4	Hydraulic Analysis and Design
5	Streambed Design
6	**Floodplain Changes**
7	Climate Resilience
8	Scour Analysis

Section Number	2021 Template Section
1	Introduction
2	Watershed and Site Assessment
3	Hydrology and Peak Flow Estimates
4	Water Crossing Design
5	Hydraulic Analysis
6	**Floodplain Evaluation**
7	Scour Analysis
8	Scour Countermeasures

6 Floodplain Evaluation

- Narrative changes
  - Detailed description of FEMA zone
- Floodplain storage section removed
- Flood risk assessment (after PHD)

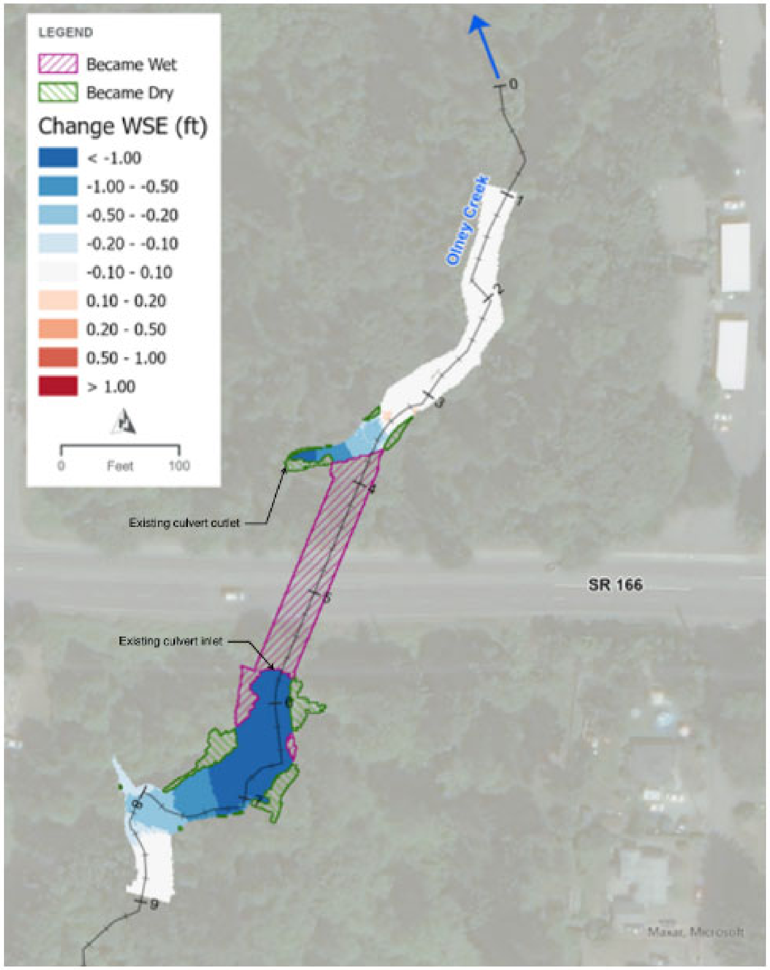


Figure 33: 100-year WSE change from existing to proposed conditions *(add FEMA zone extents and GIS parcels to figure)*

7 Scour Analysis

Section Number	2020 Template Section
1	Introduction
2	Watershed and Site Assessment
3	Hydrology and Peak Flow Estimates
4	Hydraulic Analysis and Design
5	Streambed Design
6	Floodplain Changes
7	Climate Resilience
8	**Scour Analysis**

Section Number	2021 Template Section
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4	Water Crossing Design
5	Hydraulic Analysis
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8	Scour Countermeasures

Washington State
Department of Transportation

Hydraulics Manual

M 23-03.06

December 27, 2021

Engineering and Regional Operations Hydraulics Office

7 Scour Analysis

- Additional instructions for completion of sections
- Lateral Migration
- Scour calculations
  - Hydraulics Manual
  - Bridge Scour Memo

8 Scour Countermeasures

Section Number	2020 Template Section
1	Introduction
2	Watershed and Site Assessment
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8	Scour Analysis

Section Number	2021 Template Section
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5	Hydraulic Analysis
6	Floodplain Evaluation
7	Scour Analysis
8	**Scour Countermeasures**

8 Scour Countermeasures

- Additional section created
- Minimal effort for PHD

For PHD:

The need for scour countermeasures has not yet been determined. If scour countermeasures are needed they will not encroach within the minimum hydraulic opening. *If key piece LWM are proposed inside a crossing structure a buried rock revetment scour countermeasure will be required and the minimum hydraulic opening will need to be widened to account for the space needed for the rock revetment outside of the MHO. Unless agreement with WDFW/tribe allow for encroachment, in which case add discussion here and what has been coordinated. Revise PHD narrative if proposing key piece LWM within structure.*

For FHD:

See WSDOT Hydraulics Manual Chapter 7-4.11 Scour Countermeasures (2022) for design considerations. FHD to document details on the countermeasure design and extents. Section should also document design analysis.

9 Summary Table

- Reorganization of content
- Additional information included
- Hydraulic commitments made throughout the PHD/FHD review process should be described and documented
  - LWM, habitat features, scour, design slope, structure type, etc.

Table 18: Report summary

Stream crossing category	Element	Value	Report location
Habitat gain	Total length	XXXX LF	2.1 Site Description
Bankfull width	Reference reach found?	Yes/No	2.7.1 Reference Reach Selection
	Design BFW	X.X ft	2.7.2 Channel Geometry
	Concurrence BFW	X.X ft	2.7.2 Channel Geometry
Floodplain utilization ratio (FUR)	Flood-prone width	X.X ft	2.7.2.1 Floodplain Utilization Ratio
	Average FUR	X.X (add two values if different for US/DS)	2.7.2.1 Floodplain Utilization Ratio
Channel morphology	Existing	See link	2.7.2 Channel Geometry
	Proposed	See link	4.3.2 Channel Complexity
Hydrology/design flows	100 yr flow	XX cfs	3 Hydrology and Peak Flow Estimates
	2080 100 yr flow	XX cfs	3 Hydrology and Peak Flow Estimates
	2080 100 yr used for design	Y/N (elaborate if used for width but not freeboard, etc.)	3 Hydrology and Peak Flow Estimates
	Dry channel in summer	Yes/No	3 Hydrology and Peak Flow Estimates
Channel geometry	Existing	See link	2.7.2 Channel Geometry
	Proposed	See link	4.1.1 Channel Planform and Shape
Channel slope/gradient	Existing culvert	X.X%	2.6.2 Existing Conditions
	Reference reach	X.X%	2.7.1 Reference Reach Selection
	Proposed	X.XX%	4.1.3 Channel Gradient
Hydraulic width	Existing	X ft	2.6.2 Existing Conditions
	Proposed	XX ft	4.2.2 Hydraulic Width
	Added for climate resilience	Yes/No	4.2.2 Hydraulic Width
Vertical clearance	Required freeboard	X.X ft	4.2.3 Vertical Clearance
	Required freeboard applied to 100 yr or 2080 100 yr	100 yr/2080 100 yr	4.2.3 Vertical Clearance
	Maintenance clearance	Recommended/Required X ft	4.2.3 Vertical Clearance
	Low chord elevation	See link	4.2.3 Vertical Clearance
Crossing length	Existing	X.X ft	2.6.2 Existing Conditions
	Proposed	X.X ft	4.2.4 Hydraulic Length
Structure type	Recommendation	Yes/No	4.2.6 Structure Type
	Type		4.2.6 Structure Type
Substrate	Existing	See link	2.7.3 Sediment
	Proposed	See link	4.3.1 Bed Material
	Coarser than existing?	Yes/No	4.3.1 Bed Material
Channel complexity	LWM for bank stability	Yes/No	4.3.2 Channel Complexity

Stream crossing category	Element	Value	Report location
	LWM for habitat	Yes/No	4.3.2 Channel Complexity
	LWM within structure	Yes/No	4.3.2 Channel Complexity
	Meander bars	#	4.3.2 Channel Complexity
	Boulder clusters	#	4.3.2 Channel Complexity
	Coarse bands	#	4.3.2 Channel Complexity
	Mobile wood	Yes/No	4.3.2 Channel Complexity
Floodplain continuity	FEMA mapped floodplain	Yes/No	6 Floodplain Evaluation
	Lateral migration	Yes/No	2.7.5 Channel Migration
	Floodplain changes?	Yes/No	6 Floodplain Evaluation
Scour	Analysis	See link	7 Scour Analysis
	Scour countermeasures	Yes/No/Determined at FHD	8 Scour Countermeasures
Channel degradation	Potential?	Range	7.2 Long-term Aggradation/Degradation of the Channel Bed
Channel degradation	Allowed?	Yes/No	7.2 Long-term Aggradation/Degradation of the Channel Bed

2020 > 2021 Appendix Summary

	2020 Appendix Section
A	FEMA Floodplain Map
B	Hydraulic Field Report Form
C	SRH-2D Model Results
D	Streambed Material Sizing Calculations
E	Stream Plan Sheets, Profile, Details
F	Scour Calculations (FHD ONLY)
G	Manning's Calculations
H	Large Woody Material Calculations (FHD ONLY)
I	Reach Assessment

*DO NOT delete unused appendices
(to maintain continuity with PHDs)

	2021 Appendix Section
A	FEMA Floodplain Map
B	Hydraulic Field Report Form
C	Streambed Material Sizing Calculations
D	Stream Plan Sheets, Profile, Details
E	Manning's Calculations
F	Large Woody Material Calculations
G	**Future Projections for Climate-Adapted Culvert Design**
H	SRH-2D Model Results
I	**SRH-2D Model Stability and Continuity**
J	Reach Assessment
K	Scour Calculations (FHD ONLY)
L	**Floodplain Analysis (FHD ONLY)**

Checklist

- Use alongside template
- Additional detail provided

5 Hydraulic Analysis

5.1 Model Development

5.1.1 Topographic and Bathymetric Data

- ☐ Where the topography/bathymetric data was supplied from
- ☐ When was the data collected?
- ☐ What is the datum?
- ☐ Key topographic/structural controls discussed
- ☐ If LiDAR was used, it should be described

5.1.2 Model Extent and Computational Mesh

- ☐ Upstream and Downstream Domain Limits for existing and proposed (if different)
- ☐ Reason limits were chosen
- ☐ Limits are far enough away not to influence results
- ☐ Total area mesh covers, minimum number of elements (rect + triang)
- ☐ Figures showing existing and proposed mesh limits

5.1.3 Material/Roughness

- ☐ Describe each Manning's n value used
- ☐ Figure showing where the Manning's n values are (two figures if existing/proposed different)
- ☐ Describe how LWM was modeled in both existing and proposed conditions

5.1.4 Boundary Conditions

- ☐ Boundary Conditions described
- ☐ Geometric data for culverts described
- ☐ Any other boundary conditions described (pressure flow)
- ☐ Discharge values
- ☐ Figure showing all BCs, labeling any culverts, pressure boundaries, etc.
- ☐ Table or screenshot of inputs for Linear BC or HY-8
- ☐ All data included to recreate boundary conditions/rating curves

5.1.5 Model Run Controls

- ☐ SRH-2D model control (Start Time, Time Step, End Time, Initial Condition, Flow (if defaults not used)
- ☐ State whether the model reached a stable steady state result

5.1.6 Model Assumptions and Limitations

- ☐ Assumptions listed, states no assumptions if there are none

5.2 Existing Condition

- ☐ Figure showing location of cross sections and alignment stationing used for results reporting
- ☐ Average Hydraulic Results for Existing Conditions
- ☐ Longitudinal Profile with 2-year, 100-year, 500-year
- ☐ Existing conditions velocity map with 100-year flow & Cross section locations
- ☐ Existing conditions channel and floodplain velocities filled out
- ☐ Whether overtopping occurs, if so, when and does it match with maintenance records?

5.3 Natural Conditions (if applicable)

- ☐ Figure showing location of cross sections and alignment stationing used for results reporting
- ☐ Average Hydraulic Results for Natural Conditions
- ☐ Longitudinal Profile with 2-year, 100-year, 500-year, 2080 100-year
- ☐ Natural conditions velocity map with 100-year flow & Cross section locations
- ☐ Natural conditions channel and floodplain velocities filled out

5.4 Proposed Conditions

- ☐ Figure showing location of cross sections and alignment stationing used for results reporting
- ☐ Average Hydraulic Results for Proposed Conditions
- ☐ Longitudinal Profile with 2-year, 100-year, 500-year, 2080 100-year
- ☐ Proposed conditions velocity map with 100-year flow & Cross section locations
- ☐ Proposed conditions channel and floodplain velocities filled out

Q&A

Tracking Spreadsheet

Gabe Ng, PE

Northwest Region Fish Passage Design Manager

Jacobs

Color Key	
Grey cells	Task/milestone complete (1/1/00 means complete or not needed)
Red text	Planned date is past due.
Green cell	Planned date is within the next 45 days.
Yellow cell	Needs date forecast
Light yellow	Status = "Hold"
Pinkish	Status = "Canceled"
Speckled	Status = "No further work"

	180		WSDOT	WSDOT	WSDOT	WSDOT	Consultant	Consultant	Consultant
Days from previous task →									
Completed	273		375		347		329		295
Past Due	0		2		4		2		19
Due within 45 days	17		10		35		22		22
Needs a forecast	0		0		5		12		23

				Location data		Actions		SME /	General Info				Survey						
Row	WDFW ID #	Project Title	Consultant	State Route	Mile Post	Action required by	Action needed	Primary Author	ProjectWise Link	Idealized PHD completion date (start + 8 months)	Project initiation / NTP		Site Visit #1 and Survey Assessment		Survey Received		Site Visit #2 and Pre-Design Assessment		Field Repo
											Planned	Actual	Planned	Actual	Planned	Actual	Planned	Actual	Planned
334	994984	I-90_MP24.86_UNTtoLakeCrk	All other sites	90	24.86	Consultant	Site Visit #1 and Survey Assessment		994984										
335	990265	I-90_MP42.17_MasonCrk_rdwy+fish	All other sites	90	42.17	Consultant	Site Visit #1 and Survey Assessment		990265										
336	994927	I-90_MP42.21_MasonCrk_rdwy+fish	All other sites	90	42.21	Consultant	Site Visit #1 and Survey Assessment		994927										
337	994912	I-90_MP42.32_UNTtoSnoqualmieRiv_rdwy+fish	All other sites	90	42.32	Consultant	Site Visit #1 and Survey Assessment		994912										
338	310516	07.65_SextonCrk	HNTB	2	7.65	Consultant	Site Visit #1 and Survey Assessment	HNTB	310516	9/30/22	1/30/22				1/28/22				
339	991795	23.94_UnnamedtoDevereauxCrk	Jacobs GEC	3	23.94	Consultant	Input forecasted dates		991795				1/1/00	1/1/00	2/7/22				
340	991797	25.31_SweetwaterCrktoHoodCanal	Jacobs GEC	3	25.31	Consultant	Input forecasted dates		991797				1/1/00	1/1/00	2/14/22				
341	999626	26.26_MindyCrktoUnionRiver	Jacobs GEC	3	26.26	Consultant	Input forecasted dates		999626				1/1/00	1/1/00	2/21/22				
342	991991	26.40_UnnamedtoUnionRiver	Jacobs GEC	3	26.4	Consultant	Input forecasted dates		991991				1/1/00	1/1/00	2/21/22				
343	997235	SR003_MP4.67_UNTtoOaklandBay	All other sites	3	4.67	Consultant	Site Visit #1 and Survey Assessment		997235										
344	996742	UnnamedtoDyesInlet	Jacobs GEC	3	41.52	Consultant	Field Report Sent		996742				1/1/00	1/1/00	8/4/21	8/4/21	12/10/21	12/10/21	
345	996748	UnnamedtoDyesInlet	Jacobs GEC	3	42.56	Consultant	Input forecasted dates	Nich	996748				1/1/00	1/1/00	7/3/21	7/3/21	12/1/21	12/1/21	1/20/22
346	15.02460.96	StrawberryCrktoDyesInlet	Jacobs GEC	3	44.8	Consultant	PHD Draft to Prime		15.02460.96				1/1/00	1/1/00	9/9/21	9/9/21	12/1/21	12/1/21	12/21/21
347	996804	BigScandiaCrktoLibertyBay	Jacobs GEC	3	49.48	Consultant	Field Report Sent		996804				1/1/00	1/1/00	9/9/21	9/9/21	12/1/21	12/1/21	
348	991241	SFJohnsonCrktoJohnsonCrk	Jacobs GEC	3	50.85	Consultant	Input forecasted dates	Nich	991241				1/1/00	1/1/00	10/22/21	10/22/21	11/30/21	11/30/21	12/16/21
349	991744	JohnsonCrktoLibertyBay	Jacobs GEC	3	52.21	Consultant	Input forecasted dates	Karen	991744				1/1/00	1/1/00	11/5/21	11/5/21	12/1/21	12/1/21	1/25/22
350	991242	UnnamedtoKinmanCrk	Jacobs GEC	3	57.23	Consultant	Input forecasted dates	Karen	991242				1/1/00	1/1/00	1/3/22	1/3/22	11/30/21	11/30/21	1/20/22
351	991240	UnnamedtoHoodCanal	Jacobs GEC	3	58.21	Consultant	Input forecasted dates		991240				1/1/00	1/1/00	12/30/21	1/11/22	12/2/21	12/2/21	12/17/21
352	990395	SpringCrktoHoodCanal	Jacobs GEC	3	58.49	Consultant	Input forecasted dates	Karen	990395				1/1/00	1/1/00	1/7/22	1/11/22	11/30/21	11/30/21	1/25/22
353	991612	UnnamedtoHoodCanal	Jacobs GEC	3	59.52	Consultant	Field Report Sent		991612				1/1/00	1/1/00	1/7/22	1/13/22	12/1/21	12/1/21	
354	997365	SR003_MP7.16_UNTtoOaklandBay	All other sites	3	7.16	Consultant	Site Visit #1 and Survey Assessment		997365										
355	997371	SR003_MP8.28_UNTtoOaklandBay	All other sites	3	8.28	Consultant	Site Visit #1 and Survey Assessment		997371										
356	991347	UNT to Salmon Creek	Geo	4	7.34	Consultant	Survey Received	Eggers	991347	6/8/22	1/1/00	10/8/21	1/1/00	1/1/00	1/31/22		12/8/21	12/8/21	1/18/22

Fish Passage Complexity Determination

Cade Roler

Olympic Region Tribal Liaison

WSDOT

Eliza McGovern

Northwest Region Tribal Liaison

WSDOT

Goal of the Exercise

Process Improvement Goals:

- Capacity challenges of a growing program
  - Review turnarounds becoming a bottleneck
- Less need for technical assistance
- Create a collaborative process that mitigates risks to permitting while expediting delivery during pre-design and design.
- **Level of review based on projects complexity.**

Complexity Determination Factors

- Stream grading extent
- Risk of degradation/aggradation
- Channel realignment
- Expected stream movement
- Gradient challenges
- Potential for backwater impacts
- Freeboard
- Stream size/BFW
- Slope Ratio
- Sediment supply
- Stream simulation criteria
- Channel confinement
- Geotech or seismic considerations
- Tidal influence
- Alluvial Fan
- Fill Depth
- Impact of nearby obstructions
- Nearby infrastructure
- Bank protection
- FUR

Complexity can change as new information becomes available

Field form filled out on site visit #3

Collaborative approach

Co-Manager Site Visit #3

- Fill out complexity field form with resource co-managers.
  - Initial values determined during site visit #2 and presented during Pre-Site Visit Meeting
- Identify red flags and elements of concern
  - Documented in hydraulic field report
- Field report distributed for concurrence.
- Eliza will talk through the field form

Low Complexity

Pre-Design

- A brief project summary (include red flag summary)
- Document how project will meet or exceed stream simulation and WAC 220.660.190
- Structure free zone
- General project status updates during coordination meetings

Design

- Identify elements to coordinate on
- If Design-Build – Table 2.30 for RFP
- Draft HPA permit drawings
- Final HPA application into APPS
- FHD

US 101 Dean Creek

Medium Complexity

Pre-Design

- Include elements listed for low complexity and….
  - PHD Lite
  - Structure Free Zone/Structure Proposal/Type Size Location Documentation

Design

- Include elements listed for low complexity and…
  - Preliminary bridge plans
    - If applicable
  - Draft stream plans at around 60% design
    - Includes LWM layout
  - Bank protection plan
    - If applicable

SR 530 Schoolyard Creek

High Complexity

Pre-Design

- Include elements listed for low/medium complexity and….
  - Full PHD

Design

- Include elements listed for low/medium complexity and….
  - Additional coordination on specific design elements determined during site visit and throughout design.

US 101 Siebert Creek

Field Form

PROJECT NAME:	
WDFW SITE ID:	
STATE ROUTE/MILEPOST:	
SITE VISIT DATE:	
ATTENDEES:	
ANTICIPATED LEVEL OF PROJECT COMPLEXITY - Low/Medium/High (*additional considerations or red flags may trigger the need for new discussions*):	
IN WATER WORK WINDOW	

The following elements of projects should be discussed before the production of a Preliminary Hydraulic Design by members of WSDOT and WDFW to identify the level of complexity for each site, and corresponding communication and review. While certain elements may be categorized as indicators of a low/medium/high complexity project, these are only suggestions, and newly acquired information may change the level of complexity during a project. The ultimate documentation category for a given site is up to both WSDOT and WDFW, considering both site characteristics and synergistic effects.

Discuss the following elements as they apply to the project. Rank each element as low, medium, or high in complexity. If there are items that need follow-up, mark those and provide a brief description in the column labeled, "Is follow up needed on this item?" The assigned level of complexity determines the appropriate agreed upon review from WDFW (see review parameters here (*final full doc goes here*)). Ultimately, WSDOT needs to acquire an HPA from WDFW for fish passage projects and the agreed upon communication and review of project elements will contribute to efficiencies in the permitting process.

Field Form

Fish Passage Project Site Visit - Determining Project Complexity

Project Elements (anticipated)	Low Complexity	Medium Complexity	High Complexity	Is follow up needed on this item?
Stream grading				
Risk of degradation/aggradation				
Channel realignment				
Expected stream movement				
Gradient				
Potential for backwater impacts				
Meeting requirements for freeboard				
Stream size, and Bankfull Width				
Slope ratio				
Sediment supply				
Meeting stream simulation				
Channel confinement				
Geotech or seismic considerations				
Tidal influence				
Alluvial fan				
Fill depth above barrier				
Presence of other nearby barriers				
Presence of nearby infrastructure				
Need for bank protection				
Floodplain utilization ratio				

2

SR 9 UNT to Landingstrip Creek

Figure 6. Outlet with water surface drop on October 22, 2019

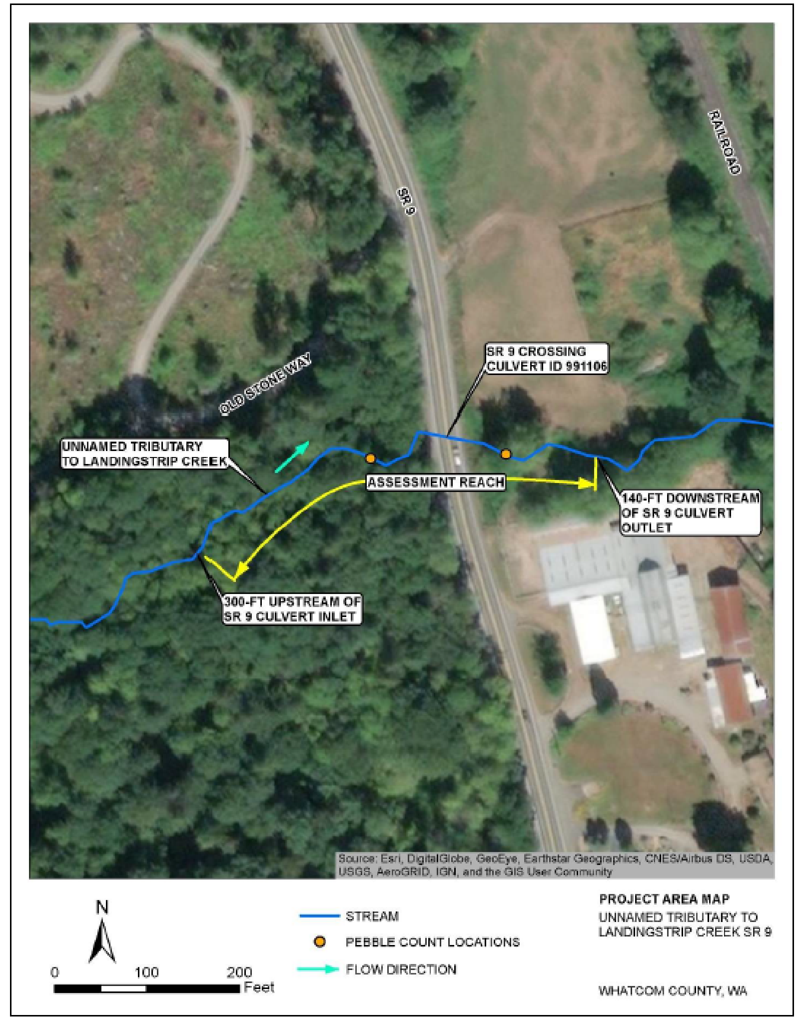

Figure 2.1 Project Area

SR 9 UNT to Landingstrip Creek

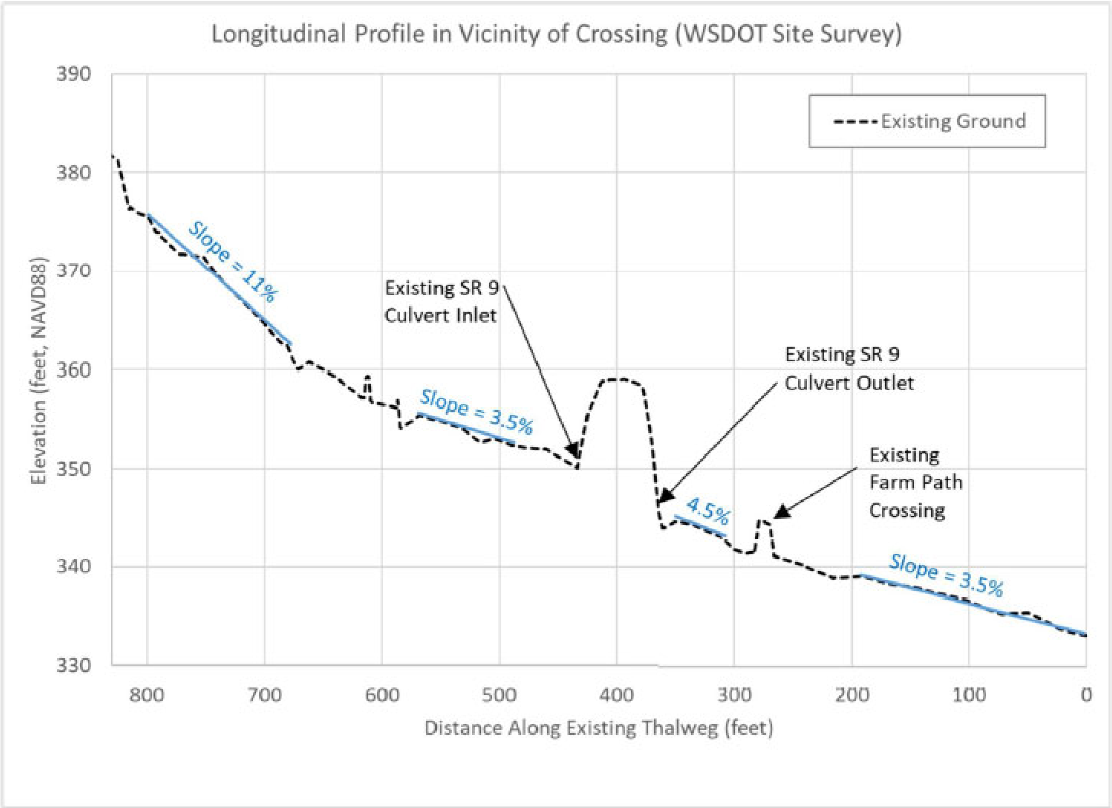

Figure 3.6 Longitudinal Profile of Unnamed Tributary to Landingstrip Creek near existing SR 9 crossing

Work in Progress!

Field form and Guidance doc coming soon

Please provide feedback!