

INSTREAM PROJECT DESIGN CHECKLIST

For Design and Construction of Flood and Erosion Protection Facilities and Habitat Restoration Projects that May Include Large Wood Placement or Natural Wood Recruitment

Project Name Fall City Floodplain Restoration Project Project Manager Fauna Nopp

River/River Mile/Bank Snoqualmie River / RM 33.5 / both banks

Date 5/6/2022

Check one or both:

- Project includes placement of large wood elements.
- Project may influence the recruitment, mobility and accumulation of natural large wood.

Note: If the project is comprised of emergency work, then fill out and file this form within 30 days of completion of emergency work.

I. Project Background and Preliminary Design (30-40 Percent) Information

(Provide general information at a conceptual level)

- 1. Describe the overall river management context, strategy and objectives for the river reach. Refer to pertinent plans, policies or documents pertaining to flood hazards, salmon recovery, etc.**

The project is located within a reach of the river that has been identified by restoration planners as one of the highest value restoration reaches on the Snoqualmie river. The project will address four of the Snohomish River Basin Salmon Conservation Plan's (2005) highest priority ecological actions in the Upper-Mainstem Snoqualmie River sub-basin: reconnection of off-channel habitats; restoration of shoreline conditions; restoration of hydrologic and sediment processes; and riparian enhancement. The proposed project will benefit ESA-listed Chinook salmon and steelhead trout by restoring the habitat-forming processes that create and sustain the river and floodplain ecosystems. The project is part of the "Snoqualmie Fall City Reach Reconnection" (Project ID# 07-MPR-305) work identified in the 2012 Snohomish Basin 3-year work plan.

- 2. Describe the goals and objectives of the project and its relative importance to the success of DNRP program goals and mandates. Identify funding source(s) and describe any applicable requirements or constraints.**

The primary goal of the Fall City Floodplain Restoration Project is to restore floodplain functions and processes that create and sustain riverine habitat and aid salmon recovery. The project will reconnect 145 acres of Snoqualmie River floodplain by removing approximately 1,300 feet of left bank levee and 1,400 feet of right bank revetment, allowing the river to expand, migrate and reconnect with former channels within this reach. The project will also excavate 3,300 feet of side channel in the right bank floodplain to initiate the creation of off-channel rearing and refuge habitats. In order to reduce flood risks, the project will realign about 1,600 feet of Neal Road away from channel migration hazards and construct 900 feet of setback revetment along the realigned road.

The project addresses high priority salmon habitat restoration needs for the threatened Snoqualmie Chinook stock identified in the federal Puget Sound Salmon Recovery Plan (2007). According to the Snohomish River Basin Salmon Conservation Plan (2005) this project reach is located in a “first priority restoration” mainstem sub-basin. Eventual implementation of projects in this reach, including the Fall City Floodplain Restoration Project, will be a significant step toward achieving the Plan goal of restoring 80 acres of off-channel habitat and five miles of restored edge habitat in the highest priority areas of the Snoqualmie watershed.

The primary objective of this project is to restore natural river processes, such as floodplain inundation, side channel reconnection, gravel bar formation, improved edge habitat, and channel migration along the Snoqualmie River. This will improve rearing and spawning habitat conditions for numerous native species including ESA-listed Chinook salmon and steelhead trout and reduce flood and erosion risks.

Other important project objectives include:

- Maintain or improve current levels of flood hazard protection of private property and public infrastructure;
- Address potential impacts the project may have on recreational boater safety as a result of restoring the natural processes of channel migration and wood recruitment and retention.
- Avoid unnecessary impacts to agriculture and provide benefits where possible
- Reduce risks to flood protection infrastructure and reduce flood facility maintenance costs.
- Reduce the need for maintenance of Neal Road and meet King County Road Standards requirements for re-alignment of Neal Rd.

The project will be primarily funded by the following sources:

- Washington State Recreation and Conservation Office (Salmon Recovery Funding Board and Puget Sound Acquisition and Restoration funds)
- King County Flood Control District (King County Cooperative Watershed Management Grant)
- King County (Surface Water Management Fees)
- Washington State Department of Ecology (Floodplains by Design grant)

- 3. Describe the existing (and historic, if relevant) site and reach conditions, including structural features, channel form, and the presence of naturally-deposited large wood. Describe known utilization by salmonids and any important or unique biological or ecological attributes.**

The Snoqualmie at Fall City (SAFC) reach is defined as the 6-mile-long segment of the Snoqualmie River downstream of the Raging River confluence at Fall City. The reach here has a low-gradient and historically meandered widely across the valley bottom. The SAFC reach has been heavily modified by river straightening, road construction, farming activities and flood and erosion control measures such as levee and revetment construction (Figure 1). In the 1930's, more than 100,000 cubic yards of gravel were dredged from the mouth of the Raging River. An existing side channel of the Snoqualmie River was dredged across the “Carlson” meander bend and levees were constructed along both banks to protect public and private property from flood and erosion damage, effectively straightening the river (Figure 2). The Barfuse Levee was constructed in the 1960s to further constrain channel migration.

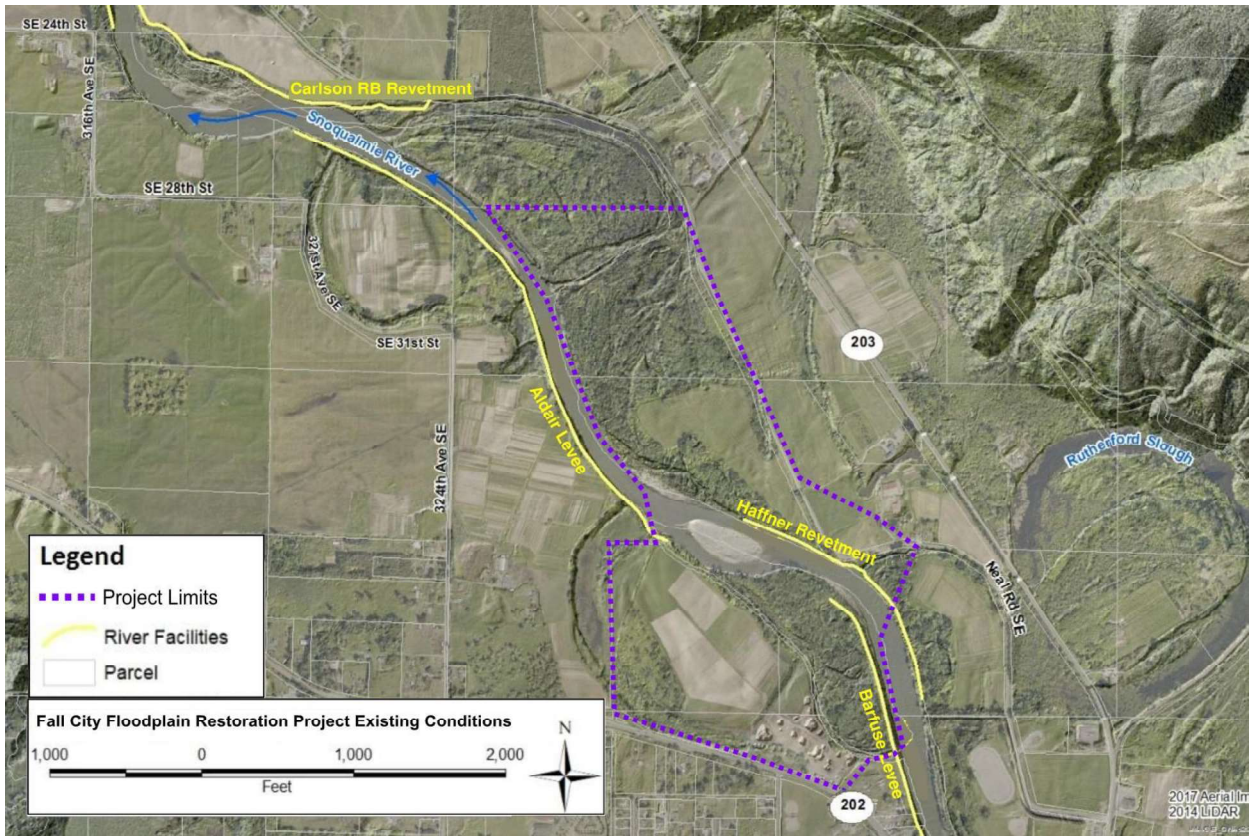


Figure 1 – Snoqualmie at Fall City reach (2014 hillshade lidar and 2017 othoimagery)



Figure 2 – 1936 aerial photography of a portion of the SAFC reach

The Barfuse Levee on the left bank (the left bank is the bank on the left when facing downstream) is approximately 1,800 feet in length, and ranges in height from 1 foot above the surrounding floodplain at its upstream end to a height of 10 feet further downstream. The Barfuse levee does not prevent inundation of the site because water flows around the downstream end of the facility and backwaters a disconnected side channel. The rock armor along the face of the levee is effective at preventing lateral channel migration into the forested floodplain despite being in a state of disrepair. The 2,200-foot long Haffner revetment on the right bank does not provide any flood protection but arrests channel migration into the right bank floodplain and protects Neal Road. Both the levee and revetment have been damaged and repaired, most recently in 1997.

Downstream of the project area are the Aldair levee on the left bank and the Upper Carlson restoration site on the right bank. The Aldair levee is 3,000 feet long and provides substantial flood and channel migration protection to the left bank floodplain. A 1,400-foot long levee was removed in 2014 in the Upper Carlson area. The right bank has retreated since levee removal, allowing the formation of a left bank gravel bar and the recruitment of large wood.

Artificial confinement has inhibited lateral migration and floodplain wetland formation, severely limiting available salmonid habitat for rearing, refuge, and spawning. The constraints posed by the levees reduce recruitment and retention of sediment and wood in the river or floodplain in the project area. Trees from upstream of the site are transported through this reach due to the depth and velocity of the mainstem river during moderate to large floods. Large trees growing on top of and landward of the armored banks have been protected from erosion and recruitment to the river for over 60 years. A large mid-channel bar is located in the unarmored segment between the Haffner and Aldair flood protection facilities. The mid-channel bar splits flow through two shallow riffles and erodes the left bank, resulting in the recruitment of trees from the forested floodplain. This naturally occurring instream wood typically swings parallel to flow and may persist for several flood seasons before being transported downstream. Since the removal of the Upper Carlson levee in 2014, a relatively small amount of instream wood has accumulated along the right bank downstream of the project area. Naturally occurring instream wood can be found sporadically further downstream, typically in the form of older snags embedded in the sandy riverbed or more recently recruited logs along the edge of eroding forested banks.

Existing hazards to boaters are relatively minor in the project area during moderate to low flows (<2500 CFS), but more significant risks exist between the project area and the downstream takeout in wider portions of the channel where natural wood has accumulated in the channel over the last 20-30 years. The mainstem river through the project area has a gentle gradient, low sinuosity, steep banks along outside bends, and flat bank-attached gravel bars on inside bends.

The area downstream of the Raging River that includes the project reach provides one of the best mainstem Chinook salmon spawning areas in the Snoqualmie watershed. Chinook, steelhead trout, pink and chum salmon all spawn in this reach. Steelhead and resident trout (cutthroat and rainbow), Chinook, and coho all rear in this reach.

4. Describe what is known about adjacent land uses and the type, frequency, and seasonality of recreational uses in the project area. Are there nearby trail corridors, schools or parks? What is the source(s) of your information?

Most of the adjacent land is privately owned and used for agricultural and residential purposes. The King County Department of Natural Resources and Parks owns two adjoining properties on the right bank: the Fall City Natural Area encompasses the downstream extent of the project area and continues downstream and the Fall City Community Park is immediately upstream. On the left bank, King County

owns several parcels associated with the former Rainier Wood Recycling business. These parcels will be planted and converted to open space as part of this project.

Floating the Snoqualmie River, particularly on inner tubes and small rafts, is a popular recreational activity in the summer. The number of floaters on the Snoqualmie River tends to be largely driven by weather, with limited use when air temperatures are below 70 degrees and much higher use when temperatures reach 80 degrees. This typically corresponds with the months of June to mid-September. King County conducted a survey of aquatic recreational use in the Snoqualmie River during the summer of 2013 in order to have a better understanding of the amount and type of in-water use in the SAFC reach and to inform future salmon restoration and flood risk reduction project design. Results from the recreational use study indicate that there is very high recreational use above the SR 202 bridge in Fall City during the summer months, with up to several hundred users per day (Herrera 2014). A very high percentage (>~85%) of these users above the bridge were in less maneuverable boats (inner tubes or rafts) and most (>~80%) did not have any paddles. Less than 5% of users were observed to be wearing life vests.

In the reach downstream of the bridge (which coincides with the Fall City Floodplain Restoration project area), there were typically fewer than 10 users per day who either put in at the SR202 bridge or who bypassed the take-out at the bridge and continued downstream to the Neal Road WDFW boat ramp to take-out. In general, the users in this lower reach were in more maneuverable boats (kayaks, canoes, drift boats, etc.), with only ~50% in inner tubes or rafts and most (>~60%) of the boats did have paddles. Life jacket use is also greater downstream of the bridge, with ~25% of users observed wearing life vests.

Jet boats, drift boats, and rafts are common in the reaches upstream and downstream of the SR 202 bridge during salmon and steelhead runs in fall, winter, and spring. Jet boats and jet skis are common downstream of the project reach during the summer months, but rarely enter the project area during low flow conditions due to shallow riffles immediately downstream.

As shown by the recreational use study, most inexperienced floaters use the upstream river reach and do not float through the project reach. Since 2014, use of the downstream reach by unskilled floaters has been discouraged by King County through signage indicating the presence of wood hazards (Figure 3) and targeted public outreach. Local residents have reported an increase in use of the upstream reach during this same timeframe, due in part to a new shuttle service operated by a local business called Fall City Floating. The business offers equipment rentals and shuttles floaters from the take-outs at the Fall City Community Park near the SR202 bridge to a put-in location near Tokul Creek, approximately 3.5 miles upstream. According to their website, Fall City Floating includes life jackets with all equipment rentals and requires their use (Website accessed 11/4/2020, <https://www.fallcityfloating.com/rental-policies>).

Two popular take-outs are located just upstream of the project area, including a boat launch on the left bank at the mouth of the Raging River and an informal take-out point on the right bank just downstream of the SR 202 bridge in the Fall City Community Park. Kiosks have been installed at both take-out locations with river safety information posted and a free life jacket exchange to encourage the use of PFDs among river users. Though most unskilled floaters do not float through the project site, some floaters do continue on or put-in at the Raging River boat launch or the SR 202 bridge and float downstream through the SAFC reach. The nearest downstream improved access point to the river is the Washington State Department of Fish and Wildlife (WDFW) parking lot and ramp, located approximately 2.5 miles downstream off Neal Road. The parking lot is small so this is not a popular access point for recreational boaters. These floaters either take-out at the Neal Road boat ramp, continue downstream to informal take-out locations between the Neal Road boat launch and Carnation, or continue all the way to Carnation where there is another WDFW ramp at the Tolt River confluence.

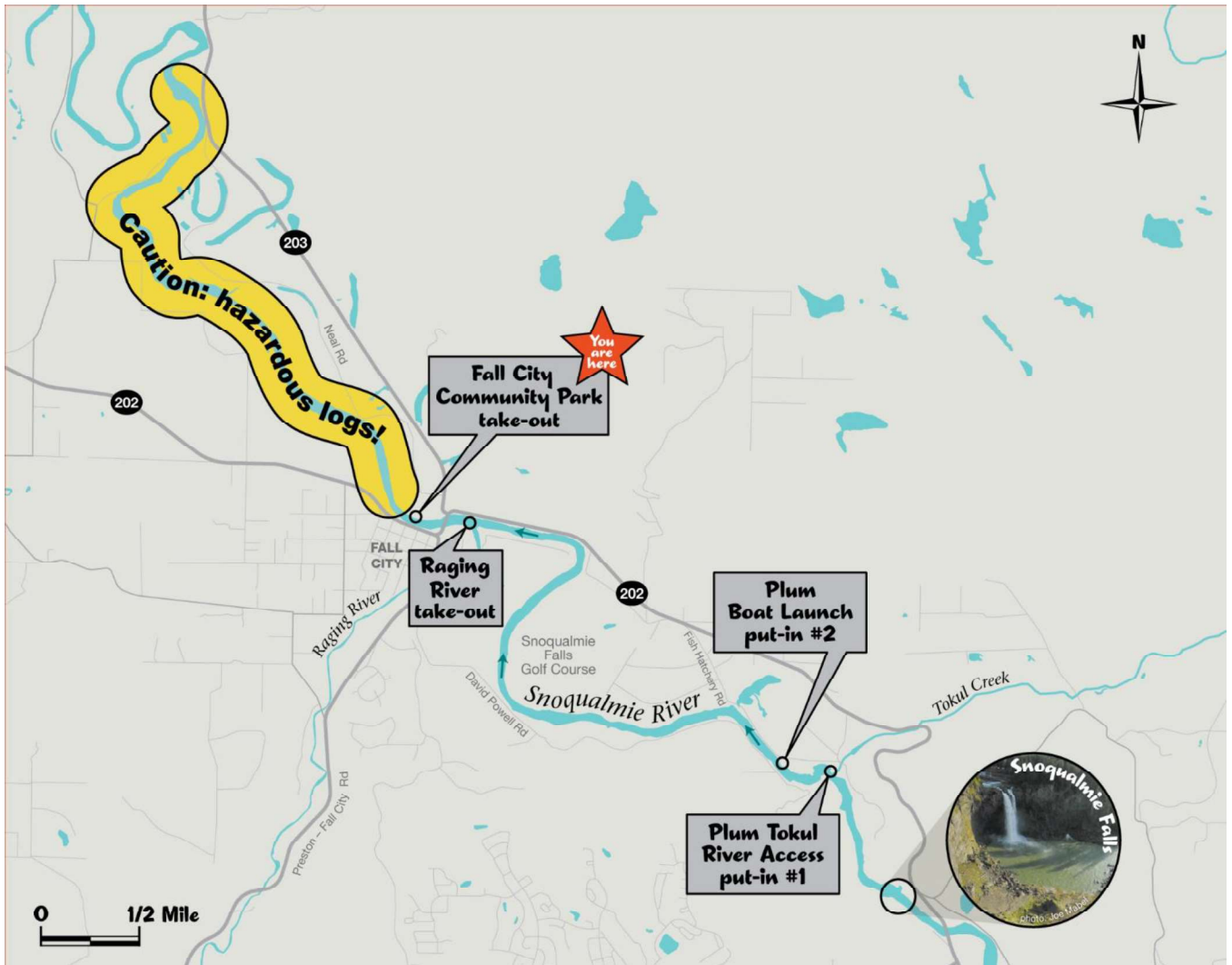


Figure 3 – Example of the signage at put-in and take-out locations encouraging river users to recreate upstream of Fall City. The Fall City Floodplain Recreation project is located in the upstream extent of the yellow hazardous logs area.

5. **If the project includes wood placement, describe the conceptual design of large wood elements of the project, including, if known at this stage in the design, the amount, size, location, orientation, elevation, anchoring techniques, and type of interaction with the river and stream at a range of flows.**

Bank Deflector Engineered Log Structures

The project proposes to construct three large “bank deflector” engineered log structures (ELS) along the Haffner setback rock revetment on the right bank and a fourth bank deflector ELS on the left bank near the upstream end of the Aldair Levee (see Figures 4 and 5). The purpose of the right bank deflector ELSs is to protect Neal Road, prevent channel entrainment along the smooth rock revetment, and to increase edge complexity. The right bank deflector ELSs will be buried approximately 60 to 100 feet from the channel and will be gradually exposed as the bank retreats following revetment removal. The purpose of the left bank deflector ELS is to protect the upstream end of the Aldair levee from flanking due to possible future migration and to increase edge complexity. The left bank deflector ELS will be constructed into the existing bank and located in a low velocity area at the tail-out of the secondary flow split on the west side of the mid-channel bar.

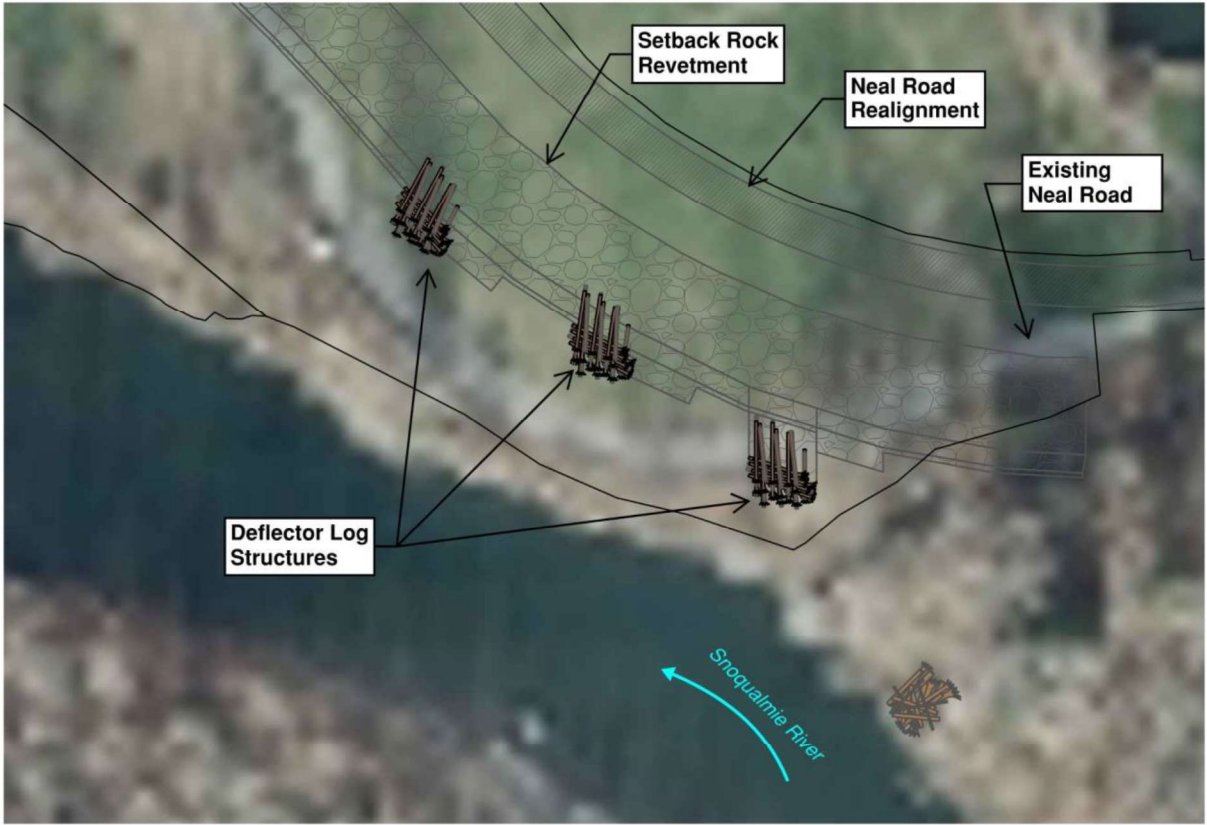


Figure 4 – Right bank deflector ELS



Figure 5 – Left bank deflector ELS

Logs in the deflector jams will be pile-supported, connected with chain, ballasted with riprap and excavation spoils, and embedded into the bank. Horizontal logs will be placed between elevations 68 and 84, which is approximately ten feet below the summer low water level to the ordinary highwater line (Figure 6). Each jam will be composed of approximately 40 imported logs and 10 deeply embedded timber piles. Log diameter will be between 18 and 30 inches and most will have an intact rootwad to maximize flow obstruction and habitat enhancement. The ELSs will incorporate racking logs, slash material, and rock backfill to minimize flow through the structure that could otherwise be a recreational user hazard and reduce functional performance of the structure.

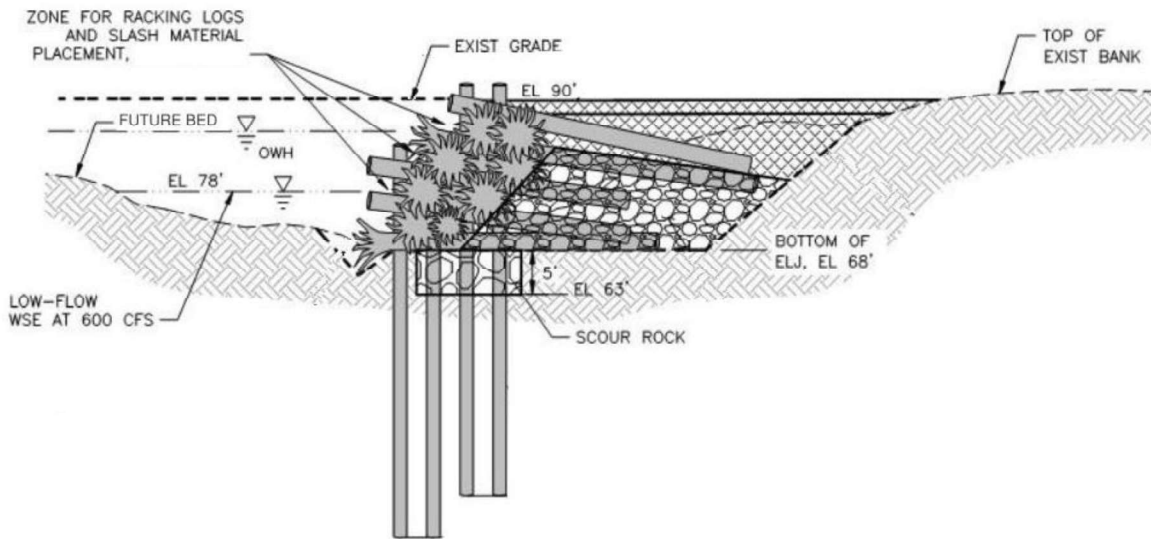
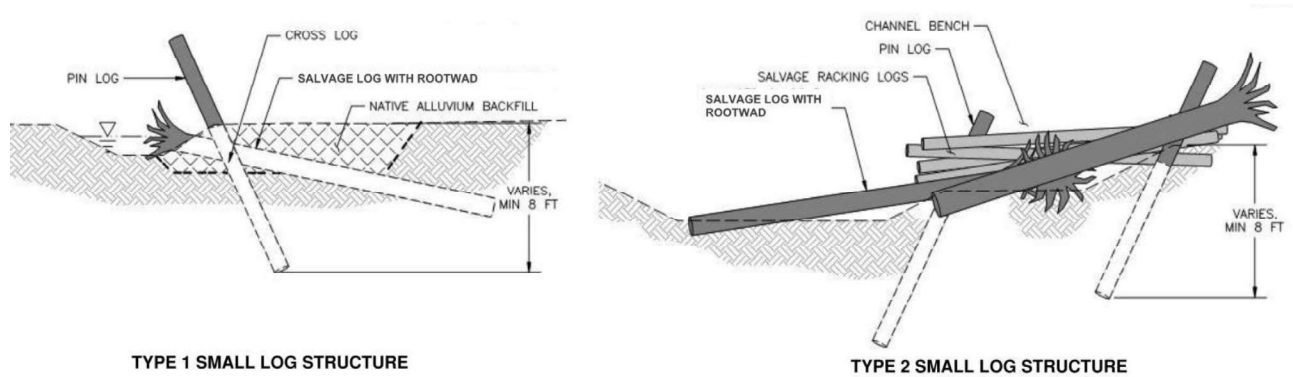


Figure 6 – Cross-section of Bank Deflector ELS once exposed due to channel migration

Side Channel Small Log Structures

Small log structures (Types 1 and 2) will be installed along both the left and right bank side channels to promote hydraulic diversity and habitat forming processes. These structures will be composed of wood salvaged onsite and will be partially embedded in the bed and banks of the side channels (Figure 7). These structures are considered mobile and may be recruited by high flows and/or local erosion. They will be comprised of individual logs with no chains or cables and will be located in off-channel areas where there is no immediate downstream risk associated with individual logs that may float downstream.



TYPE 1 SMALL LOG STRUCTURE

TYPE 2 SMALL LOG STRUCTURE

Figure 7 – Cross-section of Type 1 and Type 2 Small Logs Structures (looking downstream)

Side Channel Inlet Log Structures

Log structures will be installed at the inlet of the right bank side channel to regulate flow into the channel and moderate channel expansion and bed load ingestion (Figure 8). The inlet log structures will be embedded into the bank and bed of the side channel and individual logs will not be connected together (i.e. no chain, cable, rod, rope, etc.). Jams will be positioned on both banks of the side channel. Embedment will provide stability against buoyant forces associated with the 25-year flood, but the wood is expected to be mobilized over time, either by migration of the main channel or expansion of the side channel.

The inlet structures will be constructed of logs salvaged onsite. Horizontal logs will be placed between elevations 75 and 84, which is approximately three feet below the summer low water level to the ordinary highwater line. Log diameter will be between 12 and 30 inches and most will have an intact rootwad to maximize flow obstruction and habitat enhancement. Details for these structures are under development, but Figure 9 shows a preliminary design for the inlet structure.

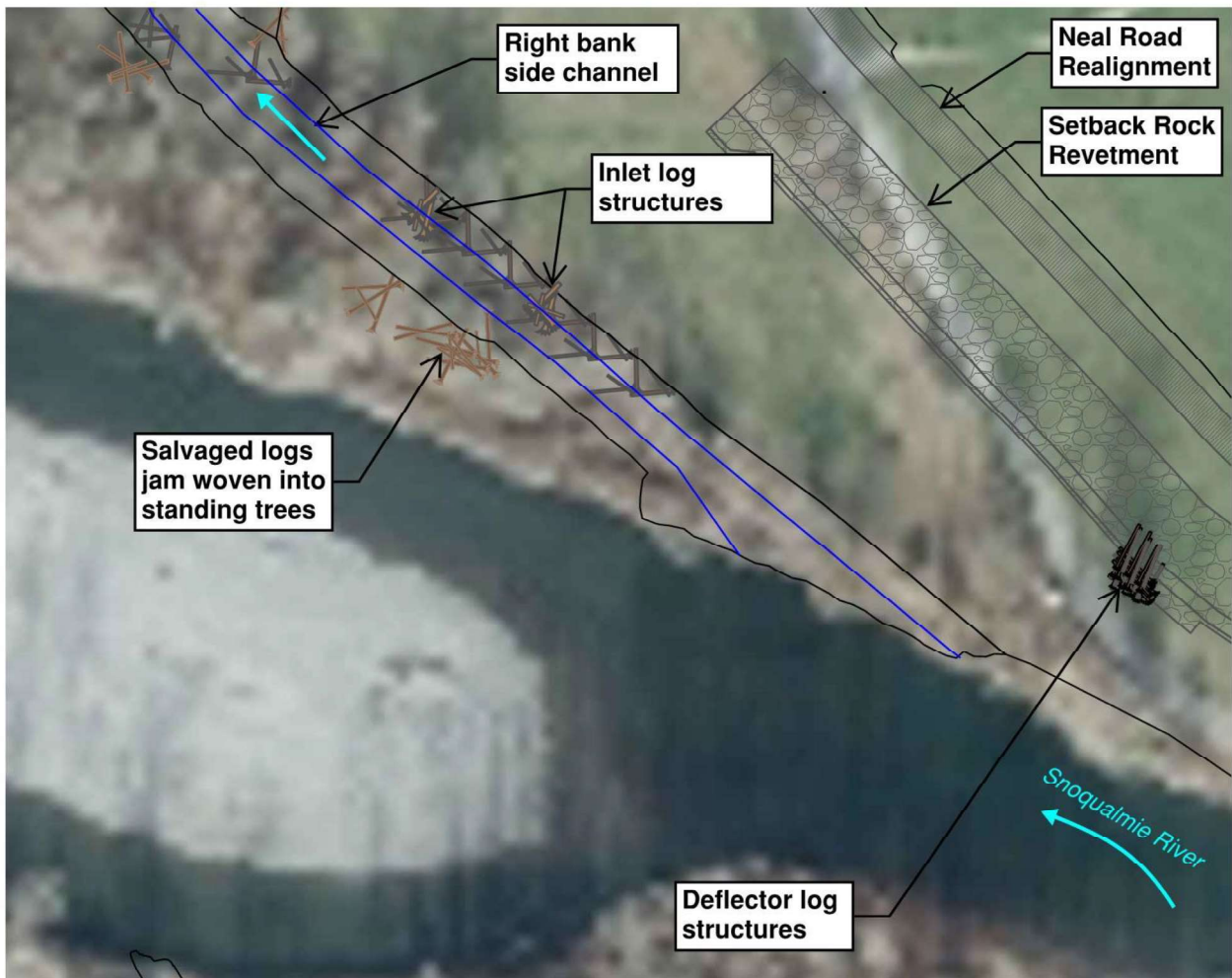


Figure 8 –Side Channel Inlet ELS Plan and Floodplain Wood

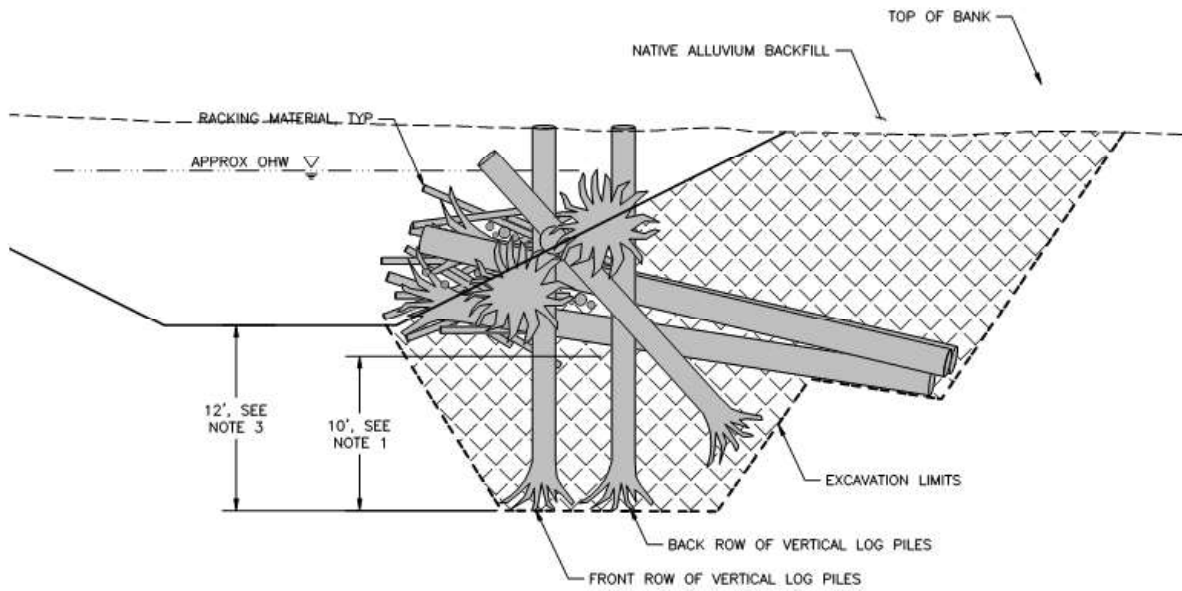


Figure 9 – Cross-section of Side Channel Inlet ELS, looking downstream.

Buried Log Clusters

Salvaged wood will also be embedded in the outside (right) bank of the Snoqualmie channel at the location of the existing Haffner revetment (Figure 10). The intent of this wood placement is to increase the amount of wood that interacts with the main-stem Snoqualmie and to increase edge complexity as the bank retreats. Embedment will provide stability against buoyant and drag forces in the as-built condition, but the wood is considered mobile and is expected to be incrementally recruited as the main channel migrates. The wood will be placed between elevations 74 and 80, which is approximately four feet below the summer low water level to four feet below the ordinary highwater line. This is similar to the elevations of embedded logs at this same location that were installed as mitigation for a 1997 repair of the Haffner revetment (Figure 11).

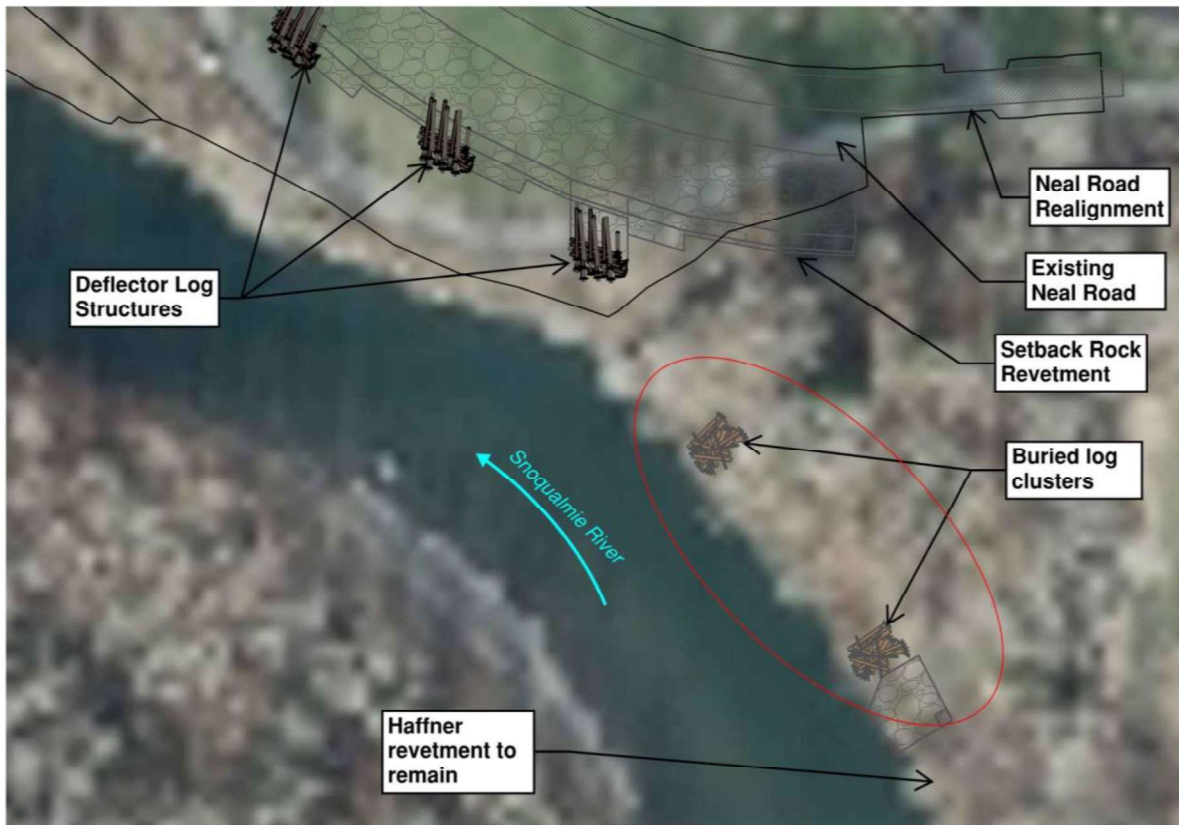


Figure 10 – Location of of Buried Log Clusters



Figure 11 – Photograph of the 1997 repair of the Haffner Revetment, which included bank embedded wood near the summer low flow water elevation.

Floodplain Roughening Engineered Log Structures

Linear floodplain roughening structures will be installed throughout the floodplain to locally “roughen” the floodplain, reducing downstream hydraulic energy and trapping woody debris. The structures use shallow timber piles, horizontal logs, and slash to create a permeable obstruction to flow (Figure 12). Roughening structures will be constructed along the realigned portion of Neal Road to provide low cost hydraulic roughening to buffer potentially erosive flow along the bank adjacent to Neal Road. They will also be located at hydraulic constrictions, such as in the upstream end of the Alm oxbow and where the right bank side channel crosses natural low ground. These structures are not in active channel areas where they could pose a risk to recreational users.

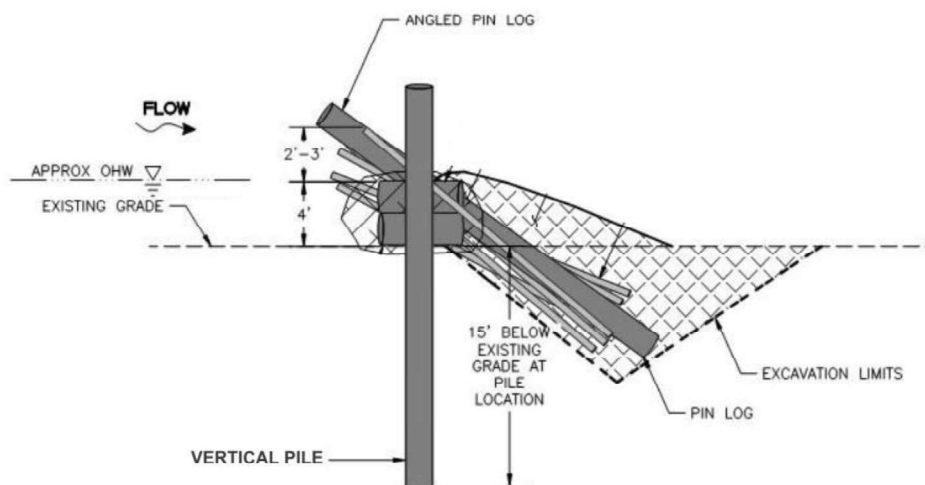


Figure 12 – Cross-section of Floodplain Roughening ELS, looking downstream.

Salvaged Wood Floodplain Jams

Several hundred large trees (50- to 120-foot-long) will be removed within the construction disturbance footprint and salvaged to be used to construct floodplain roughness features throughout the site to simulate naturally occurring floodplain wood accumulations. Salvaged wood will be primarily placed along the left and right bank side channels within stands of trees (Figures 13 and 14). To the extent possible, trees will be felled with rootwads intact and placed as close to their original location as possible. These floodplain jams will be placed above the ordinary highwater mark elevation in off-channel areas where they will not interact with recreational users and where there is no immediate downstream risk associated with wood transport. Placement and stability assessments of all the wood planned for the site are based on a combination of two-dimensional hydraulic modeling results, geomorphic response analysis, reference reach conditions and professional judgment. Salvaged wood logs will be placed upstream of standing trees, in an interlocking matrix, and/or ballasted with excavated soil material in order to provide short-term stability against buoyancy and drag forces. Jams will be faced with racking and slash material to decrease permeability. Individual placed logs may be mobilized and move downstream as the river migrates and side channels evolve. However, as channels migrate and evolve some portion of the floodplain wood is expected to create periodic stable jams along the bank margins and at flow splits, possibly recruiting additional wood over time. Standing trees are also expected to be recruited from both banks as channels migrate into forested floodplain areas, and the site is likely to recruit and retain wood from upstream sources. Details for the floodplain jams are under development, but Figure 15 shows a preliminary design concept.



Figure 13 – Placement of floodplain roughening ELSs and salvaged wood floodplain jams and individual logs in the right bank floodplain adjacent to the constructed right bank side channel.

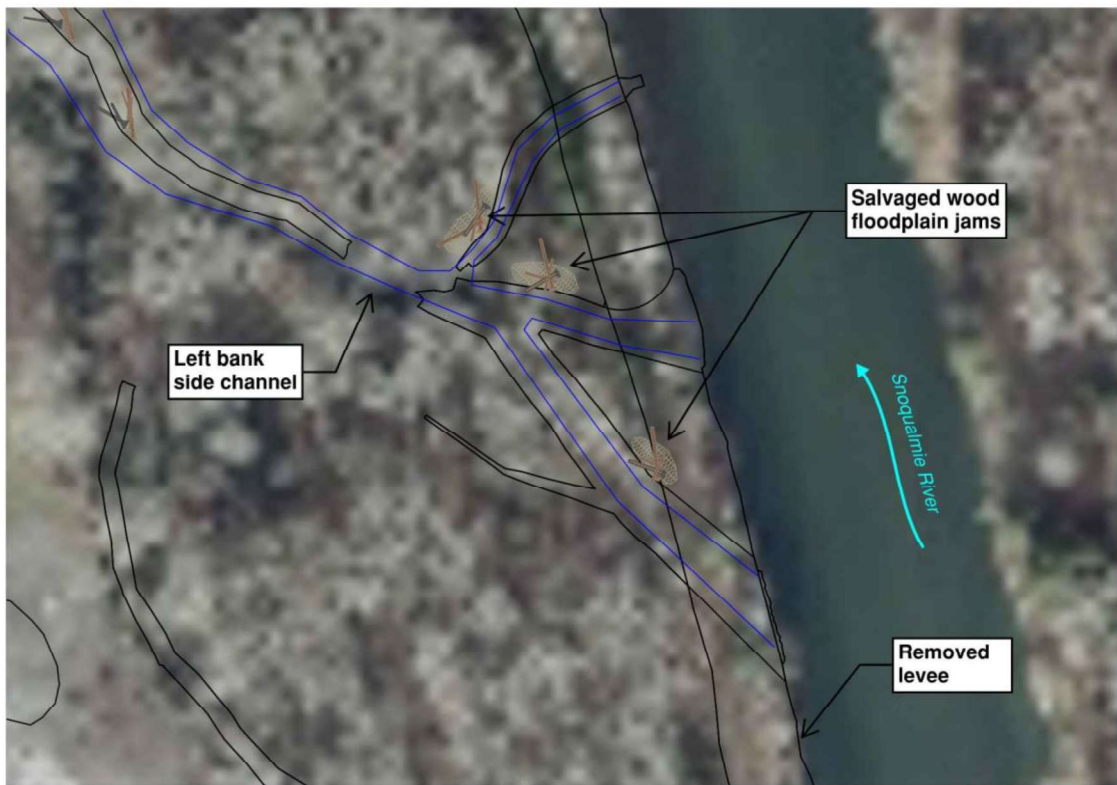


Figure 14 – Placement of salvaged wood floodplain jams and individual logs at the inlet to the left bank side channel.

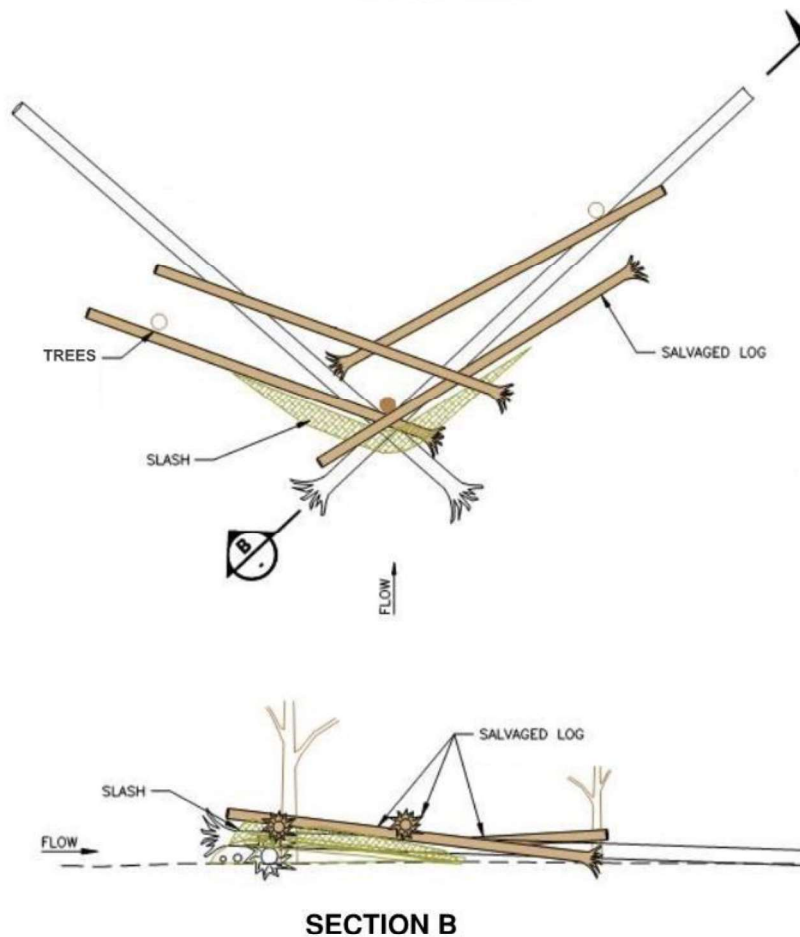


Figure 15 – Preliminary detail of floodplain jam

6. **If the project includes wood placement, what is the intended structural, ecological or hydraulic function of the placed wood? What role does the placed wood have in meeting the project’s goals and objectives? Is the project intended to recruit or trap additional large wood that may be floating in the river?**

The purpose of each specific design element that involves placement of wood is described in the answer to Question five above.

Large wood harvested from on-site will be strategically placed within the floodplain to help direct overbank (flood) flows and to moderate bank erosion. The wood and native plantings are intended to help mimic floodplain roughness that would otherwise be provided by mature native vegetation and downed wood that are typical components of undeveloped floodplain forests. The presence of the wood is expected to help moderate the rate of change during moderate flow conditions but will not prevent channel migration or major shifts in alignment that are driven by large and/or longer duration storms. Placed wood will therefore contribute towards achieving the goal of restoring floodplain functions and processes that provide for natural development of riverine habitat and aid salmon recovery.

The armored SAFC reach currently serves as a transport reach for wood, allowing most wood that floats in from upstream to move downstream. The reach has a few pieces of wood along the margin of the channel but

no persistent, large in-stream jams. A large floodplain jam has grown on the right bank gravel bar immediately downstream of the Upper Carlson project, but this wood only interacts with the river during high flows (>10,000 cfs).

If the SAFC reach responds to levee and revetment removal as predicted, it will begin to accumulate wood and at least initially store a large portion of the wood that would otherwise float past the site. During future flood events, the site will also contribute additional wood as banks erode, but this effect is expected to be negated by the reach trapping greater quantities of wood from upstream. This is consistent with other unconstrained reaches of the river where wider, more complex channel conditions, connected floodplains and accessible side channels provide ample opportunities for capturing and retaining wood.

The project addresses high priority salmon habitat restoration needs for the threatened Snoqualmie Chinook stock identified in the federal Puget Sound Chinook Recovery Plan (2007). According to the Snohomish Plan (2005) this project reach is in a “primary restoration” (i.e. first priority) mainstem sub-basin. As part of the Snohomish River Basin Salmon Conservation Plan development, models were used to show that improvements in edge (margins of the mainstem river), off-channel, in-channel and riparian conditions increased population performance in mainstem rivers. Hardened banks along the SAFC reach virtually preclude channel migration and the accumulation of large wood and sediment. Approximately 70% of the left bank and 55% of the right bank are armored in the SAFC reach. Channel forming processes and features are limited to two small unconstrained areas with actively growing bars and eroding or erodible banks. The lack of channel migration and accumulation of wood and sediment in this reach has reduced the availability of high-quality spawning and juvenile rearing habitat for salmonids. There is also a lack of wood cover in adjacent pools where adults hold during spawning.

- 7. Is the project likely to affect the recruitment, mobility or accumulation of natural large wood, e.g., by encouraging wood deposition on or near the site or promoting bank erosion that may cause tree toppling? Describe expected site evolution and its potential effects on natural wood dynamics.**

The Presence of in-channel wood in the project area is likely reduced from historical levels on the Lower Snoqualmie River due to a reduction in local and upstream wood supply due to logging and bank armoring as well as a decrease in the abundance of in-channel complexity that can trap wood. Local wood recruitment is diminished due to both the removal of streamside conifers and bank armoring that prevents lateral migration and stream banks now dominated by fast-decaying hardwood species. Wood supplied from the Upper Snoqualmie River is likely abraded and moderately simplified as a result of traveling over Snoqualmie Falls.

The Fall City Floodplain Restoration project will increase lateral connectivity into side channels, expand bar area via bank migration and overall channel widening, and enable wood recruitment via bank migration. These impacts will have a net effect of increasing reach-scale wood supply and trapping efficiency (the likelihood of in-channel features accumulating wood). Wood recruitment is likely along the left bank (mainly upstream of the side channel outlet), the right bank (mainly upstream of Rutherford Slough), and along the right bank side channel. As in-channel bars continue to grow, we expect natural large wood jams to form on the higher elevations of the left bank point bar, mid-channel bar and the right bank bar opposite the upstream end of the Aldair levee. Wood transported from upstream will likely be transported into the right bank and left bank side channels, where it may contribute to wood jam formation and moderate sediment trapping. These structures are not in active channel areas where they could pose a risk to recreational users.

- 8. Describe how public safety considerations have been incorporated into the preliminary project design. For placed wood, address each of the considerations:**
 - a. Type, frequency, and seasonality of recreational use;**

As shown in the recreational use study on the Snoqualmie River, there is a wide range of skill and ability among Snoqualmie River users, but skilled users tend to be more common in the project area and unskilled floaters tend to be far more numerous immediately upstream of the project (Herrera 2014). Refer to the response to Question 4 above and the study for more detailed information.

Unskilled users tend to use the river during the warm summer months that also coincide with the low flow period (June to mid-September) when the river flow typically ranges between 600 and 4,000 cfs. Skilled boaters use the river from spring through fall, and particularly during salmon fishing season (September through December) when the river flow ranges between 600 and 10,000 cfs.

Given this, placed wood has been designed assuming occasional unskilled users during low to moderate flows (600 and 4,000 cfs) and more frequent skilled users during higher flows (up to 10,000 cfs).

b. Wood location, positioning, and anchoring techniques;

The majority of placed wood will be located relatively high in the floodplain (above the 10,000 cfs water level) or will be set back into the floodplain or within side channels such that it does not create immediate boating hazards for main-stem users. The only instances where large wood will be placed in the main channel is in the deflector ELS at the upstream end of the Aldair levee and the bank embedded jams on the right bank near the Rutherford slough outlet. The ELS will be mostly embedded in the existing bank and is in a location where it is separated from the primary flowpath by a large mid-channel gravel bar. The bank embedded jams will be installed in approximately the same location as embedded rootwads from a 1997 repair. Those rootwads have not posed a hazard due to the relatively low velocities at this location during low and moderate flow conditions and the unobstructed visibility from upstream.

Engineered structures such as the bank deflectors and floodplain roughening structures will be stabilized by timber pilings, embedment into riprap and soil, and limited use of chain. Stability calculations will consider buoyant, drag, and impact forces associated with the 100-year flood hydraulic conditions. Engineered structures are designed to be fixed and essentially impermeable and have been located where they will be easily visible from upstream.

Habitat jams will be passively anchored by placing logs upstream of standing trees or by partial embedment, to mimic naturally occurring wood features. Long logs with large rootballs may also be used to stabilize habitat jams due to their large mass and ability to rack on standing vegetation.

c. Maximizing achievement of project goals and objectives while minimizing potential public safety risks;

Wood along the Lower Snoqualmie River induces local geomorphic change, such as creating transient pool habitat, stabilizing bar-tops, and inducing or reducing bank toe erosion, as well as local hydraulic effects like roughening bar-tops, regulating flow into side channels, and enhancing overbank flow. The absence of large wood in the project reach is a key contributor to the simplified channel and degraded aquatic habitat conditions. The design team has been mindful of recreational users throughout the design process and has modified the preliminary design accordingly to protect public safety and minimize impacts to recreational uses. Consideration of potential hazards has progressed through a series of steps including early identification of risks, data collection to understand specific site conditions that affect those risks, and evaluation and assessment using available tools. However, the design team must also ensure that the project meets its primary goal of restoring dynamic river processes, including the restoration of large wood as an integral element of floodplain structure and function, enhancing floodplain connectivity, and restoring river processes that create and sustain a complex, connected network of spawning, rearing, and refuge habitat for salmonids.

The project design incorporates many elements to avoid or reduce potential impacts to a broad range of recreational users, while still achieving the primary habitat goals of the project. It is important to note that regardless of these efforts, rivers are by their nature dangerous places. Dynamic natural processes will

promote changes in the character of the river in this reach, including changes in flow characteristics, formation of more natural banks and bars, and transport and recruitment of wood from onsite and upriver. These conditions will continue to evolve and change, particularly during and after high flow events.

d. Use of established and recognized engineering, geological, and ecological expertise.

The design team consists of a multidisciplinary team of engineers, ecologists, and geologists with extensive knowledge of Northwest rivers and many years of experience designing stream and river restoration projects. A consultant team supports King County, with technical experts from Herrera Environmental Consultants, Watershed Science and Engineering, and Shannon and Wilson, who bring extensive expertise in large wood design, hydraulic modeling, ecology, and geomorphology. The consultant team has a combined experience of more than 100 years designing projects in Northwest river systems.

9. Has the project been reviewed and approved by a Licensed Professional Civil Engineer? Please list other licensed technical staff who have reviewed and provided input on the design (e.g., Licensed Geologist and Licensed Engineering Geologist). Specify the Engineer of Record for the design and any other Licensed Professionals who have sealed their portion of the design plans. Were all reviews and approvals completed?

The multidisciplinary team noted above includes several licensed professional engineers and is overseen by a licensed professional engineer, Ian Mostrenko of Herrera Environmental Consultants. Ian is a river engineer with approximately 30 years of experience who will be stamping the final plans. The King County team managing the project includes two professional engineers as well as a licensed engineering geologist. An independent technical review of the preliminary design was conducted by Vaughn Collins, PE, of Northwest Hydraulic Consultants.

10. Has the project been reviewed and approved by a King County Professional Ecologist (e.g., person with an advanced degree in aquatic and/or biological sciences from an accredited university or equivalent level of experience) if ecological benefits are an intended project objective, to evaluate the consistency of the design with project goals, existing environmental policies and regulations, and expected or known permit conditions? Specify the Reviewing Ecologist for the project. Was this review and approval completed? What is the anticipated schedule for completing project milestones (30-40% design, final design, major construction/earthmoving) and for soliciting public input)?

The team includes several ecologists meeting those criteria. The senior ecologist on the team is an aquatic ecologist with both an advanced degree and more than five years of experience planning, designing, and implementing river restoration projects and more than ten years monitoring such projects. The project plans are also being reviewed by the Unit Manager, Jon Hansen, who has over 30 years of experience in the field of ecological restoration.

Project Schedule:

Preliminary design including public meetings: Completed November 2020

SEPA comment period: January 22, 2021 to February 5, 2021

Final design: Expected completion in November 2021

Construction: Expected summer of 2022

Project Manager _____ Date _____

Supervising Engineer, Project Supervisor or Unit Manager _____ Date _____

II. Pre-Construction Information (70% or 100% design with permits) *These questions relate to the designed and permitted project. Information should include input resulting from permit review process, SEPA, boater safety meetings and any other stakeholders.*

1. **Have any answers provided in Section I at the Preliminary Design Phase changed in the interim? If so, provide the new answers and the rationale for the change.**

The left bank Deflector Engineer Log Structure (ELS) at the upstream end of Aldair was replaced with a smaller installation of buried riprap and embedded logs as shown in Figure 16. The embedded logs are in essentially the same location, elevation, and orientation as the previously proposed ELS logs. The main difference is that they are not pile supported but are instead stabilized by burial/embedment.

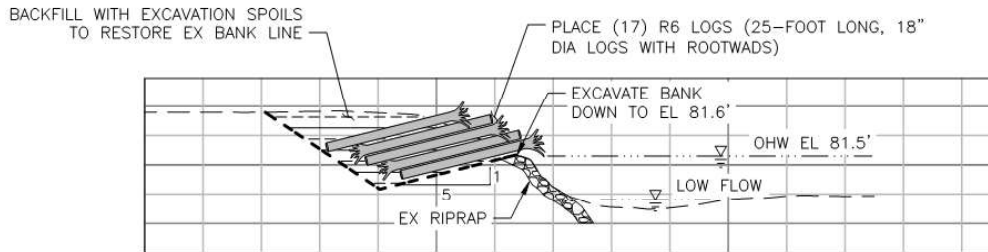


Figure 16 – Aldair End Protection Wood Placement

The Side Channel Inlet Jam log structure design was also modified to include a series of Buried Log Cluster in the adjacent floodplain as shown in Figure 17. The purpose of the Buried Log Clusters is to regulate the rate of side channel widening and channel migration. The logs are stabilized by embedment and are located between elevations 78 and 84, roughly corresponding to the summer low flow water elevation up to the ordinary highwater elevation.

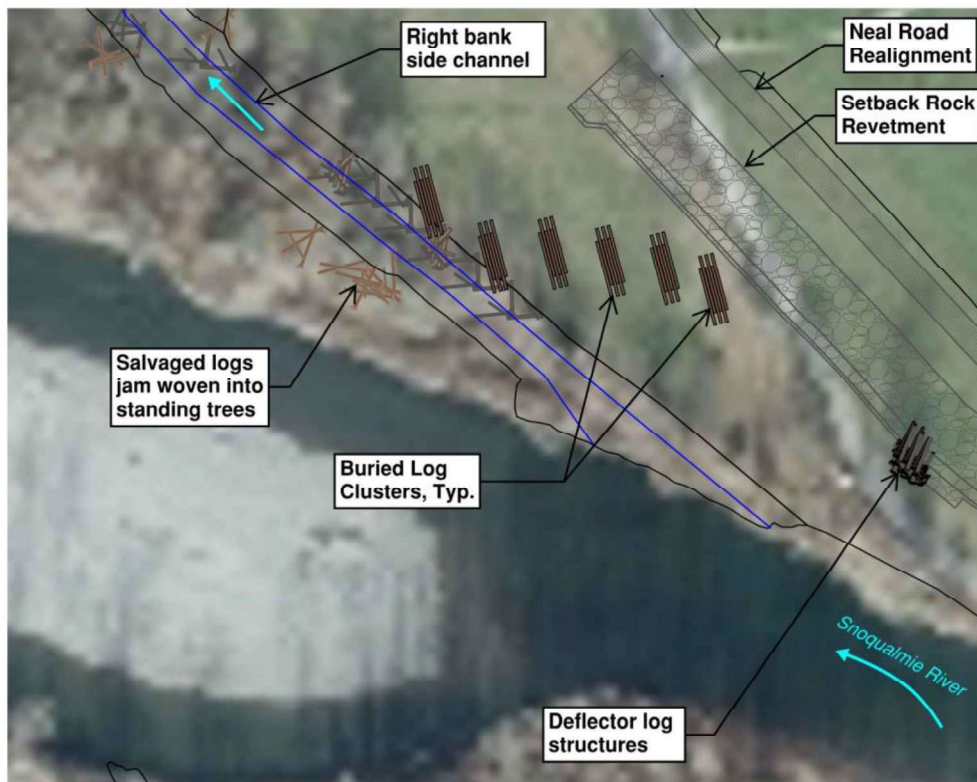


Figure 17 – Side Channel Inlet Jams and Buried Log Clusters

2. What regulatory review or permits are required for the project (e.g. HPA, Clearing and Grading permit, COE permits)? List any conditions or requirements included in the permit approvals relevant to placement of large wood in the project.

The following permits were obtained for the project:

1. US ARMY CORPS OF ENGINEERS CLEAN WATER ACT SECTION 404 PERMIT
2. US ARMY CORPS OF ENGINEERS NATIONWIDE PERMIT 27
3. WASHINGTON STATE DEPARTMENT OF ECOLOGY'S CLEAN WATER ACT SECTION 401 WATER QUALITY CERTIFICATION
4. WASHINGTON STATE DEPARTMENT OF ECOLOGY'S NPDES CONSTRUCTION STORMWATER GENERAL PERMIT
5. WASHINGTON DEPARTMENT OF FISH AND WILDLIFE'S HYDRAULIC PROJECT APPROVAL (HPA) PERMIT
6. KING COUNTY CLEARING AND GRADING PERMIT
7. KING COUNTY EXEMPTION FROM SHORELINE MANAGEMENT ACT
8. KING COUNTY PARKS PARTNERSHIP APPROVAL

Permit conditions related to large wood include:

- HPA Condition 35: Place large wood (or similar) waterward of OHW line as shown on plans.
- HPA Condition 36: Bury base of bank protection structures deep enough to prevent undermining.
- HPA Condition 38/43: Use fir, cedar, or other coniferous species to construct the log or rootwad fish habitat structures.
- HPA Condition 44: Place fish habitat structures in low flow channel.

3. What specific actions or project elements were employed to address public safety in the final, permit-approved design?

Large wood has generally been placed off-channel, or in locations along the channel where good sightlines and/or low velocity conditions exist.

4. Describe how the project team solicited public input on the preliminary design. Describe the input received from the public and how, if appropriate, the project team has responded to this input.

The project has been presented at the annual Large Wood Recreational meeting every year since 2019. The 40-percent design drawings were shared on the project website and input was solicited at a virtual public meeting held in October 2020. Additional public outreach was conducted as part of the State Environmental Policy Act compliance, along with targeted engagement with nearby landowners and community groups, including Fall City Community Association, Snoqualmie Valley Preservation Alliance, and Snoqualmie Valley Watershed Improvement District. No specific safety concerns about the proposed large wood design were raised during this public outreach campaign. The Snoqualmie Indian Tribe has repeatedly requested that the project design be modified to include more in-channel large woody debris to replace the large quantities that were removed during Euro-American settlement and development in the late-nineteenth and early-twentieth centuries. Based on this input, the project team has incorporated additional Buried Log Clusters along the main channel banks at locations with good sight distance and low energy hydraulics as shown in Figure 17.

5. Describe any additional design modifications or mitigating actions that were or will be taken in response to the public comments.

No additional public comments have been raised about large woody debris.

6. Will further educational or informational materials be made available to the public to heighten awareness of the project (e.g., public meeting, press release, informational website, or temporary or permanent signage posted in the vicinity of the project)? If so, explain.

In addition to public meetings and targeted engagement during preliminary design, the community and other stakeholders have been given an opportunity to provide input during final design. The King County Sheriff's Office Marine Unit and the Fall City Fire Department have also been informed of the project and they have not expressed specific design concerns. During May of 2022, pre-construction notices will be distributed in the form of a press release, phone calls, and postcards to approximately 1800 nearby residents, businesses, and stakeholders. The project webpage will also be updated with construction schedule information and all written material is being translated into six different languages, including Spanish.

Signage is an important element of this project due to the high volume of floaters upstream of the project area. In 2014/15, extensive river recreation outreach was conducted as part of the Upper Carlson project and permanent signs were installed at three put-in locations upstream of this river reach and the Fall City bridge. Those signs are being replaced with new signs that are also translated into Spanish. Fall City Floating, the company that rents innertubes out of Fall City Park, is including a construction notice for this project in their waiver during innertube rental. Prior to construction, an additional sign will be installed upstream of the Fall City bridge warning floaters and boaters to exit the river prior to the construction area. Should floaters or boaters go past the bridge there will be more signs within the project area directing them to stay on one side of the river. A project construction sign will be posted near the major roads on both sides of the river through the 2-yr construction period with contact information, website link, and QR code to webpage and language translations. Stakeholders and tribes are currently being consulted on content for a permanent educational sign that will be installed on the left bank, public property.

7. If the project is expected to influence the recruitment, mobility or accumulation of natural wood, has a Public Safety Management Plan been completed?

Monitoring and maintenance obligations with respect to potential hazards associate with Large Woody Debris dynamics are included in the Site Management Plan and Monitoring and Maintenance plan.

Fauna Nopp

5/9/2022

Project Manager

Date

MANSFIELD, Will

Digitally signed by MANSFIELD, Will
 DN: E=Will.Mansfield@kingcounty.gov, CN="MANSFIELD, Will", OU=Users, OU=King Street, OU=WLRD, DC=dnrp, DC=kingcounty, DC=icl
 Location: Seattle, WA
 Date: 2022.05.12 17:49:59-07'00'

Supervising Engineer, Project Supervisor or Unit Manager

Date

III. Post-Construction Actions or Project Modifications

8. Have any answers provided in Sections I and II at the Preliminary design and Pre-Construction phases changed in the interim? If so, provide the new answers and the rationale for the change.

9. Briefly describe the scope and timing of post-construction monitoring and inspection activities planned for the project as they relate to large wood. If a Public Safety Management Plan or Monitoring Plan has been developed for the project, you may simply reference and attach that document.

10. If post construction monitoring or inspections result in modifications to the project, please describe the action taken and the rationale and consistency with the Public Safety Management Plan, if applicable.

Project Manager

Date

Supervising Engineer, Project Supervisor or Unit Manager

Date