
Black Slough Reach Restoration Project Community Workshop

September 10th, 5:30 p.m.
Van Zandt Community Hall



WORKSHOP AGENDA

1. Welcome and Introductions
2. Project Overview
3. Overview of Existing Conditions Assessment
4. Overview of Typical Restoration Approaches and Considerations
5. Break
6. Facilitated Q&A
7. Wrap Up & Next Steps

PROJECT BACKGROUND

- WRIA 1 Salmonid Recovery Plan (2005) identified habitat limiting factors in the South Fork.
- Identified as a project reach in the 2006 Acme Confluence report by the Nooksack Indian Tribe.
- Led to design grant sponsored by Nooksack Indian Tribe in 2010, preliminary design in 2013, final design and implementation were not pursued due to other project priorities.
- Lummi Nation assumed sponsorship in 2022.
- Hired Natural Systems Design (NSD) in 2023 as engineering consultant.
- Hired Triangle Associates as outreach consultant in 2024.

PROJECT APPROACH

Collaboratively develop project designs that prioritize habitat benefits and address landowner needs.

Work with landowners to identify access locations.

Preliminary Design reviewed by stakeholders and landowners.



PROJECT GOALS

- Improve habitat conditions for threatened South Fork Nooksack early Chinook (chinook) salmon and reduce flood risk throughout the area.

PROJECT GOALS (CONT.)

- Key concerns for habitat improvement include high water temperature, low habitat diversity, and habitat features such as deep pools with woody cover.



PROJECT GOALS (CONT.)

- Avoid any increase to flood and erosion risk to properties and infrastructure in the project reach.



Source: Whatcom Co River & Flood



Source: @Whatcom County Farmers (On Twitter/ X)

OBJECTIVES

The project will restore the SF Nooksack Black Slough Reach by installing a series of engineered log jams (ELJs), while exploring other restoration alternatives.

1. CREATE OR ENCOURAGE A VARIETY OF TYPES OF POOLS



2. IDENTIFY OPPORTUNITIES TO IMPROVE EDGE HABITAT WITH WOOD



3. EXPLORE MODIFICATIONS TO NON-FUNCTIONING LEVEES/BANK PROTECTION



4. WORK WITH BNSF TO IMPROVE HABITAT CONDITIONS ALONG RAILROAD



Source: <https://www.bnsf.com/news-media/news-releases/newsrelease.page?reId=bnsf-railway-announces-2021-economic-development-results>



5. IMPROVE HABITAT IN THERMAL REFUGE AREAS



6. EXPAND AND DIVERSIFY RIPARIAN VEGETATION

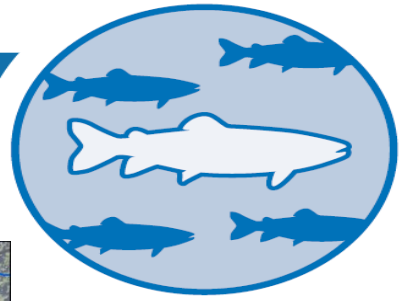


ENGAGEMENT TO DATE



EXISTING CONDITIONS

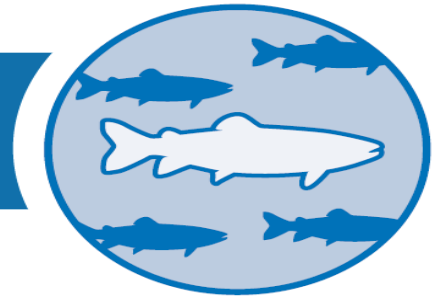
Site Setting, History, & Geomorphic Conditions



- Field Reconnaissance
- Topobathymetric Survey
- Sediment Sampling
- Evaluation of Historical Channel Change
- Influence of Bank Armoring
- Presence/function of Large Wood



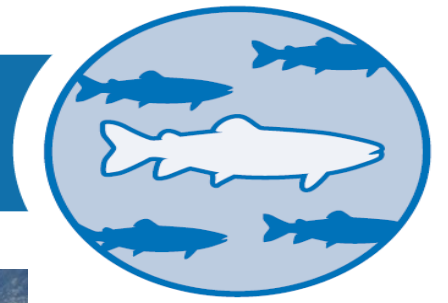
Site Setting, History, & Geomorphic Conditions



- Historical logging and floodplain clearing of large trees
- Removal of instream wood and logjams
- Bank armoring with riprap revetments installed
- Results in simplification of channel form and profile, reduced sinuosity and loss of habitat complexity



Site Setting, History, & Geomorphic Conditions

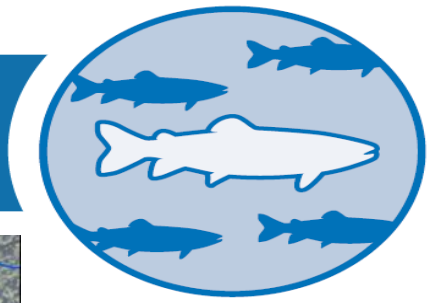


Large Wood

- Wood quantity is order of magnitude less than expected in unimpaired forested valley
- Primarily unstable bar top wood with limited habitat benefit
- Logs large enough to qualify as Key Piece capable of inducing wood jams are largely absent
- Locally, trees recruited to channel have formed pools but are not stable over time
- Previous actions include ELJs and piles to stabilize existing wood



Site Setting, History, & Geomorphic Conditions



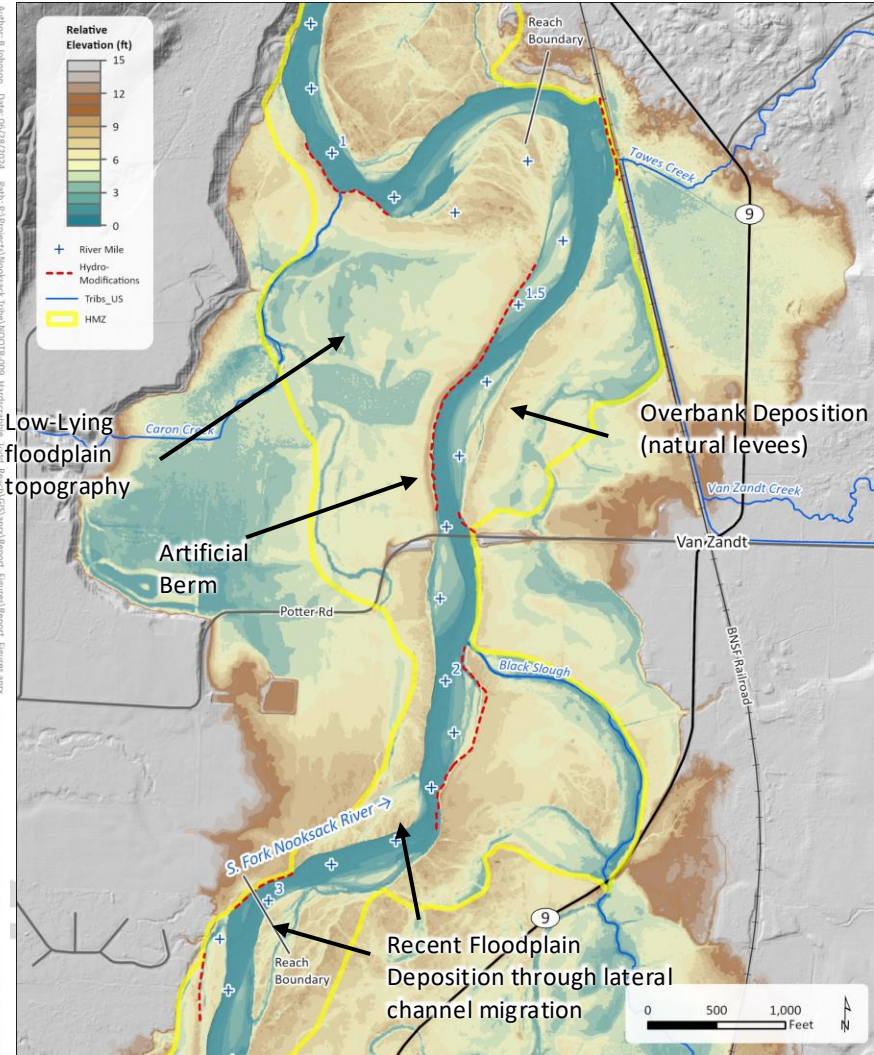
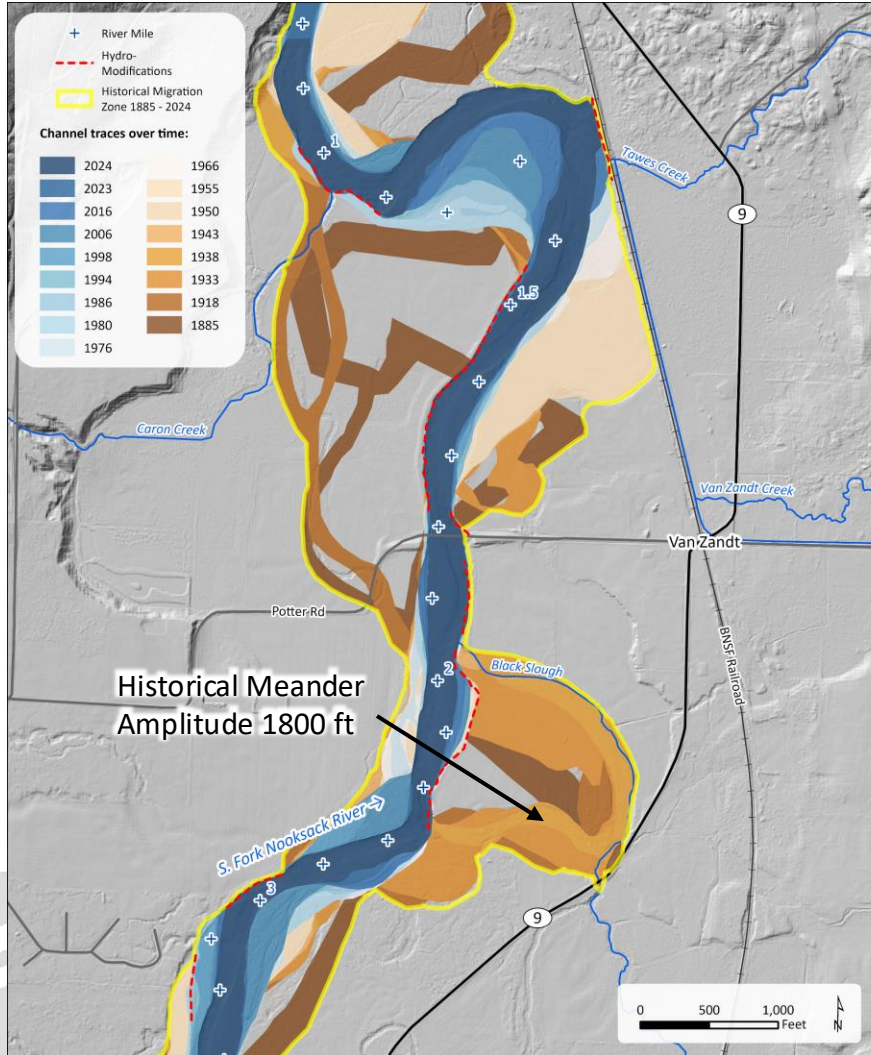
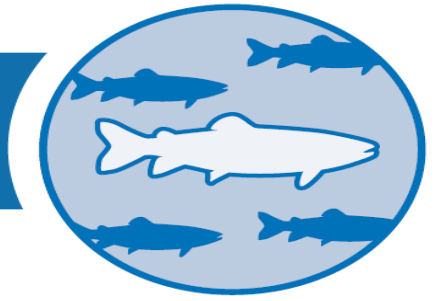
- >50% of Channel with Riprap
- Recent washouts
- Localized bank armor sloughing



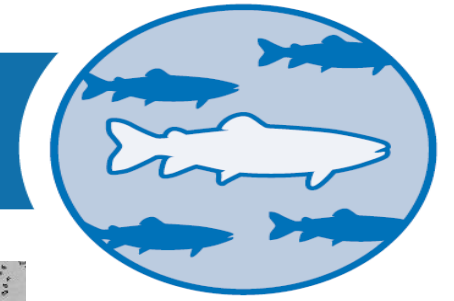
Reach Restoration Project
September 10, 2024



Site Setting, History, & Geomorphic Conditions



Hydrology & Hydraulics – Model Development



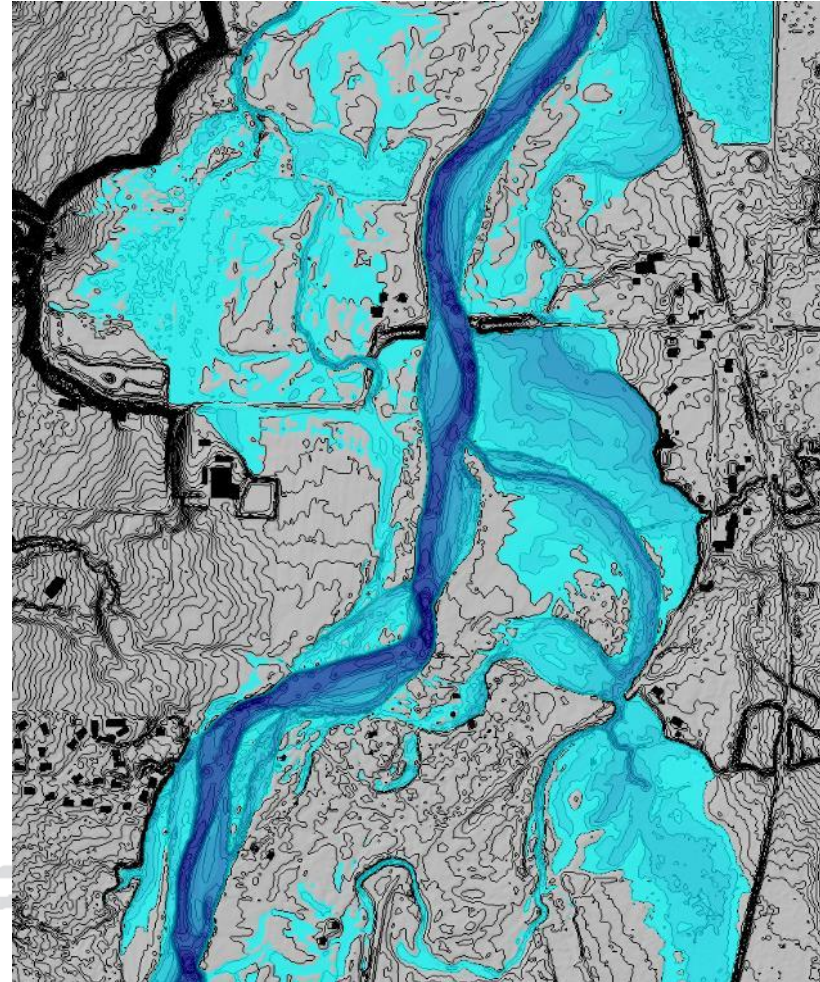
■ Model Topography

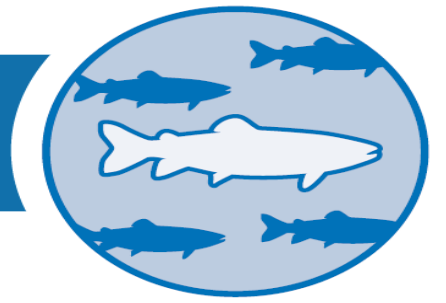
- ▶ Composite surface with multiple inputs
 - ▶ Most recent LiDAR (floodplain surfaces)
 - ▶ Bathymetric survey
 - ▶ UAV-generated DSM

} Active Channel

■ Model Extent

- ▶ ~3.8 miles along mainstem
- ▶ Covers entire valley bottom
- ▶ Focuses on mainstem and floodplain (not tributaries)
- ▶ Multiple tributary drainages
 - ▶ Used 5 inputs
- ▶ Multiple Hydraulic Structures
 - ▶ ~18 included in model
 - ▶ Several more possible structure locations ignored for now





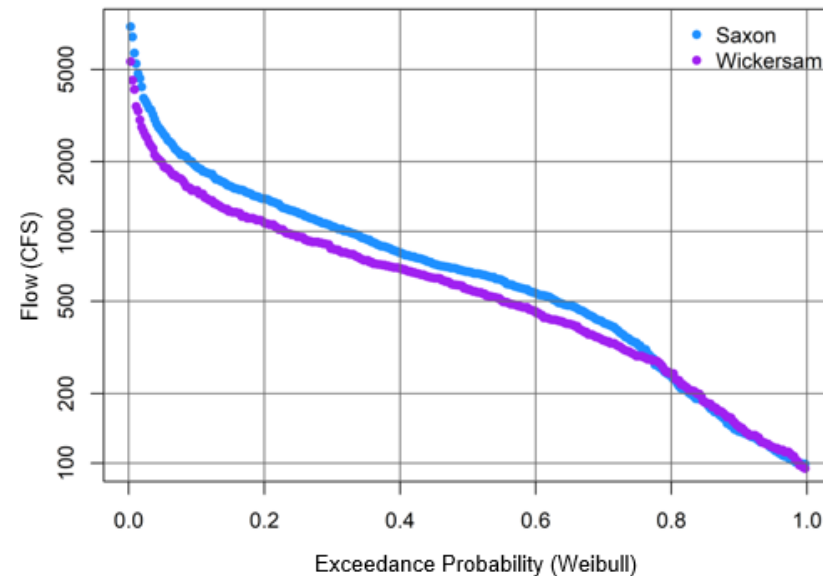
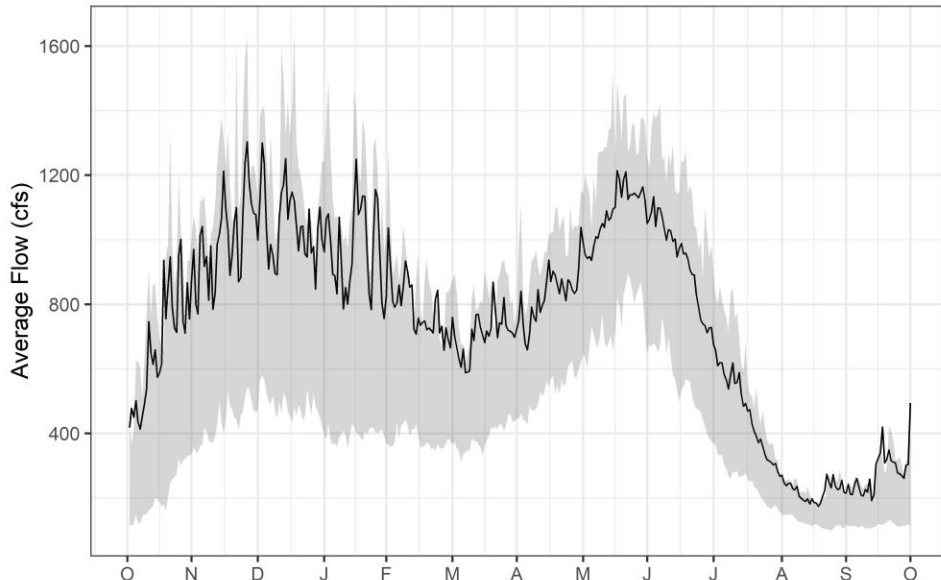
■ Streamflow characteristics

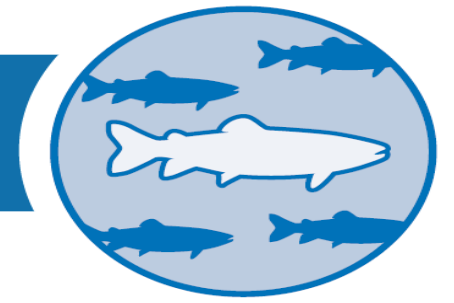
▶ Gage analysis (3 Gages, 1 SnoTel)

- ▶ Typical flows
- ▶ Peak flows for hydraulic modeling

▶ Previous work:

- ▶ USGS Groundwater study: mildly gaining groundwater
- ▶ LNR and NIT obs: de-watered tributaries and consistently warm temperatures





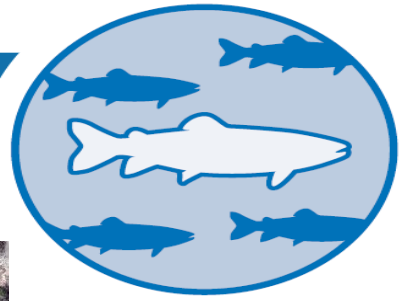
■ Increased Peak Flows

- ▶ 23-34%, based on EPA (2022)
 - ▶ Increased scour
 - ▶ Increased channel width and depth
 - ▶ Highlights need for:
 - floodplain engagement,
 - roughness,
 - multiple high flow paths

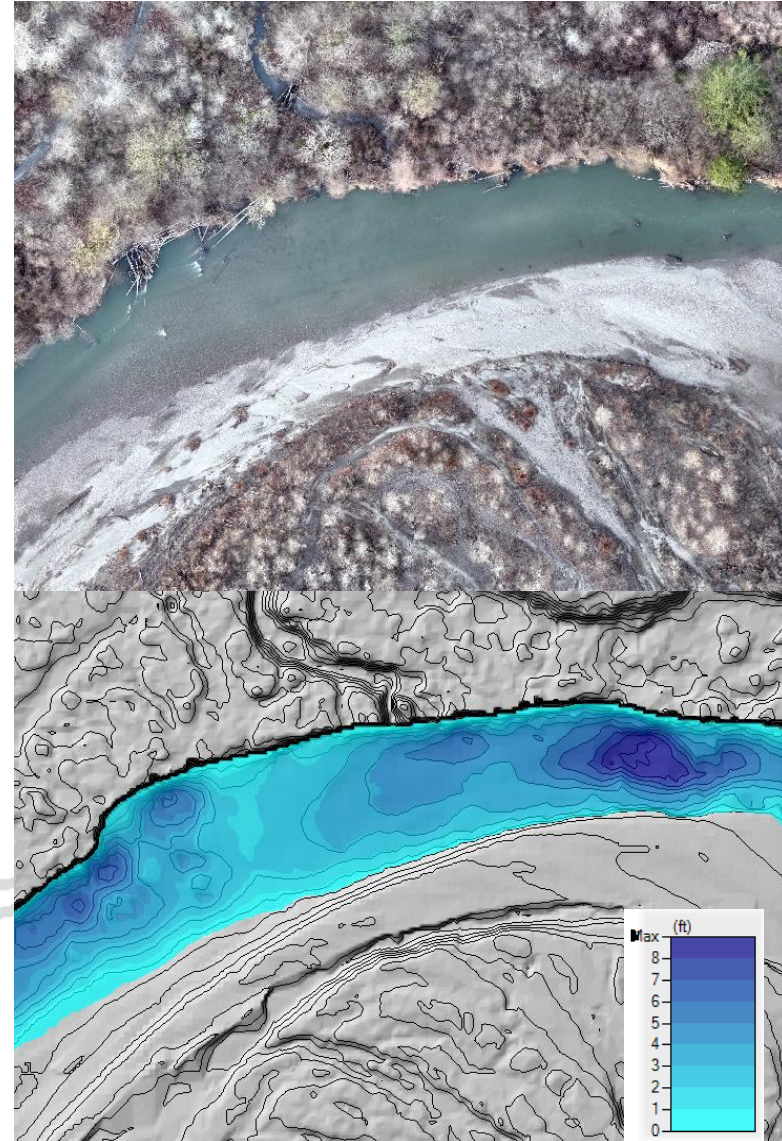
■ Decreased Low Flows

- ▶ -20% or greater (up to -65%, based on Wenger (2010))
 - ▶ Decreased water depth, increased dewatering
 - ▶ Increased temperatures
 - ▶ Highlights need for:
 - Pools,
 - High quality, connected low flow habitat (shade, cover),
 - Hyporheic and groundwater inputs and connections

Hydrology & Hydraulics – Existing Conditions Results (Low Flow)

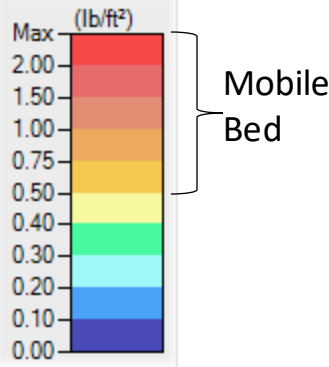
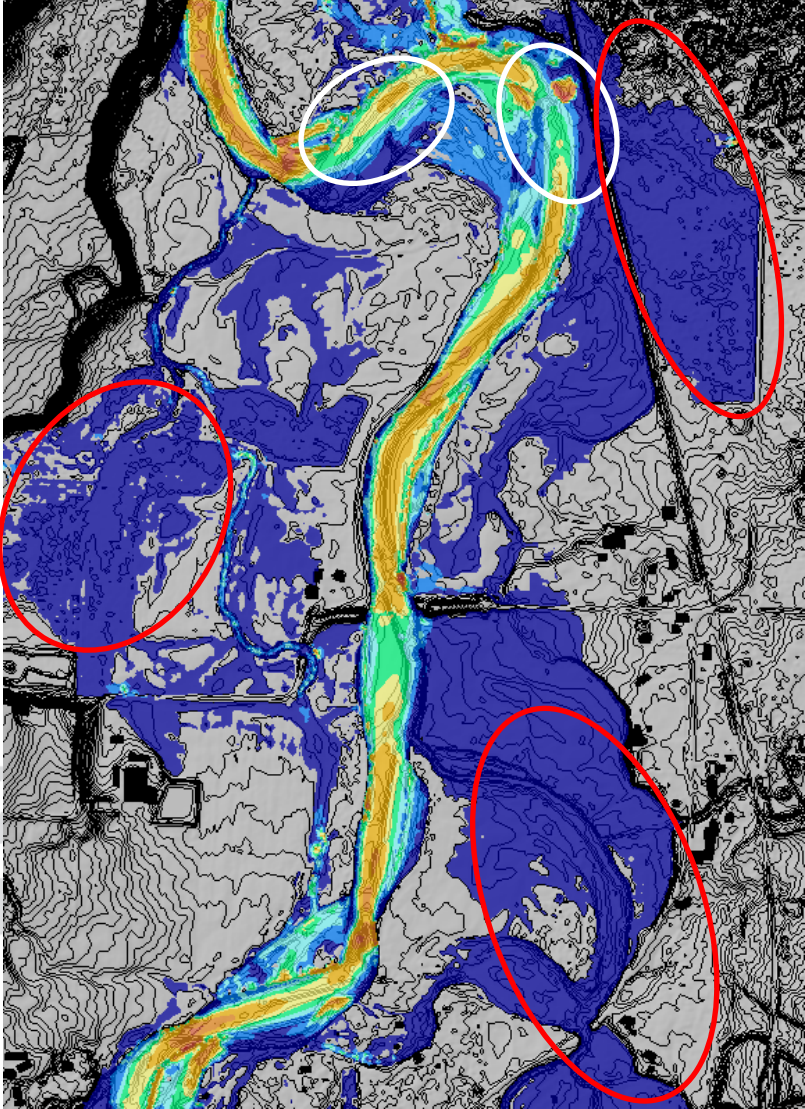
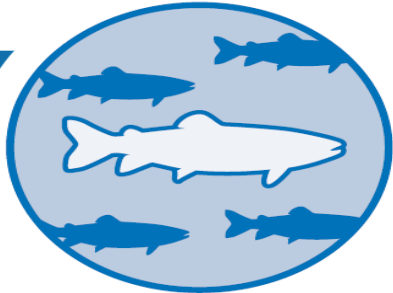


- Relatively constant channel width
- Active channel typically meanders between gravel bars
- Few instances of split flow or connected off-channel features
- Consistent depth and velocity
 - ▶ Depth (2-3 ft)
 - ▶ Velocity (1.5-3 ft/sec)
 - ▶ Lots of 'run' habitat
- Few pools, but typically at outside of meander bends and associated with wood

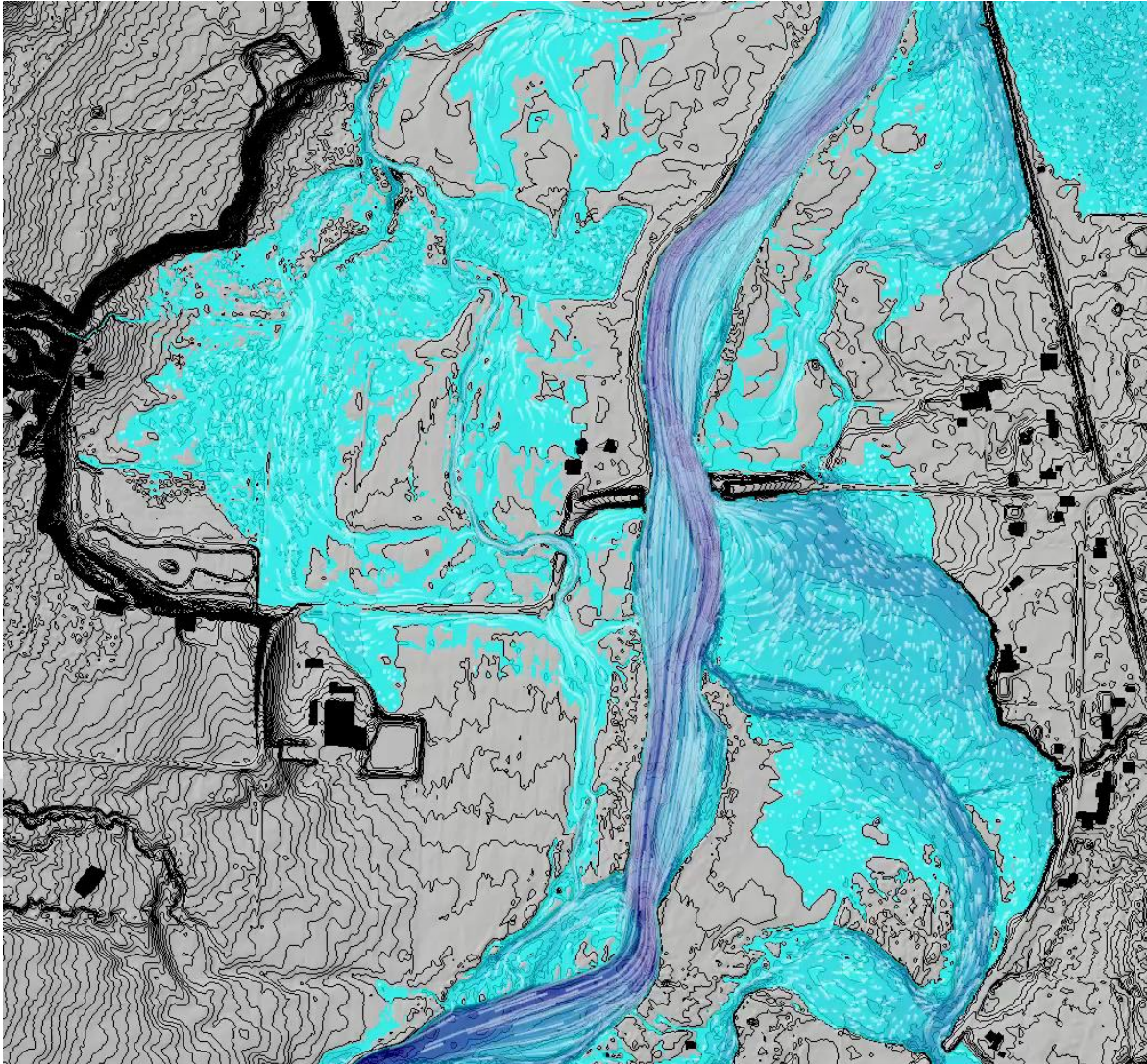
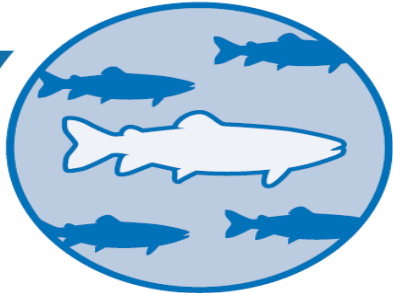


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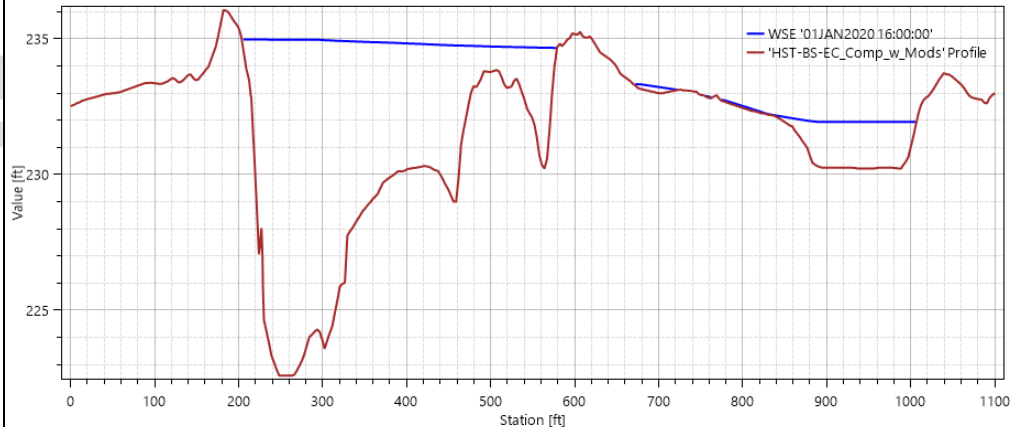
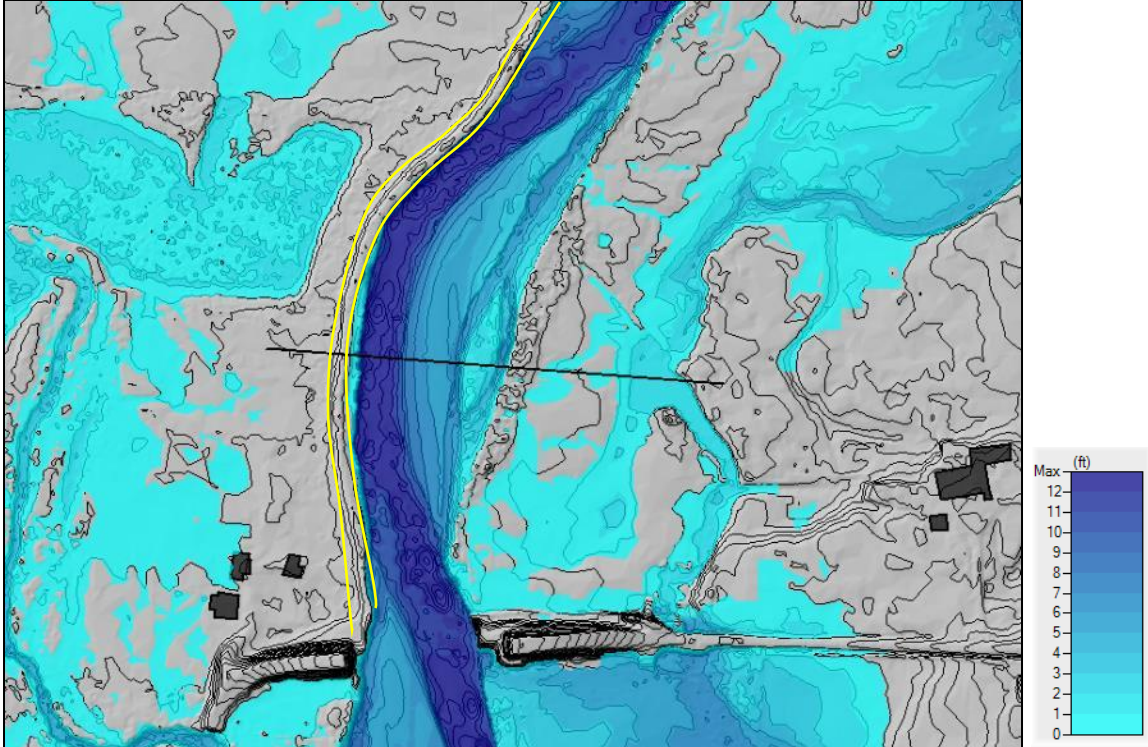
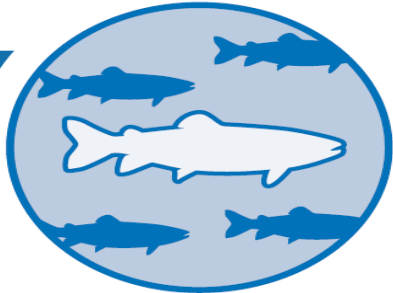
Hydrology & Hydraulics – Existing Conditions Results (2-yr)



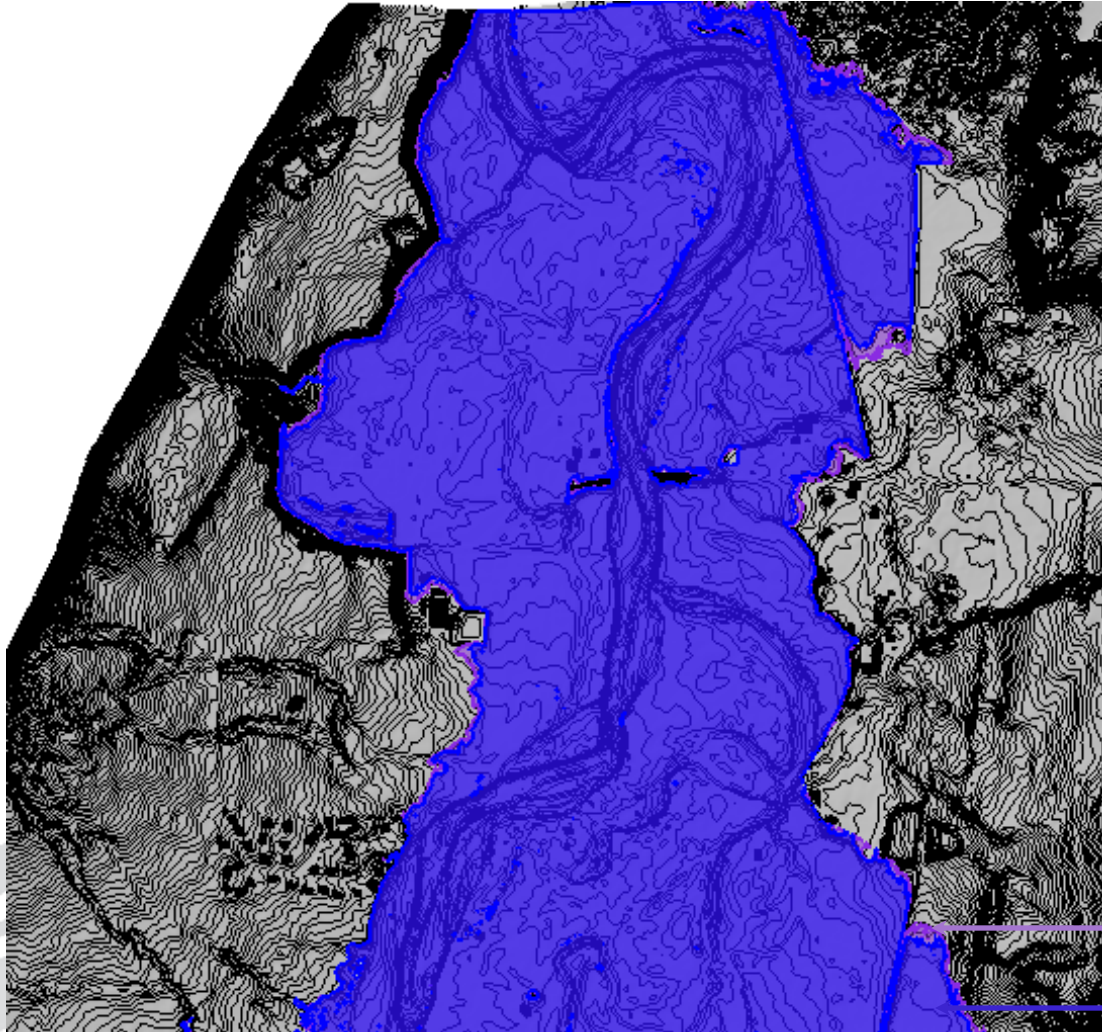
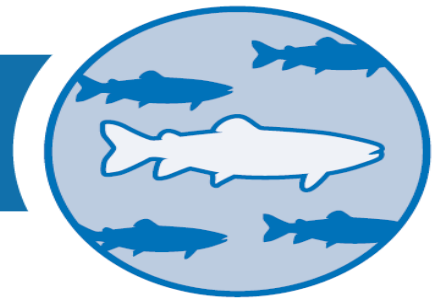
Hydrology & Hydraulics – Existing Conditions Results (2-yr)



Hydrology & Hydraulics – Existing Conditions Results (2-yr)



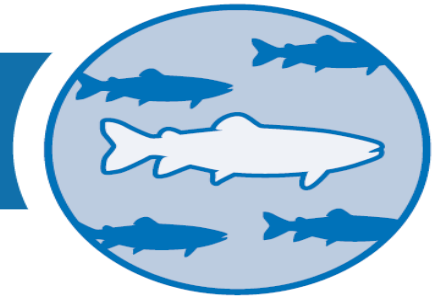
Hydrology & Hydraulics – Existing Conditions Results (10-yr and 100-yr)



- Inundation of infrastructure
- Increases in depth and velocity (more erosion and scour)
- Almost entire channel bed is mobilized
- Moderate floodplain depths (0-3 ft outside of swales/channels) and velocities (1-2 ft/sec)

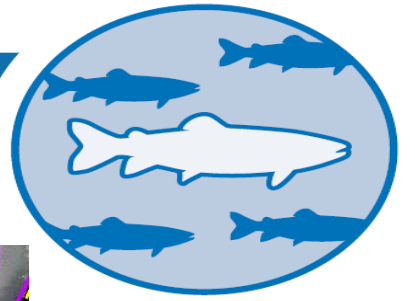
Q100 Inundation

Q10 Inundation

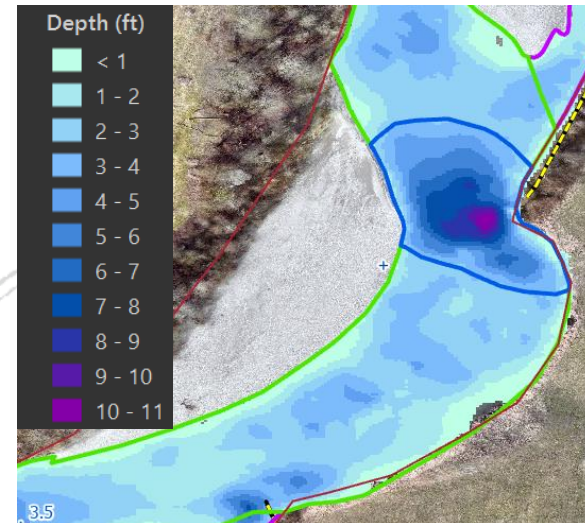


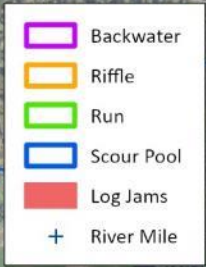
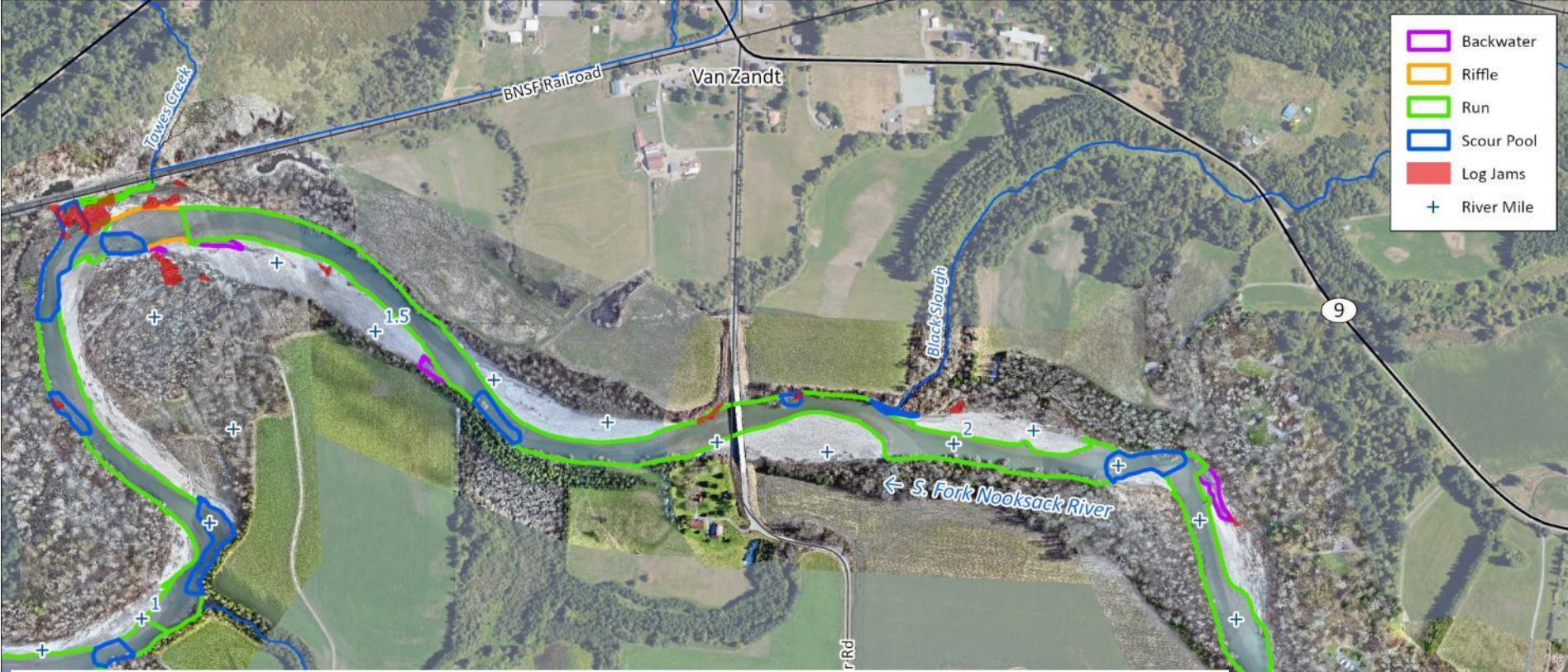
- Model appears to be performing well
- Mainstem habitat lacks diverse conditions (majority of reach classified as run)
- Pools associated with outside of meander bends and wood
- Floodplain connectivity is an issue
 - ▶ several anthropogenic features near Potter Road impact floodplain processes
 - ▶ Increased connectivity and/or inset floodplain lessens shear stress on the bed (decreases likelihood of redd scour)
- Floodplain infrastructure and ‘plumbing’ make for a very complicated model

Instream Habitat Analysis Methods



- Habitat liming factors and recovery targets from:
 - ▶ 2021 Update to WRIA 1 Recovery Plan
 - ▶ 2020 Nooksack River Instream Project Effectiveness
 - ▶ 2023 WRIA 1 SRFB Grant Cycle – Habitat indicators, Methods, and Guidance Matrix
- Habitat mapping using a topographic model, hydraulic model output, field observations, drone imagery
- Large wood mapping from drone imagery and field observations
- Updated hydromodifications layer

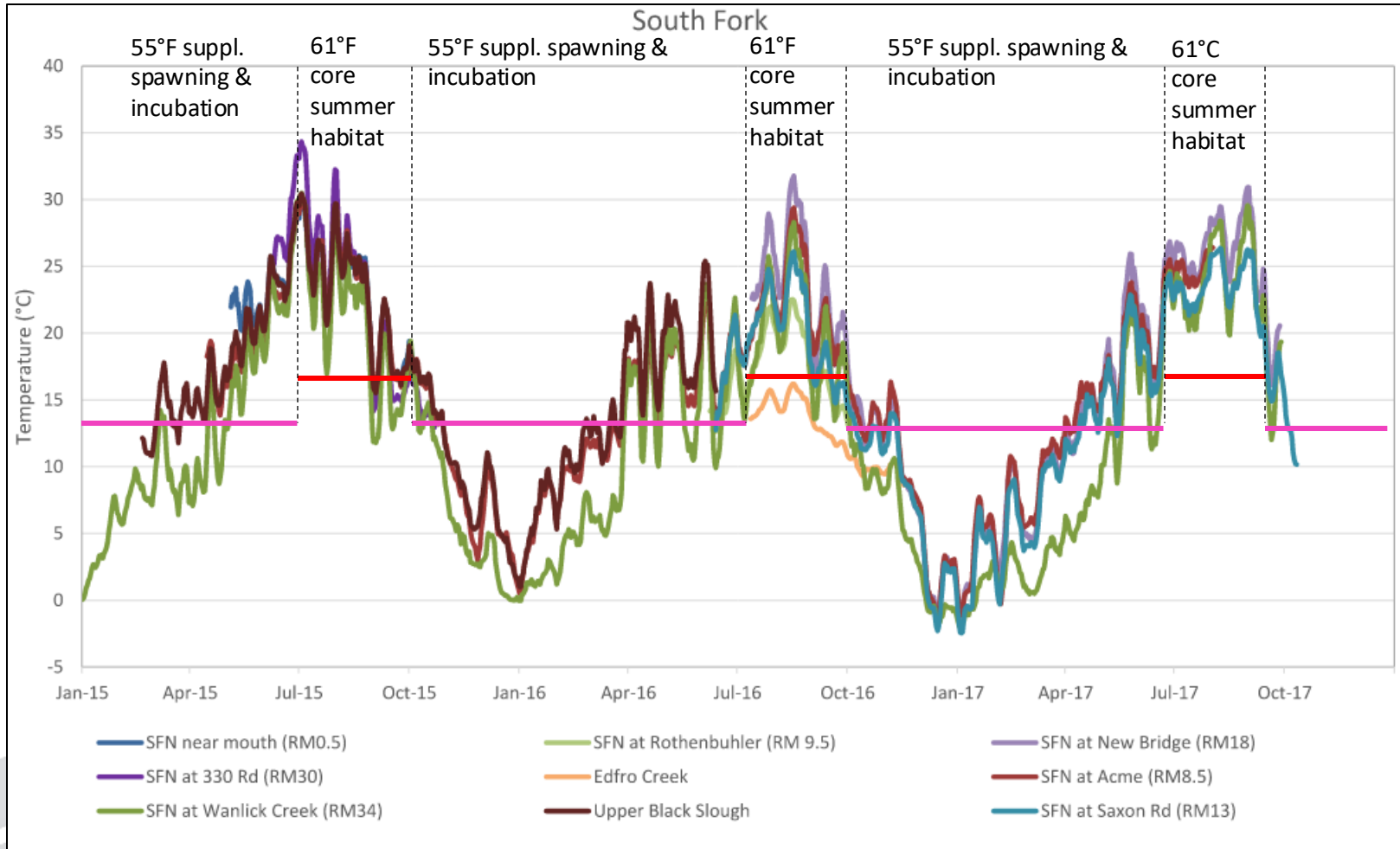
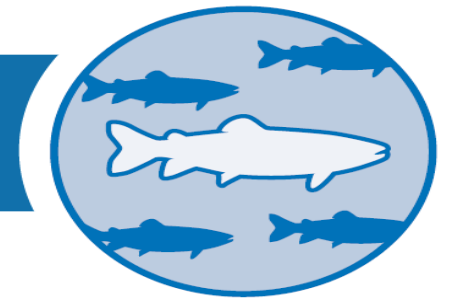




CATEGORY	METRIC	EXISTING CONDITION	TARGET
Pools and habitat diversity	Pool frequency ^{a,b}	8.4 widths / pool	1.4 Channel Widths / Pool
	Number of primary pools ^b	6	22 for Black Slough (167 for L SFN)
	Pools formed by large wood (%) ^b	44%	70%
	Number of High quality pools: > 1 m residual depth and formed by wood ^{b,c}	4	16 for Black Slough (117 for L SFN)
	Habitat diversity: # of habitat units / km ^a	6.2 / km	15 units / km (good); 20 units / km (very good)
Large wood	Key-sized wood: pieces > 9 m ³ per 100 m ^b	0.13 pieces / 100 m	1.16 pieces / 100 m
	Area of wood engaged at low flow (m ²) ^c	1,571 m ²	Increase EC to PC
Channel and floodplain	Length of natural banks and bar edge types ^{a, b, c}	72%	90% natural edge
	Perennial side channel length ^c	0 ft	Increase EC to PC
	Side channel length at 2-yr flood ^c	0 ft	Increase EC to PC
	2-yr flood area (acres) ^c	118.1 acres	Increase EC to PC
	100-yr flood area (acres) ^c	778.2 acres	Increase EC to PC

a. 2020 Nooksack River Instream Project Effectiveness
 b. 2021 Summary of Habitat Status and Trends and Habitat Goals Update to WRIA 1 Salmon Recovery Plan
 c. 2023 WRIA 1 SRFB Grant Cycle – Habitat Indicators, Methods, and Guidance Matrix

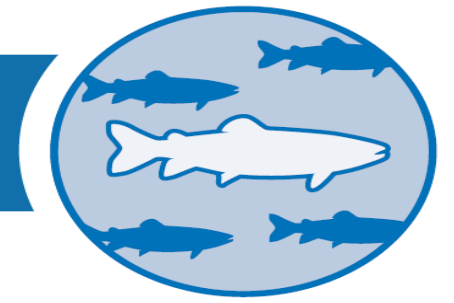
Instream Habitat Conditions – Temperature



Use Classification	Criteria	
Core summer salmonid habitat, spawning, rearing, and migration	$\leq 16\text{ }^{\circ}\text{C}$ 7-DADMax ^{a,b}	(61°F)
Char spawning and rearing	$\leq 12\text{ }^{\circ}\text{C}$ 7-DADMax ^{a,b}	(54°F)
Supplemental salmonid spawning and incubation	$\leq 13\text{ }^{\circ}\text{C}$ 7-DADMax ^{a,b} (Sept 1–Jul 1)	(55°F)

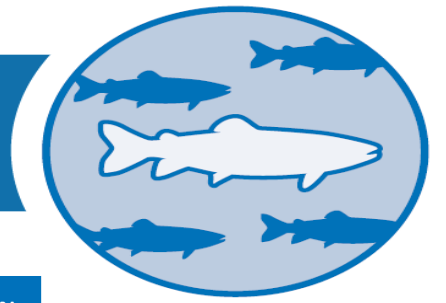
Source: Nooksack River Watershed Water Temperature Assessment Report

Instream Habitat Conditions - Summary



- Instream habitat is degraded and well below recovery targets
- Habitat has been improving since 2005, but requires intervention to increase rate and recovery potential
- Simplified stream channel dominated by runs and low habitat diversity
- Quantity and quality of pool habitat is poor and driven geomorphic impairments and a lack of log jams and key pieces
 - ▶ A few deep high-quality pools are present
- No side channels
- Instream temperatures threaten key life stages

Floodplain & Riparian Conditions

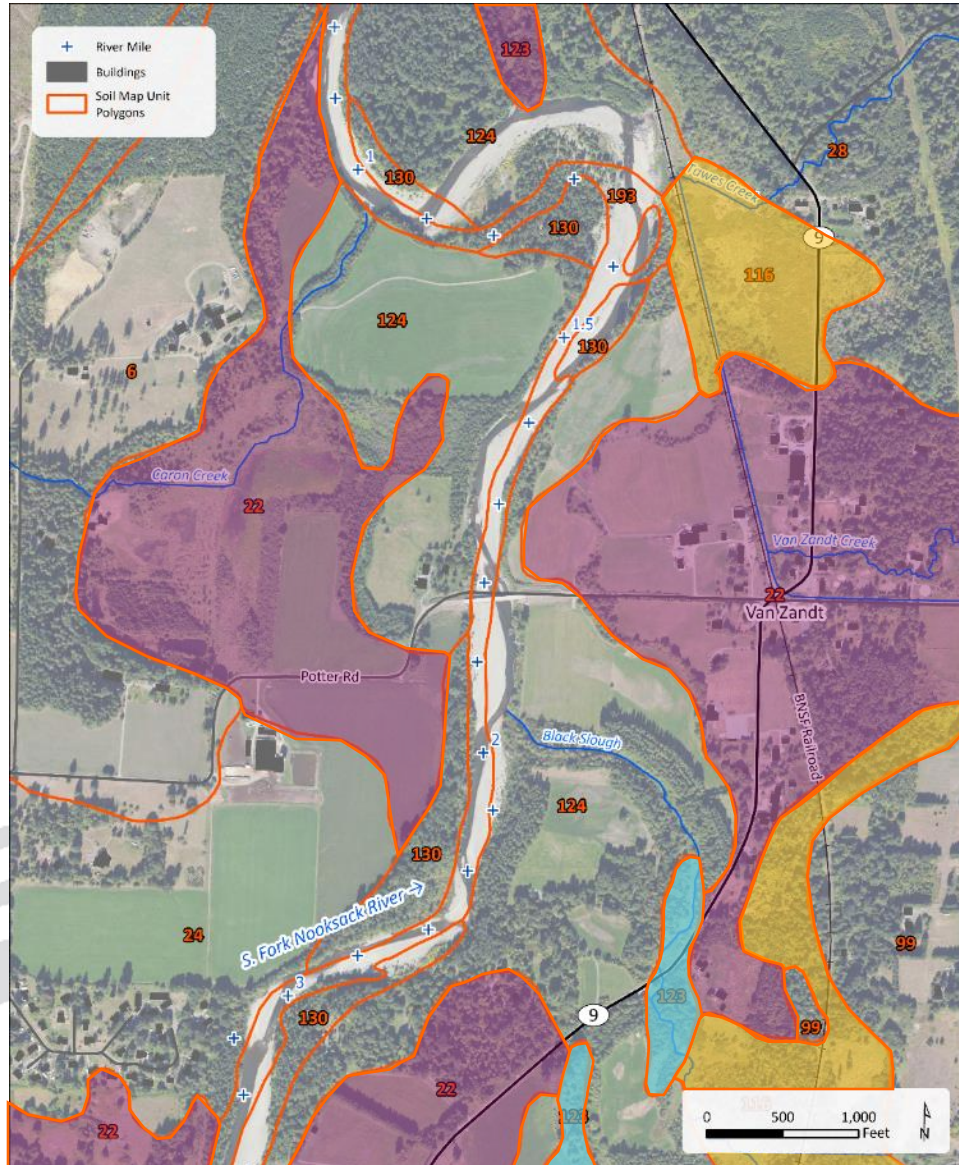
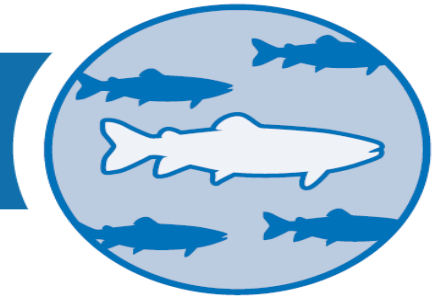



■ Characteristics Considered


- ▶ Soils
- ▶ Wetlands
- ▶ Vegetation
- ▶ Land Use


FLOODPLAIN ELEMENT	CHARACTERISTICS CONSIDERED	FUNCTION PROVIDED / IMPLICATION FOR INSTREAM HABITATS
Soil / Substrate	Hydraulic conductivity Ability to support wetland and riparian habitats	Water quality improvement Cold water input Floodwater attenuation Groundwater recharge
Wetland Presence	Hydrologic connectivity Vegetation composition Soil conditions	Off channel habitat Allochthonous/nutrient input Water quality improvement Groundwater recharge
Vegetation	Species / age class (longevity) / composition / cover LWM recruitment potential	Shade for instream / channel habitats Allochthonous/nutrient input LWM Recruitment Potential Bank stabilization
Land Use	Infrastructure Land use / management	Change in floodplain connectivity Change in LWM potential Change in availability of off channel habitats and associated water quality improvement potential

Floodplain & Riparian Conditions – Soils



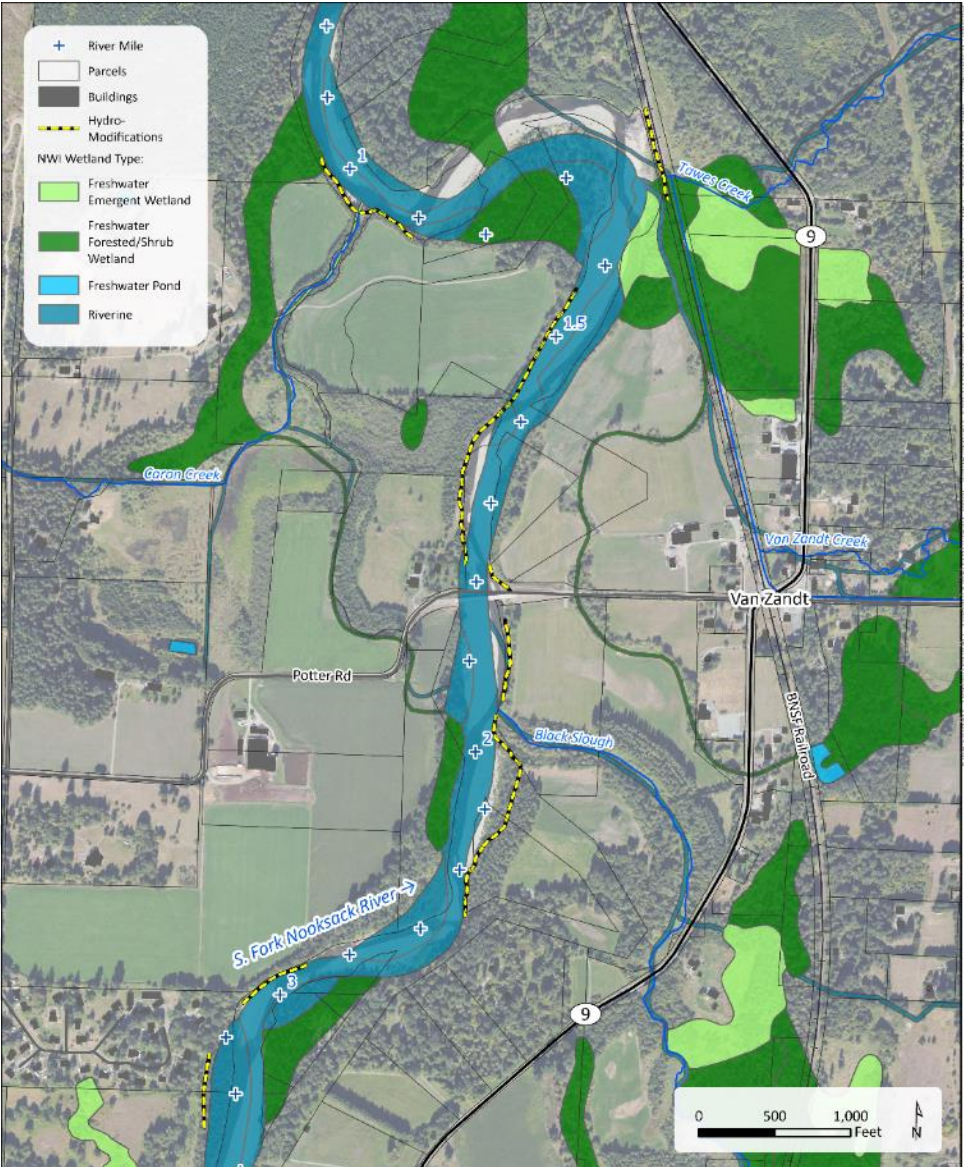
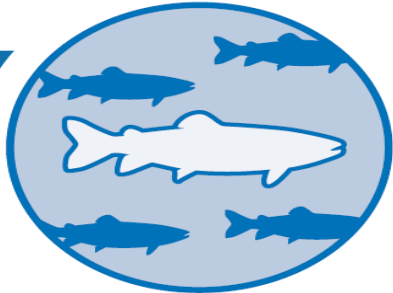
 Pangborn muck, drained, 0-2% slopes (116)

 Briscot silt loam, drained, 0-2% slopes (22)

 Puget silt loam, drained, 0-2% slopes (123)

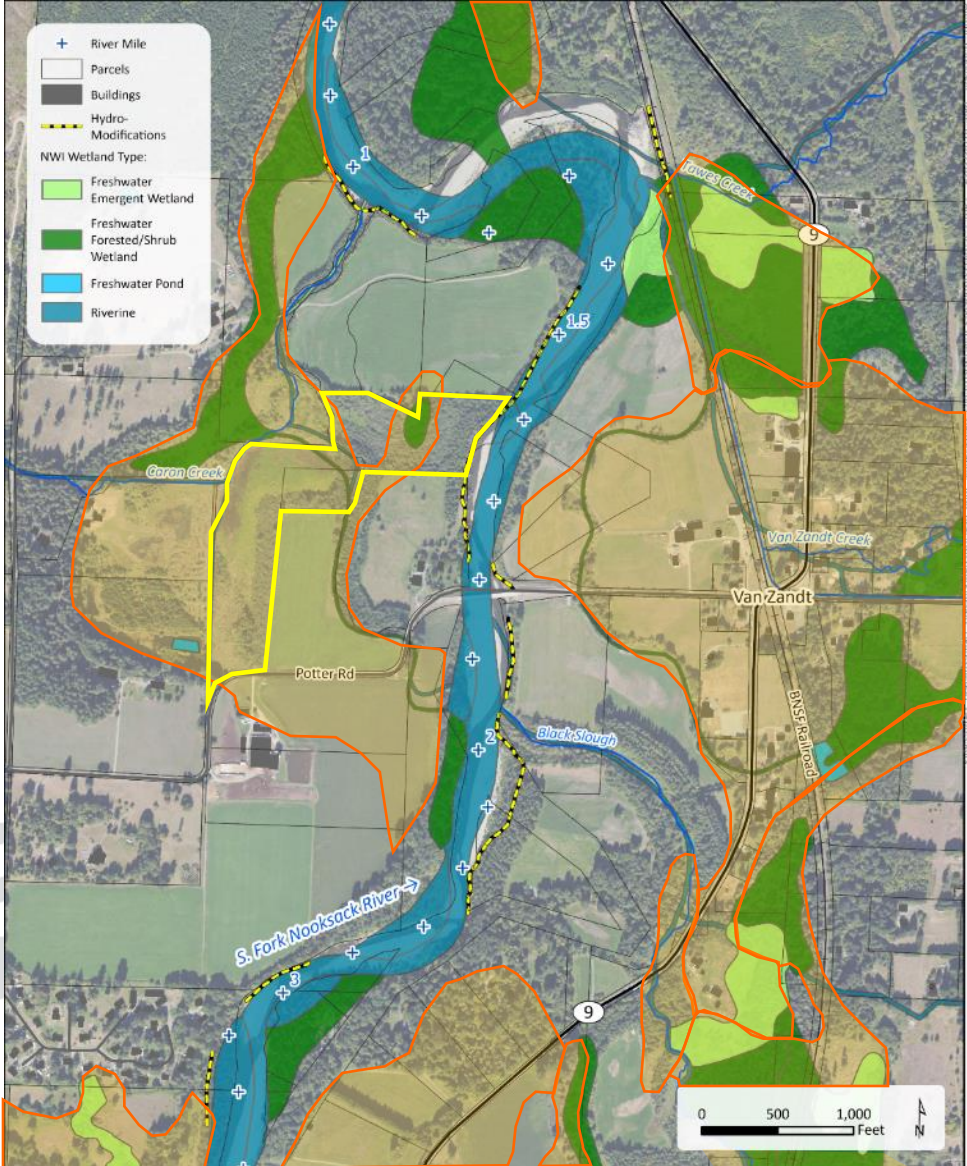
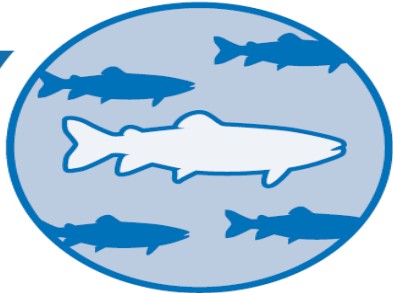
- ▶ Poorly drained
- ▶ Slow to ponded runoff
- ▶ Moderate permeability
- ▶ Depth to water table: 12-35"

Floodplain & Riparian Conditions – Wetlands



- Freshwater Emergent
- Freshwater Scrub/Shrub
- Freshwater Pond
- Riverine

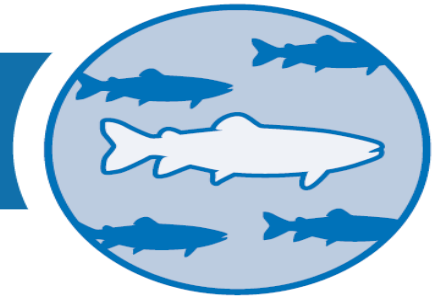
Floodplain & Riparian Conditions – Wetlands



- Freshwater Emergent
- Freshwater Scrub/Shrub
- Freshwater Pond
- Riverine

- Overlay of mapped hydric soils
- WSDOT compensatory mitigation site

Floodplain & Riparian Conditions – Veg Overview

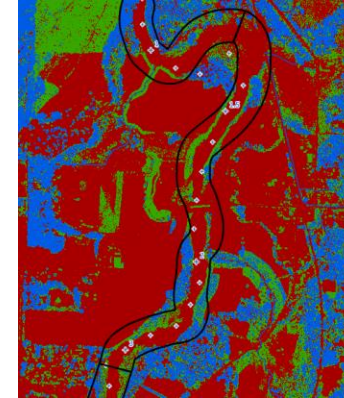
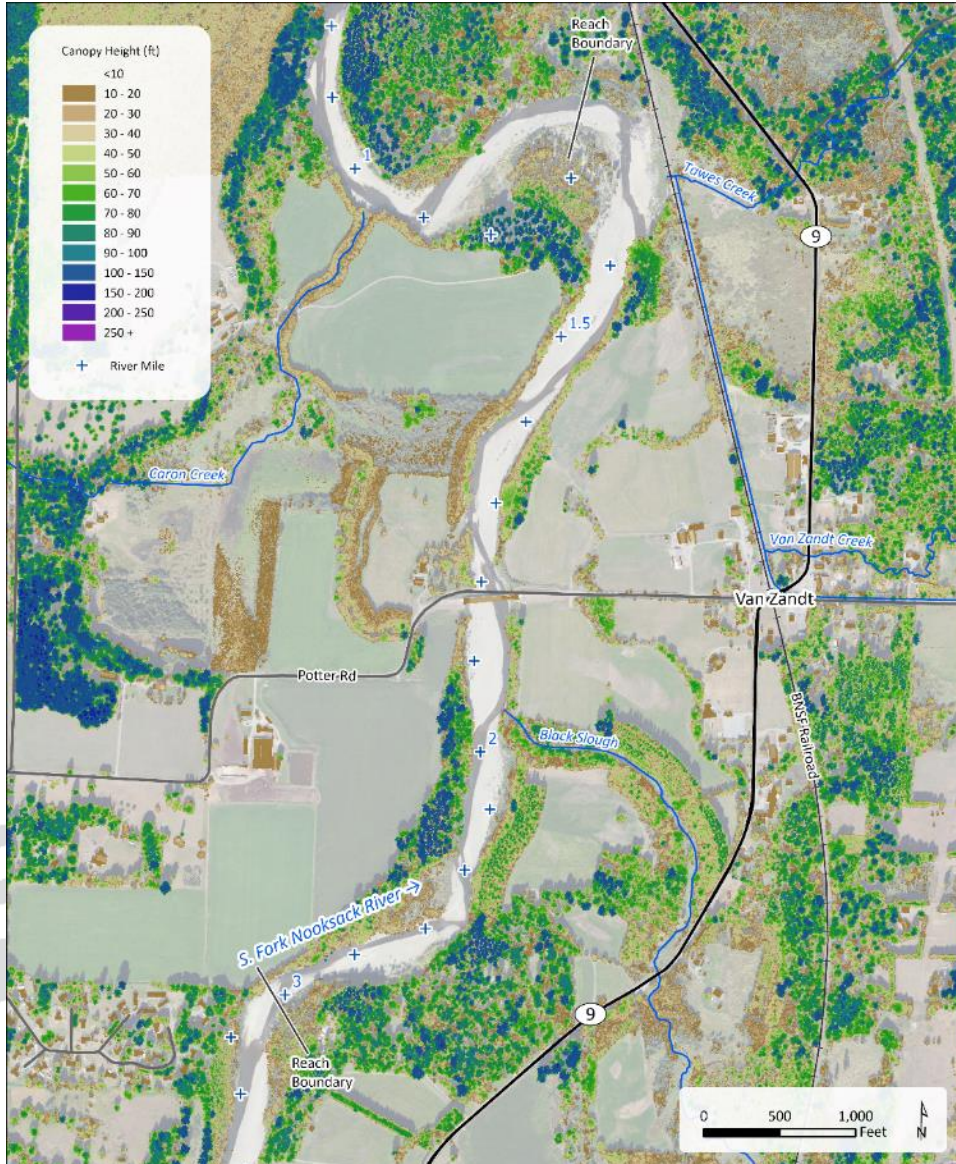
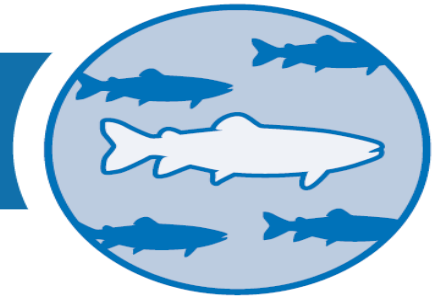


- Dominated by deciduous red alder, cottonwood and willow
- Few inclusions of western red cedar, Douglas fir, and Sitka spruce
- Little coniferous regeneration (saplings)
- Invasive reed canarygrass and Himalayan blackberry, knotweed are present
- Reach contains at least one extensive wetland complex
- Beaver activity noted



Black Slough Reach – RM 1.3

Floodplain & Riparian Conditions – Vegetation



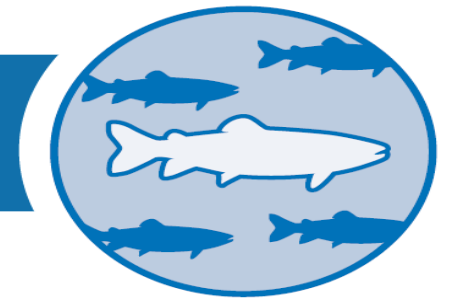
General height distribution

- ▶ 67% <10'
- ▶ 20% 10-50'
- ▶ 13% 50-171'

(includes unvegetated areas – 300' buffer offset from generalized channel CL)

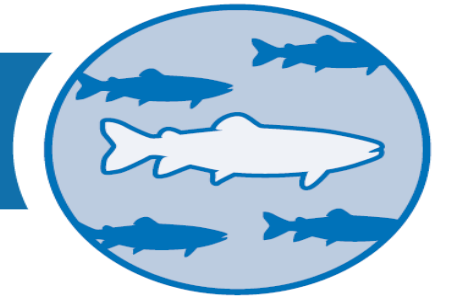


Existing Conditions Summary



- Channel length and complexity limited by channel straightening and bank hardening
- Removal of instream wood and riparian corridor has created a simplified channel
 - ▶ Lacking instream cover and habitat complexity
 - ▶ High instream temperatures
 - ▶ Little shade provided to mainstem
 - ▶ Current forested areas not long lived
- Significant floodplain and off channel habitat disconnection resulting from infrastructure presence
 - ▶ Tributary and side channel connections limited/disconnected
 - ▶ Contributes to increase in mainstem velocities and increased scour
 - ▶ Limited availability for attenuation of floodwaters and predicted increases in peak flows

Project Opportunities

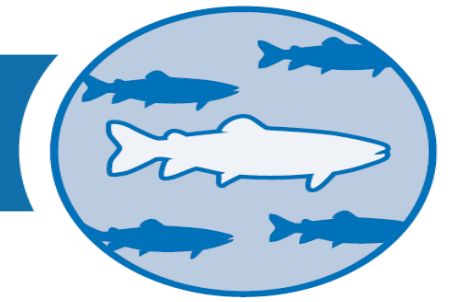


- Typical restoration tools available
- Questions to consider:
 - ▶ Are there specifics you would like to see?
 - ▶ Does our assessment align with your observations?
 - ▶ Gaps?



Black Slough at Highway 9

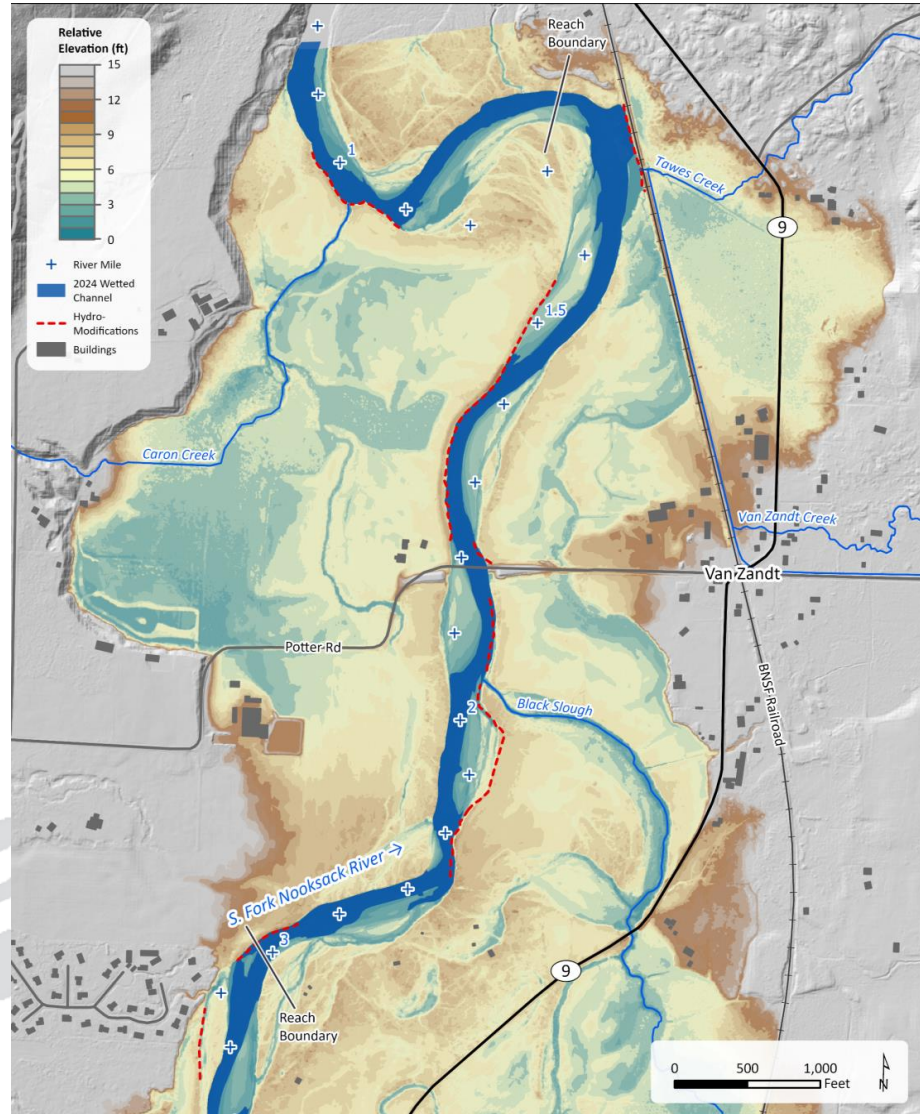
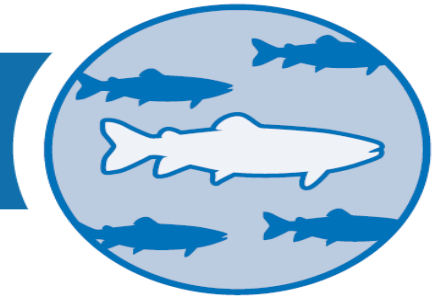
Project Opportunities – Typical Restoration Tools



Tool	Limiting Factor(s)
ELJs	All
ELJ-Protected Revegetation	High temps, Low Habitat Diversity
Enhance Known Cold-Water Refuges	High temps
Riparian Planting	High temps, Low Habitat Diversity
Improve Floodplain Connectivity	High temps, Low Habitat Diversity
Floodplain BDAs and ELJs	High temps, Low Habitat Diversity
Floodplain Flow path Modifications	High temps, Low Habitat Diversity
Levee Removal	High temps, Low Habitat Diversity
Side Channel Excavation	Low Habitat Diversity
Riprap Removal	Low Habitat Diversity
Riprap Setback	Low Habitat Diversity
Riprap Enhancement	Low Habitat Diversity
Infrastructure Removal /Modification	Low Habitat Diversity

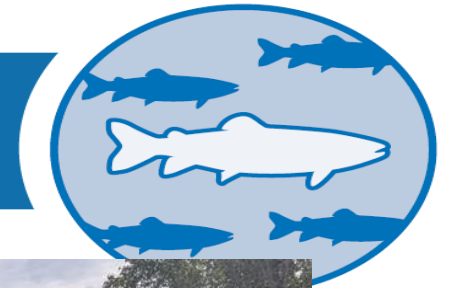
- Timeline for results
- Direct and indirect results
- Complimentary actions

Project Opportunities – Instream Habitat Improvement



- Install mainstem Engineered Log Jams (ELJs)
 - ▶ Increase habitat complexity and deep pools
 - ▶ Needed throughout reach, more heavily on outside of bends
 - ▶ Use to increase targeted floodplain activation and direct flows into off channel features
 - ▶ Tighter spacing of ELJs increases hyporheic flow

Project Opportunities – Instream Habitat Improvement



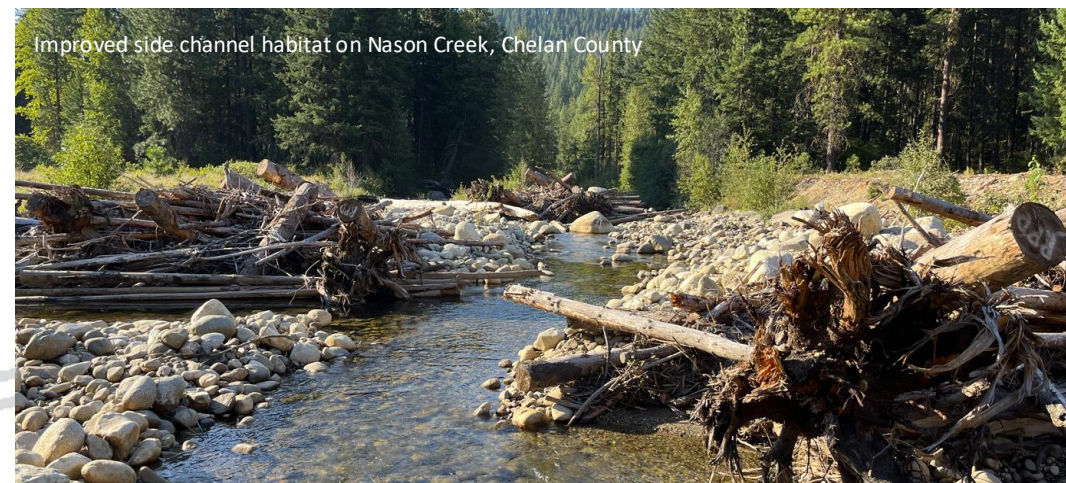
Recently installed ELJ on the Middle Fork Nooksack River



Improved side channel habitat on the Wenatchee River, Chelan County

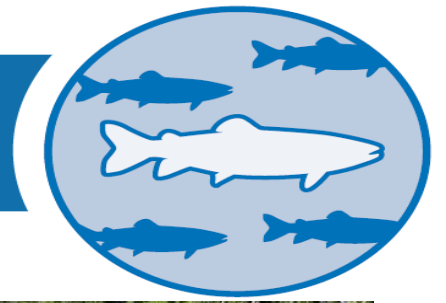


Recently installed ELJ on the Elwha River, Clallam County



Improved side channel habitat on Nason Creek, Chelan County

Project Opportunities – Additional Improvements



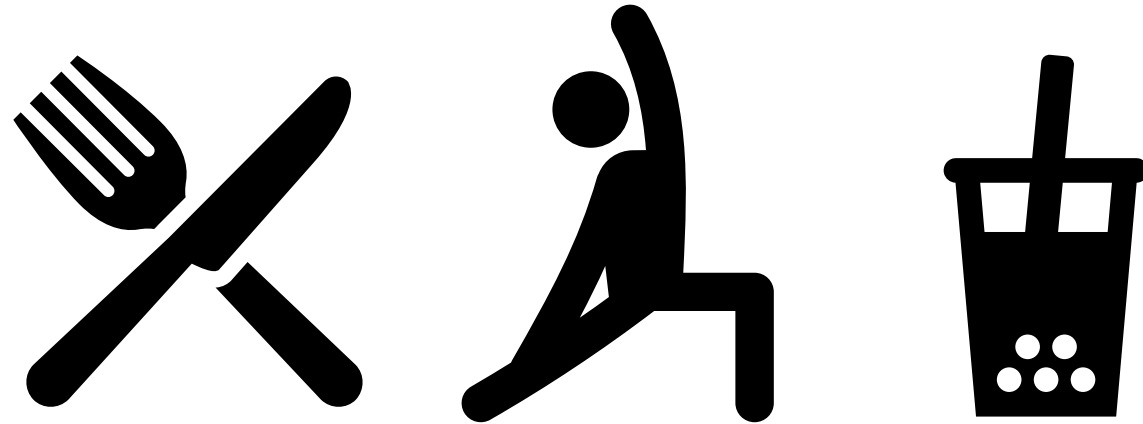
- Reengage and create off channel habitats formalizing side and high flow channels and reconnecting to wetlands and cool water inputs
 - ▶ Roughen surface with LWM to slow flow and create refuge
 - ▶ Expand existing riparian vegetation
 - ▶ Protect plantings with LWM

- Replace / modify riprap to enhance bank complexity with pools and complex woody cover

- Improve connectivity through existing infrastructure
 - ▶ Increase capacity at crossings
 - ▶ Add additional connections through RR prism
 - ▶ Accommodate for expected increase in peak flows

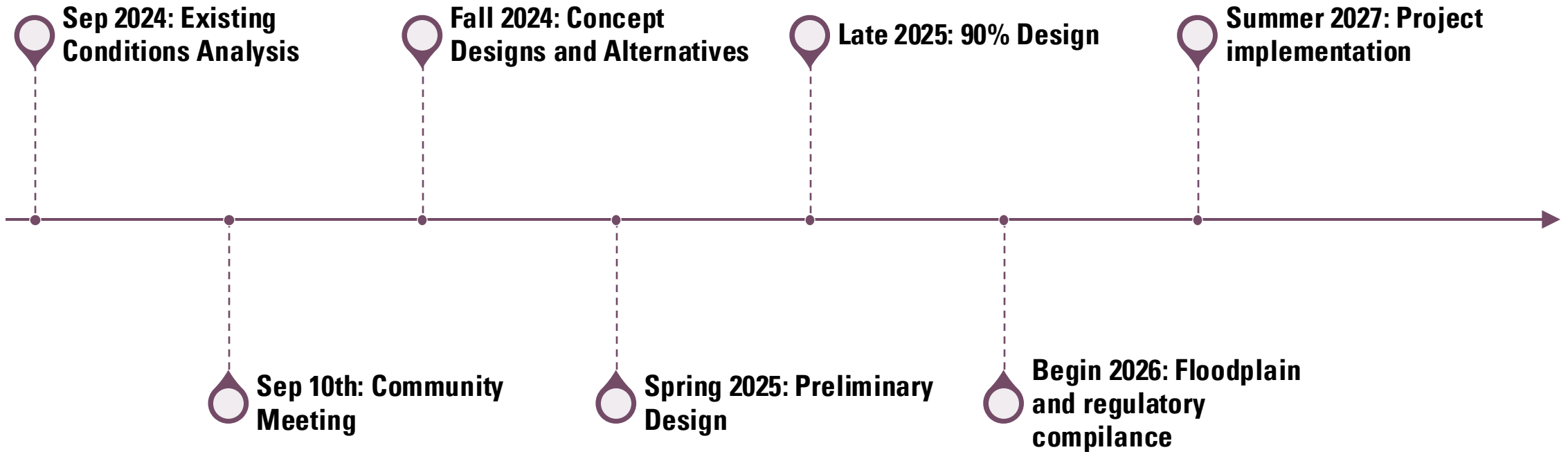


BREAK



Q&A

PROJECT TIMELINE



NEXT STEPS

1. Lummi will update the project website with summary notes by the end of September
2. Lummi will invite interested landowners to a site visit
3. Check for updates on the website: <https://www.lummi-nsn.gov/s/blackslough>



